1) A quantity of water is frozen solid and then heated from 0°C to 10°C. Which statement best describes the properties of the water during this time?
   A) Mass changes but volume remains constant.  
   B) Mass and volume change.  
   C) Volume and density change.  
   D) Volume changes but density remains constant.

2) A student incorrectly converted 20°C to 64°F instead of 68°F. What is the student's approximate percent error?
   A) 4%  
   B) 6.3%  
   C) 5.9%  
   D) 44%

3) As water cools from 4°C to 0°C, its density
   A) decreases  
   B) remains the same  
   C) increases

4) The diagram below represents a rectangular object with a mass of 450 grams. According to the Earth Science Reference Tables, what is the density of the object?
   A) 3 grams per cubic centimeter  
   B) 2 grams per cubic centimeter  
   C) 1 gram per cubic centimeter  
   D) 4 grams per cubic centimeter

Questions 5 and 6 refer to the following:

The graph below shows changes in the Sun's magnetic activity and changes in the number of sunspots over a period of approximately 100 years. Sunspots are dark, cooler areas within the Sun's photosphere that can be seen from Earth.
5) Which graph best represents the relationship between the number of sunspots and the amount of magnetic activity in the Sun?

![Graph A](image)

![Graph B](image)

![Graph C](image)

![Graph D](image)

6) The graph indicates that years having the greatest number of sunspots occur
   A) in a cyclic pattern, repeating approximately every 11 years
   B) randomly and unpredictably
   C) precisely at the beginning of each decade
   D) in a cyclic pattern, repeating approximately every 6 years

Questions 7 through 11 refer to the following:

The diagrams below represent four solid materials, A, B, C, and D. Some of their physical properties are shown. The dimensions of the materials are recorded in centimeters. The graph indicates the relationship between the mass and volume of materials B and C.

![Diagram A](image)

![Diagram B](image)

![Diagram C](image)

![Diagram D](image)

(not to scale)

7) What is the density of sample A?
   A) 0.25 g/cm³
   B) 56 g/cm³
   C) 14 g/cm³
   D) 4.0 g/cm³
8) If the density for material $D$ were plotted on the graph, where would this line be located?
   A) on the same line as material $C$
   B) between the lines for materials $B$ and $C$
   C) between the line for material $C$ and the $y$-axis
   D) between the line for material $B$ and the $x$-axis

9) If sample $B$ is a perfect cube, what is the length of any one side?
   A) 4.0 cm
   B) 32 cm
   C) 21 cm
   D) 2.0 cm

10) If sample $C$ were cut in half, the slope of the line for material $C$ on the graph would
    A) increase
    B) decrease
    C) remain the same

11) What is the mass of another sample of material $C$ whose volume is 5 cubic centimeters?
    A) 4.0 g
    B) 32 g
    C) 20. g
    D) 8.0 g

12) Hot water at 90°C is poured into cup $A$. Cool water at 20°C is poured into cup $B$. Styrofoam covers are placed on the cups. An aluminum bar and a thermometer are placed through holes in each cover. Points $X$ and $Y$ are locations on the aluminum bar. The data table shows temperature readings taken every minute for 20 minutes.

<table>
<thead>
<tr>
<th>Minute</th>
<th>Cup A</th>
<th>Cup B</th>
<th>Temperature of Water (°C)</th>
<th>Temperature of Water (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>90</td>
<td>20</td>
<td>11</td>
<td>76</td>
</tr>
<tr>
<td>1</td>
<td>88</td>
<td>20</td>
<td>12</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>86</td>
<td>20</td>
<td>13</td>
<td>74</td>
</tr>
<tr>
<td>3</td>
<td>85</td>
<td>21</td>
<td>14</td>
<td>73</td>
</tr>
<tr>
<td>4</td>
<td>83</td>
<td>21</td>
<td>15</td>
<td>72</td>
</tr>
<tr>
<td>5</td>
<td>82</td>
<td>22</td>
<td>16</td>
<td>71</td>
</tr>
<tr>
<td>6</td>
<td>81</td>
<td>22</td>
<td>17</td>
<td>70</td>
</tr>
<tr>
<td>7</td>
<td>80</td>
<td>22</td>
<td>18</td>
<td>69</td>
</tr>
<tr>
<td>8</td>
<td>79</td>
<td>22</td>
<td>19</td>
<td>68</td>
</tr>
<tr>
<td>9</td>
<td>78</td>
<td>23</td>
<td>20</td>
<td>67</td>
</tr>
<tr>
<td>10</td>
<td>77</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What was the approximate rate of temperature change for the water in cup $A$ for the first 10 minutes?
   A) 1.3 °C/min
   B) 13.0 °C/min
   C) 7.7 °C/min
   D) 0.77 °C/min

13) The diagram below shows a glass jar containing a clear liquid and a floating rock. Which conclusion about the relative density of the rock and the liquid is true?

