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To the Teacher:

The Answer Key for the Brief Review in Earth Science provides answers to all of the questions in the book, including the sample Regents Examinations provided in the back of the book.

To determine concepts that might require more intense review, students can take the Diagnostic Tests provided for each topic. Then, to help you test your students during the review process, one Quiz for each topic is provided. Both the Diagnostic Tests and Topic Quizzes have questions that are not in the book itself, so you will be able to check students’ understanding of some of the concepts in the topic without simply repeating questions they have seen in the book.

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Acknowledgments appear on p. A-1, which constitutes an extension of this copyright page.

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Regents Examinations and questions appear courtesy of the New York State Education Department/New York Regents Exam.
1. Each dot on the graph below shows the result of separate scientific studies of the relationship between the rates of erosion in regions of different relief. Relief is the local difference between the highest and the lowest elevations.

The results of these combined studies indicate that with each 100-meter increase in relief, the rate of erosion generally
(1) decreases at a rate of 10 cm/1,000 years
(2) decreases at a rate of 20 cm/1,000 years
(3) increases at a rate of 10 cm/1,000 years
(4) increases at a rate of 20 cm/1,000 years

Base your answer to question 2 on the passage below and on your knowledge of earth science.

**Asteroids**

Most known asteroids are found orbiting the Sun approximately halfway between the orbits of Mars and Jupiter, in a vast ring known as the Asteroid Belt. Occasionally, though, an asteroid leaves this orbit belt and moves into a more eccentric orbit that brings it into the inner solar system. This sudden change may be caused by an impact with another asteroid or by the gravitational pull of Jupiter or Mars.

2. Approximately how many million kilometers from the Sun is the Asteroid Belt?

3. A student determines the density of a mineral to be 1.5 grams per cubic centimeter. If the accepted value is 2.0 grams per cubic centimeter, what is the student’s percent deviation (percent error)?

<table>
<thead>
<tr>
<th>Option</th>
<th>Percent Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25.0%</td>
</tr>
<tr>
<td>2</td>
<td>33.3%</td>
</tr>
<tr>
<td>3</td>
<td>40.0%</td>
</tr>
<tr>
<td>4</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

4. State one way that humans could protect themselves from harm if a severe hail warning is issued for their locality.

Base your answer to question 5 on the bedrock cross section below. The cross section represents part of Earth's crust where natural gas, oil, and water have moved upward through a layer of folded sandstone and filled the pore spaces at the top of the sandstone layer.

5. The final arrangement of the natural gas, oil, and water within the sandstone was caused by differences in their

<table>
<thead>
<tr>
<th>Option</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>density</td>
</tr>
<tr>
<td>2</td>
<td>specific heat</td>
</tr>
<tr>
<td>3</td>
<td>relative age</td>
</tr>
<tr>
<td>4</td>
<td>radioactive half-life</td>
</tr>
</tbody>
</table>
Base your answer to question 6 on the passage below and on your knowledge of earth science.

A Newly Discovered Planet

Scientists studying a Sun-like star named Ogle-Tr-3 discovered a planet that is, on the average, 3.5 million kilometers away from the star's surface. The planet was discovered as a result of observing a cyclic decrease in the brightness of Ogle-Tr-3 every 28.5 hours. The changing brightness is the result of the planet blocking some of the starlight when it is between Ogle-Tr-3 and Earth. This observation allowed scientists to find not only the planet, but also to determine the planet's mass and density. The mass has been calculated to be approximately 159 times the mass of Earth. The planet is only 20% as dense as Jupiter. Scientists think that this low density is the result of being very close to Ogle-Tr-3.

6. The density of the discovered planet has been estimated to be approximately
   (1) 5.5 g/cm³  (3) 1.3 g/cm³
   (2) 2.0 g/cm³  (4) 0.3 g/cm³

7. Scientists can plan to photograph a solar eclipse because most astronomical events are
   (1) cyclic and predictable
   (2) cyclic and unpredictable
   (3) random and predictable
   (4) random and unpredictable

8. A student is asked to classify several rocks. For best results, the classification should be based on
   (1) inferences  (3) hypotheses
   (2) interpretations  (4) observations

9. The map that follows shows the path of an ash cloud that resulted from the Mount St. Helens volcanic eruption. The map was developed from satellite photographs.

10. The graph below shows the relationship between mass and volume for three samples, A, B, and C, of a given material.

   What is the density of this material?
   (1) 1.0 g/cm³  (3) 10.0 g/cm³
   (2) 5.0 g/cm³  (4) 20.0 g/cm³
DIAGNOSTIC TEST TOPIC 2

Base your answers to questions 1 and 2 on the following temperature field map provided.

The map shows air temperatures, in degrees Fahrenheit, recorded at the same time at weather stations across North America. The air temperature at location A has been deliberately left blank.

1. On the map provided, use smooth, curved solid lines to draw the 30°F, 40°F, and 50°F isotherms.

2. What is the most probable air temperature at location A?

3. The approximate latitude of Utica, New York, is
   (1) 43°05' N   (3) 75°15' E
   (2) 43°05' S   (4) 75°15' W

4. The topographic map that follows shows a hill. Points X and Y represent locations on the hill's surface. Elevations are shown in meters.

What is the gradient between points X and Y?
   (1) 40 m/km   (3) 100 m/km
   (2) 80 m/km   (4) 120 m/km

5. The diagram below shows an observer on Earth measuring the altitude of Polaris.

What is the latitude of this observer?
   (1) 90° N   (3) 43° N
   (2) 66.5° N   (4) 23.5° N
Base your answers to questions 6 and 7 on the map below, which shows the latitude and longitude of five observers, A, B, C, D, and E, on Earth.

90° W 80° W 70° W

A

80°  W  70°  W

B

10° N

C

Equator

D

E

10° S

6. What is the altitude of Polaris (the North Star) above the northern horizon for observer A?
   (1) 0°  (3) 80°
   (2) 10°  (4) 90°

7. Which two observers would be experiencing the same apparent solar time?
   (1) A and C  (3) B and E
   (2) B and C  (4) D and E

8. When the time of day for a certain ship at sea is 12 noon, the time of day at the Prime Meridian (0° longitude) is 5 p.m. What is the ship’s longitude?
   (1) 45° W  (3) 75° W
   (2) 45° E  (4) 75° E

9. Which New York State river flows generally southward?
   (1) St. Lawrence River
   (2) Niagara River
   (3) Genesee River
   (4) Hudson River

10. Which temperature zone of Earth’s atmosphere contains the most water vapor?
    (1) mesosphere  (3) thermosphere
    (2) stratosphere  (4) troposphere

11. An environmental scientist needs to prepare a report on the potential effects that a proposed surface mine in New York State will have on the watershed where the mine will be located. In which reference materials will the scientist find the most useful data with which to determine the watershed’s boundaries?
    (1) topographic maps
    (2) geologic time scales
    (3) tectonic plate maps
    (4) planetary wind maps

12. Which element is most abundant in Earth’s lithosphere?
    (1) oxygen  (3) hydrogen
    (2) silicon  (4) nitrogen

13. As a ship crosses the Prime Meridian, an observer on the ship measures the altitude of Polaris at 60°. What is the ship’s location?
    (1) 60° south latitude and 0° longitude
    (2) 60° north latitude and 0° longitude
    (3) 0° latitude and 60° east longitude
    (4) 0° latitude and 60° west longitude

14. At which New York State location will an observer most likely measure the altitude of Polaris as approximately 42°?
    (1) Jamestown  (3) Oswego
    (2) Plattsburgh  (4) New York City

15. The North Star (Polaris) can be used for navigation in Earth’s Northern Hemisphere because
    (1) Polaris is located directly over the Tropic of Cancer
    (2) Polaris is the brightest and most easily located star
    (3) the altitude of Polaris is equal to the observer’s latitude
    (4) the position of Polaris changes with the seasons
DIAGNOSTIC TEST  TOPIC 3

1. Which object in our solar system has the greatest density?
   (1) Jupiter   (3) the Moon
   (2) Earth     (4) the Sun

2. The diagram below shows the elliptical orbit of a planet revolving around a star. The star and $F_2$ are the foci of this ellipse.

   What is the approximate eccentricity of this ellipse?
   (1) 0.22   (3) 0.68
   (2) 0.47   (4) 1.47

3. Which object is closest to Earth?
   (1) the Sun   (3) the Moon
   (2) Venus     (4) Mars

Base your answers to questions 4 through 8 on the two diagrams that follow. Diagram I shows the orbits of the four inner planets. Black dots in diagram I show the positions in the orbits where each planet is closest to the Sun. Diagram II shows the orbits of the planets that are farthest from the Sun. The distance scale in diagram II is different than the distance scale in diagram I.

4. On diagram I, place the letter W on Mars's orbit to represent the position of Mars where the Sun's gravitational force on Mars would be weakest.

5. On diagram II, circle the names of the two largest Jovian planets.

6. How long does it take the planet Uranus to complete one orbit around the Sun? Units must be included in your answer.

7. Describe how the orbits of each of the planets are similar in shape.

8. Pluto's orbital speed is usually slower than Neptune's orbital speed. Based on diagram II, explain why Pluto's orbital speed is sometimes faster than Neptune's orbital speed.

9. Which event takes the most time?
   (1) one revolution of Earth around the Sun
   (2) one revolution of Venus around the Sun
   (3) one rotation of the Moon on its axis
   (4) one rotation of Venus on its axis

10. Compared to Earth's solar system, the universe is inferred to be
    (1) younger and larger
    (2) younger and smaller
    (3) older and larger
    (4) older and smaller
11. Compared with our Sun, the star Betelgeuse is
   (1) smaller, hotter, and less luminous
   (2) smaller, cooler, and more luminous
   (3) larger, hotter, and less luminous
   (4) larger, cooler, and more luminous

12. Astronomers viewing light from distant galaxies observe a shift of spectral lines toward the red end of the visible spectrum. This shift provides evidence that
   (1) orbital velocities of stars are decreasing
   (2) Earth’s atmosphere is warming
   (3) the Sun is cooling
   (4) the universe is expanding

13. What is the main reason that the gravitational attraction between Earth and the Moon changes each day?
   (1) Earth’s axis is tilted at 23.5°.
   (2) Earth’s rotational speed varies with the seasons.
   (3) The Moon has an elliptical orbit.
   (4) The Moon has a spherical shape.

14. Which list shows stars in order of increasing temperature?
   (1) Barnard’s Star, Polaris, Sirius, Rigel
   (2) Aldebaran, the Sun, Rigel, Procyon B
   (3) Rigel, Polaris, Aldebaran, Barnard’s Star
   (4) Procyon B, Alpha Centauri, Polaris, Betelgeuse

15. Most scientists believe the Milky Way Galaxy is
   (1) spherical in shape
   (2) 4.6 billion years old
   (3) composed of stars revolving around Earth
   (4) one of billions of galaxies in the universe

16. When viewed from Earth, the light from very distant galaxies shows a red shift. This is evidence that these distant galaxies are
   (1) revolving around the Sun
   (2) revolving around the Milky Way
   (3) moving away from Earth
   (4) moving toward Earth

17. The picture below represents the shape of the Milky Way Galaxy.

   The Milky Way Galaxy is best described as
   (1) elliptical
   (2) irregular
   (3) circular
   (4) spiral

18. Compared to the temperature and luminosity of the star Polaris, the star Sirius is
   (1) hotter and more luminous
   (2) hotter and less luminous
   (3) cooler and more luminous
   (4) cooler and less luminous
DIAGNOSTIC TEST  TOPIC 4

Base your answer to question 1 on the diagram below and on your knowledge of earth science. The diagram shows the apparent paths of the Sun at the beginning of each season for an observer at a location in New York State.

1. The Sun’s apparent daily movement across the sky is caused by
   (1) the Sun’s revolution around Earth
   (2) Earth’s revolution around the Sun
   (3) the Sun’s rotation on its axis
   (4) Earth’s rotation on its axis

2. The diagram below shows the relative positions of the Sun, the Moon, and Earth when an eclipse was observed from Earth. Positions A and B are locations on Earth’s surface.

   Which statement correctly describes the type of eclipse that was occurring and the position on Earth where this eclipse was observed?
   (1) A lunar eclipse was observed from position A.
   (2) A lunar eclipse was observed from position B.
   (3) A solar eclipse was observed from position A.
   (4) A solar eclipse was observed from position B.

3. The diagram below shows the Moon at four positions in its orbit around Earth as viewed from above the North Pole.

   Beginning with the Moon at position X (the new-Moon phase), which sequence of Moon phases would be seen by an observer on Earth during 1 month?

   (1) □□□□
   (2) □□□□
   (3) □□□□
   (4) □□□□

4. How long does Earth take to complete one orbit around the Sun?
   (1) 1 day
   (2) 1 month
   (3) 1 year
   (4) 1 decade

5. A cycle of Moon phases can be seen from Earth because the
   (1) Moon's distance from Earth changes at a predictable rate
   (2) Moon’s axis is tilted
   (3) Moon spins on its axis
   (4) Moon revolves around Earth
6. The passage of the Moon into Earth's shadow causes a
   (1) lunar eclipse   (3) new Moon
   (2) solar eclipse   (4) full Moon

Base your answers to questions 7 and 8 on the graph below. The graph shows the recorded change in water level (ocean tides) at a coastal city in the northeastern United States during 1 day.

7. Which inference about tides is best made from this graph?
   (1) The hourly rate of tidal change is always the same.
   (2) The rate of tidal change is greatest at high tide.
   (3) The tidal change is a random event.
   (4) The tidal change is cyclic.

8. According to the pattern shown on the graph, the next high tide will occur on the following day at approximately
   (1) 12:30 a.m.   (3) 3:15 a.m.
   (2) 2:00 a.m.   (4) 4:00 a.m.

9. The diagram below represents the major stars of the constellation Orion, as viewed by an observer in New York State.

Which statement best explains why Orion can be observed from New York State on December 21 but not on June 21?
   (1) Orion has an eccentric orbit around Earth.
   (2) Orion has an eccentric orbit around the Sun.
   (3) Earth revolves around the Sun.
   (4) Earth rotates on its axis.

10. Which observation is a direct result of changes in distance between Earth and the Sun?
    (1) A Foucault pendulum shows predictable changes in its direction of swing.
    (2) The apparent diameter of the Sun shows predictable changes in size.
    (3) The length of daylight at the poles changes from 0 to 24 hours during the year.
    (4) Summer occurs in the Northern Hemisphere at the same time that winter occurs in the Southern Hemisphere.
1. Equal volumes of the four samples shown below were placed outside and heated by energy from the Sun’s rays for 30 minutes.

![Images of samples: Water, Copper pennies, Basaltic sand, Iron fragments]

The surface temperature of which sample increased at the slowest rate?
(1) water  (3) basaltic sand
(2) copper pennies  (4) iron fragments

2. During nighttime cooling, most of the energy radiated by Earth’s oceans into space is
(1) ultraviolet rays  (3) visible light rays
(2) gamma rays  (4) infrared rays

3. Which type of land surface would probably reflect the most incoming solar radiation?
(1) light colored and smooth
(2) light colored and rough
(3) dark colored and smooth
(4) dark colored and rough

4. On a day with no wind, the air temperature outside a house is 10°C. The air temperature inside the house is 18°C. Which diagram best represents the air circulation pattern that is most likely to occur when a window of the house is first opened?

![Diagrams of air circulation: (1) top, (2) middle, (3) bottom, (4) bottom]

5. Land surfaces of Earth heat more rapidly than water surfaces because
(1) more energy from the Sun falls on land than on water
(2) land has a lower specific heat than water
(3) sunlight penetrates to greater depths in land than in water
(4) less of Earth’s surface is covered by land than by water

6. An increase in the amount of which atmospheric gas is thought to cause global climate warming?
(1) oxygen  (3) nitrogen
(2) hydrogen  (4) carbon dioxide

7. Which type of electromagnetic energy has the longest wavelength?
(1) infrared radiation
(2) radio wave radiation
(3) ultraviolet radiation
(4) x-ray radiation
8. Which method of energy transfer is primarily responsible for energy being lost from Earth into space?  
(1) conduction  (3) solidification  
(2) convection  (4) radiation

9. How many joules are required to evaporate 1 gram of boiling water?  
(1) 1  (3) 2260  
(2) 334  (4) 10,000

10. A square meter of surface of which of these natural areas would most likely absorb the most insolation during a clear day?  
(1) a fast-moving river  
(2) a dark-green forest  
(3) a beach with white sand  
(4) a snow-covered field

11. Which two gases have been added to Earth’s atmosphere in large amounts and are believed to have increased global warming by absorbing infrared radiation?  
(1) neon and argon  
(2) chlorine and nitrogen  
(3) hydrogen and helium  
(4) methane and carbon dioxide

12. During which phase change of water is the most energy released into the environment?  
(1) water freezing  
(2) ice melting  
(3) water evaporating  
(4) water vapor condensing

13. Which color of the visible light spectrum has the shortest wavelength?  
(1) red  
(2) blue  
(3) violet  
(4) orange

14. The diagram shows a beaker of water being heated. As the colored dye pellet dissolves, the dye will show the movement of water in the beaker. On the diagram, draw arrows in the water to show the direction the dye will move when the water is heated as shown.

15. Which graph best represents the relative wavelengths of the different forms of electromagnetic energy?
Name ___________________________ Date ______________________

**DIAGNOSTIC TEST TOPIC 6**

Base your answers to questions 1 through 3 on the data table below. A student recorded the hours of daylight and the altitude of the Sun at noon on the twenty-first day of every month for one year in Buffalo, New York.

<table>
<thead>
<tr>
<th>Date</th>
<th>Hours of Daylight</th>
<th>Altitude of the Sun at Noon (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 21</td>
<td>9.5</td>
<td>32.3</td>
</tr>
<tr>
<td>February 21</td>
<td>10.8</td>
<td>40.1</td>
</tr>
<tr>
<td>March 21</td>
<td>12.0</td>
<td>47.3</td>
</tr>
<tr>
<td>April 21</td>
<td>13.7</td>
<td>55.1</td>
</tr>
<tr>
<td>May 21</td>
<td>14.8</td>
<td>62.5</td>
</tr>
<tr>
<td>June 21</td>
<td>15.3</td>
<td>70.4</td>
</tr>
<tr>
<td>July 21</td>
<td>14.8</td>
<td>63.3</td>
</tr>
<tr>
<td>August 21</td>
<td>13.7</td>
<td>55.5</td>
</tr>
<tr>
<td>September 21</td>
<td>12.1</td>
<td>47.7</td>
</tr>
<tr>
<td>October 21</td>
<td>10.8</td>
<td>39.9</td>
</tr>
<tr>
<td>November 21</td>
<td>9.5</td>
<td>32.1</td>
</tr>
<tr>
<td>December 21</td>
<td>9.0</td>
<td>24.4</td>
</tr>
</tbody>
</table>

1. On the graph below, draw a line to represent the general relationship between the altitude of the Sun at noon and the number of hours of daylight throughout the year at Buffalo.

2. The sky model diagram below shows the apparent path of the Sun on March 21 for an observer in Buffalo, New York. Draw a line to represent the apparent path of the Sun from sunrise to sunset at Buffalo on May 21. Be sure your path indicates the correct altitude of the noon Sun and begins and ends at the correct positions on the horizon.

3. On the same sky model diagram, place an asterisk (*) at the apparent position of the North Star as seen from Buffalo.

4. Large oceans moderate the climatic temperatures of surrounding coastal land areas because the temperature of ocean water changes
   (1) rapidly, due to water's low specific heat
   (2) rapidly, due to water's high specific heat
   (3) slowly, due to water's low specific heat
   (4) slowly, due to water's high specific heat

5. A square meter of surface of which of these natural areas would most likely absorb the most insolation during a clear day?
   (1) a fast-moving river
   (2) a dark-green forest
   (3) a beach with white sand
   (4) a snow-covered field
6. Most of the solar radiation absorbed by Earth's surface is later radiated back into space as which type of electromagnetic radiation?
   (1) X-ray (3) infrared
   (2) ultraviolet (4) radio wave

7. A student in New York State looked toward the eastern horizon to observe sunrise at three different times during the year. The student drew the following diagram that shows the positions of sunrise, A, B, and C, during this one-year period.

   Which list correctly pairs the location of sunrise to the time of the year?
   (1) A—June 21 (3) A—March 21
   B—March 21      B—June 21
   C—December 21   C—December 21
   (2) A—December 21 (4) A—June 21
   B—March 21      B—December 21
   C—June 21       C—March 21

8. In which diagram is the observer experiencing the greatest intensity of insolation?

   Which letter represents the surface that most likely absorbs the greatest amount of insolation?
   (1) A  (3) C
   (2) B  (4) D

9. The diagram below shows four surfaces of equal area that absorb insolation.

   Which date is represented by the diagram?
   (1) March 21 (3) September 23
   (2) June 21   (4) December 21
DIAGNOSTIC TEST  TOPIC 7

1. Which type of air mass is associated with warm, dry atmospheric conditions?
(1) cP  (3) mP
(2) cT  (4) mT

2. Which station model shows the correct form for indicating a northwest wind at 25 knots and an air pressure of 1023.7 mb?

3. The cross section below shows a side view of the area along line XY on the map. On lines 1 and 2 in the cross section, place the appropriate two-letter air-mass symbols to identify the most likely type of air mass at each of these locations.

4. The forecast for one city located on the map is given below:
"In the next hour, skies will become cloud covered. Heavy rains are expected with possible lightning and thunder. Temperatures will become much cooler." State the name of the city for which this forecast was given.

5. Identify one action that people should take to protect themselves from lightning.

6. Which statement best explains why an increase in the relative humidity of a parcel of air generally increases the chance of precipitation?
(1) The dewpoint is farther from the condensation point, causing rain.
(2) The air temperature is closer to the dewpoint, making cloud formation more likely.
(3) The amount of moisture in the air is greater, making the air heavier.
(4) The specific heat of the moist air is greater than the drier air, releasing energy.
7. A parcel of air has a dry-bulb temperature of 24°C and a relative humidity of 55%. What is the dewpoint of this parcel of air?
(1) 6°C  (2) 14°C  (3) 24°C  (4) 29°C

8. Weather along most fronts is usually cloudy with precipitation because the warm air along most fronts is usually
(1) sinking and cooling, causing water to evaporate
(2) sinking and warming, causing water to evaporate
(3) rising and cooling, causing water vapor to condense
(4) rising and warming, causing water vapor to condense

9. What is the relative humidity if the dry-bulb temperature is 22°C and the wet-bulb temperature is 17°C?
(1) 5%  (2) 14%  (3) 60%  (4) 68%

10. Most of the Gulf Stream Ocean Current is
(1) warm water that flows southwestward
(2) warm water that flows northeastward
(3) cool water that flows southwestward
(4) cool water that flows northeastward

Base your answers to questions 11 through 13 on the diagram below, which represents the planetary wind and moisture belts in Earth's Northern Hemisphere.

11. The climate at 90° north latitude is dry because the air at that location is usually
(1) warm and rising
(2) warm and sinking
(3) cool and rising
(4) cool and sinking

12. The paths of the surface planetary winds are curved due to Earth's
(1) revolution  (3) circumference
(2) rotation  (4) size

13. The tropopause is approximately how far above sea level?
(1) 12 mi  (2) 12 km  (3) 60 mi  (4) 60 km

14. If a low-pressure system follows a typical storm track across New York State, it will move toward the
(1) southeast  (3) northeast
(2) southwest  (4) northwest

Base your answers to questions 15 and 16 on the weather map below, which shows a low-pressure system centered near Poughkeepsie, New York. Isobars shown are measured in millibars.

