١

1-

(a) 4 (1)

2-

(d) $\left(\frac{2}{3}, \frac{5}{3}\right)$ (1)

3-

(a) $\vec{r} = \vec{BA} = \vec{A} - \vec{B} = (-1, 1, -4)$ (1/2)

$$\vec{M}_B = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -1 & 1 & -4 \\ 3 & -2 & 4 \end{vmatrix} = -4\vec{i} - 8\vec{j} - \vec{k}$$ (1/2) (1/2)

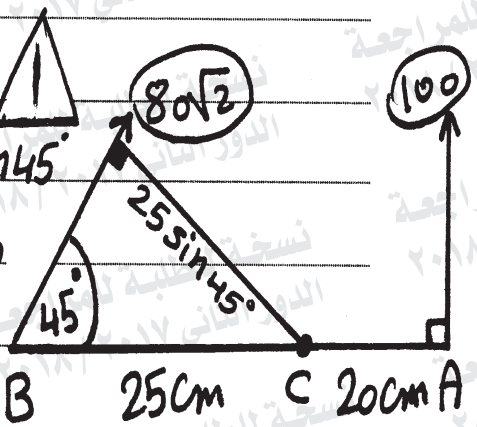
The length of perpendicular $= \frac{\|\vec{M}_B\|}{\|\vec{F}\|}$ (1/2)

$$= \frac{\sqrt{(-4)^2 + (-8)^2 + (-1)^2}}{\sqrt{(3)^2 + (-2)^2 + (4)^2}} = \frac{9\sqrt{29}}{29} = 1.67 \text{ length unit}$$ (1/2) (1/2)

[b] $M_C = 100 \times 20 - 80\sqrt{2} \times 25 \sin 45°$ (1)

$M_C = 2000 - 2000 = 0$ ($\frac{1}{2}$)

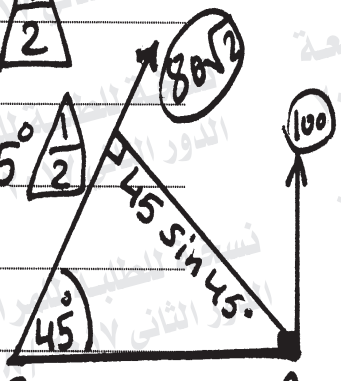
∴ The line of action of the resultant passes through the point C



($\frac{1}{2}$)

$M_A = -80\sqrt{2} \times 45 \sin 45°$ ($\frac{1}{2}$)

$= -3600$ N.cm.



∴ The magnitude of the moment of the forces about A equals 3600 N.cm. ($\frac{1}{2}$)

(تراعى الحلول الأخرى)

4-

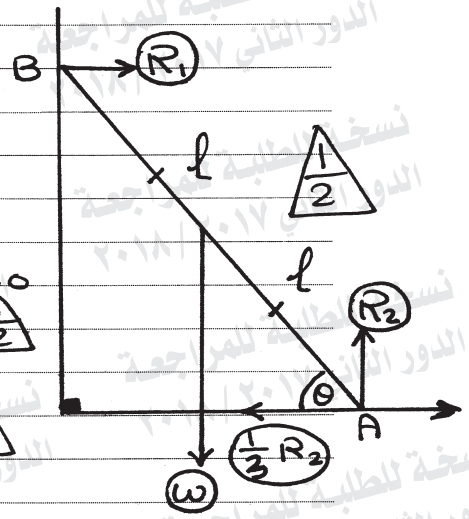
(b) 18 (1)

5-

(b) 55 (1)

6-

[a] Let the length of the rod = 2ℓ cm



(1/2)

$\therefore$ the rod is in equilibrium

$\therefore x = 0, y = 0, M_A = 0$ (1/2)

$\therefore R_2 = W$

$R_1 = \frac{1}{3} R_2$

$\therefore R_1 = \frac{1}{3} W$ (1/2)

$\because M_A = 0 \Rightarrow W\ell\cos\theta - R_1 \times 2\ell\sin\theta = 0$

$W\ell\cos\theta = \frac{1}{3} W \times 2\ell\sin\theta$ (1/2)

