Conceptual Physics: Form TR2.18A Name ______________________________

TEST 2 REVIEW Date _________________ Period _____

Test Review № 2

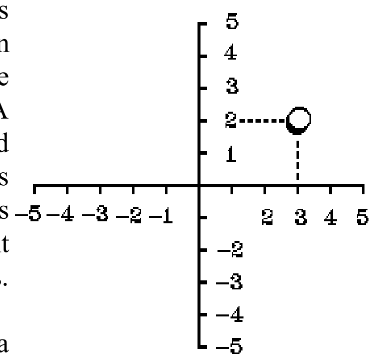
Graphing

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 .

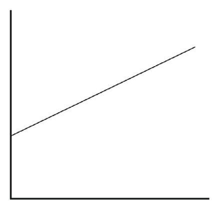
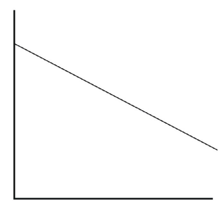
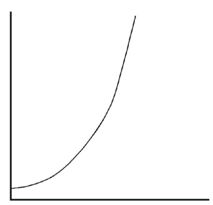
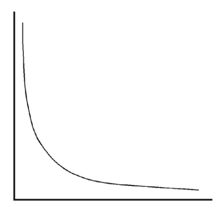
Selecting Appropriate Intervals. The space between the numbers on the axes is called an ***interval***. The numbers on the axes are usually spaced evenly, however, the intervals on the vertical and horizontal axes do not need to be the same. The intervals should be selected in such a way that the graph 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.

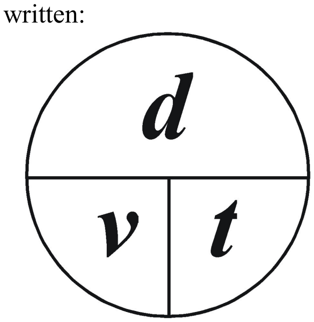
Drawing and Interpreting the Graph. Each of the points you plot represents a single measurement of a relationship for which an infinite number of measurements could have been made. When you draw a line or curve through the points, you are predicting from a small sample of data what the other measurements 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		

Speed. Speed is the change in distance per unit of time. It is often used interchangeably with velocity, although they are not the same. Velocity has a direction. Speed is the magnitude or size of a velocity. The symbol"*v*" is often used even in formulas where direction is not important. If "*d*" is the symbol for distance, and "*t*" is the symbol for time, the calculational formula can be written:

$$v = \frac{d}{t} \qquad d = vt \qquad t = \frac{d}{v}$$



Sample Problem

How long does it take to travel 9,750 km at a speed of 75 km/h?

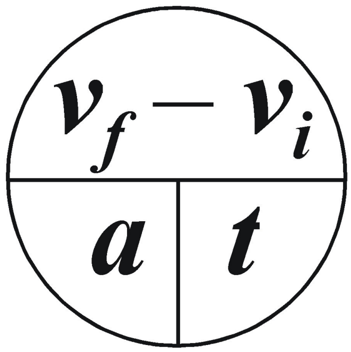
$$t = \frac{d}{v} = \frac{9{,}750km}{75\,{}^{km}\!/_{h}} = 130h$$

Acceleration. Whether you are speeding up, slowing down, or just changing direction, any change in velocity is acceleration. When an object falls from a window, it is accelerating. When a plane lands and comes to a stop, it is accelerating. As the earth zips around the sun it is accelerating. A car that goes from zero to 50 km/h in 5 seconds is accelerating. A car that goes from zero to 100 km/h in 5 seconds is also accelerating. The accelerations are not equal, however. A car that goes from zero to 100 km/h in 5 seconds has a greater acceleration than one that goes from zero to 50 km/h in 5 seconds. Acceleration is the change in velocity over time. Acceleration, time, and the final velocity can be calculated as shown below.

$$a = \frac{\Delta v}{t} = \frac{v_f - v_i}{t}\ ;\ t = \frac{v_f - v_i}{a}\ ;$$

$$and \quad v_f = v_i + at$$

- $a = acceleration$
- $\Delta v = change\ in\ velocity$
    - $v_f = final\ velocity$
    - $v_i = initial\ velocity$



Sample Problem 1

What is the acceleration of a car that speeds up from 85 km/h to 100 km/h in 3 seconds?

$$a = \frac{v_f - v_i}{t}$$

$$a = \frac{100\,{}^{km}\!/_{h} - 85\,{}^{km}\!/_{h}}{3s}$$

$$= 5\,{}^{km}\!/_{h \cdot s}$$

Sample Problem 2

A falling brick passes a window at a speed of 29.4 m/s. How fast will it be going 2 seconds later if the acceleration of gravity is 9.8 m/s^2?