15. Which city is most likely experiencing winds of the greatest velocity?
(1) New York City  (3) Poughkeepsie
(2) Binghamton  (4) Scranton

16. Surface winds are most likely blowing from
(1) Danbury toward New York City
(2) Poughkeepsie toward Scranton
(3) Binghamton toward Danbury
(4) Port Jervis toward Binghamton
1. Which set of surface soil conditions on a hillside would result in the most infiltration of rainfall?
   (1) gentle slope, saturated soil, no vegetation
   (2) gentle slope, unsaturated soil, vegetation
   (3) steep slope, saturated soil, vegetation
   (4) steep slope, unsaturated soil, no vegetation

2. Which surface soil type has the slowest permeability rate and is most likely to produce flooding?
   (1) pebbles
   (2) sand
   (3) silt
   (4) clay

3. The columns A, B, C, and D shown below contain equal volumes of sediment.
   - Column A: Mixed particles (0.00001 cm to 0.5 cm in size)
   - Column B: Uniform-sized particles (0.2 cm)
   - Column C: Sorted particles (0.0001 cm to 0.2 cm in size)
   - Column D: Dry mud (Smaller than 0.0004 cm in size)

   When an equal volume of water is added to each column, the greatest rate of infiltration will occur in which column?
   (1) A
   (2) B
   (3) C
   (4) D

4. The arrows in the cross section below show the prevailing winds moving across northern New York State into Vermont during the summer.

   Compared to the climate of location A, the climate of location B is
   (1) warmer and wetter
   (2) warmer and drier
   (3) cooler and wetter
   (4) cooler and drier

5. Which graph best represents the relationship between soil particle size and the rate at which water infiltrates permeable soil?

   - Graph 1: Decreasing rate of infiltration with increasing soil particle size
   - Graph 2: Increasing rate of infiltration with increasing soil particle size
   - Graph 3: Constant rate of infiltration
   - Graph 4: No relationship between soil particle size and infiltration rate

6. Soil composed of which particle size usually has the greatest capillarity?
   (1) silt
   (2) fine sand
   (3) coarse sand
   (4) pebbles
7. The diagram below shows the result of leaving an empty, dry clay flowerpot in a full container of water for a period of time. The water level in the container dropped to level A. The top of the wet area moved to level B.

![Diagram of clay flowerpot and water levels]

Level B is higher than level A because water
(1) is less dense than the clay pot
(2) is more dense than the clay pot
(3) traveled upward in the clay pot by capillary action
(4) traveled downward in the clay pot by capillary action

8. If a low-pressure system follows a typical storm track across New York State, it will move toward the
(1) southeast
(2) southwest
(3) northeast
(4) northwest

9. In general, the probability of flooding decreases when there is an increase in the amount of
(1) precipitation
(2) infiltration
(3) runoff
(4) snow melt

10. Which statement best summarizes the general effects of ocean currents at 20° S latitude on coastal regions of South America?
(1) The east coast and west coast are both warmed.
(2) The east coast and west coast are both cooled.
(3) The east coast is warmed and the west coast is cooled.
(4) The east coast is cooled and the west coast is warmed.

11. London, England, is located at approximately 51° 30' north latitude and 0° longitude. Elmira, New York, is located at approximately 42° 10' north latitude and 76° 54' west longitude. What is one reason why London has a warmer average winter temperature than Elmira?
(1) London is located closer to the equator.
(2) London is located at a higher elevation.
(3) London’s climate is modified by the North Atlantic Ocean Current.
(4) London’s climate is modified by its longer duration of insolation.

12. The average temperature at Earth’s equator is higher than the average temperature at Earth’s South Pole because the South Pole
(1) receives less intense insolation
(2) receives more infrared radiation
(3) has less land area
(4) has more cloud cover

13. Which sediment size would allow water to flow through at the fastest rate?
(1) clay
(2) silt
(3) sand
(4) pebbles

14. Which component of Earth’s atmosphere is classified as a greenhouse gas?
(1) oxygen
(2) carbon dioxide
(3) helium
(4) hydrogen

15. Large oceans moderate the climatic temperatures of surrounding coastal land areas because the temperature of ocean water changes
(1) rapidly, due to water’s low specific heat
(2) rapidly, due to water’s high specific heat
(3) slowly, due to water’s low specific heat
(4) slowly, due to water’s high specific heat
Base your answers to questions 1 through 3 on the block diagrams below, which show three types of streams with equal volumes.

Type 1
- Straight channel
- Narrow, V-shaped valley

Type 2
- Flood plain
- Wider valley with sloping walls

Type 3
- Oxbow meandering channel
- Broad valley with wide, swampy flood plain

1. Explain how the differences between the type 1 and type 3 stream channels indicate that the average velocities of the streams are different.

2. Explain why the outside of the curve of a meandering channel experiences more erosion than the inside of the curve.

3. Explain how the cobbles and pebbles that were transported by these streams became smooth and rounded in shape.

4. What are the largest particles that a stream can transport when its velocity is 200 centimeters per second?
   - (1) silt
   - (2) sand
   - (3) pebbles
   - (4) cobbles

5. The cross section below shows a V-shaped valley and the bedrock beneath the valley.

Which agent of erosion is responsible for cutting most V-shaped valleys into bedrock?
   - (1) surface winds
   - (2) running water
   - (3) glacial ice
   - (4) ocean waves

6. Which agent of erosion is mainly responsible for the formation of the depressions occupied by both the kettle lakes and finger lakes found in New York State?
   - (1) wind
   - (2) waves
   - (3) streams
   - (4) glaciers

7. Glaciers often form parallel scratches and grooves in bedrock because glaciers
   - (1) deposit sediment in unsorted piles
   - (2) deposit rounded sand in V-shaped valleys
   - (3) continually melt and refreeze
   - (4) drag loose rocks over Earth’s surface

8. Two streams begin at the same elevation and have equal volumes. Which statement best explains why one stream could be flowing faster than the other stream?
   - (1) The faster stream contains more dissolved minerals.
   - (2) The faster stream has a much steeper gradient.
   - (3) The streams are flowing in different directions.
   - (4) The faster stream has a temperature of 10°C, and the slower stream has a temperature of 20°C.
9. A stream flowing at a velocity of 75 centimeters per second can transport
(1) clay, only
(2) pebbles, only
(3) pebbles, sand, silt, and clay, only
(4) boulders, cobbles, pebbles, sand, silt, and clay

10. The picture below shows a geological feature in Ischigualasto National Park, Argentina.

Which process most likely produced the present appearance of this feature?
(1) wind erosion
(2) volcanic eruption
(3) earthquake vibrations
(4) plate tectonics

11. The two photographs below show dates on tombstones found in a cemetery. The tombstones were 5 meters apart and both faced north. Both Tombstone A and Tombstone B had their dates cut into the rock in 1892.

Which statement best explains why the dates are more difficult to read on tombstone A than on tombstone B?
(1) Tombstone A is composed of minerals less resistant to weathering than tombstone B.
(2) Tombstone A has undergone a longer period of weathering than tombstone B.
(3) Tombstone A experienced cooler temperatures than tombstone B.
(4) Tombstone A was exposed to less acid rain than tombstone B.

12. Landscapes will undergo the most chemical weathering if the climate is
(1) cool and dry
(2) cool and wet
(3) warm and dry
(4) warm and wet

13. The long, sandy islands along the south shore of Long Island are composed mostly of sand and rounded pebbles arranged in sorted layers. The agent of erosion that most likely shaped and sorted the sand and pebbles while transporting them to their island location was
(1) glaciers
(2) landslides
(3) wind
(4) ocean waves


Which layer appears to be the least resistant to weathering?
(1) A
(2) B
(3) C
(4) D
**Diagnosic Test Topic 10**

1. The map below shows the large delta that formed as the Mississippi River emptied into the Gulf of Mexico.

Which process was primarily responsible for the formation of the delta?
(1) glacial erosion  
(2) cementation of sediment  
(3) deposition of sediment  
(4) mass movement

2. Which property would best distinguish sediment deposited by a river from sediment deposited by a glacier?
(1) mineral composition of the sediment  
(2) amount of sediment sorting  
(3) thickness of sediment layers  
(4) age of fossils found in the sediment

3. What will be the most probable arrangement of rock particles deposited directly by a glacier?
(1) sorted and layered  
(2) sorted and not layered  
(3) unsorted and layered  
(4) unsorted and not layered

4. What is the minimum water velocity needed in a stream to maintain the transportation of the smallest boulder?
(1) 100 cm/sec  
(2) 200 cm/sec  
(3) 300 cm/sec  
(4) 500 cm/sec

5. Many north-to-south elongated hills are found scattered across New York State. These hills contain a mixture of unsorted sediments of all sizes. Erosion and deposition by which agent probably formed these hills?
(1) wind  
(2) waves  
(3) streams  
(4) glaciers

6. The map below shows a river emptying into an ocean, producing a delta.

Which graph best represents the relationship between the distance from the river delta into the ocean and the average size of sediments deposited on the ocean floor?

7. Complete the table below, by listing three agents of erosion and identifying one characteristic surface feature formed by each agent of erosion.

<table>
<thead>
<tr>
<th>Agent of Erosion</th>
<th>Surface Feature Formed</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
</tr>
</tbody>
</table>
8. The photograph below shows a sand dune that formed in a coastal area.

This sand dune was most likely formed by
(1) water flowing from the left
(2) water flowing from the right
(3) wind blowing from the left
(4) wind blowing from the right

9. When the velocity of a stream suddenly decreases, the sediment being transported undergoes an increase in
(1) particle density (3) deposition
(2) erosion (4) mass movement

10. The block diagram below shows a displacement of rock layers.

Which process describes the downward sliding of the rock material?
(1) tidal changes (3) mass movement
(2) glacial erosion (4) lava flow

11. The map below shows a meandering river. A–A' is the location of a cross section. The arrows show the direction of the river flow.

Which cross section best represents the shape of the river bottom at A–A'? (1) (3) (2) (4)

12. A stream is transporting the particles W, X, Y, and Z, shown below.

Which particle will most likely settle to the bottom first as the velocity of this stream decreases?
(1) W (3) Y
(2) X (4) Z
Base your answers to questions 1 through 3 on the diagram and table below. The diagram represents a felsic igneous rock. Letters A, B, and C represent three different minerals in the rock sample. The table describes the physical properties of minerals A, B, and C found in the igneous rock sample.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Name of Mineral</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

1. State the texture of this igneous rock.
2. On the table provided below, state the names of minerals A, B, and C.
3. State two processes responsible for the formation of an igneous rock.
4. Bedrock located near Old Forge, New York, would most likely have which characteristics?
   (1) clastic texture consisting of angular sediments of mostly quartz and feldspar cemented together
   (2) crystalline texture composed predominantly of gypsum
   (3) noncrystalline, glassy texture with a dark color
   (4) foliated texture with mica and feldspar separated into bands

5. Which process most likely formed a layer of the sedimentary rock, gypsum?
   (1) precipitation from seawater
   (2) solidification of magma
   (3) folding of clay-sized particles
   (4) melting of sand-sized particles

6. Which igneous rock contains the minerals potassium feldspar and quartz?
   (1) andesite
   (2) pegmatite
   (3) vesicular rhyolite
   (4) scoria

Base your answers to questions 7 through 9 on the diagram below, which represents a part of the rock cycle. The igneous rock, granite, and the characteristics of sedimentary rock X and metamorphic rock Y are shown.

7. Identify sedimentary rock X.
8. Identify metamorphic rock Y.
9. Complete the table below, with descriptions of the observable characteristics used to identify granite.

10. The presence of brachiopod, nautiloid, and coral fossils in the surface bedrock of a certain area indicates the area was once covered by
   (1) tropical vegetation
   (2) glacial deposits
   (3) volcanic ash
   (4) ocean water
11. Which diagram represents a landscape where fine-grained igneous bedrock is most likely to be found?

(1) 

(2) 

(3) 

(4) 

12. Which processes most likely formed the shale bedrock found near Ithaca, New York?
(1) uplift and solidification
(2) burial and compaction
(3) heat and pressure
(4) melting and recrystallization

13. The mineral graphite is often used as
(1) a lubricant
(2) an abrasive
(3) an ART of iron
(4) a cementing material

14. The shore of which New York State body of water has large amounts of metamorphic bedrock exposed at the surface?
(1) western shore of Lake Champlain
(2) eastern shore of Lake Erie
(3) southern shore of Long Island Sound
(4) southern shore of Lake Ontario

15. Which type of rock most likely contains fossils?
(1) scoria
(2) gabbro
(3) schist
(4) shale

16. The two most abundant elements by mass in Earth's crust are oxygen and
(1) potassium
(2) hydrogen
(3) nitrogen
(4) silicon

17. The diagrams below show the crystal shapes of two minerals.

Quartz and halite have different crystal shapes primarily because
(1) light reflects from crystal surfaces
(2) energy is released during crystallization
(3) of impurities that produce surface variations
(4) of the internal arrangement of the atoms

Base your answers to question 18 on the geologic cross section below. The large cone-shaped mountain on Earth's surface is a volcano. Letters A, B, and C represent certain rocks.

18. Which statement correctly describes the relative ages of rocks A and C and gives the best supporting evidence from the cross section?
(1) A is younger than C, because A is a lower sedimentary rock layer.
(2) A is younger than C, because the intrusion of A metamorphosed part of rock layer C.
(3) A is older than C, because A has older index fossils.
(4) A is older than C, because the intrusion of A cuts across rock layer C.
**Diagnostic Test Topic 12**

1. Based on the theory of plate tectonics, it is inferred that over the past 250 million years North America has moved toward the
   (1) northwest  (3) southeast
   (2) southwest  (4) northeast

Base your answers to questions 2 and 3 on the block diagram below. The diagram shows the tectonic plate boundary between Africa and North America 300 million years ago, as these two continents united into a single landmass. The arrows at letters A, B, C, and D represent relative crustal movements. Letter X shows the eruption of a volcano at that time.

2. Identify the type of tectonic plate motion represented by the arrow shown at D.

3. Identify the type of tectonic motion represented by the arrows shown at A, B, and C.

4. Which two tectonic plates are separated by a mid-ocean ridge?
   (1) Indian-Australian and Eurasian
   (2) Indian-Australian and Pacific
   (3) North American and South American
   (4) North American and Eurasian

5. An earthquake's first P-wave arrives at a seismic station at 12:00:00. This P-wave has traveled 6000 kilometers from the epicenter. At what time will the first S-wave from the same earthquake arrive at the seismic station?
   (1) 11:52:20
   (2) 12:07:40
   (3) 12:09:20
   (4) 12:17:00

6. A seismic station is recording the seismic waves produced by an earthquake that occurred 4200 kilometers away. Approximately how long after the arrival of the first P-wave will the first S-wave arrive?
   (1) 1 min 05 sec
   (2) 5 min 50 sec
   (3) 7 min 20 sec
   (4) 13 min 10 sec

Base your answers to questions 7 through 10 on the passage and map below and on your knowledge of earth science. The passage provides some information about the sediments under Portland, Oregon, and the map shows where Portland is located.

**Bad seismic combination under Portland:** Earthquake faults and jiggly sediment

Using a technique called seismic profiling, researchers have found evidence of ancient earthquake faults under Portland, Oregon. The faults may still be active, a USGS (United States Geological Survey) seismologist will announce tomorrow. The research also turned up a 250-foot deep layer of silt and mud, deep under the city, which may have been caused by a catastrophic ice dam break some 15,000 years ago. The two findings could together mean bad news, as soft sediment is known to amplify ground shaking during strong earthquakes. In the 1989 San Francisco earthquake, much of the damage to buildings was caused by liquefaction, a shaking and sinking of sandy, water-saturated soil along waterways.

— Robert Roy Britt

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**North American Plate**

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7. Explain why Portland is likely to experience a major earthquake.

8. Why is the presence of a layer of silt and mud deep under the city a danger to Portland? [1]

9. Describe one precaution that can be taken to prevent or reduce property damage in preparation for a future earthquake in Portland. [1]

10. What type of tectonic plate boundary is shown at the San Andreas Fault? [1]

11. What is the approximate location of the Canary Islands hot spot? (1) 32° S 18° W (3) 32° N 18° W (2) 32° S 18° E (4) 32° N 18° E

Base your answers to questions 12 through 14 on the map below. The map shows the continents of Africa and South America, the ocean between them, and the ocean ridge and transform faults. Locations A and D are on the continents. Locations B and C are on the ocean floor.

12. The hottest crustal temperature measurements would most likely be found at location (1) A (2) B (3) C (4) D

13. Which table best shows the relative densities of the crustal bedrock at locations A, B, C, and D?

<table>
<thead>
<tr>
<th>Relative Densities of Crust</th>
<th>Relative Densities of Crust</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Dense</td>
<td>Less Dense</td>
</tr>
<tr>
<td>A, B</td>
<td>C, D</td>
</tr>
</tbody>
</table>

14. Which graph best shows the relative age of the ocean-floor bedrock from location B to location C?

<table>
<thead>
<tr>
<th>Age</th>
<th>Location</th>
<th>Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old</td>
<td>B Location</td>
<td>(1)</td>
</tr>
<tr>
<td>Young</td>
<td>C Location</td>
<td>(2)</td>
</tr>
<tr>
<td>Young</td>
<td>B Location</td>
<td>(3)</td>
</tr>
<tr>
<td>Old</td>
<td>C Location</td>
<td>(4)</td>
</tr>
</tbody>
</table>

15. Why does the oceanic crust sink beneath the continental crust at a subduction boundary? (1) The oceanic crust has a greater density. (2) The oceanic crust is pulled downward by Earth’s magnetic field. (3) The continental crust has a more mafic composition. (4) The continental crust is pulled upward by the Moon’s gravity.
Diagnostic Test  TOPIC 13

1. A fossil shell contains 25% of the original amount of its carbon-14. Approximately how many years ago was this shell part of a living organism?
   (1) 5,700 years ago
   (2) 11,400 years ago
   (3) 17,100 years ago
   (4) 22,800 years ago

2. According to fossil evidence, which sequence shows the order in which these four life-forms first appeared on Earth?
   (1) reptiles —> amphibians —> insects —> fish
   (2) insects —> fish —> reptiles —> amphibians
   (3) amphibians —> reptiles —> fish —> insects
   (4) fish —> insects —> amphibians —> reptiles

3. Earth's early atmosphere formed during the Early Archean Era. Which gas was generally absent from the atmosphere at that time?
   (1) water vapor
   (2) carbon dioxide
   (3) nitrogen
   (4) oxygen

4. The graph below shows the rate of decay of the radioactive isotope K-40 into the decay products Ar-40 and Ca-40.

   [Graph]

   Analysis of a basalt rock sample shows that 25% of its radioactive K-40 remained undecayed. How old is the basalt?
   (1) 1.3 billion years
   (2) 2.6 billion years
   (3) 3.9 billion years
   (4) 4.6 billion years

Base your answers to questions 5 through 9 on the geologic cross section below and on your knowledge of Earth science. The cross section shows New York State index fossils in rock layers that have not been overturned. Rock unit A is an igneous intrusion and line XY represents an unconformity.

5. Based on fossil evidence, determine the geologic period during which the unconformity formed.

6. Identify the coral index fossil that would most likely be found in the same layer as the index fossil Ctenocrinus.

7. Each index fossil existed for a relatively short geologic time interval. State one other characteristic that each fossil must have to be considered an index fossil.

8. Describe the type of depositional environment in which the fossilized organisms lived.

9. Identify one piece of evidence shown in this cross section that indicates that the igneous intrusion, A, is older than the sandstone layer.
10. Which characteristic is most useful in correlating Devonian-age sedimentary bedrock in New York State with Devonian-age sedimentary bedrock in other parts of the world?
- (1) color
- (2) index fossils
- (3) rock types
- (4) particle size

11. The diagram below shows a geologic cross section. Letters A through D represent different rock units.

Which sequence correctly shows the age of the lettered rock units, from oldest to youngest?
- (1) A → B → C → D
- (2) C → D → A → B
- (3) D → B → A → C
- (4) D → C → B → A

12. The diagram below represents a geologic cross section of a portion of Earth's crust.

Folding and erosion occurred after the formation of the
- (1) Gayle shale
- (2) Freeport sandstone
- (3) Erie coal, but before formation of Freeport sandstone
- (4) Dunbar limestone, but before formation of Erie coal

Base your answers to questions 13 and 14 on the diagram and information below about fossil snails and on your knowledge of Earth science.

Snails have lived in most of the world's oceans over a period of hundreds of millions of years. Paleontologists discovered that in warm, tropical waters more snails have shells that, when viewed from the top, spiral outward in a clockwise direction. In cool or cold waters, more snails have shells that spiral outward in a counterclockwise direction. Both clockwise- and counterclockwise-spiraled snail fossils have been found in New York State bedrock.

13. In a slab of rock that contains many fossil snails, what evidence would lead geologists to conclude that the slab was formed in a tropical climate?

14. State one reason bedrock that formed in tropical regions is found in New York State.
1. Great volcanic eruptions send dust and ash into the stratosphere. Weeks after such great eruptions, air temperatures are often
   (1) cooler than normal because the atmosphere is less transparent
   (2) cooler than normal because the atmosphere is more transparent
   (3) warmer than normal because the atmosphere is less transparent
   (4) warmer than normal because the atmosphere is more transparent

2. New York State's Adirondacks are classified as a mountain landscape region. Describe one bedrock characteristic and one land surface characteristic that were used to classify the Adirondacks as a mountain landscape region. [2]

3. Which block diagram best represents a portion of a plateau?

4. The cross section below shows the rock structure of a deeply eroded, domed mountain region.

5. In which New York State landscape region is most of the surface bedrock composed of metamorphic rock?
   (1) Adirondacks
   (2) Catskills
   (3) Erie-Ontario Lowlands
   (4) Newark Lowlands

6. In which New York State landscape region is Niagara Falls located?
   (1) Tug Hill Plateau
   (2) St. Lawrence Lowlands
   (3) Allegheny Plateau
   (4) Erie-Ontario Lowlands

7. The occurrence of parallel scratches on bedrock in a U-shaped valley indicates that the area has most likely been eroded by
   (1) a glacier
   (2) a stream
   (3) waves
   (4) wind
Great Balls of Fire

The Earth's predicted near-miss with asteroid XF11 in the year 2028 has once again focused attention on the fear that a large asteroid or comet hitting our planet could trigger a global catastrophe. To back this up, every article and television program about XF11 boldly asserted that the dinosaur extinction was caused by a giant asteroid impacting into the Earth 65.5 million years ago. This has typically been accompanied by a picture of frightened dinosaurs looking skyward at a huge flaming meteorite streaking across the horizon. This scenario is so widely accepted that few commentators bother to question it any more. There is, however, much evidence to suggest that an asteroid may not have hit the Earth 65.5 million years ago and that, even if it did, it did not cause the mass extinction of life attributed to it. There is also the possibility that dinosaurs may not have been around to witness it!

by Paul Chambers
Fortean Times 111 (June, 1998), pp 34–37

8. If an asteroid struck Earth 65.5 million years ago, what surface feature was most likely created by this asteroid impact?

9. Identify one geologic process occurring on Earth that could have hidden or even destroyed this inferred impact feature.

10. Explain how an asteroid impact may have been able to cause a worldwide mass extinction of dinosaurs.

11. Which component of Earth's atmosphere is classified as a greenhouse gas?
(1) oxygen (2) carbon dioxide (3) helium (4) hydrogen

12. The photograph below shows an eroded plateau found in the southwestern United States.

The landscape was developed by the processes of
(1) crustal uplift and stream erosion
(2) crustal uplift and glacial erosion
(3) crustal folding and stream erosion
(4) crustal folding and glacial erosion

13. The graph below shows the change in carbon dioxide concentration in parts per million (ppm) in Earth's atmosphere from 1960 to 1990.

