MOS Solutions (Resultant of the force system)

1.

$$\theta_1 = \tan^{-1} {}^2\!/_3 = 33.69$$

$\Sigma Fx.$

$$\Sigma Fx = 50 - 55 \cos 33.69 - 30 \sin 30 - 40 \sin 50$$

$$+ F_6 \cos\alpha = -50 \cos 30$$

$$F_6 \cos\alpha = -1.897$$

$$\Sigma FJ = 55 \sin 33.69 - 30 \cos 30 - 40 \cos 50 + F_6 \sin\alpha$$

$$+ 60 = 50 \sin 30$$

$$F_6 \sin\alpha = -13.816$$

$$\alpha = 82.182 \quad, \qquad F_6 = 13.946 \, kN$$

$$\sim 2 \, kN$$
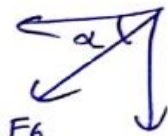
2.

$4 -$

$$\Sigma FX = 5 + 40 \cos 20 - 45 \cos 20 = 0.302 \, kN$$

$$\Sigma FJ = 30 + 40 \sin 20 + 45 \sin 20 = 59.072 \, kN$$

$$R = 59.072 \qquad\qquad \theta = 89.707$$

$$M_A^{d} = 5(1.5) + 40 \cos 20 (3) - 40 \sin 20 (1) + 10$$
$$\qquad\qquad - 45 \sin 20 (3)$$

$$= 70.41 \, kN\text{-}m \qquad\qquad d = 1.192 \, m$$
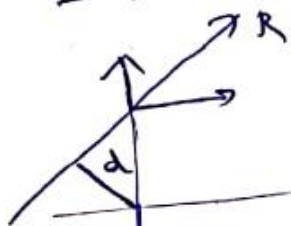
$$\sim \, (r \qquad \theta_3 = 26.565$$

3.

a) Force – Couple System at A:
$F_x = 50 \times \sin 30 = 25$ N. $\longrightarrow$
$F_y = 50 \times \cos 30 = 43.3$ N $\downarrow$
These forces can be moved to
A by adding the couple.
Moment of the couple about A
$+\ \sum M_A = F_x \times 50 - F_y \times 100$
$= 25 \times 50 - 43.3 \times 100$
$= -3080$ N-mm.
$= 3080$ N-mm

30 mm · B
· A
50 mm
Fx=50 sin 30
100 mm · 30°
50N
Fy=50 cos 30

Fx=50 sin 30
A
50 mm · M_A=3080N-mm
Fy=50 cos 30
100 mm

4.

Soln: Hence resultant passes through B & E

Net moment about B & E is zero

$\sum M_a = 0$ $\qquad \sum M_E = 0$

+ve
$\sum M_E = 0$

$200 \times 400 + 300 \times 400 - M + 175 \times \sin 30 \times 200 -$
$150 \sin 30 \times 200 + 150 \cos 30 \times 200 = 0$

$M = 228480.76$ N-mm

+ve
$\sum M_B = 0$

$200 \times 200 - 228480.16 + F \sin 45 \times 400 + F \cos 45 \times 200$
$+ 175 \sin 30 \times 600 + 175 \cos 30 \times 200 - 150 \sin 30 \times 600$
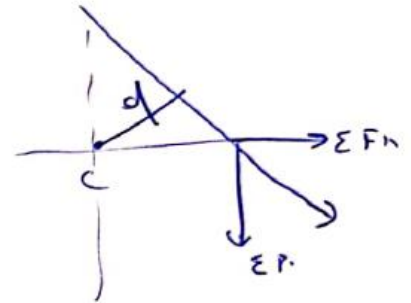$+ 150 \cos 30 \times 400 = 0$

$F = 232.656$ N

5.

$$\Sigma Fx = 16 \cos 20 + 40 \cos 40 = 45.677 \, N$$

$$\Sigma Fy = 16 \sin 20 - 20 - 60 - 40 \sin 40 = -100.239 \, N$$

$$R = 110.156 \, N \qquad \theta = \underline{65.502}$$

$$M_c = 16 \cos 20 (2.571) + 16 \sin 20 (7.064) - 20 (3.064)$$
$$+ 60 (3) = 196.032 \, N-m$$

$$d = 1.78 \, m$$

6.

$$\theta_1 = \tan^{-1} \tfrac{3}{4} = 36.87 \qquad\qquad \theta_2 = \tan^{-1} \tfrac{1}{2} = 26.565$$

$$\xrightarrow{+} \Sigma FX = F_6 \cos\alpha + 40 \cos 36.87 + 35 + 25 \cos 26.565$$
$$+ 50 \cos 45 + 60 \cos \overset{63.13}{\cancel{26.565}} = -100$$
$$F_6 \cos\alpha = -251.834 \, KN \quad —①$$

$$+\uparrow \Sigma Fy = F_6 \sin\alpha + 40 \sin 36.87 - 25 \sin 26.565 +$$
$$50 \sin 45 - 60 \sin 63.13 = 0$$
$$F_6 \sin\alpha = 5.347 \, KN \quad —②$$
$$\alpha = 1.216°$$
$$F_6 = 251.891 \, KN$$

7.

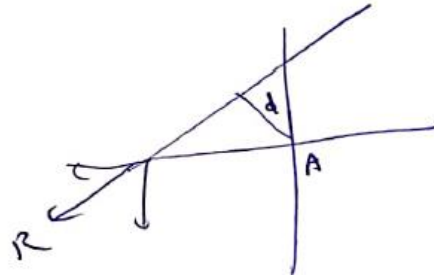$\Sigma Fx = -70 \cos 20 - 60 + 50 + 30 \cos 30 = -49.798 \, KN$

$\Sigma Fy = -70 \sin 20 - 30 \sin 30 = -38.941 \, kN$

$R = 63.216 , \quad \theta = 38.025$

$MA\overset{\curvearrowright}{\lrcorner} = 60 (2) - 50 (2) - 30 \cos 30 (4) + 30 \sin 30 (3)$

$\qquad = -38.923 \, KN-r$

$d = \dfrac{0.616 \, m}{}$

8.

$\overrightarrow{\underset{+ve}{\Sigma Fx}} = 80 - 40\cos 30° = 45.36 \, KN \enspace \textcircled{or} \enspace 45.36 \, KN (\longrightarrow)$

$\underset{+ve}{\overset{\uparrow}{\Sigma Fy}} = 150 - 40\sin 30° = -170 \, KN \enspace \textcircled{or} \enspace 170 \, KN (\downarrow)$

$R = \sqrt{45.36^2 + 170^2} = 175.95 \, KN$

$\alpha = 75.06°$
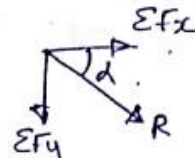
$\underset{+ve}{\overset{\curvearrowright}{\Sigma}} M_c = 80 \times 3 - 150 \times 5 - 40 \times 1.5 = -570 \, KN \cdot m \enspace \textcircled{or} \enspace 570 \, KN \cdot m \, (\curvearrowright)$

$x = \left| \dfrac{\Sigma M_c}{\Sigma Fy} \right| = 3.35 m$

R Intersect $\overset{BC}{at}$ a distance 3.353m from C

$\textcircled{or}$

R intersect BC at a distance 4.647 m from B