$\therefore \cos\theta = \frac{2}{3}\sin\theta$

$\frac{\sin\theta}{\cos\theta} = \frac{3}{2} \Rightarrow \tan\theta = \frac{3}{2}$ (1/2)

$\therefore m(\angle\theta) = 56^\circ 19'$ (1/2)

b

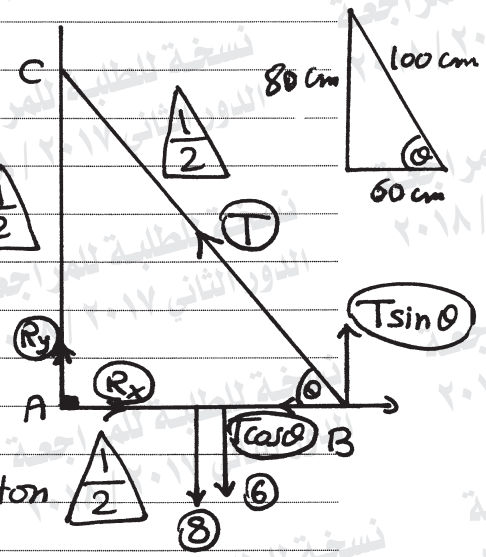
∴ The rod is in equilibrium.

∴ $X=0, Y=0, M_A=0$ $\frac{1}{2}$

∴ $T\sin\theta \times 60 - 8 \times 30 - 6 \times 40 = 0$

∴ $T \times \frac{4}{5} \times 60 = 480$

∴ $T = 10$ Newton $\frac{1}{2}$



$\frac{1}{2}$

$R_x = T\cos\theta = 10 \times \frac{3}{5} = 6$ Newton $\frac{1}{2}$

$R_y = 6 + 8 - T\sin\theta = 14 - 10 \times \frac{4}{5} = 6$ Newton $\frac{1}{2}$

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

$R = \sqrt{(6)^2 + (6)^2} = 6\sqrt{2}$ Newton. $\frac{1}{2}$

(تراعى الحلول الأخرى)

7-

(c) $\mu_s > \mu_k$ 1

8-

(d) 32 1

9-

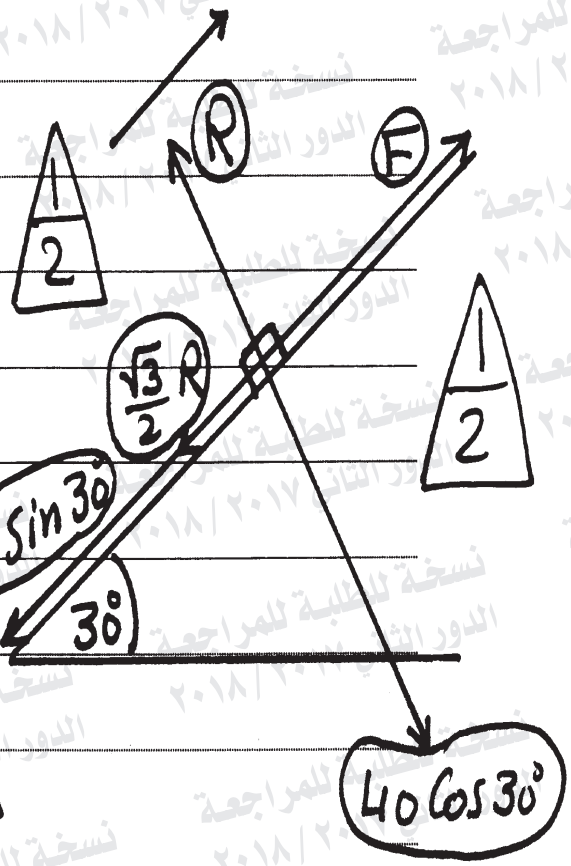
$\therefore R = 40 \cos 30$

$\therefore R = 20\sqrt{3}$ Newton $\frac{1}{2}$

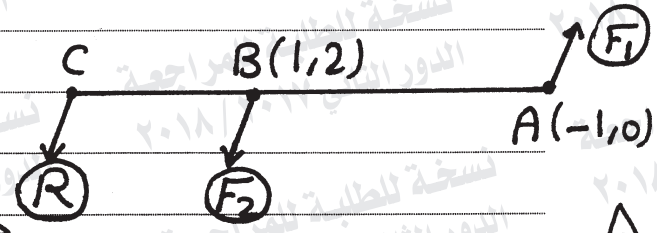
$F = \frac{\sqrt{3}}{2} R + 40 \sin 30^\circ$ $\frac{1}{2}$

