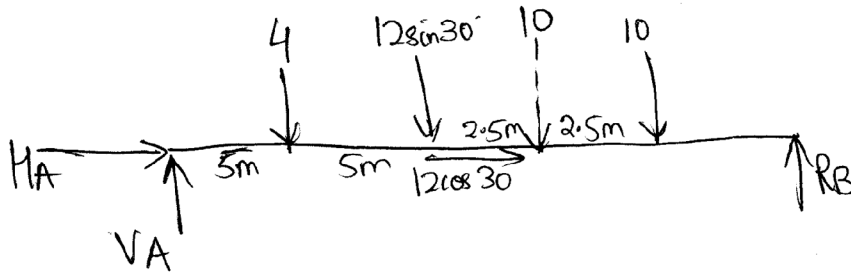
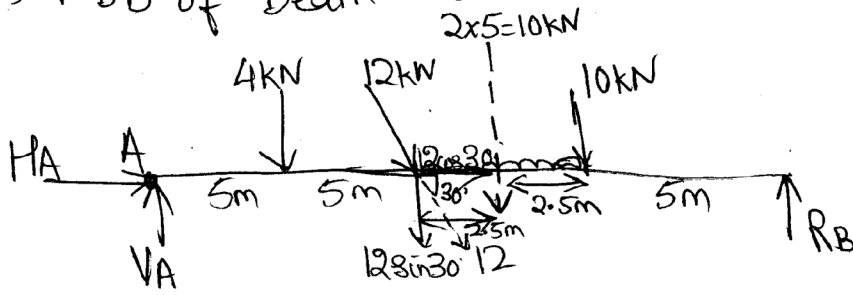
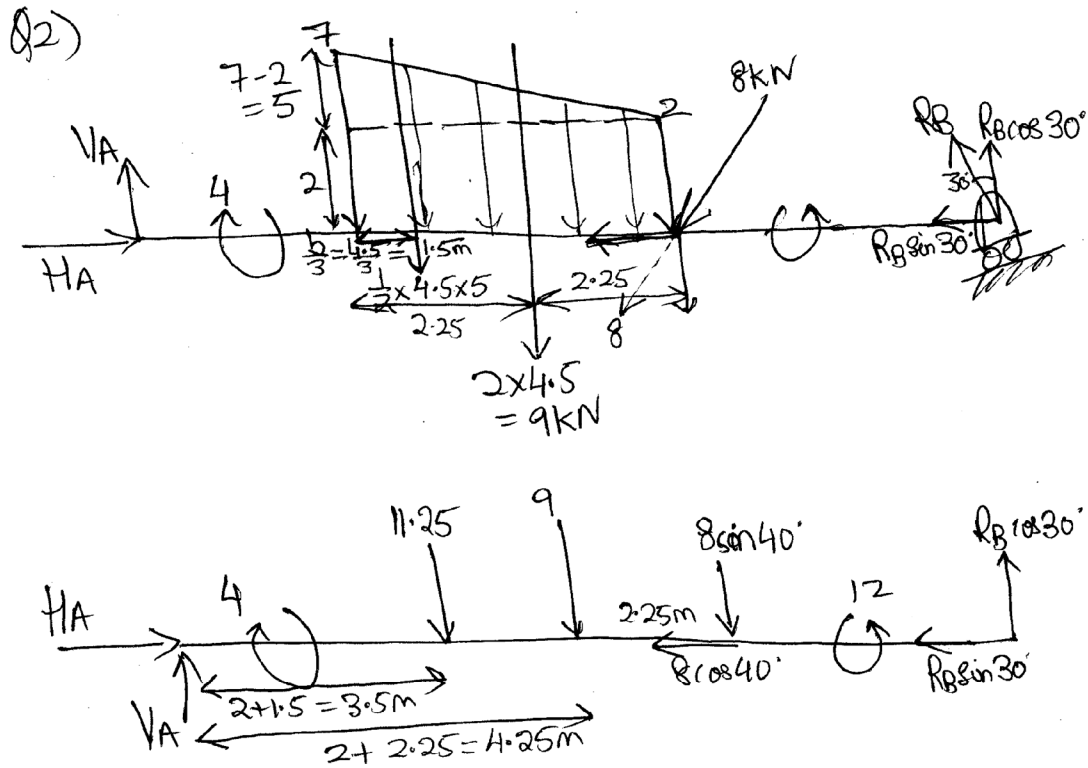