The most likely cause of the overall change in the level of carbon dioxide from 1960 to 1990 is an increase in the
(1) number of violent storms
(2) number of volcanic eruptions
(3) use of nuclear power
(4) use of fossil fuels

14. Rocks and minerals are natural resources that are mined in New York State. State one negative impact that should be considered before mining these natural resources.
**Answers To Diagnostic Test 1**

1. 3
2. 400 to 600 million km
3. 1
4. [1] Allow 1 credit. Acceptable responses include, but are not limited to: Seek indoor shelter and if indoors, stay away from windows.
5. 1
6. 4
7. 1
8. 4

**Answers To Diagnostic Test 2**

1. [2] An example of correctly drawn isotherms is shown below.

![Map of the United States with isotherms drawn](image_url)

- Allow 2 credits for correctly drawing all three required isotherms. If the student draws more than the three required isotherms, all must be correct to receive 2 credits.
- Allow only 1 credit for correctly drawing only two required isotherms. or Allow only 1 credit for correctly drawing all three required isotherms, but any additional isotherms drawn are incorrect.

**Note:** Allow credit even if the isotherms extend to the border of the map.

2. [1] Allow 1 credit for any temperature value between the student-drawn isotherms adjacent to point A. Allow credit for the isotherm value only if the isotherm passes through point A.
3. 1
4. 1
5. 2
6. 2
7. 3
8. 3
9. 4
10. 4
11. 1
12. 1
13. 2
14. 1
15. 3

**Answers To Diagnostic Test 3**

1. 2
2. 3
3. 3

4. [1] Allow 1 credit for placing the letter W within the area shown on Diagram I indicated by the bracket. Also allow credit if a symbol other than W is used.

**Example of a 1-credit response:**

![Diagram I](image_url)

5. [1] Allow 1 credit for circling only Saturn and Jupiter. Both planets must be circled to receive credit.

**Example of a 1-credit response:**

![Diagram II](image_url)

(Not drawn to scale)

6. [1] Allow 1 credit for 84 years or 84.0 years. Correct units must be included in the answer.
7. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The orbits are elliptical or oval shaped.
   - The orbits are nearly circular.
8. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - Sometimes Pluto is closer to the Sun than Neptune is.
   - Part of Pluto’s orbit is sometimes located within Neptune’s orbit.
9. 1
10. 3
11. 4
12. 4
13. 3
14. 1
15. 4
16. 3
17. 4
18. 2
### Answers to Diagnostic Test 4

1. 4  
2. 3  
3. 2  
4. 3  
5. 4  
6. 1  
7. 4  
8. 2  
9. 3  
10. 2

### Answers to Diagnostic Test 5

1. 1  
2. 4  
3. 1  
4. 4  
5. 2  
6. 4  
7. 2  
8. 4  
9. 3  
10. 2  
11. 4  
12. 4  
13. 3  
   Example of a 1-credit response:

### Answers to Diagnostic Test 6

1. [1] Allow 1 credit for a line on the graph showing that, as the altitude of the noontime Sun increases, the hours of daylight increase.

### Answers to Diagnostic Test 7

1. 2  
2. 2  
3. [1] Allow 1 credit if both air masses are correct as shown below. Allow credit for either upper- or lowercase letters.
   (1) cP  
   (2) mT
   **Note:** Do not allow credit if the letters are reversed, such as, Tm.


5. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - Move indoors.
   - Do not use electrical equipment or telephones.
   - Do not stand under tall objects.

6. 2  
7. 2  
8. 3  
9. 3  
10. 2  
11. 4
Agent of Erosion | Surface Feature Formed
---|---
Waves | beach, sandbars, barrier islands
Wind | loss of topsoil, dunes
Glacier | U-shaped valley, moraines, drumlins
Running water (streams) | V-shaped valley, deltas, meanders
Mass movement | landslides, slumps

8. 4 9. 3 10. 3
11. 3 12. 1

1. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to:
   - The type 3 stream meanders more.
   - The type 3 stream occupies a wider floodplain.
   - The type 1 stream has a straighter course.

2. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to:
   - Stream velocity is greater on the outside of the meandering channel.
   - Stream flow is slower on the inside of the meandering channel.
   - Water is moving faster on the outside of a meander curve.

3. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to:
   - These tumbling cobbles and pebbles were abraded against other transported rocks and the stream channel.
   - Abrasion occurred as the rocks bounced and rolled along the bottom of the streambed.
   - Sharp corners and edges were knocked off, scraped, and/or worn down.
   - Grinding against other sediment and rocks

Note: Do not allow credit for statements that describe the water alone as the primary cause of rounding.

4. 4 5. 2 6. 4
7. 4 8. 2 9. 3
10. 1 11. 1 12. 4
13. 4

4. 4 5. 1 6. 3
9. [1] Allow 1 credit for a correct description of two or more characteristics. Acceptable responses include, but are not limited to:

<table>
<thead>
<tr>
<th>Characteristic of Granite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texture</td>
<td>coarse</td>
</tr>
<tr>
<td></td>
<td>nonvesicular</td>
</tr>
<tr>
<td></td>
<td>1 mm to 10 mm</td>
</tr>
<tr>
<td>Color</td>
<td>light colored</td>
</tr>
<tr>
<td></td>
<td>white</td>
</tr>
<tr>
<td></td>
<td>pink</td>
</tr>
<tr>
<td></td>
<td>gray</td>
</tr>
<tr>
<td>Density</td>
<td>low</td>
</tr>
<tr>
<td></td>
<td>2.7 g/cm³</td>
</tr>
</tbody>
</table>

10. 4 11. 1 12. 2
13. 1 14. 1 15. 4
16. 4 17. 4 18. 2

1. 1
2. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - subduction
   - convergence
3. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - transform movement
   - faulting
   - The plates slide past each other.

4.  4  5.  2  6.  2

   Acceptable responses include, but are not limited to, these examples:
   - Tectonic plates are shifting in this region.
   - The ancient faults detected under Portland may still be active.
   - Soft sediment causes minor earthquakes to become major earthquakes.
   Portland is located near a plate boundary.

Note: Do not allow credit for hot spot.

   Acceptable responses include, but are not limited to, these examples:
   - Soft sediment can amplify earthquake ground movement.
   - Buildings can be damaged by liquefaction within those sediments during the earthquakes.
   - Structures can collapse, tilt, or sink during an earthquake.

   Acceptable responses include, but are not limited to, these examples:
   - Reinforce buildings to provide greater stability.
   - Make buildings more flexible.
   - Redesign or reconstruct highway overpasses.
   - Rewrite or enforce strict building codes.
   - Restrict building in surface areas identified as more susceptible to earthquake damage.

10. [1] Allow 1 credit for transform plate boundary or transform fault or transform.
    Note: Do not allow credit for faulting, fault, or hot spot.

11.  3  12.  3  13.  2

14.  4  15.  1

**Answers To Diagnostic Test 13**

1.  2  2.  4  3.  4
4.  2
5. [1] Allow 1 credit for Devonian Period.
6. [1] Allow 1 credit for *Pleurodictyum*.
7. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - widespread geographic distribution

8. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The organisms lived in a shallow sea.
   - They lived in a marine environment.

9. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - There is no contact metamorphism between rock unit A and the sandstone.
   - An unconformity exists between the igneous intrusion and sandstone layer.

10.  2  11.  4  12.  3

13. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - Clockwise spiral snail shells are found in greater numbers.

---

14. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - New York State experienced a warmer climate when it was located closer to the Equator.
   - The North American Plate has drifted northward from the equator region over time.
   - New York State used to be in the tropics.

---

1.  1
2. [2] Allow 1 credit for a correct bedrock characteristic. Acceptable responses include, but are not limited to, these examples:
   - The Adirondacks have faulted, folded, and deformed bedrock.
   - The Adirondacks have intensely metamorphosed bedrock.
   - The oldest bedrock is near the center of the Adirondacks.

   and

   Allow 1 credit for a correct land surface characteristic. Acceptable responses include, but are not limited to, these examples:
   - The Adirondacks have high elevations.
   - The Adirondacks have steep slopes.
   - The Adirondacks are a partially eroded dome.

3.  1  4.  2  5.  1
6.  4  7.  1
8. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - crater
   - impact crater
   - large hole

9. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - deposition of sediment
   - erosion
   - subduction
   - volcanic lava flow
   - weathering

10. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
    - Dust that was thrown into Earth’s atmosphere caused a change in Earth’s climate.
    - The impact caused fires that killed plants and animals.
    - Dust from the impact blocked sunlight that cooled Earth and caused many green plants to die.

11.  2  12.  1  13.  4
14. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
    - Rocks and minerals are nonrenewable resources.
    - Mining can result in pollution of the land, water, and air in the region.
    - Mining can result in the removal of topsoil.
    - danger to miners
    - destruction of natural habitats
    - landscape destruction
Review Questions
1. 4  2. 2  3. 1
4. 2  5. 2  6. 4
7. 3  8. 4  9. 2
10. 2  11. 2  12. 2
13. 2  14. 3  15. 3
16. Place the beads in water. The group of beads with the lower density will float and the other group will sink.
17. Use a balance to determine the mass of the sample. Then use the density formula to determine the volume.
18. 3  19. 2  20. 1
21. 3
22. Accept any correct answer. Examples: changes in seasons; phases of the moon; sunrise and sunset
23. 3  24. 3  25. 4
26. 3  27. 3  28. 2
29. 3  30. 2
31. Accept any correct answer. Examples: pollen, volcanic gases, X-rays from uranium and radon in rocks
32. 1
33. Accept any correct answer. Examples: cities, urban areas, regions with much industry
34. 3  35. 3  36. 4
37. 4  38. 4  39. 4

Regents Practice
Part A
1. 1  2. 4  3. 1
4. 2  5. 1  6. 3
7. 2  8. 4  9. 3
10. 2  11. 3  12. 2
13. 2  14. 2  15. 2
16. 4  17. 3  18. 4
19. 1  20. 1

Part B
21. 140 = 4.1%; 150 = 2.7%; 160 = 9.6%
22. 3
23. Sandstone has a higher density.
24. 0.8 g/mL
25. the same
26. 2.0%
27. 4°C
28. It will sink to the bottom of the liquid.
29. Accept any reasonable answers. Examples: to prevent loss of life; to prevent injuries, to prevent loss of property

Part C
32. The crude oil is less dense than water so it floats on top of the water.
33. It is a natural disaster because it is not caused by humans and it has the possibility to cause loss of life, personal injury, or loss of property (pipeline and crops).
34. % deviation = \( \frac{\text{difference from accepted value}}{\text{accepted value}} \times 100 \)
% deviation = \( \frac{50,000 \text{ gal} - 35,000 \text{ gal}}{35,000 \text{ gal}} \times 100 \)
Percent deviation is 43%.
35. rate of change = \( \frac{\text{change in field value}}{\text{time}} \)
rate of change = \( \frac{5000 \text{ gal} - 0 \text{ gal}}{14 \text{ days}} \)
Rate of change is 357 gallons per day.
36. The crude oil in the soil is pollution because, in the concentration stated, it killed most of the crops so it was a substance harmful to the plant part of the environment.
37 a. Allow no credit for writing the equation.
37 b. Allow 1 credit for correctly substituting both acceptable values into the equation given in part a. The student need not record the units. Acceptable responses include, but are not limited to, these examples:
\[
\text{rate of change} = \frac{2,600 \text{ km}}{96 \text{ hours}}
\]
37 c. Allow 1 credit for correctly calculating the rate, based on the student's answer in part b. Correct units must be given. Acceptable responses include, but are not limited to, these examples:
\[
\text{rate of change} = 27 \frac{\text{km}}{\text{hr}}
\]
38. [3] Allow 1 credit for measuring the distance with the rope, and Allow 1 credit for timing the apples, and Allow 1 credit for a correct equation. Acceptable responses include, but are not limited to, these examples:
\[
\text{distance} = \text{change in field value}
\]
\[
\text{rate of change} = \frac{\text{change in distance}}{\text{time}}
\]
26. a. \(\text{gradient} = \frac{\Delta \text{elevation}}{\Delta \text{distance}}\) or 
\(\text{gradient} = \frac{580 - 480}{400} = 0.25\)
26. b. \(\text{gradient} = \frac{580 - 400}{200} = 0.4\)
26. c. 50 meters/kilometer or 50 m/km

Answers To Topic 2

Review Questions

1. 1
2. 3
3. 1
4. 3
5. 3
6. 2
7. 2
8. 2
9. 3
10. 2
11. 3
12. 1
13. 4
14. 4
15. 1
16. 4
17. 4
18. 2
19. 2
20. altitude increases
21. 2
22. 1
23. 1
24. 1
25. 1
26. 2
27. 2
28. 3
29. 3
30. 4
31. 1
32. it decreases
33. 2
34. 3
35. 3
36. 4
37. 3
38. 2
39. 4
40. Vails Gate Ridge
41. 1
42. 2
43. 2
44. 1
45. 3
46. 4
47. 4
48. 2

Regents Practice

Part A

1. 1
2. 3
3. 3
4. 3
5. 4
6. 1
7. 4
8. 3
9. 4
10. 3
11. 3
12. 2
13. 1
14. 1
15. 1

Part B

16. 48° 32’ N
17. 122° 3’ W
18. east or easterly
19. 2160
30. a. Allow no credit for writing the equation.
b. Allow 1 credit for correctly substituting both temperature and distance information (±10 miles) into the equation written in part a. The student need not record the units. Acceptable responses include, but are not limited to, these examples:

Gradient = \frac{10 \, ^\circ \text{F}}{200 \text{ miles}}

Gradient = \frac{10}{200}

c. Allow 1 credit for correctly calculating the gradient, based on the student’s answer in part b. Units that are consistent with the student’s answer in part b must be included to receive credit. Acceptable responses include, but are not limited to, these examples:

Gradient = \frac{0.05 \, ^\circ \text{F}}{\text{mile}} \text{ or } \frac{0.05 \, ^\circ \text{F}}{\text{mile}}

Gradient = \frac{0.05 \, ^\circ \text{F}}{\text{mile}} \text{ or } \frac{0.05 \, ^\circ \text{F}}{\text{mile}}

31. 2

32. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

Temperatures generally decrease as latitude increases.
Temperature and latitude are inversely related.

Part C

33. A model is any way of representing something and a plastic relief model of Glick represents Glick.

34. It is primarily composed of hydrogen and oxygen.

35. The hydrosphere would be between the atmosphere and lithosphere.

36. The majority of Glick’s most dense substances would be in its deep interior or core.

37. The location would be 37° S latitude, but no specific longitude could be determined with this information.

38. Traveling due west would not change the altitude of Glotch, thus there would be no change noticed.

39. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples: Lack of contour lines indicates a relatively flat area. The stream shows meanders. The contour lines are spaced far apart.

40. a. Allow 1 credit for North or northeast or north northeast.

41. Allow 1 credit for correctly indicating on the map the location of the second campsite (±0.2 mi).

42. Allow 1 credit for either route shown on the map above or for any other appropriate route from the student’s plotted campsite on which the 500-foot contour line is crossed only once.

**Answers to Topic 3**

**Review Questions**

1. 2  
2. 3  
3. 1  
4. 1  
5. 2  
6. 2  
7. 4  
8. 4  
9. 4  
10. 3  
11. 2  
12. 1  
13. 2  
14. 1  
15. 4  
16. 4  
17. 1  
18. 4  
19. 2  
20. 3  
21. 2  
22. 4  
23. 4  
24. 2  
25. 2  
26. 1  
27. 1  
28. 1  
29. 1  
30. 4  
31. 4  
32. 1  
33. 3  
34. 1  
35. 2  
36. 4  
37. 1  
38. 2  
39. 3  
40. 4  
41. 1  
42. 3  
43. 1  
44. 2  
45. 2  
46. 1  
47. 2  
48. 1  
49. 3  
50. 3

**Regents Practice**

**Part A**

1. 2  
2. 4  
3. 1  
4. 3  
5. 4  
6. 2  
7. 1  
8. 3  
9. 1  
10. 3  
11. 2  
12. 2  
13. 1  
14. 4  
15. 4  
16. 1  
17. 1  
18. 1  
19. 2
Part B
20. A galaxy is a gravitational collection of millions or billions of stars while a constellation is a group of stars that form a pattern as viewed from Earth and are used to help people locate celestial objects.
21. A planet is a large object that orbits a star while a moon is an object that orbits a planet (or asteroid).
22. 23. 24. 25.

Planets' Average Orbital Speed Versus Average Distance From Sun (AU)

26. Accept any scientifically correct answer or accurate interpretation of the student's graph. Examples: Planets with the higher orbital speeds are located closer to the sun. Distances from the sun and orbital speed are inversely related.
27. Mars and Jupiter
28. Vesta
29. a. eccentricity = \( \frac{d}{l} \) where \( d \) is the distance between foci and \( l \) is the length of the major axis.

b. eccentricity = \( \frac{4}{5} \)

Allow 3.9 cm to 4.1 cm for distance between foci and 7.6 cm to 8.1 cm for length of major axis.

c. Accept correctly calculated eccentricity based on student's answer in b, but do not accept answers recorded in fractions or with units. Examples: eccentricity = 0.5 or \( e = 0.5 \)

d. Allow 1 credit for a scientifically correct answer or for an accurate interpretation based on the student's calculation of the eccentricity of the elliptical orbit. Examples: The elliptical orbit is more eccentric than Earth's orbit. Earth's orbit is more round.
30. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Cosmic background radiation remains.
   — There is a red shift in the light from stars in distant galaxies.
   — the apparent expansion of the universe
   — More-distant stars are moving away from Earth at a greater rate than nearby stars.
31. [1] Allow 1 credit for 1300 ± 200 million years.
32. [1] Allow 1 credit for the correct response shown below.
   Brightest: (a) Betelgeuse
   (b) Polaris
   (c) Aldebaran
   (d) Sirius

   Least Bright: (e) the Sun

Part C
33. The Big Bang theory states that the universe is continuing to expand. This would explain the observed red shift Doppler effect of most galaxies.
34. Accept any distance between 227.9 km and 149.6 km.
35. Accept any answer between 687 days and 365.26 days.
36. The most likely shape of the planet is spherical or like a sphere.
37. The oldest possible rock would be 4.6 billion years.
38. You would need to know how long it takes the planet to make one rotation on its axis.
39. Thelma would be considered a terrestrial planet because it is closer to the sun than Mars and is relatively small in diameter and largely solid. You can infer that it is solid because its density is relatively high (between Earth's density and Mars' density).
40. The magnitude of gravitation between the sun and Thelma would be greater than the gravitation between the sun and Mars. The reasons for this are that Thelma is closer to the sun and because it has a greater density and diameter than Mars, thus a higher mass.
41. If Thelma got hit with a five-mile-wide asteroid, you would expect that a large impact crater would form on the solid surface of Thelma.
42. Allow 1 credit for a response that states that luminosity increases, then decreases.
43. Allow 1 credit for Procyon B.
44. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples: A shift of light from distant galaxies toward the red end of the spectrum shows galaxies are moving away from Earth. The red shift shows that the universe is expanding.
45. Allow 1 credit for a correct response. Allow credit for any answer that shows the correct relative-age relationship even if the actual ages are incorrect. Acceptable responses include, but are not limited to, these examples: Earth and our solar system are younger than the Milky Way Galaxy. The estimated age of Earth and our solar system is 4.6 billion years and these distant galaxies are 12 billion years old. Our solar system is about 5 billion years old, much younger than these 12-billion-year-old galaxies.
46. [1] Allow 1 credit if the center of the student's X is within the bracket shown below.

Example of a 1-credit response:

![Image of asteroid orbit](image)

47. [1] Allow 1 credit for Halley's Comet and an acceptable reason. Acceptable reasons include, but are not limited to:
- The comet traveled a greater distance during that time.
- Halley's orbit is closer to the Sun.

48. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Halley's Comet orbits the Sun.

---

**ANSWERS TO TOPIC 4**

**Review Questions**

1. 2  
2. 3  
3. 4  
4. 4  
5. because Earth rotates from west to east  
6. 2  
7. 3  
8. 4  
9. 1  
10. 4  
11. 2  
12. 4  
13. 3  
14. 4  
15. 4  
16. 3  
17. 2  
18. 3  
19. 4  
20. 2  
21. Because Earth orbits the sun, different parts of the sky are visible from Earth at different times.

---

**Regents Practice**

**Part A**

1. 4  
2. 2  
3. 1  
4. 3  
5. 3  
6. 3  
7. 1  
8. 3  
9. 4  
10. 2  
11. 3  
12. 2  
13. 4  
14. 4  
15. 4  
16. 2  
17. 3  
18. 1  

---

**Part B**

19. 1  
20. 50 minutes  
21. 2  
22. The Moon is closer to Earth than the sun is.  
23. 1  
24. [1] Allow 1 credit for all three times indicated correctly. Pacific is 7 a.m.; Mountain is 8 a.m.; and Eastern is 10 a.m.

---

25. See Figure 4-17 of student book. Accept "shadow" as label for "umbra" and "penumbra." Phase of the moon is new moon.

26–27.

---

28. 43° N or 43° North  
29. Allow 1 credit for the answer 3 p.m. (+ or -1 hour)

---

**Part C**

30. Earth would still have tides because of the gravitational pull of the sun.

31. The ocean tides would be much lower at high tide and still lower at low tide without the moon and the timing of the tides would be slightly different.

32. Since the moon is involved in the production of both the lunar and solar eclipses, if there were no moon, neither type of eclipse would occur.

33. Timekeeping would have been affected by the lack of a moon because early people kept time by the moon. Without the moon there would be no concept of the month, and the year would have to be divided into different units.

---

EARTH SCIENCE ANSWER KEY 37
34. The day would be altered most.
35. The daily apparent motions of celestial objects in the sky would not exist without Earth’s rotation. Also the Coriolis effect and the apparent motions of the Foucault pendulum would not exist without Earth’s rotation.

36 a. Allow 1 credit for the Moon drawn on the night side of Earth directly opposite the Sun. Allow credit even if the size of the Moon is not drawn proportionally or if the Moon is not shaded or is shaded incorrectly.

b. Allow 1 credit if the arrow or arrows clearly show Earth rotating counterclockwise.

37. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, this example: Barringer Crater was caused by the impact of a meteorite (or meteor or comet or asteroid).

38. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, this example: February has only 28 or 29 days and a complete cycle of the Moon phases takes 29\(\frac{1}{2}\) days.

40. [1] Allow 1 credit for Earth being located between the Sun and the Moon. Shading of Earth and the Moon is not necessary. The Sun, the Moon, and Earth must be identified but do not need to be drawn to scale. Acceptable responses include, but are not limited to, this example:

41. [1] Allow credit for a correct response. Acceptable responses include, but are not limited to, this example: The Sun appeared to rise earlier each day due to Earth’s rotation spinning on its axis. Note: Do not allow credit for “The days get longer” because the response does not describe the time of sunrise.

42. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

43. Allow 1 credit for drawing the Moon on the orbit directly between the Sun and Earth.

44. [1] Allow 1 credit for 1 or 1.1 revolution.
45. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

46. [1] Allow 1 credit for Mercury.
47. Allow 1 credit. Acceptable responses include, but are not limited to:

48. Acceptable answers include, but are not limited to: Friction in erosional systems, gravitational energy, tidal energy, and energy from meteor impact.

