Part 1: *(1 point each)*

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

1. The position, ***x***, of an object is given by the equation $x = A + Bt + Ct^2$, where ***t*** refers to time. What are the **dimensions** of ***A***, ***B***, and ***C*** respectively?

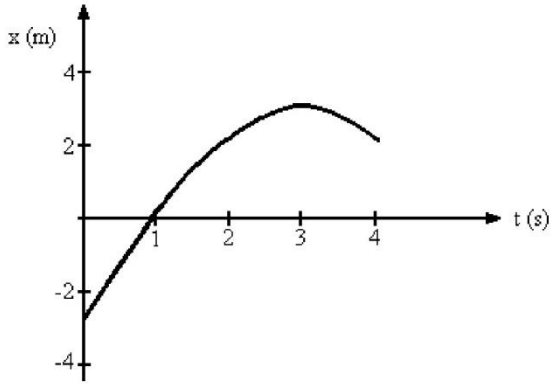
(A) distance, distance, distance (B) distance, time, time
(C) distance, time, time^2 (D) distance, distance/time, distance/time^2
(E) distance/time, distance/time^2, distance/time^3

2. When is the average velocity of an object equal to the instantaneous velocity?

(A) always (B) never (C) only when the velocity is constant
(D) only when the velocity is increasing at a constant rate
(E) only when the velocity is decreasing at a constant rate

3. The figure below represents the position of a particle as it travels along the **x–axis**. What is the ***average speed*** of the particle between $t = 1\ s$ and $t = 4\ s$?

(A) 1.0 m/s (B) 1.3 m/s (C) 0.67 m/s
(D) 0.50 m/s (E) 0.25 m/s



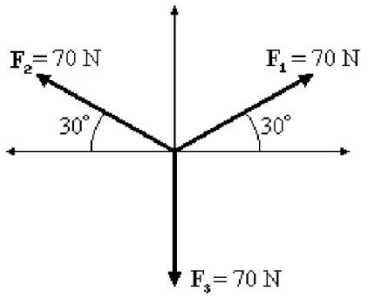
4. The velocity of a particle as a function of time is given by $\boldsymbol{v_{(t)} = 2.3\left(\frac{m}{s}\right) + 4.1\left(\frac{m}{s^2}\right)t - 6.2\left(\frac{m}{s^3}\right)t^2}$. What is the ***average acceleration*** of the particle between $t = 1.0\ s$ and $t = 2.0\ s$?

(A) -12.5 m/s^2 (B) -14.5 m/s^2 (C) 12.5 m/s^2
(D) 14.5 m/s^2 (E) 0 m/s^2

5. A car is traveling at ***26.0 m/s*** when the driver suddenly applies the brakes, giving the car a constant deceleration. The car comes to a stop in a distance of ***120.0 m***. How fast was the car moving when it was ***60.0 m*** past the point where the brakes were applied?

(A) 22.5 m/s (B) 18.3 m/s (C) 15.0 m/s (D) 12.1 m/s (E) 9.20 m/s

6 Refer to the figure below. Three forces $\vec{F}_1 = \vec{F}_2 = \vec{F}_3 =$ ***70 N*** are acting on an object as shown in the figure. Which one of the following statements is true regarding the resultant force acting over the object?



(A) The resultant force is 35 N.
(B) The resultant force is 70 N.
(C) The resultant force is 140 N.
(D) The resultant force is 210 N.
(E) The resultant force is 0 N.

7. Ahmad kicks a soccer ball with an initial velocity of ***25 m/s*** at an angle of ***30°*** above the horizontal. The horizontal component of the velocity of the ball is described by one of the following statements.

(A) It increases uniformly. (B) It decreases uniformly.
(C) It is zero. (D) It is 25 m/s.
(E) It remains constant during the ball's flight.

8. A bullet is fired from ground level with a speed of ***150 m/s*** at an angle ***30.0°*** above the horizontal at a location where $\boldsymbol{g = 10.0\ m/s^2}$. What is the vertical component of its velocity when it is at the highest point of its trajectory??

(A) 0 m/s. (B) 10 m/s. (C) 75.0 m/s. (D) 130 m/s.
(E) 150 m/s.

9. A boy kicks a football with a certain initial velocity at an angle ***20°*** above the horizontal. In ***2.0 seconds***, the ball reaches at its highest point in its trajectory. What is the initial velocity of the ball?

(A) 9.8 m/s (B) 20 m/s (C) 57 m/s (D) 4.9 m/s (E) 29 m/s

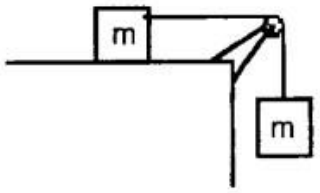
10. A ***777*** aircraft has a mass of ***300,000 kg***. At a certain instant during its landing, its speed is ***27.0 m/s***. If the braking force is ***435,000 N***, how much further does it travel along the runway before it comes to a stop?

