Part 1: *(1 point each)*

For the following questions, please circle ◯ the correct answer to the nearest number for quantitative questions. Please read each question carefully.

1. A certain physical quantity, R, is calculated using the formula: $R = 4a^2(b - c)$ where a, b, and c are distances. What is the **SI** unit for R?

(A) cm (B) cm^2 (C) m (D) m^2 (E) m^3

2. Two vectors **A** and **B** are added together to form a vector **C**. The relationship between the magnitudes of the vectors is given by $A + B = C$. Which one of the following statements concerning these vectors is true?

(A) **A** and **B** must be displacements.
(B) **A** and **B** must have equal lengths.
(C) **A** and **B** must point in opposite directions.
(D) **A** and **B** must point in the same direction.
(E) **A** and **B** must be at right angles to each other.

3. A force, $\mathbf{F}_1$, of magnitude ***2.0 N*** and directed due ***east*** is exerted on an object. A second force exerted on the object is $\mathbf{F}_2$ = ***2.0 N***, due ***north***. What is the magnitude and direction of a third force, $\mathbf{F}_3$, which must be exerted on the object so that the resultant force is zero?

(A) 1.4 N, 45° north of east
(B) 1.4 N, 45° south of west
(C) 2.8 N, 45° north of east
(D) 2.8 N, 45° south of west
(E) 4.0 N, 45° east of north

4. A player throws a fast ball with a velocity of ***43 m/s*** to the ***south***. It hits a wall and bounces back with a velocity of ***51 m/s*** to the ***north***. What was the average acceleration of the ball during the ***1.0 ms*** when it was in contact with the second player?

(A) 4.3×10^4 m/s^2, south.
(B) 5.1×10^4 m/s^2, north.
(C) 9.4×10^4 m/s^2, north.
(D) 2.2×10^3 m/s^2, south.
(E) 7.0×10^3 m/s^2, north.

5. A ball is shot straight up from the surface of the earth with an initial speed of ***19.6 m/s***. Neglect any effects due to air resistance. How much time elapses between the throwing of the ball and its return to the original launch point?

(A) 4.00 s (B) 2.00 s (C) 12.0 s (D) 8.00 s (E) 16.0 s

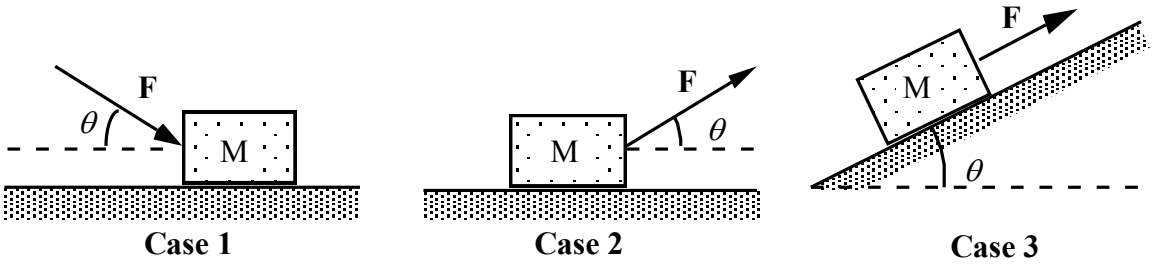
6 A car travels along a highway with a velocity of ***24 m/s, west***. The car exits the highway; and ***4.0 s*** later, its instantaneous velocity is ***16 m/s, 45° north of west***. What is the magnitude of the average acceleration of the car during the four-second interval?

(A) 2.4 m/s^2. (B) 4.2 m/s^2. (C) 1.2 m/s^2. (D) 11 m/s^2.
(E) 17 m/s^2.

7. A ball is thrown at an angle of **45°,** the angle that yields the maximum range in the absence of air resistance. What is the ratio of the ball's maximum height to its range?

