

PART I: MULTIPLE CHOICE QUESTIONS (5 pts each)

Choose the best answer for each of Questions 1-14 below. Mark your answer on your scantron form using a #2 pencil.

1. Young's modulus describes how difficult it is to deform a material by stretching it. Consider a bar of original length  $L_0$  and cross-sectional area  $A$  subjected to a force  $F$  applied to one of its ends while the other end is held fixed. Under the action of this force, the length of the bar increases by an amount  $\Delta L$ . It turns out that, if the applied force  $F$  is not too large, then the force  $F$  required to stretch the bar is given by:

$$F = Y \left( \frac{\Delta L}{L_0} \right) A,$$

in which  $Y$  is Young's modulus. Find the dimensions of Young's modulus.

- a)  $\frac{[M]}{[L][T]^2}$   
b)  $Y$  is dimensionless  
c)  $\frac{[M]}{[L]^2 [T]}$   
d)  $\frac{[M]^2}{[T][L]}$   
e)  $\frac{[M]}{[T][L]}$
2. An interior decorator is selecting wallpaper to cover three of the four walls in his client's office. The walls are of uniform height, which the interior decorator measures to be 2.743 m. Two of the three walls to be covered are the same length, each wall being 9.252 m long. The decorator measures the length of the third wall to be covered and finds that the third wall is 7.621 m long. Using the correct number of significant figures, find the total area of wallpaper needed to cover all three walls.
- a) 52.35 m<sup>2</sup>  
b) 71.66 m<sup>2</sup>  
c) 71.7 m<sup>2</sup>  
d) 35.837 m<sup>2</sup>  
e) 46.28 m<sup>3</sup>

3. The speed of sound in air at 20° C is about 343 m/s. What is this speed in feet per second? Assume that any conversion factors you use are known *exactly*.

- a)  $1.13 \times 10^3$  ft/s
- b) 427 ft/s
- c) 7290 ft/s
- d) 0.113 ft/s
- e) 1592 ft/s

4. Consider the graph of velocity (in m/s) versus time (in seconds) shown in Figure 1. What is the instantaneous acceleration at  $t = 2.00$  s?

- a)  $5.00 \text{ m/s}^2$
- b)  $1.00 \text{ m/s}^2$
- c)  $0.00 \text{ m/s}^2$
- d)  $-5.00 \text{ m/s}^2$
- e)  $-1.00 \text{ m/s}^2$

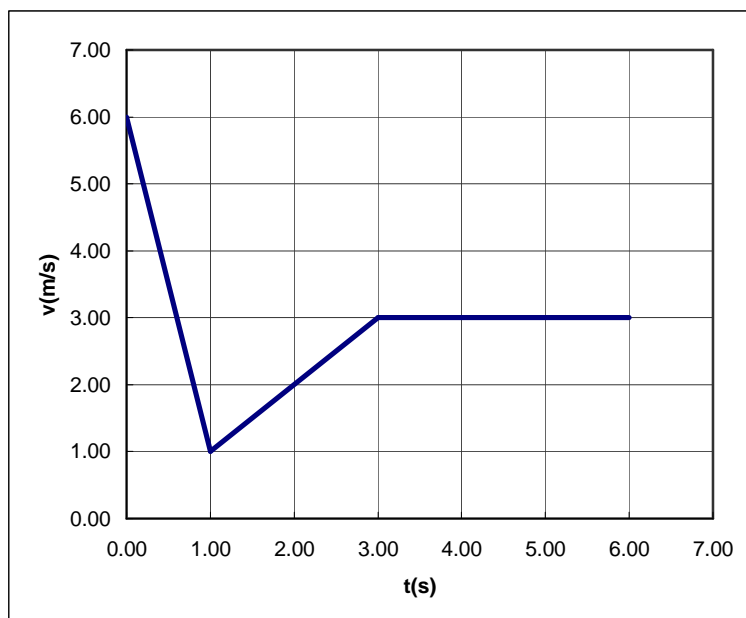


Fig. 1.

5. A car is traveling down a straight road with a constant acceleration. At  $t = 5.0$  s its velocity is 8.0 m/s and at  $t = 8.0$  s its velocity is 12 m/s. What is the distance traveled in that interval of time?

