(Q1) Lets say $\theta = B\hat{A}C$

$$\cos\theta = \frac{0,24}{\sqrt{0,24^2+0,18}} = 36,87^\circ$$

a.) take moment about C and apply the equilibrium condition $\Sigma M_C = 0$

taking sign conventions, anticlockwise moment is taken as positive and clockwise moment is taken as negative.

$$-(240N)(0,8m) - (240N)(0,4m) + (T_{AB}\cos\theta)(0,18m) = 0$$

$$T_{AB}(\cos 36,87^\circ)(0,18m) = 240(0,8+0,4)$$

$$\boxed{T_{AB} = 2\,000\,N}$$

b.) $\Sigma F_x = 0$ $\quad \Sigma F_y = 0$

Take sum of all horizontal forces is equal to zero,

$$\Sigma F_x = 0$$

$$-2000N(\cos 36,87^\circ) + C_x = 0$$

$$C_x = 1600N$$

Take sum of all vertical forces is equal to zero, $\Sigma F_y = 0$

$$C_y - 2000N(\sin 36,87) - 240N - 240N = 0$$

$$C_y = 1680N$$

The reaction at C is $R_C = \sqrt{C_x^2 + C_y^2}$

$$R_C = \sqrt{(1600N)^2 + (1680N)^2}$$

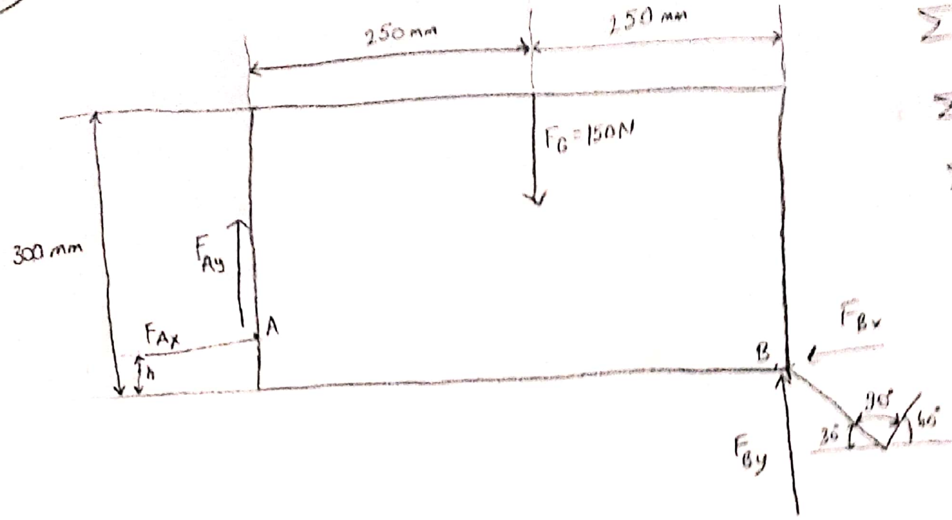
$$\boxed{R_C = 2320\ N}$$

the direction of R_C is $\tan\theta = \frac{C_y}{C_x}$

$$\tan\theta = \frac{1680N}{1600N}$$

$$\boxed{\theta = 46,4^\circ}$$

Q2 Free body diagram



$\Sigma F_x = 0,$

$\Sigma F_y = 0$

$\Sigma M_A = 0$

a.) distance of the point A from the base, $h = 0$

From $\Sigma M_A = 0$

$-(150N)(250mm) - (F_{Bx} \cdot h) + F_{By}(500mm) = 0$

$0 = (-37500\ N.mm) + F_{By}(500mm)$

$F_{By}(500\ mm) = (37500\ N.mm)$

$F_{BY} = \dfrac{(37500\ N.mm)}{(500\ mm)} = 75\ N$

From the condition of equilibrium, $\Sigma F_y = 0$

$F_{Ay} - (150\ N) + F_{By} = 0$

$F_{Ay} - (150\ N) + (75N) = 0$ $\qquad F_{Ay} = 75\ N$

From the condition of equilibrium, $\Sigma F_x = 0$

Assume the forces acting in the positive x-direction as positive

$\Sigma F_x = F_{Ax} - F_{Bx}$ $\qquad$ Apply condition of equilibrium

$0 = F_{Ax} - F_{Bx}$ $\qquad F_{Ax} = F_{Bx}$

$F_{B_y} = F_B \sin 30°$

$75\ N = F_B \sin 30°$ $\qquad F_B = \dfrac{75\ N}{\sin 30°} = 150N$

$\boxed{F_B = 150N}$ $\qquad \boxed{\theta_B = 30°}$

$F_{Bx} = F_B \cos 30°$
$= 150 \cos 30°$
$= 130N$

Substituting in expression (1)

