

PHYSICS 231, MIDTERM I, September 30, 2002

Name: _____

Useful constants: $\rho_{\text{water}}=1000 \text{ kg/m}^3$, $g=9.8 \text{ m/s}^2$, $1 \text{ hp} = 746 \text{ W}$, $1 \text{ m} = 100 \text{ cm}$, $1 \text{ km} = 1000 \text{ m}$, $1 \text{ kg} = 1000 \text{ g}$ (grams)

Choose the most nearly correct answer.

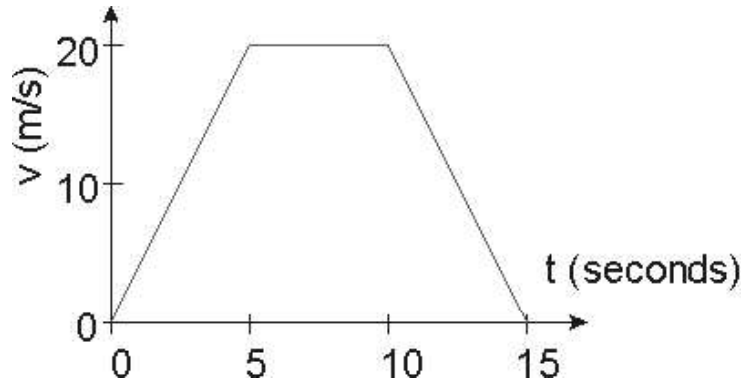
1. If a car is traveling at 28 m/s , its speed in miles per hour is closest to:

(1 mile = 1609 m)

- a) 25
- b) 32
- c) 48
- d) 63
- e) 75

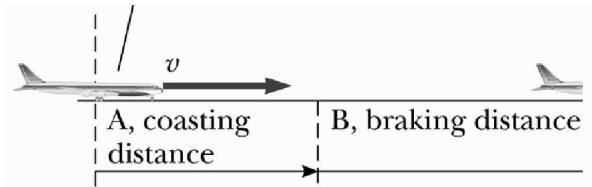
2. Considering the plot below, what distance did the object move between $t = 0$ and $t = 15$ seconds.

- a) 100 m
 - b) 981 m
 - c) 200 m
 - d) 98.1 m
 - e) 196.2 m



3. A jetliner lands at a speed of 70 m/s , coasts at that speed for 2 seconds before the pilot applies the brake resulting in a deceleration of 5 m/s^2 . The total distance traveled before the jetliner comes to a complete stop is closest to: (SF example 2.5)

- a) 1250 m
- b) 350 m
- c) 470 m
- d) 560 m
- e) 630 m



4. A train moves at a constant velocity of 60 mph. A cannon is stationed on a flatcar moving with the train. The cannon has a muzzle velocity of 120 mph. If the gunner wishes for the cannon ball to land on top of the cannon, he should: (ignore air resistance)

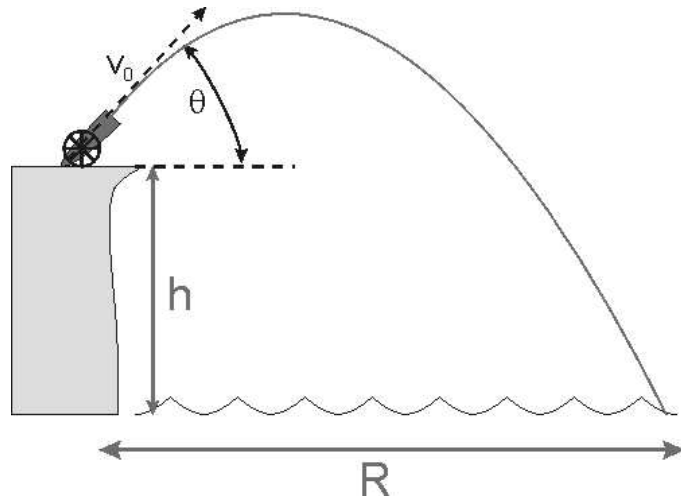
- a) point the cannon directly upwards
- b) tilt the cannon forward (westward) at an angle of 30 degrees with respect to the vertical.
- c) tilt the cannon forward (westward) at an angle of 60 degrees with respect to the vertical.
- d) tilt the cannon backwards (eastward) at an angle of 30 degrees with respect to the vertical.
- e) none of the above: you can't catch the cannon ball at constant speed; you must either speed up or slow down to do so.

5. An airplane is rated at an air speed of 400 mph. After accounting for the wind, a pilot flies the plane due east from Denver to Kansas City despite a strong north wind of 80 mph. What is the ground speed of the airplane during this trip?

- a) 480 mph
- b) 407.9 mph
- c) 320 mph
- d) 391.9 mph
- e) 440 mph

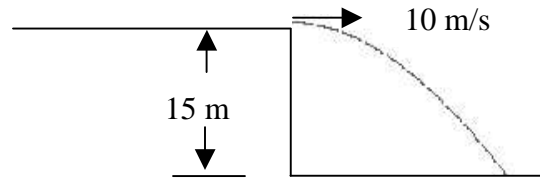
6. A cannon is shot off a cliff into the sea. The gunner can adjust the angle relative to the horizontal from -90 to $+90$ degrees, and can adjust the muzzle velocity, v_0 . Choose the ONE STATEMENT which is FALSE. Ignore air resistance.

