Homework 2 solutions

E 14. The speed increases (changes) are the same during the entire free fall. The change is equal to the acceleration, which is the same during the fall ($g = -9.8\ m/s^2$). See, for example Fig. 1.2.3

E.15. Regardless of their horizontal components of velocity, all objects fall at the same rate. The ball and bullet descend together.

E.18. He should kick the ball as high as possible. The time of flight is only determined by the height of the kick (in the y-direction , the ball needs to go up and fall back down).

E.19. In the absence of air effects, a ball hit at 45° above horizontal will travel farthest. A ball hit higher or lower won't travel as far. (see class slides)

P. 3 $v = v_0 + a \cdot t$ $\quad v_0 = 0,\ a = 3.71\ \frac{m}{s^2}$

$v = a \cdot t$

$v = 3.71\ \frac{m}{s^2} \cdot 3s$

$\underline{v = 11.13\ m/s}$

P.7 (we need to solve P7 before P6)

Just consider fall down: $v_{top} = 0,\ a = g = -9.8\ \frac{m}{s^2}$

$x_b = x_{top} + v_{top} \cdot t + \frac{1}{2} a t^2, \quad x_0 = 0, \quad x_{bottom} = -0.5m$

$\rightarrow x_{bottom} = +\frac{1}{2} a t^2$

$\rightarrow t = \sqrt{\frac{x_{bottom}}{\frac{1}{2} a}}$

$= \sqrt{\frac{-0.5m}{-\frac{1}{2} \cdot 9.8\ \frac{m}{s^2}}}$

$\underline{t = 0.32s}$ $\Rightarrow$ Time to go up and down: $T = 2 \cdot t = \underline{0.64s}$ //

P. 6 (Just consider fall down)

$v_{bottom} = v_{top} + a \cdot t, \quad v_{top} = 0$

$v_{bottom} = -9.8\ \frac{m}{s^2} \times 0.32s$

$\underline{v_{bottom} = 3.1\ \frac{m}{s}}$

P.4 $g_{Mars} = 3.71 \frac{m}{s^2}$, $t = 3s$

$x = \cancel{x_0}^{0} + \cancel{v_0}^{0} \cdot t + \frac{1}{2} g_{Mars} \cdot t^2$

$x = \frac{1}{2} g_{Mars} \cdot t^2$

$x = \frac{1}{2} \cdot 3.71 \frac{m}{s^2} \cdot (3s)^2$

$\underline{\underline{x = 16.7 \, m}}$ //

P.5 $weight_{Mars} = m \cdot g_{Mars}$; $g_{Mars} = 3.71$

$weight_{Earth} = m \cdot g_{earth}$ $g_{Earth} = 9.81 \frac{m}{s}$

$\Rightarrow$ Your Mars weight is a factor $\frac{9.81}{3.71} = \underline{\underline{2.64}}$

smaller than your Earth weight.