Review Questions

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1. 3</td>
<td>2. 1</td>
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<tr>
<td>4. 3</td>
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<td>6. 4</td>
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<tr>
<td>7. 4</td>
<td>8. refraction</td>
<td>9. 4</td>
</tr>
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<td>10. 4</td>
<td>11. 3</td>
<td>12. 4</td>
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</tr>
<tr>
<td>43. 4</td>
<td>44. 3</td>
<td>45. 3</td>
</tr>
<tr>
<td>46. 334 joules</td>
<td>47. 1</td>
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Regents Practice

Part A

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</tr>
<tr>
<td>13. 1</td>
<td>14. 2</td>
<td>15. 4</td>
</tr>
</tbody>
</table>
Part B

16. LAMP ON LAMP OFF

Time (min)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

17. 8 minutes
18. 1.2°C/min
19. radiation
20. Dark-colored objects absorb more electromagnetic energy than light-colored objects.
21. conduction
22. Make the can rougher, make the can darker, or any other scientifically correct answer.
23. The specific heat of the iron is less than the dry air because the specific heat of iron is 0.45 joules/gram • °C and the specific heat of dry air is 1.01 joules/gram • °C.
24. The black can would emit the most energy at 10 minutes.
25. (Note: The isotherms may be drawn as straight lines or as smoothly curved lines. The 25°C isotherm may be drawn in a circular pattern with closure around the location of the source or extended to the top and right sides of the map. The 23°C and 24°C isotherms may also be drawn in circular patterns, very close together. None of the isotherms can touch or cross one another.)

Temperature Field Map (°C)

26. a. gradient = \frac{\text{change in field value}}{\text{change in distance}} = \frac{\Delta \text{temperature}}{\Delta \text{distance}}

b. gradient = \frac{27°C - 24°C}{2.2m} = \frac{3°C}{2.2m}

27. The S should be over or touching the 27°C with a tolerance of 2mm.
28. The L should be over or touching the 20°C with a tolerance of 2mm.

Part C

29. Geothermal energy is the result of nuclear (or atomic) decay or nuclear (or atomic) fission. Most of Earth's geothermal energy comes from the nuclear decay of elements with half lives in the millions or billions of years, therefore, they will result in energy production much longer than the supply of fossil fuels.
30. Geothermal energy comes from atoms splitting—nuclear (atomic) decay (fission). The sun's energy is the result of nuclear fusion in which atoms combine to form heavier atoms.
31. In the Inferred Properties of Earth's Interior in the Earth Science Reference Tables, the temperature curve shows an increase in temperature as depth into Earth increases, thus there must be energy in Earth's interior.
32. Since 2260 joules per gram must be added to liquid water to change it to gaseous water during evaporation or vaporization, gaseous water or steam has more energy per gram than liquid water. Therefore, steam deposits would most likely produce greater amounts of energy than hot liquid water.
33. Solar energy evaporates the water which becomes clouds and eventually precipitation that flows into lakes or streams to produce hydroelectric energy. Gravitation causes the water to fall from the clouds and causes water to fall in streams and from lakes to produce hydroelectric energy.

Answers To Topic 6

Review Questions

1. 1  2. 2  3. 2
4. 1  5. 3  6. 2
7. 1  8. 1  9. 3
10. 4  11. 1  12. 4
13. 1  14. 1  15. 2
16. 1  17. 4  18. 1
19. 2  20. 2  21. 2
22. 4  23. 1  24. 3
25. 3  26. 3  27. 3
28. 3  29. 3  30. 2
31. 4  32. 1  33. 3
34. 4  35. 2  36. 1
37. 4  38. 1  39. 2
40. 4  41. 3  42. 2
43. 3  44. 3  45. 1
46. 2  47. 3  48. 3
Regents Practice

Part A

1. 1
2. 3
3. 1
4. 1
5. 1
6. 3
7. 2
8. 2
9. 4
10. 1
11. 4
12. 3
13. 2
14. 1
15. 1
16. 2
17. 2
18. 3
19. 4

Part B

20. Much insolation is reflected, absorbed, and scattered by the atmosphere.
21. Accept any scientifically correct answer. Examples: more aerosols or clouds in the dashed area.
22. Accept any scientifically correct reason. Examples: CFC-12 has a high relative greenhouse effect. CFC-12 has a long decay rate.
23. Releasing 1 kilogram of methane would contribute more because methane has a greater relative greenhouse effect than 3 kilograms of carbon dioxide.
24. Answers include: In winter, the ice and snow at high altitudes reflect more insolation than the areas do in summer without ice and snow. The lower angles of incidence in winter result in more reflection of insolation by Earth's surface.
25. The sun's rays are more direct on the southern slopes than on the northern slopes.
26. The sun is usually higher in the sky at the equator; therefore, the angle of incidence and heating are greater there.
27. The noontime shadows become shorter with the approach of the summer solstice.
28. Earth's average temperature decreased.

Part C

29. The industrial revolution, the growth in human population, and the increased use of fossil fuels have increased the amount of greenhouse gases in the atmosphere. The more greenhouse gases, the more energy that is stored in the atmosphere, causing higher temperatures at Earth's surface.
30. Accept any reasonable answer. Examples: reducing the use of fossil fuels, planting more trees to absorb more carbon dioxide, reduce population, adding aerosols to the stratosphere to reduce insolation.
31. Accept any reasonable answer. Examples: The sun gave off less energy during the Little Ice Age and it got colder in these areas. Volcanic eruptions increased the aerosol content of the atmosphere reflecting more insolation which cooled the Northern Hemisphere.
32. Accept any reasonable answers. Example: Ice and snow are good reflectors of insolation and the reflection caused by the increased ice and snow would result in less heating of Earth's surface and atmosphere.
33. Accept any reasonable answers. Example: Dark-colored aerosols deposited on land or ice would absorb more insolation and heat Earth's surface and atmosphere.
34 a. Allow 1 credit for June.
34 b. Allow 1 credit for $23\frac{1}{2}^\circ$ N or Tropic of Cancer.
35. Allow 1 credit for a correct response. Accept student responses that indicate that A is longer than B, even if the specific length of the day, in hours, is stated incorrectly. Acceptable responses include, but are not limited to, these examples: There are more daylight hours at A than at B. A is longer.
36. Allow a maximum of 3 credits: Allow 1 credit if the north end of the axis is tilted away from the Sun (approximately $23\frac{1}{2}^\circ$). and Allow 1 credit if the North Pole is appropriately labeled, based on the student's drawn axis, and Allow 1 credit if the Equator is correctly drawn or is drawn perpendicular to the axis in the student's answer.

37. [2] Allow a maximum of 2 credits, allocated as follows:
   • Allow 1 credit if the shadow three hours later is drawn within the dashed lines shown below.
   • Allow 1 credit if the length of the shadow after three hours is longer than the solar noon shadow.
   Allow this credit even if the direction of the shadow is incorrectly drawn.

Answers To Topic 7

Review Questions

1. 3
2. 2
3. 1
4. 4
5. 1
6. 2
7. 1
8. 1
9. 4
10. 3
11. 4
12. 4
13. 2
14. 3
15. 1
16. 2
17. 1
18. 2
19. 3
20. 2
21. 1
22. 4
23. 2
24. 1
25. 1
26. 3
27. 3
28. 2
29. 2
30. 4
31. 4
32. 2
33. 3
34. 4
35. 1
36. 1
37. 3
38. 4
39. 4
40. 1
41. 2
42. 1
Regents Practice

Part A

1. 2  2. 1  3. 4  4. 2  5. 2  6. 3  7. 4  8. 1  9. 2 10. 1 11. 3 12. 2 13. 2 14. 3 15. 4 16. 4 17. 1 18. 3

Part B

20. 6 A.M. to 3 P.M.

21. As air temperature increases, relative humidity decreases, or as air temperature decreases, relative humidity increases.

22. 6 A.M.

23. Cloud cover increases as the front approaches. It decreases after the front passes.

24. Barometric pressure increases as the front passes.

25. Temperature decreases as the front passes.

26. Answer should indicate that warm air is rising over cold air as the front passes. Examples: mT is pushed up by cP. mT rises over cP. cP moves under mT. Collision of air masses forces air to rise and cool below the dew point.

27. 65

28. Accept any of the following: Partly cloudy, or mostly sunny; 25% or 1/4 cloud cover; 75% or 3/4 clear.

Part C

29. It is snowing at the 102nd floor because the clouds are cold enough to produce snow and the air at this height is not warm enough to melt the snow. At the 50th floor the air must be warm enough to melt the snow, changing it into rain. There is no precipitation at street level because the rain must have evaporated between the 50th floor and street level.

30. Freezing rain would strike the sidewalk.

31. The statement is incorrect because the Empire State Building is 1250 feet tall and since New York City is near sea level the building is about 1250 feet above sea level. According to the Earth Science Reference Tables, the stratosphere starts at an elevation of 7 1/2 miles (or 39,600 feet), thus the top of the Empire State Building is in the troposphere, not the stratosphere.

32. Answers should include two of the following: Air density would decrease from the bottom to the top of the Empire State Building. Air pressure would decrease from the bottom to the top of the Empire State Building. Temperature would decrease from the bottom to the top of the Empire State Building. Wind speed would increase from the bottom to the top of the Empire State Building.

33. [1] Allow 1 credit for showing “high” air pressure over the land and “low” air pressure over the ocean.

34. [1] Allow 1 credit for showing “warm” air temperature over the ocean and “cool” air temperature over the land.

35. [1] Allow 1 credit for 25°–26.5° N and 75.5°–77° W. The student’s answer must include N and W.

36. [1] Allow 1 credit for arrows showing a counterclockwise direction. Arrows showing a counterclockwise and outward direction are not acceptable. Acceptable responses include, but are not limited to, this example:
37. Allow 1 credit for a correct and complete response. Acceptable responses include, but are not limited to, these examples:

Rising air cools to the dewpoint and water vapor condenses.

Condensation occurs when the dewpoint is reached.

38. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

Over land there is less energy from evaporating water.

Winds decrease in strength due to friction with the land.

39 a. Allow a maximum of 2 credits, 1 credit for each of two dangerous conditions. Acceptable responses include, but are not limited to, these examples: flooding and tornadoes, storm surge and collapsing structures, hail and lightning, downed electrical wires and flying debris.

39 b. Allow 1 credit for a correct response. The response must be an emergency preparation that can be taken prior to the approaching hurricane hitting the area. Acceptable responses include, but are not limited to, these examples: Evacuate to a higher elevation. Take shelter. Board up windows. Build a seawall.

40. Allow 1 credit for drawing the cold front symbol in the correct location. Allow credit even if the symbol is not shaded.

41. Allow 1 credit for an X located over the water in the diagonally lined area.

32. Examples: The interior city will have warmer summers and colder winters than the coastal city. The coastal city will have cooler summers and warmer winters than the interior city.

33. 1
34. It generally decreases or gets colder.
35. 4 36. 4 37. 3
38. 1 39. 4 40. 1
41. 3 42. 2 43. 4
44. 3 45. 1 46. 1
47. 3 48. 2 49. 3
50. Location D 51. 2 52. Location F
53. It is increased.
54. 3 55. 4 56. 1
57. 2 58. 3 59. 1
60. Allow 1 credit. Acceptable responses include, but are not limited to:

— When Lake Erie is covered with ice, the air moving over it will pick up less moisture.
— Less evaporation will take place.
— When Lake Erie is covered with ice, the air is heated less.

61. 3

Regents Practice

Part A

1. 4 2. 2 3. 2
4. 3 5. 4 6. 3
7. 2 8. 2 9. 2
10. 3 11. 1 12. 1
13. 1 14. 4 15. 3
16. 1 17. 1 18. 2
19. 1

Part B

[2]

Weather Station

20 a. Allow 1 credit if seven to ten elevations are correctly plotted (±50 m).
20 b. Allow 1 credit for surrounding each point with the correct symbol.
21. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

As elevation increases from A to E, precipitation increases.

direct relationship
22. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
- C is on the leeward side.
- Prevailing winds cause air to rise at location F, creating more clouds and causing heavier rainfall.

23. Give one credit for a graph like the one below.

![Graph showing amount of insolation over time]

24. Location A receives less insolation in January.

25. B

26. F

27. Location F is much further from the moderating effect of a large body of water (ocean).

28. Give one credit for 3 arrows similar to those on the map.

![Map showing locations and arrows indicating wind directions]

29. Give one credit for a W in any of the locations shown on the map.

30. It would increase the amount of precipitation.

31. D

32. The prevailing winds blowing from the ocean blow down the mountains towards A causing the air to compress and heat up resulting in little condensation and rain.

33. G has a higher elevation than location J.

34. C

35. [1] Allow 1 credit for 10°C to 15°C.

36. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- City X is located farther inland from the ocean.
- City Y is located closer to a large body of water.

37. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Both cities have their highest temperatures in June, July, and August.

Part C

38. Accept any scientifically correct answer. Examples: High carbon dioxide and/or methane content in the atmosphere at that time could have produced high greenhouse effects, such as on Venus. If there was more ocean and less land, temperatures at Earth's surface would have been warmer because the water holds heat longer than land. More decay of radioactive materials could have produced higher temperatures than expected. More impact of meteorites could have provided additional heat.

39. The sediment around the second well was cemented, non-porous, or impermeable and the water could not move to the well.

40. Water would travel inland through the pores in the sand because it is permeable, and water would move up higher than ocean level because of capillary movement (capillarity).

41. The pores in the sediment above the water table are partly filled with air and partly with water, while the pores in the sediment below the water table are filled only with water. If the water table is lowered, the sediments just above the new water table could compress and take up less volume, allowing the land to sink and crack.

42. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
- The temperature of the lake water at the surface must be higher than the temperature of the air flowing over the water.
- Water temperature is warmer than air temperature.
43. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
prevailing winds
Lake Ontario runs lengthwise from west to east, and the prevailing winds pick up moisture as they flow across the entire length.

44. On the east or right side of the Adirondacks or near the shore of Lake Ontario

45. [1] Allow 1 credit for a correct response that includes the idea of **rising** or **cooling air** or **increased condensation** or **orographic lifting**.

46. The land area near the shore of Lake Ontario

47. Accept any scientifically correct answer. Examples include: The water of Lake Ontario has a higher specific heat than the land; Lake Ontario water is more transparent than land and thus heats up slower; Convection currents transfer heat energy better in the Lake Ontario water compared to land thus doesn’t heat up as fast as land; Much of the solar energy is used up in evaporating water of Lake Ontario instead of just heating its water.

**Note:** If the student draws additional isolines, all must be correct to receive credit. Allow credit even if the isolines extend into Lake Martin.

**Example of a 1-credit response:**

![Diagram of isolines](image)

49. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— As distance from the tank increases, the concentration of contaminants in the groundwater decreases.
— An inverse relationship exists between the distance from the tank and the concentration of contaminants in the groundwater.

50. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— Place the tank above ground to observe leaks more easily.
— Build an extra liner around the tank.
— Replace tanks regularly.

---

**Answers To Topic 9**

**Review Questions**

1. 1  
2. 1  
3. 2  
4. 4  
5. As the length of time increases, the depth of soil generally increases; or a direct relationship.  
6. 3  
7. a temperature climate with alternating freezing and thawing with high humidity or moisture  
8. 4  
9. 2  
10. 3  
11. 2  
12. 2  
13. 1  
14. 4  
15. Answers include: all erosion of sediments directly by gravity is mass movement.  
16. 3  
17. 1  
18. 2  
19. 3  
20. 1  
21. Accept any correct answer. Example: pebbles  
22. 3  
23. 1  
24. 2  
25. 2  
26. 4  
27. Accept any scientifically correct answer. Example: Explanation should refer to the limited height to which sand grains are blown by the wind.  
28. 2  
29. 3  

**Regents Practice**

**Part A**

1. 3  
2. 3  
3. 1  
4. 4  
5. 2  
6. 1  
7. 3  
8. 1  
9. 3  
10. 1  
11. 4  
12. 3  
13. 3  
14. 2  
15. 1  
16. 1  

**Part B**

18. 3  
19. 3m/km ± 0.2m/km  
20. F–F’ or F  
21. 1

---

**Key**

- Groundwater-monitoring well
- Underground gasoline tank
34. Sand castles are made by humans and thus sediment has to be moved or eroded by humans to make the castle.

35. Answers include glaciers, running water (streams), gravity (mass movement or rock fall), wind, ocean waves, ocean currents, and humans.

36. The sediment would likely become smaller in volume and mass, more rounded, and smoother. These changes would be caused by abrasion during transport by running water, wind, waves, ocean currents, and glaciers. The sediment may also become frosted or pitted by wind erosion or scratched by glacial erosion.

37. [1] Allow 1 credit if the center of 10, 11, or 12 Xs are plotted within the circles shown on the graph below and are correctly connected with a line that passes within the circles.

38. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - As stream discharge increases, suspended sediment increases.
   - There is a direct relationship between stream discharge and suspended sediment.

39. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - Snowmelt in April results in a greater discharge.
   - Greater rainfall in April.
   - Saturated ground would cause more runoff in April.

**Answers To Topic 10**

**Review Questions**

1. 3  
2. It decreases.  
3. 4  
4. 3  
5. 3  
6. 4  
7. Accept any scientifically correct characteristics. Examples: poorly sorted sediments, scratches/grooves/striations, sub-angular sediments

8. 4  
9. 4  
10. 4  
11. 1  
12. 2  
13. 1  
14. 1  
15. 2  
16. 3  
17. 2  
18. 1  
19. 1  
20. 1  
21. 4  
22. 1  
23. 4  
24. 2  
25. 1
Regents Practice

Part A
1. 2 2 3 1
2. 4 5 4 6 2
3. 2 8 2 9 3
4. 1 11 2

Part B
12. b, a delta-like feature of sorted and layered sediments deposited by water running out the front of a melting glacier
13. d, mounds of sand deposited on land by wind that has slowed down
14. d, elongated deposits of wave and ocean current deposited sand, not attached to the shore, that are below, at, or above average sea level
15. a, an unsorted and unlayered deposit of sediment deposited directly at the sides, bottom, or end of a glacier
16. a, an elongated deposit of moraine mounded up by an advancing glacier
17. d, an elongated deposit of sand by wave and ocean current, not attached to the land or shore
18. e, mounds of sand on land deposited by wind that has slowed down
19. c, a generally level plain at the sides of streams that have been created by streams eroding their sides as they change course and then covered by sediments deposited when the streams move out of their channel when flooding occurs
20. 4 21. 2 22. 2
21. 3 24. 3 25. 4
22. 2 27. 2 28. 3
23. [1] Allow 1 credit for any value from 9.75 to 10.25.
24. 3 3 5 2 36. 2

Part C
32. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— The slope decreased.
— The gradient decreased from location B to location C.
— The surface was steeper near B and flatter near C.
33. [2] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
The stream velocity decreases.
The still water of the lake slows the stream current.
34. 3 35. 3 36. 2

Part C
37. The gold would be found on the inside of a meander where water velocity is slowest and where more dense sediments, such as gold, would likely be deposited. Also halite and gypsum dissolve in water and are carried as dissolved sediments, thus they are not likely to be deposited as solid sediments unless the stream was drying up.
38. Sediments deposited at the mouth of a stream are arranged from larger to smaller as they go out into a lake due to horizontal sorting—as a river slows down on entering a lake the larger sediments are deposited out into the lake. A reason why sediments would get bigger the deeper down one digs is because the shoreline between the lake and river has moved toward the lake center and the stream deposited the larger sediments further and further out into the lake the older (thus deeper down) the time of sediment deposition.
39. I disagree with her inference that the sediments were deposited by a glacier. The evidence for this includes: 1. Glacial valleys are U-shaped and this valley was V-shaped like those carved by streams; 2. Glacial sediments are unsorted and these sediments are all pebbles and are thus sorted like those deposited by streams; 3. The sediments were rounded and smooth like stream or beach deposits. Glacial sediment tends to be sub-rounded or subangular in shape; and 4. Glacial sediments often have scratches on them and these sediments have no markings on them such as stream or beach deposits have.
40. Allow 1 credit for glaciers or ice.
41. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples: Unsorted sediments are different from bedrock. Parallel scratches in the bedrock.
42. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples: Rocks were abraded by tumbling. Sediments rolled along the streambed.
43. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples: When liquid water freezes, it expands and breaks off pieces of rock or frost action.
44. gravity or mass movement
45. Answers include the sediments would only be sand size or smaller and the sediments may have a frosted or pitted surface.

46. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
   - The valley has a U-shaped cross section.
   - The bottom of the valley is round.
   - Nonglaciated mountain valleys are V-shaped; this one is U-shaped.

47. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
   - piles of unsorted sediments deposited across the valley floor (moraines)
   - parallel scratches and/or grooves in the bedrock (striations)

Review Questions
1. 1  2. 4  3. 3  4. 2  5. 1
6. Answers include: They have different atomic structures.
7. 3  8. 3  9. 2  10. 4  11. 3  12. 1  13. 1  14. 4  15. 3  16. 1  17. 3  18. 1
19. 2  20. conglomerate  21. 3  22. 3  23. 1  24. 3  25. 2  26. 4  27. 4
28. Answers include: texture and size of mineral crystals or grains
29. 2  30. 4  31. 3  32. 3  33. 3  34. 2  35. Answers include: in the past, the area had a large evaporating sea or ocean
36. 4  37. 1  38. 2  39. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - Rocks and minerals are nonrenewable resources.
   - Mining can result in pollution of the land, water, and air in the region.
   - Mining can result in the removal of topsoil.
   - danger to miners
   - destruction of natural habitats
   - landscape destruction
40. Answers include: coal and petroleum
41. 2  42. 4  43. 4  44. 3  45. 4  46. 1  47. Answers include: coal formed in the distant past and is a fossil while wood is from present-day trees

Regents Practice
Part A
1. 1  2. 1  3. 2  4. 2  5. 2  6. 2
35. The smooth sides or surfaces could be crystal faces that formed when the mineral formed, or the sides could be cleavage sides formed when the mineral sample was broken. One way to tell which way the sides were formed is to break the sample and compare the geometry of the sides with the original sample. If the geometry is the same, then the original sides were likely to have been formed by breaking. Another way to determine the difference would be to melt the sample and let it cool very slowly in an open area so that its crystal surfaces would form, and then again compare the geometry with the original sample.

36. If the density of the two samples were determined, you could distinguish graphite from hematite by making reference to mineral tables. The streak of graphite is black and the streak of hematite is red. Graphite has a greasy feel and hematite does not.

37. Allow a maximum of 3 credits, 1 credit each for: Rock A—shale Rock B—gneiss Rock C—granite or diorite or pegmatite.

38. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples: heat and/or pressure The rock is buried deep underground. plate collisions mountain building.

39. Allow 2 credits for granite and for an answer describing the greater hardness of the minerals found in granite. Acceptable responses include, but are not limited to, this example: Granite is composed mainly of quartz and feldspar that are resistant to abrasion because of their hardness (7 and 6, respectively), while marble is made of calcite, which is softer (hardness of 3). Allow only 1 credit if granite is chosen but the explanation is not acceptable. Allow no credit if the student chooses marble.

40 a. Allow 1 credit for calcite and quartz.

40 b. Allow 1 credit for heat and pressure.

41. [1]

Allow 1 credit for the correct placement of contact metamorphism symbols above and below B as shown in the diagram above.

42. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
   C was formed before both B and A.
   C is older than both B and A.

43. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
   Rock A is a mixture of rounded rock fragments of different sizes connected together.
   Rock A is a horizontal layer.

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**Answers to Topic 12**

Answer to question on page 249: 9 hr 56 min 30 sec

**Review Questions**

1. Accept any scientifically accurate diagram of folded strata. Example: Figure 12-1-C on page 245 of the student edition.

   Accept any scientifically correct explanation which may include plate collision, plate convergence, or uplifting forces.

2. The strata must have been uplifted or raised from its original position.

   a. 3  b. 4  c. 5  d. 2

3. The density of Earth's core must be greater than 5.5 gm/cm³.

   a. 4  b. 3  c. 42  d. 3

4. Answers may include any two of these: rock correlation, fossil correlation, correlation of coastlines, correlation of mineral deposits.

5. age of rocks, mineral composition, magnetic orientation

   a. 53  b. 4  c. 54  d. 1

---

**Regents Practice**

**Part A**

1. 4  2. 2  3. 3

4. 2

5. 5:02 P.M. ± 10 seconds

6. 4  7. 3  8. 1

9. 4  10. 2  11. 3

12. 3  13. 2  14. 2

15. 3  16. 2  17. 2

18. 1
20. Wind was blowing from the north when the volcano was erupting.

