# FIRST YEAR PHYSICS
JANUARY, 2003

Directions: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points. Use: $g = 9.8$ m/s^2.

1. The density of an object is defined as:
   a. the volume occupied by each unit of mass.
   b. the amount of mass for each unit of volume.
   c. the weight of each unit of volume.
   d. the amount of the substance that has unit volume and unit mass.
   e. the amount of the substance that contains as many particles as 12 grams of the carbon-12 isotope.

2. The position of a particle moving along the x axis is given by $x = (21 + 22t - 6.0t^2)$ m, where t is in s. What is the average velocity during the time interval t = 1.0 s to t = 3.0 s?
   a. –6.0 m/s   b. –4.0 m/s   c. –2.0 m/s   d. –8.0 m/s   e. 8.0 m/s

3. Vx is the velocity of a particle moving along the x axis as shown. If x = 2.0 m at t = 1.0 s, what is the position of the particle at t = 6.0 s?

   a. –2.0 m   b. +2.0 m   c. +1.0 m   d. –1.0 m   e. 6.0 m
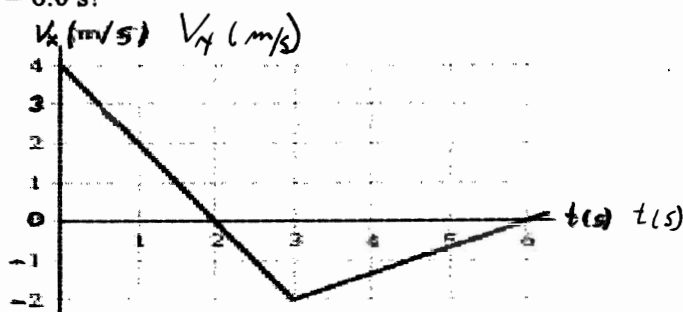
4. A particle starts from rest at x = 0 and moves for 10 s with an acceleration of +2.0 cm/s^2. For the next 20 s, the acceleration of the particle is –1.0 cm/s^2. What is the position of the particle at the end of this motion?
   a.   zero   b. +3.0 m   c. –1.0 m   d. +2.0 m   e. –3.0 m

5. Big Bad Bob weighs 1000 N on Earth. The acceleration of gravity on the moon is one-sixth of the value on Earth. What is Big Bubba's mass on the moon?
   a.   0 kg   b. 17 kg   c. 102 kg   d. 170 kg   e. 1000 kg

6. Two children start at one end of a street, the origin, run to the other end, then head back. On the way back Joan is ahead of Mike. Which statement is correct about the distances run and the displacements from the origin?
   a.   Joan has run a greater distance and her displacement is greater than Mike's.
   b.   Mike has run a greater distance and his displacement is greater than Joan's.
   c.   Joan has run a greater distance, but her displacement is less than Mike's.
   d.   Mike has run a greater distance, but his displacement is less than Joan's.
   e.   Mike has run a shorter distance, and his displacement is less than Joan's.

7. The velocity at the midway point of a ball able to reach a height y when thrown with velocity v_o at the origin is:

   a. $\dfrac{v_0}{2}$ b. $\sqrt{v_o{}^2 - 2gy}$ c. $\sqrt{\dfrac{v_o{}^2}{2}}$ d. $\sqrt{v_o{}^2 + 2gy}$ e. gy

8. The diagram below shows 3 vectors which sum to zero, all of equal length. Which statement below is true?
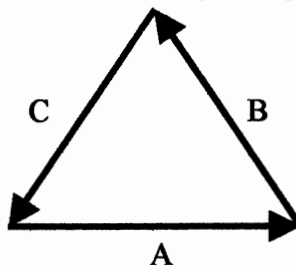
   a. $A + B = A - C$
   b. $A + B = B - C$
   c. $A - B = 2A - C$
   d. $A - B = 2A + C$
   e. $2A + 2B = 2C$

9. The initial speed of a cannon ball is 0.20 km/s. If the ball is to strike a target that is at a horizontal distance of 3.0 km from the cannon, what is the minimum time of flight for the ball?
   a. 16 s   b. 21 s   c. 24 s   d. 14 s   e. 19 s

