1) Suppose you are standing at the edge of a canyon. You clap and hear the sound of the echo off of the other side of the canyon wall about 1.5 seconds later. You estimate the canyon wall to be about 0.5 km away.

a) what is the speed of sound in meters per second?

b) what is it in km per hour?

$0.5\ km \left(\frac{1000\ m}{1\ km}\right) = 500\ m$

there + back = total distance traveled in 1.5 sec = 2(500m)

$V = \frac{D}{t} = \frac{m}{s} = m/s$ ✓

$V = \frac{2(500)m}{1.5\ sec} = \frac{1000\ m}{1.5\ sec} = 666.67\ m/s$

★ a) the speed of sound is about 666.67 m/s

$\frac{1000\ m}{1.5\ s}\left(\frac{1\ km}{1000\ m}\right)\left(\frac{3600\ sec}{1\ hr}\right) = \frac{3600\ km}{1.5\ hr} = 2400\ km/hr$

★ b) the speed of sound is 2400 km/hr

2)

a) what is $0.25\ m^3$ to cm^3?

$0.25\ m^3 = 250000\ cm^3$

$0.25\ m^3\left(\frac{100\ cm}{1\ m}\right)^3 = 0.25(100)^3 = 250000\ cm^3$

b) what is 100 km/hr in m/s?

100 km/hr ≈ 27.78 m/s

$\frac{100\ km}{1\ hr}\left(\frac{1000\ m}{1\ km}\right)\left(\frac{1\ hr}{3600\ s}\right) = \frac{100(1000)m}{3600\ s} = 27.78\ m/s$

c) what is 2 Kg m/s² in gm cm/ms²

"2 kilogram meters per sec² in grams cm per millisec²"

$2\ kg \cdot m \cdot s^{-2} = 0.2\ gm \cdot cm \cdot ms^{-2}$

$\frac{2\ kg \cdot m}{s^2}\left(\frac{1000\ g}{1\ kg}\right)\left(\frac{100\ cm}{1\ m}\right)\left(\frac{1\ s}{1000\ ms}\right)^2$

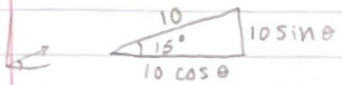
$\frac{2(1000\ g)(100\ cm)}{(1000\ ms^2)}$

$\frac{200000\ g\ cm}{1000000\ ms^2}$

$0.2\ \frac{g\ cm}{ms^2}$

1) Write the following vectors in component form:

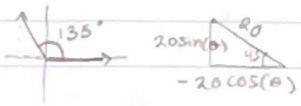
a) $\vec{x}_1$ is a vector w/ magn. 10 meters that makes an angle of 15° with respect to the x-axis



$\vec{x}_1 = 10\cos(15°)\hat{\imath} + 10\sin(15°)\hat{\jmath}$

$\vec{x}_1 = (9.659\hat{\imath} + 2.588\hat{\jmath})$ m

b) $\vec{x}_2$ is a vector w/ magn. 20 m that makes an angle of 135° with respect to the x-axis



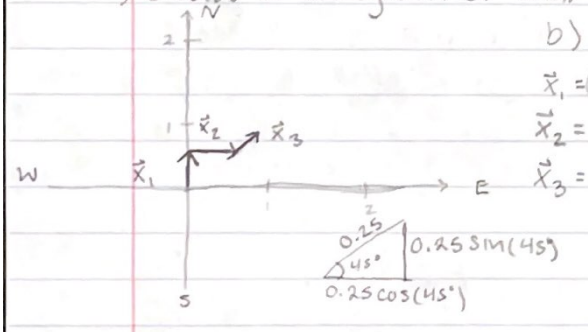
$\vec{x}_2 = -20\cos(45°)\hat{\imath} + 20\sin(45°)$

$\vec{x}_2 = \left(-\frac{20}{\sqrt{2}}\hat{\imath} + \frac{20}{\sqrt{2}}\hat{\jmath}\right)$ m