Q1) FBD of beam AB is:-





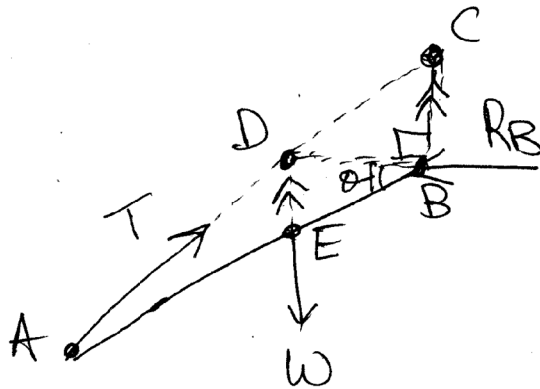
$$\begin{aligned} BE &= 10 \\ BD &= \frac{10}{\cos \theta} \\ BF &= 15 \cos \theta \\ BG &= 30 \cos \theta \end{aligned}$$


$$\sum f_y = 0$$

$$\sum M_B = 0$$

$$\therefore R_B \times O + R_D \times BD - 25 \times BF - 50 \times BG = 0$$

(Q4)



$$BC = 0.4\text{m}$$

$$\triangle ADE \sim \triangle ACB$$

$$DE = \frac{1}{2} BC$$

$$= 0.2\text{m}$$

$$BE = AE = 0.4\text{m}$$

$$\sin \theta = \frac{DE}{BE} = \frac{0.2}{0.4}$$

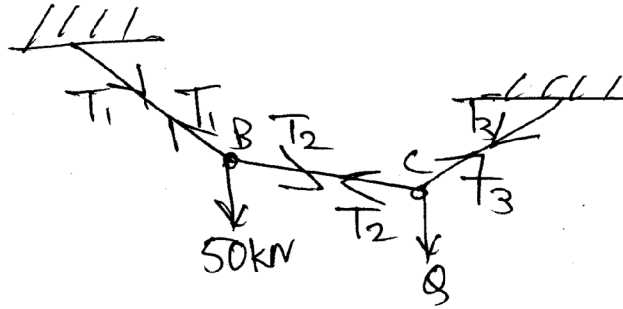
$$\therefore \theta = 30^\circ$$

$$\angle ABC = 90^\circ + 30^\circ = 120^\circ$$

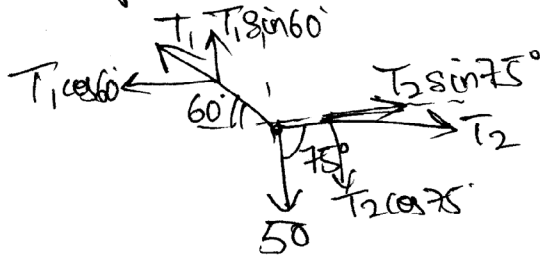
In $\triangle ABC$, By cosine rule

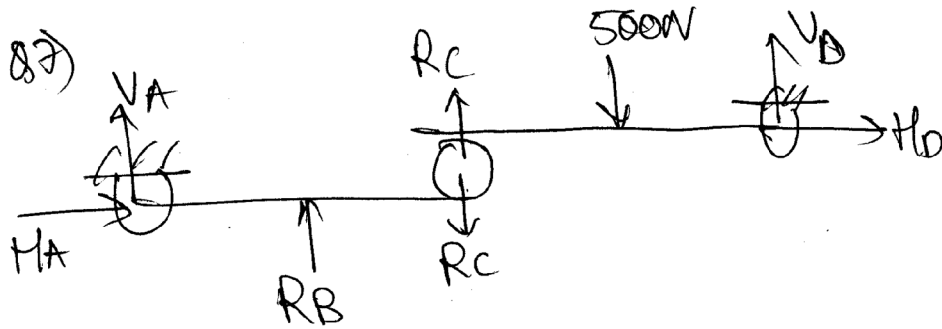
$$AC^2 = AB^2 + BC^2 - 2(AB)(BC) \cos \angle ABC$$

Q5)