10. An airplane flies horizontally with a speed of 300 m/s at an altitude of 400 m. Assume that the ground is level. What horizontal distance from a target must the pilot release a bomb so as to hit the target?
    a. 3.0 km   b. 2.4 km   c. 3.3 km   d. 2.7 km   e. 1.7 km

11. A car travels counterclockwise around a flat circle of radius 0.25 km at a constant speed of 20 m/s. When the car is at point A as shown in the figure, what is the car's acceleration?
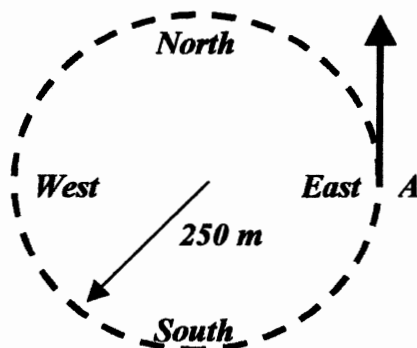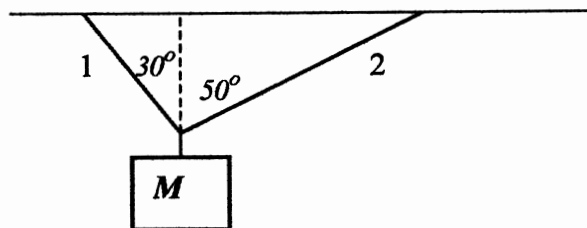

    a. 1.6 m/s^2, east   b. Zero   c. 1.6 m/s^2, south   d. 1.6 m/s^2, north   e. 1.6 m/s^2, west

12. A car travels in an oval path as shown below. $v_A = 25$ m/s, West, and $v_B = 20$ m/s, North. The ratio of the magnitude of the acceleration at B to that at A, $\dfrac{a_B}{a_A}$ is:
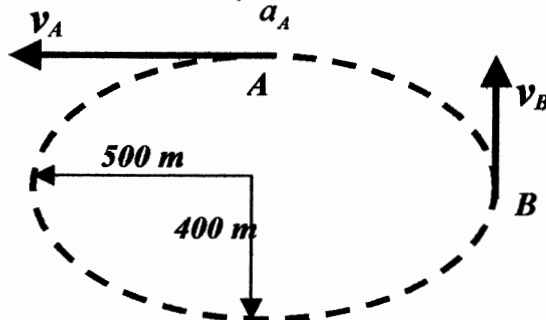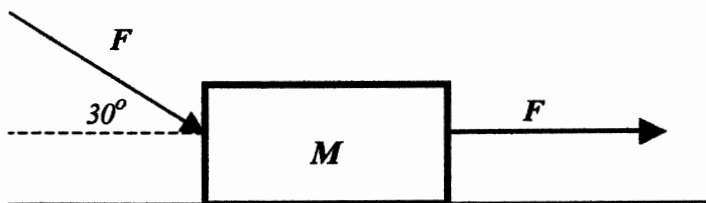

    a. 0.512   b. 0.64   c. 0.8   d. 1.25   e. 1.56

13. In the figure, if the tension in string 1 is 23 N, the angles are 30° and 50° respectively, what is the mass of the object shown?


   a. 3.8 kg   b. 3.4 kg   c. 3.0 kg   d. 4.2 kg   e. 5.0 kg

14. The horizontal surface shown on which the block slides is frictionless. If F = 20 N and M = 5.0 kg, what is the magnitude of the resulting acceleration of the block?


   a. 5.3 m/s²   b. 6.2 m/s²   c. 7.5 m/s²   d. 4.7 m/s²   e. 3.2 m/s²

15. The tension in a string from which a 4.0-kg object is suspended in an elevator is equal to 44 N. What is the acceleration of the elevator?
   a. 11 m/s² upward
   b. 1.2 m/s² upward
   c. 1.2 m/s² downward
   d. 10 m/s² upward
   e. 2.4 m/s² downward

16. A highway curve has a radius of 0.14 km and is unbanked. A car weighing 12 kN goes around the curve at a speed of 24 m/s without slipping. What is the coefficient of friction between the road on the tires?
   a. 0.12   b. 0.14   c. 0.24   d. 0.42   e. 2.4

17. A split highway has a number of lanes for traffic. For traffic going in one direction, the radius for the inside of the curve is half the radius for the outside. One car, car A, travels on the inside while another car of equal mass, car B, travels at equal speed on the outside of the curve. Which statement about resultant forces on the cars is correct?
   a. The force on A is half the force on B.
   b. The force on B is half the force on A.
   c. The force on A is four times the force on B.
   d. The force on B is four times the force on A.
   e. There is no net resultant force on either as long as they stay on the road while turning.

