1. $V_x$ 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

2. A particle moving along the $x$ axis has a position given by $x = (24t - 2.0t^3)$ m, where $t$ is measured in s. What is the magnitude of the acceleration of the particle at the instant when its velocity is zero?

   a. $24 \text{ m/s}^2$  
   b. zero  
   c. $12 \text{ m/s}^2$  
   d. $48 \text{ m/s}^2$  
   e. $36 \text{ m/s}^2$

3. An automobile traveling along a straight road increases its speed from $30.0$ m/s to $50.0$ m/s in a distance of $180$ m. If the acceleration is constant, how much time elapses while the auto moves this distance?

   a. $6.00$ s  
   b. $4.50$ s  
   c. $3.60$ s  
   d. $4.00$ s  
   e. $9.00$ s

4. John throws a rock straight down with speed $12$ m/s from the top of a tower. The rock hits the ground after $2.37$ s. What is the height of the tower? (air resistance is negligible)

   a. $4.8$ m  
   b. $19.6$ m  
   c. $27.5$ m  
   d. $38.4$ m  
   e. $56.0$ m

5. Two vectors $\vec{A}$ and $\vec{B}$ are given by $\vec{A} = 5\hat{i} + 6\hat{j} + 7\hat{k}$ and $\vec{B} = 3\hat{i} - 8\hat{j} + 2\hat{k}$. If these two vectors are drawn starting at the same point, what is the angle between them?

   a. $106^\circ$  
   b. $102^\circ$  
   c. $110^\circ$  
   d. $113^\circ$  
   e. $97^\circ$
6. Vectors \( \vec{A} \) and \( \vec{B} \) are shown. What is the magnitude of a vector \( \vec{C} \) if \( \vec{C} = \vec{A} - \vec{B} \)?

![Diagram](image)

- a. 46
- b. 10
- c. 30
- d. 78
- e. 90

7. The three forces shown act on a particle. What is the direction of the particle’s acceleration?

![Diagram](image)

- a. 35°
- b. 45°
- c. 65°
- d. 55°
- e. 85°

8. Two vectors \( \vec{A} \) and \( \vec{B} \) are given by \( \vec{A} = 5\hat{i} + 6\hat{j} + 7\hat{k} \) and \( \vec{B} = 3\hat{i} - 8\hat{j} + 2\hat{k} \). If these two vectors are drawn starting at the same point, what is the angle between them?

- a. 106°
- b. 102°
- c. 110°
- d. 113°
- e. 97°

9. At \( t = 0 \), a particle leaves the origin with a velocity of 12 m/s in the positive \( x \) direction and moves in the \( xy \) plane with a constant acceleration of \( \left( -2.0\hat{i} + 4.0\hat{j} \right) \text{ m/s}^2 \). At the instant the \( y \) coordinate of the particle is 18 m, what is the \( x \) coordinate of the particle?

- a. 30 m
- b. 21 m
- c. 27 m
- d. 24 m
- e. 45 m

10. In 2.0 s, a particle moving with constant acceleration along the \( x \) axis goes from \( x = 10 \) m to \( x = 50 \) m. The velocity at the end of this time interval is 10 m/s. What is the acceleration of the particle?

- a. +15 m/s\(^2\)
- b. +20 m/s\(^2\)
- c. −20 m/s\(^2\)
- d. −10 m/s\(^2\)
- e. −15 m/s\(^2\)
11. A ball is thrown horizontally from the top of a building 0.10 km high. The ball strikes the ground at a point 65 m horizontally away from and below the point of release. What is the speed of the ball just before it strikes the ground?

a. 43 m/s  
   b. **47 m/s**  
   c. 39 m/s  
   d. 36 m/s  
   e. 14 m/s

12. A bird, accelerating from rest at a constant rate, experiences a displacement of 28 m in 17 s. What is the final velocity after 11 s?

a. 0.19 m/s  
   b. 1.6 m/s  
   c. 3.3 m/s  
   d. **2.1 m/s**  
   e. 5.1 m/s

13. A ball is thrown at an angle of $\theta = 30$ deg from the top of a building 0.10 km high. If the magnitude of ball’s initial velocity is 20 m/s, how long is the ball in air?

a. 1.2 s  
   b. 4.8 s  
   c. **5.7 s**  
   d. 12.6 s  
   e. 18.0 s

14. The initial speed of a cannon ball is 200 m/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

15. A 3.00-kg mass undergoes an acceleration given by $\mathbf{a} = (2\mathbf{i} + 5\mathbf{j})$ m/s$^2$. The magnitude of the net force is

a. 2.0 N  
   b. 4.0 N  
   c. 6.0 N  
   d. 12.0 N  
   e. **16.0 N**

16. A 10-kg block on a horizontal plane is connected by a cord over a massless, frictionless pulley to a second block of mass $m$. What hanging mass $m$ is needed so that the 10-kg block can move at acceleration of 2.8 m/s$^2$?

a. 1 kg  
   b. 2 kg  
   c. 3 kg  
   d. **4 kg**  
   e. 5 kg
17. The horizontal surface on which the block slides is frictionless. If $F = 20 \text{ N}$ and $M = 5.0 \text{ kg}$, what is the magnitude of the resulting acceleration of the block?

\[ a. \ 5.3 \text{ m/s}^2 \]
\[ b. \ 6.2 \text{ m/s}^2 \]
\[ c. \ 7.5 \text{ m/s}^2 \]
\[ d. \ 4.7 \text{ m/s}^2 \]
\[ e. \ 3.2 \text{ m/s}^2 \]

18. At an instant when a 4.0-kg object has an acceleration equal to $\left( 5\hat{i} + 3\hat{j} \right) \text{ m/s}^2$, one of the two forces acting on the object is known to be $\left( 12\hat{i} + 22\hat{j} \right) \text{ N}$. Determine the magnitude of the other force acting on the object.

\[ a. \ 2.0 \text{ N} \]
\[ b. \ 13 \text{ N} \]
\[ c. \ 18 \text{ N} \]
\[ d. \ 1.7 \text{ N} \]
\[ e. \ 20 \text{ N} \]

19. The tension in a string from which a 4.0-kg object is suspended in an elevator is equal to 28 N. What is the acceleration of the elevator?

\[ a. \ 11 \text{ m/s}^2 \text{ upward} \]
\[ b. \ 1.2 \text{ m/s}^2 \text{ upward} \]
\[ c. \ 1.2 \text{ m/s}^2 \text{ downward} \]
\[ d. \ 10 \text{ m/s}^2 \text{ upward} \]
\[ e. \ 2.8 \text{ m/s}^2 \text{ downward} \]