#1 $\Sigma M_A = 12R_B - 12(400)\cos 15° - 600(4) = 0$

$12R_B = 4800\cos 15° + 2400$

$R_B = \underline{586.37\text{ N}}$

$\Sigma F_x = -400\sin 15° + R_{Ax} = 0$

$R_{Ax} = 400\sin 15°$

$= \underline{103.53\text{ N}}$

$\Sigma F_y = R_{Ay} - 600 - 400\cos 15° + 586.37$

$R_{Ay} = 600 + 400\cos 15° - 586.37$

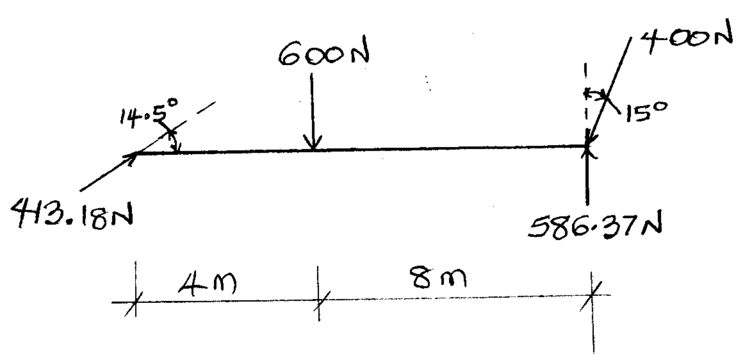
$= \underline{400\text{ N}}$

Resultant reaction at A

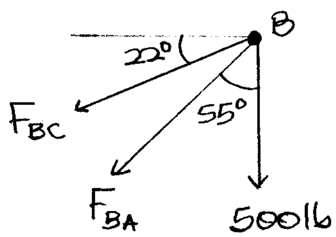
$R_A = \sqrt{R_{Ax}^2 + R_{Ay}^2} = \sqrt{103.53^2 + 400^2}$

$= \underline{413.18\text{ N}}$,

at an angle $\tan^{-1}\left(\frac{103.53}{400}\right) = 14.5°$ to the +ve x-axis.



2. Equilibrium of joint B



$$\Sigma F_x = -F_{BC}\cos 22^\circ - F_{BA}\sin 55^\circ = 0$$

$$F_{BC} = \frac{-F_{BA}\sin 55^\circ}{\cos 22^\circ} = -0.8835\, F_{BA}$$

$$F_{BC} = -0.8835\, F_{BA} \quad \text{----} \quad (2.1)$$

$$\Sigma F_y = -F_{BC}\sin 22^\circ - F_{BA}\cos 55^\circ - 500 = 0$$

$$0.8835\, F_{BA}\sin 22^\circ - F_{BA}\cos 55^\circ - 500 = 0$$

$$(0.8835\sin 22^\circ - \cos 55^\circ)F_{BA} = 500$$

$$F_{BA} = -2060.91\,\text{lb},$$

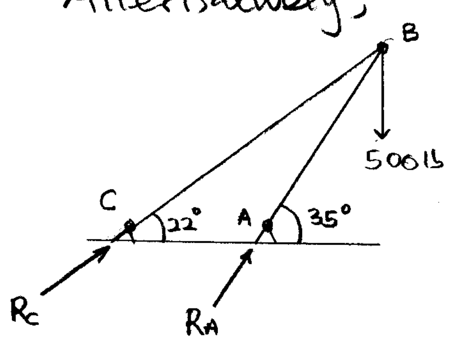
meaning $F_{BA} = \underline{2060.91\,\text{lb}}$ ↗ (from B), and not ↙ assumed

For equilibrium of bar AB,

Force at A = $F_{AB} = -F_{BA} = +2060.91\,\text{lb}$ or $2060.91\,\text{lb}$ ↗ 35° (at A)

From (2.1), $F_{BC} = -0.8835(-2060.91) = +1820.81\,\text{lb}$ or $\underline{1820.81\,\text{lb}}$ ↙ (from B)

Alternatively,



$$\Sigma F_x = R_C\cos 22^\circ + R_A\cos 35^\circ = 0$$

$$R_C = \frac{-R_A\cos 35^\circ}{\cos 22^\circ} = -0.8835\, R_A \quad \text{--} \quad (2.2)$$

$$\Sigma F_y = R_C\sin 22^\circ + R_A\sin 35^\circ = 500$$

$$-0.8835\sin 22^\circ R_A + R_A\sin 35^\circ = 500$$

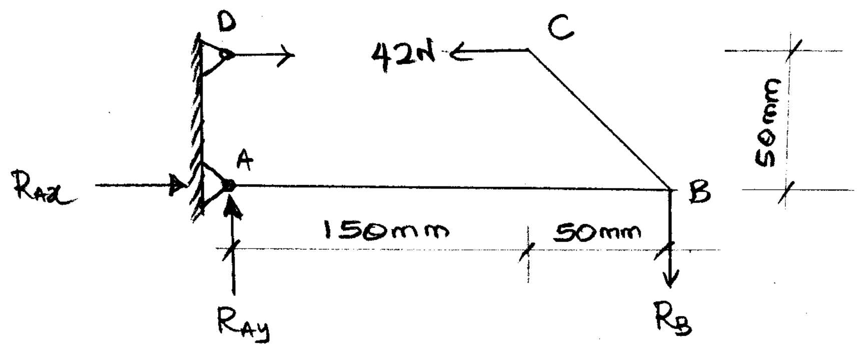
$R_A = 2060.91\,\text{lb}$ ↗ (at A), and from (2.2),

