The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING

EARTH SCIENCE

Thursday, January 26, 2017 — 9:15 a.m. to 12:15 p.m., only

The possession or use of any communications device is strictly prohibited when taking this examination. If you have or use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

Use your knowledge of Earth science to answer all questions in this examination. Before you begin this examination, you must be provided with the 2011 Edition Reference Tables for Physical Setting/Earth Science. You will need these reference tables to answer some of the questions.

You are to answer all questions in all parts of this examination. You may use scrap paper to work out the answers to the questions, but be sure to record your answers on your answer sheet and in your answer booklet. A separate answer sheet for Part A and Part B-1 has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet. Record your answers to the Part A and Part B-1 multiple-choice questions on this separate answer sheet. Record your answers for the questions in Part B-2 and Part C in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

All answers in your answer booklet should be written in pen, except for graphs and drawings, which should be done in pencil.

When you have completed the examination, you must sign the declaration printed on your separate answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet and answer booklet cannot be accepted if you fail to sign this declaration.

Notice …

A four-function or scientific calculator and a copy of the 2011 Edition Reference Tables for Physical Setting/Earth Science must be available for you to use while taking this examination.

DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.
Part A

Answer all questions in this part.

Directions (1–35): For each statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the 2011 Edition Reference Tables for Physical Setting/Earth Science. Record your answers on your separate answer sheet.

1. Which statement best explains why stars viewed from the Northern Hemisphere appear to revolve around Polaris?
   (1) Polaris rotates on its axis.
   (2) Earth rotates on its axis.
   (3) Polaris revolves around Earth.
   (4) Earth revolves around Polaris.

2. The hydrosphere covers approximately what percentage of Earth's lithosphere?
   (1) 100%  (3) 50%
   (2) 70%  (4) 25%

3. The deflection of prevailing winds and ocean currents in the Northern Hemisphere is called
   (1) eccentricity
   (2) refraction
   (3) the Coriolis effect
   (4) the Doppler effect

4. Earth's rate of revolution is approximately
   (1) 1° per day  (3) 23.5° per day
   (2) 15° per day  (4) 360° per day

5. The asteroid Ceres lies at an average distance of 414 million kilometers from the Sun. The period of revolution of Ceres around the Sun is approximately
   (1) 438 days  (3) 4.6 years
   (2) 687 days  (4) 12.6 years

6. Which planet has a density that is less than the density of liquid water?
   (1) Mercury  (3) Mars
   (2) Earth  (4) Saturn

7. The diagram below represents two planets of equal mass, A and B, revolving around a star. The planets are represented at specific positions in their orbits.

(Not drawn to scale)

When both planets are at the positions represented, planet B
   (1) can be seen at night from planet A, and planet B is moving faster in its orbit
   (2) can be seen at night from planet A, and planet B is moving slower in its orbit
   (3) cannot be seen at night from planet A, and planet B is moving faster in its orbit
   (4) cannot be seen at night from planet A, and planet B is moving slower in its orbit
8 Compared to terrestrial planets, Jovian planets have
(1) smaller equatorial diameters and shorter periods of revolution
(2) smaller equatorial diameters and longer periods of revolution
(3) larger equatorial diameters and shorter periods of revolution
(4) larger equatorial diameters and longer periods of revolution

9 Clouds most likely form as a result of
(1) moist air rising, compressing, and warming
(2) moist air rising, expanding, and cooling
(3) dry air rising, compressing, and warming
(4) dry air rising, expanding, and cooling

10 The dewpoint is 15°C. What is the wet-bulb temperature on a sling psychrometer if the dry-bulb temperature is 18°C?
(1) 16°C (3) 3°C
(2) 2°C (4) 20°C

11 Which weather instrument is used to measure air temperatures recorded on a weather map?
(1) anemometer (3) thermometer
(2) wind vane (4) barometer

12 Equal masses of basalt, granite, iron, and copper received the same amount of solar energy during the day. At night, which of these materials cooled down at the fastest rate?
(1) basalt (3) iron
(2) granite (4) copper

13 Equal areas of which type of surface will reflect the most insolation?
(1) light gray rooftop (3) snow-covered field
(2) dark tropical forest (4) black paved road

14 Riverhead, New York, has a smaller average daily temperature range than Elmira, New York, because Riverhead is located
(1) near a large body of water
(2) at a lower latitude
(3) at a higher elevation
(4) near a large city

15 Which diagram best represents the relative wavelengths of visible light, ultraviolet energy, and infrared energy?

(1) Ultraviolet
   Visible light
   Infrared

(2) Infrared
   Visible light
   Ultraviolet

(3) Visible light
   Ultraviolet
   Infrared

(4) Infrared
   Ultraviolet
   Visible light

16 Volcanic ash is a good geologic time marker because the ash
(1) is deposited rapidly over a large area
(2) spreads evenly in all compass directions
(3) is easily weathered and eroded
(4) remains in the atmosphere for millions of years

17 The change in life-forms in the fossil record from less complex organisms to more complex organisms over time is best explained by
(1) extinction
(2) evolution
(3) dynamic equilibrium
(4) original horizontality
18 The graph below shows the yearly air temperature and precipitation of a location on Earth.