$F = \frac{\sqrt{3}}{2} \times 20\sqrt{3} + 20$

$F = 50$ Newton $\frac{1}{2}$



10-



$\vec{F_1} = 3\vec{i} - \vec{j}$

$\vec{F_1} = (3,-1)$

$\vec{F_2} = -9\vec{i} + 3\vec{j} = (-9,3) = -3(3,-1)$ (1/2)

$\therefore \vec{F_2} = -3\vec{F_1}$

$\therefore \vec{F_1}$ & $\vec{F_2}$ act alonge two parallel (opposite direction)

$\therefore$ C the point of the effect of the Resultant divides $\overline{AB}$ in ratio 3 : 1 externally (1/2)

$\vec{R} = \vec{F_1} + \vec{F_2} = -6\vec{i} + 2\vec{j}$ (1/2)

$\therefore C = \left(\frac{3\times1 - 1\times(-1)}{3-1}, \frac{3\times2 - 1\times0}{3-1}\right)$

$C = (2,3)$ (1/2)

(تراعى الحلول الأخرى)

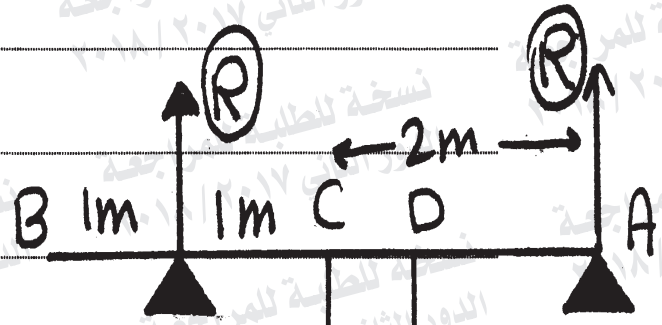
11-

(b) $20\sqrt{5}$ (1)

12-

(c) 49 (1)

13-



$R + R = 10 + 50$

$2R = 60$

$R = 30$ kg.wt. ($\frac{1}{2}$)

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

$\therefore 50 \times AD + 10 \times 2 - 30 \times 3 = 0$ ($\frac{1}{2}$)

$50\,AD = 70$

$AD = 1.4$ meter. ($\frac{1}{2}$)

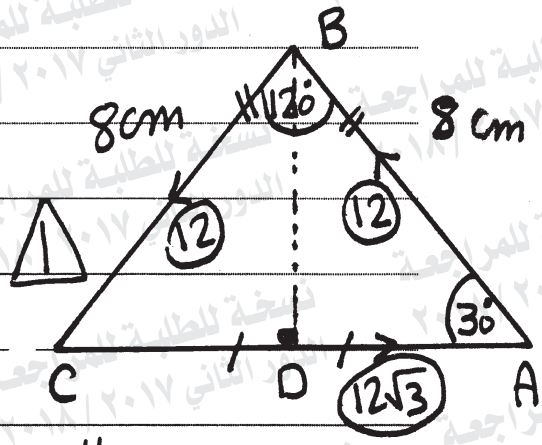
14-

$AD = 8 \cos 30°$

$AD = 4\sqrt{3}$ cm.

$AC = 8\sqrt{3}$

$m = \frac{12}{8} = \frac{12}{8} = \frac{12\sqrt{3}}{8\sqrt{3}} = \frac{3}{2}$



∵ The forces act in the same cyclic order

∴ The set form a couple whose moment $= 2 \times$ area of triangle $\times m$

$= 2 \times \left(\frac{1}{2} \times 8 \times 8 \sin 120°\right) \times \frac{3}{2}$

$= 48\sqrt{3}$ Newton. cm.

