

QUIZ 3 Blue, PHY 191 B, Friday, Sep 16, 2016 (10 pts)

Question 1: A rocket is launched straight up at a constant acceleration of 7 m/s^2 . 8 seconds after liftoff, a bolt falls off the side of the rocket. How much time *later* (i.e., after detaching) does the bolt hit the ground? (Pick the closest answer)

- a) 6 s b) 10 s c) 15 s d) 18 s e) 20 s

ANSWER: 15 s (2 pts)

REASONING: (4 pts)

KEY

GREEN: 18s "(d)"

PINK: 8s "(b)"

For bolt, the velocity 'v' at the instant it detaches from the rocket, is given by

$$v = v_{i1} + a_R \Delta t_1 \text{ for motion from 0 to A}$$

$$\Rightarrow v = 0 + 7(8) = 56 \text{ m/s} \quad \text{--- (1) (1 pt)}$$

Bolt's height 'd' when it detaches from rocket is found by applying $\Delta s = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$ to the motion of "rocket + bolt" from 0 to A:

$$d = 0 + \frac{1}{2} (7)(8^2) = 224 \text{ m} \quad \text{--- (2) (1 pt)}$$

Once bolt detaches from rocket, the bolt's in FREE FALL!

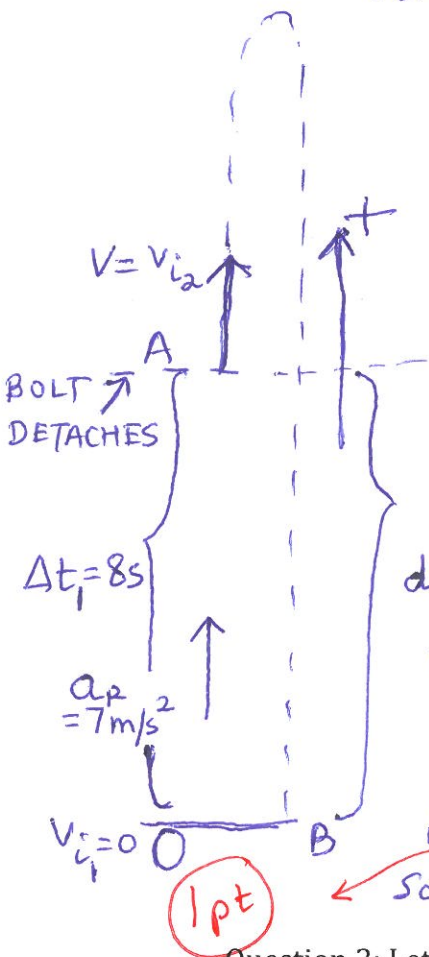
for the bolt's motion from A to B:

$$v_{i2} = v = 56 \text{ m/s}; \quad a = -9.8 \text{ m/s}^2; \quad \Delta s = -224 \text{ m}$$

To determine Δt_2 , the time taken to go from A to B by bolt, you may use $\Delta s_2 = v_{i2} \Delta t + \frac{1}{2} a_2 (\Delta t)^2$,

$$\text{i.e. } -224 = 56 \Delta t + \frac{1}{2} (-9.8) (\Delta t)^2 \quad \text{--- (3) (2 pts)}$$

SOLVE EQN 3 which is a QUADRATIC EQN in Δt to obtain $\Delta t = 14.6 \text{ sec} \approx 15 \text{ sec}$.



Question 2: Let $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = 2\hat{i} - 3\hat{j}$ and $\vec{F} = 3\vec{A} - 2\vec{B}$.

a) Write \vec{F} in component form. (1 pt)

$$\vec{F} = 3(3\hat{i} + 4\hat{j}) - 2(2\hat{i} - 3\hat{j}) = (9-4)\hat{i} + (12+6)\hat{j} = 5\hat{i} + 18\hat{j}$$

GREEN: $\vec{F} = \hat{i} + 24\hat{j}$ PINK: $\vec{F} = 7\hat{i} + 15\hat{j}$

b) What is the magnitude of \vec{F} ? (1pt)

$$|\vec{F}| = \sqrt{5^2 + 18^2} = 18.7 \approx 19$$

GREEN: $|\vec{F}| = 24.02 \approx 24$ PINK: $|\vec{F}| = 16.6 \approx 17$

c) What is the direction of \vec{F} (i.e., angle made w/ x-axis)? (1pt)

$$\theta = \tan^{-1} \left(\frac{18}{5} \right) = 74.5^\circ \approx 75^\circ$$

GREEN: $\theta = 87.6^\circ \approx 88^\circ$ PINK: $\theta = \tan^{-1} \left(\frac{15}{7} \right) = 65^\circ$