[Graph showing air temperature and precipitation over the year]

This location would be most likely at a latitude of
(1) 0° (3) 50° N
(2) 35° S (4) 90° N

19 Arrows in the diagram below represent the daytime flow of air over a coastal region.

[Diagram showing daytime flow of air over a coastal region]

Which process primarily transfers heat by moving air?
(1) conduction (3) radiation
(2) convection (4) transpiration

20 The graph below shows the radioactive decay of rubidium-87.

[Graph showing radioactive decay of rubidium-87]

What percentage of rubidium-87 atoms will be left after four half-lives?
(1) 25.0% (3) 6.25%
(2) 12.5% (4) 3.125%

21 The pressure at the interface between Earth’s outer core and inner core is inferred to be
(1) 0.2 million atmosphere
(2) 1.5 million atmospheres
(3) 3.1 million atmospheres
(4) 3.6 million atmospheres

22 Which type of tectonic plate boundary is found between the South American Plate and the Scotia Plate?
(1) transform (3) divergent
(2) convergent (4) complex or uncertain

23 The epicenter of an earthquake was located 1800 kilometers from a seismic recording station. If the S-wave arrived at the seismic station at 10:06:40 a.m., at what time did the P-wave arrive at the same seismic station?
(1) 10:03:00 a.m. (3) 10:09:40 a.m.
(2) 10:03:40 a.m. (4) 10:10:20 a.m.

24 A strong earthquake that occurs on the ocean floor could result in the formation of
(1) a tsunami (3) an El Niño event
(2) a delta (4) an ocean current
25 The block diagram below represents a rapid downslope flow of saturated soil and rock layers.

What are two likely causes of this rapid downslope flow?

(1) groundwater and abrasion
(2) groundwater and gravity
(3) prevailing wind and abrasion
(4) prevailing wind and gravity

26 The map below shows a stream. Letters A, B, C, and D represent locations on the stream surface. Arrows represent the direction of stream flow.

Which two locations have the greatest stream velocities?

(1) A and B
(2) B and C
(3) C and D
(4) D and A

27 Which climate conditions most likely produce a landscape with rounded hills, large river valleys with many tributaries, and tropical vegetation?

(1) cool and arid
(2) cool and humid
(3) warm and arid
(4) warm and humid

28 The block diagram below represents two parallel mountain ranges.

Which two geologic processes most likely created this landscape region?

(1) volcanism, followed by metamorphism
(2) faulting, followed by deposition
(3) folding, followed by erosion
(4) glaciation, followed by rifting

29 Which agent of erosion most likely moves sediments in a sand dune?

(1) wind
(2) glaciers
(3) wave action
(4) running water

30 Which rock is composed of a mineral that can be used for the production of cement?

(1) basalt
(2) limestone
(3) rock salt
(4) rock gypsum

31 On April 21, the altitude of Polaris, as viewed from a location in New York State, was measured as 41.3°. What will the altitude of Polaris be when viewed one month later, on May 21, from the same location?

(1) 23.5°
(2) 41.3°
(3) 66.7°
(4) 90°
32 The diagrams below represent constellations seen by an observer in New York State facing south at midnight on July 7 and January 3.

![constellation diagram - July 7](image1)

![constellation diagram - January 3](image2)

Which motion causes the observer to see different constellations at midnight on July 7 compared to midnight on January 3?

(1) revolution of the constellations in their orbits  (3) rotation of the stars in the constellations
(2) revolution of Earth in its orbit  (4) rotation of Earth on its axis

33 The diagram below represents a model of the size of the Sun and indicates the color of the Sun.

![Sun model](image3)

Which diagram best represents the relative size and indicates the color of *Polaris* compared to the Sun?

- (1) Red star
- (2) Red star
- (3) Yellow star
- (4) Yellow star
34 The diagram below represents the apparent path of the Sun as seen by an observer on June 21 at a location in New York State.

Which diagram best represents the apparent path of the Sun at this same location on December 21?

