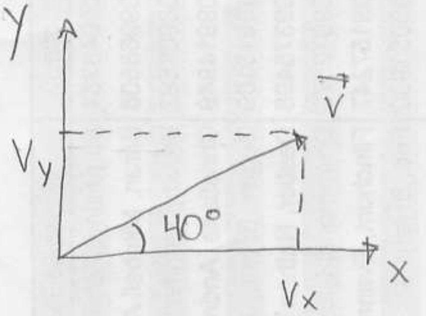
Problem Set Chapter 3 Solutions:

$\boxed{3.7}$

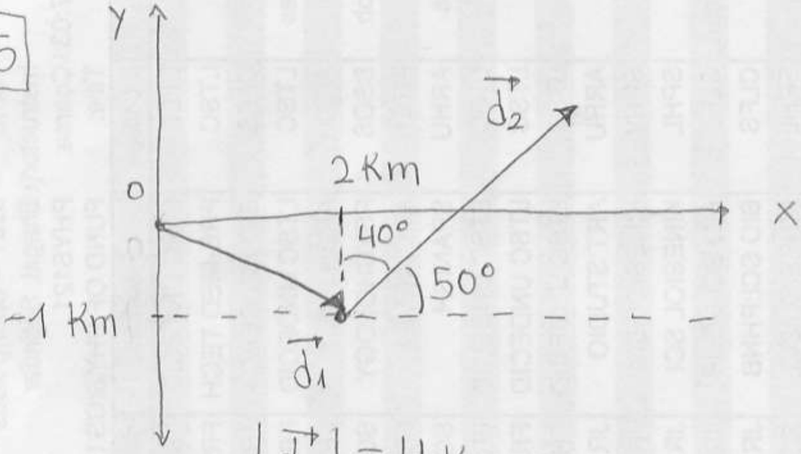


$V_y = 10\,\text{m/s}$ $\qquad |\vec{V}| = \sqrt{12^2+10^2} = 15.56\,\text{m/s}$

$$\tan 40° = \frac{V_y}{V_x}$$

$$V_x = \frac{10\,\text{m/s}}{\tan(40°)} = \underline{12\,\text{m/s}}$$

$\boxed{3.15}$



$\vec{d}$ = Total displacement

$$\vec{d} = \vec{d_1} + \vec{d_2}$$

$$\vec{d_1} = 2\hat{x} - \hat{y}$$

$$\vec{d_2} = d_{2x}\hat{x} + d_{2y}\hat{y}$$

$$|\vec{d_2}| = 4\,\text{Km}$$

$$d_{2x} = |\vec{d_2}| \cos 50°$$

$$d_{2y} = |\vec{d_2}| \sin 50°$$

$$\vec{d_2} = 4\text{Km}\cos 50°\,\hat{x} + 4\text{Km}\sin 50°\,\hat{y}$$

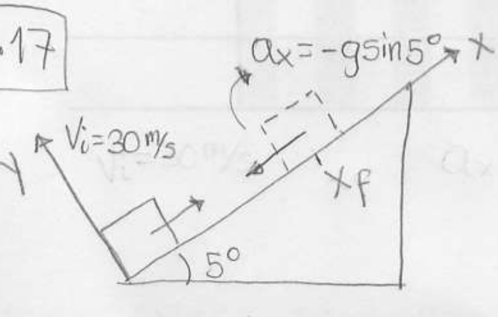
$$\vec{d_1} = 2\text{km}\,\hat{x} - 1\text{Km}\,\hat{y}$$

$$\vec{d} = (4\text{Km}\cos 50° + 2\text{Km})\hat{x} + (4\text{Km}\sin 50° - 1\text{Km})\hat{y}$$