   A) The rock is less dense than the liquid.
   B) The rock is more dense than the liquid.
   C) The rock and the liquid have the same density.
14) The diagram below represents a cylinder which contains four different liquids, W, X, Y, and Z, each with a different density (D) as indicated. A piece of solid quartz having a density of 2.7 g/cm³ is placed on the surface of liquid W. When the quartz is released, it will pass through

A) W, but not X, Y, or Z
B) W, X, Y, and Z
C) W and X, but not Y or Z
D) W, X, and Y, but not Z

15) A student calculates the densities of five different pieces of aluminum, each having a different volume. Which graph best represents this relationship?

A) ![Graph A]
B) ![Graph B]
C) ![Graph C]
D) ![Graph D]

16) 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?
A) 1.0 g/cm³
B) 10.0 g/cm³
C) 20.0 g/cm³
D) 5.0 g/cm³

17) A person incorrectly measured the length of a room as 13.0 meters when the actual length was 12.0 meters. What is the person's approximate percent deviation (percentage of error)?
A) 5.9%
B) 1.0%
C) 7.7%
D) 8.3%

18) A rock's density is calculated as 2.7 g/cm³ but its accepted density is 3.0 g/cm³. Which equation, when solved, will provide the correct percent deviation from the accepted value?
A) Deviation(%) = \frac{3.0 - 2.7}{3.0} \times 100
B) Deviation(%) = \frac{3.0 - 2.7}{2.7} \times 100
C) Deviation(%) = \frac{2.7}{3.0} \times 100
D) Deviation(%) = \frac{3.0}{2.7} \times 100
Questions 19 through 21 refer to the following:

The data table below shows the industrial uses of wollastonite, a mineral mined in the eastern Adirondack Mountains of New York State.

<table>
<thead>
<tr>
<th>Industrial Uses of Wollastonite</th>
<th>Percent of Total Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastics</td>
<td>37</td>
</tr>
<tr>
<td>Ceramics</td>
<td>28</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>10</td>
</tr>
<tr>
<td>Paint</td>
<td>10</td>
</tr>
<tr>
<td>Asbestos substitute</td>
<td>9</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>6</td>
</tr>
</tbody>
</table>

19) On the pie graph below, complete the graph to show the percent of each industrial use of wollastonite. Label each section of the pie graph with its industrial use. [The percent for Miscellaneous and for Asbestos substitute has been drawn and labeled for you.]

20) Wollastonite forms during the intense metamorphism of a sandy limestone. The expression below shows part of the process that results in the formation of wollastonite.

\[
\text{Metamorphism: } \quad \text{CaCO}_3 + \text{SiO}_2 \rightarrow \text{CaSiO}_2 + \text{CO}_2
\]

(a) Name the two minerals involved in the formation of wollastonite.
(b) What two conditions normally cause intense metamorphism?

21) Identify the geologic age of the New York State Adirondack Mountain bedrock in which wollastonite deposits are found.
22) If each side of the cube shown below has the same length as the measured side, what is the approximate volume of the cube?

A) 6.60 cm³  B) 2.20 cm³  C) 10.65 cm³  D) 4.84 cm³

Questions 23 through 27 refer to the following:

The diagram below represents a solid material of uniform composition.

23) The mass of this piece of material is approximately
A) 4.4 g  B) 9.3 g  C) 0.23 g  D) 32 g

24) When this material is placed in a container of water, it sinks to the bottom of the container. Compared to the density of water, the density of the material is
A) the same  B) greater  C) less

25) Which graph best represents the relationship between the mass and volume of various-sized pieces of this material?

26) Which statement about this object is an inference?
A) The object has sharp corners.
B) The object is longer than it is wide.
C) The object is made of a naturally occurring substance.
D) the object has flat sides.
27) If this material is heated and expands, the density of the material will
   A) increase  B) remain the same  C) decrease

28) The basic measurements used to describe stream velocity are
   A) length and shape  B) distance and time
   C) time and direction  D) mass and volume

29) The information below is a classification of six common rocks, based on how they were formed. In which group would conglomerate rock be placed in this classification?

   Group A  Group B
   basalt    sandstone
   granite   shale

   Group C
   marble    gneiss

   A) Group B  B) Group A  C) Group C

30) A pebble has a mass of 35 grams and a volume of 14 cubic centimeters. What is its density?
   A) 4.0 g/cm³  B) 2.5 g/cm³  C) 490 g/cm³  D) 0.4 g/cm³

31) The table below identifies four density groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Density g/cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.0-3.9</td>
</tr>
<tr>
<td>B</td>
<td>4.0-7.9</td>
</tr>
<tr>
<td>C</td>
<td>8.0-11.9</td>
</tr>
<tr>
<td>D</td>
<td>12.0-15.9</td>
</tr>
</tbody>
</table>

   According to this classification system, a sample of quartz with a mass of 27 grams and a volume of 10 cubic centimeters should be placed in group
   A) A  B) B  C) C  D) D

32) The use of a triple-beam balance to determine the mass of a rock is an example of measuring by using
   A) inferences and interpretations  C) a direct comparison with a standard
   B) all of the five senses  D) a combination of dimensional quantities

33) As a volume of air expands due to heating, the density of this air will
   A) increase  B) remain the same  C) decrease
Questions 34 through 38 refer to the following:

The table below shows data for a student's collection of rock samples A through I, which are classified into groups X, Y, and Z. For each rock sample, the student recorded mass, volume, density, and a brief description. The density for rock D has been left blank.

