PHYS 10310

Solution Exam 1 Problem 1

a) $1\,gm = \frac{1}{1000}\,kg \;\; \frac{1}{1000}\,\frac{mt}{kg}$

$= 10^{-3} \cdot 10^{-3}\, mt$

$\boxed{1\,gm = 10^{-6}\, mt}$

$1000\,g = 1\,kg$

$1\,g = \frac{1}{1000}\,kg$

$1000\,kg = 1\,mt$

$kg = \frac{1}{1000}\,mt$

b) $100\,cm = 1\,m$

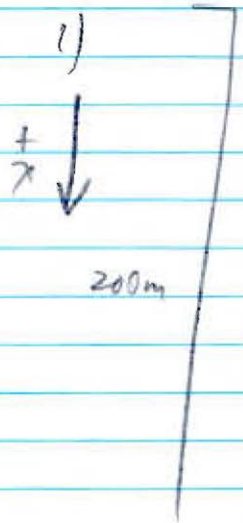
$1\,cm = \frac{1}{100}\,m = 10^{-2}\,m$

$1\,cm^2 = 10^{-4}\,m^2$

$\boxed{1\,cm^3 = 10^{-6}\,m^3}$

Solution 2

1)



$g = 9.8\ m/s$

$S = \frac{1}{2} g t^2$

$S = 4.9 \cdot 25 \qquad t = 5s$

$= 122.5\ m$

$V = 9.8 \times 5 = 49\ m/s$

At 5 sec Balloon $S = 122.5m$, $V = 49\ m/s$

$X = X_0 + V_0 t + \frac{1}{2} g t^2$

$= 122.5 + 49t + 4.9t^2$ Balloon

$= 200 - 40t + 4.9t^2$ Arrow

$200 - 40t + 4.9t^2 = 122.5 + 49t + 4.9t^2$

$200 - 122.5 = 89t$

$77.5\ m = 89t \Rightarrow \boxed{t = 0.87s}$

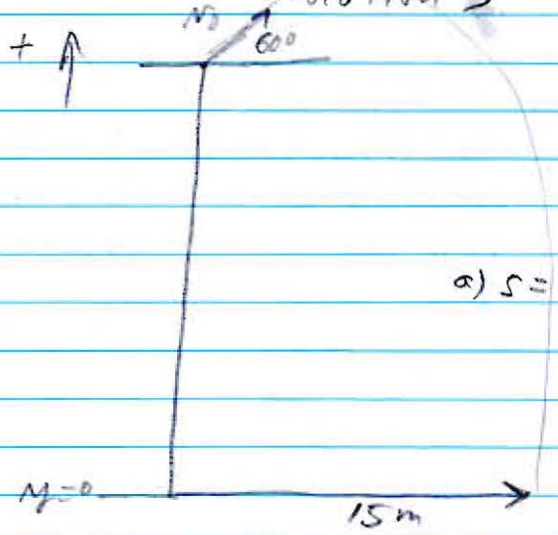
Where does it hit?

$200 - 40t + 4.9t^2 = 169\ m$

Check

$122.5 + 49t + 4.9t^2 = \boxed{169m}$

Solution 3



$v_{x_0} = v_0 \cos 60°$

$v_{y_0} = v_0 \sin 60°$

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

a) $s = v_{x_0} t$ $\quad t = 6.5\ s$ $\quad s = 15\ m$

$v_{x_0} = s/t = 15\ m / 6.5\ s = 2.31\ m/s$

$v_0 \cos 60°$

$$v_0 = \frac{2.31\ m/s}{\cos 60°} = 4.62\ m/s$$

b) $y = y_0 + v_0 t - \frac{1}{2} g t^2$

$0 = y_0 + v_0 \sin 60° \cdot 6.5 - \frac{1}{2} 9.8 (6.5)^2$

$y_0 = \frac{1}{2} 9.8 (6.5)^2 - 4.62 \sin 60° \cdot 6.5$

$$y_0 = 181\ m$$

c) $v_y = v_{0y} - g t = 4.62 \sin 60° - 9.8 \cdot 6.5$

$v_x = v_{0x} = 4.62 \cos 60° =$

$\vec{v} = (2.31, -59.7)\ m/s$

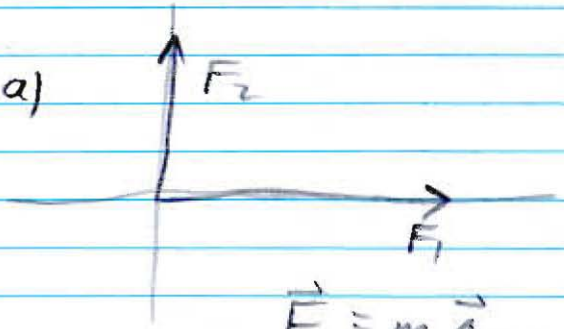
$$|\vec{v}| = 59.7\ m/s$$

Exam Problem 4

$m = 43g = .043kg$

b) $t = 0$ $\quad \vec{v} = (0,0)$, $\vec{r} = (0,0)$

a)



$\vec{F} = F_1 + F_2 = (0.071, 0.081)$

$\vec{F} = m\vec{a}$ $\quad \vec{a} = \frac{\vec{F}}{m} = \left(\frac{0.071}{0.043}, \frac{0.081}{0.043}\right)$

$\vec{a} = (1.65, 1.88)\ m/s^2$

c) $\vec{a}$ const. $\quad \vec{V} = \vec{V}_0 + \vec{a}t$

$\vec{x} = \vec{x}_0 + \vec{V}_0 t + \frac{1}{2}at^2$

$t = 1.2s$

$V = \vec{a} \cdot 1.2 = (1.98, 2.26)\ m/s$

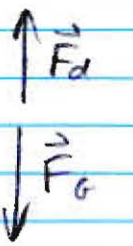
$\vec{r} = \vec{a} \cdot \frac{t^2}{2} = \vec{a} \cdot 0.72 = (1.19, 1.35)\ m$

d) $t = 3.6s$ $\quad \vec{V} = \vec{a} \cdot 3.6 = (5.94, 6.77)\ m/s$

$\vec{x} = \vec{a}\frac{t^2}{2} = \vec{a} \cdot 6.48 = (10.7, 12.2)\ m$

Exam 1

Solution 5



$$\vec{F}_G = -mg\vec{j}$$

$$\vec{F}_d = Av^2\vec{j} = ma$$

Units of A $\quad \frac{F}{v^2} = \frac{N s^2}{m^2}$

But $N = kg\ m/s^2$

$$= \frac{kg\ m}{s^2}\frac{s^2}{m^2} = \frac{kg}{m}$$

a) Units of A $\frac{kg}{m}$

Dimensions Mass/Length

b) $$\vec{a} = \frac{d\vec{v}}{dt} = \frac{\vec{F}}{m} = \left(\frac{Av^2 - mg}{m}\right)\vec{j} = \left(\frac{Av^2}{m} - g\right)\vec{j}$$

c) Terminal $\vec{v}$ when $\vec{a} = 0$

$$\frac{Av^2}{m} - g = 0$$

$$\frac{Av^2}{m} = g \Rightarrow \quad v^2 = \frac{gm}{A}$$

$$v_T = \sqrt{\frac{gm}{A}}$$