FBD of point B is:-

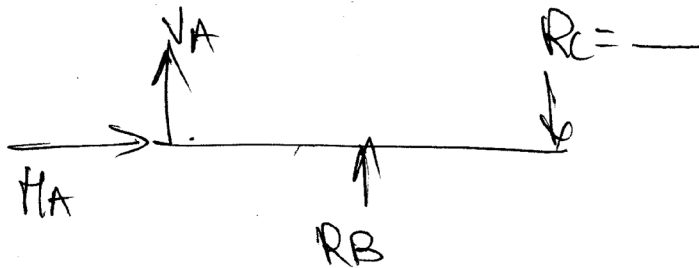




FBD of CD is:-



FBD of ABC is:-



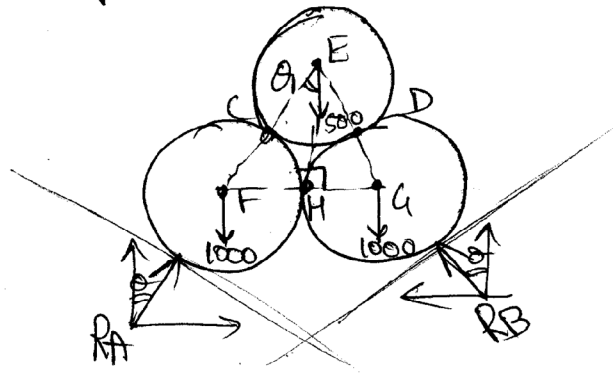
$$\sum f_{ij} = 0$$

$$\sum M_B = 0$$

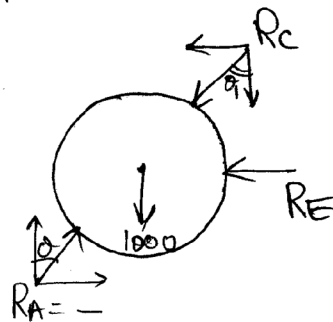
$$+ R_D \times AD - 1500 \cos 60^\circ \times AD - 1500 \sin 60^\circ \times BD = 0$$

$$AD = \sqrt{AB^2 - BD^2}$$

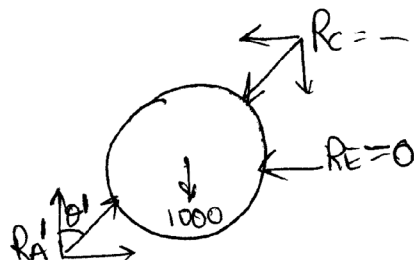
Q9) FBD of spheres are :-



FBD of sphere 2 is:-

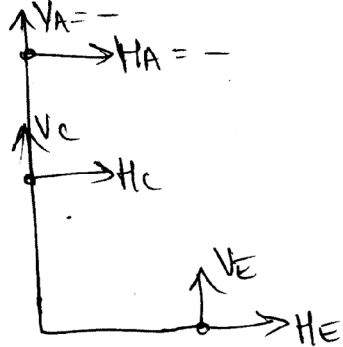


(ii)

