



Physics Olympiad and Problem Solving Programs
N210 - Introductory Physics Olympiad
Problem Set 4.2 - Mock Exam: Kinematics Solutions

Name:

Date:

1. \boxed{C} . In fall drop, the acceleration is always g if air resistance is not considered.

2. To find the height, we have $0 = 15^2 + (2)(-10)h$, which means $h = \boxed{1.1 \text{ m}}$.

The speed will be the same as 15 m/s, but the direction is downward.

$$15 = 0 + (10)t \text{ or } t = 15/10 = \boxed{1.5 \text{ s}}.$$

3. $v_0 = 40 \text{ m/s}$, $y = 20 \text{ m}$, find t .

$$20 = 40t - 5t^2, \text{ solve for } t = \boxed{7.5 \text{ s}}.$$

Remark: There are two values of t for the same y . The smaller one represents the distance going up while the larger one represents the distance going down, which takes longer time.

4. The first stone drops 3.20 m in $t = \sqrt{\frac{2y}{a}} = \sqrt{\frac{2 \times 3.2}{10}} = 0.8 \text{ s}$. It will fall to the bottom in $t = \sqrt{\frac{2 \times 15}{10}} = 1.73 \text{ s}$. Thus, stone two needs $1.73 - 0.8 = 0.93 \text{ s}$ to reach the bottom.

$$15 = v_0(.93) + (5)(.93)^2, \text{ which leads to } v_0 = \boxed{1.15 \text{ m/s}}.$$

5. \boxed{A} . In constant velocity, each second the car moves 0.30. Thus, it moves 2.4 m in 3.0 s.

6. \boxed{B} . Since $v_f^2 = v_i^2 - 2gh$ and $v_f = 0$, we have $2gh = v_i^2$. h is directly proportional to v^2 . Double v means 4 times of h .

7. \boxed{C} .

8. \boxed{B} . Use harmonic mean, $R = \frac{2}{\frac{1}{80} + \frac{1}{100}} = 89 \text{ km/h}$.

9. \boxed{E} . Break pedal causes negative acceleration to slow a car down. The gas pedal accelerates a car. The steering wheel changes the direction of a car.

10. \boxed{A} . The speed ratio of the two cars is $\frac{5}{4}$. In 3 seconds, car 2 can finish $\frac{1}{4}$ of the track, which is 250 meters. Therefore, car A needs at least 250 m lead time.