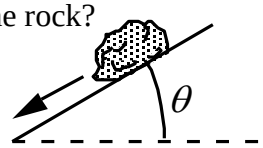
(A) 1.0. (B) 0.75. (C) 0.67. (D) 0.50 (E) 0.25.

8. Note the following situations:
In which case will the magnitude of the normal force on the block be equal to **(*Mg* + *F* sin *θ*)**?



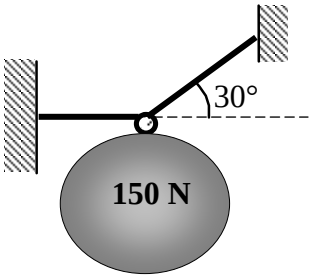
(A) case *1* only. (B) case *2* only. (C) both cases *1* and *2*. .
(D) both cases *2* and *3*. (E) cases *1*, *2*, and *3*.

9. A ***2.0 N*** rock slides on a frictionless inclined plane. Which one of the following statements is true concerning the normal force that the plane exerts on the rock?



(A) The normal force is zero Newton.
(B) The normal force is 2.0 N.
(C) The normal force is less than 2.0 N, but greater than zero newtons.
(D) The normal force is greater than 2.0 N.
(E) The normal force *increases* as the angle of inclination, *θ*, is *increased*.

10. A system of two cables supports a ***150 N*** ball as shown. What is the tension in the right-hand cable?



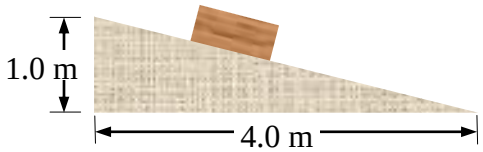
(A) 87 N. (B) 150 N. (C) 170 N. (D) 260 N.
(E) 300 N.

11. What is the tension in the horizontal cable?

(A) 87 N. (B) 150 N. (C) 170 N. (D) 260 N. (E) 300 N.

12. In an experiment with a block of wood on an inclined plane, with dimensions shown in the figure, the following observations are made:

(1) If the block is placed on the inclined plane, it remains there at rest.
(2) If the block is given a small push, it will accelerate toward the bottom of the incline without any further pushing.



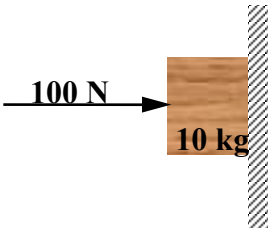
Which is the *best* conclusion that can be drawn from these observations?

(A) The coefficient of kinetic friction must be negative.
(B) Both coefficients of friction must be less than 0.25.
(C) Both coefficients of friction must be greater than 0.25.
(D) The coefficient of static friction must be less than the coefficient of kinetic friction.
(E) The coefficient of static friction is greater than 0.25 while the coefficient of kinetic friction is less than 0.25.

13. A rock is suspended from a string; and it accelerates upward. Which statement is true concerning the tension in the string?

(A) The tension points downward.
(B) The tension is less than the weight of the rock.
(C) The tension is equal to the weight of the rock.
(D) The tension is greater than the weight of the rock.
(E) The tension is independent of the magnitude of the rock's acceleration.

14. A ***10 kg*** block is pushed against a vertical wall by a horizontal force of ***100 N*** as shown in the figure. The coefficient of static friction, μ_s, between the block and the wall is ***0.60***; and the coefficient of kinetic friction, μ_k, is ***0.40***. Which one of the following statements is true if the block is initially at rest?



(A) The total force exerted on the block by the wall is directed horizontally.
(B) The block slides down the wall with an acceleration of magnitude 3.8 m/s^2.
(C) The block will slide down the wall because the force of static friction can be no larger than 60 N.
(D) The block will remain at rest because the coefficient of static friction is greater than the coefficient of kinetic friction.
(E) The block will slide down the wall because the coefficient of kinetic friction is less than the coefficient of static friction.