(1)  

(2)  

(3)  

(4)
The topographic map below shows a portion of the Cayuta Creek that is located in New York State. Points A, B, C, and D represent locations on Earth’s surface.

Which point on the map most likely represents a location within the flood plain associated with Cayuta Creek?

(1) A  (2) B  (3) C  (4) D
Base your answers to questions 36 through 38 on the cross section below and on your knowledge of Earth science. The cross section represents processes in the water cycle. Arrows represent the movement of water. Letters A, B, C, and D represent locations on Earth’s surface.

36 The downward movement of water from location A will usually be greatest when the soil is
(1) nonporous and the particles are uniformly small in size
(2) nonporous and the particles are uniformly large in size
(3) porous and the particles are uniformly small in size
(4) porous and the particles are uniformly large in size

37 What would most likely reduce the amount of runoff at location B?
(1) infiltration occurring faster than precipitation  (3) saturated soil below the land surface
(2) greater condensation than evaporation       (4) a frozen land surface

38 The greatest amount of transpiration and evaporation will occur most likely when the air temperature is
(1) low and the humidity is low            (3) high and the humidity is low
(2) low and the humidity is high          (4) high and the humidity is high
Base your answers to questions 39 and 40 on the graphs below and on your knowledge of Earth science. The graphs show air temperatures and dewpoints in °F, and wind speeds in knots (kt) from 2:00 a.m. to 11:00 p.m. at a certain New York State location.

39 Which station model represents the weather data for this location at 4:00 p.m.?

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

   58  58  40  58

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

40 What was the relative humidity at 8:00 p.m.?

   (1) 30%
   (2) 45%
   (3) 75%
   (4) 100%
Base your answers to questions 41 through 44 on the three bedrock outcrops below and on your knowledge of Earth science. The outcrops, labeled I, II, and III, are located within 15 kilometers of each other. Lines AB and CD represent unconformities. Line XY represents a fault. No overturning of the layers has occurred.

41 Which layer is the youngest?
(1) gray limestone  (3) brown siltstone
(2) red conglomerate (4) brown sandstone

42 The unconformities at AB and CD resulted from
(1) uplift and erosion, followed by subsidence and deposition
(2) movement along a crack between two rock layers
(3) contact metamorphism between two sedimentary layers
(4) regional metamorphism of deeply buried sedimentary rocks

43 Based on evidence shown in the diagram, which rock layer is older than fault XY?
(1) tan conglomerate  (3) brown siltstone
(2) black shale        (4) white limestone

44 Which processes produced the brown siltstone layer in outcrops I and II?
(1) cooling and solidification of mafic lava at Earth’s surface
(2) cooling and solidification of felsic magma deep within Earth
(3) compaction and cementation of rock fragments ranging in size from 0.006 to 0.2 centimeter in diameter
(4) compaction and cementation of rock fragments ranging in size from 0.0004 to 0.006 centimeter in diameter
Base your answers to questions 45 through 47 on the passage below and on your knowledge of Earth science.

**Island Arcs**

Island arcs are long, curved chains of oceanic islands associated with seismic activity and mountain-building processes at certain plate boundaries. They occur where oceanic tectonic plates collide. Along one side of these island arcs, there is usually a long, narrow deep-sea trench. At island arcs, the denser plate is subducted and is forced into the partially molten mantle under the less dense plate. The islands are composed of the extrusive igneous rocks basalt and andesite. The basalt originates most likely from the plastic mantle. The andesite originates most likely from the melting of parts of the descending plate and sediments that had accumulated on its surface.

45 An island arc is found along the
   (1) East Pacific Ridge                  (3) Aleutian Trench
   (2) Iceland Hot Spot                   (4) Peru-Chile Trench

46 Most of the basalt that forms island arcs comes from the
   (1) crust                               (3) asthenosphere
   (2) rigid mantle                        (4) stiffer mantle

47 Which list identifies minerals present in andesite from the greatest percentage by volume to the least percentage by volume?
   (1) biotite, plagioclase feldspar, amphibole
   (2) biotite, amphibole, plagioclase feldspar
   (3) plagioclase feldspar, biotite, amphibole
   (4) plagioclase feldspar, amphibole, biotite
Base your answers to questions 48 through 50 on the cross section and data table below and on your knowledge of Earth science. The cross section shows the profile of a stream that is flowing down a valley from its source. Points A through E represent locations in the stream. The data table shows the average stream velocity at each location. The volume of water in the stream remains the same at all locations.

