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Dissecting Vector Kinematics: 10th Grade Physics Challenge

Can you predict the trajectory of an accelerating particle? Synthesize motion equations to resolve complex one-dimensional displacement and velocity problems.

1. A hyper-loop pod traveling at 120 m/s undergoes a constant deceleration of 8.0 m/s^2 . To calculate the distance required for the pod to reach a complete stop, which kinematic relationship is most efficient?

- A. $v = u + at$
- B. $\Delta x = ut + \frac{1}{2}at^2$
- C. $v^2 = u^2 + 2a\Delta x$
- D. $\Delta x = ((u + v)/2)t$

2. If an object's velocity is zero at a specific instant, its acceleration at that same instant must also be zero.

- A. True
- B. False

3. A drone launches from a platform and accelerates from rest at a rate of 4.5 m/s^2 for exactly 6.0 seconds. The total displacement of the drone during this interval is ___ meters.

- A. 27.0
- B. 54.0
- C. 81.0
- D. 162.0

4. A maglev train travels 200 km West, then 150 km North, and finally 200 km East. What is the magnitude of the train's total displacement?

- A. 550 km
- B. 250 km
- C. 150 km
- D. 50 km

5. An experimental rocket car starts from rest and reaches a velocity of 100 m/s over a distance of 400 meters. What is the magnitude of its constant acceleration?

- A. 12.5 m/s^2
- B. 25.0 m/s^2
- C. 0.25 m/s^2
- D. 1.25 m/s^2

6. A particle moves along a straight path. If its position function is defined by a quadratic equation of time ($x = At^2 + Bt$), the acceleration of the particle is ____.

- A. Zero

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- B. Constant
- C. Linearly increasing
- D. Exponentially increasing

7. An object traveling with a negative velocity and a negative acceleration is currently slowing down.

- A. True
- B. False

8. Which of the following scenarios describes a situation where the average velocity is exactly zero over a specific time interval?

- A. A race car completing one full lap around a circular track.
- B. An elevator ascending from the 1st floor to the 10th floor.
- C. A sprinter running 100 meters in a straight line.
- D. A stone falling from a cliff into the ocean.

9. On a velocity-time graph, a horizontal line located at $v = -5$ m/s represents an object that is ____.

- A. Moving at a constant speed in the negative direction
- B. At rest at a negative position
- C. Accelerating at 5 m/s^2
- D. Decelerating toward the origin

10. A projectile is launched horizontally. If air resistance is neglected, the horizontal component of its velocity remains constant because:

- A. Gravity only acts in the vertical dimension.
- B. Horizontal motion is independent of time.
- C. The mass of the projectile is negligible.
- D. Velocity is a scalar quantity.