1-

(a) -1 $\triangle 1$

2-

(c) 5 $\triangle 1$

3-

$\boxed{a}$ $\vec{r} = \overrightarrow{BA} = \vec{A} - \vec{B}$

$\vec{r} = (1,-1,4) - (2,-3,1) = (-1,2,3)$ $\triangle \frac{1}{2}$

$$\vec{M}_B = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -1 & 2 & 3 \\ 2 & 3 & -1 \end{vmatrix} \quad \triangle \tfrac{1}{2} \quad = -11\vec{i} + 5\vec{j} - 7\vec{k} \quad \triangle \tfrac{1}{2}$$

The length of perpendicular $= \dfrac{\|\vec{M}_B\|}{\|\vec{F}\|}$ $\triangle \frac{1}{2}$

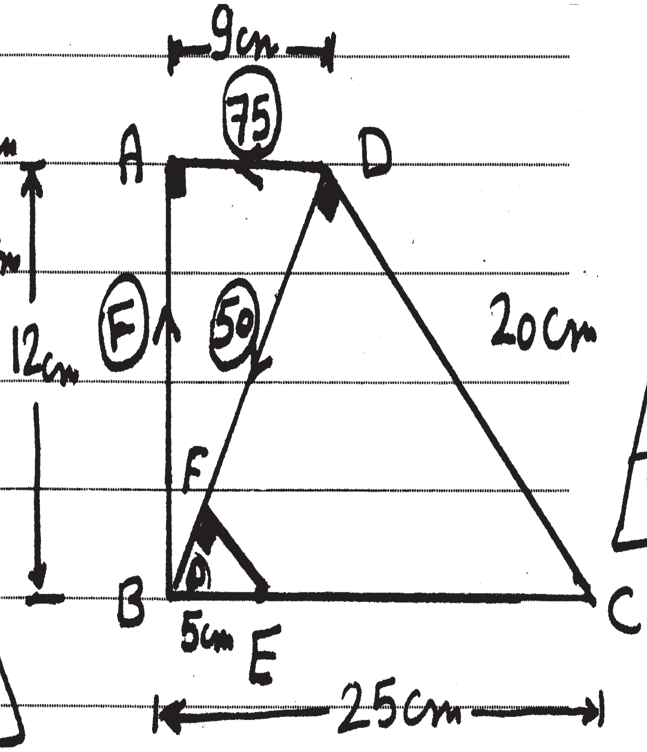
$$= \frac{\sqrt{(-11)^2+(5)^2+(-7)^2}}{\sqrt{(2)^2+(3)^2+(-1)^2}} \simeq 3.7 \text{ length unit}$$

$\triangle \frac{1}{2}$ $\triangle \frac{1}{2}$

b

$DB = \sqrt{9^2+12^2} = 15cm$

$DC = \sqrt{(25)^2-(15)^2} = 20cm$



$EF = 5\sin\theta$

$EF = 5 \times \frac{20}{25} = 4cm$ $\frac{1}{2}$

$\because M_C = 0$ $\frac{1}{2}$

$\therefore 50 \times 20 + 75 \times 12 - F \times 25 = 0$

$\therefore F = 76$ Newton $\frac{1}{2}$

$\therefore M_E = -76 \times 5 + 75 \times 12 + 50 \times 4$ $\frac{1}{2}$

$M_E = 720$ Newton.cm $\frac{1}{2}$

(تراعى الحلول الأخرى)

4-

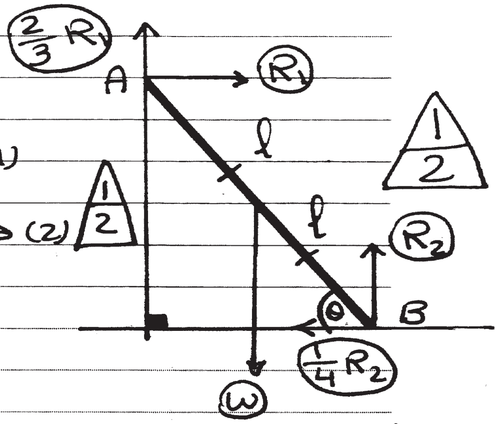
(b) 12 $\triangle 1$

5-

(a) (3,3) $\triangle 1$

6-

(a) In equilibrium



$\triangle \frac{1}{2}$

(i) $X = 0 \ , Y = 0$

$\therefore R_1 = \frac{1}{4} R_2 \longrightarrow (1)$

$\therefore R_2 + \frac{2}{3} R_1 = w \longrightarrow (2)$ $\triangle \frac{1}{2}$

From (1) & (2)

