Unit Review: Kinematics

Part A Extended Answers

1. Identify each of the following quantities as either a vector (v) or a scalar (s):

   a. Speed _____

   b. Acceleration _____

   c. Mass _____

   d. Weight _____

2. Explain the difference between position, displacement, and distance.

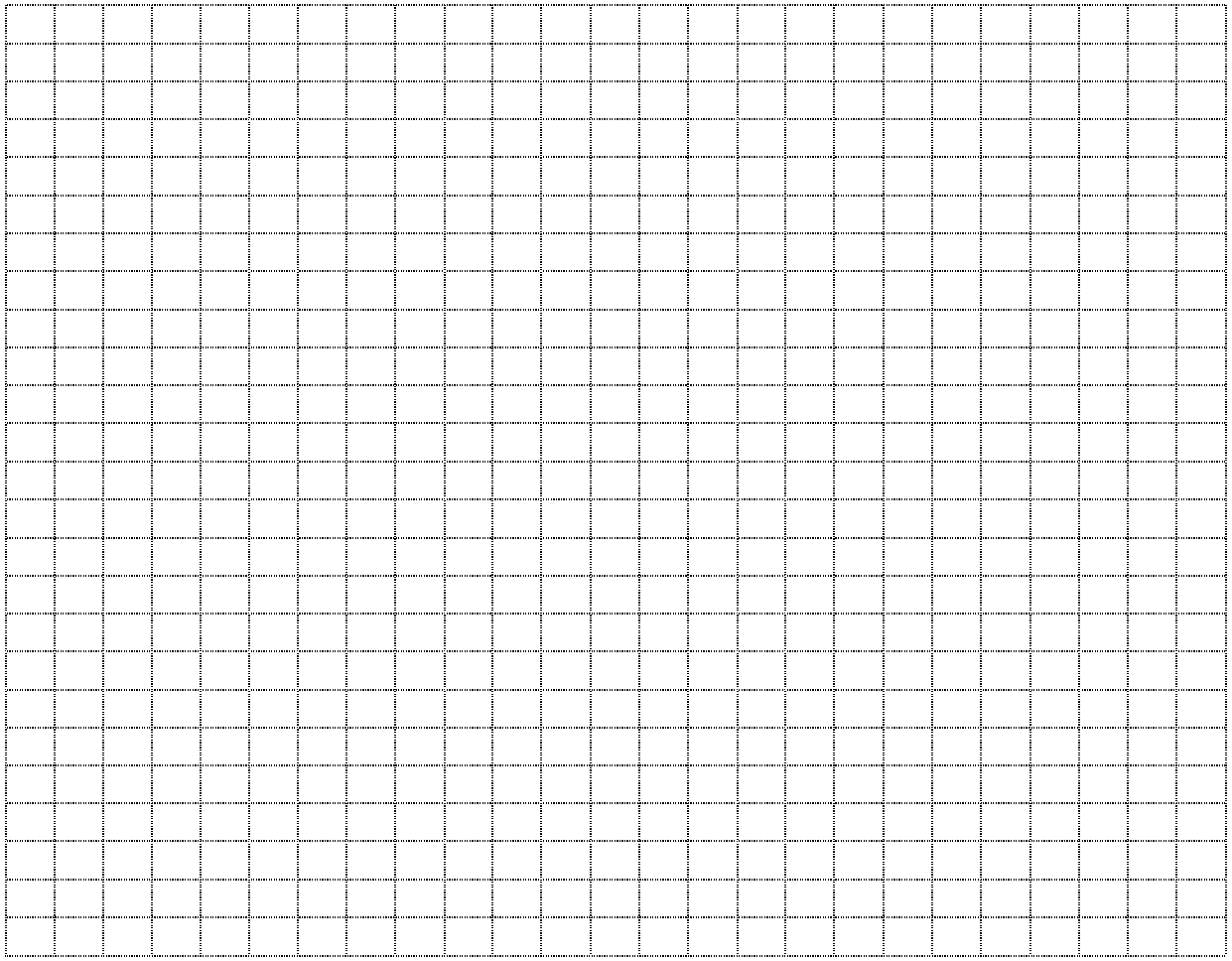
3. Explain the difference between an instant of time and an interval of time.

4. A beam of light is generated at point A. It travels east, strikes a mirror, and returns to point A $0.23\ s$ later. If the speed of light is $3.0 \times 10^8\ m/s$, how far away is the mirror from point A?

5. The position of an automobile changes over a 20 second time period as shown in the table below:

Time (s)	Position (m)
0	0
4	20
8	20
14	–20
20	–5

a. Plot the position-time graph of the motion.



b. Give a detailed description of the car's motion from beginning to end.

c. Calculate the velocity of the car in each of the following time intervals:

i. 0 to 4 s

ii. 4 to 8 s

iii. 8 to 14 s

iv. 14 to 20 s

d. Calculate the displacement of the car for the entire 20 s interval.

e. Calculate the average velocity of the car from $t = 4$ s to $t = 14$ s.

6. A bullet is traveling at $325\ m/s$ when it strikes a target and is brought to rest in $0.05\ s$. What is the acceleration of the bullet while it is stopping?

7. A car is at rest at a red light. The light turns green and the car accelerates away from the light at a rate of $2.8\ m/s^2$. After accelerating for 5 seconds, the driver then applies the breaks and decelerates to a stop at a second red light. If the driver took 3 seconds to stop, determine the distance between the two lights.