- a) The speed of the projectile when it hits the water depends on v_0 but does not depend on θ .
- b) The range of the projectile, R , depends on both v_0 and θ .
- c) The y-component of the velocity is zero at the highest point of the trajectory.
- d) The x-component of the velocity stays constant throughout the trajectory.
- e) The time the projectile spends in the air is independent of v_0 .



7. A ball is thrown horizontally from the top of a 15 m high cliff. If the initial speed of the ball is 10 m/s, what is the speed of the ball when it hits the ground? Ignore air resistance.

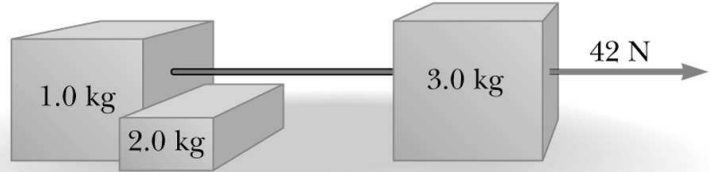
- a) 10 m/s
- b) 15 m/s
- c) 19.8 m/s
- d) 29.8 m/s
- e) none of the above



8. The three blocks are being pulled to the right with a rope whose tension is $T = 42 \text{ N}$. The blocks slide on a frictionless table. What is the magnitude of the force between the 2-kg block and the 1-kg block?

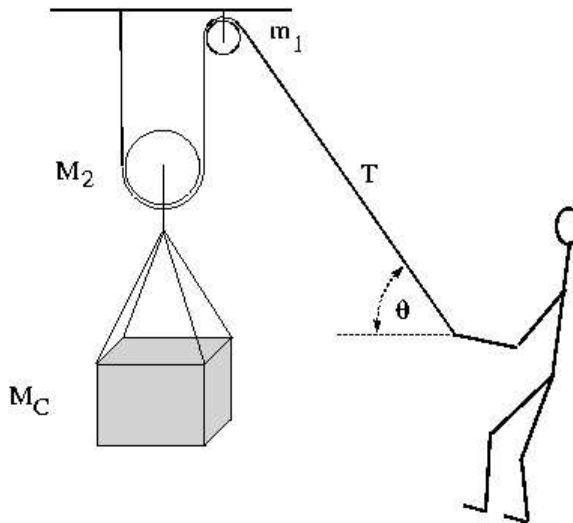
- a) 42 N
- b) 21 N
- c) 14 N
- d) 7 N
- e) 0

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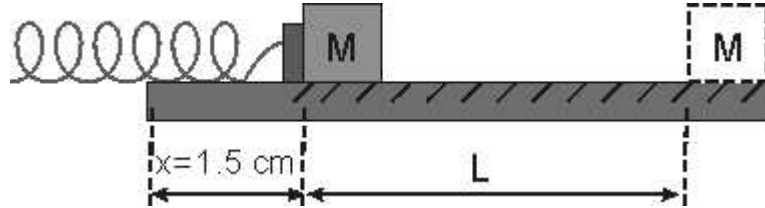
9. A student is holding a carton of mass $M_C = 120 \text{ kg}$ in the air with the pulley system shown here. The pulleys have masses $M_2 = 20 \text{ kg}$ and $m_1 = 10 \text{ kg}$. The cables are assumed to be massless and the pulleys are assumed to be frictionless. The angle of the cable is $\theta = 45$ degrees. What is the tension in the cable?

- a) 1177 N
- b) 687 N
- c) 1472 N
- d) 971 N
- e) 5456 N



10. A massless spring with spring constant $k=1500 \text{ N/m}$, is compressed a distance of $x = 1.5 \text{ cm}$ to launch a box of mass, $M = 0.15 \text{ kg}$. The box slides across a table top where the coefficient of friction is $\mu = 0.22$. What is the distance L that the box slides before it stops? (Assume the friction exists only over the hashed portion of the table)

- a) 52.1 cm
- b) 3.50 m
- c) 88.7 cm
- d) 1.34 m
- e) 91.1 cm



11. A baseball of mass 0.1 kg and a bowling ball of mass 1.5 kg collide head on. How should one fill in the two blanks to make the following statement correct.

The magnitude of the force experienced by the baseball is _____ the magnitude of the force experienced by the bowling ball and the magnitude of the baseball's acceleration is _____ the magnitude of the acceleration experienced by the bowling ball.

(Quick Quiz 4.6)

- a) greater than / equal to
- b) equal to / equal to
- c) equal to / greater than
- d) greater than / greater than
- e) less than / equal to

12. A bucket of water with total mass 125 kg is raised from a well at a constant speed of 3.6 m/s by means of a motor. Assuming an efficiency of 0.8 , how many horsepower must the motor deliver?

- a) 5.9 hp
- b) 7.4 hp
- c) 45 hp
- d) 450 hp
- e) 560 hp