<table>
<thead>
<tr>
<th>Group</th>
<th>Rock</th>
<th>Mass (g)</th>
<th>Volume (cm³)</th>
<th>Density (g/cm³)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>A</td>
<td>82.9</td>
<td>34.4</td>
<td>2.41</td>
<td>Grey, smooth, rounded</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>114.2</td>
<td>42.6</td>
<td>2.68</td>
<td>Brown, smooth, rounded</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>144.7</td>
<td>63.2</td>
<td>2.29</td>
<td>Black, smooth rounded</td>
</tr>
<tr>
<td>Y</td>
<td>D</td>
<td>159.4</td>
<td>59.7</td>
<td></td>
<td>Black and grey crystals, angular</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>87.7</td>
<td>33.1</td>
<td>2.65</td>
<td>Clear and pink crystals, angular</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>59.6</td>
<td>21.0</td>
<td>2.84</td>
<td>White, grey, and black crystals, angular</td>
</tr>
<tr>
<td>Z</td>
<td>G</td>
<td>201.1</td>
<td>68.4</td>
<td>2.94</td>
<td>Grey, shiny flat</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>85.1</td>
<td>39.8</td>
<td>2.14</td>
<td>Brown, sandy feel, flat</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>110.2</td>
<td>47.3</td>
<td>2.33</td>
<td>Dark grey, flaky flat</td>
</tr>
</tbody>
</table>

34) The student broke rock G into two pieces. Compared to the density of the original rock, the density of one piece would most likely be
   A) the same  B) greater  C) less

35) The student's classification system is based on
   A) mass  B) color  C) shape  D) density

36) Which statement is an inference rather than an observation?
   A) Rock B has been rounded by stream action.
   B) Rock E has a volume of 33.1 cm³.
   C) Rock H is flat.
   D) Rock G is the same color as rock I.

37) To obtain the data recorded in the column labeled "Description," the student used
   A) a triple-beam balance
   B) a calculator
   C) an overflow can
   D) her senses

38) The approximate density of rock sample D is
   A) 2.67 g/cm³  B) 3.75 g/cm³  C) 3.32 g/cm³  D) 2.75 g/cm³

39) A student determines the density of a mineral to be 3.5 grams per cubic centimeter. If the accepted value is 4.8 grams per cubic centimeter, what is the student's approximate percent error?
   A) 13%  B) 73%  C) 27%  D) 37%

40) A mineral sample is found to have a density of 3.0 grams per cubic centimeter. It is then broken into two pieces, with one piece twice as large as the other. The smaller of the two pieces will have a density of
   A) 1.5 g/cm³  B) 1.0 g/cm³  C) 6.0 g/cm³  D) 3.0 g/cm³

41) Which statement made during a weather report is most likely an inference?
   A) The record low temperature for this date was set in 1957.
   B) The high temperature for the day was recorded at 2 p.m.
   C) The current barometric pressure is 29.97 in.
   D) Hot and humid conditions will continue throughout the week.

42) Which information in the Earth Science Reference Tables is an inference rather than an observation?
   A) The Earth's outer core is made of iron.
   B) A P-wave travels 5,600 kilometers in 9 minutes.
   C) Temperature decreases as elevation in the troposphere increases.
   D) Saturn's period of rotation is 10 hours 14 minutes.
43) Which statement about a cumulus cloud seen over Syracuse, N.Y., is an inference?
   A) The cloud has an irregular shape.
   B) The cloud formed over Lake Ontario.
   C) The cloud appears white.
   D) The base of the cloud is determined to be 2.6 km above ground.

44) An empty 250-milliliter beaker has a mass of 60 grams. When 100 milliliters of oil is added to the beaker, the total mass is 140 grams. The density of the oil is approximately
   A) 0.6 g/ml        B) 1.4 g/ml        C) 0.8 g/ml        D) 1.7 g/ml

45) As shown below, an empty 1,000-milliliter container has a mass of 250.0 grams. When filled with a liquid, the container and the liquid have a combined mass of 1,300. grams.

![Diagram of container filled with liquid]

What is the density of the liquid?
   A) 1.05 g/mL        B) 1.00 g/mL        C) 1.30 g/mL        D) 0.95 g/mL

46) Water has the greatest density at
   A) 100°C in the gaseous phase      B) 0°C in the solid phase
   C) 4°C in the liquid phase        D) 4°C in the solid phase

47) Water has its greatest density at a temperature of
   A) 32°C      B) 10°C      C) -6°C      D) 4°C

48) Compared to the density of liquid water, the density of an ice cube is
   A) always less      B) sometimes less and sometimes greater
   C) always the same      D) always greater

49) A classification system is based on the use of
   A) the human senses to observe properties of objects
   B) inferences to make observations
   C) observed properties to group objects with similar characteristics
   D) instruments to observe properties of objects

