Test Review № 2

Graphing

A *graph* is a visual display of information. Graphs make it especially easy to see ***relationships*** among ***variables***. A variable is anything that can change or vary. A relationship exists between two variables when a change in one can predict changes in the other.

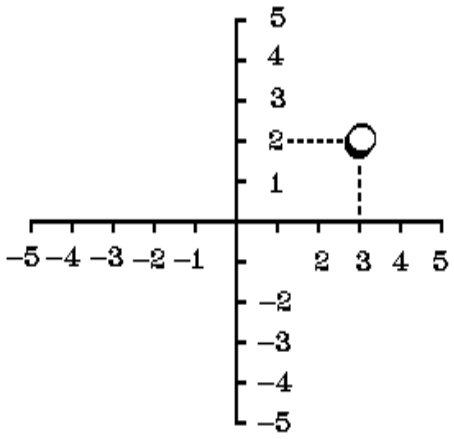
Types of Graphs.

Pie charts show proportions. *Pictographs* use pictures to show amounts. *Bar graphs* or *histograms* show discrete variables. *Line graphs* show continuous variables. Most graphs used in the sciences are line graphs. To make a proper visual display for a line graph, you need to: [1] Select the axes; [2] Select the origin; [3] Select the interval; [4] Plot the points; and [5] Draw the best straight line or curve.

Constructing Line Graphs

A well constructed graph has as little wasted space (or empty space) as possible. Following are some of the steps you need to take in order to construct visually effective graphs.

Selecting Axes. An ***axis*** is a straight line which may have numbers or categories arranged along it. Graphs showing the relationship between two variables generally have two axes arranged at right angles. The horizontal axis is often called the *X-axis*. The vertical axis is often called the *Y-axis*. The two perpendicular axes form the ***coordinates*** by which any point can be located. The graph below shows the point (3,2). It is located 3 across on the *X-axis* and 2 up on the *Y-axis*.



Notice that the axes form four quadrants with a central point at (0,0). This central point is called the ***origin***. Points to the left of the origin have negative *X*-values. Points below the origin have negative *Y*-values. Many of the quantities measured by scientists do not have negative values. It doesn't make any sense to speak of a length, or a mass, or a volume below zero. A graph showing the relationship between the mass and volume of pennies, for example, would have no negative values. There is no reason to graph this relationship on axes that have places for negative values. It is a waste of space! Graphs such as this with only positive values have axes shaped like an "**L**". This is the shape of the axes surrounding the quadrant in the upper right (Quadrant I). All the other quadrants (Quadrant II - Quadrant IV) have places for negative values. These quadrants are not displayed when they are empty.

The type of axes you select for a graph is determined by the kind of values that your data have. If your data have both positive and negative values, then you will select a full set of coordinates with all four quadrants. If your data can take on only positive values, then you will select Quadrant I only, and your axes will be shaped like an "**L**".

Selecting an Origin. The origin of a graph is an ***arbitrary*** point. This means it is selected for convenience. When the data displayed on a graph have both positive and negative values, it makes sense to select the point (0,0)

as the origin because it is in the middle. When the graph is entirely in Quadrant I, however, points other than (0,0) may be more convenient to use as the origin. When the range of the data is small compared to the distance from zero to the lowest data point, it is wise to use a number closer to the lowest data point as the origin rather than using zero. The range of the data is the difference between the highest data point and the lowest data point .