(A) 40.5 m. (B) 142 m. (C) 181 m. (D) 251 m.
(E) 456 m.

11. A ***50.0 kg*** crate is being pulled along a horizontal, smooth surface. The pulling force is ***10.0 N*** and is directed ***20.0°*** above the horizontal. What is the acceleration of the crate?

(A) 0.0684 m/s^2 (B) 0.188 m/s^2 (C) 0.200 m/s^2 (D) 0.376 m/s^2
(E) 0.0728 m/s^2

12. Two identical masses are attached by a light string that passes over a small pulley, as shown in the figure below. The table and the pulley are frictionless. The masses are moving



(A) with an acceleration less than g.
(B) at constant speed.
(C) with an acceleration greater than g.
(D) with an acceleration equal to g.
(E) with an acceleration that cannot be determined without additional information.

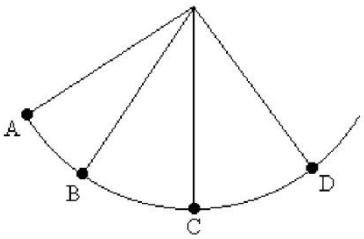
13. If you walk ***5.0 m*** horizontally forward at a constant velocity carrying a ***10 N*** object, the amount of work you do is

(A) more than 50 J. (B) equal to 50 J. (C) less than 50 J, but more than 0 J
(D) 0.0 J E) cannot be determine, need more information.

14. Two identical vertical springs S_1 and S_2 have masses $m_1 = 400\ g$ and $m_2 = 800\ g$ attached to them. If m_1 causes spring S_1 to stretch by ***4 cm***, what is the ratio of the potential energy of S_1 and S_2? **Use g = 10 m/s^2**.

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

15. A mass is attached to one end of a string. The other end of the string is attached to a rigid support. The mass is released at ***A*** and swings in a vertical arc to points ***B, C***, and ***D***, as shown in the figure below. Neglect air resistance and use $g = 10\ m/s^2$.
At what point does the mass have the most potential energy?



(A) A (B) B (C) C (D) D
(E) not enough information.

16. Refer to the **figure** in **Question 15,** at what point does the mass have the most kinetic energy?

(A) A (B) B (C) C (D) D
(E) not enough information.

End of Part 1

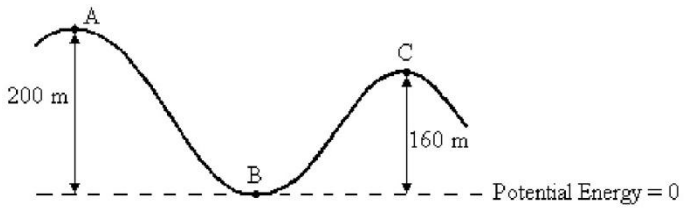
Part 2:

Please read each question carefully and show your steps in the space provided with the appropriate units to receive partial credit. Each question is graded on a 4 points scale. ***Draw a Free Body Diagram when is needed.***

1. Three boxes rest side–by–side on a smooth, horizontal floor. Their masses are ***5.0 kg***, ***3.0 kg***, and ***2.0 kg***, with the ***3.0 kg*** mass in the center. A force of ***50 N*** pushes on the ***2.0 kg*** mass, which pushes against the other two masses. What is the contact force between the ***3.0 kg*** mass and the ***2.0 kg*** mass? **(6 points)**

***Answer*_____**

2. A roller coaster of mass ***80.0 kg*** is moving with a speed of ***20.0 m/s*** at position ***A*** as shown in the figure below. The vertical height at position ***A*** above ground level is ***200 m***. **Neglect friction and use $g = 10.0\ m/s^2$.** **(5 points)**
What is the speed of the roller coaster at point ***C***?



***Answer*_____**

3. A two–dimensional elastic collision of two particles. Particle ***1*** of mass m_1 approaching a stationary particle ***2*** of mass m_2. As a result of their interaction, the incident particle moves away along a line that makes an angle of ***30°*** with its original path, and the other particle moves away along a line that makes an angle of ***30°*** to the other side of the original path of the incident particle. What is the ratio of the masses, m_1/m_2? **(5 points)**

***Answer*_____**

4. A ***2.00 g*** bullet hits and becomes embedded in a ***5.00 kg*** wood block which is hanging from a ***1.20 m*** long string. This causes the block to swing through an arc of ***3.50°***. What was the velocity of the bullet before it hit the block? **(6 points)**

***Answer*_____**

Good Luck