

حل أسئلة درس السرعة والسرعة المتجهة



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المزيد من مادة
فيزياء:

التواصل الاجتماعي بحسب الصف التاسع



صفحة المناهج
الإماراتية على
فيسبوك

المزيد من الملفات بحسب الصف التاسع والمادة فيزياء في الفصل الأول

شرح مفاهيم التسارع ومخططات الحركة

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GRADE 9 PHYSICS — WORKSHEET SOLUTIONS

Unit 2 — Lesson 4: How Fast? (Velocity and Speed) | Answer Key & Solutions

Student Name: _____

Grade: Grade 9 Physics

Date: _____

CORE CONCEPTS SUMMARY — LESSON 4: HOW FAST?

- **Slope of Position-Time Graph:** The slope equals average vector velocity ($v = \Delta x / \Delta t$). Steeper slopes represent greater speeds.
- **Average Vector Velocity vs. Speed:** Velocity is a vector (magnitude + direction, $v = \text{displacement} / \text{time}$), while Speed is a scalar (magnitude only, $v = \text{distance} / \text{time}$).
- **Equation of Motion at Constant Velocity:** $x_f = v \cdot t + x_i$ (matches $y = mx + b$, where x_i is initial position and v is slope).
- **Instantaneous Speed/Velocity:** Speed or velocity of an object at a specific instant in time (slope of tangent line).

Question 1: The change in position divided by the time interval in which this change occurred is called the ...

A. Average speed

B. Average vector velocity

C. Instantaneous vector velocity

D. Instantaneous speed

Detailed Solution & Scientific Reasoning:

Correct Answer: B. Average vector velocity

Detailed Reasoning: By definition, **average vector velocity** (v) is the displacement (change in position Δx) divided by the time interval (Δt) during which the change occurred: $v = \Delta x / \Delta t$.

Question 2: Based on the adjacent position-time graph, the speed of the object at the exact instant $t = 4$ s is called ...

A. Average speed

B. Instantaneous vector velocity

C. Instantaneous speed

D. Variable speed

Detailed Solution & Scientific Reasoning:

Correct Answer: C. Instantaneous speed

Detailed Reasoning: The speed of an object evaluated at a single specific instant in time (such as $t = 4$ s) is called the **instantaneous speed**. On a curved position-time graph, it is determined by the slope of the tangent line at that exact instant.

Question 3: Based on the data in the table below, what is the magnitude of the average vector velocity of the toy car's motion during the first 12 s?

t (s): 0.0, 3.0, 5.0, 9.0, 12

x (cm): +50, +20, 0.0, -15, -30

Detailed Solution & Scientific Reasoning:

Detailed Calculation:

1. Identify initial and final conditions from the table:
 - Initial position at $t_i = 0.0$ s: $x_i = +50$ cm
 - Final position at $t_f = 12$ s: $x_f = -30$ cm
2. Calculate displacement: $\Delta x = x_f - x_i = -30 \text{ cm} - (+50 \text{ cm}) = -80 \text{ cm}$
3. Calculate average vector velocity: $v = \Delta x / \Delta t = -80 \text{ cm} / 12 \text{ s} = -6.67 \text{ cm/s}$
4. **Magnitude of average vector velocity = 6.67 cm/s (or ~6.7 cm/s).**

Question 4: A mouse moves along a straight line. Find the mouse's position relative to the origin if it moves at 12.8 m/s North for a period of 3.10 s.

Detailed Solution & Scientific Reasoning:

Detailed Calculation:

Given: $v = +12.8$ m/s (North), $t = 3.10$ s, assuming starting position $x_i = 0$ m.

Equation of motion: $x_f = x_i + v \cdot t = 0 + (12.8 \text{ m/s} \times 3.10 \text{ s}) = +39.68 \text{ m} = \mathbf{+39.7 \text{ m North}}$ (3 significant figures).

