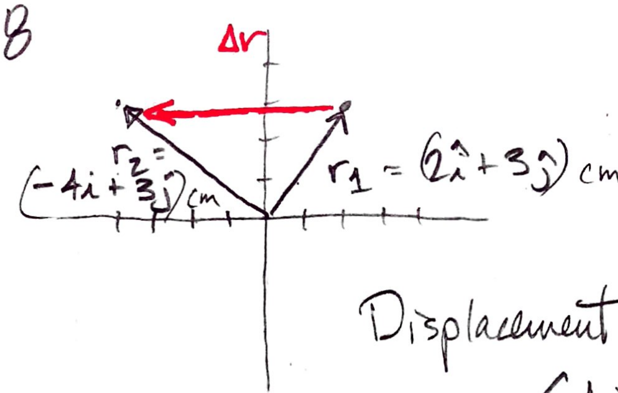
Ch4, #18

4.18

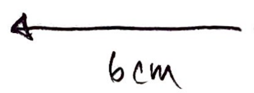


Displacement $\vec{\Delta r} = \vec{r}_f - \vec{r}_i$

$= (-4i + 3j) - (2i + 3j)$

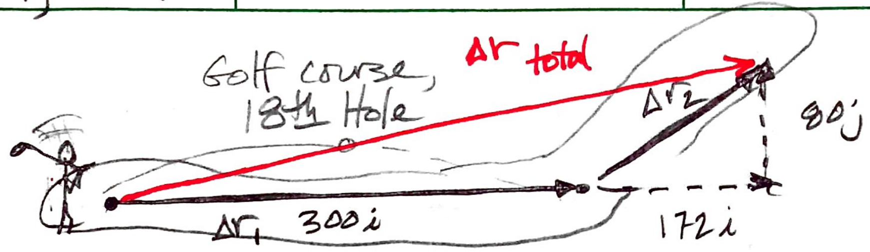
$= \boxed{(-6i + 0j)\ \text{cm}}$

This makes sense – the point indicated by the vector r_1 has moved 6 cm to the left.



Chapter 4, #19

4.19



$$\Delta r_{total} = \Delta r_1 + \Delta r_2$$
$$= (300\,i) + (172\,i + 80\,j)$$
$$= \boxed{(472\,i + 80\,j)\ m}$$ unit-vector form

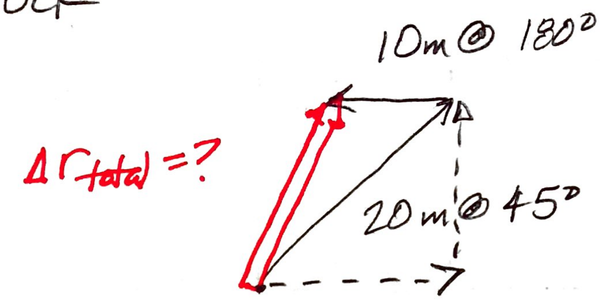
$$\text{Magnitude} = \sqrt{472^2 + 80^2}$$
$$= 479\ m$$

$$\text{Direction } \theta = \tan^{-1}\frac{80}{472} = 9{,}62^\circ$$

$$\text{So } \Delta r = \boxed{479\,m \ @\ 9{,}62^\circ}$$ polar form

Chapter 4, #22

4.22 Puck



$\Delta r = \Delta r_1 + \Delta r_2$

Add components

$r_1 x = 20 \cos 45 = 14.1$

$r_1 y = 20 \sin 45 = 14.1$

$r_2 x = -10$

$r_2 y = 0$

$\Delta r_{total\,x} = r_1 x + r_2 x$

$= 14.1 - 10$

$= \underline{4.1}$

$\Delta r_{total\,y} = r_1 y + r_2 y$

$= 14.1 + 0$

$= \underline{14.1}$

$\text{Mag} = \sqrt{4.1^2 + 14.1^2} = \boxed{14.7\ \text{m}}$

$\text{Dir} = \tan^{-1}\left(\frac{14.1}{4.1}\right) = \boxed{73.8°}$

Chapter 4, #26

4.26 $\quad r = (3t^2\hat{i} + 5\hat{j} - 6t\hat{k})$ m

3-dimensional position!

