Sol. 1. $m = 5kg$, $u = 0$, distance $s = 40$

$$s = ut + \frac{1}{2}gt^2$$

$$40 = 0 \times t + \frac{1}{2} \times 9.81 t^2$$

$$t^2 = \frac{40 \times 2}{9.81} \Rightarrow t = \sqrt{8.15}$$

$$\boxed{t = 2.85 \text{ seconds}}$$

Av. Velocity $= \frac{u+v}{2} = \frac{s}{t}$

$$\frac{u+v}{2} = \frac{40}{2.85} = 14.03$$

$$\frac{0+v}{2} = 14.03 \Rightarrow v = 2 \times 14.03$$

$$\boxed{v = 28.07 \text{ m/s}}$$

$F = m \times a$

$a = \frac{v}{t} = \frac{28.07}{2.85}$

$F = 5 \times 9.84$

$a = 9.84 \text{ m/s}^2$

$$\boxed{F = 49.24 N}$$

Momentum $= p = mv$

$p = 5 \times 28.07$

$$\boxed{p = 140.35 N}$$

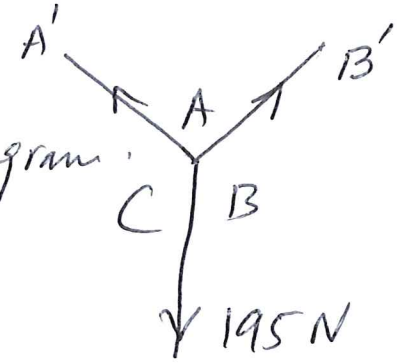
(b) Mass $\propto$ volume

m (kg) $\propto V$ (m^3)

$m = \rho V$

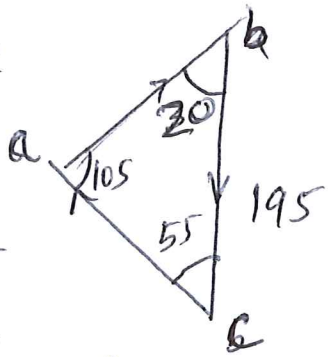
(density) $\boxed{\rho = \frac{m}{V} \text{ kg/m}^3}$

Q.No.2



space diagram.

Apply sine rule



vector diagram

$$\frac{195}{\sin 105} = \frac{ab}{\sin 55}$$

$$ab = \frac{195}{\sin 105} \times \sin 55$$

$$ab = 165.36\ N$$

$$ac = \frac{195}{\sin 105} \times \sin 20$$

$$ac = 69.04\ N$$

Q.No.3

Taking moments about A

$$R_B \times 9 = 20 \times 4 + 30 \times 6$$

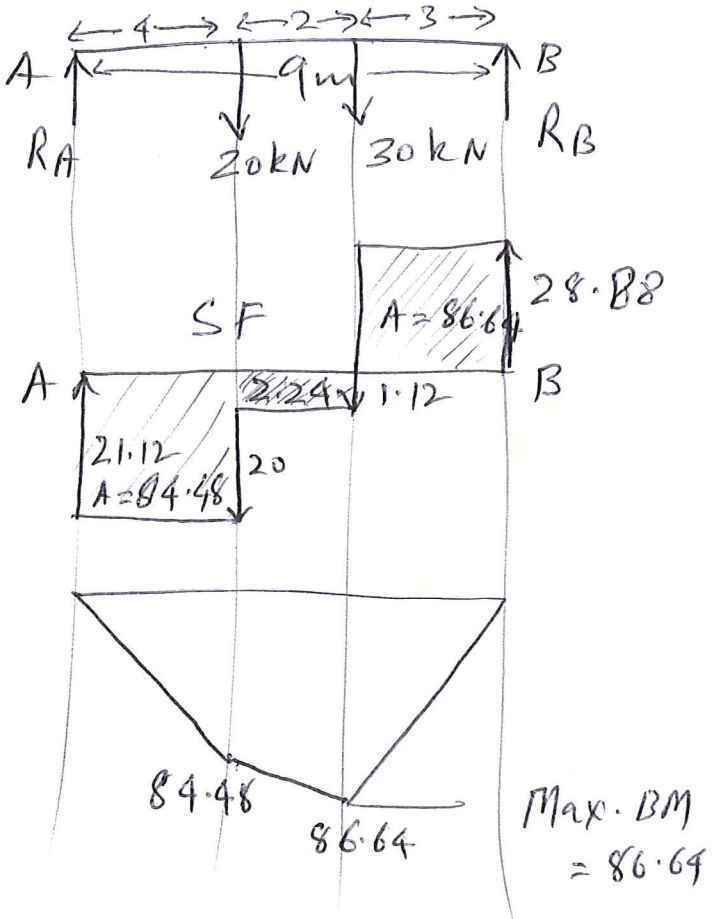
$$R_B \times 9 = 80 + 180$$

$$R_B = \frac{260}{9}$$

$$\boxed{R_B = 28.88\ kN}$$

$$R_A = 50 - 28.88$$

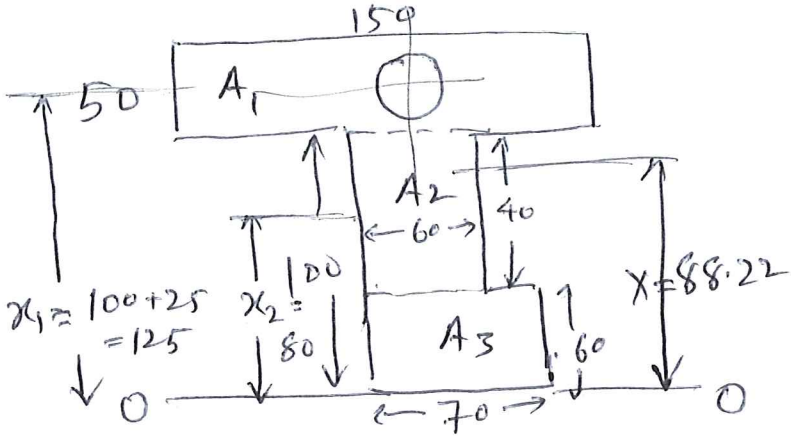
$$\boxed{R_A = 21.11\ kN}$$



Q. No 4 $A_1 = 150 \times 50 - \pi 10^2$

$A_1 = 7185.84\ mm^2$

$x_1 = 125\ mm$



$A_2 = 40 \times 60 = 2400\ mm^2$

$x_2 = 80\ mm$

$A_3 = 60 \times 70 = 4200\ mm^2$

$x_3 = 30\ mm$

$\bar{x}$ C.G from O-O $= \dfrac{\Sigma \text{ moments of areas}}{\Sigma \text{ Areas}}$

$= \dfrac{7185.84 \times 125 + 2400 \times 80 + 4200 \times 30}{(7185.84 + 2400 + 4200)}$

C.G $= 88.22\ mm$

Q. No 5

$D = 300\ mm \Rightarrow r = \dfrac{300}{2} = 150\ mm$

$N = 35\ rpm$

load $= 12\ kN$

Power $= ?$

Power $= ?$ Torque = Force (load) x radius

$= 12 \times 0.15$

$T = 1.8\ kN-m$

$\text{Power} = \dfrac{2\pi N T}{60}$

$= \dfrac{2\pi \times 35 \times 1.8}{60}$

$P = 6.597\ kW$

$\boxed{P = 6.6\ kw}$