Question 5: The figure shows a car moving along a straight line. At $t_i = 0$ s, $x_i = 0$ m; at $t_f = 10$ s, $x_f = 200$ m. Calculate:

1- The car's displacement.

2- The time interval.

3- The average vector velocity.

Detailed Solution & Scientific Reasoning:

Detailed Step-by-Step Solution:

1. **Displacement:** $\Delta x = x_f - x_i = 200 \text{ m} - 0 \text{ m} = \mathbf{+200 \text{ m}}$ (200 m to the right/forward).
2. **Time interval:** $\Delta t = t_f - t_i = 10 \text{ s} - 0 \text{ s} = \mathbf{10 \text{ s}}$.
3. **Average vector velocity:** $v = \Delta x / \Delta t = +200 \text{ m} / 10 \text{ s} = \mathbf{+20.0 \text{ m/s}}$ (20 m/s in the direction of motion).

Question 6: A car is driven at 97 km/h for three hours, then at 72 km/h for another three hours. What is the magnitude of its average vector velocity?

Detailed Solution & Scientific Reasoning:

Detailed Step-by-Step Calculation:

1. First leg displacement: $\Delta x_1 = v_1 \times t_1 = 97 \text{ km/h} \times 3 \text{ h} = 291 \text{ km}$
2. Second leg displacement: $\Delta x_2 = v_2 \times t_2 = 72 \text{ km/h} \times 3 \text{ h} = 216 \text{ km}$
3. Total displacement: $\Delta x_{\text{total}} = 291 \text{ km} + 216 \text{ km} = 507 \text{ km}$
4. Total time interval: $\Delta t_{\text{total}} = 3 \text{ h} + 3 \text{ h} = 6 \text{ h}$
5. Average vector velocity: $v_{\text{avg}} = 507 \text{ km} / 6 \text{ h} = \mathbf{84.5 \text{ km/h}}$.

Question 7: What is the magnitude of the average vector velocity of an object that moved from position 6.5 m to position 3.5 m relative to the origin, in a time of 3.0 s?

- A. 9.0 m/s
C. 2.0 m/s

B. 3.3 m/s

D. 1.0 m/s

Detailed Solution & Scientific Reasoning:

Correct Answer: D. 1.0 m/s

Detailed Calculation:

Displacement $\Delta x = x_f - x_i = 3.5 \text{ m} - 6.5 \text{ m} = -3.0 \text{ m}$.

Average velocity $v = \Delta x / \Delta t = -3.0 \text{ m} / 3.0 \text{ s} = -1.0 \text{ m/s}$.

Magnitude of average velocity = $|-1.0 \text{ m/s}| = \mathbf{1.0 \text{ m/s}}$.

Question 8: An object moves along a straight line according to the relation $x = 12 + 5t$, where distance is in meters and time in seconds. Find the magnitude of:

- The object's velocity
- The object's initial position
- The object's position at $t = 6 \text{ s}$
- The time for the object to reach position 60 m

Detailed Solution & Scientific Reasoning:

Detailed Solutions (Comparing $x_f = vt + x_i$ with $x = 5t + 12$):

1. **Velocity:** $v =$ coefficient of $t = \mathbf{5 \text{ m/s}}$.
2. **Initial position:** $x_i =$ constant term (when $t = 0$) = **12 m**.
3. **Position at $t = 6 \text{ s}$:** $x = 12 + 5(6) = 12 + 30 = \mathbf{42 \text{ m}}$.
4. **Time to reach position 60 m:** $60 = 12 + 5t \Rightarrow 5t = 48 \Rightarrow t = 48 / 5 = \mathbf{9.6 \text{ s}}$.

Question 9: Based on the position-time graph showing three straight lines starting from origin (Ahmad: 10 m at 4 s; Ali: 6.5 m at 4 s; Saif: 3 m at 4 s), which statement is correct?