<table>
<thead>
<tr>
<th>Location in Stream</th>
<th>Average Stream Velocity (cm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>110</td>
</tr>
<tr>
<td>C</td>
<td>130</td>
</tr>
<tr>
<td>D</td>
<td>20</td>
</tr>
<tr>
<td>E</td>
<td>15</td>
</tr>
</tbody>
</table>

48 The average stream velocity at each location is controlled primarily by the
(1) elevation above sea level
(2) slope of the land
(3) sediment carried by the stream
(4) distance from the stream’s source

49 What is the largest type of sediment that could be transported at location B?
(1) silt
(2) sand
(3) pebbles
(4) cobbles

50 Which features could be formed by the stream between locations D and E?
(1) meanders
(2) kettle lakes
(3) barrier islands
(4) drumlins
Part B–2

Answer all questions in this part.

Directions (51–65): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the 2011 Edition Reference Tables for Physical Setting/Earth Science.

Base your answers to questions 51 through 54 on the diagram below and on your knowledge of Earth science. The diagram represents a model of the expanding universe.

51 Identify the name of the event that is inferred by scientists to have occurred when the universe first formed. [1]

52 Identify one piece of evidence that led astronomers to infer that the universe is expanding. [1]

53 Identify the force that caused stars and planets in the universe to become layered according to density differences in their composition. [1]

54 Identify the nuclear process that combines lighter elements into heavier elements to produce the energy radiated by stars. [1]
55 Identify one date represented by this diagram. [1]

56 State the time at location A when it is noon at location B. Indicate a.m. or p.m. in your answer. [1]
Base your answers to questions 57 through 60 on the passage and map below and on your knowledge of Earth science. The map shows the positions of the eye (center) of Hurricane Sandy in its path from October 24 to October 31, 2012. A high-pressure center (H) is shown on the map.

**Hurricane Sandy**

In October 2012, Hurricane Sandy produced extreme damage to New York City and the coast of New Jersey due to high winds and a high storm surge. A storm surge is the rise in the level of ocean water along a coast that is caused by strong winds blowing toward land from a severe storm. High ocean tides, occurring at the same time, added to the height of the storm surge. A high-pressure center, located just south of Newfoundland, Canada, affected Hurricane Sandy by altering the path of the jet stream. This change in the jet stream, combined with surface wind circulation around the high-pressure center, caused Hurricane Sandy to curve westward, making landfall along the coast of New Jersey.

**Path of Hurricane Sandy from October 24, 2012 to October 31, 2012**

![Map of Hurricane Sandy's path from October 24 to October 31, 2012](image-url)
57 Using information from the map, complete the data table in your answer booklet by identifying the latitude and longitude positions of the eye of Hurricane Sandy from October 27, 2012 to October 29, 2012. Express your latitude and longitude positions to the nearest whole degree. [1]

58 Describe the surface wind circulation around the high-pressure center (H) that is located south of Newfoundland. [1]

59 The data table below shows the air pressure, measured in millibars (mb), and surface wind speed, measured in miles per hour (mi/h), recorded near the center of Hurricane Sandy on three separate days.

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Pressure (mb)</th>
<th>Surface Wind Speed (mi/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 24, 2012</td>
<td>973</td>
<td>70</td>
</tr>
<tr>
<td>October 27, 2012</td>
<td>958</td>
<td>75</td>
</tr>
<tr>
<td>October 29, 2012</td>
<td>943</td>
<td>90</td>
</tr>
</tbody>
</table>

On the set of axes in your answer booklet, draw a line to represent the general relationship between air pressure and surface wind speed associated with Hurricane Sandy for these three days. [1]

60 Explain why Hurricane Sandy weakened on October 30 and October 31. [1]
Base your answers to questions 61 through 65 on the geologic timeline below and on your knowledge of Earth science. The geologic timeline, drawn to scale, represents Earth’s geologic history. The letters A through H on the timeline represent the times of occurrence for specific, labeled geologic events. The time of occurrence for letter A has been omitted.

<table>
<thead>
<tr>
<th>Geologic Event</th>
<th>Letter</th>
<th>Time of Occurrence (Million Years Ago)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First cells with a nucleus</td>
<td>C</td>
<td>2100</td>
</tr>
<tr>
<td>Earliest stromatolites, fossil evidence of cyanobacteria</td>
<td>B</td>
<td>3300</td>
</tr>
<tr>
<td>Cambrian Period begins</td>
<td>D</td>
<td>542</td>
</tr>
<tr>
<td>Earliest amphibians</td>
<td>E</td>
<td>366</td>
</tr>
<tr>
<td>Permian Period ends</td>
<td>F</td>
<td>251</td>
</tr>
<tr>
<td>Earliest mammals</td>
<td>G</td>
<td>215</td>
</tr>
<tr>
<td>Cretaceous Period ends</td>
<td>H</td>
<td>65.5</td>
</tr>
<tr>
<td>Present</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
61 Identify the two consecutive letters on the timeline that represent the time span within which the earliest insects appeared on Earth. [1]

