Name_____ Date_____ Period_____

Physics Unit Test #2 Review

Heat Transfer, Thermodynamics, Circular motion, Law of Gravitation, Electrostatics, and Circuits

1. Kristle sits on a swing that is attached to an overhanging tree limb by a rope. Kristle's mom pushes him so that his centripetal acceleration is 5.3 m/s². If the length of the rope is 2.2m, what is Kristle's tangential speed?

$a = 5.3 m/s^2$
$r = 2.2m$
$v = ?$

$a_c = \frac{v^2}{r}$

$2.2 \times 5.3 = \frac{v^2}{2.2} \times 2.2$

$11.66 = v^2$

$\sqrt{11.66} = \sqrt{v^2}$

$v = 3.41 m/s$

2. Grannie is riding a skateboard and had a tangential speed of 9.2 m/s around a circular track with a radius of 27.0 m. If the magnitude of the force that maintains the skateboard's circular motion is 265 N, what is the combined mass of the skateboard and the rider?

$v = 9.2 m/s$
$r = 27m$
$F = 265N$
$m = ?$

$F = ma$ and $a = \frac{v^2}{r}$ combine

$F = m\left(\frac{v^2}{r}\right)$

$265 = \frac{m(9.2)^2}{27}$

$265 = \frac{m(9.2)^2}{27}$ solve

$\frac{265}{3.135} = \frac{m\,3.135}{3.135}$

$84.5 kg = m$

3. Two asteroids, ($m_1 = 1.00 \times 10^{12}$ kg and $m_2 = 5.0 \times 10^{12}$ kg), are floating in space. The force of attraction between them is 10.000 N. **How far apart** are their centers of mass?

$m_1 = 1 \times 10^{12}$
$m_2 = 5 \times 10^{12}$
$F = 10N$
$d = ?$
$G = 6.67 \times 10^{-11}$

$F = G\frac{m_1 m_2}{d^2}$

$d^2 \times F = G\frac{m_1 m_2}{d^2} \times d^2$

$\frac{d^2 F}{F} = \frac{G m_1 m_2}{F}$

$d^2 = \frac{G m_1 m_2}{F}$

$d = \sqrt{\frac{G m_1 m_2}{F}}$

$d = \sqrt{\frac{(6.67 \times 10^{-11})(1 \times 10^{12})(5 \times 10^{12})}{10}}$

$d = 5.77 \times 10^6 m$

4. A pith ball with an excess charge of +9 μC is placed 13.8 cm from another pith ball which carries a charge of −5.3 μC. Find the force between these charges. $\mu = add \times 10^{-6}$

$q_1 = 9 \times 10^{-6} C$
$q_2 = -5.3 \times 10^{-6} C$
$d = 0.138 m$
$K = 9 \times 10^9$
$F_e = ?$

$F_e = K\frac{q_1 q_2}{d^2}$

$F_e = 9 \times 10^9 \left(\frac{(9 \times 10^{-6})(-5.3 \times 10^{-6})}{(0.138)^2}\right)$

$F_e = -22.5 N$

5. An electrostatic charge of 23 μC is placed at a distance of 19 cm from a second charge. The force of attraction between the two charges is 32.4 N. Find the magnitude of the second charge. $\mu = \times 10^{-6}$

$F = K\frac{q_1 q_2}{d^2}$

$d^2 F = K\frac{q_1 q_2}{d^2} \times d^2$

$\frac{d^2 F}{Kq_1} = \frac{Kq_1 q_2}{Kq_1}$

$\frac{d^2 F}{Kq_1} = q_2$

$\frac{(.19)^2 \times (32.4)}{(9 \times 10^9)(23 \times 10^{-6})} = q_2$

$2.99 \times 10^{-15} C = q_2$

$q_1 = 23 \times 10^{-6} C$
$d = 19cm \rightarrow 0.19m$
$F = 32.4 N$
$q_2 = ?$
$K = 9 \times 10^9$

Name_____ Date_____ Period_____

6. 23.0 g of mercury is heated from 45°C to 155°C, and absorbs 425 joules of heat in the process. To the nearest hundredth J/g°C, calculate the specific heat capacity of mercury.

$Q = m \times C_p \times \Delta T$

$m = 23\ g$
$\Delta T = 155 - 45 = 110°C$
$Q = 425\ J$

$425 = 23 \times C_p \times 110$

$\frac{425}{2530} = \frac{2530 \times C_p}{2530}$

$0.17\ J/g°C = C_p$

7. A 1450 kg car travels at 23 m/s along a horizontal curve of radius 350 m. What is the centripetal force on the car?

$m = 1450kg$
$v = 23m/s$
$r = 350m$
$F = ?$

$F = ma$ and $a = \frac{v^2}{r}$ (combine)

$F = \frac{mv^2}{r}$

$F = \frac{1450 \times (23)^2}{350}$

$F = 2192\ N$

8. Two objects gravitationally attract with a force of 100 N. If the distance between the two objects' centers is tripled, then the new force of attraction is 11.11 N.