$F_{Ax} = 130N$

$\theta_A = \arctan\left(\frac{F_{Ay}}{F_{Ax}}\right)$

$= \arctan\left(\frac{75}{130}\right)$

$\boxed{\theta_A = 30°}$

$F_A = \sqrt{F_{Ax}^2 + F_{Ay}^2}$

$= \sqrt{(130N)^2 + (75N)^2}$

$\boxed{F_A = 150N}$

b.) $\Sigma M_A = 0$

$(-37500 N.mm) - F_B \cos 30°(200mm) + F_B \sin 30°(500mm) = 0$

$F_B(76{,}8\,mm) = (37500\,N.mm)$

$F_B = \frac{37500\,N.mm}{76.8\,mm}$

$\boxed{F_B = 488{,}28\,N}$ $\boxed{\theta_B = 30°}$

$F_{Bx} = F_B \cos \theta_B$
$F_{Bx} = 488{,}28 \cos 30°$
$= 422{,}86\,N$

$F_{By} = F_B \sin \theta_B$
$= 488{,}28 \sin 30°$
$= 244{,}14\,N$

$\Sigma F_y = 0$

$F_{Ay} - (150N) + (244{,}14\,N) = 0$

$F_{Ay} = -94{,}14\,N$

$\Sigma F_x = 0$

$F_{Ax} - 422{,}86\,N = 0$

$F_{Ax} = 422{,}86N$

The angle of reaction F_A,

$\theta_A = \tan^{-1} \frac{F_{Ay}}{F_{Ax}}$

$= \tan^{-1}\left(\frac{(-94{,}14N)}{(422{,}86N)}\right)$

$\boxed{\theta_A = 12{,}55°}$

$F_A = \sqrt{F_{Ax}^2 + F_{Ay}^2}$

$= \sqrt{(422{,}86N)^2 + (-94{,}14N)^2}$

$= 433{,}21\,N$

$\boxed{F_A = 433{,}21N}$ $\boxed{\theta_A = 12{,}55°}$

Q3

$W = mg$

$W = 100 \times 9,81$

$= 981\,N$

a.) $\sum M_{AB} = 0$

$\lambda_{AB} \cdot \left[(\overline{AC} \times T_{CD}) + (\overline{AC} \times \overline{T_{CE}}) + (\overline{AG} \times \overline{W}) \right] = 0$

$\overline{W}$: weight force

λ_{AB}: unit vector

the position vector of AB

$\overline{AB} = \overline{OB} - \overline{OA}$

$= 0,87i - 0,09i$

$= 0,78i$

$\lambda_{AB} = \dfrac{\overline{AB}}{AB}$

$\lambda_{AB} = \dfrac{0,78i}{0,78} = i$

$AB = \sqrt{(0,78)^2}$

$= 0,78\,m$

same for AC

$\overline{AC} = \overline{OC} - \overline{OA}$

$= 0,69i + 0,45k - (0,09i)$

$= 0,6i + 0,45k$

for AG

$\overline{AG} = \overline{OG} - \overline{OA}$

$= \dfrac{(0,69 + 0,27)}{2} i + \dfrac{(0,45)}{2} k - 0,09i$

$= 0,48i + 0,225k - 0,09i$

$= 0,39i + 0,225k$

$\overline{T_{CD}} = T_{CD} \cdot \lambda_{CD}$

$\lambda_{CD} = \dfrac{\overline{CD}}{CD}$

position vector of CD

$\overline{CD} = \overline{OD} - \overline{OC}$

$= 0,675j - (0,69i - 0,45k)$

$= -69i + 0,675j - 0,45k$

$CD = \sqrt{(-0,69)^2 + (0,675)^2 + (-0,45)^2}$

$= \sqrt{1,1336}$

$= 1,065\,m$

So $\lambda_{CD} = \dfrac{-0,69i + 0,675j - 0,45k}{1,065} = -0,65i + 0,634j - 0,423k$

$\bar{T}_{CD} = T . \lambda_{CD}$

$= T . (-0{,}65i + 0{,}634j - 0{,}423k)$

$\lambda_{CE} = \frac{\bar{CE}}{CE}$

$\lambda_{CE} = \frac{0{,}27i + 0{,}675j - 0{,}45k}{0{,}855}$

$\bar{CE} = \bar{OE} - \bar{OC}$

$= 0{,}96i + 0{,}675j - (0{,}69i + 0{,}45k)$

$= 0{,}27i + 0{,}675j - 0{,}45k$

$= 0{,}316i + 0{,}789j - 0{,}526k$

$CE = \sqrt{(0{,}27)^2 + (0{,}675)^2 + (-0{,}45)^2}$

$= \sqrt{0{,}0729 + 0{,}455 + 0{,}2025}$

$= \sqrt{0{,}7304}$

$= 0{,}855\ m$

$\bar{T}_{CE} = T . \lambda_{CE}$

$\bar{T}_{CE} = T . (0{,}316i + 0{,}789j - 0{,}526k)$

$\lambda_{AB} . [(\bar{AC} \times \bar{T}_{CD}) + (\bar{AC} \times \bar{T}_{CE}) + (\bar{AG} \times \bar{W})] = 0$

substitude all value then we get

$T = \frac{220{,}725}{0{,}6403} = \boxed{344{,}72\ N}$ tension in DCE

b) $\Sigma M_{B_z} = 0$

$-A_y(0{,}78) + (W)(0{,}39) - [T_{CD}j](0{,}18) - [T_{CE}j](0{,}18) = 0$

$-0{,}78 A_y + 382{,}6 - 39 - 48{,}95 = 0$

$0{,}78 A_y = 294{,}65$

$A_y = 377{,}75\ N$

$\Sigma M_{B_y} = 0$

$A_z(0{,}78) - [T(0{,}423)](0{,}18) - [T(0{,}65)](0{,}45) - [T(0{,}526)](0{,}18)$

$+ [T(0{,}316)](0{,}45) = 0$

Substitute 344,72N for T

$0,78 A_z - 26,25 - 100,83 - 32,63 + 49,0 = 0$

$0,78 A_z = 110,71$

$A_z = 141,93 N$

$\Sigma F_x = 0$

$A_x - T(0,65) + T(0,316) = 0$

Substitute 344,72N for T,

$A_x = 115,14 N$

the reaction force vector at point A, is $(115,14N)i + (377,75N)j + (141,93 N)k$

$\Sigma F_y = 0$

$B_y - W + A_y + T(0,634) + T(0,789) = 0$

Substitute 344,72N for T

$\boxed{B_y = 112,72N}$

$\Sigma F_z = 0$

$B_z - A_z - T(0,423) - T(0,526) = 0$

$T = 344,72N$ $141,93N = A_z$

$B_z = 185,213N$

the reaction force vector is $(112,72 N)j + (185,213N)k$