62 State the time of occurrence for the geologic event labeled A on the geologic timeline. [1]

63 Describe the major change in Earth’s atmosphere that was occurring at the time when the first cells with a nucleus appeared on Earth. [1]

64 The table below lists the five major mass extinctions that occurred on Earth during the Paleozoic and Mesozoic Eras.

<table>
<thead>
<tr>
<th>Time of Mass Extinction</th>
<th>Description of Mass Extinction Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter H on timeline</td>
<td>Dinosaurs, along with 80% of all organisms</td>
</tr>
<tr>
<td>End of Triassic</td>
<td>Most ammonoids, many brachiopods and gastropods, 80% of four-legged animals</td>
</tr>
<tr>
<td>Letter F on timeline</td>
<td>Largest mass extinction in history, 90% of all species</td>
</tr>
<tr>
<td>Late Devonian</td>
<td>70-80% of marine species</td>
</tr>
<tr>
<td>Late Ordovician</td>
<td>85% of marine species</td>
</tr>
</tbody>
</table>

Identify the group of marine organisms found in the 2011 Edition Reference Tables for Physical Setting/Earth Science that became extinct during the largest mass extinction in history. [1]

65 Identify the geologic eon during which event letter B occurred. [1]
Part C

Answer all questions in this part.

Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the 2011 Edition Reference Tables for Physical Setting/Earth Science.

Base your answers to questions 66 through 69 on the data table below and on your knowledge of Earth science. The data table shows the average level of atmospheric carbon dioxide (CO₂), measured in parts per million (ppm), for the month of February at the Mauna Loa observatory in Hawaii from 2008 to 2014.

<table>
<thead>
<tr>
<th>Year</th>
<th>Average February Atmospheric CO₂ Levels (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>386</td>
</tr>
<tr>
<td>2009</td>
<td>387</td>
</tr>
<tr>
<td>2010</td>
<td>390</td>
</tr>
<tr>
<td>2011</td>
<td>392</td>
</tr>
<tr>
<td>2012</td>
<td>394</td>
</tr>
<tr>
<td>2013</td>
<td>396</td>
</tr>
<tr>
<td>2014</td>
<td>398</td>
</tr>
</tbody>
</table>

66 On the grid in your answer booklet, construct a line graph by plotting the data for the average February atmospheric carbon dioxide (CO₂) levels for the years 2008 to 2014. Connect the plots with a line. [1]

67 These measurements of atmospheric carbon dioxide were collected at an altitude of 3.4 kilometers. Identify the temperature zone of the atmosphere where these data were collected. [1]

68 Identify one major greenhouse gas, other than carbon dioxide. [1]

69 Describe two human activities that would decrease the amount of carbon dioxide that humans add to Earth’s atmosphere. [1]
Base your answers to questions 70 through 73 on the weather map in your answer booklet and on your knowledge of Earth science. The weather map shows the center of a high-pressure system (H) and the center of a low-pressure system (L) affecting North America. Isobars are drawn for the eastern portion of the map, and one isobar is drawn around the high-pressure center. Air pressures are shown at various points in the western portion of the map. All air pressures were recorded in millibars (mb). Points A through F represent surface locations.

70 On the map in your answer booklet, draw the 1012 mb, 1016 mb, and 1020 mb isobars. Extend the isobars to the edges of the map. [1]

71 Convert the air pressure at location A from millibars (mb) to inches of mercury (in of Hg). [1]

72 Calculate the air pressure gradient between locations A and B in millibars per kilometer. [1]

73 Identify one possible air pressure at the center of the low-pressure system. [1]

Base your answers to questions 74 through 77 on the diagram in your answer booklet and on your knowledge of Earth science. The diagram represents the Moon’s orbit around Earth as viewed from space above Earth’s North Pole (NP). Letter A represents one position of the Moon in its orbit.