50) A person measures the length of a piece of wood to be 41 centimeters. If the actual length is 40 centimeters, what is the percent deviation (percent of error) from the actual length?
   A) 9.8%      B) 1.0%      C) 2.5%      D) 5.0%

51) A person observes a sediment consisting of clay, sand, and pebbles and then states that this material was transported and deposited by an agent of erosion. This statement is
   A) an inference      B) an observation      C) a fact      D) a measurement
52) Using a ruler to measure the length of a stick is an example of
A) predicting the length of the stick by guessing
B) extending the sense of sight by using an instrument
C) measuring the rate of change of the stick by making inferences
D) calculating the percent of error by using a proportion

53) A student determines that the density of an aluminum sample is 2.9 grams per cubic centimeter. If the accepted value for the density of aluminum is 2.7 grams per cubic centimeter, what is the student's approximate percent deviation?
A) 0.70%  B) 20%  C) 0.20%  D) 7.4%

54) The diagrams below represent two differently shaped blocks of ice floating in water. Which diagram most accurately shows the blocks of ice as they would actually float in water?

A)  
B)  
C)  
D)  

55) The diagrams below represent fossils found at different locations. When classified by similarity of structure, which three fossils should be grouped together?
A)  C, F, and J  
B)  B, D, and I  
C)  A, F, and H  
D)  E, G, and H
56) The field map below shows the average size of particles deposited by streams that drained an area of Maryland during the Pleistocene Epoch. The field values represent particle diameters in centimeters.

Which particle size would be most common at location X? [Particles are drawn actual size.]
A)  
B)  
C)  
D)  

57) The drawing below represents five positions of a balloon after being released from a ship. The drawings of the balloon are not to scale compared to the altitude distances, but are to scale with each other.

In order to make the balloon rise, the density of the gas put inside the balloon must be
A) more than the density of the air at sea level
B) the same as the density of the air at sea level
C) less than the density of the air at sea level
58) In which phase (state) do most Earth materials have their greatest density?
A) liquid  B) gaseous  C) solid

59) While walking on a glacier, an observer makes several statements. Which statement is an inference?
A) "Some of the snow on this glacier is powdery."
B) "There are many cracks in this glacier."
C) "Some parts of this glacier will start melting this spring."
D) "The rocks on this glacier are of different sizes."

60) Which statement about a burning candle is most likely an inference?
A) Carbon dioxide and water vapor are produced by the burning.
B) The candle wax is melting.
C) The flame is yellow.
D) The wick gets shorter as the candle burns.

61) The graph below shows the relationship between the mass and volume of a mineral. What is the density of this mineral?

![Graph showing relationship between mass and volume](image)

A) 4.5 g/cm³  B) 30 g/cm³  C) 6.0 g/cm³  D) 9.0 g/cm³

62) A student finds the mass of igneous rock sample to be 48.0 grams. Its actual mass is 52.0 grams. What is the student's approximate percent deviation (percent of error)?
A) 4.0%  B) 7.7%  C) 8.3%  D) 9.2%

Questions 63 through 65 refer to the following:

The diagrams below represent four solid objects made of the same uniform material. The accepted values for the volume and mass of each object are given, except for the volume of object A.

63) What is the volume of object A?
A) 2.00 cm³  B) 8.00 cm³  C) 4.00 cm³  D) 1.00 cm³

64) A sample having a volume of 1 cubic centimeter was cut from each object. Which is an accurate statement about the samples?
A) The sample from object B has the greatest volume.
B) The sample from object D has the greatest density.
C) Each sample has the same shape.
D) Each sample has the same mass.
65) Which diagram best shows what would happen if the four objects were placed in a large beaker of water at room temperature?

A) 

B) 

C) 

D) 

66) Student A finds the density of a piece of quartz to be 2.50 grams per cubic centimeter. Student B finds the density to be 2.80 grams per cubic centimeter. The actual density of quartz is 2.65 grams per cubic centimeter. Which is a true statement about student A's percent of error (percent deviation)?

A) It is less than student B's percent of error.  
B) It is the same as student B's percent of error.  
C) It cannot be determined.  
D) It is greater than student B's percent of error. 

67) Ocean tides are best described as

A) predictable and noncyclic 
B) predictable and cyclic 
C) unpredictable and cyclic 
D) unpredictable and noncyclic

68) In the classroom during a visual inspection of a rock, a student recorded four statements about the rock. Which statement about the rock is an observation?

A) The rock cooled very rapidly. 
B) The rock dates from the Precambrian Era. 
C) The rock formed deep in the Earth's interior. 
D) The rock is black and shiny. 

69) The circumference of the Earth is about 4.0 \times 10^4 kilometers. This value is equal to

A) 4,000 km 
B) 400 km 
C) 40,000 km 
D) 400,000 km

Questions 70 through 73 refer to the following:

The graph above shows the mass and volume for five different samples of the mineral pyrite.
70) The density of pyrite and the density of water were plotted on the same graph. Which diagram below best represents how the graph should appear?

