PHYSICS 191/193

PRACTICE QUESTIONS
MIDTERM TEST

1. Given that $\vec{a} = (1.0\,\hat{i} + 1.0\,\hat{j} + 1.0\,\hat{k})$ and $\vec{b} = (-1.0\,\hat{i} - 1.0\,\hat{j} - 1.0\,\hat{k})$:

   a) Find the scalar product between these two vectors.
   b) What is the angle between these two vectors? Does this make sense? Explain.
   c) What is the vector product of these two vectors?
   d) What is $3\vec{a} - 2\vec{b}$?

2. A rock is thrown directly upwards from the edge of the roof of a building that is 37.5 meters high. The rock misses the building on its way down, and is observed to strike the ground 4.0 seconds after being thrown. Take the acceleration due to gravity to have a magnitude of 9.8 m/s^2 and neglect any air resistance. With what speed was the rock thrown?

3. A rocket takes off vertically from the launchpad with no initial velocity but a constant upward acceleration of 2.25 m/s^2. At 15.4s after blastoff, the engines fail completely so the only force on the rocket from then on is the pull of gravity (free fall).

   a) What is the maximum height the rocket will reach above the launchpad?
   b) How fast is the rocket moving at the instant before it crashes onto the launchpad?
   c) How much longer after the engines fail does it take for the rocket to crash on the launchpad?

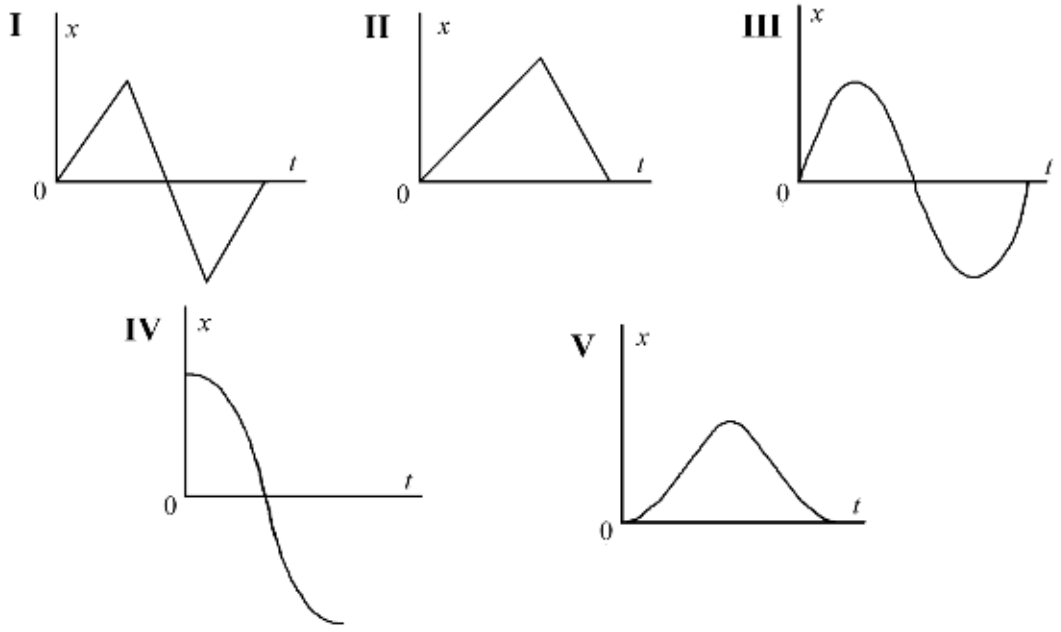
4. A projectile is fired at time t=0.0s, from the edge of a vertical cliff next to the ocean, with initial velocity components of v_{ox} = 60 m/s and v_{oy} = -10 m/s. The projectile eventually falls into the ocean at some distance below the horizontal level of the cliff. The time of flight of the projectile before it impacts the ocean is 20.0s. What is the magnitude of the velocity at time t=15.0s? What is the angle of the velocity vector just before the projectile hits the ocean?

5. A rock is thrown from the roof of a building, with an initial velocity of 10 m/s at an angle of 30.0 degrees above the horizontal. The rock is observed to strike the ground 43.0 m from the base of the building. What is the height of the building?