$$v_f = v_i + at$$

$$v_f = 29.4\,{}^{m}\!/_{s} + \left(9.8\,{}^{m}\!/_{s^2}\right)(2s)$$

$$= 49.0\,{}^{m}\!/_{s}$$

Sample Problem 3

How long does it take to stop a car going 88 km/h if it accelerates at a rate of –5 km/h/s?

$$t = \frac{v_f - v_i}{a}$$

$$t = \frac{0\,{}^{km}\!/_{h} - 88\,{}^{km}\!/_{h}}{-5\,{}^{km}\!/_{h \cdot s}}$$

$$= 17.6s$$

Free Fall. A pot falls from a window. Before it fell, its speed was 0 m/s. As it fell, it sped up or accelerated. The speed increased the entire time it was falling. Since the initial speed was 0 m/s, the final speed can be expressed as : $v_f = at$. The final speed of an object with a constant acceleration after a given amount of time has passed is also called the instantaneous speed. The acceleration of gravity, g, is 9.8 m/s^2. For an object in free fall with an initial speed of 0 m/s, the final speed is: $v_f = gt$. If the initial speed of the falling object, v_i , is not zero, it needs to be added to get the instantaneous or final speed: $v_f = gt + v_i$.

Sample Problem 1

A child drops a toy out of a window. It falls for 3.0 seconds. How fast is it going just before it hits?

Step 1: Write the values of the variables

v_i = 0 m/s
t = 3 s
g = 9.8 m/s^2

Step 2: Substitute values into the equation

$$v_f = gt + v_i$$

v_f = (9.8 m/s2)(3 s) + 0 m/s = 29.4 m/s

Sample Problem 2

A child bounces a ball by throwing it down at 3.0 m/s. It hits the ground after 0.25 seconds. How fast is it going just before it hits?

Step 1: Write the values of the variables

v_i = 3.0 m/s
t = 0.25 s
g = 9.8 m/s^2

Step 2: Substitute values into the equation

$$v_f = gt + v_i$$

v_f = (9.8 m/s2)(0.25 s) + 3.0 m/s = 5.45 m/s

In Sample Problem 1, we calculated that an object that falls for 3.0 seconds with an initial speed of 0 m/s reaches a speed of 29.4 m/s. Since the acceleration is constant, the average speed between any two measurements is the midpoint. It is found by adding the two values and dividing by two. The average speed of the falling object was:

$$v_{average} = \frac{v_f + v_1}{2} = \frac{29.4\,{}^m\!/\!_s + 0\,{}^m\!/\!_s}{2} = 14.7\,{}^m\!/\!_s$$

In the three seconds it was falling, it traveled a distance $d = vt = (14.7\ {}^m\!/\!_s)(3.0\ s) = 44.1\ m$. The same result can be obtained using the formula $d = \frac{1}{2}at^2 + v_i t$

$d = \frac{1}{2}at^2 + v_i t = \frac{1}{2}(9.8\ {}^m\!/\!_{s^2})(3.0\ s)^2 = 44.1\ m$

A penny falling from the Empire State Building hits the ground in 9.5 seconds. How far did it fall?

Step 1: Write the values of the variables

$v_i = 0\ {}^m\!/\!_s$
$t = 9.5\ s$
$a = g = 9.8\ {}^m\!/\!_{s^2}$

Step 2: Substitute values into the equation

$$d = \tfrac{1}{2}at^2 + v_i t$$

d = ½(9.8 m/s2)(9.5 s)^2 + (0 m/s)(9.5 s) = 442 m

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.

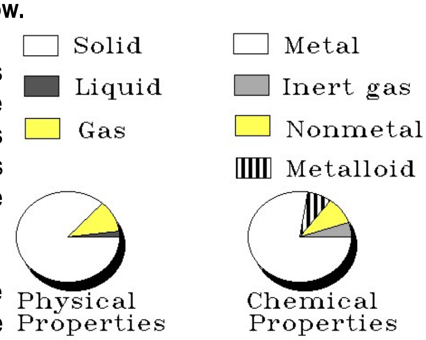
5. The number of axes a graph would have if it showed the relationship between two variables is (1) 1, (2) 2, (3) 3, (4) 4.

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.

7. 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 and negative.

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

Below are two graphs showing the occurrence of physical and chemical properties of the first 104 elements. Answer questions 9-12 based on the graphs below.



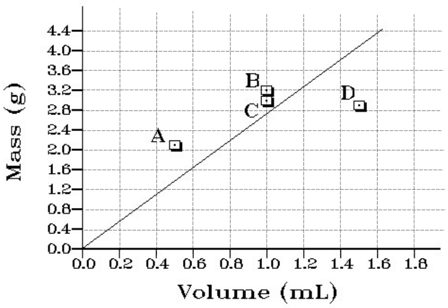
9. What type of graphs are pictured to the right? (1) line graphs (2) pictograms (3) histograms (4) pie charts

10. 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.