2) a person goes for a walk. They head 0.5 km to the north, then 0.5 km to the East. Finally, they head North-East @ an angle of 45° w/ respect to the x-axis for 0.25 km

a) draw a diagram of their trajectory

b) what is their final location in x, y coordinate



$\vec{x}_1 = (0\hat{\imath} + 0.5\hat{\jmath})$ km

$\vec{x}_2 = (0.5\hat{\imath} + 0\hat{\jmath})$ km

$\vec{x}_3 = \left(\frac{0.25}{\sqrt{2}}\hat{\imath} + \frac{0.25}{\sqrt{2}}\hat{\jmath}\right)$ km

$\vec{x}_f = \left(\left(0.5 + \frac{0.25}{\sqrt{2}}\hat{\imath}\right) + \left(0.5 + \frac{0.25}{\sqrt{2}}\hat{\jmath}\right)\right)$ km

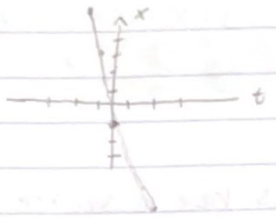
$\vec{x}_f = (0.68\hat{\imath} + 0.68\hat{\jmath})$ km or $(0.68, 0.68)$ km

c) $\sqrt{\left(0.5 + \frac{0.25}{\sqrt{2}}\hat{\imath}\right)^2 + \left(0.5 + \frac{0.25}{\sqrt{2}}\hat{\jmath}\right)^2} = |\vec{x}_f|$

$= 0.957$ km is the distance from the origin

1) the position of a particle moving along the x-axis is given by $x(t) = -1 - 4t$ m

a) what is the displacement of the particle between $t = -2$ sec and $t = 2$ sec



$x(-2) = -1 - 4(-2) = -1 + 8 = 7$ m

$x(2) = -1 - 4(2) = -1 - 8 = -9$ m

$\Delta x = x(2) - x(-2)$

$= -9 - 7$

$\Delta x = -16$ m

$-4(2) + 4(-2)$

$-8 + -8$

$= -16$ m

b) what is the velocity?

$x(t) = -1 - 4t$ m

$x'(t) = v(t) = -4$ m/s

2) a particle moves along the x-axis according to $x(t) = -2t + 7t^2$

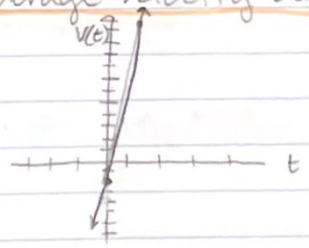
a) what is the average velocity between $t = 0$ and $t = 2$ sec?

$x(t) = 7t^2 - 2t$ Av. $v = \frac{x(2) - x(0)}{2 - 0} = \frac{(-2 \cdot 2 + 7 \cdot 4) - 0}{2} = \frac{-4 + 28}{2} = \frac{24}{2} = 12$ m/s

$x'(t) = v(t) = 14t - 2$

Average velocity between $t = 0$ and $t = 2$ sec is 12 m/s

b)



c) the instantaneous velocity at $t = 1$ sec is $v(1) = 14(1) - 2$

$= 12$ m/s

d) $v(t) = 14t - 2$

$v'(t) = a(t) = 14$ m/s^2

3) Sprinter has a constant acceleration of $5\ m/s^2$. Suppose she starts from rest.

a) how long does it take her to reach her top speed of 10 m/s

$V(t) = V_i + at \rightarrow 10 = at \rightarrow \frac{10}{5} = 2$ seconds to reach 10 m/s

$\frac{m/s}{m/s^2} = \frac{m}{s} \cdot \frac{s^2}{m} = s$ ✓

b) what is her displacement at that time

$V_f^2 = V_i^2 + 2a\Delta x \rightarrow V_i^2 = 0 + 2a\Delta x \rightarrow \frac{V_f^2}{2a} = \Delta x$ $\quad \frac{m^2}{s^2} \cdot \frac{s^2}{m} = m$ ✓

$\Delta x = \frac{(10)^2}{2(5)} = \frac{100}{10} = 10\ m$ $\quad \Delta x = 10\ m$

c) Suppose she is running the 100m sprint. If she continues at 10 m/s for the remainder of the race, what will be her total time?

