PHYS11 CH123:

Test Prep

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Table of Contents

Introduction

- This presentation covers key concepts and problem-solving techniques for your upcoming physics test
- We'll review problems from three chapters:
    - Chapter 1: Unit Conversion and Estimation
    - Chapter 2: Frames of Reference and Displacement
    - Chapter 3: Kinematics and Motion
- Each problem will be presented with a step-by-step solution
- Focus on understanding the concepts and problem-solving approaches

Table of Contents

Chapter 1: Problem 30

A generation is about one-third of a lifetime. Approximately how many generations have passed since the year 0 AD?

Solution:

$$\text{history} \cdot \frac{10^{11}\ \text{s}}{\text{history}} \cdot \frac{1\ \text{generation}}{1/3\ \text{lifetime}} \cdot \frac{0.5\ \text{lifetime}}{10^{9}\ \text{s}} = \underline{150\ \text{generations}}$$

Chapter 1: Problem 30 - Explanation

Explanation:

1. Start with the total time since 0 AD (history)
2. Convert this time to seconds: $\frac{10^{11}\ \text{s}}{\text{history}}$
3. Convert seconds to lifetimes: $\frac{0.5\ \text{lifetime}}{10^{9}\ \text{s}}$
4. Convert lifetimes to generations: $\frac{1\ \text{generation}}{1/3\ \text{lifetime}}$
5. Multiply all these factors together
6. This simplifies to 150 generations

Key concept: Unit conversion and fraction multiplication

Table of Contents

Chapter 2: Problem 28

Suppose a train is moving along a track. Is there a single, correct reference frame from which to describe the train's motion?

A. Yes, there is a single, correct frame of reference because motion is a relative term.

B. Yes, there is a single, correct frame of reference which is in terms of Earth's position.

C. No, there is not a single, correct frame of reference because motion is a relative term.

D. No, there is not a single, correct frame of reference because motion is independent of frame of reference.

Chapter 2: Problem 28 - Solution

Solution: The correct answer is **C**. No, there is not a single correct frame of reference because motion is a relative term.

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Chapter 2: Problem 28 - Solution

Solution: The correct answer is **C**. No, there is not a single correct frame of reference because motion is a relative term. Explanation:

- Option C is correct: Motion depends on what you compare it to (relative motion).
- Option D is incorrect: It wrongly states that motion doesn't change with perspective.
- Examples:
    - On the train: Train seems still, landscape moves.
    - On the platform: Train moves, platform seems still.
    - In a car alongside: Train might seem to move slowly.
- This illustrates the principle of relativity in physics: motion description depends on the chosen reference frame.

Chapter 2: Problem 28 - Explanation

Explanation:

- Motion is relative: The movement of an object can be described differently depending on the observer's frame of reference
- Multiple valid frames: For a moving train, we could describe its motion relative to the ground, a passenger inside the train, or even another moving object
- Each frame is correct: The motion described from each of these perspectives would be correct for that particular frame of reference
- No absolute frame: There isn't a single, universally "correct" frame of reference that takes precedence over others

Key concept: Relativity of motion and frames of reference

Chapter 2: Problem 51

Calculate that object's net displacement over the time shown.

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A. 540 m B. 2,520 m C. 2,790 m D. 5,040 m

Chapter 2: Problem 51 - Solution

Solution: The correct answer is **C**. The net displacement is 2,790 m.
Calculation:

- Area of rectangle: $18\ \text{m/s} \cdot 30\ \text{s} = 540\ \text{m}$
- Area of triangle: $\frac{1}{2} \cdot 150\ \text{m/s} \cdot 30\ \text{s} = 2,250\ \text{m}$
- Total area: $540\ \text{m} + 2,250\ \text{m} = 2,790\ \text{m}$

Explanation:

1. Identify the shape: The area under the line consists of a rectangle and a triangle
2. Calculate the area of the rectangle: $18\ \text{m/s} \cdot 30\ \text{s} = 540\ \text{m}$
3. Calculate the area of the triangle: $\frac{1}{2} \cdot 150\ \text{m/s} \cdot 30\ \text{s} = 2,250\ \text{m}$
4. Sum the areas: $540\ \text{m} + 2,250\ \text{m} = 2,790\ \text{m}$

Key concept: In a velocity-time graph, the area under the curve represents displacement

Table of Contents

You throw a ball straight up with an initial velocity of 15.0 m/s. It passes a tree branch on the way up at a height of 7.00 m. How much additional time will pass before the ball passes the tree branch on the way back down?
A. 0.574 s B. 0.956 s C. 1.53 s D. 1.91 s

Solution: The correct answer is **D**. 1.91 s

Step 1: Find the velocity at the branch

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$v = \sqrt{v_0^2 + 2a(x - x_0)}$$

$$v = \sqrt{(15.0 \text{ m/s})^2 + 2(-9.8 \text{ m/s}^2)(7 \text{ m} - 0 \text{ m})}$$

$$v = 9.37 \text{ m/s}$$

Chapter 3: Problem 32 - Solution Part 2

Step 2: Find the time from the branch to the top

$$v = v_0 + at$$
$$t_1 = \frac{v - v_0}{a} = \frac{0 \text{ m/s} - 9.37 \text{ m/s}}{-9.8 \text{ m/s}^2} = 0.956 \text{ s}$$

Step 3: Double the time for total up and down

$$t = 2t_1 = 2(0.956 \text{ s}) = 1.91 \text{ s}$$

Chapter 3: Problem 32 - Explanation

Explanation:

1. Use $v^2 = v_0^2 + 2a(x - x_0)$ to find velocity at the branch
2. Use $v = v_0 + at$ to find time from branch to top
3. Double this time for total time up and down

Key concepts:

- Kinematic equations for constant acceleration
- Symmetry of motion under constant acceleration
- Negative acceleration for upward motion

Table of Contents

Conclusion

- We've covered key problems from three important chapters:
  - Unit conversion and estimation
  - Frames of reference and displacement
  - Kinematics and motion
- Focus on understanding the concepts behind each problem
- Practice applying these problem-solving techniques
- Remember to identify given information, choose appropriate equations, and check units
- Good luck on your upcoming test!