21. Iceland is at a hot spot and it is also located at a mid-ocean ridge.

22. {1} Allow 1 credit. Acceptable responses include, but are not limited to:
   — trench
   — Peru-Chile trench
   — a subduction zone
   — a convergent boundary
   — a fault

23. {1} Allow 1 credit. Acceptable responses include, but are not limited to:
   — divergence
   — seafloor spreading

24. {1} Allow 1 credit for a correctly drawn line. The line may be curved or straight, and the lowest point should be at the mid-ocean ridge.

Example of a 1-credit response:

25. {1} Allow 1 credit. Acceptable responses include, but are not limited to:
   — The arrival time of the P-wave at station A is later than the arrival time of the P-wave at station B.
   — The arrival time difference between the P-wave and S-wave is greater at station A.
   — The amplitudes of the P-wave and S-wave tracings are greater on the seismogram at station B.

26. {1} Allow 1 credit for 15 minutes 50 seconds (±10 seconds).

27. Pasadena is closest to the earthquake epicenter.

28. Accept any scientifically acceptable cause for earthquakes that occur in the area shown on the map. Examples: Earthquakes in this part of the United States are probably caused by movement along the boundaries of the North American and Pacific plates. Earthquakes in this part of the United States are probably caused by movement along the San Andreas Fault.

30. Allow 1 credit for each of three appropriate actions. Examples include: Develop and practice a family disaster plan; Learn drop, cover and hold procedures; Make an emergency kit of important phone numbers, food, water, and medical supplies; Obtain emergency communication devices such as a battery radio or cell phone; Locate and learn how to turn off gas, water and electrical supplies; Plan an evacuation route.

31. {1} Allow 1 credit for any value from 500°C to 1200°C.

32. {1} Allow 1 credit for Indian-Australian Plate.

33. {1} Allow 1 credit. Acceptable responses include, but are not limited to:
   — subduction
   — convergence
   — plate collision

34. {1} Allow 1 credit. Acceptable responses include, but are not limited to:
   — move to higher ground
   — evacuate
   — move inland

35. One possible landscape feature would be a volcano such as those in Hawaii, because the formation of Hawaiian volcanoes was associated with a hot spot.

36. Since there is no plate tectonics on Mars there would be no mid-ocean ridges and continental rift valleys associated with plate divergence. Without plate convergence there would be no chains of volcanoes like island arcs, no oceanic trenches, no folded or fault block mountains where plates converge.
37. There would be no subduction and rifting on Mars without plate movements.
38. Folded mountains are formed at places where plates converge in association with young mountains, and without plate movements folded mountains most likely would not exist on Mars.
39. Most metamorphic rocks on Earth form in association with the regional metamorphism of plate convergence and without plate movements on Mars this type of metamorphic rock would not be likely to exist. Since Mars has volcanoes, there must have been magma and lava to cause contact metamorphism. Thus Mars should have contact metamorphic rocks.
40. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
   - Region: California
     Explanation: crustal movement along the San Andreas Fault
   - Region: Pacific Northwest Coast
     Explanation: A subduction zone is nearby.
41. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
   - Continent shapes fit together like puzzle parts.
   - Sea-floor spreading occurs at mid-ocean ridges.
   - Bedrock can be correlated on the opposite sides of some oceans.
   - Fossil evidence is found in the matching bedrock of South America and Africa.
   - Matching mountain ranges between continents
42. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
   - West coast of South America
   - Aleutian Trench
   - Boundary of Juan de Fuca Plate and North American Plate
43. [1] Allow 1 credit for any response from 70 to 700 kilometers.
44. [1] Allow 1 credit for Triassic Period.

Answers To Topic 13

Review Questions
1. 4  2. 1  3. 1  4. 2
5. Answers include: use index fossils or radioactive decay dating to indicate that the age of the rocks gets younger toward the top
6. 2  7. 1  8. 3  9. 3
10. Answers include: lived for a short time or a small vertical extent, has a wide horizontal distribution and is a single species of life
11. the limestone particles
12. 4  13. 1  14. 4  15. 2
16. 3  17. 4  18. 2  19. 2

20. Answers include: Sedimentary rocks form near Earth's surface and most igneous and metamorphic rocks don't. The high heat and pressure associated with igneous and metamorphic rock would destroy any evidence of life.
21. Answers include: The rocks in Elmira are Devonian in age and are thus too old; the Mesozoic Era is the age of dinosaurs and there are no rocks of that age in Elmira.
22. 4  23. 1
24. 2  25. 3
26. 1  27. 4
28. 1  29. 3
30. 2  31. 2
32. 3  33. 3
34. 3  35. 2
36. Answers include: Scientific principles generally remain the same with time, thus we can interpret the past through an understanding of the present.
37. 3  38. 4
39. 2  40. 2
41. 2  42. 4
43. 3  44. 4
45. 1
46. Answers include: carbon-14 has such a short half-life that too little would be left to measure in Ordovician age (444 to 488 million years old) fossils.
47. 1  48. 4
49. Answers include: Free oxygen started to build up in Earth's atmosphere.
50. 3  51. 1  52. 1

Regents Practice
Part A
1. 1  2. 1  4. 2  5. 2  6. 1
7. 2  8. 3  9. 4  10. 2  11. 2  12. 1
13. 1  14. 3  15. 3

Part B
16. Answers include: use of index fossils, radioactive decay dating, and correlation by matching sequences of rock layers.
17. See drawing.

50 Earth Science Answer Key
18. Answers include: The limestone layers protrude farther. There is less evidence of erosion to the limestone layers.
19. 542 million years
20. Paleozoic Era and Carboniferous or Pennsylvanian Period
21. Answers include: photosynthetic life forms, plants, and/or bacteria
22. Answers include: can cause isolation of land areas resulting in independent evolution, can cause an increase of marine environments compared to land environments
23. During the Silurian this area was hot and dry and there was much evaporation of an ocean or sea forming salt and gypsum. Today the conditions are warm and humid.
24. Answers include: A dust cloud caused by the impact cooled Earth resulting in an ice age; fires from the impact burned much of Earth's surface; acid precipitation killed most of the vegetation.
25. Earth was likely melted or largely melted at this time and gravity caused the more dense parts, such as iron, to move toward the center or core.
26. Allow credit for any answer that shows the correct relative-age relationship. Acceptable answers include: Earth and solar system are younger than the most distant galaxies.
27. sedimentary or any specific type of clastic or bioclastic sedimentary rock
28. Paleozoic Era

Part C
29. [1] Allow 1 credit for the correct response shown below.
   Oldest
   (1) siltstone
   (2) limestone
   (3) granite intrusion or granite or intrusion
   (4) shale
   (5) vesicular basalt or basalt
   Youngest
   (6) sandstone
31. [1] Allow 1 credit for marble or hornfels.
32. Between the shale and the limestone and/or the granite intrusion.
33. Only on Earth are surface temperatures, for most of the planet, neither too hot nor too cold for life as we know it. Also, Earth temperatures and pressures allow for liquid water to exist, conditions that don't exist on the other planets. Free oxygen in a high density exists only on Earth and much Earth life requires this oxygen.
34. If magma intrudes a sandstone and the magma is near the solidification temperature, and then a piece of sandstone falls into the magma, it will become an inclusion and not be melted.
35. New radon is constantly being produced by the radioactive decay of uranium which has an extremely long half-life.
36. The fact that radon gets concentrated in basements is likely due to the high density of radon compared to normal air and thus the radon sinks into the basements or just doesn't rise out of the basements naturally.
37. Radon would not be suitable for use in normal radioactive dating. Because of its very short (four-day) half-life, there would be too little left after a few years to be able to measure an event accurately. If you were trying to measure events of only hours to weeks old, then radon may be useful.
38. A home owner in the Reading Prong could make sure that the parts of the home below ground level are sealed tightly and made impermeable to radon. A homeowner could also use a forced-air moving system to constantly remove air, including radon, from a home.
39. 3 40. 2 41. 2
42. Allow 1 credit for Triassic Period.
43. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples: They have only been found in a narrow geographic range.
44. Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples: Use the law of superposition to compare the age with the age of other nearby fossils and/or rock layers, radioactive age dating (not C-14)
45. [1] Allow 1 credit for the correct response shown below.
   
   2 1 4 3
46. [1] Allow 1 credit for a response that includes any two of the processes involved in forming an unconformity. Acceptable responses include, but are not limited to:
   — uplift
   — weathering
   — erosion
   — submergence
   — deposition
   — burial
47. [1] Allow 1 credit for a correct response.
   Acceptable responses include, but are not limited to, these examples:
   unconformity
   nonconformity
   time gap in the rock record
   buried erosional surface
   Acceptable responses include, but are not limited to, these examples:
   heat and pressure
   recrystallizing of preexisting rock
   metamorphism
49. [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

- Hexameroceras
- Eucalyptocrinus
- Eurypterus
- Cooksonia
- Cystiphyllum
- Eospirifer

50. [1] Allow 1 credit for circling letter I.

51. [1] Allow 1 credit if the center of the X is located anywhere in the contact metamorphic zone in the limestone layer.

**Example of a correct response for questions 50 and 51:**

![Diagram](image)

52. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- There is no contact metamorphism shown in rock unit D.
- Rock unit F was eroded, then rock unit D was formed.
- There is a buried erosional surface between F and D.
- Rock unit D is on top of rock unit F.

53. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- Rock unit H was displaced by movement along a fault.
- Rock unit H was broken when an earthquake occurred.

**ANSWERS TO TOPIC 14**

**Review Questions**

1. The process that produces mountains also produces folded, faulted, and tilted rocks.

2. 1 3 3 4 2

3. 3 6 1 7 3

8. The Adirondacks have distorted rock structure and are thus mountains, but the Catskills do not have distorted rock structure.

9. Elevation will remain about the same.

10. 1 11. 2 12. 1

13. 4 14. 4 15. 4

16. Answers include: U-shaped valleys, parallel scratches and grooves, polished rock, and many low hills of unsorted sediment

17. Answers include: Glacial valleys are usually U-shaped and stream valleys are often V-shaped.

18. 3 19. 4 20. 4

21. 4 22. 4 23. 1

24. 1 25. 4 26. 2

27. 1 28. 2 29. 3

30. 3

**Regents Practice**

**Part A**

1. 2 2. 3 3. 1

4. 1 5. 2 6. 3

7. 3 8. 1 9. 3

10. 3 11. 1 12. 3

13. 1 14. 3 15. 2

**Part B**

16. No fossils are likely found in the Adirondack Mountains because the conditions that formed the metamorphic rock there would destroy any evidence of life.

17. Answers include: streams, running water, and glaciers

18. Answers include: Devonian or Devonian Period, or anything between 359 and 416 million years ago

19. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- burning fossil fuels
- exhaust emission from automobiles
- smoke from factories

20. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- Allegheny Plateau
- Appalachian Plateau (uplands)
- Catskills

21. E

22. anything between 99 and 60 ppm

23. Answers include: Without the trees, the runoff would likely be greater as there would not be trees to stop the runoff. There would be less transpiration.

**Part C**

24. Answers include: Heavy rain and steep slopes (cliffs), deforestation, or clay soil layers

25. Answers include: how far inland wave action goes, the amount of land slope, location of streams, amount of runoff compared to infiltration, and clay content of soil

26. Answers include: subducting or colliding plates and a plate boundary that can result in earthquakes and volcanic eruptions

27. Answers include: Artificially add varying amounts of rainfall to the area to see how much rainfall is required to produce a mudslide. Then compare these results with rainfall data for the area to see if expected rainfall produces enough water to cause mudslides.

28. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- The landscape has a high relief.
- There is a large difference in elevation between the top and bottom rocks in the cross section.
- steep slopes
- high elevation


30. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- unsorted
- mixed
- not in layers
TOPIC 1 QUIZ

1. Which descriptive term illustrates an inference about a mineral?
   (1) transparent    (3) younger
   (2) bitter        (4) smooth

2. Students often use classification systems to
   (1) extend their powers of observation
   (2) organize their observations in a meaningful way
   (3) make direct comparisons with standard units of measurement
   (4) make more accurate interpretations

3. Students calculated the circumference of a globe to be 60 centimeters. The actual circumference of the globe is 63 centimeters. The percent deviation of the students' calculation was
   (1) 0.48%    (3) 5.0%
   (2) 4.8%     (4) 21%

4. Which of the following is NOT a natural resource?
   (1) plastics
   (2) trees
   (3) minerals
   (4) gases from the atmosphere

5. If a glacier receives new snow each year but stays the same size because of melting and evaporation, the glacier is
   (1) a natural resource
   (2) in dynamic equilibrium
   (3) a non-cyclic change
   (4) classified as a hazard

6. Why have humans been such a big factor in the pollution of the environment?
   (1) They have had many wars.
   (2) They are larger in size than most animal forms.
   (3) Their technology creates pollutants.
   (4) They are the only form of life that can adapt to almost all the environments on Earth's surface.

7. The eruption of Mount St. Helens in 1980 resulted in the movement of volcanic ash across the northwestern United States. The movement of the ash at 1.5 kilometers above sea level is shown as a shaded path on the map below. The times marked on the path indicate the length of time the leading edge of the ash cloud took to travel from Mount St. Helens to each location.

   Calculate the average rate of movement of the volcanic ash for the first 15 hours, following the directions below.
   a. Write the equation used to determine the average rate of the volcanic ash
   b. Substitute values into the equation
   c. Solve the equation and label the answer with the correct units.
8. As shown in the following diagram, an empty 1000 mL container has a mass of 250 g. When filled with a liquid, the container and the liquid have a combined mass of 1300 g.

What is the density of the liquid?
(1) 1.00 g/mL
(2) 1.05 g/mL
(3) 1.30 g/mL
(4) 0.95 g/mL

9.-11. List three completely different types of natural hazards.
1. What is the approximate diameter of Earth?
   (1) 3476 km
   (2) 6378 km
   (3) 12,756 km
   (4) 25,512 km

2. According to the *Earth Science Reference Tables*, as altitude increases from the tropopause to the mesopause, the atmospheric temperature will
   (1) decrease only
   (2) increase only
   (3) decrease, then increase
   (4) increase, then decrease

3. The hydrosphere is mostly
   (1) solid rock
   (2) liquid water
   (3) gaseous air
   (4) water vapor

4. Earth's lithosphere is divided up into many moving sections called
   (1) tectonic plates
   (2) pauses
   (3) gradients
   (4) continental crusts

5. As a person travels due west across the United States, what happens to the altitude of Polaris (the North Star)?

Base your answers to questions 6 and 7 on your knowledge of earth science and the following map which shows a north polar view of Earth. Some of the latitude and longitude lines have been labeled. Points A through E are points on Earth's surface.

6. Which two points have the same latitude?

7. The location of point D is
   (1) 30^° N, 120^° E  (3) 320^° N, 30^° E
   (2) 30^° N, 120^° W  (4) 120^° N, 30^° W

8. As a ship crosses the Prime Meridian, the altitude of Polaris is 65°. What is the ship's location?
   (1) 0^° longitude, 65^° South latitude
   (2) 0^° longitude, 65^° North latitude
   (3) 0^° latitude, 65^° West longitude
   (4) 0^° latitude, 65^° East longitude
9. If an isoline bends south on a map, what will happen to its value?

10. The layer of bedrock near Earth's surface that forms a continuous shell around Earth is called the
(1) troposphere  (3) lithosphere
(2) stratosphere  (4) hydrosphere

Base your answers to questions 11 through 16 on the following topographic map and your knowledge of earth science.

11. What is the elevation at the intersection of Jones Road and Smith Road?
   (1) 450 m  (3) 550 m
   (2) 500 m  (4) 600 m

12. What is the elevation of the highest contour line on hill W?
   (1) 440 m  (3) 560 m
   (2) 510 m  (4) 610 m

13. On which side of hill X is the steepest slope found?
   (1) north  (3) southeast
   (2) east    (4) southwest

14. In which general direction is Trout Brook flowing when it passes under Smith Road?
   (1) northeast  (3) southeast
   (2) northwest (4) southwest

15. Which diagram best represents the profile along a straight line between points A and B?

16. If the scale of the map is 1 cm = 1 km, what is the total length of Jones Road on the map to the nearest 0.1 km?

17. Which list shows atmospheric layers in the correct order upward from the Earth's surface?
   (1) thermosphere, mesosphere, stratosphere, troposphere
   (2) troposphere, stratosphere, mesosphere, thermosphere
   (3) stratosphere, mesosphere, troposphere, thermosphere
   (4) thermosphere, troposphere, mesosphere, stratosphere
**TOPIC 3 QUIZ**

1. Distinguish between a celestial object and the universe.

6. Describe how nuclear fusion results in energy production in stars.

2. Very similar background radiation observed from earth coming from all directions in space is evidence for the
   (1) Big Bang origin of the universe
   (2) Big Bang origin of the solar system
   (3) Big Bang origin of Earth
   (4) Big Bang origin of our moon

7. Describe two specific characteristics that distinguish the star Polaris from the star Aldebaran.

3. Billions of stars held together by gravitation in the same portion of the universe are called
   (1) solar systems
   (2) constellations
   (3) galaxies
   (4) main sequences

4. Explain why some stars in the Milky Way Galaxy have a blue shift Doppler effect and other stars in the Milky Way Galaxy have a red shift Doppler effect.

8. A star the size of the sun will eventually become a
   (1) blue super giant
   (2) neutron star
   (3) black hole
   (4) white dwarf

9. Which of the following is not included in our solar system?
   (1) Big Bear constellation
   (2) the sun
   (3) the asteroid belt
   (4) the moon

10. Which member of the solar system has a diameter of $3.48 \times 10^8$ kilometers?
    (1) Earth’s Moon
    (2) Pluto
    (3) Earth
    (4) the Sun
11. Which diagram most accurately represents the diameter of the moon and the diameter of Earth?

(1) Moon
(2) Moon
(3) Earth
(4) Earth

12. In the last million years impact craters on terrestrial planets are NOT likely to have resulted from a collision with

(1) moons
(2) comets
(3) asteroids
(4) meteors

13. Which terrestrial planet takes the longest time to orbit the sun?

14. Planet A has a greater mean distance from the sun than planet B. On the basis of this fact, which further comparison can be correctly made between the two planets?

(1) Planet A is larger.
(2) Planet A’s revolution period is longer.
(3) Planet A’s speed of rotation is greater.
(4) Planet A’s day is longer.

15. Which planet has an orbit with an eccentricity most similar to the eccentricity of the Moon’s orbit around the Earth?

(1) Earth
(2) Saturn
(3) Jupiter
(4) Pluto

16. As the distance between Earth and a satellite increases, the gravitational attraction between them will

(1) decrease
(2) increase
(3) remain the same

17. The force of gravity between two objects is greatest when

(1) masses are small and the objects are close together
(2) masses are small and the objects are far apart
(3) masses are large and the objects are close together
(4) masses are large and the objects are far apart

18. Which star is cooler and many times brighter than Earth’s Sun?

(1) Barnard’s Star
(2) Betelgeuse
(3) Rigel
(4) Sirius

19. What is the eccentricity of an orbit having a major axis of 100 million miles and a focal distance of 10 million miles?

(1) 1
(2) 10
(3) 0.1
(4) 0.01
**Topic 4 Quiz**

1. Why do stars appear to move through the night sky at the rate of 15 degrees per hour?

2. To a person located at 43° N latitude the sun appears to set due west on
   (1) December 22   (3) September 21
   (2) September 1   (4) June 22

3. The graph below represents the relationship between the altitude of the sun at solar noon at various times during the year for a given location on Earth’s surface.

   ![Graph of Altitude of Sun]

   What latitude would have the data shown in the graph?
   (1) 23 1/2° N   (3) 66 1/2° N
   (2) 23 1/2° S   (4) 66 1/2° S

4. The moon’s apparent motion in the sky from east to west is due to what Earth motion?

5. Diagram I below represents a group of celestial objects observed in the night sky on October 25. Diagram II represents the same objects 1 month later.

   [Diagram I and Diagram II]

   The object in diagram II that moved was most likely a
   (1) galaxy   (3) planet
   (2) meteor   (4) star

6. Name the type of model in which the sun, other stars, and the moon orbit Earth.

7. Why does a constellation appear in different parts of the sky during a given year?
8. In 1851, the French physicist Jean Foucault constructed a large pendulum that always changed its direction of swing at the same rate in a clockwise direction. According to Foucault, this change in direction of swing was caused by the
(1) moon’s rotation on its axis
(2) moon’s revolution around Earth
(3) Earth’s rotation on its axis
(4) Earth’s revolution around the sun

9. A sundial indicates
(1) local time (2) time zone time
(3) standard time (4) mean solar time

10. When it is 10 P.M. in New York City (75° W), what is the time zone time in Berlin (15° E)?

11. If two locations are 75 degrees apart in longitude how many hours apart are they in time?

12. Only one-half of the lighted portion of the moon is visible on Earth at the phase known as
(1) first quarter (2) full moon
(3) new crescent (4) new moon

13. The average interval between one high tide and the next high tide is approximately
(1) 24 hours (2) 12 hours
(3) 3 hours (4) 6 hours

14. State the two positions of the moon at which an eclipse could occur.

15. In what phase of the moon can a lunar eclipse occur?

16. The diagram below shows the relative positions of the sun, Earth, and moon in space. Letters A, B, C, and D represent locations on Earth’s surface.

At which location would an observer on Earth have the best chance of seeing a total solar eclipse?
(1) A (2) B
(3) C (4) D

17. During a 9-hour period, Earth rotates about
(1) 15° (2) 90°
(3) 135° (4) 360°
**Topic 5 Quiz**

1. Which of the following is a form of electromagnetic energy?
   - (1) microwaves
   - (2) sound waves
   - (3) surface ocean waves
   - (4) earthquake P- and S-waves

2. Which of the following forms of electromagnetic energy has the longest wavelength?
   - (1) visible light
   - (2) ultraviolet
   - (3) X-rays
   - (4) gamma rays

3. What color and texture of a material would absorb the LEAST solar radiation?
   - (1) black and smooth
   - (2) black and rough
   - (3) white and smooth
   - (4) white and rough

4. An object is in energy equilibrium. What must happen to the object to remain in energy equilibrium if it is heated by electromagnetic energy?
   - (1) the object must expand
   - (2) the object must change phase
   - (3) the object must emit the same amount of energy it gained
   - (4) the object must emit energy in a shorter wavelength than the energy it gained

5. Which statement is the best example of heat energy transfer by conduction?
   - (1) Heat energy is transferred from the bottom to the top of a lake.
   - (2) Heat energy is transferred from the surface soil to the rocks below.
   - (3) Heat energy is transferred from Earth's surface to the upper atmosphere.
   - (4) Heat energy is transferred from the sun to Earth.

6. Mechanical energy is
   - (1) the average kinetic energy of a substance
   - (2) the total kinetic and potential energy of a substance
   - (3) determined only by the amount of mass in a substance
   - (4) the specific heat, mass, and temperature of a substance

7. At which temperature does an object radiate the LEAST amount of electromagnetic energy?
   - (1) 250 K
   - (2) −10°C
   - (3) 45°F
   - (4) 50°C

8. In which phase does water have the greatest specific heat?
   - (1) solid
   - (2) liquid
   - (3) gas

9. A student placed two containers of soil in direct sunlight for 10 minutes and observed that moist soil warmed more slowly than dry soil. Which statement best explains this difference?
   - (1) The moist soil was darker and absorbed less energy.
   - (2) The water in the moist soil absorbed energy, evaporated, and cooled the soil.
   - (3) The dry soil was rougher and reflected more sunlight.
   - (4) The dry soil was lighter in color and received less energy.