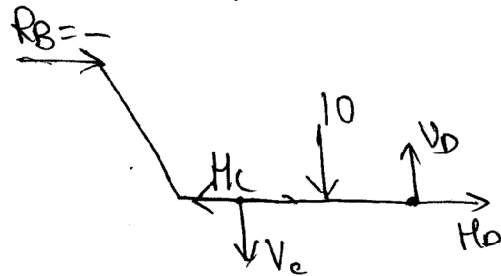


Q10) FBD of system is:-

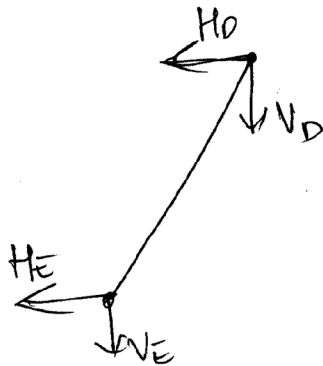
FBD of ACE is:-



FBD of BCD is:-

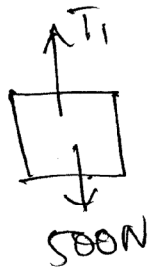


FBD of DE is:-



811) FBD of entire system is:-

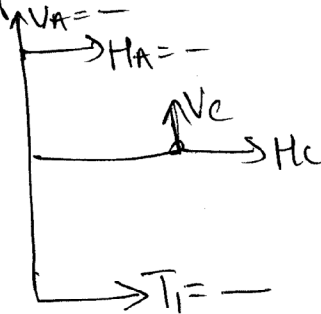
FBD of W is:-



$$\sum F_y = 0$$

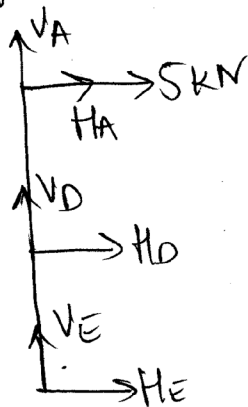
$$\therefore T_1 = 500N$$

FBD of ACE is:-

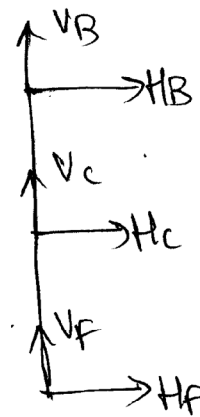


Q12) FBD of system is

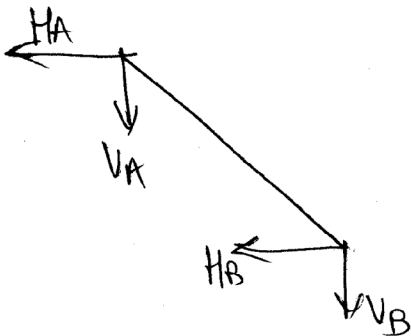
FBD of ADE is



FBD of BCF is



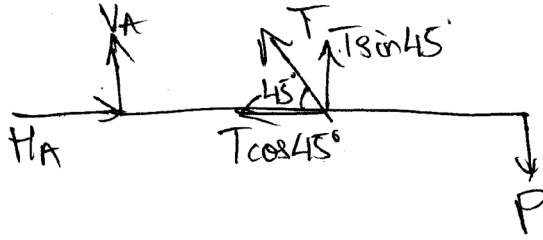
FBD of AB is



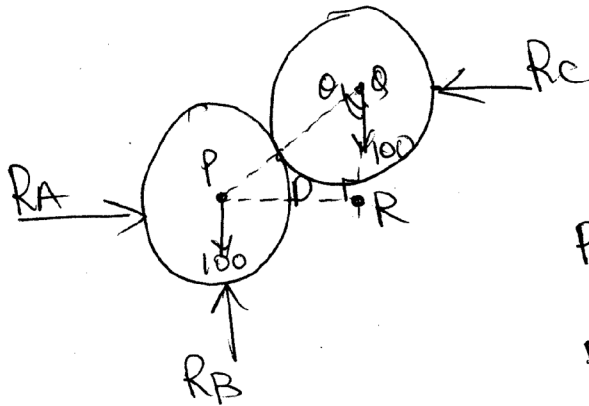
FBD of CD is



Q13) FBD of ACB is :-



Q14) FBD of both spheres are

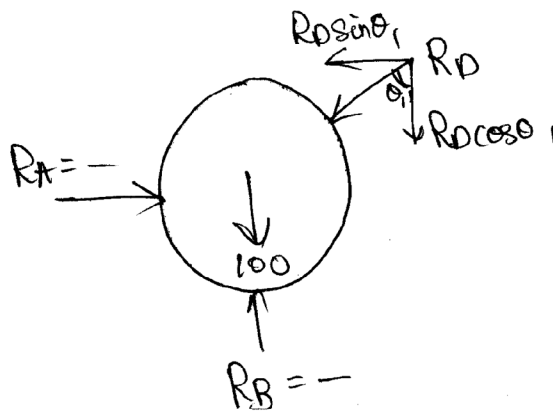


$$PR = 900 - PA - QC$$

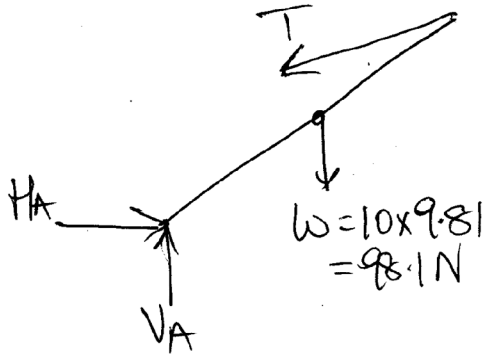
$$= 900 - 250 - 250$$

$$PQ = r_1 + r_2 = \text{---}$$

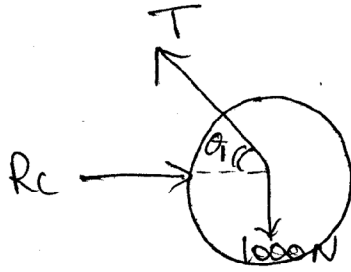
FBD of lower sphere is



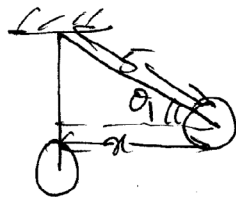
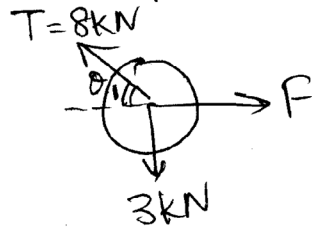
Q15)



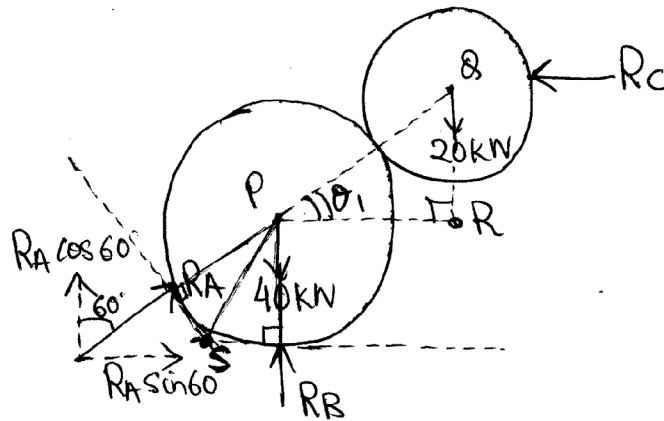
Q16) FBD of sphere 'a'