18. How much work is done by a person lifting a 2.0-kg object from the bottom of a well at a constant speed of 2.0 m/s for 5.0 s?
   a. 0.22 kJ   b. 0.20 kJ   c. 0.24 kJ   d. 0.27 kJ   e. 0.31 kJ

19. A block is pushed across a rough horizontal surface from point *A* to point *B* by a force (magnitude P = 5.4 N) as shown in the figure. The magnitude of the force of friction acting on the block between *A* and *B* is 1.2 N and points A and B are 0.5 m apart. If the kinetic energies of the block at A and B are 4.0 J and 5.6 J, respectively, how much work is done on the block by the force P between A and B?
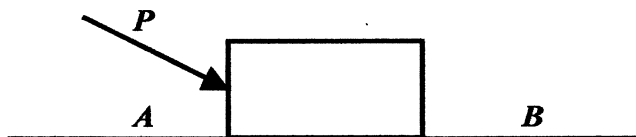
a. 2.7 J   b. 1.0 J   c. 2.2 J   d. 1.6 J   e. 3.2 J

20. A body moving along the x-axis is acted upon by a force F_x that varies with *x* as shown. What work is done by this force as the object moves from x = 1 m to x = 8 m?
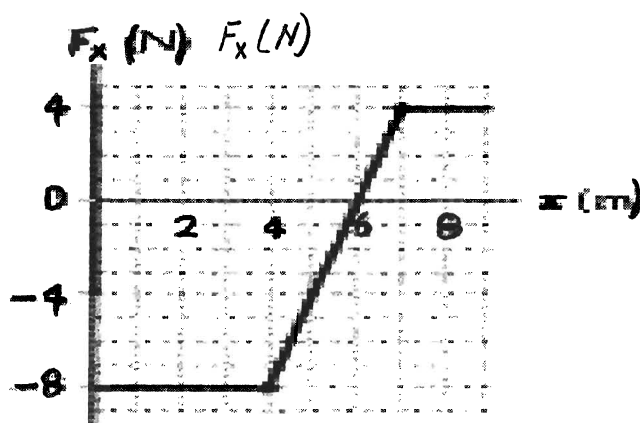
a. −2 J   b. −18 J   c. −10 J   d. −26 J   e. +18 J

21. At what rate is the gravitational force on a 2.0-kg projectile doing work at an instant when the velocity of the projectile is 4.0 m/s directed 30° above the horizontal?
a. +39 W   b. −78 W   c. −39 W   d. +78 W   e. +25 W

22. The same constant force is used to accelerate two carts of the same mass on frictionless tracks. The force is applied to cart A twice as long as it is applied to cart B. The work the force does on A is W_A, that on B is W_B. Which statement is correct?
a. $W_A = W_B$.   b. $W_A = \sqrt{2}\ W_B$.   c. $W_A = 2\ W_B$.   d. $W_A = 4\ W_B$.   e. $W_B = 2 W_A$.

23. A 0.60-kg object is suspended from the ceiling at the end of a 2.0-m string. As this suspended object swings, it has a speed of 4.0 m/s at the lowest point of its path. What maximum angle does the string make with the vertical as the object swings?
a. 61°   b. 54°   c. 69°   d. 77°   e. 47°

FIRST-YEAR PHYSICS EXAM

JANUARY 2003

SOLUTIONS

1. B	14. C
2. C	15. B
3. D	16. D
4. B	17. B
5. C	18. B
6. C	19. C
7. C	20. D
8. D	21. C
9. A	22. D
10. D	23. B
11. E	24. A
12. A	25. D
13. C	