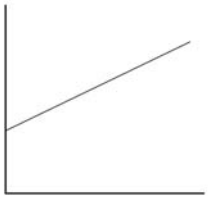
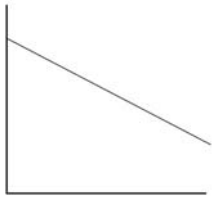
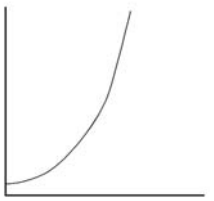
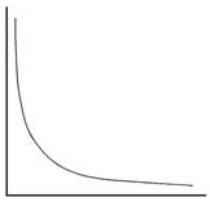
Selecting Appropriate Intervals. The space between the numbers on the axes is called an ***interval***. The numbers on the axes are usually spaced evenly, however, the intervals on the vertical and horizontal axes do not need to be the same. The intervals should be selected in such a way that the graph is spread out enough to cover the entire graphing space while leaving room for all the points to fit.

$$Interval \geq \frac{Range}{Boxes}$$

Plotting the Points. Points are plotted by locating the horizontal and vertical coordinates of each point on the axes. If imaginary perpendicular lines are extended through the axes at the coordinates of a point, the place where the perpendicular lines cross is where the point is plotted.

Drawing and Interpreting the Graph. Each of the points you plot represents a single measurement of a relationship for which an infinite number of measurements could have been made. When you draw a line or curve through the points, you are predicting from a small sample of data what the other measurements would have been had you made them in the laboratory. If you believe that each point represents a perfect measurement, then you would connect the points as in a connect the dot drawing. In reality, however, measurements made in the laboratory are imperfect. Each point that you plot only approximates the *TRUE* relationship because of errors of measurement. Due to errors of measurement, data gathered in the laboratory rarely fall directly on the line or curve. As a result, you need to interpret the data by drawing the best line or curve through the points. Errors of measurement tend to be random. This means that measurements have an equal chance of being too high or too low. The best line or curve is drawn in such a way that the points are distributed equally above and below it.

Types of Relationships.

	Direct	Indirect
Linear		
Curved		

Answer the questions below by circling the number of the correct response

1. The type of graph usually used to display laboratory data is a (1) pie chart, (2) pictogram, (3) line graph, (4) bar graph.

2. The type of graph usually used to display proportions is a (1) pie chart, (2) pictogram, (3) line graph, (4) bar graph.

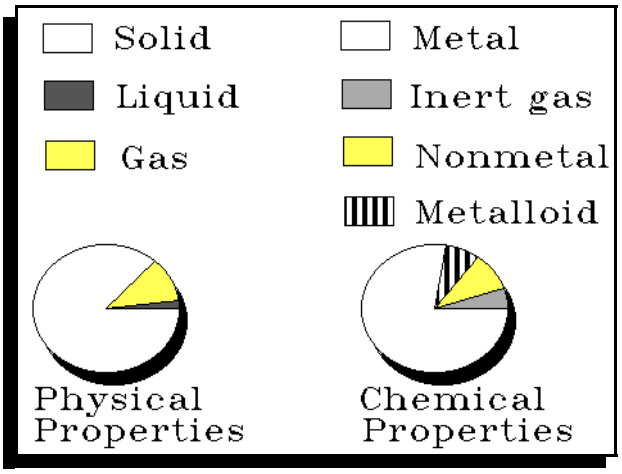
3. The axes of a graph would include only the upper right quadrant if the points to be plotted are (1) all positive, (2) all negative, (3) both positive and negative, (4) either all positive or all negative.

4. An appropriate interval for a graph ten boxes long with scores ranging from 0.0 to 0.9 is (1) 1.0, (2) 10, (3) 0.1, (4) 5.

5. The number of axes a graph would have if it showed the relationship between two variables is (1) 1, (2) 2, (3) 3, (4) 4.

6. If the origin of a graph is (0,0) and the scores to be plotted on the *X-axis* vary from 25 to 100, what is the range of the *X-axis*? (1) 0, (2) 25, (3) 75, (4) 100.

Below are two graphs showing the occurrence of physical and chemical properties of the first 104 elements. Answer questions 7-10 based on the graphs below.