a) $v(t)$ & $a(t)$?

$$v = \frac{dr}{dt} = \frac{d}{dt}(3t^2\hat{i} + 5\hat{j} - 6t\hat{k})$$
$$= (6t\hat{i} + 0\hat{j} - 6\hat{k})\ \text{m/s}$$

$$a = \frac{dv}{dt} = \frac{d}{dt}(6t\hat{i} + 0\hat{j} - 6\hat{k})$$
$$= (+6\hat{i})\ \text{m/s}^2$$

b) At time $t = 0$, $\quad v = 6(0) + 0 - 6\hat{k}$

$= 6.0$ m/s in the $\hat{k}$ direction

$a = +6.0\ \text{m/s}^2$ in the $\hat{i}$ direction

Chapter 4, #27

4.27

$$a = (4i + 3j)\ m/s^2$$

At $t = 0$, $r = 0$ & $v = 0$

a) $v(t)$ & $r(t) = ?$

$$v = \int a \cdot dt$$

$$v = \int 4i + 3j \cdot dt$$

$$v = (4i + 3j)t + C$$

This is $v_{initial}$, which they've told us is 0, so...

$$\boxed{v = (4i + 3j)t\ m/s}$$

$$r(t) = \int v \cdot dt$$

$$= (4i + 3j)t \cdot dt$$

$$= \frac{1}{2}(4i + 3j)t^2 + C$$

This is $r_{initial}$, which they've told us is 0.

$$\boxed{r = \frac{1}{2}(4i + 3j)t^2\ m}$$

b) Find the equation of the path of the particle, ie. find y as a function of x.

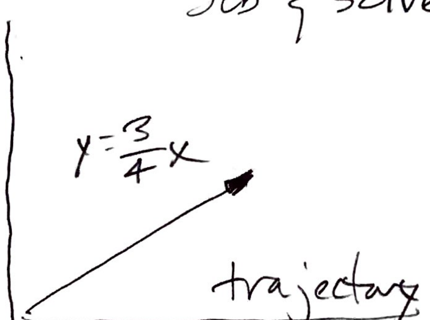
Well. The i coordinate is x, so $x = \frac{1}{2}4t^2 = 2t^2$

j coordinate is y, so $y = \frac{1}{2}3t^2 = 1.5t^2$

Sub & solve: $t^2 = \frac{x}{2}$, so

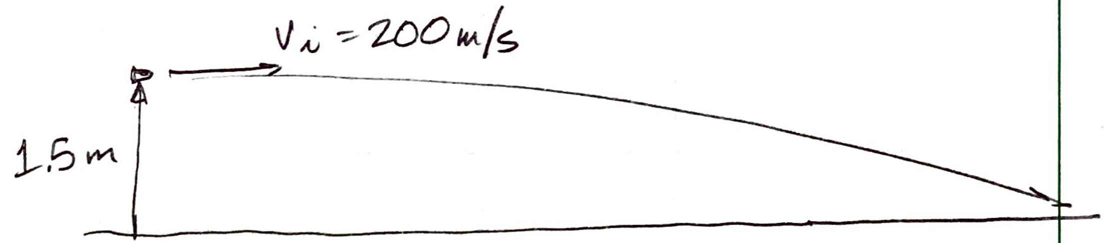
$$y = 1.5\left(\frac{x}{2}\right) = \frac{3x}{4}$$

$$\boxed{y = \frac{3}{4}x}$$



Chapter 4, #33

4,33



a) Time to hit ground = time to fall 1.5 m.
Sideways motion doesn't affect that.

$$\Delta y = v_i t + \frac{1}{2} a t^2$$

$$-1.5\,m = 0t + \frac{1}{2}(-9.8\,m/s^2)\,t^2$$

↑ No initial vertical velocity!

$$\frac{-1.5\,m}{\frac{1}{2}(-9.8)} = t^2$$

$$\boxed{0.55\,s = t}$$

Note: Consider solving with variables first, then substituting in values:

$$\frac{2\Delta y}{a} = t^2$$

$$t = \sqrt{\frac{2\Delta y}{a}}$$

⋮

b) How far does bullet travel in that time?

