2: Estimations and Unit Analysis

1. $\frac{D}{T} = \frac{(T)(S)}{T}$ $\quad 2\frac{D}{T} = S \quad \frac{250m}{1.5s} = 333.333\ m/s$

$333.333\ m/s \times 3.6 = 1200\ km/hr$

C: 330 m/s, 1200 km/hr

2. $1\ m^3 = 1{,}000{,}000\ cm^3$

$.25\ m^3 = \frac{1}{4}\ m^3$

$(\frac{1}{4})(1{,}000{,}000) = 250{,}000\ cm^3$

B: $250{,}000\ cm^3$, 28 m/s

3. 100 km/hr in m/s

km/hr $\rightarrow$ m/s $= (x)/3.6$

$100/3.6 = 27.77 \simeq 28\ m/s$

B: 28 m/s

4. $D = \frac{m}{V}$, $D = \frac{9\ kg}{0.001\ m^3} \rightarrow \frac{9000\ g}{1000\ cm^3} = 9.0\ g\ cm^{-3}$

B: $9.0\ g\ cm^{-3}$, copper

3 Vectors

1) 10 meters and angle of 30° above x-axis

$10\sin(30°) = 5\hat{j}$
$10\cos(30°) = 5\sqrt{3}\hat{i}$

$\vec{x_1} = 5\sqrt{3}\hat{i} + 5\hat{j}$

A: $\vec{x_1} = 5\sqrt{3}\hat{i} + 5\hat{j}$

2) $20\sin(180°) = 0\hat{j}$
$20\cos(180°) = -20\hat{i}$

D: $\vec{x_1} = -20\hat{i}$

3) East; 2 blocks - +2
North; 3 blocks - +3
West; 6 blocks - -6

$2 - 6 = -4\hat{i}$ blocks
$3 = 3\hat{j}$ blocks

1 block = 500 m
$-4/2 = -2\hat{i}$
$3/2 = 1.5\hat{j}$

C: $\vec{x} = -2\hat{i} + 1.5\hat{j}$

4. Motion Along a Straight Line

1. D: The particle has a positive, constant velocity

2. 1 sec: 1 m/s, 2 sec: 3 m/s, 3 sec: 5 m/s, 4 sec: 7 m/s

A: 2 m/s

3. $X(t) = -2t + 7t^2$ average v between $t=0$ and $t=2$ sec

$X(0) = -2(0) + 7(0)^2$ $\quad X(2) = -2(2) + 7(2)^2$

$X(0) = 0$ $\quad X2 = 24$

$24 - 0 / 2 - 0 = 12$ m/s

C: 12 m/s

4. Average acceleration between $t=0$ and $t=2$ sec

$-2(1) + 7(1)^2$ $\quad -2(2) + 7(2)^2$

$-2 + 7 = 5$ $\quad -4 + 28 = 24$

$24 - 0 / 2 - 0 = 12 \text{ m/s}^2$

C: 12 m/s^2

5a) Constant acceleration of $5.0\ m/s^2$. Starts from rest
2 seconds $= 10\ m/s$

Check is: $= \frac{1}{2}(5.0)(2)^2$
$5 = 10$

B: 2 seconds

b. Displacement: $\Delta x = \vec{x}_f - \vec{x}_i$ final: 10 m initial: 0m

$\Delta x = 10_m - 0_m = 10m$

B: 10 meters

C) 100 m sprint: continues at $10.0\ m/s$

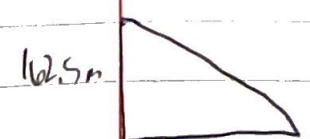
Displacement: $10m \rightarrow 90\ m$ left $\frac{90\ m}{10\ m/s} = 9$ seconds

acceleration to 10 m/s = 2 seconds + 9 seconds = 11 seconds
(10 m) (90 m) (100 m)

C: 11 seconds

5 Motion in Two and Three Dimensions

1. $d = v_i t + \frac{1}{2} a t^2$



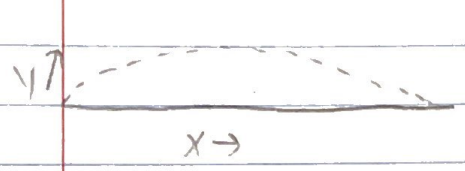
$a_y = -9.81\ m/s^2$ $a_x = 0$
$v_{iy} = 0\ m/s$ $v_x = ?$
$d_y = -162.5\ m$ $d_x = 75\ m$

$d = v_i t + \frac{1}{2} a t^2$
$d = \frac{1}{2} a_y t^2$
$\sqrt{\frac{2d}{a}} = t$

$$\sqrt{\frac{2(162.5\,m)}{-9.81\,m/s^2}} = 5.75592\,sec \qquad V = \frac{d}{t} = \frac{75m}{5.75592\,sec} \approx 13\,m/s$$

B: 13 m/s

2. 45° angle, horizontal 40 m/s



$V_{0y} = 40 \sin(45°) = 28.28427$
$V_{0x} = 40 \cos(45°) = 28.2847$

$\Delta y = V_0 t + \frac{1}{2} a t^2$
$0 = 28.2847 t + \frac{1}{2}(-9.8) t^2$
$t \approx 5.77$ sec

$\Delta x = (28.2847)(5.77)$
$\Delta x = 163.20$

C: 160m

3. $\Delta y = V_0 t + \frac{1}{2} a t^2$
$0 = 28.2847 + \frac{1}{2}(-9.8) t^2$
$t \approx 5.77$ sec

B: 5.5 seconds

6 Forces

$m = .25$ kg
$L_1 = 68$ cm
$L_2 = .48$ cm

$F = kx$ $\quad kx - mg = 0$ $\quad kx = mg$ $\quad k = \frac{mg}{x}$

$k = \frac{(.25)(9.8)}{.68 - .48} = 12.25$ N/m

D: 12 N/m

2. $F = m/a \rightarrow a = F/m$ $F_r = F - m \times g \times$ (coefficient of friction (μ))

$a = (F - m \times g \times \mu)/m \rightarrow a = F/m - \mu \times g$

$75/75 - 0.1 \times 9.81$ 1N accelerates 1kg by 1m/s

$a = 1.01325\ m/s^2$

B: $1\ m/s^2$

3. An example of a substance which increases acceleration of an object is oil as it reduces the friction between the object and the floor.