$4R_1 + \frac{2}{3} R_1 = w$

$\frac{14}{3} R_1 = w$

$\therefore R_1 = \frac{3}{14} w \quad \& \quad R_2 = \frac{6}{7} w$ $\triangle \frac{1}{2}$

(ii) $M_B = 0$ $\triangle \frac{1}{2}$

(let the length of the ladder $= 2\ell$)

$\therefore -R_1 (2\ell \sin\theta) - \frac{2}{3} R_1 (2\ell \cos\theta) + w(\ell \cos\theta) = 0$

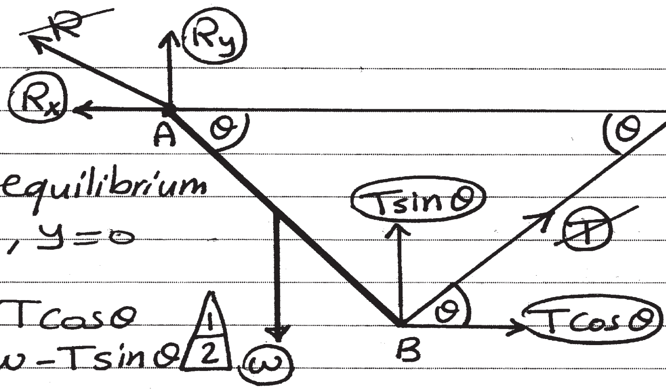
$-\frac{3}{14} w (2\ell \sin\theta) - \frac{2}{3} \times \frac{3}{14} w (2\ell \cos\theta) + \ell w \cos\theta = 0$ $\triangle \frac{1}{2}$

$-\frac{3}{7} \tan\theta - \frac{2}{7} + 1 = 0$ divide by $(w \ell \cos\theta)$

$\frac{3}{7} \tan\theta = \frac{5}{7}$

$\tan\theta = \frac{5}{3} \quad \therefore m(\hat{\theta}) = 59^\circ 2'$ $\triangle \frac{1}{2}$

b



$\frac{1}{2}$

From equilibrium
$X = 0 \ , \ Y = 0$

$\therefore R_x = T\cos\theta$
$R_y = \omega - T\sin\theta$ $\frac{1}{2}$

let the length of the rod be $2l$

$\because M_A = 0$ $\frac{1}{2}$

$\therefore -\omega(l\cos\theta) + T\sin\theta(2l\cos\theta) + T\cos\theta(2l\sin\theta) = 0$

divide by $(l\cos\theta)$ $\frac{1}{2}$

$\therefore -\omega + 4T\sin\theta = 0$

$\therefore \omega = 4T\sin\theta$

$\therefore T = \frac{\omega}{4\sin\theta}$ $\frac{1}{2}$

$\therefore R_x = \frac{\omega\cos\theta}{4\sin\theta} = \frac{\omega}{4}\cot\theta$

$R_y = \omega - \frac{\omega}{4\sin\theta} \times \sin\theta = \frac{3}{4}\omega$

$R = \sqrt{(R_x)^2 + (R_y)^2}$

$R = \sqrt{\frac{\omega^2}{16}\cot^2\theta + \frac{9}{16}\omega^2}$

$R = \frac{\omega}{4}\sqrt{\cot^2\theta + 9}$ $\frac{1}{2}$

(تراعى الحلول الأخرى)

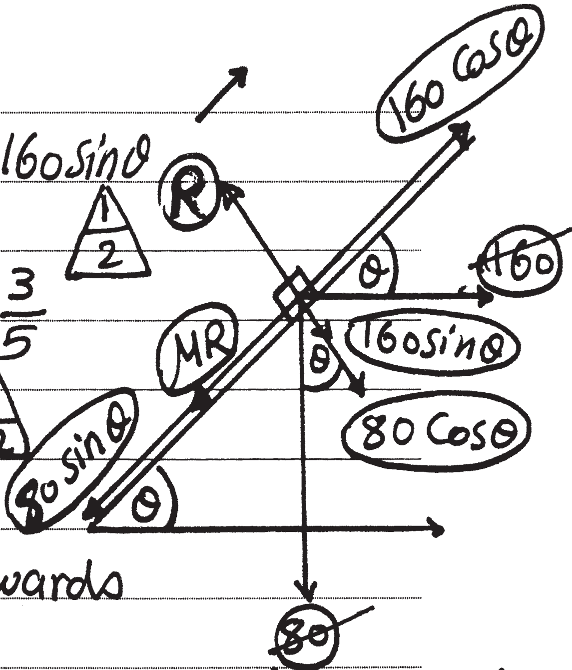
7-

(a) 48 1

8-

(c) 90 1

9-



$R = 80\cos\theta + 160\sin\theta$ $\frac{1}{2}$

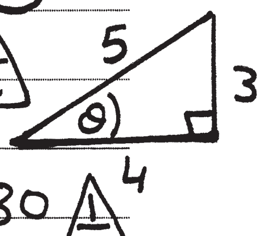
$R = 80 \times \frac{4}{5} + 160 \times \frac{3}{5}$