A) ![Diagram A]
B) ![Diagram B]
C) ![Diagram C]
D) ![Diagram D]

71) If one of the original samples of pyrite were cut in half, the density of each half would be
A) less than the original sample
B) greater than the original sample
C) the same as the original sample

72) If a sample of pyrite has a volume of 50 cm³, its mass would be
A) 350 g  B) 15 g  C) 250 g  D) 150 g

73) According to the graph above, the density of pyrite is about
A) 7.5 g/cm³  B) 5.0 g/cm³  C) 2.5 g/cm³  D) 0.5 g/cm³

74) A centimeter is 0.01 meter. This measurement can also be expressed as
A) \(1 \times 10^2\) m  B) \(1 \times 10^{-1}\) m  C) \(1 \times 10^{-2}\) m  D) \(1 \times 10^0\) m

75) A student observed a freshly dug hole in the ground and recorded statements about the sediment at the bottom of the hole. Which statement is an inference?
A) Some of the particles are rounded.
B) Over 50% of the sediments are the size of sand grains or smaller.
C) The hole is 2 meters deep.
D) The sediments were deposited by a stream.

76) A student determines the density of a rock to be 2.2 grams per cubic centimeter. If the accepted density of the rock is 2.5 grams per cubic centimeter, what is the percent deviation (percentage of error) from the accepted value?
A) 30.0%  B) 8.8%  C) 13.6%  D) 12.0%

77) A measurement is best defined as
A) an interpretation based on theory
B) a direct comparison with a known standard
C) an inference made by using the human senses
D) a group of inferred properties

78) Which statement about an unidentified rock sample is most likely an inference?
A) The rock is a metamorphic rock.
B) The rock has shiny, wavy mineral bands.
C) The rock has no visible fossils.
D) The rock is composed of large crystals.
79) Which property was probably used to classify the substances below?

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>aluminum</td>
</tr>
<tr>
<td>gasoline</td>
<td>ice</td>
</tr>
<tr>
<td>alcohol</td>
<td>iron</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>water vapor</td>
</tr>
<tr>
<td>air</td>
</tr>
<tr>
<td>oxygen</td>
</tr>
</tbody>
</table>

A) specific heat  
B) state (phase) of matter  
C) abundance within the Earth  
D) chemical composition

80) The dewpoint temperature of the air is determined to be 10°C. If the accepted value for the dewpoint temperature on that day is 12°C, what is the percent deviation from the accepted dewpoint value?

A) 13.9%  
B) 2.0%  
C) 16.7%  
D) 83.3%

81) A student classifies several objects. The classification system should be based on

A) interpretations  
B) inferences  
C) hypotheses  
D) observations

82) The grouping of objects or events based on similar characteristics is called

A) measurement  
B) observation  
C) classification  
D) interpretation

83) A number of objects are grouped on the basis of common properties. What is this process called?

A) measurement  
B) classification  
C) inference  
D) observation

84) A student measured the mass of a rock sample and recorded it as 51 grams. Later it is found that the accepted value of the rock's mass is 60 grams. What was the percent deviation (percent error) of the original mass?

A) 15%  
B) 9%  
C) 18%  
D) 7%

85) During a laboratory activity, four students each determined the density of the same piece of granite. The results are shown in the table below.

<table>
<thead>
<tr>
<th>Student</th>
<th>Density Determined</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.69 g/cm³</td>
</tr>
<tr>
<td>2</td>
<td>2.71 g/cm³</td>
</tr>
<tr>
<td>3</td>
<td>2.72 g/cm³</td>
</tr>
<tr>
<td>4</td>
<td>2.69 g/cm³</td>
</tr>
</tbody>
</table>

The accepted value for the density of granite is 2.70 grams per cubic centimeter. Therefore, the results of this activity indicate that

A) each student determined the exact accepted value for the density of granite  
B) the accepted density of granite is incorrect  
C) the density determined by each student contains a small error  
D) the balance used by student 3 was broken

86) Under the same conditions of temperature and pressure, three different samples of the same uniform substance will have the same

A) mass  
B) volume  
C) density  
D) shape
87) The graph below shows the snow line (the elevation above which glaciers form at different latitudes in the Northern Hemisphere).

At which location would a glacier most likely form?
A) 45°N latitude at an elevation of 1,000 m
B) 0° latitude at an elevation of 6,000 m
C) 30°N latitude at an elevation of 3,000 m
D) 15°N latitude at an elevation of 4,000 m

88) A student calculates the period of Saturn's revolution to be 31.33 years. What is the student's approximate deviation from the accepted value?
A) 1.9%
B) 19%
C) 6.3%
D) 5.9%

89) A student calculates the specific heat of ice to be 0.40 cal/g °C. What is the student's percent deviation from the accepted value?
A) 20.6%
B) 2.0%
C) 25.4%
D) 2.5%
A group of Earth Science students decided to take an adventurous camping trip, so they rode bicycles to a New York State park that was located in an isolated area. They traveled up a steep hill. When they reached the top, they looked at the landscape and noticed a lake at the bottom of the hill. They named it Hidden Lake. To the left of Hidden Lake was a large field with a small stream. They decided to set up their campsite in the field near Hidden Lake. To get to the field, they cycled down a very steep slope.