10. What is the major source of energy for the Earth?
    - (1) electrical storms
    - (2) radioactive decay of Earth materials
    - (3) the sun
    - (4) thermal currents in the mantle

11. Compare the change that takes place in the nucleus of atoms in nuclear decay (fission) and in nuclear fusion.
12. The diagram below represents a large beaker of water being heated to demonstrate convection.

The movement of water upward from A toward B results primarily from
(1) differences in density in the water
(2) air movements across the surface of the water
(3) capillary action within the water
(4) the shape of the beaker

13. During which change does water lose 2,260 joules of heat energy per gram?
(1) changing from a liquid to a gas
(2) changing from a gas to a liquid
(3) changing from a solid to a liquid
(4) changing from a liquid to a solid

14. Which process requires the addition of energy to water?
(1) freezing of water
(2) cooling of water
(3) vaporization of water
(4) condensation of water

15. By which process does starlight travel through space?
(1) absorption
(2) conduction
(3) convection
(4) radiation

16. As heat energy is added to an open container of boiling water, the temperature of the boiling water will
(1) decrease
(2) increase
(3) remain the same

17. As Earth's surface absorbs solar energy and then radiates it, the wavelength of the outgoing energy will have
(1) increased
(2) decreased
(3) remained the same
TOPIC 6 QUIZ

1. Earth’s surface air temperatures change less during cloudy nights than during clear nights because clouds reflect and water vapor absorbs
   (1) visible light
   (2) ultraviolet light
   (3) infrared radiation
   (4) gamma radiation

2. What is a major effect on humans of lowering concentrations of ozone in the upper atmosphere?

3. Which statement best explains why, at high latitudes, reflectivity of insolation is greater in winter than in summer?
   (1) The North Pole is tilted toward the sun in winter.
   (2) Snow and ice reflect almost all insolation.
   (3) The colder air holds much more moisture.
   (4) Dust settles quickly in cold air.

4. How does the amount of visible light reflected by a smooth, dark-colored concrete surface compare with the amount of visible light reflected by a smooth, light-colored concrete surface?
   (1) The dark-colored surface will reflect less visible light.
   (2) The dark-colored surface will reflect more visible light.
   (3) The dark-colored surface will reflect the same amount of visible light.

5. Compared to land surface temperature changes, water surface temperature changes occur
   (1) more slowly because water has a lower specific heat
   (2) more slowly because water has a higher specific heat
   (3) faster because water has a lower specific heat
   (4) faster because water has a higher specific heat

6. Which is the main cause of seasons on Earth?
   (1) difference in Earth-sun distance at perihelion and aphelion
   (2) inclination of Earth’s axis of rotation to the plane of its orbit
   (3) change of inclination of Earth’s axis of rotation in relation to the plane of its orbit
   (4) increase in velocity of Earth as it approaches the sun

7. Approximately how many hours of daylight are received at the North Pole on June 21?
   (1) 0  (3) 18
   (2) 12  (4) 24

8. At what time of day do surface locations on Earth usually have maximum air temperatures?
   (1) 4 A.M.  (3) 3 P.M.
   (2) 12 noon  (4) 8 P.M.

9. When is an object in heat balance?
   (1) when the radiation emitted by the object is equal to that absorbed by the object
   (2) when the radiation emitted by the surroundings is equal to that absorbed by the object
   (3) when the radiation emitted by the object is equal to that absorbed by the surroundings
   (4) when the wavelength of the radiation emitted by the object is equal to that absorbed by the object
10. Which graph best represents what most likely happens to the temperature of Earth's atmosphere as the amount of carbon dioxide in the atmosphere increases over a period of many years?

(1) 

11. How does the amount of electromagnetic energy reaching Earth's surface change when volcanic eruptions add much volcanic ash to the stratosphere?

12. When cold water replaces warm water in the eastern Pacific Ocean, resulting in major worldwide weather changes, what is the condition called?

13. When the sun has low numbers of sunspots, how much electromagnetic energy does the sun emit compared to average times?

14. What are two conditions that could result in a new ice age on Earth?
TOPIC 7 QUIZ

1. Where does the greatest amount of daily weather change take place?
   (1) tropopause (3) troposphere
   (2) stratopause (4) stratosphere

2. Which instrument is used in detecting the interface between two air masses?
   (1) barometer (3) spectrometer
   (2) seismometer (4) photometer

3. According to the Earth Science Reference Tables, an atmospheric pressure of 1019 millibars is equal to
   (1) 31.05 inches of mercury
   (2) 30.15 inches of mercury
   (3) 30.09 inches of mercury
   (4) 30.00 inches of mercury

4. As the temperature of the atmosphere at a given location increases, the air pressure will most likely
   (1) decrease
   (2) increase
   (3) remain the same

5. Under which conditions is atmospheric pressure greatest?
   (1) warm and dry (3) cool and dry
   (2) warm and moist (4) cool and moist

6. Close spacing of isobars on a weather map is a good indicator of
   (1) low visibility
   (2) low dewpoint temperatures
   (3) high air temperatures
   (4) high wind velocity

7. According to the Earth Science Reference Tables, an air pressure of 29.47 inches of mercury is equal to
   (1) 996 mb (3) 1022 mb
   (2) 998 mb (4) 1014 mb

8. Which process is primarily responsible for the transfer of energy by air currents within Earth's atmosphere?
   (1) convection (3) absorption
   (2) radiation (4) conduction

9. The energy supply of a hurricane directly comes from
   (1) heat released by condensation
   (2) evaporation of tropical waters
   (3) the trade winds
   (4) discharges from lightning

10. Locations that have major yearly changes in weather caused by shifting of wind belts experience
    (1) monsoons (3) El Niño
    (2) hurricanes (4) jet streams

11. Most surface ocean currents are caused by
    (1) tides
    (2) evaporation
    (3) prevailing winds
    (4) salinity differences

12. Which process occurs when water vapor moves out of the leaves of a tree into the atmosphere?
    (1) condensation (3) runoff
    (2) infiltration (4) transpiration

13. The safest place to be when a tornado arrives is
    (1) under a tall tree
    (2) in a car
    (3) in the basement of a house
    (4) under a bed in the attic

14. How does an increase in air temperature affect the amount of water vapor needed to saturate the air?
**TOPIC 7 QUIZ (CONTINUED)**

15. What is the dewpoint temperature when the dry-bulb temperature is 22°C and the wet-bulb temperature is 15°C?
   (1) 7°C  (3) 12°C
   (2) 10°C  (4) 14°C

16. When clouds form, heat energy is released into the atmosphere by
   (1) expanding air
   (2) falling precipitation
   (3) condensation nuclei
   (4) condensing water vapor

17. Which type of precipitation forms when rain freezes in the atmosphere before hitting Earth's surface?

18. Which graph best shows the relationship between atmospheric transparency and the concentration of pollution particles in the air?

   ![Graph 1](image1)
   ![Graph 2](image2)
   ![Graph 3](image3)
   ![Graph 4](image4)
1. The primary source of most of the moisture for Earth’s atmosphere is
   (1) soil-moisture storage
   (2) rivers and lakes
   (3) melting glaciers
   (4) oceans

2. The ground below the water table is always
   (1) below sea level
   (2) drier than the ground above the water table
   (3) impermeable
   (4) saturated with water

3. How does the removal of vegetation affect the amount of surface water retention after precipitation?

4. As the amount of vegetation at a certain location INCREASES, the amount of water vapor entering the air at that location will
   (1) decrease
   (2) increase
   (3) remain the same

5. Surface runoff will generally be greatest when the
   (1) rainfall is light and the ground is permeable
   (2) infiltration rate is greater than the rainfall rate
   (3) slope of the land is too great to permit infiltration
   (4) ground is permeable and unsaturated

6. Water can pass through a sandstone sample because the sample is
   (1) permeable
   (2) organic in origin
   (3) composed of pebble-sized particles
   (4) well compacted and cemented

7. Which soil-property measurement usually is greater when particles are fine than when particles are coarse?
   (1) infiltration
   (2) capillarity
   (3) porosity
   (4) permeability rate

8. How does the amount of people using a trail or dirt path at a school campus affect the rate of infiltration in the area of the path?

9. Which soil condition usually exists when flooding occurs during a rainstorm?
   (1) The soil is unsaturated.
   (2) Soil water storage is equal to zero.
   (3) Soil infiltration is less than surface runoff.
   (4) Soil permeability is equal to the rate of precipitation.

10. Which factors have the LEAST effect on the climate of a region?
    (1) latitude and elevation
    (2) longitude and population density
    (3) wind belts and storm tracks
    (4) mountain barriers and nearness to large bodies of water
**TOPIC 8 QUIZ (CONTINUED)**

11. The primary factor controlling climate zones on Earth is
   (1) elevation  (3) latitude
   (2) local time  (4) longitude

12. What is the name of prevailing winds that reverse direction with changing seasons?

13. The chief climatic control affecting the Finger Lake region of New York State is
   (1) prevailing winds
   (2) lake currents
   (3) ocean currents
   (4) mountain ranges

14. How do the average temperatures of urban areas compare to surrounding farming regions?

15. A desert often forms on the leeward side of a mountain range, as shown in the cross section below.

   ![Diagram of mountain range with windward and leeward sides]

   After most of the moisture is removed from the air on the windward side, deserts form on the leeward side because the sinking air
   (1) compresses and warms
   (2) compresses and cools
   (3) expands and warms
   (4) expands and cools

16. Which condition makes surface runoff of rainfall most likely?
   (1) The gradient of the surface is low.
   (2) Permeability rate exceeds the rate of rainfall.
   (3) Surface soil pore spaces are filled.
   (4) The porosity of the surface soil is high.

17. Through which of the following loose soil materials does water infiltrate fastest?
   (1) clay
   (2) silt
   (3) sand
   (4) pebbles

18. What is the name of the cool ocean current that flows along the west coast of South America?
   (1) Brazil Current
   (2) Peru Current
   (3) South Equatorial Current
   (4) North Pacific Current
Topic 9 Quiz

1. Which type of weathering will produce new chemical substances?
   (1) frost action
   (2) abrasion
   (3) oxidation
   (4) temperature change

2. Rocks usually weather faster on mountain tops compared to rocks in valleys because of differences in
   (1) direction of prevailing winds
   (2) daily temperature range
   (3) air pressure
   (4) mineral composition

3. Which of the following would result in the most weathering?
   (1) rocks buried below the water table
   (2) surface bedrock that is highly cracked
   (3) an atmosphere low in carbon dioxide
   (4) surface rocks with a low permeability

4. Two tombstones, A and B, each have been standing in a cemetery for 100 years. The same style and size of lettering is clear on A but not on B. Which is the most probable reason for the difference?
   (1) B was more protected from the atmosphere than A.
   (2) A has minerals that are more resistant to weathering than those in B.
   (3) A is more porous than B.
   (4) B is smaller than A.

5. Chemical weathering of limestone is likely to be most rapid under which pair of conditions?
   (1) warm and moist
   (2) cold and moist
   (3) warm and dry
   (4) cold and dry

6. Humus, which is formed by the decay of plant and animal matter, is important for the formation of most
   (1) soils
   (2) minerals
   (3) sediment
   (4) surface bedrock

7. In areas of low erosion rates the formation of soil will increase as
   (1) time increases
   (2) urbanization increases
   (3) soil slope increases
   (4) deforestation increases

8. The slow creeping of soil downhill is most directly caused by
   (1) volcanic eruptions
   (2) earthquakes
   (3) gravity
   (4) wind

9. The greater the time that stream sediment is transported, the greater the probability that the sediment will become more
   (1) angular and smaller
   (2) angular and larger
   (3) rounded and smaller
   (4) rounded and larger

10. The area drained by a stream and its tributaries is called its
    (1) drainage pattern
    (2) landscape region
    (3) divide
    (4) watershed

11. The velocity of a stream depends largely on
    (1) the length of the valley
    (2) slope of the stream bed
    (3) volume of sediment being carried
    (4) width of the stream banks

12. All other factors being equal, as the shape of a stream channel becomes more semi-circular the velocity of a stream
    (1) increases
    (2) decreases
    (3) does not change
13. Which current is a cool ocean current that flows completely around Earth?
   (1) Antarctic Circumpolar Current
   (2) Gulf Stream
   (3) North Equatorial Current
   (4) California Current

14. Which primarily controls the amount of sediment that a stream is able to carry?
   (1) the amount of dissolved minerals
   (2) the volume of stream water
   (3) the type of rock in the stream bed
   (4) liquid water temperature

15. A flood plain is largely the result of
   (1) downcutting by a stream
   (2) capturing of small streams by larger streams
   (3) sidecutting by a stream and deposition during flooding
   (4) long term decreases in stream velocity

16. What landscape feature is formed by deposition of sediment at the end or mouth of a stream?

17. Wind erosion is most effective in those regions where the climate is
   (1) cold
   (2) dry
   (3) hot
   (4) humid

18. The diagrams below represent landscape features found along the seacoast. The arrows show ocean-wave direction. Which shoreline has been shaped more by deposition than by erosion?

19. Sand is moved along ocean shores in one direction largely because
   (1) most ocean waves hit shore at some angle
   (2) hurricane waves push the sand
   (3) tsunami waves produced by earthquakes usually come from one direction
   (4) prevailing winds push sand in one direction along most shores
TOPIC 10 QUIZ

1. Streams that are outlets of lakes usually have little solid sediment because
   (1) the lakes act as depositional basins for solid sediments
   (2) streams coming out of lakes have little velocity and cannot erode
   (3) the lake reduces the volume of water available to streams
   (4) the dissolved minerals precipitate out into the lake

2. A decrease in a river's velocity will most likely result in more
   (1) erosion by the river
   (2) deposition within the river
   (3) large particles being carried by the river
   (4) dissolved material being picked up by the river

3. Which pair of features best indicates the direction of former glacial movement?
   (1) scratches and drumlins
   (2) outwash plains and flood plains
   (3) moraines and meanders
   (4) kettle lakes and glacial soil

4. Large and dense sediments tend to be deposited in which part of a meander (bend) of a stream?
   (1) on the outside of the meander
   (2) on the inside of the meander
   (3) in the middle of the stream
   (4) near the surface of the stream

5. The four particles in the table below are of equal volume and are dropped into a column filled with water

<table>
<thead>
<tr>
<th>Particle</th>
<th>Shape</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>flat</td>
<td>2.5 g/cm³</td>
</tr>
<tr>
<td>B</td>
<td>flat</td>
<td>3.0 g/cm³</td>
</tr>
<tr>
<td>C</td>
<td>round</td>
<td>2.5 g/cm³</td>
</tr>
<tr>
<td>D</td>
<td>round</td>
<td>3.0 g/cm³</td>
</tr>
</tbody>
</table>

Which particle would usually settle most rapidly?
   (1) A  (3) C
   (2) B  (4) D

6. In a delta, what is the most probable arrangement of sediments from the shore outward into the ocean?
   (1) pebbles, sand, silt
   (2) pebbles, silt, sand
   (3) sand, pebbles, silt
   (4) silt, pebbles, sand

7. List two characteristics of sediments deposited directly by glaciers.
8. A sedimentary particle is dropped into a cylinder of water. The particle will take the longest time to settle if the particle has
   (1) low density, small size, and spherical shape
   (2) low density, small size, and flattened shape
   (3) high density, large size, and spherical shape
   (4) high density, large size, and flattened shape

9. List two depositional landscape features formed by streams.

10. Most of the natural surface material on Long Island is classified as
    (1) sediments deposited by glaciers and streams
    (2) rocks precipitated from an ancient sea
    (3) sediments deposited by wind
    (4) rocks formed by the collision of tectonic plates

11. Which New York State resources are a direct result of the glaciers that once covered most of the state?
    (1) sand and gravel
    (2) halite and gypsum
    (3) magnetite and calcite
    (4) limestone and marble

12. Moraines are recognized as glacial deposits because they are composed of rock materials that are
    (1) uniform in size and layered
    (2) uniform in size and not layered
    (3) many different sizes and layered
    (4) many different sizes and not layered

13. What is the name of the broad, layered, and sorted sediment deposit formed by the runoff from a glacier?

14. A student partly filled a cake pan with sand in which four ice cubes were buried. This demonstration would best illustrate the origin of
    (1) meanders
    (2) kettle hole lakes
    (3) moraines
    (4) glacial grooves

15. Offshore deposits of sand slightly above sea level that are not attached to the shoreline are called
    (1) a beach
    (2) a sand dune
    (3) a barrier island
    (4) a moraine

16. Sand dunes on the coast of the Atlantic Ocean on Long Island are formed by the deposition by which agent of erosion?

17. Angular sediments deposited at the base of steep slopes are mostly likely directly deposited by which agent of erosion?
**TOPIC 11 QUIZ**

1. Why are minerals considered natural?  
   (1) They are not formed by living things.  
   (2) They are not formed by people.  
   (3) They have not formed in historical times.  
   (4) They are made of elements that are not radioactive.

2. The mineral quartz is composed of what two chemical elements?

3. By mass, which chemical element is most abundant in Earth’s crust?

4. Large deposits of rock gypsum and rock salt usually form in areas of  
   (1) active volcanoes  
   (2) continental ice sheets  
   (3) fault zones in the crust  
   (4) shallow evaporating seas

5. Which substance is produced as a result of evaporation?  
   (1) halite  
   (2) sandstone  
   (3) pumice  
   (4) gneiss

6. Which property of the mineral diamond allows diamond powder to be used to shape gems for jewelry?  
   (1) crystal shape  
   (2) luster  
   (3) cleavage  
   (4) hardness

7. The light that reflects off a mineral or the mineral’s shine is what mineral property?

8. Which common mineral fizzes when dilute hydrochloric acid (HCl) is placed on it?  
   (1) calcite  
   (2) quartz  
   (3) feldspar  
   (4) talc

9. The classification of rocks into sedimentary, igneous, and metamorphic is based on  
   (1) origin  
   (2) density  
   (3) color  
   (4) age

10. In which New York State landscape region was most of the surface bedrock formed by the recrystallization of rock under conditions of high temperature and high pressure?  
    (1) Newark Lowlands  
    (2) Erie-Ontario Lowlands  
    (3) Adirondack Mountains  
    (4) Allegheny Plateau

11. One can determine the texture of most rocks by observing  
    (1) their mineral crystal size  
    (2) their color  
    (3) their mark on a streak plate  
    (4) their reaction to acids

12. Which processes would directly result in the formation of sedimentary rocks?  
    (1) melting and compression  
    (2) cooling and crystallization  
    (3) burial and cementing  
    (4) faulting and folding

**Topic 11 Quiz (continued)**

13. A rock is composed of several large, rounded pebbles and sand grains cemented together. Which inference about the rock is best supported by this description?
   (1) The rock is older than the pebbles.
   (2) The rock is igneous.
   (3) The rock is sedimentary.
   (4) The rock resulted from evaporation of seawater.

14. Fossils would most likely be found in a sample of
   (1) limestone
   (2) granite
   (3) quartzite
   (4) metaconglomerate

15. Which sedimentary rocks are clastic and consist of particles that have diameters smaller than 0.006 centimeter?
   (1) conglomerate and sandstone
   (2) siltstone and shale
   (3) bituminous coal and breccia
   (4) fossil limestone and rock gypsum

16. Which would most likely cause molten rock material to become glassy igneous rock?
   (1) cooling over a long period of time
   (2) cooling under high pressure
   (3) cooling on the surface
   (4) cooling at a great depth

17. The geologic cross section below shows limestone that was intruded. Part of the limestone (zone A) was heated intensely but was not melted.

![Geologic cross section](image)

Which type of rock most likely formed in zone A?
   (1) gneiss
   (2) slate
   (3) marble
   (4) obsidian

18. Which extrusive igneous rock is composed of approximately 40% quartz, 20% potassium feldspar, 20% plagioclase feldspar, 10% biotite mica, and 10% amphibole?
   (1) rhyolite
   (2) gabbro
   (3) granite
   (4) basalt

19. Describe a geological event that commonly results in regional metamorphism.
**Topic 12 Quiz**

1. Which observed feature would provide the best evidence of crustal stability?
   (1) horizontal sedimentary layers
   (2) changed benchmark elevations
   (3) folded, faulted, and tilted rock strata
   (4) marine fossils at elevations high above sea level

2. The diagram below shows a cross section of sedimentary rock layers.

3. The diagram below shows a portion of Earth’s crust.

   The movements indicated by the arrows represent the process of
   (1) volcanism    (3) folding
   (2) metamorphism (4) faulting

4. What is the name of the location on Earth's surface directly above the place where an earthquake originates?

   Which statement about the deposition of the sediments best explains why these layers have the curved shape shown?
   (1) Sediments were deposited in horizontal layers and later disturbed by crustal activity.
   (2) Sediments were deposited on an uneven, curving seafloor.
   (3) Sediments were deposited after widespread volcanic eruptions.
   (4) Sediments were deposited between two diverging oceanic plates.

5. What is the minimum number of seismic stations needed to locate most earthquake epicenters?
   (1) 1    (2) 2    (3) 3    (4) 4

6. At which epicenter distance is the difference in arrival times between P-waves and S-waves greatest?
   (1) 1000 km    (2) 3000 km
   (3) 5000 km    (4) 7000 km
**TOPIC 12 QUIZ (CONTINUED)**

7. The highest waves from an earthquake on the seismogram of a seismograph are most often used to find the
   (1) earthquake magnitude
   (2) depth of earthquake origin
   (3) distance to the epicenter
   (4) area of sinking land

8. When inside, at the first indication of an earthquake
   (1) run outside
   (2) get under a strong object
   (3) run to the basement
   (4) get to your emergency supplies

9. Volcanic mountains are made by
   (1) extrusions of igneous rock
   (2) intrusions of igneous rock
   (3) uplift of basaltic ocean crust
   (4) deposits of sediments weathered from igneous rocks

10. From the top of the stiffer mantle to the center of Earth, the rock material is inferred to be
    (1) solid all the way to the center of the inner core
    (2) solid, then liquid to the center of the inner core
    (3) solid, then liquid, then solid again to the center of the inner core
    (4) solid, then liquid, then gaseous to the center of the inner core

11. The pressure at the interface between the mantle and the outer core of Earth is inferred to be approximately
    (1) 1.0 million atmospheres
    (2) 1.4 million atmospheres
    (3) 3.0 million atmospheres
    (4) 3.4 million atmospheres

12. According to the *Earth Science Reference Tables*, the border between the South American plate and the African plate is best described as
    (1) converging and located at an oceanic ridge
    (2) converging and located at an oceanic trench
    (3) diverging and located at an oceanic ridge
    (4) diverging and located at an oceanic trench

13. Volcanic features like those in Hawaii and Yellowstone are associated with
    (1) diverging plates
    (2) converging plates
    (3) transform plate movements
    (4) hot spots

14. What is the direct cause of most earthquakes?
    (1) gravitational pull on bedrock by the moon
    (2) deposition of sediment in lakes and oceans
    (3) movement of bedrock along a fault line
    (4) heat exchange between the crust and the atmosphere

15. A long time of uplift and mountain building is called a(n)
    (1) orogeny
    (2) unconformity
    (3) seismic event
    (4) subduction

16. Which geologic event most likely caused the Taconic Mountains to form?
    (1) the melting of a subducted oceanic plate
    (2) the collision of North America and Africa
    (3) the eruption of an ancient volcanic mountain chain
    (4) the massive erosion and deposition of Mesozoic rocks
**Topic 13 Quiz**

1. What is the relative age of most rocks at Earth's surface compared to rocks beneath the surface?

2. The diagram below shows a cross section of a portion of the upper crust of Earth. The rock layers have not been overturned.