$$\boxed{\vec{d} = (4.6\ \text{Km})\,\hat{x} + (2.1\ \text{Km})\,\hat{y}}$$

$$\boxed{|\vec{d}| = \sqrt{d_x^2 + d_y^2} = 5.1\text{Km}}$$

$\boxed{3.17}$



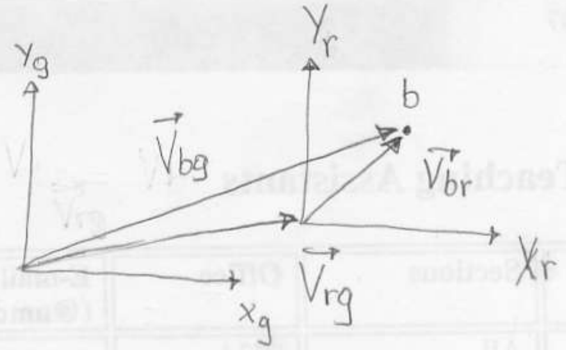
$$\overset{0}{\cancel{V_F^2}} = V_i^2 + 2a_x(X_f - \overset{0}{\cancel{X_i}})$$

$$V_i^2 = 2g\sin 5°\,X_f$$

$$\boxed{X_f = \frac{V_i^2}{2g\sin 5°} = 530\ \text{m}}$$

$\boxed{3.23}$

b= boat
r= river
g= ground



$$\vec{V}_{bg} = \vec{V}_{rg} + \vec{V}_{br}$$

Down the river: $V_{bg1} = V_{rg} + V_{br1} = \dfrac{30\ \text{Km}}{3.0\ \text{h}} = 10\ \text{Km/h}$

During the return trip, the river is flowing against the boat:

$$V_{bg2} = V_{rg} + V_{br2} = -\frac{30\ \text{Km}}{5.0\ \text{h}} = -6.0\ \text{Km/h}$$

So $V_{br2} = -V_{br1}$, thus

$$\left.\begin{cases} V_{rg} + V_{br} = 10\ \text{Km/h} \\ V_{rg} - V_{br} = -6.0\ \text{km/h} \end{cases}\right\} \quad 2V_{rg} = 4.0\ \text{km/h}$$

$$\boxed{V_{rg} = 2.0\ \text{Km/h}}$$

$\boxed{3.25}$

s= staple gun
p= part
g= ground

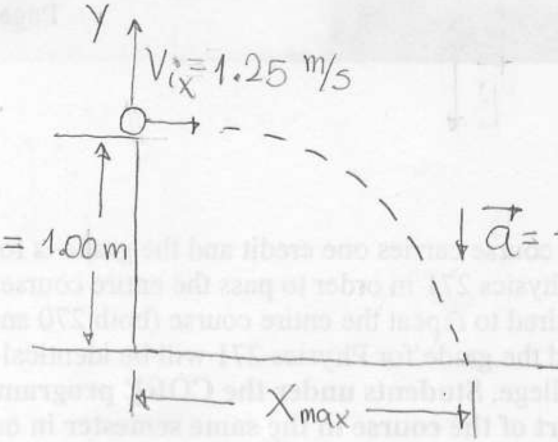
$$\vec{V}_{pg} = \vec{V}_{ps} + \vec{V}_{sg}$$

$$3.0\ \text{m/s} = V_{ps} - 1.0\ \text{m/s}$$

$$V_{ps} = 4.0\ \text{m/s}$$

$$\boxed{4.0\ \frac{\text{m}}{\cancel{\text{s}}} \left| \frac{1\ \cancel{\text{s}}}{10\ \text{staples}} \right| = 0.40\ \frac{\text{m}}{\text{staple}}}$$