$F = G\frac{m_1 m_2}{d^2}$ $\quad F = G\frac{m_1 m_2}{3d^2} \rightarrow \frac{1}{3^2} = \frac{1}{9}F$

$100N \times \frac{1}{9} = 11.11N$

9. Two objects gravitationally attract with a force of 83 N. If the distance between the two objects' centers is halved, then the new force of attraction is 332 N.

$F = G\frac{m_1 m_2}{d^2}$ $\quad F = G\frac{m_1 m_2}{\frac{1}{2}d^2} \rightarrow \frac{1}{(\frac{1}{2})^2} = \frac{1}{\frac{1}{4}} = 4F$

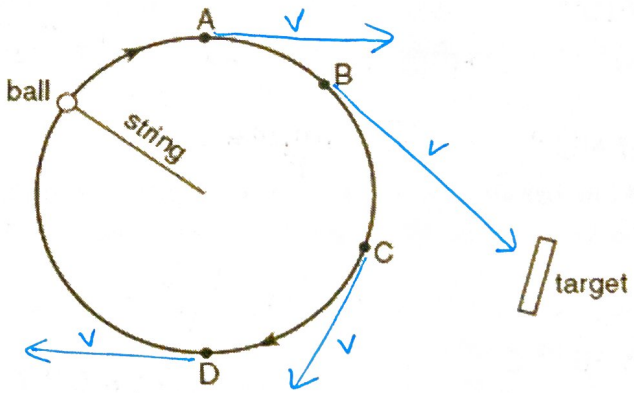
$83N \times 4 = 332N$

10. The gravitational force between two massive spheres

A. depends on how massive they are
B. is always an attraction.
C. depends inversely on the square of the distances between them.
D. all of the above

11.

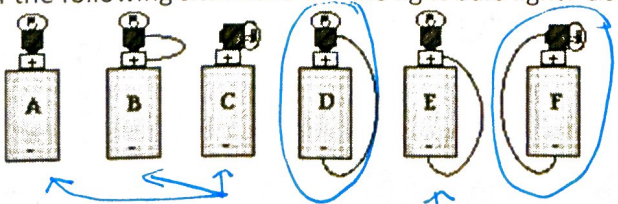
A ball attached to a string is moved at constant speed in a horizontal circular path. A target is located near the path of the ball as shown in the diagram.



At which point along the ball's path should the string be released, if the ball is to hit the target?

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

12. In which of the following situations will the light bulb light? List all that apply.



no path to − terminal

wire not touching bulb

Name_____ Date_____ Period_____

13. When two light bulbs are connected in series, the
    a. same amount of current always flows through each light bulb.
    b. current through each light bulb is proportional to its resistance
    c. neither of these
    d. bulbs will not light because of their resistance.

14. When one light bulb in a series circuit containing several light bulbs burns out,
    a. the other light bulbs burn brighter.
    b. nothing changes in the rest of the circuit.
    c. none of the other bulbs will light up.
    d. All of the bulbs will light.

15. A closed circuit is a circuit in which
    a. current can flow.
    b. is prevented from flowing.
    c. does not have a battery.
    d. it contains numerous resistors.

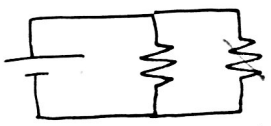
16. The total resistance of a 3-ohm resistor and a 6-ohm resistor in series is
    a. 18 ohms.
    b. 9 ohms.
    c. 0.5 ohms.
    d. 2 ohms.

$R_T = R_1 + R_2 + R_3 \ldots$

$R_T = 3\Omega + 6\Omega$

$R_T = 9\Omega$

17. When one light bulb in a parallel circuit containing several light bulbs burns out,
    a. the other light bulbs burn brighter.
    b. nothing changes in the rest of the circuit.
    c. none of the other bulbs will light up.
    d. None of the above



18. The first law of thermodynamics is a restatement of the
    a. principle of entropy.
    b. law of heat addition.
    c. Carnot cycle.
    d. conservation of energy.

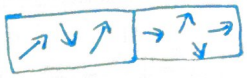
19. Specific heat capacity is related to the amount of internal energy _____.
    a. transferred by one molecule
    b. one molecule contains
    c. a specific object has
    d. needed to change the temperature of one gram of a substance one degree

20. Imagine you could observe the individual atoms that make up a piece of matter and that you observe the motion of the atoms becoming more orderly. What can you assume about the system?
    a. It is gaining thermal energy.
    b. Its entropy is increasing.
    c. Its entropy is decreasing.
    d. Positive work is being done on the system.