Q17) FBD of extreme position of sphere 'a' :-

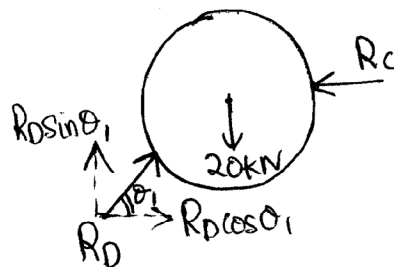


Q24) FBD of both spheres are :-

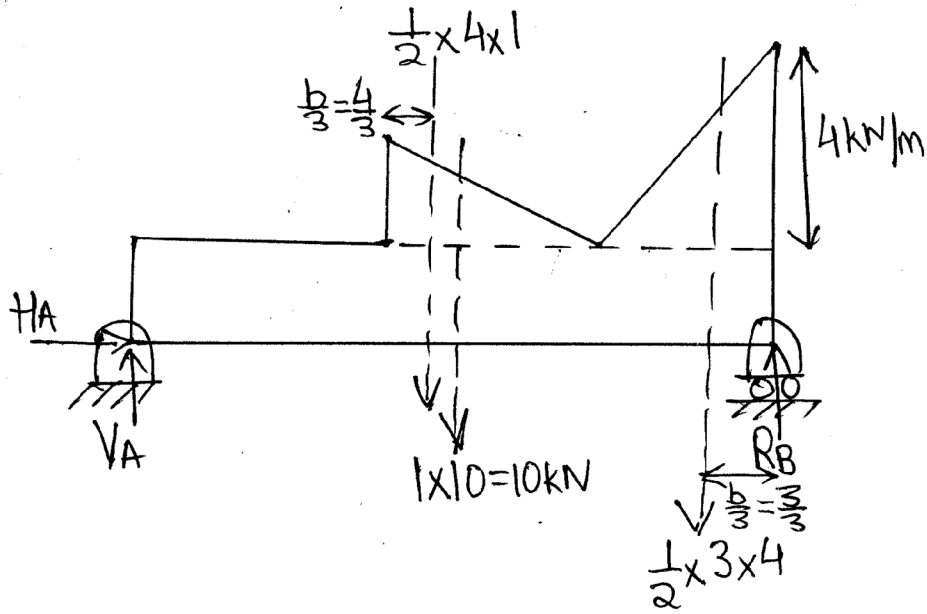


$$\begin{aligned}
 PQ &= r_1 + r_2 \\
 &= \\
 \triangle PSB &\cong \triangle PSA \\
 \therefore \angle PSB &= \angle PSA = 60^\circ \\
 PB &= r_1 = \\
 \tan \angle PSB &= \frac{PB}{SB} \\
 \therefore SB &= \\
 \therefore PR &= 1.5 - SB - r_2 \\
 &=
 \end{aligned}$$

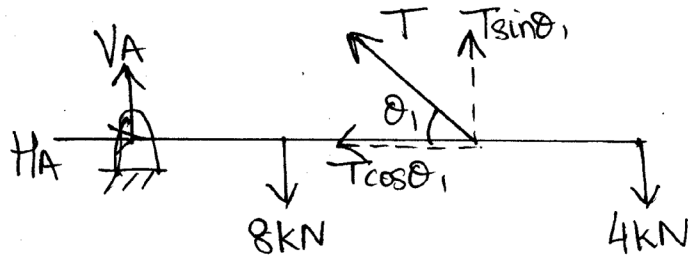
FBD of sphere Q is:-



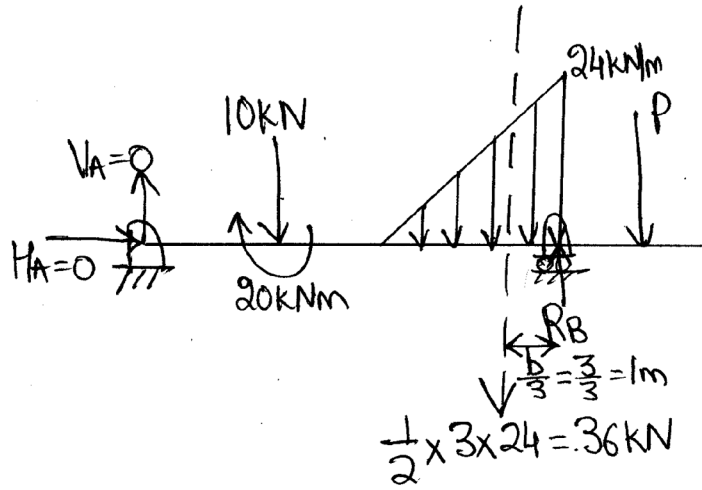
Q25)