- A. $v_{\text{Ali}} > v_{\text{Ahmad}} > v_{\text{Saif}}$
C. $v_{\text{Saif}} = v_{\text{Ali}} = v_{\text{Ahmad}}$

B. $v_{\text{Ahmad}} > v_{\text{Ali}} > v_{\text{Saif}}$

D. $v_{\text{Saif}} > v_{\text{Ali}} > v_{\text{Ahmad}}$

Detailed Solution & Scientific Reasoning:

Correct Answer: B. $v_{\text{Ahmad}} > v_{\text{Ali}} > v_{\text{Saif}}$

Detailed Reasoning: The slope of a position-time line represents average speed. Ahmad's line has the steepest slope ($10/4 = 2.5 \text{ m/s}$), followed by Ali's ($6.5/4 = 1.625 \text{ m/s}$), and Saif's ($3/4 = 0.75 \text{ m/s}$). Therefore, $\mathbf{v_{\text{Ahmad}} > v_{\text{Ali}} > v_{\text{Saif}}}$.

Question 10: Based on a position-time graph showing objects A, B, C, and D:

- 1- Rank the objects by initial position, from largest positive to largest negative.
- 2- Rank the objects by their initial distance from the origin.
- 3- Rank the objects by their average speed.

Detailed Solution & Scientific Reasoning:

Detailed Analysis & Rankings:

1. **By Initial Position at $t = 0$:** $\mathbf{B > A = D = C}$ (B passes $t = 0$ at $x \approx +8 \text{ m}$; A, C, D all pass $t = 0$ at $x \approx +4 \text{ m}$).
2. **By Initial Distance from Origin $|x_i|$:** $\mathbf{B > A = D = C}$ (B is 8 m away; A, C, D are all 4 m away from origin).
3. **By Average Speed (steepness of slope $|v|$):** $\mathbf{C \approx D > A > B}$ (C and D have steeper slopes than A and B).

Question 11: Based on a position-time graph showing objects C, B, M, and D starting from origin:

Rank the objects by their average vector velocity.

Detailed Solution & Scientific Reasoning:

Detailed Ranking:

Average vector velocity is represented directly by the slope of the position-time graph line ($v = \Delta x / \Delta t$).

Comparing the slopes of the four lines:

Line C is the steepest, followed by B, then M, and Line D is the shallowest.

Ranking: $v_C > v_B > v_M > v_D$.

Question 12: The graph shows two runners (Runner A starting at origin $x = 0$, Runner B starting at $x = 3$ m, intersecting at Point P at $t = 4$ s, $x = 7$ m):

(a) Describe the position of Runner A compared with Runner B at $t = 0$.

(b) Who is the faster runner?

(c) What happens at point P, and after it?

Detailed Solution & Scientific Reasoning:

Detailed Answers:

(a) At $t = 0$ (y-axis intersection), Runner A is at the origin (0 m), while Runner B is **3 m ahead** of Runner A.

(b) **Runner A is faster** because Runner A's line has a steeper slope (steeper slope = higher average speed).

(c) At point P (intersection point at $t = 4$ s, $x = 7$ m), Runner A **catches up** with Runner B (they occupy the exact same position). After point P, Runner A **passes Runner B** and moves ahead.

Question 13: A squirrel descends from a tree 8 m tall at a constant speed within 1.5 min. It remains at the base for 2.3 min. A loud noise causes it to climb back to the exact branch in 0.1 min. Which position-time graph best represents the squirrel's motion?

A. Graph A (descends to 0 m, stays flat at base, then steeply climbs back to 8 m)

B. Graph B (descends and stays at base)

C. Graph C (descends, stays, and climbs partially)

D. Graph D (ascends then descends)

Detailed Solution & Scientific Reasoning:

Correct Answer: A. Graph A

Detailed Reasoning:

1. Descending from 8 m to 0 m in 1.5 min represents a negative slope from $x = 8$ m down to $x = 0$ m.

2. Remaining at the base for 2.3 min represents a flat horizontal line at position $x = 0$ m.

3. Climbing back to 8 m in 0.1 min represents a very steep positive slope going back up to $x = 8$ m.

Graph A perfectly reflects all three distinct stages of motion.