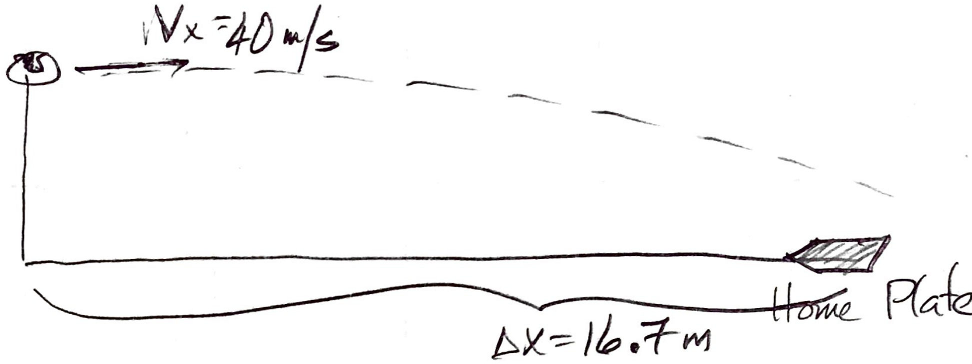
$$\Delta x = v_x t$$

$$\Delta x = (200\,m/s)(0.55\,s)$$

$$\Delta x = \boxed{110\,m}$$

Chapter 4, #38

4.38



a) How long for the ball to reach home plate?

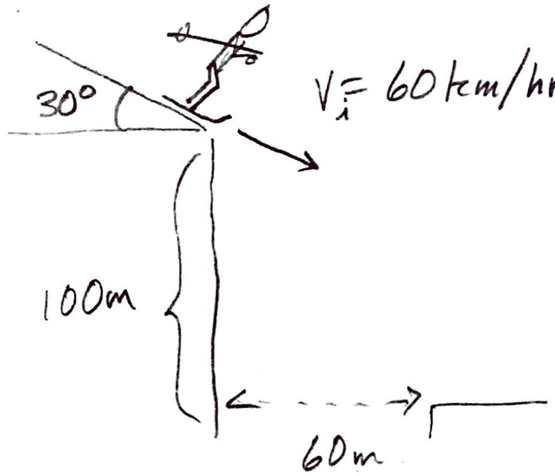
Horizontal
$$\Delta x = vt, \text{ or}$$
$$t = \frac{\Delta x}{V_x} = \frac{16.7\,m}{40\,m/s} = \boxed{0.418\,s}$$

b) How far does the ball drop in this time?

Vertical
$$\Delta y = v_i t + \tfrac{1}{2} a t^2$$
$$\Delta y = 0t + \tfrac{1}{2}(-9.8\,m/s^2)(0.418\,s)^2$$
$$\Delta y = \boxed{-0.856\,m}$$

Chapter 4, # 46

4.46



$V_i = 60\,km/hr$ @ $-30°$

Where does skier land?

Find components of initial velocity:

$$\frac{60\,km}{hr} \times \frac{1000\,m}{1\,km} \times \frac{1\,hr}{3600\,s} = 16.67\,m/s$$

$$V_x = V\cos\theta = 16.67\cos(-30) = 14.4\,m/s$$

$$V_y = V\sin\theta = \quad = -8.34\,m/s$$

One strategy for solving problem: how long does it take to cross 60 m horizontal gap?

$$\Delta t = \frac{\Delta x}{V_x} = \frac{60\,m}{14.4\,m/s} = 4.17\,s$$

Now, where is skier vertically after 4.17s have passed?

$$\Delta y = v_i t + \tfrac{1}{2}at^2$$

$$\Delta y = (-8.34)(4.17) + \tfrac{1}{2}(-9.8)(4.17)^2$$

$$\Delta y = \boxed{-120\,m}$$

Interpretation: the skier will have fallen below the edge of the gorge by the time he reaches the other side. He doesn't make it.