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

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

Answer questions 13-18 by referring to the graph below showing the mass an volume of some samples of aluminum



13. 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)

14. 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.

15. 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.

16. 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.

17. 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.

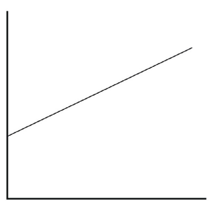
18. What type of relationship is shown by the graph above? (1) linear indirect (2) curved indirect (3) linear direct (4) curved direct.

Answer questions 19-20 by referring to the diagrams below

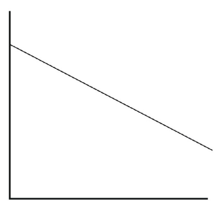
19. Which of the graphs below shows a linear direct relationship?

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

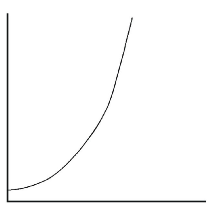
(1)



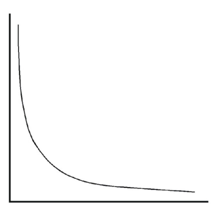
(2)



(3)



(4)



21. How fast are you traveling if a 4,500 km trip takes 4.5 h? (1) 1,000 km/h (2) 20,250 km/h (3) 0.001 km/h (4) 4504.5 km/h

22. How far can you go in 3.0 h at 85 $^{km}/_{h}$? (1) 0.035 km (2) 28.33 km (3) 255 km (4) 88 km

23. How long will it take to run a 0.4 km track at a speed of 0.16 $^{km}/_{min}$? (1) 0.56 min (2) 0.064 min (3) 0.4 min (4) 2.5 min

24. How fast will a runner be going if she speeds up from 2.7 m/s by accelerating at a rate of 0.5 m/s^2 for 6 s? (1) 3.0 m/s (2) 5.7 m/s (3) 0.3 m/s (4) 16.2 m/s

25. How long does it take for a car going 40 km/h to speed up to 75 km/h with an acceleration of 10 km/h/s? (1) 3.5 s (2) 350 s (3) 7.5 s (4) 4 s

26. What is the acceleration of a car that goes from a stop to 88 km/h in 4.0 s? (1) 352 km/h/s (2) 22 km/h/s (3) 0.045 km/h/s (4) 92 km/h/s

27. What measures the quantity of matter? (1) speed (2) weight (3) acceleration (4) mass

28. Which of the following objects is NOT accelerating? (1) a jogger moving at a constant speed (2) a car that is slowing down (3) Earth orbiting the Sun (4) a car that is speeding up

29. Which of the following equals speed? (1) acceleration/time (2) (change in velocity)/time (3) distance/time (4) displacement/time

30. Which of these is an acceleration? (1) 5 m east (2) 15m/s east (3) 52 m/s^2 east (4) 32 s^2 east

31. What is 18 cm/h north an example of? (1) speed (2) velocity (3) acceleration (4) momentum

32. Which is true when the velocity and the acceleration of an object are in the same direction? (1) The object's speed is constant. (2) The object changes direction. (3) The object speeds up. (4) The object slows down.

33. Which of the following equals the change in velocity divided by the time? (1) speed (2) displacement (3) momentum (4) acceleration

34. You travel to a city 200 km away in 2.5 hours. What is your average speed in km/h? (1) 180 km/h (2) 12.5 km/h (3) 80 km/h (4) 500 km/h

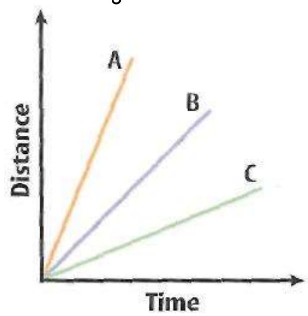
35. From the graph below, which object is moving the fastest?

(1) A

(2) B

(3) C

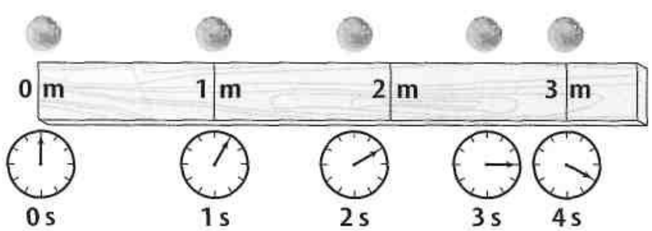
(4) It isn't possible to tell



36. What is the distance traveled divided by the time taken to travel that distance? (1) acceleration (2) velocity (3) speed (4) inertia

37. Sound travels at a speed of 330 m/s. How long does it take for the sound of thunder to travel 1,485 m? (1) 45 s (2) 4.5 s (3) 4,900 s (4) 0.22 s

Use the figure below to answer questions 39 and 40.



