



Physics Olympiad and Problem Solving Programs
N210 - Introductory Physics Olympiad
Problem Set 6.2 - Mock Exam: Newton's Laws

Name:

Date:

Instruction: This is a self-proctored, *closed-book* mock exam. You have 10 minutes to answer the following questions.

1. **B**. Use the equation $v = v_0 + gt$ we have $v_0 = v - gt = (40 \text{ m/s}) - (10 \text{ m/s}^2)(6.0 \text{ s}) = -20 \text{ m/s}$. Since the sign is opposite to the positive direction we set as downward, the answer is **20 m/s up**.
2. **B**. Let the angle between the string and the ceiling be θ , we have $2T \sin \theta = W$ or $T = \frac{W}{2 \sin \theta}$. As θ approaches to zero, the T will be very large. Thus, the smaller the θ , the larger the tension. B has the smallest θ among the five choices.
3. **C**. Newton's Third Law.
4. **C**. First, we find the velocity $v = v_0 + at = 0 + (0.8 \text{ m/s}^2)(10 \text{ s}) = 8 \text{ m/s}$. Then we need to calculate the distance for each situation. In the first 10 seconds, the distance $x = \frac{1}{2}at^2 = \frac{1}{2}(0.8 \text{ m/s}^2)(10 \text{ s})^2 = 40 \text{ m}$. In the second 10 seconds, the car moves at a constant velocity $x = x_0 + vt = 40 + (8 \text{ m/s})(10 \text{ s}) = \mathbf{120 \text{ m}}$.
5. **B**. The total distance is 800 km. The total time is $400/80 + 400/100 = 9 \text{ h}$. The average velocity is $\frac{800}{9} = \mathbf{89 \text{ km/h}}$.