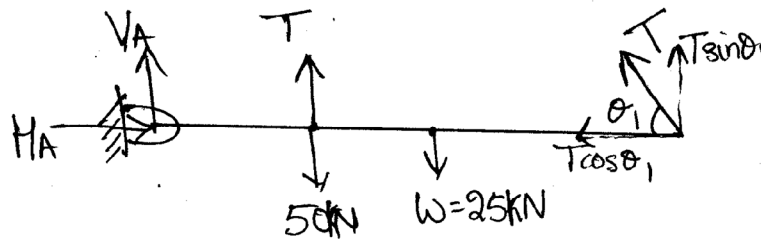
Q26) FBD of beam AB is :-



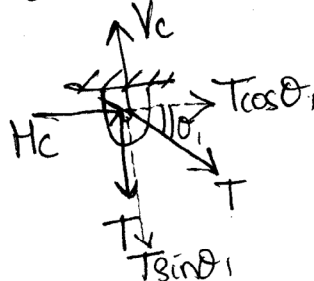
827)



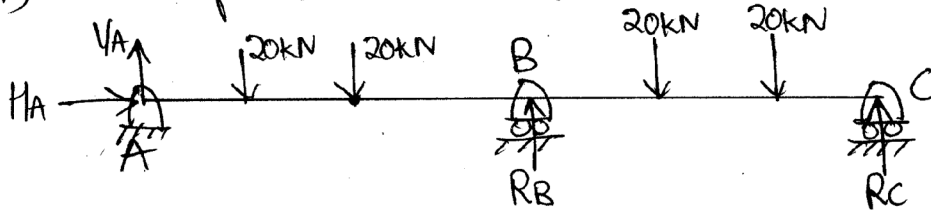
Q28) FBD of beam AB is:-



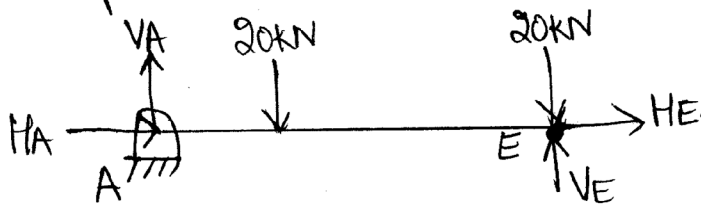
FBD of hinge C:-



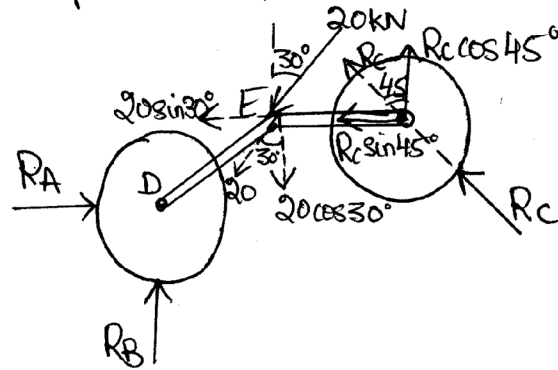
Q29) FBD of beam AC is :-



FBD of beam AE is :-



Q30) FBD of both spheres is:-



831) FBD of rod ACB is:-

$$\because AC = CD$$

$\therefore \Delta ACD$ is isosceles.

$$\therefore \angle CAD = \angle CDA = \theta_1$$

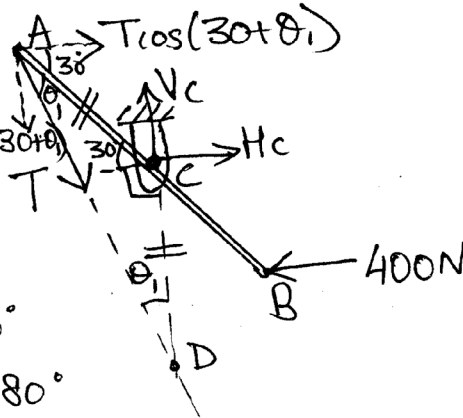
$$\therefore \theta_1 + \theta_1 + \angle ACD = 180^\circ$$