(تراعى الحلول الأخرى)

15-

(C) $\frac{\sqrt{3}}{2} F\ell$ 1

16-

(C) $20\sqrt{3}$ 1

17-

$\vec{R} = \vec{F_1} + \vec{F_2} + \vec{F_3}$

$= 2\vec{i} - 4\vec{j} + \vec{i} - 3\vec{j} - 3\vec{i} + 7\vec{j}$ 1

$= \vec{0} \rightarrow (1)$

$\vec{M_o} = \vec{OA} \times \vec{F_1} + \vec{MB} \times \vec{F_2} + \vec{M_C} \times \vec{F_3}$ $\frac{1}{2}$

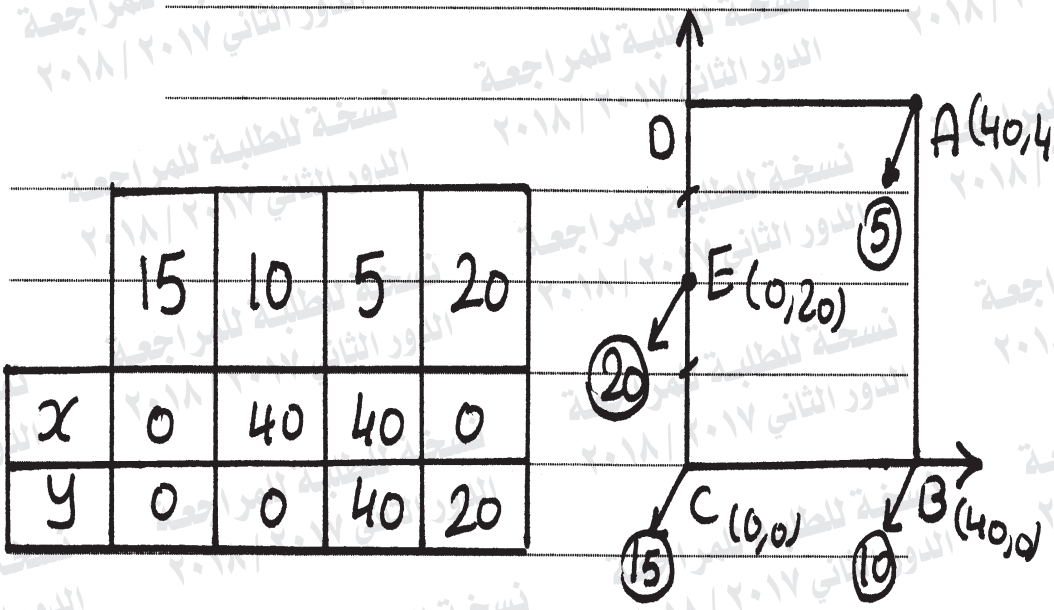
$= (-1,1) \times (2,-4) + (-2,3) \times (1,-3) + (0,1) \times (-3,7)$ $\frac{1}{2}$

$= 2\vec{k} + 3\vec{k} + 3\vec{k} = 8\vec{k} \rightarrow (2)$ $\frac{1}{2}$

From (1) & (2)

The System is equivalent to a Couple of moment 8 moment unit. $\frac{1}{2}$

18-



	15	10	5	20
x	0	40	40	0
y	0	0	40	20

$$\bar{x}_G = \frac{15\times0 + 10\times40 + 5\times40 + 20\times0}{15+10+5+20} = 12\ cm \quad \left(\frac{1}{2}\right)$$

$$\bar{y}_G = \frac{15\times0 + 10\times0 \times 5\times40 + 20\times20}{15+10+5+20} = 12\ cm \quad \left(\frac{1}{2}\right)$$

$\therefore$ The center of gravity is $(12,12)$

$$\tan\theta = \frac{\bar{y}_G}{\bar{x}_G} = 1 \quad \left(\frac{1}{2}\right) \Rightarrow m(\hat{\theta}) = 45^\circ \quad \left(\frac{1}{2}\right)$$

(تراعى الحلول الأخرى)