74 On the diagram in your answer booklet, place an X on the Moon’s orbit to indicate the position of the Moon when a solar eclipse would be observed from Earth. [1]

75 State the number of days that it takes the Moon to orbit Earth once. [1]

76 On the diagram in your answer booklet, shade the portion of the Moon that is in darkness as viewed from New York State when the Moon is at position A. [1]

77 Describe the actual shape of the Moon’s orbit. [1]
The Niagara Escarpment

A prominent feature found along the shore of Lake Ontario in western New York State is the Niagara Escarpment. This escarpment is the remains of an ancient seabed that was formed when the area was covered by a warm, shallow sea from approximately 450 to 430 million years ago. Erosion of the Taconic Mountains to the east provided the sediments deposited in this basin area. From these sediments, rock layers such as shale, sandstone, and limestone formed. Later, magnesium replaced some of the calcium in the top layer of limestone, turning it into a dolostone layer. When the high ocean levels of the Ordovician Period dropped, the draining of this inland sea caused unequal erosion of the exposed layers. The South Moraine was deposited on the top of the Niagara Escarpment in this region.

78 Identify the New York State landscape region in which the Niagara Escarpment is located. [1]

79 Identify the mineral composition of the Lockport dolostone. [1]

80 Describe the inferred position of North America when this area was covered by the warm, shallow sea. [1]

81 Describe the tectonic event that caused the Taconian orogeny. [1]
Base your answers to questions 82 through 85 on the photographs below and on your knowledge of Earth science. The photographs show eight common rock-forming minerals.

82 Identify the mineral shown that can scratch all of the other minerals shown. [1]

83 In the table in your answer booklet, place an X in the appropriate box to indicate whether each mineral is found mainly in felsic or mafic igneous rock. [1]

84 Identify the two most abundant elements, by mass, in Earth’s crust that are part of the composition of all eight of these minerals. [1]

85 Identify the two minerals shown that exhibit fracture as a dominant form of breakage. [1]
Part B–2

51

52

53

54

55

56
Position of Hurricane Sandy from October 24, 2012 to October 31, 2012

<table>
<thead>
<tr>
<th>Date</th>
<th>Latitude° (N)</th>
<th>Longitude° (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 24</td>
<td>17</td>
<td>77</td>
</tr>
<tr>
<td>October 25</td>
<td>22</td>
<td>76</td>
</tr>
<tr>
<td>October 26</td>
<td>27</td>
<td>77</td>
</tr>
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<td>October 27</td>
<td></td>
<td></td>
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<td>October 28</td>
<td></td>
<td></td>
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<tr>
<td>October 29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>October 30</td>
<td>40</td>
<td>78</td>
</tr>
<tr>
<td>October 31</td>
<td>42</td>
<td>80</td>
</tr>
</tbody>
</table>
61 ________ and ________

62 __________ million years ago

63

64

65
Average February Atmospheric Carbon Dioxide Levels

Year
2008 2009 2010 2011 2012 2013 2014

Carbon Dioxide (ppm)
385 390 395 400

67

68

69 (1)

(2)
71 ___________ in of Hg

72 ___________ mb/km

73 ___________ mb
<table>
<thead>
<tr>
<th>Mineral Name</th>
<th>Felsic</th>
<th>Mafic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium feldspar</td>
<td></td>
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<tr>
<td>Olivine</td>
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<tr>
<td>Quartz</td>
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<td></td>
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<tr>
<td>Pyroxene</td>
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</table>

84 ____________________________________________________________________ and ____________________________________________________________________

85 ____________________________________________________________________ and ____________________________________________________________________
Part A and Part B–1
Allow 1 credit for each correct response.

<table>
<thead>
<tr>
<th>Part A</th>
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<td>2</td>
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<table>
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<td>39</td>
<td>4</td>
<td>43</td>
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</tr>
</tbody>
</table>
Directions to the Teacher

Follow the procedures below for scoring student answer papers for the Regents Examination in Physical Setting/Earth Science. Additional information about scoring is provided in the publication Information Booklet for Scoring Regents Examinations in the Sciences.

Do not attempt to correct the student's work by making insertions or changes of any kind. If the student’s responses for the multiple-choice questions are being hand scored prior to being scanned, the scorer must be careful not to make any marks on the answer sheet except to record the scores in the designated score boxes. Marks elsewhere on the answer sheet will interfere with the accuracy of the scanning.

Allow 1 credit for each correct response.

At least two science teachers must participate in the scoring of the Part B–2 and Part C open-ended questions on a student’s paper. Each of these teachers should be responsible for scoring a selected number of the open-ended questions on each answer paper. No one teacher is to score more than approximately one-half of the open-ended questions on a student’s answer paper. Teachers may not score their own students’ answer papers.

Students’ responses must be scored strictly according to the Scoring Key and Rating Guide. For open-ended questions, credit may be allowed for responses other than those given in the rating guide if the response is a scientifically accurate answer to the question and demonstrates adequate knowledge as indicated by the examples in the rating guide. On the student's separate answer sheet, for each question, record the number of credits earned and the teacher's assigned rater/scorer letter.