Part B Multiple Choice
Choose the best possible answer and circle the appropriate letter.

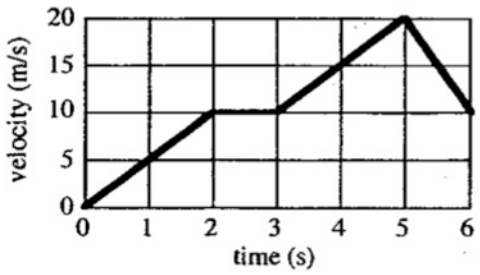
1. A physics student adds two displacement vectors with magnitudes of $8.0\ km$ and $6.0\ km$. Which of the following statements is **true** concerning the magnitude of the resultant displacement?

   a. It must be $2.0\ km$.
   b. It must be $14.0\ km$.
   c. No conclusion can be reached without knowing the directions of the vectors.
   d. It could have any value between $2.0\ km$ and $14.0\ km$ depending on how the vectors are oriented.

2. Town A lies $20\ km$ north of town B. Town C lies $13\ km$ west of town A. A small plane flies directly from town B to town C. What is the displacement of the plane?

   a. $33\ m\ [33°\ N\ of\ W]$
   b. $19\ m\ [33°\ N\ of\ W]$
   c. $24\ m\ [57°\ N\ of\ W]$
   d. $31\ m\ [57°\ N\ of\ W]$

Questions 3 to 6 refer to the following velocity-time graph.



3. During which interval(s) of the graph does the object have a constant velocity?

   a. $0\ s$ to $2\ s$
   b. $2\ s$ to $3\ s$
   c. $0\ s$ to $2\ s$ and $3\ s$ to $5\ s$
   d. $0\ s$ to $2\ s$, $3\ s$ to $5\ s$, and $5\ s$ to $6\ s$

4. During which interval(s) of the graph does the object have a constant rate of acceleration?

   a. $0\ s$ to $2\ s$
   b. $2\ s$ to $3\ s$
   c. $0\ s$ to $2\ s$ and $3\ s$ to $5\ s$
   d. $0\ s$ to $2\ s$, $3\ s$ to $5\ s$, and $5\ s$ to $6\ s$

5. How far does the object move in the interval from $t = 0$ to $t = 2\ s$?

   a. $7.5\ m$
   b. $10\ m$
   c. $15\ m$
   d. $20\ m$

6. What is the acceleration of the object in the interval from $t = 5\ s$ to $t = 6\ s$?

   a. $+20\ m/s^2$
   b. $-20\ m/s^2$
   c. $+10\ m/s^2$
   d. $-10\ m/s^2$

7. When the outdoor emergency siren at Cheryl's school was tested, the sound from the siren took $7.0\ s$ to reach her house located $2.4\ km$ from the school. What is the speed of sound in air?

   a. $240\ m/s$
   b. $340\ m/s$
   c. $440\ m/s$
   d. $540\ m/s$

8. In which of the following situations does the car have a westward acceleration?

   a. The car travels westward at a constant speed.
   b. The car travels eastward and speeds up.
   c. The car travels westward and slows down.
   d. The car travels eastward and slows down.

9. An elevator is moving upward with a speed of $11\ m/s$. Three seconds later, the elevator is still moving upward, but its speed has been reduced to $5\ m/s$. What is the average acceleration of the elevator during the $3\ s$ time interval?

   a. $2.0\ m/s^2\ [down]$
   b. $2.0\ m/s^2\ [up]$
   c. $5.3\ m/s^2\ [down]$
   d. $5.3\ m/s^2\ [up]$

10. Which one of the following situations is **not** possible?

    a. A body has zero velocity and non-zero acceleration.
    b. A body travels with a constant velocity and a constant acceleration.
    c. A body travels with a constant velocity and a changing acceleration.
    d. A body travels with a changing velocity and a constant acceleration.

11. A car, starting from rest, accelerates in a straight path at a constant rate of $2.5\ m/s^2$. How far will the car travel in 12 seconds?

    a. $180\ m$
    b. $120\ m$
    c. $30\ m$
    d. $15\ m$

12. An object moving along a straight line is decelerating. Which of the following statements **must** always be true in this situation?

    a. The direction of the acceleration is the same as the direction of the displacement.
    b. An object that is decelerating has a negative acceleration.
    c. The direction of the acceleration is opposite to that of the velocity.
    d. The acceleration changes as the object moves along the line.

13. A body initially at rest is accelerated at a constant rate for 5 seconds in the positive x direction. If the final speed of the body is $20\ m/s$, what was the body's acceleration?

    a. $0.25\ m/s^2$
    b. $2.0\ m/s^2$
    c. $4.0\ m/s^2$
    d. $9.8\ m/s^2$

14. The minimum takeoff speed for a certain airplane is $75\ m/s$. What minimum acceleration is required if the plane must leave a runway of length $950\ m$? Assume the plane starts from rest at one end of the runway.

    a. $1.5\ m/s^2$
    b. $3.0\ m/s^2$
    c. $4.5\ m/s^2$
    d. $6.0\ m/s^2$

15. An object starts from rest and accelerates uniformly in a straight line in the positive x direction. After 11 seconds, its speed is $70\ m/s$. How far does the object travel?

    a. $35\ m$
    b. $77\ m$
    c. $385\ m$
    d. $590\ m$