How long will it take to run 90 m if shes running at 10 m/s?

$V = \frac{d}{t}$

$10 = \frac{90}{t}$

$10t = 90$

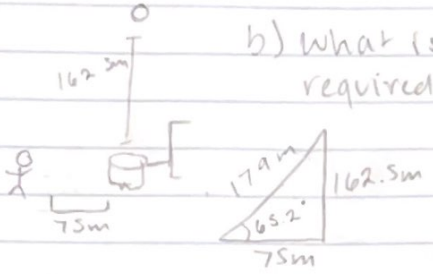
$t = \frac{90}{10} = 9$ sec

$t_{total} = 9 + 2 = 11$ sec

It will take her a total of 11 seconds to run the 100 m

1) The world record highest basketball shot was made from a height of 162.5 m above the hoop. the hoop was placed 75 m horizontally from the shooter

a)



b) What is the horizontal velocity required to make the shot

$$V = \frac{d}{t} = \frac{75\,m}{5.76\,s} = 13.02\ m/s$$

$$y_1 = y_0 + v_{y0} + \frac{1}{2}at^2$$
$$0 = 162.5 + 0 + \frac{1}{2}(-9.81)t^2$$
$$-162.5 = \frac{1}{2}(-9.81)t^2$$
$$\frac{-162.5}{-4.905} = t^2$$
$$\sqrt{33.129} = t = 5.76\,sec$$

2) a baseball is hit at a 45° angle wirespect to the horizontal @ 40 m/s

a) how far away does it land?

$$R = \frac{v_0^2 \sin(2\theta)}{g}$$
$$R = \frac{40^2 \sin(90^\circ)}{9.81}$$

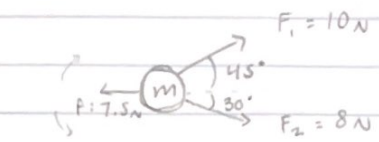
$R = 163\ m$

b) how long is it in the air?

$$T_{tof} = \frac{2 v_0 \sin(\theta)}{g}$$
$$= \frac{2(40)\cdot \sin(45^\circ)}{9.81} = \frac{80 \cdot \frac{1}{\sqrt{2}}}{9.81}$$

$T_{tof} = 5.77$ seconds

1) Find acceleration of system if mass of child + sled = 49 kg

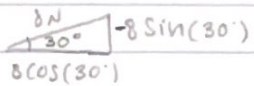


$$\vec{F}_1 + \vec{F}_2 = (10\cos(45°) + 8\cos(30°))\uparrow + (10\sin(45°) - 8\sin(30°))\uparrow$$

$$\vec{F}_1 + \vec{F}_2 = \left(\frac{10}{\sqrt{2}} + 8\frac{\sqrt{3}}{2}\right)\uparrow + \left(\frac{10}{\sqrt{2}} - \frac{8}{2}\right)\uparrow$$

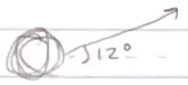
$$= (14\uparrow + 3\uparrow)\ N$$

F_x F_y



$$\tan(\theta) = \frac{3}{14}$$

$$\arctan\left(\frac{3}{14}\right) = \theta \approx 12°$$



$$F = \sqrt{(14^2)\uparrow + (3^2)\uparrow}$$

$$= \sqrt{196 + 9}$$

$$F = 14.31\ N$$

$$F - f = 14.31 - 7.5 = \underline{6.81\ N = F_{net}}$$

$$\vec{F} = m\vec{a}$$

$$\frac{F}{m} = a = \frac{6.81\ N}{49\ kg} = \underline{0.14\ m/s^2 = a}$$