- a) 5.0 m
- b) 10 m
- c) 20 m
- d) 30 m
- e) 40 m

6. A stone is thrown straight up. When it reaches its highest point, which of the following statements is true?
- a) its acceleration is zero
  - b) its velocity is zero
  - c) both its velocity and its acceleration are zero
  - d) neither the velocity nor the acceleration is zero
  - e) its acceleration is zero but the velocity is not zero
7. A basketball is thrown straight up with an initial speed of 14 m/s. How high above its release point does it reach?
- a) 5.0 m
  - b) 20 m
  - c) 25 m
  - d) 10 m
  - e) 15 m
8. A student adds two perpendicular force vectors of magnitude 12.0 N and 8.00 N. Which of the following is the only choice for the magnitude of the resultant force?
- a) 8.90 N
  - b) 4.00 N
  - c) 20.0 N
  - d) 14.4 N
  - e) 10.0 N
9. A ball rolls over the edge of a table with a horizontal velocity  $v$  m/s. The height of the table is 1.6 m and the horizontal range of the ball from the base of the table is 20 m. How long does it take for the ball to hit the ground?
- a) 0.29 s
  - b) 2.0 s
  - c) 0.57 s
  - d) 0.75 s
  - e) 1.0 s

10. Which of the following statements expresses Newton's First Law?

- a) When an object experiences a net force, the net force (i.e., the vector sum of all the forces acting on it) is equal to the object's mass times its acceleration.
- b) The net work done on an object is equal to the change in its kinetic energy.
- c) If object 1 exerts a force on object 2, then object 2 exerts a force on object 1, and these two forces are equal in magnitude and opposite in direction.
- d) An object at rest remains at rest, and an object in motion continues in motion with constant velocity, unless it experiences a net force.
- e) If the only forces that do work on an object are conservative forces, then the total mechanical energy of the object is conserved.

11. A 40.0-kg crate is being pushed along a horizontal frictionless surface. The pushing force is 15.0 N directed at an angle of  $15.0^\circ$  below the horizontal. What is the acceleration of the crate?

- a)  $0.158 \text{ m/s}^2$
- b)  $0.466 \text{ m/s}^2$
- c)  $0.362 \text{ m/s}^2$
- d)  $0.225 \text{ m/s}^2$
- e) zero

12. A 45.0-kg person steps on a scale in an elevator. The scale reads 460 N. What is the magnitude of the acceleration of the elevator?

- a)  $0.412 \text{ m/s}^2$
- b)  $9.81 \text{ m/s}^2$
- c)  $0.500 \text{ m/s}^2$
- d)  $0.332 \text{ m/s}^2$
- e)  $1.45 \text{ m/s}^2$

13. A truck is towing a car whose mass is one quarter of the mass of the truck. The force exerted by the truck on the car is 6000 N. The magnitude of the force exerted by the car on the truck is:

- a) 1500 N
- b) 24000 N
- c) 3000 N
- d) 6000 N
- e) 12000 N

14. Which of the following statements expresses Newton's third law?

- a) The net work done on an object is equal to the change in its kinetic energy.
- b) If Object 1 exerts a force on Object 2, then object 2 exerts a force on Object 1, and these two forces are equal in magnitude and opposite in direction.
- c) An object at rest remains at rest, and an object in motion continues in motion with constant velocity, unless it experiences a net external force.
- d) When an object experiences a net force, the net force (i.e., the vector sum of all the forces acting on it) is equal to the product of the object's mass and its acceleration.
- e) If the only forces that do work on an object are conservative forces, then the total mechanical energy of the object is conserved.

PART II: FREE-RESPONSE (“SHOW-YOUR-WORK”) QUESTIONS

For Question 15, write your answers in the spaces provided. If you need additional space, you may write on the backs of these pages or ask your instructor for scratch paper. **Be sure to answer each question completely and to show all of your work in any calculations.**

- (10 pts) 15. A drag racer, starting from rest, speeds up for 4.70 s with a constant acceleration of  $17.0 \text{ m/s}^2$ . The driver then immediately deploys her parachute and begins slowing down with a constant acceleration of  $-6.10 \text{ m/s}^2$ , eventually coming to rest again.
- (a.) What is the speed of the drag racer immediately after speeding up for 4.70 s? (5 pts)
  - (b.) What is the total distance that the car travels (i.e., from the time when the car begins accelerating from rest until the time when it returns to rest after the parachute has been deployed)? (5 pts)