$$R_C = -0.8835(2060.91) = -1820.81\,\text{lb}$$

or $R_C = 1820.81\,\text{lb}$ ↙ (at C)

both of which agree with our earlier results

#3.



From Hooke's law,

$F = ke$

e = stretched length − unstretched length

$= 150\text{mm} - 80\text{mm} = 70\text{ mm} = 0.07\text{m}$

$\therefore F_{CD} = 600\text{N/m} \times 0.07\text{m} = 42\text{N}$

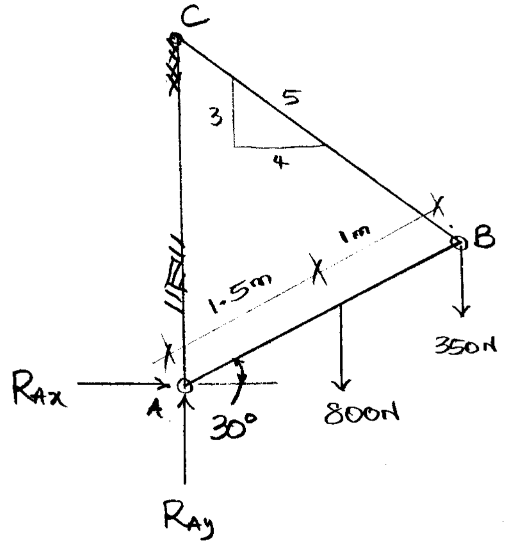
$\Sigma F_x = -42 + R_{Ax} = 0 \Rightarrow \underline{R_{Ax} = 42\text{N}}$

$\Sigma M_A = 42(50) - 200R_{By} = 0$

$R_{By} = \dfrac{42 \times 50}{200} = \underline{10.5\text{N}}$

$\Sigma F_y = R_{Ay} - 10.5 \Rightarrow R_{Ay} = \underline{10.5\text{N}}$

#4



$F_{BC}^{x} = \frac{4}{5} F_{BC} \leftarrow$, moment arm $= |AB| \sin 30°$

$F_{BC}^{y} = \frac{3}{5} F_{BC} \uparrow$, moment arm $= |AB| \cos 30°$

$F_1 = 800N$, moment arm $= |AD| \cos 30°$

$F_2 = 350N$, moment arm $= |AB| \cos 30°$

$$\Sigma M_A = \frac{4}{5} F_{BC}(2.5 \sin 30°) + \frac{3}{5} F_{BC}(2.5 \cos 30°) - 800(1.5)\cos 30° - 350(2.5)\cos 30°$$

$$= F_{BC}(2 \sin 30° + 1.5 \cos 30°) - 2075 \cos 30° = 0$$

$$F_{BC} = \frac{2075 \cos 30°}{1 + 1.5 \cos 30°} = \underline{781.63 N}$$

$$\Sigma F_x = R_{Ax} - \frac{4}{5} F_{BC} = 0 \Rightarrow R_{Ax} = \frac{4}{5} \times 781.63 N$$

$$= \underline{625.3 N}$$

$$\Sigma F_y = R_{Ay} + \frac{3}{5} F_{BC} - 800 - 350 = 0$$

$$R_{Ay} = 1150 - \frac{3}{5}(781.63) = \underline{681.0 N}$$

Therefore the horizontal and vertical components of force at the pin A are 625.3N and 681.0N respectively, while the force in Cable CB = 781.63N.

#5. There's no horizontal load on the beam, so

$$R_{Ax} = R_{Bx} = 0$$

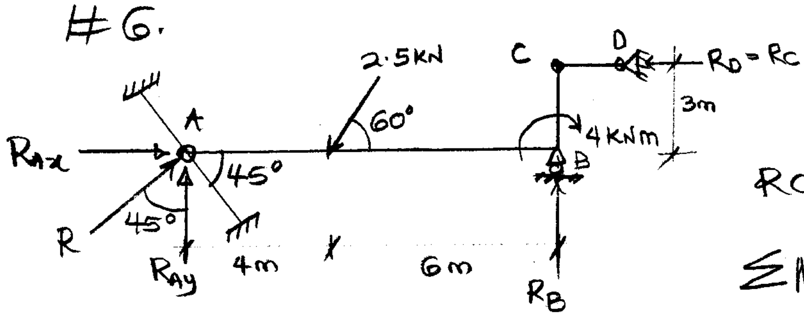
$$\Sigma M_B = 600(3) + 800(6) + 800(9) + 400(12) - 12R_{Ay} = 0$$

$$18600 - 12R_{Ay} = 0 \Rightarrow R_{Ay} = \underline{1550\,lb} \uparrow$$

$$\Sigma F_y = R_{By} + R_{Ay} - (400 + 800 + 800 + 600 + 600) = 0$$

$$R_{By} + 1550 - 3200 = 0 \Rightarrow R_{By} = \underline{1650\,lb} \uparrow$$

#6.