$$\therefore \theta_1 + \theta_1 + 120^\circ = 180^\circ$$

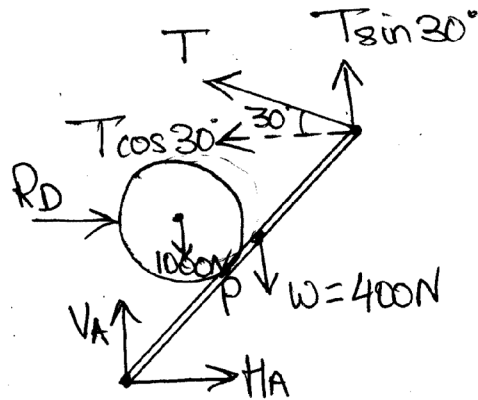
$$\therefore \theta_1 = 30^\circ$$

Applying conditions of Equilibrium

$$\sum F_x = 0$$

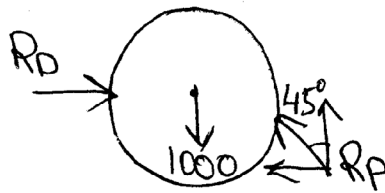


Q32) FBD of entire system is:-

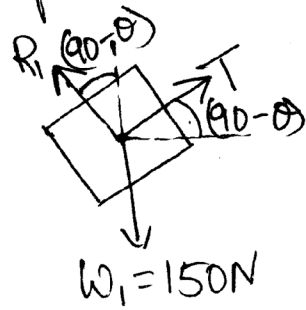


Applying conditions of Equilibrium

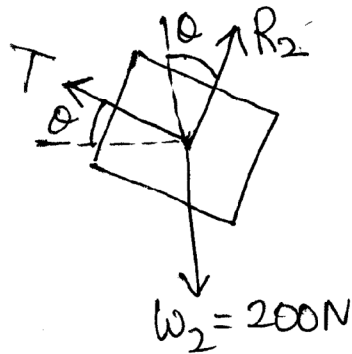
Consider FBD of sphere:-



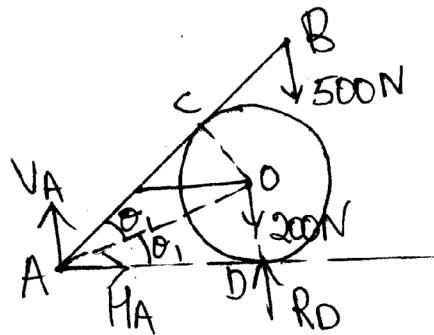
Q34) FBD of W_1 is:-



Applying conditions of equilibrium



Q35) FBD of entire system is:-



$$\triangle ABC \cong \triangle AOD$$

$$OD = r = 200 \text{ mm}$$

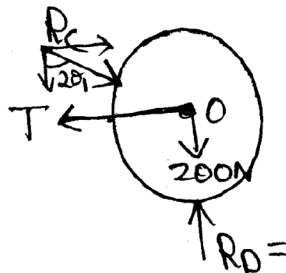
$$AD = 500 \text{ mm}$$

$$\tan \theta_1 = \frac{OD}{AD} = \frac{200}{500}$$

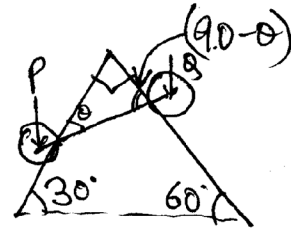
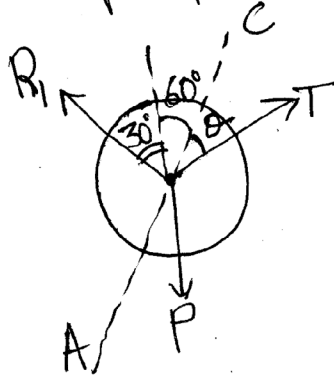
$$\therefore \theta_1 =$$