   **Earth's Surface**

   ![Diagram of Earth's Surface with labeled layers: Earth's Surface, Sandstone, Shale, Basalt, Limestone, Contact, Metamorphism]

   **Key**
   - Sandstone
   - Shale
   - Basalt
   - Limestone
   - Contact metamorphism

   The sandstone fragment found in the basaltic intrusion is
   (1) younger than the shale layer
   (2) older than the limestone layer
   (3) younger than the basaltic intrusion
   (4) older than the contact metamorphism

3. What is the relative age of a fault that cuts across many rock layers?
   (1) The fault is younger than all the layers it cuts across.
   (2) The fault is older than all the layers it cuts across.
   (3) The fault is the same age as the top layer it cuts across.
   (4) The fault is the same age as the bottom layer it cuts across.

4. What is the relative age of a fold in rocks compared to the age when the rock formed?

5. Layers of volcanic ash often serve as useful geologic time markers because ash layers usually
   (1) deposit quickly over a wide area
   (2) are older than the surrounding rock
   (3) can be sampled easily
   (4) darken with age

6. An unconformity always indicates
   (1) severe glaciation
   (2) extensive volcanic activity
   (3) a long period of arid climates
   (4) a gap in the geologic record

7. The most important result of studying Earth history is
   (1) People can predict how rapidly a species will evolve.
   (2) People can predict the times of future geologic hazards.
   (3) People can know where the continents will be in the future.
   (4) People can know how life on other planets has evolved.
8. Which property of uranium isotopes makes it useful for measuring events throughout the history of Earth?
   (1) It decays to lead very slowly.
   (2) It decays to lead very rapidly.
   (3) Its rate of decay varies with age.
   (4) It is found in small quantities in most rocks and fossils.

9. Samples of plant pollen are preserved in sediment deposited by the last glacial ice sheet in New York State. Which radioactive isotope is best for determining the age of the samples?
   (1) potassium-40
   (2) carbon-14
   (3) uranium-238
   (4) rubidium-87

10. Which statement about the species of animals and plants that lived on Earth in the past is best supported by the fossil record?
    (1) Most became extinct.
    (2) Most lived on the land.
    (3) Most were preserved in metamorphic rock.
    (4) Most appeared during the Cambrian Period.

11. How does the number of different species of life on Earth relate to the degree of separation of land masses on Earth?

12. How can the impact of large meteorites on Earth be related to time of rapid evolution of life on Earth?

13. At present, most of the heating of Earth’s interior is most likely caused by
    (1) radioactive decay
    (2) nuclear fusion
    (3) meteorite impact
    (4) tectonic plate collisions

14. What happened in the early evolution of the physical Earth that caused it to be separated into layers by density?

15. What is the relationship between evolution of life forms on Earth and the free oxygen content of the atmosphere?

16. The largest meteorite impact crater in North America formed approximately 1850 million years ago, which was during the
    (1) Middle Archean Era
    (2) Early Proterozoic Era
    (3) Early Jurassic Period
    (4) Late Cretaceous Period
**Topic 14 Quiz**

1. List two characteristics that distinguish a mountain from a plain.

2. The diagrams below represent two different plateaus.

3. Which New York State landscape region is located at 43° N, 77° W?
   - (1) Erie-Ontario Lowlands
   - (2) Hudson-Mohawk Lowlands
   - (3) the Catskills
   - (4) Tug Hill Plateau

4. A landscape region that has experienced no uplift in millions of years but has experienced much weathering and erosion would most likely have
   - (1) low elevations and low relief
   - (2) low elevations and high relief
   - (3) high elevations and low relief
   - (4) high elevations and high relief

5. Intermittent streams and many inland deltas are characteristic of regions that are
   - (1) hot
   - (2) arid
   - (3) cold
   - (4) humid

6. The diagram below represents a geologic cross section.

Which factor was probably most important in causing one plateau to develop smooth, rounded surface features and the other plateau to develop sharp, angular surface features?
   - (1) type of bedrock
   - (2) amount of folding
   - (3) time
   - (4) climate

7. Which landscape feature is most likely to be formed from a bedrock layer that is resistant to erosion?
   - (1) coastal plain
   - (2) glacial moraine
   - (3) valley
   - (4) ridge
8. The diagram below represents a cross section of the bedrock and land surface in part of Tennessee. The dotted lines indicate missing rock layers.

Which statement is best supported by the diagram?
(1) Rocks are weathered and eroded evenly.
(2) Folded rocks are more easily weathered and eroded.
(3) Deposits of sediments provide evidence of erosion.
(4) Climate differences affect the amount of erosion.

9. Thin soils with little organic material are characteristic of regions that are
(1) hot (3) cold
(2) arid (4) humid

10. Describe an example of how modern technology has drastically altered landscapes.

11. Why would exposed rocks in a park in a major urban area tend to weather faster than the same type of rock exposed in a surrounding farm region?

12. Deep, parallel grooves and scratches (striations) are found on the surface of some limestone bedrock in New York State. These scratches and grooves suggest that the surface was
(1) abraded by windblown sand
(2) scraped by rocks in a continental glacier
(3) eroded by a meandering stream
(4) cracked by the evaporation of a warm, shallow sea

13. Which characteristics best distinguish one landscape region from another?
(1) human population density and types of environmental pollutants
(2) composition of bedrock and variety of fossils
(3) bedrock structure and elevation of land surfaces
(4) stream gradients and soil types

14. Which geologic processes are mostly responsible for the present landscape features of New York State landscapes?
(1) crustal movement and erosion
(2) subsidence and metamorphism
(3) faulting and folding
(4) volcanism and subduction

15. Adding automobile exhaust gases to the atmosphere has had the greatest impact on landscape development by
(1) changing the position of tectonic plates
(2) changing Earth's prevailing wind patterns
(3) increasing the rate of chemical weathering
(4) increasing the amount of ozone in ground water

16. In a mountainous area, the rate of uplift is 1.5 meters per 1,000 years, and the rate of erosion is 2.6 meters per 1,000 years. As a result of these rates, the elevations in this area will
(1) decrease
(2) increase
(3) remain the same

17. Faults and fractures in bedrock have the greatest effect on the locations and patterns of
(1) streams
(2) moraines
(3) precipitation
(4) sand dunes
**Answers To Topic 1 Quiz**

1. 3
2. 2
3. 2
4. 1
5. 2
6. 3

7. a. Students must give the answer in the form of an equation, which must include "rate =" or "r =." Examples:

   \[ \text{rate of change} = \frac{\text{change in field value}}{\text{change in time}} \]

   \[ r = \frac{\Delta d}{\Delta t} \]

   b. rate = \frac{300 \text{ km}}{15 \text{ hr}}

   (Student need not record the units. Allow ±25 km for distance; time must be 15 hours.)

   c. Accept any correctly calculated rate based on the student's answer in b. Example:

   rate = 20 kilometers/hour

   \[ r = 20 \text{ km/hr} \]

8. 2

9-11. Answers include: mass movements, volcanic eruptions, tsunamis, earthquakes, meteorite impacts, blizzards, floods, hurricanes, tornadoes, and thunderstorms

**Answers To Topic 2 Quiz**

1. 3
2. 4
3. 2
4. 1
5. It remains the same.
6. any two of B, C, or D
7. 1
8. 2
9. It remains the same.
10. 3
11. 2
12. 3
13. 4
14. 1
15. 4
16. 2
17. 2

**Answers To Topic 3 Quiz**

1. The universe is all matter, space, and energy everywhere, while a celestial object is any object outside or above where an observer is (usually Earth).
2. 1
3. 3
4. The stars moving toward Earth have a blue shift Doppler effect and the stars moving away from Earth have a red shift Doppler effect.
5. 1
6. During nuclear fusion the nucleus of atoms combine and some of the mass is converted into energy. Nuclear fusion occurs in the high temperature and pressure conditions in the cores of most stars.

7. Answers include any two of these: 1. Polaris is less red to orange and more yellow; 2. Polaris has a higher luminosity; 3. Polaris is more massive; and 4. Polaris has a higher surface temperature.

8. 4
9. 1
10. 1
11. 4
12. 1
13. Mars
14. 2
15. 2
16. 1
17. 3

**Answers To Topic 4 Quiz**

1. This apparent motion of the stars is the result of Earth rotating at 15 degrees per hour.
2. 3
3. 2
4. the rotation of Earth from west to east
5. 3
6. geocentric model
7. Earth revolves or orbits the sun causing the nighttime sky to face different directions at different times of the year.
8. 3
9. 1
10. 4 a.m.
11. 5 hours
12. 1
13. 2
14. during new and full moon positions when Earth, moon, and sun are in a straight line
15. full
16. 2
17. 3

**Answers To Topic 5 Quiz**

1. 1
2. 1
3. 3
4. 3
5. 2
6. 2
7. 1
8. 2
9. 2
10. 3
11. In nuclear fusion the nuclei of atoms combine while in nuclear fission (nuclear decay) the nuclei of atoms split.
12. 1
13. 2
14. 3
15. 4
16. 3
17. 1

**Answers To Topic 6 Quiz**

1. 3
2. Answers include: The more ultraviolet radiation that reaches Earth's surface, the more human cancers (especially skin) and the more human eye damage.
3. 2
4. 1
5. 2
6. 2
7. 4
8. 3
9. 1
10. 2
11. less electromagnetic energy reaches Earth's surface
12. El Niño
13. less
14. Answers include any two of the following: The sun could emit less energy. More aerosols, such as volcanic ash, could enter the atmosphere. A big meteorite could impact Earth resulting in much dust (aerosols) entering the atmosphere. Conditions of Earth's orbit could change resulting in more snow in winter and/or less melting of ice and snow in summer.
### Answers to Topic 7 Quiz

<table>
<thead>
<tr>
<th>1. 3</th>
<th>2. 1</th>
<th>3. 3</th>
<th>4. 1</th>
<th>5. 3</th>
<th>6. 4</th>
<th>7. 2</th>
<th>8. 1</th>
<th>9. 1</th>
<th>10. 1</th>
<th>11. 3</th>
<th>12. 4</th>
</tr>
</thead>
</table>

14. As the temperature of the air increases, the amount of water needed to saturate the air increases.

15. 2 16. 4 17. sleet
18. 1

### Answers to Topic 8 Quiz

<table>
<thead>
<tr>
<th>1. 4</th>
<th>2. 4</th>
<th>3. As more and more vegetation is removed the amount of surface water retained decreases.</th>
<th>4. 2</th>
<th>5. 3</th>
<th>6. 1</th>
</tr>
</thead>
</table>

7. 2
8. The more people using a trail or dirt path the more soil compaction and the lower the rate of infiltration.

9. 3 10. 2 11. 3
12. monsoons 13. 1
14. The average temperature of urban areas is higher than surrounding farm regions.

15. 1 16. 3 17. 4
18. 2

### Answers to Topic 9 Quiz

<table>
<thead>
<tr>
<th>1. 3</th>
<th>2. 2</th>
<th>3. 2</th>
<th>4. 2</th>
<th>5. 1</th>
<th>6. 1</th>
<th>7. 1</th>
<th>8. 3</th>
<th>9. 3</th>
<th>10. 4</th>
<th>11. 2</th>
<th>12. 1</th>
</tr>
</thead>
</table>

13. 1 14. 2 15. 3
16. a delta 17. 2 18. 3
19. 1

### Answers to Topic 10 Quiz

<table>
<thead>
<tr>
<th>1. 1</th>
<th>2. 2</th>
<th>3. 1</th>
<th>4. 2</th>
<th>5. 4</th>
<th>6. 1</th>
</tr>
</thead>
</table>

7. Answers include: unsorted, unlayered, scratched, and subangular or subrounded shape
8. 2
9. Answers include: flood plains, deltas, sand bars, and levees
10. 1 11. 1 12. 4
13. outwash plain
14. 2 15. 3 16. wind
17. mass movement, direct gravity erosion, or gravity

### Answers to Topic 11 Quiz

<table>
<thead>
<tr>
<th>1. 2</th>
<th>2. oxygen and silicon</th>
<th>3. oxygen</th>
<th>4. 4</th>
<th>5. 1</th>
<th>6. 4</th>
<th>7. luster</th>
<th>8. 1</th>
<th>9. 1</th>
<th>10. 3</th>
<th>11. 1</th>
</tr>
</thead>
</table>

12. 3 13. 3 14. 1
15. 2 16. 3 17. 3
18. 1
19. Answers include: convergence of tectonic plates, plate subduction, and continental collision

### Answers to Topic 12 Quiz

<table>
<thead>
<tr>
<th>1. 1</th>
<th>2. 1</th>
<th>3. 4</th>
<th>4. epicenter</th>
<th>5. 3</th>
<th>6. 4</th>
<th>7. 1</th>
<th>8. 2</th>
<th>9. 1</th>
<th>10. 3</th>
<th>11. 2</th>
<th>12. 3</th>
</tr>
</thead>
</table>

13. 4 14. 3 15. 1
16. 2

### Answers to Topic 13 Quiz

<table>
<thead>
<tr>
<th>1. They are younger.</th>
<th>2. 4</th>
<th>3. 1</th>
</tr>
</thead>
</table>

4. The age of the fold is younger.

5. 1 6. 4 7. 2
8. 1 9. 2 10. 1
11. The more separated the land masses the more species of life.

12. The impact of large meteorites results in the extinction of many species which results in a time of rapid evolution.

13. 1
14. The early Earth melted or mostly melted allowing its separation by density.

15. Not until certain life forms evolved that carried on photosynthesis and emitted oxygen did free oxygen build up in Earth's atmosphere.

16. 2

### Answers to Topic 14 Quiz

<table>
<thead>
<tr>
<th>1. Answers include any two of the following; Mountains usually have distorted rock structure and plains do not. Mountains are higher in elevation than plains. Mountains have more changes in elevation (changes in relief) than plains. Mountains have higher slopes or gradients.</th>
<th>2. 4</th>
<th>3. 1</th>
<th>4. 1</th>
</tr>
</thead>
</table>

5. 2 6. 3 7. 4
8. 2 9. 2
10. Answers include: deforestation, urbanization, and use of land for farming and grazing

11. The atmosphere is more acid, humid, hot and there is more precipitation in the park area.

12. 2 13. 3 14. 1
15. 3 16. 1 17. 1

---

82 Earth Science Answer Key
Note: Allow credit even if the symbols for shale and rock salt are not parallel to the other rock layers shown.

58. [1] Allow 1 credit for the contact metamorphism symbol drawn on only the two sides of F, as shown below.

Example of a 3-credit response for questions 56, 57, and 58:

![Diagram of geologic layers and faults]

59. [1] Allow 1 credit for the sequence shown below.

<table>
<thead>
<tr>
<th>E (rock salt)</th>
<th>B (shale)</th>
<th>X (fault)</th>
<th>F (andesite)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oldest</td>
<td>Most recent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: If more than these four letters are used, all letters used must be in the correct sequence, e.g., E, D, C, B, X, F, YZ, A.

60. [1] Allow 1 credit for two acceptable processes. Acceptable responses include, but are not limited to:

- uplift
- weathering
- erosion
- submergence/subsidence
- deposition


62. [1] Allow 1 credit if the relative changes in both the stream velocity and rate of erosion are correctly described. Acceptable responses include, but are not limited to:

- Stream velocity:
  - increases
  - gets faster
  - becomes greater

- Rate of erosion:
  - increases
  - There is more erosion

63. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- abrasion/friction between the particles
- bouncing and rolling along the stream bottom
- Particle collision breaks off pieces
- Particles are weathered

Note: Do not allow “water erosion” alone because “transported by the stream” is part of the question.

Do not allow “rounding by water” alone because water alone does not produce rounding.
64. [1] Allow 1 credit if the width and placement of the shading have been correctly indicated on either the surface and/or the side view.

Example of a 1-credit response:

![Mid-ocean ridge center](image)

65. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- As distance from the ridge increases, the age of the bedrock increases.
- The farther away from the ridge, the older the age of the bedrock.
- The youngest bedrock is near the ridge center.
- Direct relationship.
- Bedrock nearer the continents is older than bedrock nearer the ridge.

Part C

66. [1] Allow 1 credit if all three contour lines are drawn correctly. If additional contour lines are drawn, all must be correct to receive credit.

Note: All three contour lines must extend to the edge of the map to receive credit.

67. [1] Allow 1 credit for a line starting at location E, ending at Spruce Creek, and within the white region shown below.

Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

Example of a 2-credit response for questions 66 and 67:

![Contour lines](image)

68. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- Has a gentler gradient.
- It is flatter.
- Section II is lower in elevation.
- Section IV is steeper.

69. [1] Allow 1 credit for any value greater than 1400 ft but less than 1500 ft.

70. [1] Allow 1 credit for any value from 323 ft/mi to 345 ft/mi.

71. [1] Allow 1 credit if all five plots are within the circles shown below and are correctly connected with a line that passes within each circle. The line should extend below 500 ft but above 400 ft in the creek valley.

Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

Profile Along Line CD

![Profile line](image)

72. [1] Allow 1 credit if the center of an X is within either clear box shown below.

Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating. Allow credit if a symbol other than an X is used. If more than one X is used, both must be correct to earn credit.

73. [1] Allow 1 credit for 3 p.m. or 3:00 p.m.

Note: Allow credit if the “p.m.” lacks periods.

74. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- The longer the Sun’s path, the longer the duration of daylight.
- The shorter the Sun’s path, the shorter the daylight will be.
- Direct relationship.
75. [1] Allow 1 credit if the centers of all three Xs are within the circles shown below.
Note: Do not allow credit if more than one X is placed on any orbit.
Allow credit even if a symbol other than an X is used.
It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

76. [1] Allow 1 credit for any value from 4 revolutions to 4.2 revolutions.

77. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— 0°
— equator
Note: Allow credit even if the student wrote “0° N” or “0° S.”

78. [1] Allow 1 credit for any value from 25,000 light-years to 35,000 light-years.

79. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— a spiral galaxy
— a dense center of stars with spiral arms
— pinwheel-shaped

80. [1] Allow 1 credit if all five astronomical features are listed in the correct order as shown below.
Smallest  Jupiter
Sun
Our solar system
Milky Way Galaxy
Largest  Universe

81. [1] Allow 1 credit if both responses are correct.
Acceptable responses include, but are not limited to:
Basalt: less than 1 mm or any value less than 1 mm
Gabbro: 1 mm to 10 mm or any value from 1 mm to 10 mm

82. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— Dunite is more mafic.
— It is more mafic.
— Dunite does not contain pyroxene.
— Dunite contains only olivine, while peridotite contains pyroxene and olivine.
— Peridotite has calcium, aluminum, and sodium.

83. [1] Allow 1 credit for clay or clay with microscopic fossils or top layer.

84. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— Clouds only reflect some of the Sun’s energy back into space.
— Some radiation still gets through to Earth’s surface.

85. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— saves energy
— reduce utility costs
— produces clean energy
— A renewable source of energy has less effect on the environment.
— less pollution/CO₂ emissions/reduced carbon footprint/less global warming
— conservation of fossil fuels
— Solar energy is renewable.
Part A

1. 3
2. 4
3. 1
4. 2
5. 1
6. 1
7. 3
8. 4
9. 4
10. 1
11. 2
12. 4
13. 4
14. 3
15. 1
16. 1
17. 2
18. 1
19. 2
20. 4
21. 3
22. 4
23. 4
24. 3
25. 1
26. 4
27. 3
28. 2
29. 2
30. 4
31. 4
32. 1
33. 1
34. 2
35. 3

Part B-1

36. 2
37. 1
38. 3
39. 1
40. 3
41. 1
42. 1
43. 2
44. 1
45. 4
46. 3
47. 4
48. 1
49. 2
50. 4

Part B-2

Allow a maximum of 15 credits for this part.

51. [1] Allow 1 credit if the centers of all ten plots are located within the boxes shown and a correctly drawn line passes within each box. The low point of the line must extend below 400 feet but not below 500 feet.

Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

52. [1] Allow 1 credit for any value from 18 to 23 with the correct units. Acceptable units include, but are not limited to:
   - ft/mi
   - feet/mile
   - feet per mile
   - ft/mile

53. [1] Allow 1 credit for any depth greater than 600 ft and less than 700 ft.

54. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The isolines are close together.
   - The spaces between the lines are small.
   - There is a greater change in depth over a shorter distance.
   - The deepest waters are closer to the southern shore than they are to the northern shore.

55. [1] Allow 1 credit if both the circle fossil symbol O and the evidence are correct. Acceptable evidence includes, but is not limited to:
   - The fossil was found only in the Devonian layer/one layer in each outcrop.
   - The fossil was geographically widespread.
   - The fossil indicates a short existence in geologic time/limited time interval.

56. [1] Allow 1 credit if both outcrop 2 is stated and the evidence is correct. Acceptable evidence includes, but is not limited to:
   - The rock layers of the same age as those shown in outcrop 2 are all found in New York State.
   - Permian Period rock is not present in New York State, but is shown in outcrops 1 and 3.

57. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - Carbon-14 has a short half-life.
   - These rock layers are too old to contain measurable carbon-14.
   - Carbon-14 is used to date recent remains.
   - No organic material remains in the rock.

58. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The bedrock in the outcrops formed during the Paleozoic Era, and Coelophysis lived during the Mesozoic Era.
   - The youngest rock layer is from the Permian, and Coelophysis did not exist yet.
   - Coelophysis lived at a much later time.
   - No Triassic bedrock is shown.
   - Layers containing Coelophysis have been removed by erosion.

59. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - scratches/striations on the bedrock surface
   - grooves in bedrock
   - a boulder transported from a more northerly outcrop on the bedrock
   - an erratic
   - drumlin

60. [1] Allow 1 credit if both responses are correct. Acceptable responses include, but are not limited to:

Moraines:
   - unsorted sediments/mixed particles
   - unlabeled

Outwash plain:
   - sorted deposits
   - layered sediments

61. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The valley would have a U-shaped appearance.
   - flat bottom and steep sides
   - rounded shape

62. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The ice is white/light colored.
   - The smooth ice reflects better than rougher land terrain.
   - The bedrock/soil is darker colored.
— Snow and ice reflect more insolation.
— Has a higher albedo

63. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— Precipitation
— Raining
— Snowing
— Sleet
— Hailing

64. [1] Allow 1 credit for 4520 J.

65. [1] Allow 1 credit if both responses are correct. Acceptable responses include, but are not limited to:
Runoff:
— Increases
— Goes up
Infiltration:
— Decreases
— Less
— Would drop to zero/near zero

Part C
Allow a maximum of 20 credits for this part.

66. [1] Allow 1 credit if the tops of all eight bars end within the acceptable range rectangles indicated below.
Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

67. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— Carbon dioxide traps heat in the atmosphere.
— Carbon dioxide absorbs infrared and reradiates it back to Venus.
— Carbon dioxide is a greenhouse gas.

68. [1] Allow 1 credit for a line with a negative slope. Examples of 1-credit responses:

69. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— Earth's distance to the Sun changes in a cyclic pattern.
— Gravity is greater when Earth is closer to the Sun.
— Earth moves slower when it is farther from the Sun.
— Earth has an elliptical/slightly eccentric orbit.

70. [1] Allow 1 credit if the 0° isotherm is correctly drawn with each end drawn to the edge of the map. If additional isotherms are drawn, all isotherms must be correct to receive credit.
Note: The isotherm need not be continued over the lakes.

Example of a 1-credit response:

71. [1] Allow 1 credit for any value from -20°C to -24°C.
72. [1] Allow 1 credit for cP or cA or mP. Allow credit for either uppercase or lowercase letters.
Note: Do not allow credit if air-mass letters are reversed, such as Ac or Pc.
For students who used the Spanish edition, either exclusively or in conjunction with the English edition of the exam, allow credit for the correct two-letter air-mass symbol as it appears in either the English or Spanish 2011 Edition Reference Tables for Physical Setting / Earth Science.

73. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— The ocean changes temperature more slowly than the nearby land does.
— Large bodies of water moderate climatic temperatures.
— A warm ocean current is flowing nearby.
— The water has a higher specific heat than the land does.

74. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — *Polaris* is not overhead.
   — All compass directions are shown.
   — The Sun's path is tilted.
   — At the North Pole, the altitude of *Polaris* is 90°.

75. [1] Allow 1 credit if the center of the X is located within the clear outlined area shown below.

   **Note:** Allow credit if a symbol other than an X is used.
   It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

---

![Earth's orbit diagram](image)

March 21

(Not drawn to scale)

76. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — the rotation of Earth
   — Earth is spinning on its axis.

77. [1] Allow 1 credit for an acceptable response for both rocks. Acceptable responses include, but are not limited to:

   **Scoria:**
   — noncrystalline
   — glassy
   — vesicular

   **Basalt:**
   — fine
   — nonvesicular

78. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — an uncertain or complex plate boundary
   — a divergent plate boundary
   — rift valley/East African Rift

79. [1] Allow 1 credit for two acceptable responses. Acceptable responses include, but are not limited to:

   — Hawaii
   — Yellowstone
   — Canary Islands
   — Tasman Hot Spot
   — St. Helena Hot Spot
   — Galapagos Hot Spot

   **Note:** Do not allow credit for Bouvet Hot Spot, Iceland Hot Spot, or Easter Island Hot Spot.

80. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — The shale and sandstone were metamorphosed by the heat of the lava.
   — The lava flow heated the rocks that it flowed over.

---

— Contact metamorphism changed the top layer of formation A.
— Heat and pressure formed hornfels and quartzite.
— metamorphism/recrystallization

81. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Faulting displaced the sandstone layer.
   — Two Peaks sandstone was broken by faults in two locations.
   — faulting

82. [1] Allow 1 credit for three acceptable responses. Acceptable responses include, but are not limited to:

   — potassium feldspar or orthoclase
   — quartz
   — plagioclase feldspar
   — biotite or mica
   — muscovite
   — amphibole or hornblende

   **Note:** If a student answers “feldspar” as one of the three responses, credit is not allowed for other responses of specific feldspar minerals. If a student answers “mica” as one of the three responses, credit is not allowed for other responses of specific mica minerals.

83. [1] Allow 1 credit if all four weather variables are correct.

   **Air temperature:** 31°F
   **Dewpoint:** 29°F
   **Wind speed:** 10 knots
   **Cloud cover:** 100%

84. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

   — The dewpoint and air temperature are nearly the same.
   — Snow is falling in Oswego.
   — There is 100% cloud cover.
   — Air pressure is low.

85. [1] Allow 1 credit for 999.5 mb.
Earth Science—June 2013

Part A

1. 4  2. 3  3. 2
4. 3  5. 1  6. 2
7. 4  8. 3  9. 1
10. 4  11. 1  12. 1
13. 2  14. 1  15. 2
16. 4  17. 1  18. 1
19. 2  20. 3  21. 3
22. 2  23. 2  24. 3
25. 4  26. 3  27. 4
28. 1  29. 2  30. 4
31. 4  32. 2  33. 4
34. 4  35. 1

Part B-1

36. 4  37. 4  38. 2
39. 4  40. 2  41. 3
42. 1  43. 4  44. 3
45. 1  46. 2  47. 1
48. 4  49. 2  50. 3

Part B-2

Allow a maximum of 15 credits for this part.

51. [1] Allow 1 credit for condensation.

52. [1] Allow 1 credit if both the soil permeability and the land surface slope are correct. Acceptable responses include, but are not limited to:
   Soil permeability:
   — high
   — The soil is unsaturated.
   — a soil that allows water to easily or rapidly seep through
   — The surface of the soil is not frozen.
   — a very permeable soil
   — loosely packed large particles
   Land surface slope:
   — a gentle slope
   — a slope that is not steep
   — a level slope
   — flat/a flat plain

53. [1] Allow 1 credit for chemical weathering and an acceptable characteristic of limestone. Acceptable characteristics include, but are not limited to:
   — Acid dissolves limestone.
   — The calcite in the limestone chemically reacts with acid.
   — Limestone is composed of calcite.

54. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — The heavy rainfall will infiltrate the ground, causing the water table to rise closer to the surface.
   — Infiltration will occur.
   — The ground becomes more saturated.
   — The saturated zone will increase.
   — The water table will rise.
   — erosion of the land surface

Note: Do not allow credit for the process of weathering acting alone.

55. [1] Allow 1 credit for position number 1.

56. [1] Allow 1 credit for any value from 29 d to 30 d.

57. [1] Allow 1 credit for position number 3.

58. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — The gravitational attraction between the Moon and Earth is least when they are farthest apart.
   — The force of gravity is less.
   — Gravitational attraction is greater when the Moon is closer to Earth.

59. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — The Moon’s period of rotation and period of revolution are equal.
   — The Moon rotates only once per revolution.
   — The Moon rotates and revolves once in 27.3 days.

60. [1] Allow 1 credit if the center of the X is within the Middle Devonian zone or the Early and Middle Devonian zone located northwest of New York City.

61. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Allegheny Plateau
   — Appalachian Plateau
   — Appalachian Uplands

62. [1] Allow 1 credit for a streambed that is deeper near the X.

Example of a 1-credit response:

X Stream surface Y

63. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Water velocity decreases, causing some sediment to be dropped.
   — The stream slows down as it enters the lake.
64. [1] Allow 1 credit if the relative positions of the symbols or particle names are in the order shown.

Example of a 1-credit response:

<table>
<thead>
<tr>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Small pebble</td>
</tr>
<tr>
<td>△ Sand</td>
</tr>
<tr>
<td>○ Silt</td>
</tr>
<tr>
<td>× Clay</td>
</tr>
</tbody>
</table>

— There was an explosive eruption of a volcano.

73. [1] Allow 1 credit for any value from 3100°C to 3300°C.

74. [1] Allow 1 credit if the centers of all six plots are within the circles shown and are correctly connected with a line that passes within each circle.

Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

65. [1] Allow 1 credit for any value from 80 cm/s to 100 cm/s.

Part C
Allow a maximum of 20 credits for this part.

66. [1] Allow 1 credit for two of the three correct responses below.
— silicon or Si
— oxygen or O
— aluminum or Al


68. [1] Allow 1 credit for two correct responses.
Acceptable responses include, but are not limited to:
— melting
— cooling
— solidification/crystallization/hardening
— heating


70. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— southeastward
— south
— ESE
— east
— SSE
— to the right

71. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— divergent
— transform
— mid-ocean ridge

72. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— Dissolved gases are released from lava as a result of a decrease in pressure.
— gas/air bubbles trapped in rapidly cooling lava

75. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— The area covered by ice in 2005 was less than the average area covered by ice from 1979 to 2000.
— The area covered by ice was less, showing evidence of global warming.
More ice melted in 2005 than the average that melted from 1979 to 2000.
The ice caps were melting, causing less surface ice in 2005.
There was less ice in 2005.

76. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- carbon dioxide or CO₂
- methane or CH₄
- water vapor or H₂O gas
- nitrous oxide or N₂O
- ozone or O₃
- chlorofluorocarbons or CFCs

77. [1] Allow 1 credit if the -1000 isoline is correctly drawn to the edge of the map. If additional isolines are drawn, all isolines must be correct to receive credit.

Example of a 1-credit response:

-2000
-3000
-4000
-5000
-6000
0
10
20
30
40
50 km

78. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- B is higher in elevation.
- Higher elevations have cooler temperatures.
- B is in the mountains.

79. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Location X is located on the leeward side of a mountain.
- Location X is located on the rain shadow side of a mountain.
- Location Y is located on the windward side of a mountain.
- Moist air rises over location Y, resulting in precipitation.
- orographic effect
- A mountain/volcano barrier separates X and Y.
- Planetary winds bring moisture to location Y, but lack this moisture by the time they get to location X.
- Location X is farther from the ocean.

80. [1] Allow 1 credit if both arrows are correctly drawn.
Example of a 1-credit response:

81. [1] Allow 1 credit if all three responses are correct. Acceptable responses include, but are not limited to:
Path X:
- Dec. 20 or Dec. 21 or Dec. 22
- winter solstice
- first day of winter
Path Y:
- March 20 or March 21 or March 22
- Sept. 21 or Sept. 22 or Sept. 23
- autumnal equinox or fall equinox
- vernal equinox or spring equinox
- an equinox
- first day of spring or first day of fall
Path Z:
- June 20 or June 21 or June 22
- summer solstice
- first day of summer

82. [1] Allow 1 credit for 15°/h.

83. [1] Allow 1 credit if the center of the X is placed on or near the unconformity (wavy line) within the region indicated in the diagram below.

Note: Allow credit if a symbol other than an X is used.
It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

84. [1] Allow 1 credit for the correct placement of both arrows as shown below.
Example of a 2-credit response for questions 83 and 84:

85. [1] Allow 1 credit for a correct response as shown below:
Deposition of rock unit C: 3
Intrusion of rock unit D: 1
Faulting along line AB: 2
Part A
1. 4
2. 2
3. 3
4. 3
5. 1
6. 4
7. 3
8. 4
9. 4
10. 1
11. 2
12. 2
13. 3
14. 1
15. 2
16. 4
17. 3
18. 4
19. 3
20. 4
21. 1
22. 2
23. 2
24. 3
25. 4
26. 3
27. 3
28. 4
29. 4
30. 2
31. 1
32. 3
33. 4
34. 1
35. 1

Part B-1
36. 3
37. 2
38. 3
39. 2
40. 3
41. 2
42. 2
43. 1
44. 4
45. 2
46. 1
47. 4
48. 3
49. 4
50. 4

Part B-2
Allow a maximum of 15 credits for this part.

51. [1] Allow 1 credit if the center of the X is located within the area between the dashed lines on either side of the Tropic of Capricorn (23.5° S).
   Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

52. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - parallelism of Earth’s axis
   - The North Pole always points toward Polaris.
   - revolution of Earth
   - location of the Sun’s vertical ray
   - duration/intensity of insolation
   - angle of insolation

53. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - 66.5° N or 66 1/2° N or 66° 30’ N
   - at the Arctic Circle
   Note: Units and a compass direction must be included if a numerical latitude is given.

54. [1] Allow 1 credit. Acceptable responses include, but are not limited to:

55. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The minerals crystallize at different temperatures.
   - Olivine is the first to crystallize and quartz is the last.
   - Quartz crystallizes at a lower temperature than olivine.
   - Olivine forms at a higher temperature.

56. [1] Allow 1 credit if both responses are correct. Acceptable responses include, but are not limited to:
   Similarity:
   - Both form at lower temperatures.
   - The rocks have similar mineral compositions.
   - The minerals have similar densities.
   - similar color
   Difference:
   - Andesite is extrusive and diorite is intrusive.
   - Andesite has a finer texture.
   - crystal size/grain size
   - cooling rates
   - environment of formation

57. [1] Allow 1 credit if the center of an X is placed within the circled area shown on the map below.
   Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

58. [1] Allow 1 credit for the rock unit Canadaway.
59. [1] Allow 1 credit for brachiopods or Mucrospirifer.
60. [1] Allow 1 credit for Avalon.
61. [1] Allow 1 credit for clear, shallow water.
63. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The glacier blocked the previous Allegheny River.
   - Ice covered the original river channel.
   - Glacial moraine diverted the river’s path.
64. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- glacial deposits
- moraines
- ridges of glacial sediments

65. [1] Allow 1 credit for a student-drawn line that is U-shaped.
Example of 1-credit response:

\[ \begin{array}{c}
\text{X} \\
\text{Y}
\end{array} \]

Part C
Allow a maximum of 20 credits for this part.

66. [1] Allow 1 credit if all nine plots are within the circles shown below and are connected with a line that passes within the circles.
Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.


68. Allow 1 credit. Acceptable responses include, but are not limited to:
- methane or CH\textsubscript{4}
- water vapor or H\textsubscript{2}O
- nitrous oxide or N\textsubscript{2}O
- ozone or O\textsubscript{3}
- chlorofluorocarbons/CFCs

69. Allow 1 credit if all seven student plots are within the circles shown below and are connected with a line from A to B that passes within the circles. The line must extend above 24 inches and below 30 inches.
Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

70. [1] Allow 1 credit for any value from 93 mi to 107 mi.

71. [1] Allow 1 credit for any value greater than 1 in., but less than 6 in.

72. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- southwest
- SW
- west southwest
- WSW

73. [1] Allow 1 credit for two acceptable responses. Acceptable responses include, but are not limited to:
- car accidents
- power outages
- damage to homes
- flooding
- trees falling on electrical lines/houses/cars
- heart attack from shoveling
- carbon monoxide poisoning
- no heat in the building

74. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- psychrometer
- wet- and dry-bulb thermometer
- hygrometer

75. [1] Allow 1 credit for 100%.

76. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Air expands as it moves up the mountain.
- The molecules move farther apart as the air rises.
- Lower pressure at higher altitudes allows molecules to move farther apart.
- The less dense air at higher altitudes allows the air molecules to spread out.

77. [1] Allow 1 credit if both responses are correct. Acceptable responses include, but are not limited to:
- Air temperature at B:
  - warmer
  - higher
  - increased
- Relative humidity at B:
  - lower
  - drier
  - decreased

78. [1] Allow 1 credit for circling only position 6.

79. [1] Allow 1 credit for a gibbous Moon, shaded generally on the right side of the diagram. The shaded area must be less than half of the circle.
Examples of 1-credit responses:

80. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— The Moon's period of rotation equals its period of revolution.
— The Moon rotates and revolves once in 27.3 days.
— The Moon rotates and revolves at the same rate.

81. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— The Moon is closer to Earth so gravity is greater.
— The Sun is much farther away.

82. [1] Allow 1 credit for any time from 6:33 p.m. to 6:45 p.m. or any military time from 18:33 to 18:45.

83. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— weathering and/or erosion
— rock abrasion
— transport by running water
— wave action

84. [1] Allow 1 credit for any value from 3.0 to 3.2 times farther.

Part A
1. 2  3. 4
4. 1  5. 2  6. 1
7. 1  8. 3  9. 4
10. 2  11. 1  12. 1
13. 4  14. 2  15. 4
16. 4  17. 3  18. 3
19. 2  20. 4  21. 4
22. 2  23. 4  24. 3
25. 2  26. 2  27. 1
28. 1  29. 1  30. 2
31. 1  32. 2  33. 3
34. 3  35. 1

Part B-1
36. 2  37. 1  38. 4
39. 2  40. 1  41. 3
42. 4  43. 1  44. 4
45. 4  46. 3  47. 2
48. 3  49. 2  50. 3

Part B-2
Allow a maximum of 15 credits for this part.

51. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — The air travels over Lake Ontario toward Oswego, picking up moisture that results in more snow.
   — The air over Toronto contains less moisture.
   — Lake-effect storms occur on the eastern side of the lake when the wind is blowing in the direction shown.

52. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Old Forge is located in the mountains.
   — Higher elevations have colder temperatures.
   — Watertown is closer to a large body of water that moderates its temperature.

53. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Water has a higher specific heat than land.
   — Water takes a longer time to cool than land.
   — Land surfaces cool faster.

54. [1] Allow 1 credit for iron meteorite(s) or iron.
55. [1] Allow 1 credit if both elements are correct.
   Acceptable responses include, but are not limited to:
   — iron/Fe
   — magnesium/Mg
   — silicon/Si
   — oxygen/O

56. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — 4,600 million y
   — 4.6 billion y
   — 4,600,000,000 y

57. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Weathering and erosion on Earth's surface have erased many craters.
   — Most meteors are very small and burn up in Earth's atmosphere.
   — Most of Earth's surface is ocean, where sediments cover impact craters.
   — Crustal plate movement has destroyed the evidence.

58. [1] Allow 1 credit if all nine ages are correctly plotted within the rectangles shown below and are connected with a line from A to B that passes within the rectangles.
   Notes: It is recommended that an overlay with the same scale as the student answer booklet be used to ensure reliability in rating.

59. Allow 1 credit for any value greater than 68 million years and less than 83 million years.
60. Allow 1 credit. Acceptable responses include, but are not limited to:
   — Plates are diverging at the Mid-Atlantic Ridge where new seafloor is forming.
   — The boundary between the South American Plate and the African Plate is a spreading center.
   — New oceanic crust is formed at mid-ocean ridges.
   — The seafloor is spreading.

61. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — North American Plate and Eurasian Plate
   — N. American Plate and African Plate

62. Allow 1 credit if the center of the X is located on the trail on or between the 7900- and 8000-foot contour lines as shown below.

63. Allow 1 credit for both an arrow on the map showing the stream flowing toward the northeast and for correct supporting evidence. Acceptable evidence includes, but is not limited to:
   — The stream is flowing from higher contour elevations to lower contour elevations.
   — Contour lines bend upstream when crossing a stream.
— Vs in the contour lines point in the opposite direction of stream flow.

Example of a correctly placed X for question 62 and a correctly drawn arrow for question 63:

68. [1] Allow 1 credit if the center of the X is within the rectangular zone shown below.
Note: It is recommended that an overlay of the same size as the student answer booklet be used to ensure reliability in rating.

(Not drawn to scale)

69. [1] Allow 1 credit for clay or for a size equal to or less than 0.0004 cm.

70. [1] Allow 1 credit for two correct responses. Acceptable responses include, but are not limited to:
— cooling
— solidification
— crystallization
— melting
— intrusion/intruding

71. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— Basalt cuts across all other rock units.
— Contact metamorphism is shown between the basalt and all rock layers.

72. [1] Allow 1 credit for Ordovician Period.

73. [1] Allow 1 credit for marble or hornfels.

74. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— They are formed over a short period of time.
— They are geographically widespread.

75. [1] Allow 1 credit for a correctly drawn 60°F isotherm. If more than one isotherm is drawn, all isotherms must be correct to receive credit. The isotherm does not have to be labeled.
Example of a 1-credit response:

67. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— As the number of partial lunar eclipses increases, the number of total lunar eclipses decreases.
— The more partial lunar eclipses there are, the fewer total lunar eclipses there are.
— When the number of partial eclipses is high, the number of total eclipses is low.
76. [1] Allow 1 credit for any value from 0.20 °F/mi to 0.30 °F/mi.

77. Allow 1 credit. Acceptable responses include, but are not limited to:
   — Miami is located at a lower latitude.
   — Atlantic City receives a lower angle of insolation/less intense insolation.
   — The temperatures in Miami are warmed by the Florida Current.
   — Miami has a longer duration of insolation.

78. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — expansion
   — cooling to the dewpoint
   — condensation
   — cooling
   — deposition

79. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Its warmest months are in January and February.
   — Its coldest months are in June and July.
   — The warm and cold times of the year are the opposite of New York’s.

80. [1] Allow 1 credit if the climate is identified as dry and an X is placed anywhere on the leeward side of the mountain range.

   Example of a correctly placed X:

81. [1] Allow 1 credit if the axis line is drawn through Earth at location A within the stippled areas shown below and the North Pole is correctly labeled.

   Note: It is recommended that an overlay of the same size as the student answer booklet be used to ensure reliability in rating.

82. [1] Allow 1 credit for an arrow at location D that shows a general west to east rotation. Allow credit if the arrow showing the direction of Earth’s rotation is correctly drawn at location A.

   Example of a 2-credit response for questions 81 and 82:

83. Allow 1 credit for any value from 88 d to 94 d.

84. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Earth’s distance to the Sun is increasing.
   — Earth is getting farther from the Sun.
   — Earth is approaching aphelion.

85. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — The nighttime side of Earth at location A faces a different region of space than at location C.
   — Earth is on different sides of the Sun in its orbit at locations A and C.
   — Earth revolves around the Sun, so locations A and C have different views of the night sky.
Part A
1. 2     2. 1     3. 3
4. 4     5. 3     6. 2
7. 4     8. 2     9. 2
10. 1    11. 4    12. 3
13. 2    14. 3    15. 2
16. 3    17. 1    18. 2
19. 2    20. 3    21. 1
22. 2    23. 3    24. 1
25. 3    26. 4    27. 4
28. 2    29. 3    30. 4
31. 2    32. 3    33. 4
34. 2

Part B-1
36. 1    37. 2    38. 1
39. 4    40. 2    41. 4
42. 3    43. 1    44. 4
45. 2    46. 3    47. 4
48. 3    49. 1    50. 1

Part B-2
Allow a maximum of 15 credits for this part.
51. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - intrusive
   - plutonic
   - underground

52. [1] Allow 1 credit if both the color and density are correct. Acceptable responses include, but are not limited to:
   Color:
   - lighter
   - whiter
   - pinker
   Density:
   - lower
   - less dense

53. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - foliated
   - mineral alignment
   - flattened crystals

54. [1] Allow 1 credit for Mesozoic Era.

55. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - Similar fossil remains are found in Africa and South America.
   - The fossil *Rugops primus*, found in Africa, is related to abelisaurids found in South America and India.
   - fossil evidence

56. [1] Allow 1 credit for sedimentary rock or any specific sedimentary rock, such as shale.

57. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - wide geographic distribution or widespread
   - lived a short period of geologic time or short lived
   - easily recognizable

58. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - divergence
   - rifting
   - seafloor spreading

59. [1] Allow 1 credit if the center of the X is located within the area indicated below.
   Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

60. [1] Allow 1 credit for 50 cm/s.

61. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - pebbles
   - 2-cm to 3-cm-diameter particles

62. [1] Allow 1 credit for 955 mi/h.

63. [1] Allow 1 credit for 12 h.

64. [1] Allow 1 credit for a graph that shows an inverse relationship.
   Example of a 1-credit response:

65. [1] Allow 1 credit for summer.

Part C
Allow a maximum of 20 credits for this part.
66. [1] Allow 1 credit for C and E.

67. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - Hawaii Hot Spot
   - mantle hot spot
   - volcano
68. [1] Allow 1 credit if all four weather variables from the data table are correctly recorded in the proper format. Allow credit if feathers are drawn on either side of the staff.

Example of a 1-credit response:

69. [1] Allow 1 credit for 1013.4 mb.

70. [1] Allow 1 credit for a response showing the basaltic intrusion cutting through the ash layer.

Example of a 1-credit response:

71. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - The horizontal rocks are on top of the tilted layers.
   - Fossils of the earliest grasses and large carnivorous mammals are more recent than *Manticoceras* and *Olenecrinus*.
   - The fossils in the tilted layers are older.

72. [1] Allow 1 credit for 251 million years.

73. [1] Allow 1 credit for correctly drawing the two isobars. The isobars should be closer together on the western side. If additional isobars are drawn, all must be correct to receive credit.

74. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - the prevailing southwest winds
   - the jet stream
   - planetary winds

75. [1] Allow 1 credit for a correct response for both air-mass symbols. Allow credit even if all uppercase letters are used.
   - Air-mass X: cP or cA
   - Air-mass Y: mT

Note: Do not allow credit if the letters are reversed, such as Pc.

76. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   - go to the basement
   - stay away from windows
   - listen to emergency warnings broadcast on radio or TV
   - go to a community emergency shelter

77. [1] Allow 1 credit if the centers of all eight plots are located within the circles shown below and are connected with a line that passes within each circle.

Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.

---

Example of a 1-credit response:

---

High and Low Tides

---

Time of Day
78. [1] Allow 1 credit for any time from 2 a.m. to 4 a.m.
79. [1] Allow 1 credit if the center of the student-drawn circle is within the brackets shown below.

80. [1] Allow 1 credit for March 3 or March 4.
81. [1] Allow 1 credit for shading half of the circle on the left side.
Example of a 1-credit response:

82. [1] Allow 1 credit for 42°.
83. [1] Allow 1 credit for troposphere.
84. [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — East Australia Current
   — South Equatorial Current
   — E. Australia C.
85. [1] Allow 1 credit if both arrows show the correct directions, even if the arrows do not pass through the dots.
Example of a 1-credit response:
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Prentice Hall Brief Review

Earth Science:
The Physical Setting

Answer Key