Fractional credit is not allowed. Only whole-number credit may be given for a response. If the student gives more than one answer to a question, only the first answer should be rated. Units need not be given when the wording of the questions allows such omissions.

For hand scoring, raters should enter the scores earned in the appropriate boxes printed on the separate answer sheet. Next, the rater should add these scores and enter the total in the space provided. The student's score for the Earth Science Performance Test should be recorded in the space provided. Then the student's raw scores on the written test and the performance test should be converted to a scale score by using the conversion chart that will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ on Thursday, January 26, 2017. The student's scale score should be entered in the box labeled “Scale Score” on the student's answer sheet. The scale score is the student's final examination score.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart may change from one administration to another, it is crucial that, for each administration, the conversion chart provided for that administration be used to determine the student’s final score.
Part B–2

Allow a maximum of 15 credits for this part.

To ensure the accuracy of overlays, select a printer setting such as full, actual size or 100% when printing this document. Do not select the fit to page setting.

51 [1] Allow 1 credit for Big Bang or Big Bang Theory.

52 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— red shift
— cosmic background radiation
— Doppler Effect
— Galaxies are moving away from each other.
— Galaxies are moving away from Earth.
— gravity waves

53 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— gravity
— gravitational attraction/gravitational pull

54 [1] Allow 1 credit for fusion or nuclear fusion.

55 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
— March 19 or March 20 or March 21 or March 22
— Sept. 21 or Sept. 22 or Sept. 23 or September 24
— vernal equinox or autumnal equinox
— equinox
— first day of spring or first day of fall

56 [1] Allow 1 credit for a response that indicates a time value of 9 a.m. Acceptable responses include, but are not limited to:
— 9:00 a.m.
— 9 o’clock in the morning
— 0900
[57] Allow 1 credit if all three student latitudes and all three student longitudes are correct.

**Position of Hurricane Sandy from October 24, 2012 to October 31, 2012**

<table>
<thead>
<tr>
<th>Date</th>
<th>Latitude°(N)</th>
<th>Longitude°(W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 24</td>
<td>17</td>
<td>77</td>
</tr>
<tr>
<td>October 25</td>
<td>22</td>
<td>76</td>
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<td>October 26</td>
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<td>October 27</td>
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<td>October 28</td>
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<td>October 29</td>
<td>37</td>
<td>71</td>
</tr>
<tr>
<td>October 30</td>
<td>40</td>
<td>78</td>
</tr>
<tr>
<td>October 31</td>
<td>42</td>
<td>80</td>
</tr>
</tbody>
</table>

[58] Allow 1 credit. Acceptable responses include, but are not limited to:
- clockwise and outward
- The winds circulate clockwise.
- The winds blow away/diverge from the center of the high.

[59] Allow 1 credit for a line showing that, generally, as air pressure increases, wind speed decreases.

**Examples of 1-credit responses:**

![Graphs showing relationship between air pressure and wind speed](graphs.png)
60 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
  — Hurricane Sandy moved over land.
  — lack of warm water to evaporate and provide energy for the hurricane
  — lack of moisture to supply the hurricane energy

Note: Do not allow credit for “pressure increased” or “wind speed decreased” because these are a result of a hurricane moving over land, not a cause of the weakening of the hurricane.

61 [1] Allow 1 credit for D and E.

62 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
  — 4600 million years ago
  — $4.6 \times 10^3$ million years ago

Note: If the student crosses out million years ago, allow credit if an equivalent value is expressed in other units (e.g., 4.6 billion years ago).

63 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
  — Oceanic oxygen began to enter the atmosphere.
  — Excess oxygen in the oceans escaped into the atmosphere.
  — A buildup of oxygen began.
  — Photosynthetic bacteria released oxygen.

64 [1] Allow 1 credit for trilobites.

65 [1] Allow 1 credit for Precambrian or Archean.
Part C

Allow a maximum of 20 credits for this part.

66 [1] Allow 1 credit if all seven plots are within or touch the circles shown and are correctly connected with a line that passes within or touches each circle.

Note: Allow credit if the line does not pass through the student plots, but is still within or touches the circles.

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

![Graph showing average February atmospheric carbon dioxide levels from 2008 to 2014](image)


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

- water vapor/H$_2$O
- methane/CH$_4$
- nitrous oxide/N$_2$O/N$_x$O
- ozone/O$_3$
- chlorofluorocarbons/CFCs
69  [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — Plant more trees/reduce deforestation.
   — Use public transportation/carpooling.
   — Burn less fossil fuel.
   — Use energy-efficient appliances/lightbulbs.
   — Convert to alternative/renewable energy (e.g., solar, wind).

