<p>| | |</p>
<table>
<thead>
<tr>
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</table>
| 1. | This is to identify the exam version you have – IMPORTANT  
Mark the A |
| 2. | This is to identify the exam version you have – IMPORTANT  
Mark the B |
| 3. | ![Graph](image)

A train car moves along a long straight track. The graph shows the position as a function of time. The graph shows that the train:

- a) speeds up all the time.
- b) slows down all the time.
- c) speeds up part of the time and slows down part of the time.
- d) moves at a constant velocity.

| 4. | A ball is thrown up into the air. While the ball is in free fall, what does its acceleration do?  
Mark the B |
|---|---|
|   | a) decreases  
b) remains constant  
c) increases and then decreases  
d) increases |
1. A projectile is fired from the edge of a building with a speed $v_0$. Assume air resistance can be neglected. Which of the directions shown will give the largest speed just before it hits the ground?

(a) direction a  
(b) direction b  
(c) direction c  
(d) all the same  
(e) none of these

\[
\text{SPEED} = \sqrt{V_x^2 + V_y^2}
\]

\[
SP_{\text{initial}} = \sqrt{V_{x_i}^2 + V_{y_i}^2} = \text{same for all}
\]

\[
V_{y_f} = V_{y_i} + 2a(y_f - y_i)
\]

\[
SP_{\text{final}} = \sqrt{V_{x_f}^2 + V_{y_f}^2} = \text{same for all}
\]

6. A projectile is fired with a speed of 40 m/s at angle of $60^\circ$ with respect to the horizon. What is its speed when it reaches its maximum elevation?

(a) zero  
(b) 40 m/s  
(c) 35 m/s  
(d) 20 m/s  
(e) none of these

\[
V_x = V_i \cos 60^\circ
\]

7. A ball is thrown straight up with a speed of 20 m/s from the edge of a 50 m tall building so that it hits the ground below. What is the speed of the ball just before it hits the ground?

(a) 24 m/s  
(b) 30 m/s  
(c) 37 m/s  
(d) 31 m/s  
(e) none of these

\[
V_{y_f}^2 = V_{y_i}^2 + 2a(y_f - y_i)
\]
8. The position of a particle is given in the graph below as a function of time.

Over what time interval is the acceleration positive?

a) 0 – 3 sec  
b) 3 – 6 sec  
c) 6 – 8 sec  
d) 9 – 12 sec

9. \( v_x \) is the velocity of a particle moving along the x-axis as shown.

What is the acceleration of the particle at \( t = 20 \) s?

- \( +2.0 \text{ m/s}^2 \)  
- \( -2.0 \text{ m/s}^2 \)  
- \( +1.0 \text{ m/s}^2 \)  
- \( -1.0 \text{ m/s}^2 \)  
- \( 0 \text{ m/s}^2 \)
10. $V_t$ is the velocity of a particle moving along the $x$ axis as shown. If $x = 0$ m at $t = 0$ s, what is the position of the particle at $t = 60$ s?

A) 0 m  
B) +1,200 m  
C) -300 m  
D) -1.0 m  
E) +600 m

11. A particle moving along the $x$-axis has a position given by $x = 54t - 2.0t^3$ m. At the time $t = 3.0$ s, the speed of the particle is zero. Which statement is correct?

a. The particle remains at rest after $t = 3.0$ s.

b. The particle no longer accelerates after $t = 3.0$ s.

c. The particle can be found at positions $x < 0$ m only when $t < 0$ s.

d. All of the above are correct.

e. None of the above is correct.

\[ v = \frac{dx}{dt} = (54 - 6t^2) \text{ m/s} \]

\[ a = \frac{dv}{dt} = -12t \]
12. The position of an object at equal time intervals is shown below:

which graph below correctly represents position versus time for this object?

<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><img src="a" alt="Graph A" /></td>
<td><img src="b" alt="Graph B" /></td>
<td><img src="c" alt="Graph C" /></td>
</tr>
<tr>
<td><img src="d" alt="Graph D" /></td>
<td><img src="e" alt="Graph E" /></td>
<td></td>
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</tbody>
</table>

13. The graph below shows the velocity versus time graph for a ball. Which explanation best fits the motion of the ball as shown by the graph?

<p>| |</p>
<table>
<thead>
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<tbody>
<tr>
<td><img src="v" alt="Velocity Graph" /></td>
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</tbody>
</table>

- a. The ball is falling, is caught, and is thrown down with greater speed.
- b. The ball is rolling, stops, and then continues rolling.
- c. The ball is rising, hits the ceiling, and falls down.
- d. The ball is falling, hits the floor, and bounces up.
- e. The ball is rising, is caught, and then is allowed to fall.
<table>
<thead>
<tr>
<th>velocity</th>
<th>$v = \frac{dx}{dt}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>acceleration</td>
<td>$a = \frac{dv}{dt}$</td>
</tr>
<tr>
<td>gravitational acceleration</td>
<td>$a = g = 9.8 \text{ m/s}^2$ downwards</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Kinematics (1-dimensional)</th>
<th>$v_f = v_i + at$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$x_f = x_i + v_i \cdot t + \frac{1}{2}a \cdot t^2$</td>
</tr>
<tr>
<td></td>
<td>$v_f^2 = v_i^2 + 2a(x_f - x_i)$</td>
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<thead>
<tr>
<th>Projectile Motion (2-dimensional)</th>
<th>$v_{xf} = v_{xi}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$x_f = x_i + v_{xi} \cdot t$</td>
</tr>
<tr>
<td></td>
<td>$v_{yf} = v_{yi} + a \cdot t$</td>
</tr>
<tr>
<td></td>
<td>$v_{yf}^2 = v_{yi}^2 + 2ay(y_f - y_i)$</td>
</tr>
<tr>
<td></td>
<td>$y_f = y_i + v_{yi} \cdot t + \frac{1}{2} \cdot a \cdot t^2$</td>
</tr>
</tbody>
</table>

| quadratic equation $x^2 + px + q = 0$ | $x_{1,2} = \frac{-p \pm (p^2/4 - q)^{1/2}}{2}$ |