The map below shows the location of the bicycle trail and the students' campsite. Points \( P \) and \( Q \) are reference points on the map.

The students decided to measure the speed of the stream by floating apples down a straight section of the stream. Describe the steps the students must take to determine the stream's surface rate of movement (speed) by using a stopwatch, a 10-foot rope, and several apples. Include the equation for calculating rate.

Which statement about a mineral sample found in a field in New York State is most likely an inference?
A) The sample is white in color.
B) The sample is rectangular, with sharp, angular corners.
C) The sample is 8 cm long, 5 cm wide, and 3 cm high.
D) The sample was transported by a glacier.

A student calculated the density of a mineral sample to be 2.7 grams per cubic centimeter. If the accepted value is 3.0 grams per cubic centimeter, what was the student's percent of error?
A) 10%  B) 11%  C) 30%  D) 9%

The actual mass of an object is 80.0 grams. A student determines the mass of the object to be 81.6 grams. What is the student's percent error?
A) 0.2%  B) 10.6%  C) 1.6%  D) 2.0%

Which statement about a rock sample is most likely an inference?
A) The rock has flat sides and sharp corners.
B) The rock is made of small, dark-colored crystals.
C) The rock has changed color due to weathering.
D) The rock has thin, distinct layers.

While on a field trip to a large lake in New York State, an observer recorded four statements about this lake. Which of these statements is most likely an inference?
A) A log is floating in the lake.
B) The lake was formed by glacial action.
C) The surface temperature of the lake is 18.5°C.
D) The water is clear enough to see the bottom of the lake.
Questions 96 through 100 refer to the following:

Tables I and II below show the volume and mass of three samples of mineral A and three samples of mineral B.

<table>
<thead>
<tr>
<th>Table I: Mineral A</th>
<th>Table II: Mineral B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample No.</strong></td>
<td><strong>Volume</strong></td>
</tr>
<tr>
<td>1</td>
<td>2.0 cm³</td>
</tr>
<tr>
<td>2</td>
<td>5.0 cm³</td>
</tr>
<tr>
<td>3</td>
<td>10.0 cm³</td>
</tr>
</tbody>
</table>

96) What is the density of sample 3 of mineral A?
A) 10.0 g/cm³  B) 25.0 g/cm³  C) 2.5 g/cm³  D) 4.0 g/cm³

97) Comparing the samples of mineral B in Table II shows that the sample with the
A) largest volume has the least mass  B) smallest volume has the least mass  C) smallest volume has the greatest density  D) largest volume has the greatest density

98) One sample of mineral B is heated until it melts. Compared to the density of the original sample, the density of the melted sample most likely will be
A) the same  B) less  C) greater

99) Sample 2 of mineral A and sample 2 of mineral B have the same
A) mass  B) color  C) density  D) volume
100) Which graph best represents the densities for all samples of mineral A and mineral B?

A)  

B)  

C)  

D)  

101) 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
A) 21%  
B) 5.0%  
C) 0.48%  
D) 4.8%

102) An observer incorrectly measured the mass of a rock as 428.7 grams. The actual mass was 450.0 grams. What was the observer's approximate percentage of error?
A) 2.1%  
B) 5.0%  
C) 4.7%  
D) 4.3%

103) The diagrams below represent four solid objects made of the same uniform material. The accepted values for the volume and mass of each object are given, except for the volume of object A.

Mass = 8.00 g  
Volume = ?

Mass = 6.30 g  
Volume = 3.15 cm³

Mass = 4.00 g  
Volume = 2.00 cm³

Mass = 3.50 g  
Volume = 1.75 cm³

A student incorrectly determines the volume of object C to be 1.90 cubic centimeters. What is the student's percentage of error?
A) 1%  
B) 10%  
C) 5%  
D) 2%

104) A prediction of next winter's weather is an example of
A) a measurement  
B) a classification  
C) an inference  
D) an observation
105) The diagram below shows a process of weathering called frost wedging.

![Diagram of frost wedging](image)

Frost wedging breaks rocks because as water freezes it increases in
A) specific heat  B) density  C) volume  D) mass

106) A mineral expands when heated. Which graph best represents the relationship between change in density and change in temperature when that mineral is heated?

![Graph options](image)

107) The graph below shows the concentration (percentage) of copper at various depths in the bedrock at a mine in Arizona.

![Graph of copper concentration](image)

Between which depths should the bedrock be mined in order to obtain rock with the highest percentage of copper?
A) 100-130 ft  B) 650-680 ft  C) 330-360 ft  D) 230-260 ft

108) What is the mass of a rock that has a density of 2.5 grams per cubic centimeter and a volume of 4.0 cubic centimeters?
A) 4.0 g  B) 10.0 g  C) 1.6 g  D) 6.2 g
Questions 109 and 110 refer to the following:

The graph below shows the maximum altitude of the Moon, measured by an observer located at a latitude of 43°N during June in a particular year. The names and appearance of the four major Moon phases are shown at the top of the graph, directly above the date on which the phase occurred.