70  [1] Allow 1 credit if all three isobars are correctly drawn and the isobars extend to the edges of the map.

   Note: If additional isobars are drawn, all must be drawn correctly to receive credit.

   Example of a 1-credit response:

   ![Diagram of isobars](image)

71  [1] Allow 1 credit for 30.12 in of Hg.

72  [1] Allow 1 credit for any value from 0.016 to 0.027 mb/km.

   Note: Do not allow credit for $\frac{4}{200}$ or $\frac{1}{50}$ because this does not show a complete calculation.
73 [1] Allow 1 credit for any value greater than 988 but less than 992 mb.

74 [1] Allow 1 credit if the center of the \( \textbf{X} \) is within or touches the box on the Moon’s orbit, as shown below.

\textbf{Note:} It is recommended that an overlay of the same scale as the student answer sheet be used to ensure reliability in rating.

Allow credit if a symbol other than an \( \textbf{X} \) is used.

75 [1] Allow 1 credit for 27.3 d or \( 27\frac{1}{3} \) d.

76 [1] Allow 1 credit if the student shades more than half of the Moon, leaving a lighted portion on the left to indicate a crescent, as shown below.

\textbf{Examples of 1-credit responses:}

\[ \text{Diagram of Moon with shaded area} \]
77 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — The Moon’s orbit has an elliptical shape.
   — slightly eccentric
   — almost a circle/nearly circular
   — oval
   — has an eccentricity of 0.055

   **Note:** Do not allow credit for “circle” or “circular” alone because the eccentricity of the Moon’s orbit is not zero.

78 [1] Allow 1 credit for Erie-Ontario Lowlands, or Erie-Ontario Plains, or Interior Lowlands.

79 [1] Allow 1 credit for dolomite or CaMg(CO₃)₂.

80 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — North America was located on/near the equator.
   — North America was located at a lower latitude.
   — It was farther south.
   — mostly in the Southern Hemisphere
   — farther east
   — southeast

81 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   — the collision between North America and a volcanic island arc
   — closing of the western part of the Iapetus Ocean
   — crustal uplift
   — convergence

82 [1] Allow 1 credit for quartz.
83 [1] Allow 1 credit for placing only four Xs in the correct columns, as shown below.

**Note:** Allow credit if a symbol other than an X is used.

<table>
<thead>
<tr>
<th>Mineral Name</th>
<th>Felsic</th>
<th>Mafic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium feldspar</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Olivine</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Quartz</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pyroxene</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

84 [1] Allow 1 credit for both oxygen (O) and silicon (Si).

85 [1] Allow 1 credit for both olivine and quartz.
Regents Examination in Physical Setting/Earth Science
January 2017
Chart for Converting Total Test Raw Scores to
Final Examination Scores (Scale Scores)

The Chart for Determining the Final Examination Score for the January 2017
Regents Examination in Physical Setting/Earth Science will be posted on the
Department’s web site at: http://www.p12.nysed.gov/assessment/ on Thursday,
January 26, 2017. Conversion charts provided for previous administrations of
the Regents Examination in Physical Setting/Earth Science must NOT be used
to determine students’ final scores for this administration.

Online Submission of Teacher Evaluations of the Test to the Department

Suggestions and feedback from teachers provide an important contribution to the test
development process. The Department provides an online evaluation form for State
assessments. It contains spaces for teachers to respond to several specific questions and to
make suggestions. Instructions for completing the evaluation form are as follows:

2. Select the test title.
3. Complete the required demographic fields.
4. Complete each evaluation question and provide comments in the space provided.
5. Click the SUBMIT button at the bottom of the page to submit the completed form.
<table>
<thead>
<tr>
<th>Key Ideas/Performance Indicators</th>
<th>Part A</th>
<th>Part B</th>
<th>Part C</th>
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<tbody>
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<td>Math Key Idea 1</td>
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<td>Math Key Idea 2</td>
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<td><strong>Standard 2</strong></td>
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<tr>
<td>Key Idea 1</td>
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<td>67, 71, 72, 75, 77, 78, 79, 80, 81, 82, 83, 84, 85</td>
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</tbody>
</table>
To determine the student’s final score, locate the student’s Total Performance Test Score across the top of the chart and the Total Written Test Score down the side of the chart. The point where the two scores intersect is the student’s final examination score. For example, a student receiving a Total Performance Test Score of 10 and Total Written Test Score of 65 would receive a final examination score of 85.
## Final Examination Scores

### Regents Examination in Physical Setting/Earth Science – January 2017 – continued

| Total Written Test Score | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0
|------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|......