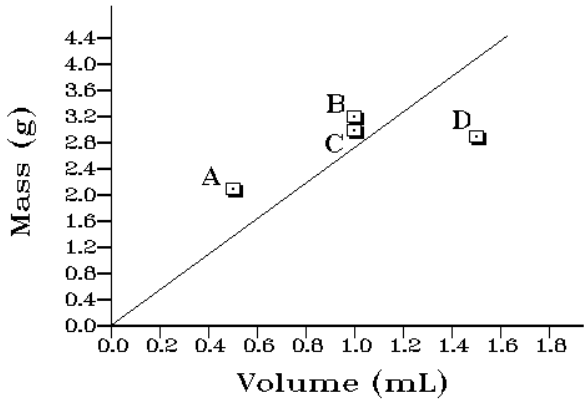
7. What type of graphs are pictured above? (1) line graphs (2) pictograms (3) histograms (4) pie charts

8. According to the graphs above, the most likely combination of physical and chemical properties is (1) solid metal, (2) liquid metalloid, (3) gaseous nonmetal, (4) inert gas.

9. Based on the graphs, a reasonable estimate for the number of metallic elements is (1) 52, (2) 104, (3) 9, (4) 81.

10. Based on the graphs, the smallest category of elements is (1) solids, (2) liquids, (3) metals, (4) metalloids.

Answer questions 11-16 by referring to the graph below showing the mass an volume of some samples of aluminum



11. What are the coordinates of point A? (1) (0, 0) (2) (1.0, 3.2) (3) (0.5, 2.1) (4) (1.0, 3.0)

12. The most likely explanation for the fact that points A-D do not fall on the line is that (1) there is no relationship between the mass and volume of aluminum, (2) there are errors of measurement, (3) the relationship between the mass and volume of aluminum is not linear, (4) the location of the line is arbitrary.

13. Based on the graph, the mass of 0.4 mL of aluminum is (1) 1.1 g, (2) 2.2 g, (3) 3.3 g, (4) 4.4 g.

14. Based on the graph, the volume of 4.4 g of aluminum is (1) 1.6 mL, (2) 1.2 mL, (3) 0.8 mL, (4) 0.5 mL.

15. Based on the graph, the density of aluminum is (1) 1.00 g/mL, (2) 2.77 g/mL, (3) 0.59 g/mL, (4) 4.43 g/mL.

16. What type of relationship is shown by the graph above? (1) linear indirect (2) curved indirect (3) linear direct (4) curved direct.

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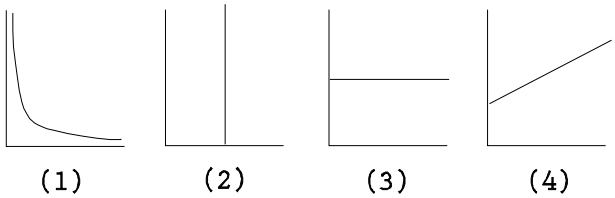
17. An example of a variable with an arbitrary zero point is (1) weight, (2) height, (3) temperature, (4) mass.

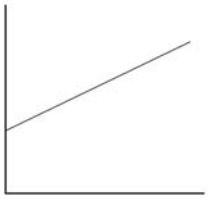
18. Which of the graphs below shows a direct relationship?



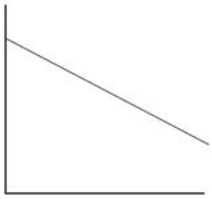
19. The axes of a graph are shaped like an "L." What does this tell you about the data? (1) The values are close together. (2) The values are all negative. (3) The values are all positive. (4) The values are both positive andnegative.

20. Which of the graphs below shows a curved indirect relationship?

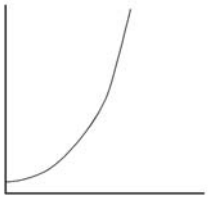
(1)



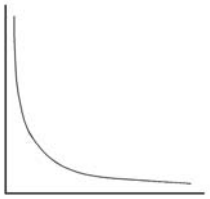
(2)



(3)



(4)



Answers

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