Applying conditions of Equilibrium

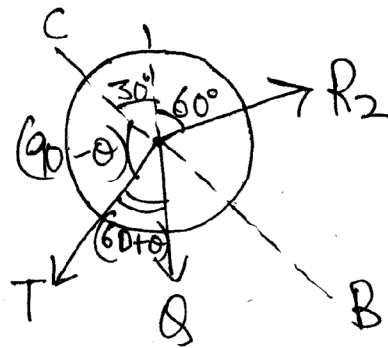
FBD of sphere is:-



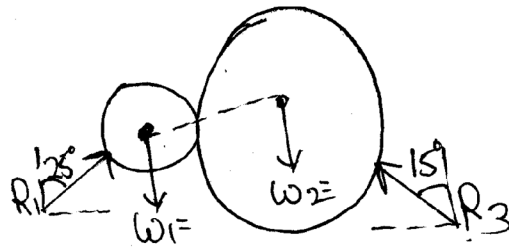
Q36) FBD of sphere D is:-



FBD of sphere C is:-

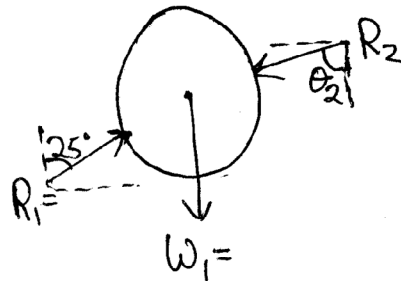


Q37) FBD of entire system is:-

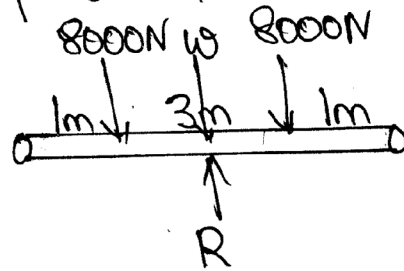


Applying conditions of equilibrium

FBD of Sphere A is:-



Q38) FBD of beam is:-



$$W = 1300 \times 5 = 6500 \text{ N}$$

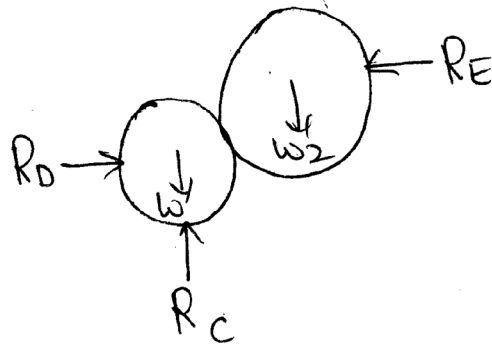
$$\sum F_y = 0$$

$$\therefore R - W - 8000 - 8000 = 0$$

$$\therefore R = 22500 \text{ N}$$

$$\begin{aligned} \therefore \text{Reaction of beam per m} &= \frac{R}{L} \\ &= \frac{22500}{5} \\ &= 4500 \text{ N/m } (\uparrow) \end{aligned}$$

Q39) FBD of both spheres are:-

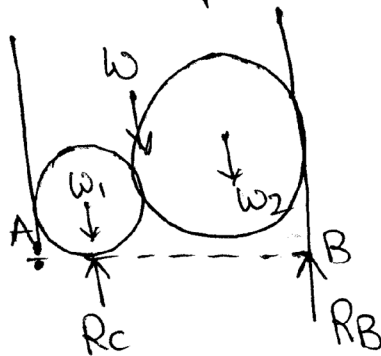


$$\sum F_y = 0$$

$$\therefore R_C - W_1 - W_2 = 0$$

$$\therefore R_C = 400 + 600 = 1000 \text{ N}$$

FBD of entire system is:-

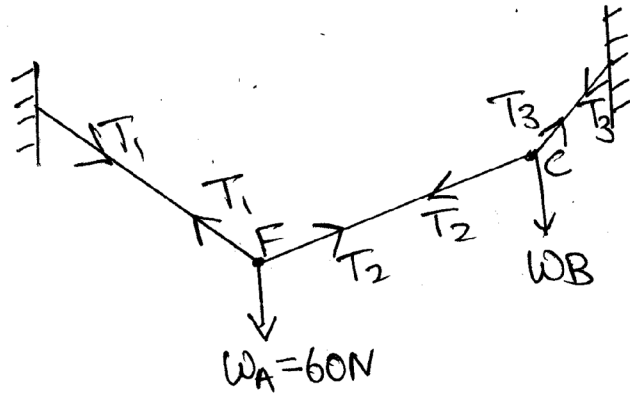


$$\sum M_B = 0$$

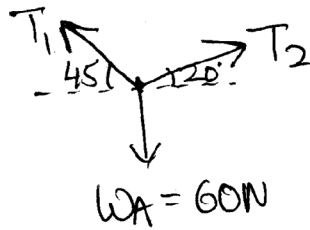
$$\therefore -W \times 40 - W_2 \times 20 + R_C \times 40 - W \times 25 = 0$$

∴

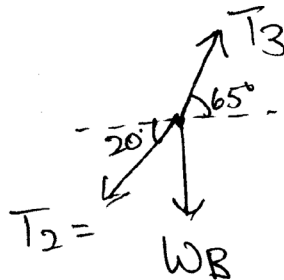
Q40)



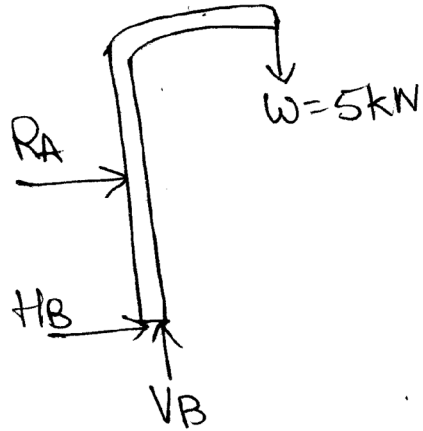
FBD of point F is:-



FBD of point C is:-



Q42) FBD of beam is:-



Q45) Since roller rolls over, hence point B loses contact with ground

$$\therefore R_B = 0$$

FBD of Sphere is