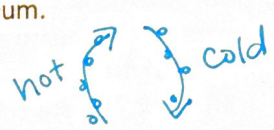
21. Temperature is related mostly to the _____.
    a. average molecular kinetic energy in a substance
    b. total kinetic energy in something
    c. average energy in a substance

Name_____ Date_____ Period_____

22. Heat transfer by conduction in metals occurs when
    a. atoms give off heat in the form of electromagnetic waves.
    b. large numbers of atoms move from place to place.
    c. electromagnetic waves travel from one place to another through a vacuum.
    d. electrons bump into atoms and other electrons

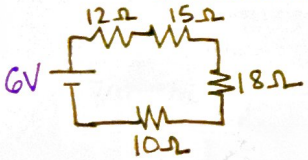


23. Heat transfer by convection occurs when
    a. electromagnetic waves travel from one place to another through a vacuum.
    b. electrons bump into other electrons.
    c. atoms give off heat in the form of electromagnetic waves.
    d. large numbers of atoms move from place to place.



Read each scenario below. Then explain which type of heat transfer is described. Some scenarios involve more than one type of heat transfer.

24. Mia places some frozen shrimp in a strainer and pours hot water over it so the shrimp will thaw faster.
    conduction-water is touching shrimp
25. On a hot summer day, Juan can walk comfortably in bare feet on the concrete sidewalk, but finds that the asphalt road will burn the soles of his feet. radiation-heating sidewalk. conduction-asphalt touching feet
26. An electric space heater warms an office. convection-warm air rises
    radiation-infrared waves coming from heater
27. Four resistors, R_1= 12Ω, R_2= 15Ω, R_3= 18Ω and R_4= 10Ω, are connected to a 6V battery in series, draw the circuit and find the total resistance and the current flowing through the circuit.



$R_T = R_1 + R_2 + R_3 \cdots$

$R_T = 12 + 15 + 18 + 10$

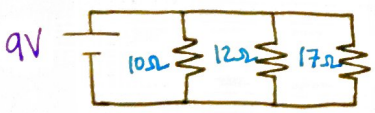
$R_T = 55\Omega$

$I = \frac{V}{R}$

$I = \frac{6V}{55\Omega}$ $\quad I = 0.109A$

V = 6V
R = 55Ω

28. Three resistors, R_1= 10Ω, R_2= 12Ω and R_3= 17Ω, are connected to a 9V battery in parallel, draw the circuit and find both the total resistance and the current flowing through the circuit.



$R_T = \frac{1}{\frac{1}{10} + \frac{1}{12} + \frac{1}{17}}$

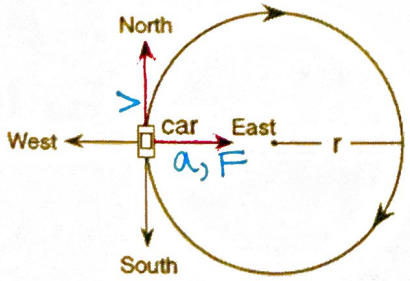
$R_T = 4.13\Omega$

$I = \frac{V}{R}$

$I = \frac{9V}{4.13\Omega} = 2.18A$

V = 9V
R = 4.13Ω

4 A car moves with a constant speed in a clockwise direction around a circular path of radius r, as represented in the diagram below.



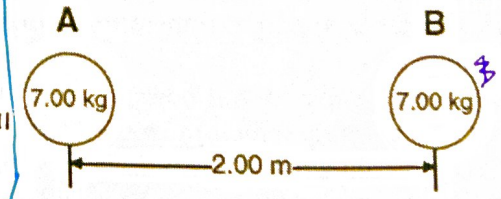
When the car is in the position shown, its acceleration is directed toward the

(1) north
(2) west
(3) south
(4) east

14 The diagram shows two bowling balls, A and B, each having a mass of 7.00 kilograms, placed 2.00 meters apart.

$m_1 = 7kg$
$d = 2m$
$m_2 = 7kg$
$G = 6.67 \times 10^{-11}$
$F = ?$

$F = G\frac{m_1 m_2}{d^2}$



What is the magnitude of the gravitational force exerted by ball A on ball B?

(1) 8.17×10^{-9} N
(2) 1.63×10^{-9} N
(3) 8.17×10^{-10} N
(4) 1.17×10^{-10} N

$F = G\frac{m_1 m_2}{d^2}$

$F = 6.67 \times 10^{-11}\left(\frac{7 \times 7}{2^2}\right) = 8.17 \times 10^{-10} N$