Question 14: An object began its motion from position $x = 20.0$ m East of origin.

1- What is its final position if it moves at constant speed of 12 m/s East for 0.5 min?

2- What is its final position if it moves at constant speed of 10 m/s West for 0.5 min?

Detailed Solution & Scientific Reasoning:

Detailed Calculations (0.5 min = 30 s):

1. Moving East ($v = +12$ m/s):

$$x_f = x_i + v \cdot t = +20.0 \text{ m} + (+12 \text{ m/s} \times 30 \text{ s}) = 20.0 + 360 = \mathbf{+380 \text{ m East}} \text{ (380 m East of origin).}$$

2. Moving West ($v = -10$ m/s):

$$x_f = x_i + v \cdot t = +20.0 \text{ m} + (-10 \text{ m/s} \times 30 \text{ s}) = 20.0 - 300 = \mathbf{-280 \text{ m}} \text{ (280 m West of origin).}$$

Question 15: A cyclist maintains constant speed 10.0 m/s East. At $t = 0$ s, cyclist is 20 m West of origin ($x_i = -20$ m).

1- What is the rider's position at $t = 60$ s?

2- What is the rider's displacement from starting point up to $t = 60$ s?

Detailed Solution & Scientific Reasoning:

Detailed Step-by-Step Solution:

1. Position at $t = 60$ s:

$$x_f = x_i + v \cdot t = -20 \text{ m} + (+10.0 \text{ m/s} \times 60 \text{ s}) = -20 + 600 = \mathbf{+580 \text{ m East.}}$$

2. Displacement up to $t = 60$ s:

$$\Delta x = x_f - x_i = +580 \text{ m} - (-20 \text{ m}) = \mathbf{+600 \text{ m East}} \text{ (or } \Delta x = v \cdot t = 10.0 \times 60 = +600 \text{ m East).}$$

Question 16: A toy car moves along a line. Consecutive positions spaced by 1.5 s time intervals: B0 ($x = 0$ m), B1 ($x = 3$ m), B2 ($x = 7$ m), B3 ($x = 12$ m), B4 ($x = 18$ m at $t = 6.0$ s).

1- What is position of cart at $t = 6.0$ s?

2- What is displacement from starting point up to $t = 6.0$ s?

3- If speed doubled, how does position-time relationship change?

Detailed Solution & Scientific Reasoning:

Detailed Answers:

1. Position at $t = 6.0$ s: Position B4 corresponding to $t = 4 \times 1.5 \text{ s} = 6.0 \text{ s}$ is $x = \mathbf{18 \text{ m}}$.

2. Displacement up to $t = 6.0$ s: $\Delta x = x_f - x_i = 18 \text{ m} - 0 \text{ m} = \mathbf{+18 \text{ m}}$.

3. If speed doubled: The line on the position-time graph becomes **twice as steep** (slope doubles), reaching the 18 m mark in half the time ($t = 3.0 \text{ s}$).

Question 17: A truck moves from position $x = 125.0$ m towards origin ($x = 0.0$ m) in a time interval $\Delta t = 5.0$ s (from $t = 0.0$ s to $t = 5.0$ s). Calculate the truck's average vector velocity.

Detailed Solution & Scientific Reasoning:

Detailed Calculation:

1. Initial position $x_i = +125.0 \text{ m}$, Final position $x_f = 0.0 \text{ m}$.

2. Displacement $\Delta x = x_f - x_i = 0.0 \text{ m} - 125.0 \text{ m} = -125.0 \text{ m}$.

3. Time interval $\Delta t = 5.0 \text{ s} - 0.0 \text{ s} = 5.0 \text{ s}$.

4. Average vector velocity $v = \Delta x / \Delta t = -125.0 \text{ m} / 5.0 \text{ s} = \mathbf{-25.0 \text{ m/s}}$ (25.0 m/s towards origin / West).

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