6. An object is thrown vertically upwards with a speed of 35 m/s. Taking g=10 m/s^2 and the positive direction to be upwards, the vertical (y) component of the velocity vector of the object 5 seconds later is:

a) + 7 m/s
b) -15 m/s
c) +15 m/s
d) -85 m/s
e) +85 m/s

7. A car starts moving from rest and experiences a (positive) acceleration along a straight road (assume that the car starts moving in the positive x direction). After a certain amount of time has elapsed, the car begins to decelerate until it stops. It then returns to its original position in a similar manner. Which of the five following position-time graphs best describes the motion?

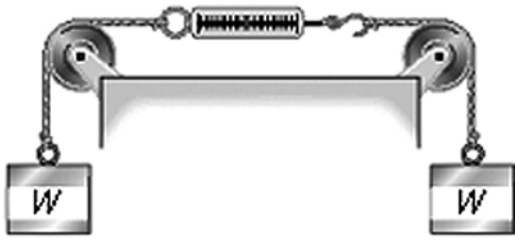


A) I
B) II
C) III
D) IV
E) V

8. A 50.0-N box is sliding on a rough horizontal floor, and the only horizontal force acting on it is friction. You observe that at one instant the box is sliding to the right at 1.75 m/s and that it stops in 2.25 s with uniform acceleration. The force that friction exerts on this box is closest to:

a) 3.97 N b) 8.93 N c) 38.9 N d) 50.0 N e) 490 N

9. Two objects, each of weight *W*, hang vertically as shown in the figure below. They are both stationary. The pulleys and the two strings attached to the objects have negligible weight, and there is no appreciable friction in the pulleys. A spring scale (used to measure force) is inserted between the two strings as shown. The reading of the spring scale is



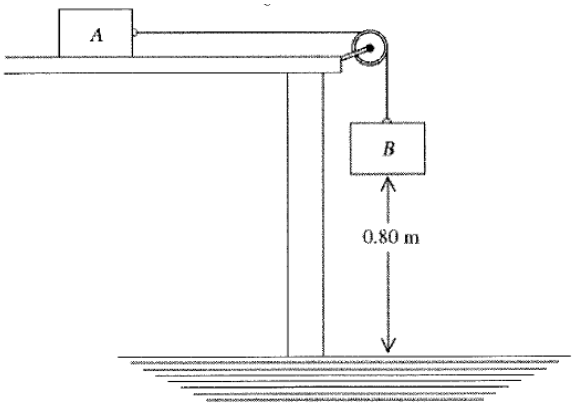
a) *W*
b) more than *W*, but not quite twice as much
c) less than *W*
d) 2*W*
e) more than 2*W*

10. Consider what happens when you jump up in the air. Which of the following is the most accurate statement? [**HINT:** Consider that you are jumping while standing on a (spring) scale which measures the contact force that YOU exert on the Earth's surface (this is just equal to your wait IF you are <u>stationary</u> relative to the earth).]

a) It is the upward force exerted by the ground that pushes you up, but this force can never exceed your weight.
b) You are able to jump up because the earth exerts a contact force upward on you that is greater than the downward contact force that you exert on the earth.
c) Since the ground is stationary, it cannot exert the upward force necessary to propel you into the air. Instead, it is the internal forces of your muscles acting only within your body itself that propels your body into the air.
d) When you push down on the earth with a force greater than your weight, the earth will push back with the same magnitude force and thus propel you into the air.
e) When you jump up the earth exerts a force F_1 on you and you exert a force F_2 on the earth. You go up because $F_1 > F_2$.

11. In the figure below, two wooden blocks of 0.30 kg mass each are connected by a string that passes over a pulley. One block slides on a horizontal table, while the other hangs suspended by the string, as shown in the figure. At $t = 0$, the suspended block is 0.80 m over the floor, and the blocks are released from rest. After 2.5 s, the suspended block reaches the floor. What is the coefficient of kinetic friction (μ_k) between the table and the sliding block?

a) 0.35 b) 0.52 c) 0.84 d) 0.65 e) 0.95



12. A stone is thrown directly upward at 15.0 m/s from ground level and feels no appreciable air resistance. Find how high it will be when its speed has been reduced to half of its initial value.