

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Answer Key: Kinematic Quest: Chasing Velocity for 12th Grade Pros

Can you predict a projectile's path? Identify the core principles governing displacement and constant acceleration in this senior physics challenge.

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**1. An oceanographer tracks a research vessel moving 40 km North, then 30 km West. What is the magnitude of the vessel's total displacement?**

**Answer:** B) 50 km

Displacement is a vector. Using the Pythagorean theorem for the perpendicular legs ( $40^2 + 30^2 = c^2$ ), the resultant magnitude is the square root of 2500, which is 50 km.

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

**Answer:** B) False

False. For example, at the peak of a ball's flight, its velocity is momentarily zero, but it is still experiencing a constant downward acceleration of  $9.8 \text{ m/s}^2$  due to gravity.

**3. A maglev train maintains a constant velocity of 120 m/s for 30 seconds. The rate of \_\_\_\_\_ during this time interval is exactly zero.**

**Answer:** C) Acceleration

Acceleration is defined as the rate of change of velocity. If velocity remains constant, the rate of change is zero.

**4. A geologist drops a sensor into a deep cavern. If the sensor falls freely from rest for 3 seconds, what is its approximate final velocity (ignoring air resistance)?**

**Answer:** C) 29.4 m/s

Using  $v = u + at$ , where  $u = 0$ ,  $a = 9.8 \text{ m/s}^2$ , and  $t = 3\text{s}$ , the final velocity  $v = 0 + (9.8 * 3) = 29.4 \text{ m/s}$ .

**5. In a displacement-vs-time graph, the \_\_\_\_\_ of the line represents the object's velocity.**

**Answer:** A) Slope

Velocity is the change in position (displacement) over the change in time (rise over run), which is mathematically the slope of the graph.

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**6. A vector quantity, such as displacement, requires both a magnitude and a specific direction.**

**Answer:** A) True

True. Unlike scalars (like mass or time) which only have magnitude, vectors must include direction to be fully defined.

**7. An athlete sprints around a circular 400-meter track and returns to the exact starting blocks. What is the displacement of the athlete?**

**Answer:** C) 0 meters

Displacement is the change in position (Final Position - Initial Position). Since the athlete returned to the start, the change in position is zero.

**8. In the kinematic equation  $v^2 = u^2 + 2as$ , the variable 's' represents \_\_\_\_\_.**

**Answer:** C) Displacement

In standard physics notation (SUVAT), 's' stands for displacement, not speed or seconds.

**9. Average speed is always equal to the magnitude of average velocity.**

**Answer:** B) False

False. Average speed is total distance divided by time, while velocity is displacement divided by time. If an object changes direction, distance is greater than displacement magnitude.

**10. A particle moves with an initial velocity of 5 m/s and experiences a constant acceleration of 2 m/s<sup>2</sup> for 4 seconds. What is its final velocity?**

**Answer:** C) 13 m/s

Using  $v = u + at$ :  $v = 5 + (2 * 4) = 5 + 8 = 13$  m/s.