$$\Sigma F_x = R\cos 45^\circ - R_C - 2.5\cos 60^\circ = 0$$

$$R\cos 45^\circ - R_C = 1.25 \quad \text{----- (6.1)}$$

$$\Sigma M_B = -10R\cos 45^\circ + 6(2.5)\sin 60^\circ - 4 + 3R_C = 0$$

$$10R\cos 45^\circ - 3R_C = 8.9904 \quad \text{----- (6.2)}$$

$$(6.2) - 3\times(6.1):\quad 7R\cos 45^\circ = 5.2404$$

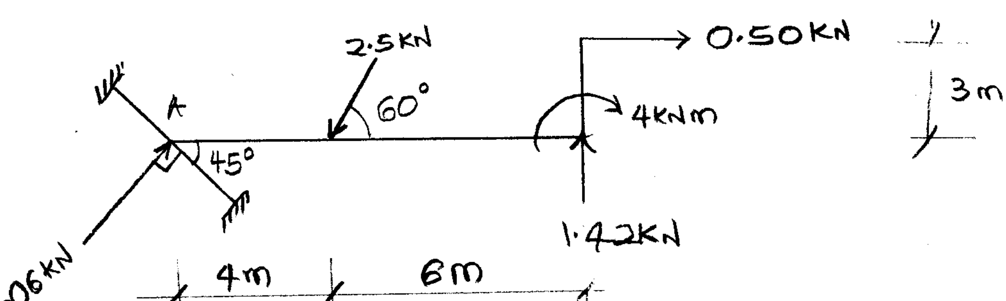
$$\Rightarrow R = \frac{5.2404}{7\cos 45^\circ} = 1.0587\ \text{KN} \approx \underline{1.06}\ \text{KN} \nearrow$$

From (6.1), $R_C = 1.0587\cos 45^\circ - 1.25$

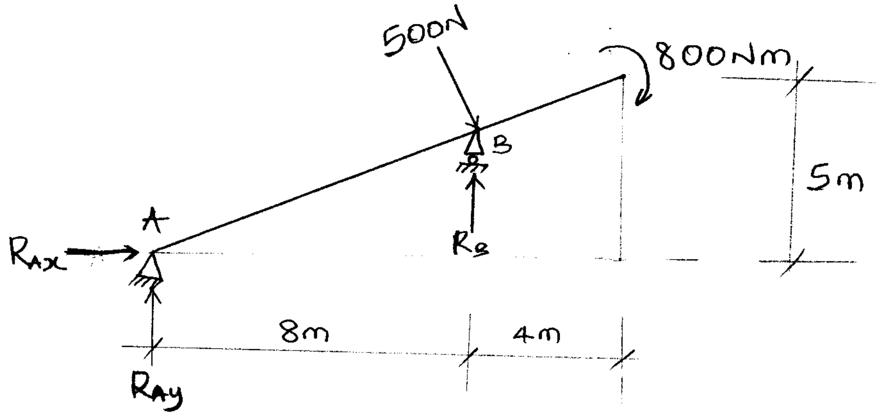
$$R_C = -0.5014 \approx \underline{0.50}\ \text{KN} \longrightarrow$$

$$\Sigma F_y = R\cos 45^\circ - 2.5\sin 60^\circ + R_B = 0$$

$$R_B = 2.5\sin 60^\circ - 1.0587\sin 45 = \underline{1.4164\ \text{KN}} \approx \underline{1.42\ \text{KN}}$$



#7.



$$\Sigma F_x = R_{Ax} + 500\left(\frac{5}{13}\right) = 0 \Rightarrow R_{Ax} = -192.31N$$

$$\Sigma M_B = -8R_{Ay} + 8\left(\frac{13}{12}\right)\left(\frac{5}{13}\right)R_{Ax} - 800 = 0$$

$$-8R_{Ay} = 1441.0333 \Rightarrow R_{Ay} = -180.13N$$

$$\Sigma F_y = R_{Ay} - 500\left(\frac{12}{13}\right) + R_B = 0$$

$$R_B = 180.13 + 500\left(\frac{12}{13}\right) = 641.67\,N$$

Resultant reaction at pin A

$$R_A = \sqrt{R_{Ax}^2 + R_{Ay}^2} = (-192.31)^2 + (-180.13)^2$$

$$= 262.77N,$$

at $\tan^{-1}\left(\frac{180.13}{192.31}\right) = 43.13°$ to the -ve x-axis (3rd Quad.)