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Answer Key: The Velocity Architect: Designing 7th Grade Motion Systems Quiz

Calculate how high-speed maglev trains and deep-sea probes maintain precision using vector displacement and non-linear acceleration analysis.

1. A drone flies 80 meters North to deliver a package, then immediately flies 30 meters South. What is the drone's total displacement relative to its launch pad?

Answer: B) 50 meters North

Displacement is a vector quantity measuring the change in position. Since North and South are opposite directions, we subtract the magnitudes (80m - 30m) to find the net change from the start.

2. An autonomous rover on Mars increases its velocity from 2 m/s to 14 m/s over a period of 4 seconds. The rover's constant acceleration is ____ m/s².

Answer: C) 3

Acceleration is the change in velocity divided by time. $(14 \text{ m/s} - 2 \text{ m/s}) / 4 \text{ seconds} = 12 / 4 = 3 \text{ m/s}^2$.

3. If a professional sprinter runs exactly one full lap around a circular 400-meter track, their total displacement is 0 meters.

Answer: A) True

Because displacement measures the straight-line distance between the starting and ending points, returning to the exact start point results in zero displacement, regardless of distance traveled.

4. Which of the following scenarios describes an object that is accelerating even though its speed remains constant?

Answer: C) A satellite orbiting Earth in a perfect circle at constant speed

Acceleration is a change in velocity. Velocity includes direction. An object in a circular path is constantly changing direction, meaning its velocity is changing (accelerating) even if speed is constant.

5. A maglev train starts from rest and accelerates at 2 m/s². Using the formula $s = ut + \frac{1}{2}at^2$, the distance the train covers in the first 10 seconds is ____ meters.

Answer: B) 100

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Since initial velocity (u) is 0, the formula simplifies to $s = \frac{1}{2}at^2$. Calculation: $0.5 * 2 * (10^2) = 1 * 100 = 100$ meters.

6. On a Velocity vs. Time graph, what does a horizontal line (zero slope) located above the x-axis represent?

Answer: B) The object is moving at a constant velocity

A horizontal line on a velocity-time graph means the velocity value is not changing as time passes, which defines constant velocity (zero acceleration).

7. Negative acceleration always means that an object is slowing down.

Answer: B) False

False. Negative acceleration means acceleration in the negative direction. If an object is already moving in the negative direction, negative acceleration would actually cause it to speed up.

8. A deep-sea research probe is dropped into the ocean. If we ignore water resistance and use gravity ($a = 9.8 \text{ m/s}^2$), its velocity after 3 seconds of free-fall would be ____ m/s.

Answer: C) 29.4

Using $v = u + at$, where $u = 0$, $a = 9.8$, and $t = 3$. Calculation: $0 + (9.8 * 3) = 29.4$ m/s.

9. A cheetah accelerates from 0 mph to 60 mph in a few seconds. If you were analyzing this using the kinematic equation $v^2 = u^2 + 2as$, which variable represents the distance the cheetah traveled during this burst?

Answer: D) s

In standard kinematic notation, ' s ' represents displacement or distance, ' u ' is initial velocity, ' v ' is final velocity, and ' a ' is acceleration.

10. The slope of a Position vs. Time graph represents the acceleration of the object.

Answer: B) False

The slope of a Position vs. Time graph represents velocity (change in position over change in time). The slope of a Velocity vs. Time graph represents acceleration.