CH = 9

Q.1	$m_1 = 1kg$	$m_2 = 1kg$	$m_3 = 1kg$
	$\vec{r}_1 = i + 4j$	$\vec{r}_2 = 3i + j$	$\vec{r}_3 = ?$

$$\vec{r}_{c.om} = 3i + 3j \qquad , M = m_1 + m_2 + m_3 = 3kg$$

$$\vec{r}_{c.o.m} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2 + m_3\vec{r}_3}{M}$$

$$3 \times (3\hat{i} + 3\hat{j}) = ((i+4\hat{j}) + (3\hat{i} + \hat{j}) + \vec{r}_3$$

$$9\hat{i} + 9\hat{j} = 4\hat{i} + 5\hat{j} + \vec{r}_3$$

$$\boxed{\vec{r}_3 = (5\hat{i} + 4\hat{j})\ m}$$

Q.2 $\vec{P}_i = \vec{P}_f$, was at rest $\Rightarrow P_i = 0$

$$\vec{P}_f = \vec{P}_f(A) + \vec{P}_f(B) + \vec{P}_f(C) = m_A\vec{V}_A + m_B\vec{V}_B + m_c\vec{V}_c$$

$$P_f = 2(3\hat{i}) + 3(-\hat{j}) + 1(\vec{V}_c)$$

$$\therefore \quad 0 = P_f \Rightarrow 0 = 6\hat{i} - 3\hat{j} + \vec{V}_c$$

$$\Rightarrow \quad \boxed{\vec{V}_c = -6\hat{i} + 3\hat{j} \ m/s}$$

Cont. CH 9:-

Q.3 at origin $\vec{r}_{c.o.m} = 0\hat{i} + 0\hat{j}$

$$\Rightarrow \vec{r}_{c.om} = \frac{1}{M}\left(m_1\vec{r}_1 + m_2\vec{r}_2 + m_3\vec{r}_3\right) \qquad (\times M)$$

$$0 = 4(3\hat{i}+4\hat{j}) + 6(-2\hat{i}-6\hat{j}) + 2\vec{r}_3$$

$$0 = 12\hat{i} + 16\hat{j} - 12\hat{i} - 36\hat{j} + 2\vec{r}_3$$

$$0 = -20\hat{j} + 2\vec{r}_3 \Rightarrow 2\vec{r}_3 = 20\hat{j}$$

$$\therefore \vec{r}_3 = 10\hat{j}$$

$$\therefore$$

$$r_3 : (0, 10)$$

Q.4

$$\vec{V}_{c.om} = \frac{1}{M}\left(m_1\vec{v}_1 + m_2(\vec{v}_2)\right)$$

$$= \frac{1}{(2+3)}\left(2\times(4\hat{i}) + 3\times(5\hat{j})\right)$$

$$\vec{V}_{c.om} = \frac{1}{5}(8\hat{i}+15\hat{j}) = 1.6\hat{i} + 3\hat{j}$$

as speed: $|\vec{V}_{com}| = \sqrt{(1.6)^2 + (3)^2}$

$$V_{c.om} = 3.4 \text{ m/s}$$

Ch.9 →

Q.5 $\vec{P}_{c.o.m} = M \vec{v}_{c.o.m}$

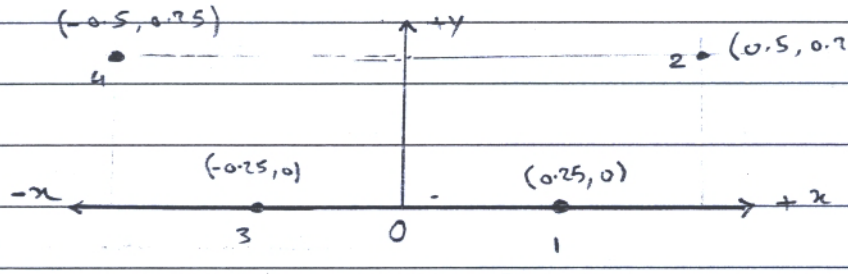
$= M\left(\frac{1}{M}(m\vec{v}_1 + m_2\vec{v}_2)\right)$

$= 5\,(12\hat{i} - 16\hat{j} + (-20\hat{i} + 14\hat{j}))$

$= 5(-8\hat{i} - 2\hat{j})$

$\vec{P}_{c.o.m} = -40\hat{i} - 10\hat{j}$

Q.6 First we will locate the center of mass for each segmnt of the wire: as follow:



Now lets locate the center of mass of these "4" segments: (each with mass $\frac{M}{4}$)

$X_{c.o.m} = \frac{1}{M}\left(\frac{M}{4}(0.25 + 0.5 - 0.25 - 0.5)\right)$

$= 0$

$Y_{c.o.m} = \frac{1}{M}\left(\frac{M}{4}\right)(0 + 0.25 + 0 + 0.25)$

$= \frac{1}{4}(0.5) = \frac{1}{8}\ m$

$\therefore$ Center of Mass : $(0, \frac{1}{8})$

end/ch.9