38. During which time period is the ball's average speed the fastest? (1) between 0 and 1 s (2) between 1 and 2 s (3) between 2 and 3 s (4) between 3 and 4 s

39. What is the average speed of the ball? (1) 0.75 $^m/_s$ (2) 1 $^m/_s$ (3) 10 $^m/_s$ (4) 1.3 $^m/_s$

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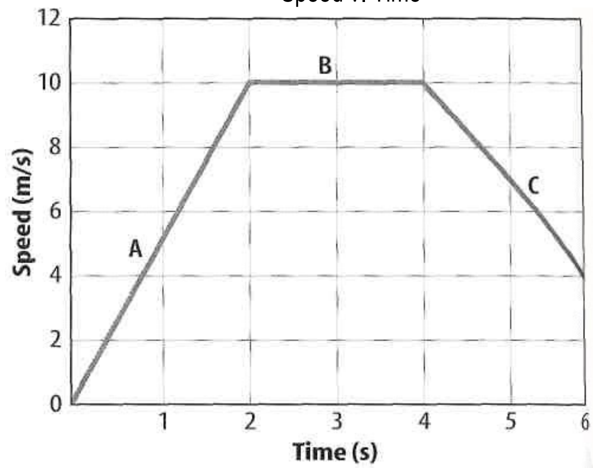
40. A car accelerates from 15 m/s to 30 m/s in 3.0 s. What is the car's acceleration? (1) 10 m/s^2 (2) 25 m/s^2 (3) 15 m/s^2 (4) 5.0 m/s^2

41. Which of the following can occur when an object is accelerating? (1) It speeds up. (2) It changes direction. (3) It slows down. (4) all of the above

Use the figure below to answer questions 43 - 45.

Speed v. Time



42. What is the acceleration between 0 and 2 s? (1) 10 m/s^2 (2) 5 m/s^2 (3) 0 m/s^2 (4) –5 m/s^2

43. During what time period does the object have a constant speed? (1) between 1 and 2 s (2) between 2 and 3 s (3) between 4 and 5 s (4) between 5 and 6 s

44. What is the acceleration between 4 and 6 s? (1) 10 m/s^2 (2) 4 m/s^2 (3) 6 m/s^2 (4) –3 m/s^2

45. An acorn falls from the top of an oak and accelerates at 9.8 m/s^2. It hits the ground in 1.5 s. What is the speed of the acorn when it hits the ground? (1) 9.8 m/s (2) 15 m/s (2) 20 m/s (4) 30 m/s

46. A girl walks 2 km north, then 2 km east, then 2 km south, then 2 km west. What is her displacement? (1) 0 km (2) 2 km (3) 3 km (4) 8 km

47. A girl leaves school at 3:00 and starts walking home. Her house is 2 km from school. She gets home at 3:30. What was her average speed? (1) 1 km/h (2) 2 km/h (3) 3 km/h (4) 4 km/h

48. A football, a hockey puck, and a tennis ball all fall down in the absence of air resistance. Which of the following is true about their acceleration? (1) The acceleration of the football is greater than the other two.(2) The acceleration of the hockey puck is greater than the other two. (3) The acceleration of the tennis ball is greater than the other two. (4)They all fall down with the same constant acceleration. (5) More information is required .

49. A tennis ball is dropped from the top of a tall building. A second tennis ball is thrown down from the same building. Make a statement about the acceleration of each tennis ball. (1) The first ball falls with a greater acceleration. (2) The second ball falls with a greater acceleration. (3) They both fall with the same acceleration because they started from the same height. (4) The both fall with the same acceleration because they are in a free fall. (5) More information is required

50. How far will a brick starting from rest fall freely in 3.0 seconds? (1) 15 m (2) 29 m (3) 44 m (4) 88 m

51. How far will a pot fall from a window in 2.5 seconds? (1) 31 m (2) 12 m (3) 25 m (4) 61 m

Answer questions 54-56 about a ball that falls from the roof of a tall building:

52. How fast will it be going after 10 seconds?

53. What is the average speed while falling

54. How far did it fall?

Answers

1. 3	15. 1	29. 3	43. 2
2. 1	16. 1	30. 3	44. 4
3. 1	17. 2	31. 2	45. 2
4. 3	18. 3	32. 3	46. 1
5. 2	19. 1	33. 4	47. 4
6. 4	20. 4	34. 3	48. 4
7. 3	21. 1	35. 1	49. 4
8. 3	22. 3	36. 3	50. 3
9. 4	23. 4	37. 2	51. 1
10. 1	24. 2	38. 1	52. 980 $^m/_s$
11. 4	25. 1	39. 1	53. 490 $^m/_s$
12. 2	26. 2	40. 4	54. 4900 m
13. 3	27. 4	41. 4	
14. 2	28. 1	42. 2	