$\boxed{3.28}$



$$Y_f - Y_i = V_{iy}t + \frac{1}{2}a_y t^2$$

$$V_{fy} = V_{iy} + a_y t$$

$$Y_i = 1.00\ m,\ Y_f = 0$$

$$a_y = -g,\ V_{iy} = 0$$

$$X_f - X_i = V_{ix}t + \frac{1}{2}a_x t^2$$

$$V_{fx} = V_{ix} + a_x t$$

$$X_i = 0,\ X_f = X_{max}$$

$$V_{ix} = 1.25\ m/s,\ a_x = 0$$

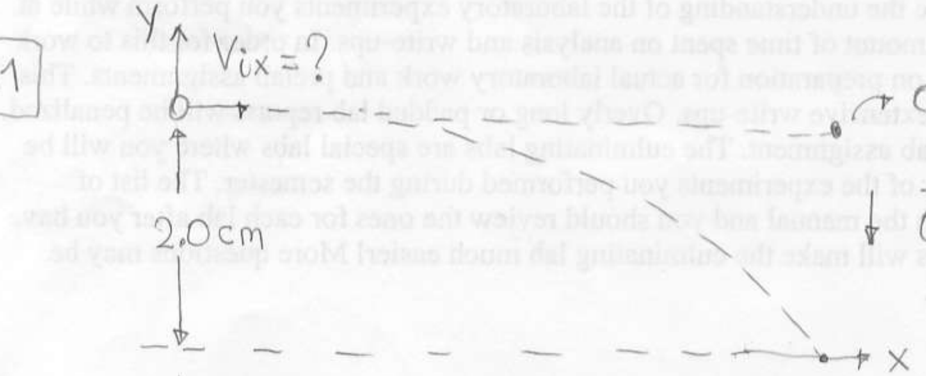
$$X_{max} = 1.25\ m/s\ t$$

$$\boxed{X_{max} = 0.565\ m}$$

$$-1.00\ m = -\frac{1}{2}gt^2$$

$$t = \sqrt{\frac{2.00\ m}{9.8\ m/s^2}} \Rightarrow \boxed{t = 0.452\ s}$$

$\boxed{3.31}$



$$X_f - X_i = V_{ix}t + \frac{1}{2}a_x t^2$$

$$V_{fx} = V_{ix} + a_x t$$

But : $X_i = 0$, $X_f = 50\ m$

$a_x = 0$

$$X_f = V_{ix}t$$

$$50\ m = V_{ix}t$$

$$\boxed{V_{ix} = 782\ m/s}$$

$$Y_f - Y_i = V_{iy}t + \frac{1}{2}a_y t^2$$

$$V_{fy} = V_{iy} + a_y t$$

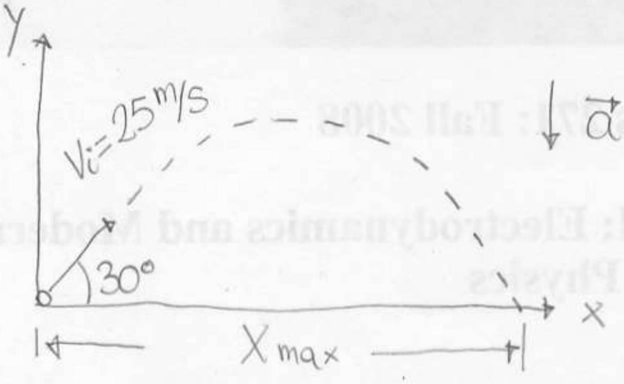
But $Y_i = 0.020\ m$, $Y_f = 0$

$V_{iy} = 0$, $a_y = -g$

$$0.020\ m = \frac{1}{2}gt^2$$

$$\boxed{t = 0.064\ s}$$

$\boxed{3.33}$



$$\downarrow \vec{a} = -g/6\,\hat{y}$$

$$Y_f - Y_i = V_{iy}t + \frac{1}{2}a_y t^2$$

$$V_{fy} = V_{iy} + a_y t$$

$$\vec{V_i} = V_{ix}\hat{x} + V_{iy}\hat{y} \qquad Y_f = 0,\ Y_i = 0$$

$$\cos 30° = \frac{V_{ix}}{V_i}\ ;\ \sin 30° = \frac{V_{iy}}{V_i} \qquad a_y = -g/6$$