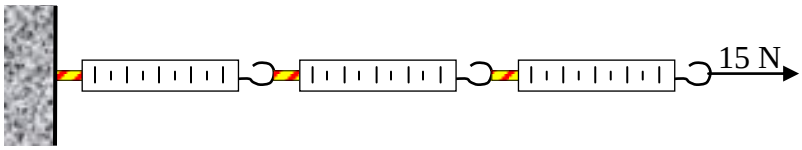
15. When an object experiences uniform circular motion, the direction of the acceleration is.

(A) in the same direction as the velocity vector.
(B) in the opposite direction of the velocity vector.
(C) is directed to the center of the circular path.
(D) is directed away from the center of the circular path.
(E) depends on the speed of the object.

16. For an object that travels at a fixed speed along a circular path, the acceleration of the object is

(A) larger in magnitude the smaller the radius of the circle.
(B) in the same direction as the velocity of the object.
(C) smaller in magnitude the smaller the radius of the circle.
(D) in the opposite direction of the velocity of the object.
(E) zero.

17. Three spring scales are attached along a straight line as shown. The scale on the left is attached to a wall. A force of ***15 N*** is applied to the scale at the right. What is the reading on the middle scale?



(A) 0 N. (B) 45 N.
(C) 10 N. (D) 5 N.
(E) 15 N.

18. A truck has four times the mass of a car and is moving with twice the speed of the car. If $\boldsymbol{K_t}$ and $\boldsymbol{K_c}$ refer to the kinetic energies of truck and car respectively, it is correct to say that

(A) $K_t = 16K_c$. (B) $K_t = 4K_c$. (C) $K_t = 2K_c$. (D) $K_t = K_c$.
(E) $K_t = \frac{1}{2}K_c$.

19. A force produces power ***P*** by doing work ***W*** in a time ***T***. What power will be produced by a force that does six times as much work in half as much time?

(A) $12P$. (B) $6P$. (C) $24P$. (D) $\frac{1}{6}P$. (E) $\frac{1}{12}P$

20. The ratio of the mass of object ***A*** to the mass of object ***B*** is ***2:1*** and the ratio of their speeds is ***1:2*** in the same order. What is the ratio of their kinetic energies?

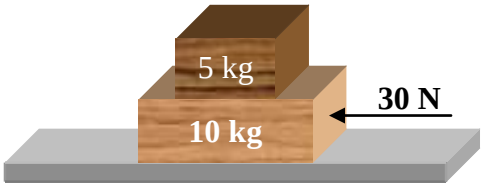
(A) 1:2 (B) 2:1 (C) 3:1 (D) 1:3 (E) 1:4

END OF PART 1

Part 2:

Please read each question carefully and show your steps in the space provided with the appropriate units to receive partial credit. *Draw a Free Body Diagram when is needed.*

1. Two blocks rest on a horizontal *frictionless* surface as shown. The surface between the top and bottom blocks is roughened so that there is no slipping between the two blocks. A ***30 N*** force is applied to the bottom block as suggested in the figure. What is the magnitude of the force of static friction between the top and bottom blocks? **(6 points)**



***Answer*_____**

2. The wheels of an automobile are locked as it slides to a stop from an initial speed of ***30.0 m/s.*** If the coefficient of kinetic friction is ***0.600*** and the road is horizontal, approximately how long does it take the car to stop? **(6 points)**

***Answer*_____**

3. A physics student runs up ***4*** flights of stairs in ***22*** seconds. He weighs ***510*** N. If each flight rises ***310 cm*** **(6 points)**

(a) What is his change in potential?

***Answer (a)*_____**

(b) What average power (watts) was required during the ***22 s***?

***Answer (b)*_____**

4. A spaceship is observed traveling in the positive ***x*** direction with a speed of ***150 m/s*** when it begins accelerating at a constant rate. The spaceship is observed ***25 s*** later traveling with an instantaneous velocity of ***1500 m/s*** at an angle of ***55°*** above the ***+x*** axis. What is the acceleration of the spaceship? **(6 points)**

***Answer*_____**

Good Luck