$R = 160$ Newton $\frac{1}{2}$

$\frac{1}{2}$

$\because$ the motion upwards

$\therefore 160\cos\theta = \mu R + 80\sin\theta$ $\frac{1}{2}$

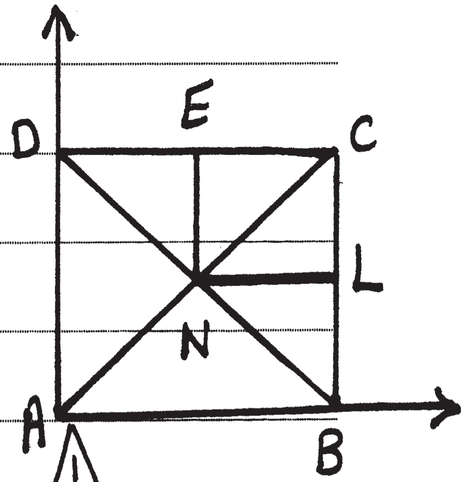


$\mu R = 160 \times \frac{4}{5} - 80 \times \frac{3}{5} = 80$ $\frac{1}{2}$

$160\,\mu = 80 \Rightarrow \mu = \frac{1}{2}$ $\frac{1}{2}$

10-

$$\frac{\text{area of rectangle NLCE}}{\text{area of rectangle ABCD}} = \frac{4 \times 6}{8 \times 12} = \frac{1}{4} \quad \frac{1}{2}$$



$$X_G = \frac{(4K)(6) + (-K)(9)}{(4K) + (-K)} = 5 \text{ cm} \quad \frac{1}{2}$$

$$Y_G = \frac{(4K)(4) + (-K)(6)}{(4K) + (-K)} = \frac{10}{3} \text{ cm} \quad \frac{1}{2}$$

	4K	-K
x	6	9
y	4	6

$\frac{1}{2}$

$\therefore$ The center of Gravity of the remaining part is $\left(5, \frac{10}{3}\right)$

$$\tan\theta = \frac{y}{x} = \frac{10}{3} \times \frac{1}{5} = \frac{2}{3} \quad \frac{1}{2}$$

(تراعى الحلول الأخرى)

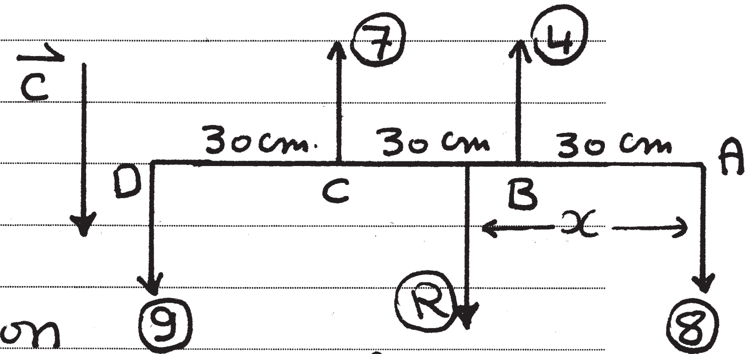
11-

(C) [0, 12] 1

12-

(C) The sum of the moments of the forces about any Point vanishes and the resultant of the forces vanish. 1

13-



$\vec{R} = 8\vec{C} + 9\vec{C} - 7\vec{C} - 4\vec{C}$

$\vec{R} = 6\vec{C}$

$\therefore R = 6$ Newton

and acts on the direction of the two forces 8 N, 9 N. $\frac{1}{2}$

Let the resultant acts at a point apart x cm from A.