$$V_{ix} = 12.5\sqrt{3}\ \text{m/s}\ ;\ V_{iy} = 12.5\ \text{m/s}$$

$$0 = 12.5\,\text{m/s}\ t - \frac{1}{12}g t^2$$

$$0 = t\left(12.5\,\text{m/s} - \frac{1}{12}g t\right) \quad \begin{cases} t = 0 \\ \text{or} \\ t = \dfrac{12 \cdot 12.5\,\text{m/s}}{g} = \boxed{15.3\ \text{s}} \end{cases} \quad a)$$

b) $$X_f - X_i = V_{ix}t + \frac{1}{2}a_x t^2 \qquad \begin{cases} a_x = 0 \\ X_i = 0 \end{cases},\ X_f = X_{max}$$

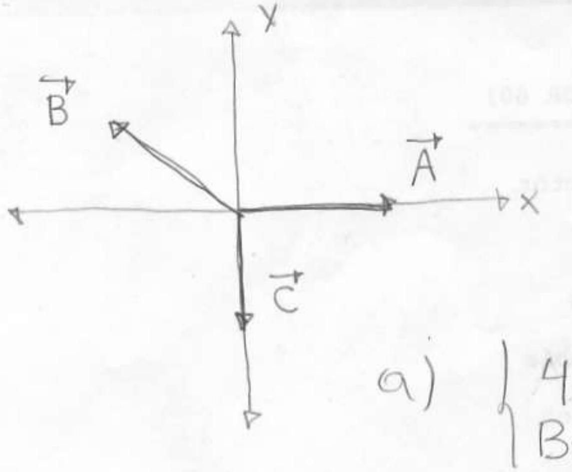
$$X_{max} = 12.5\sqrt{3}\ \text{m/s}\ t \Rightarrow \boxed{X_{max} = 331\ \text{m}}$$

c) $$Y_f - Y_i = V_{iy}t + \frac{1}{2}a_y t^2 \quad \text{But}: \begin{cases} Y_f = 0 \\ Y_i = 0 \end{cases} ;\ a_y = -g$$

$$0 = 12.5\,\text{m/s}\ t - \frac{1}{2}g t^2 \rightarrow \begin{cases} t = 0 \\ \text{or} \\ t = \dfrac{2 \cdot 12.5\,\text{m/s}}{g} = 2.55\ \text{s} \end{cases}$$

$$X_{max} = 12.5\sqrt{3}\,\text{m/s}\ t \Rightarrow \boxed{X_{max} = 55.2\ \text{m}}$$

3.43



$$\vec{D} = \vec{A} + \vec{B} + \vec{C} = 2\hat{x}$$

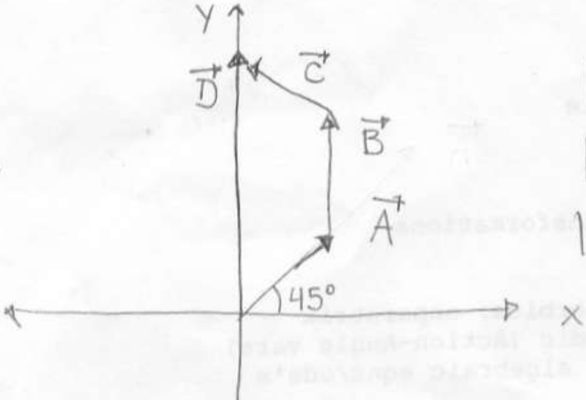
$$= 4\hat{x} + B_x\hat{x} + B_y\hat{y} - 2\hat{y} = 2\hat{x}$$

$$= (4 + B_x)\hat{x} + (B_y - 2)\hat{y} = 2\hat{x}$$

a) $\begin{cases} 4 + B_x = 2 \Rightarrow \boxed{B_x = -2} \\ B_y - 2 = 0 \Rightarrow \boxed{B_y = 2} \end{cases}$

b) $\vec{B} = -2\hat{x} + 2\hat{y}$ $\begin{cases} |\vec{B}| = B = \sqrt{4+4} = 2\sqrt{2} \\ \tan\alpha = -1 \Longrightarrow \alpha = 135° \end{cases}$