109) Which terms describe both the changes in the maximum altitude of the Moon and the changes in the Moon's phases over a period of several years?
   A) noncyclic and predictable  
   B) cyclic and predictable  
   C) cyclic and unpredictable  
   D) noncyclic and unpredictable

110) What was the maximum altitude of the Moon on June 22?
   A) 50°  
   B) 43°  
   C) 46°  
   D) 40°
Questions 111 through 114 refer to the following:

The diagram below represents a three-dimensional solid object of uniform material.

[Diagram of a three-dimensional solid object]

**111)** What is the density of the object?
A) 0.3 g/cm³  
B) 5.5 g/cm³  
C) 1.3 g/cm³  
D) 3.2 g/cm³

**112)** If the object is cut in half, the density of each piece will be
A) less than that of the original object  
B) the same as that of the original object  
C) greater than that of the original object

**113)** The object appears to have many flat surfaces, most of which are four-sided. This statement is best described as
A) a prediction  
B) an inference  
C) a measurement  
D) an observation

**114)** The mass of the object could best be determined by
A) counting the number of flat surfaces it contains  
B) placing it in a beaker of water  
C) comparing it with a known standard mass  
D) calculating its circumference

**115)** A student determined the porosity of a sample of soil to be 37.6%. The actual porosity is 42.3%. The student’s percent deviation from the accepted value (percentage of error) is approximately
A) 4.7%  
B) 11.1%  
C) 12.5%  
D) 79.9%
Questions 116 through 120 refer to the following:

Object A below is a solid cube of uniform material having a mass of 65 grams and a volume of 25 cubic centimeters. Cube B is a part of cube A.

116) The density of the material in cube A is determined at different temperatures and phases of matter. At which temperature and in which phase of matter would the density of cube A most likely be greatest? [Assume a standard atmospheric pressure.]
   A) at 20\(^\circ\)C and in the solid phase  
   B) at 200\(^\circ\)C and in the solid phase  
   C) at 1800\(^\circ\)C and in the liquid phase  
   D) at 2700\(^\circ\)C and in the gaseous phase

117) The density of cube A is
   A) 0.38 g/cm\(^3\)  
   B) 2.6 g/cm\(^3\)  
   C) 0.26 g/cm\(^3\)  
   D) 3.8 g/cm\(^3\)

118) If pressure is applied to cube A until its volume is one-half of its original volume, its new density will be
   A) one-half its original density  
   B) one-third its original density  
   C) twice its original density  
   D) the same as its original density

119) If cube B is removed from cube A, the density of the remaining part of cube A will
   A) decrease  
   B) remain the same  
   C) increase

120) The mass of cube B is measured in order to calculate its density. The cube has water on it while its mass is being measured. How would the calculated value for density compare with actual density?
   A) The calculated density value would be less than the actual density.  
   B) The calculated density value would be the same as the actual density.  
   C) The calculated density value would be greater than the actual density.

121) What is the diameter of the Earth? [Refer to the Earth Science Reference Tables.]
   A) 127,400 km  
   B) 6,370 km  
   C) 63,700 km  
   D) 12,740 km

122) A scientist who is studying a stream would have the most difficulty determining the stream's
   A) temperature  
   B) transported sediment size  
   C) age in years  
   D) velocity

Questions 123 and 124 refer to the following:

The data table below shows the volume and mass of three different samples, A, B, and C, of the mineral pyrite.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Volume (cm(^3))</th>
<th>Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.5</td>
<td>12.5</td>
</tr>
<tr>
<td>B</td>
<td>6.0</td>
<td>30.0</td>
</tr>
<tr>
<td>C</td>
<td>20.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
123) On the grid below, plot the data (volume and mass) for the three samples of pyrite and connect the points with a line.

![Graph](image)

124) State the mass of a 10.0-cm³ sample of pyrite.

125) An interpretation based upon an observation is called
A) an inference  
B) a measurement  
C) a classification  
D) a fact

126) The diagrams below represent two solid objects, A and B, with different densities.

![Objects](image)

What will happen when the objects are placed in a container of water (water temperature = 4°C)?
A) Both objects will sink.  
B) Object B will float, and object A will sink.  
C) Object A will float, and object B will sink.  
D) Both objects will float.

127) A student’s measurement of the mass of a rock is 30 grams. If the accepted value for the mass of the rock is 33 grams, what is the percent deviation (percent of error) of the student’s measurement?
A) 9%  
B) 30%  
C) 11%  
D) 91%
128) The diagrams below represent four solid objects made of the same uniform material. The accepted values for the volume and mass of each object are given, except for the volume of object A.

Mass = 8.00 g  
Volume = ?

Mass = 6.30 g  
Volume = 3.15 cm³

Mass = 4.00 g  
Volume = 2.00 cm³

Mass = 3.50 g  
Volume = 1.75 cm³

A student made four statements about the objects. Which statement was an observation?
A) Object B is a sphere.  
B) Object D may be able to float due to its shape.  
C) Object A is a piece of the mineral halite.  
D) Object C is made of silicon and oxygen.

