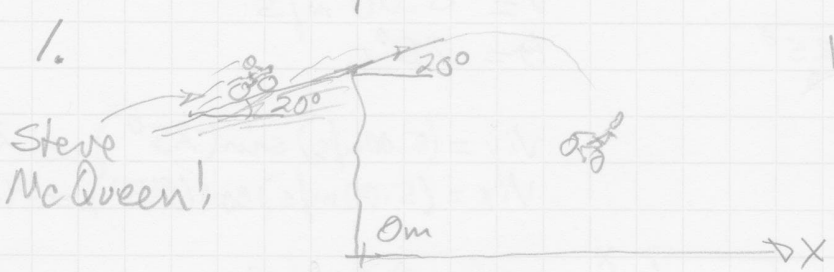
P. 257 Dr. Bob

1.



$V = 94\,km/h\left(\frac{1000m}{1km}\right)\left(\frac{1h}{3600s}\right)$

$V = 26.1\,m/s$

$y_i = ?$ $\quad V_{iy} = (26.1\,m/s)\sin 20° = 8.93\,m/s$

$y_f = 0m$ $\quad V_{fy} = ?$

$t_i = 0s$ $\quad a_y = -9.8\,m/s^2$ $\quad x_i = 0m$

$t_f = 5.5s$ $\quad x_f = ?$

$V_x = (26.1\,m/s)\cos 20°$

$V_x = 24.5\,m/s$

a) $\cancel{y_f}^{\,0} = y_i + V_{iy}\Delta t + \frac{1}{2}a_y \Delta t^2$

$y_i = -V_{iy}\Delta t - \frac{1}{2}a_y \Delta t^2$

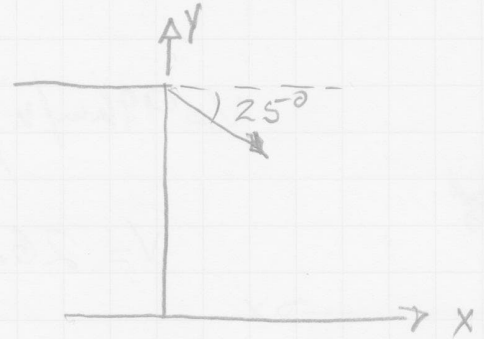
$= -(8.93\,m/s)(5.5s) - \frac{1}{2}(-9.8\,m/s^2)(5.5s)^2$

$\boxed{y_i = 99m}$

b) $x_f = x_i + V_x \Delta t = 0m + (24.5\,m/s)(5.5s)$

$\boxed{x_f = 135m}$

2.



$v = 5.00\ m/s$
$\theta = 25°$

$v_{iy} = (5.00\ m/s)\sin(-25°) = -2.11\ m/s$
$v_{ix} = (5.00\ m/s)\cos(-25°) = 4.53\ m/s$

$a_y = -9.8\ m/s^2$

$y_i = 50\ m$ $\quad v_{fy} = ?$ $\quad t_i = 0\ s$ $\quad x_i = 0\ m$
$y_f = 0\ m$ $\quad t_f = ?$ $\quad x_f = ?$

a) $t_f = ?$

$y_f = y_i + v_i \Delta t + \frac{1}{2} a_y \Delta t^2$ ($y_f = 0$)

$0 = (-4.9\ m/s^2)\Delta t^2 + (-2.11\ m/s)\Delta t + 50\ m$

$$\Delta t = \frac{2.11\ m/s \pm \left[(-2.11\ m/s)^2 - 4(-4.9\ m/s^2)(50\ m)\right]^{1/2}}{2(-4.9\ m/s^2)}$$

