FIRST EXAM

Name (print) Emerson Name (signed)

Discussion Instructor (circle one): Emerson Gaughan Iguchi Stoops Zhang

Discussion Section #:_______

SHOW ALL WORK!!!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

On the moon there is a cliff 1500 m high. At t = 0 a rock is dropped from the top of the cliff. At the same time (t = 0) a bullet is shot upwards from the bottom with an initial velocity of 75 m/s (a slow bullet).

10 (a) Calculate the distance down from the top of the cliff to the point where the bullet and rock meet.

\[ y = y_0 + v_0 t + \frac{1}{2} a t^2 \]
\[ y_f = 1500 \text{ m} - \frac{g t^2}{2} \]
\[ y_b = 1500 - 75t - \frac{g t^2}{2} \]
\[ \Rightarrow 1500 - \frac{g t^2}{2} = 75t - \frac{g t^2}{2} \]
\[ t = 20 \text{ s} \]
\[ y_f = 1500 - \frac{1.67(20)^2}{2} = 1166 \text{ m} \Rightarrow 334 \text{ m} \text{ below top} \]

(b) Calculate the velocity of the bullet when they meet.

\[ v_f^2 = v_0^2 + 2a\Delta y \]
\[ v_f^2 = 75^2 - 2(1.67)(1166) \]
\[ v_f^2 = 75^2 - 1.67(20) \Rightarrow v_f = 41.6 \text{ m/s} \]

(c) Calculate the time interval between the landing of the rock and the landing of the bullet at the bottom of the cliff.

\[ y = v_0 t - \frac{1}{2} g t^2 \rightarrow 0 = v_0 t - \frac{1.67 t^2}{2} \]
\[ t = 2 \frac{3000}{1.67} = 189.8 \text{ s} \]
\[ \Rightarrow +1500 = \frac{1.67 t^2}{2} \Rightarrow t_f = \frac{3000}{9} = 424.4 \text{ s} \]
\[ \Delta t = 89.8 \text{ s} - 42.4 \text{ s} = 47.4 \text{ s} \]

Average 19.0

Common errors:

1) Starting port with \[ v_f^2 = v_0^2 + 2a(y-y_0) \], this gives you 2 unknowns + 3 unknowns unless you are very careful

2) sign errors of various kinds

3) Assuming they meet at top or bottom of cliff

4) Wrong gravity - leads to senseless answers which were unrecognized!