129) Which property is used to classify the land-derived sedimentary rocks listed in the Earth Science Reference Tables?
A) particle size  
B) color  
C) mineral composition  
D) fossil content

130) According to the Earth Science Reference Tables, which graph best represents the average densities of the Sun, Moon, and Earth?

A)  
B)  
C)  
D)  

131) A student incorrectly measured the volume of a mineral sample as 63 cubic centimeters. The actual volume was 72 cubic centimeters. What was the student’s approximate percent deviation (percentage of error)?
A) 9.0%  
B) 15.3%  
C) 12.5%  
D) 14.2%

132) Which statement about a rock sample is an inference?
A) The rock was formed 100 million years ago.  
B) A balance indicates the rock’s mass is 254 grams.  
C) The rock has no visible crystals and is red.  
D) The rock scratches a glass plate.

133) The diagrams below show physical changes in four materials after a period of time. Chemical composition of each material remained the same. Which material most likely changed in density?
A)  
B)  
C)  
D)  

134) A student measures the length of a room to be 6.9 meters. The actual length of the room is 7.5 meters. Determine the student’s percent deviation (percent of error).
A) 14%  
B) 6%  
C) 8%  
D) 20%
Questions 135 through 138 refer to the following:

The diagrams below represent three solid objects made of the same uniform material. The name of each shape is shown, along with its mass \((M)\) and volume \((V)\).

![Diagrams of a cube, pyramid, and sphere with their respective mass and volume values.]

135) What is the actual length of any one side of the cube?
   A) 1.0 cm  
   B) 8.0 cm  
   C) 2.0 cm  
   D) 3.0 cm

136) If the cube were cut into four smaller cubes, the density of one of the small cubes, compared to that of the original cube, would be
   A) the same  
   B) one-sixteenth as great  
   C) four times as great  
   D) one-fourth as great

137) If the sphere is heated to a temperature below its melting point, which is most likely to occur?
   A) The volume of the sphere will decrease, but its density will increase.
   B) Both the volume and density of the sphere will decrease.
   C) The volume of the sphere will increase, but its density will decrease.
   D) Both the volume and density of the sphere will increase.

138) Which line on the graph below best represents the density of the three samples?

![Graph showing curves labeled A, B, and C.]

   A) C  
   B) A  
   C) B

139) Scientists often use classification systems in order to
   A) make direct comparisons with standard units of measurement  
   B) extend their powers of observation  
   C) organize their observations in a meaningful way  
   D) make more accurate interpretations

140) As air on the surface of Earth warms, the density of the air
   A) increases  
   B) remains the same  
   C) decreases
141) The diagram below shows equal masses of four different earth materials at different temperatures.

Which material has the greatest density?
A) dry air  B) granite  C) iron  D) water

142) The diagrams below represent 100-gram samples of four different Earth materials at room temperature. Each material has an initial temperature of 20°C.

What happens when the four substances are heated?
A) Their volume and mass both increase.
B) Their volume increases but their mass remains constant.
C) Their volume and mass both decrease.
D) Their volume decreases but their mass remains constant.

143) What is the density of a rock which has a mass of 35 grams and a volume of 7.0 cubic centimeters?
A) 42 g/cm³  B) 0.20 g/cm³  C) 5.0 g/cm³  D) 28 g/cm³

144) A student determines the mass of a rock to be 196 grams, but the actual mass of the rock is 200 grams. The student's approximate percent deviation (percentage of error) is
A) 4.0%  B) 2.0%  C) 1.0%  D) 1.5%

145) A student determines that the porosity of a large volume of sand is 40%. The accepted value is 46%. What is the student's approximate percent deviation (percent of error) from the accepted value?
A) 10%  B) 46%  C) 7%  D) 13%

Questions 146 through 150 refer to the following:

The diagrams below represent three samples of the same substance, each having a different size and shape. [The diagrams are not drawn to scale.]
146) If sample $B$ were split in half, what would be the density of each piece?
   A) 1.0 g/cm$^3$      B) 3.0 g/cm$^3$      C) 6.0 g/cm$^3$      D) 1.5 g/cm$^3$

147) What is the density of sample $A$?
   A) 2.0 g/cm$^3$      B) 0.33 g/cm$^3$      C) 4.0 g/cm$^3$      D) 3.0 g/cm$^3$

148) If sample $C$ were compressed, which would probably occur?
   A) The volume would decrease and the density would increase.
   B) The volume would increase and the density would decrease.
   C) The volume would increase and the density would increase.
   D) The volume would decrease and the density would decrease.

149) Which order of letters ranks the samples by volume from largest to smallest?

150) Which graph best represents the relationship between the mass and volume of the substance?
   A) ![Graph A]
   B) ![Graph B]
   C) ![Graph C]
   D) ![Graph D]

151) The primary purpose of a classification system is to enable people to
   A) organize observations in a meaningful way
   B) eliminate inaccurate inferences
   C) extend their powers of observation
   D) make measurements that are very accurate