$= -0.215\ s \pm 3.202\ s$

$\boxed{\Delta t = 3.00\ s}$

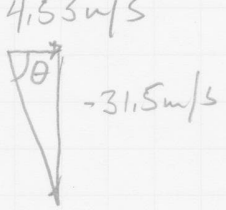
b) $v_{yf} = v_{yi} + a_y \Delta t$

$= -2.11\ m/s + (-9.8\ m/s^2)(3.00\ s)$

$v_{yf} = -31.5\ m/s$

$$v_f = \sqrt{v_x^2 + v_{fy}^2} = \sqrt{(4.53\ m/s)^2 + (-31.5\ m/s)^2}$$

$\boxed{v_f = 31.8\ m/s}$

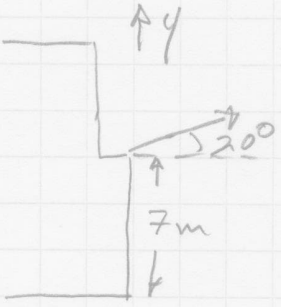


$$\theta = \tan^{-1}\left(\frac{-31.5\ m/s}{4.53\ m/s}\right) = -81.8°$$

$\boxed{\theta = -81.8° \text{ or } 278.2°}$

P.257

3.



$\Delta t = 1.3s$ $\quad y_i = 7m \quad y_f = 1m$

$x_i = 0m$

$a_y = -9.8 m/s^2$

a) $V = ?$ $\qquad y_f - y_i = V_{iy}\Delta t + \frac{1}{2} a \Delta t^2$

$$\frac{(y_f - y_i) + \frac{1}{2} a \Delta t^2}{\Delta t} = V_{iy}$$

$$V_{iy} = \frac{(1m - 7m) - \frac{1}{2}(-9.8 m/s^2)(1.3s)^2}{(1.3s)}$$

$$V_{iy} = 1.75 m/s$$

$$V_{iy} = V \sin 20°$$

$$V = \frac{V_{iy}}{\sin 20°} = \frac{1.75 m/s}{\sin 20°}$$

$$\boxed{V = 5.13 m/s}$$

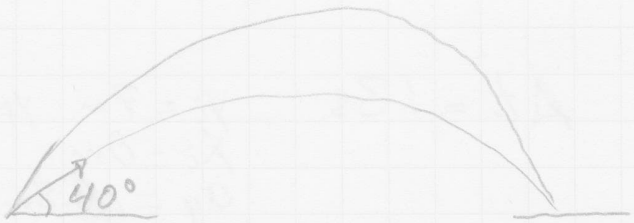
b) $V_x = 5.13 m/s \cos 20° = 4.82 m/s$

$$\Delta X = V_x \Delta t = (4.82 m/s)(1.3s)$$

$$\Delta X = X_f - \cancel{X_i}^{\,0} = X_f = 6.27m$$

$$\boxed{X_f = 6.27m}$$

4.



$$\text{Range} = \frac{V_i^2 \sin 2\theta_i}{g}$$

What angle does $\sin(2(40°)) = \sin 2\theta_i$?

45° is the maximum range because $\sin(2(45°)) = 1$ the maximum for sin

$\sin(2(45° + 5°)) = \sin(2(45° - 5°))$ symmetry of sine

$\theta = 45° + 5° = 50°$

$\boxed{\theta = 50°}$

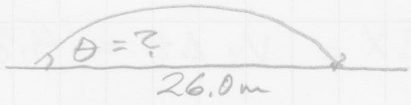
5.

$$\text{Range} = \frac{V_i^2 \sin 90°}{g} \qquad \theta = 45° \text{ for maximum}$$

$$\text{Range} = \frac{(35.0\,m/s)^2 (1)}{9.8\,m/s^2} = 125\,m$$

$\boxed{\text{Range} = 125\,m}$

6. $V_i = 18.0\,m/s$
$\theta_i = ?$
$\text{Range} = 26\,m$



$$\text{Range} = \frac{V_i^2 \sin 2\theta_i}{g}$$

$$\sin 2\theta_i = \frac{(\text{Range})(g)}{V_i^2}$$

$$\theta_i = \tfrac{1}{2} \sin^{-1}\left[\frac{(\text{Range})(g)}{V_i^2}\right] = \tfrac{1}{2} \sin^{-1}\left[\frac{(26m)(9.8\,m/s^2)}{(18.0\,m/s)^2}\right]$$

$\boxed{\theta = 26° \text{ or } 64°}$