$\because$ The sum of the moments of the forces about A = The moment of the resultant about A $\frac{1}{2}$

$\therefore 6x = (-4)(30) + (-7)(60) + (9)(90)$ $\frac{1}{2}$

$6x = 270 \Rightarrow x = 45$ Cm. $\frac{1}{2}$

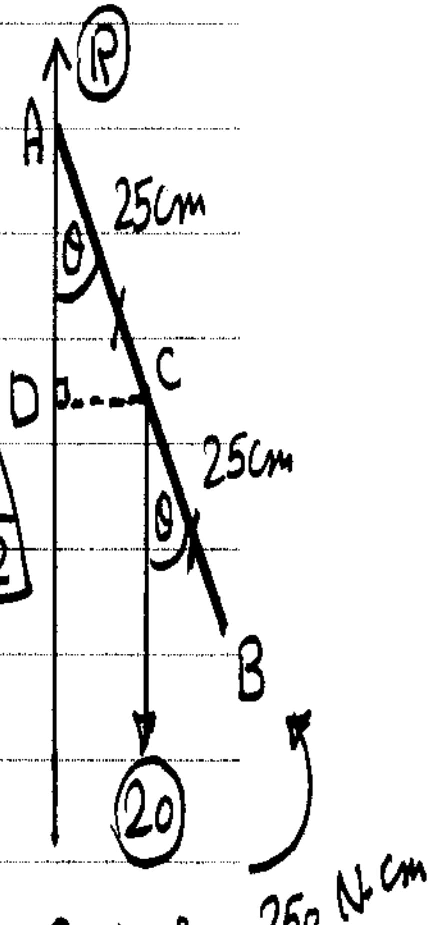
14-

$\because$ the rod is equilibrium

$\therefore$ The two forces R and 20 N must Form a couple of moment -250 N.cm.

where R = weight = 20 N. $\frac{1}{2}$

$\overrightarrow{R}$ works vertically up.



$-20\,CD = -250$ $\frac{1}{2}$

$20 \times 25 \sin\theta = 250$ $\frac{1}{2}$

$\sin\theta = \frac{1}{2} \Rightarrow \theta = 30^\circ$ $\frac{1}{2}$ or $\theta = 150^\circ$

(تراعى الحلول الأخرى)

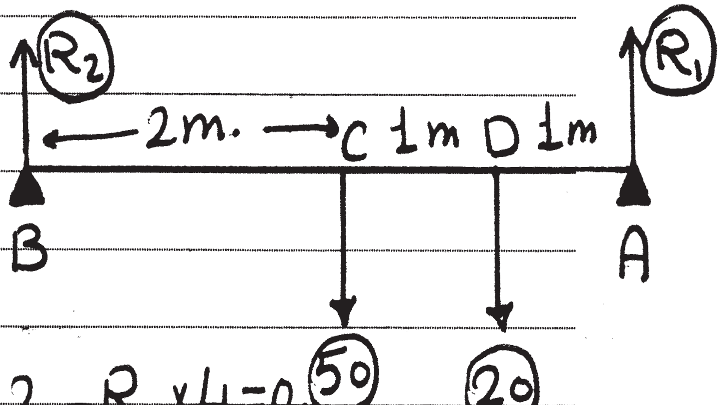
15-

(C) 160 $\quad$ 1

16-

(C) −2 $\quad$ 1

17-



$R_1 + R_2 = 70$

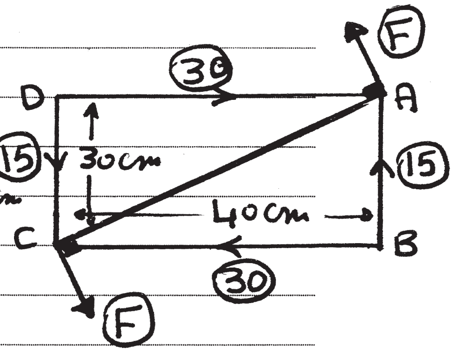
$M_A = 0$ $\quad \frac{1}{2}$

$\therefore 20 \times 1 + 50 \times 2 - R_2 \times 4 = 0$ $\quad \frac{1}{2}$

$120 = 4R_2 \quad \Rightarrow R_2 = 30$ Kg.wt. $\quad \frac{1}{2}$

$R_1 = 40$ Kg.wt. $\quad \frac{1}{2}$

18-



∵ The two forces 15, 15 form a couple whose moment M_1: $\frac{1}{2}$

$M_1 = 15 \times 40 = 600$ dyne.cm

∵ The two forces 30, 30 form a couple whose moment M_2:

$M_2 = -30 \times 30 = -900$ dyne.cm $\frac{1}{2}$

∴ The system is equivalent to a couple its moment

$M = M_1 + M_2 = 600 - 900 = -300$ dyne.cm

∴ $\|\vec{M}\| = 300$ dyne.cm $\frac{1}{2}$

in equilibrium: The two forces F, F represented in the figure form a couple equilibrium with the resultant couple

∴ $F \times 50 = 300$ 1

∴ $F = 6$ dyne

(تراعى الحلول الأخرى)

(انتهت الإجابة وتراعى الحلول الأخرى)