3.48



$$|\vec{A}| = 26.0\text{ Km}$$

$$|\vec{B}| = 45.0\text{ Km}$$

$$|\vec{D}| = 70.0\text{ km}$$

$$\vec{D} = \vec{A} + \vec{B} + \vec{C}$$

$$\vec{C} = \vec{D} - \vec{A} - \vec{B}$$

$A_x = 26.0\text{ Km}\cos 45° = 13.0\sqrt{2}\text{ Km}$

$A_y = 26.0\text{ Km}\sin 45° = 13.0\sqrt{2}\text{ Km}$

$$\vec{C} = 70.\text{ Km}\,\hat{y} - 13.0\sqrt{2}\text{ km}(\hat{x}+\hat{y}) - 45.0\,\hat{y}$$

$\boxed{\vec{C} = -18.4\text{ Km}\,\hat{x} + 6.6\text{ Km}\,\hat{y}}$ $\boxed{|\vec{C}| = 19.5\text{ Km}}$

$\tan\alpha = -\dfrac{6.6\text{ Km}}{18.4\text{ Km}} \Rightarrow \boxed{\alpha \simeq 160.2°}$

$\boxed{3.54}$

m = man

s = sidewalk

g = ground

d = distance from gate to baggage claim

$$V_{mg} = V_{ms} + V_{sg}$$

① if the sidewalk is broken then: $V_{sg} = 0$

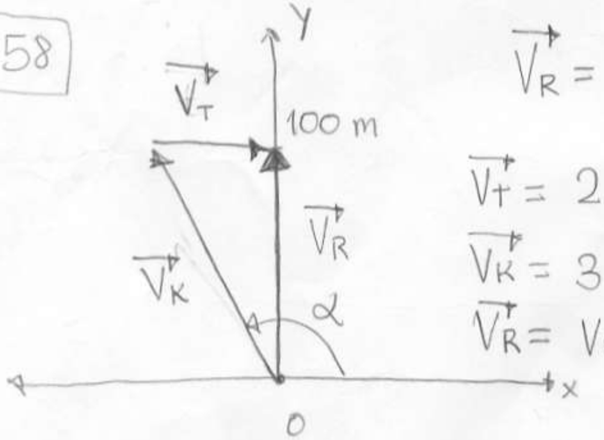
② if the man doesn't walk while riding the sidewalk then: $V_{ms} = 0$

$$V_{ms} = \frac{d}{50s} \; ; \; V_{sg} = \frac{d}{75s}$$

$$V_{mg} = \frac{d}{t} = \frac{d}{50s} + \frac{d}{75s} \Rightarrow \frac{1}{t} = \frac{1}{50s} + \frac{1}{75s}$$

$$\boxed{t = 30s}$$

$\boxed{3.58}$



$$\vec{V_R} = \vec{V_K} + \vec{V_T}$$

$$\vec{V_T} = 2.0\,m/s\;\hat{x}$$

$$\vec{V_K} = 3.0\,m/s\,(\cos\alpha\,\hat{x} + \sin\alpha\,\hat{y})$$

$$\vec{V_R} = V_R.\,\hat{y}$$

$$V_R\hat{y} = (2.0\,m/s + 3.0\,m/s\cos\alpha)\,\hat{x} + 3.0\,m/s\,\sin\alpha\,\hat{y}$$

$$2.0\,m/s + 3.0\,m/s\cos\alpha = 0$$

$$\cos\alpha = -2/3$$

a) $\boxed{\alpha = 132^\circ}$

$$V_R = 3.0\,m/s\cdot\sin\alpha$$

$$V_R = 2.2\,m/s$$

b) $100\,m = 2.2\,m/s \cdot t \Rightarrow \boxed{t = 44.7\,s}$