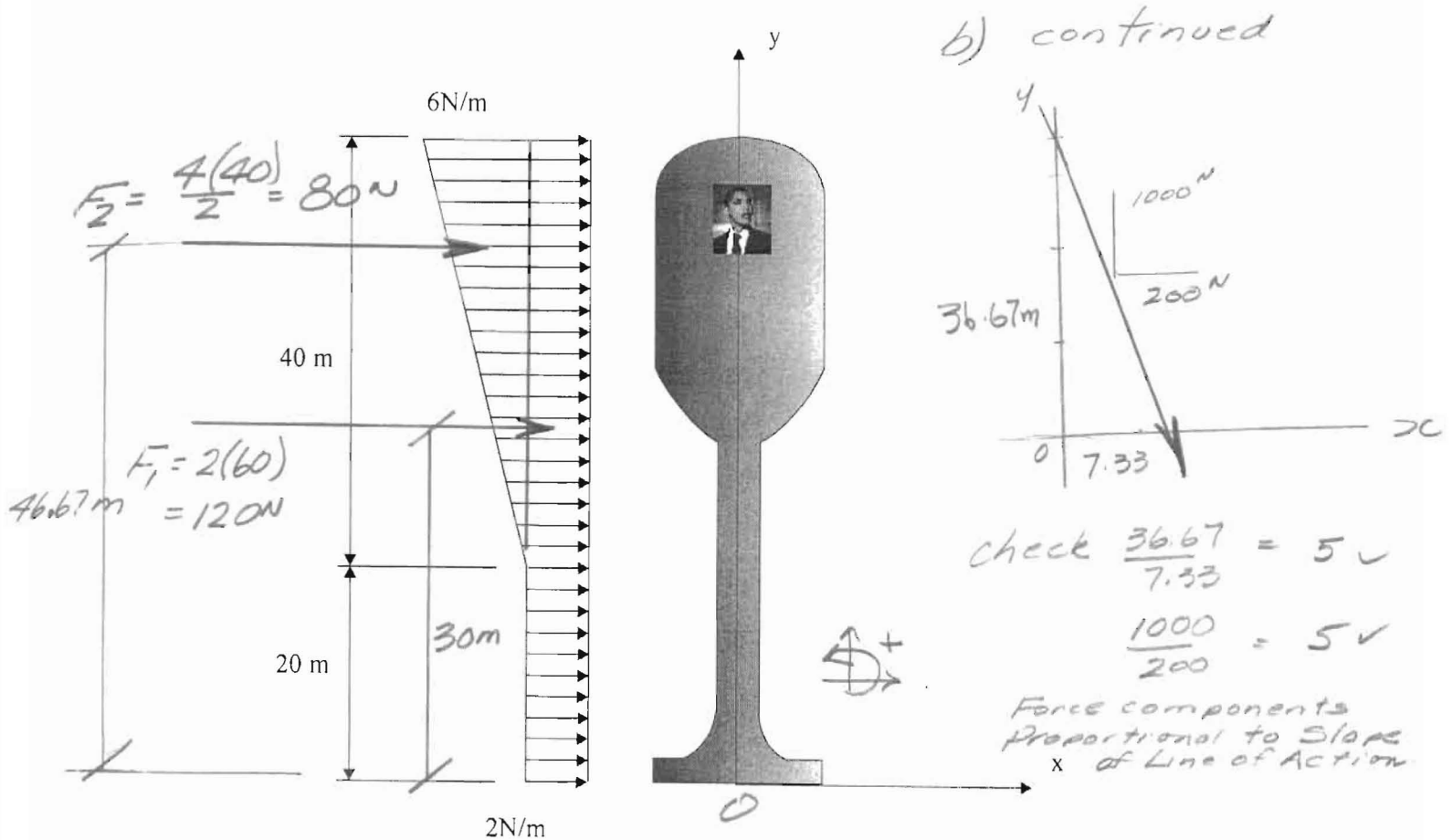


QUESTION 1

The wind load on a water tank outside Winnipeg is shown in the figure below. The total weight of the water and the tower is 1000 N (acting vertically downward on the y axis).

- Find the equivalent force-couple at the intersection of the x and y axis.
- Replace the force system by a single force and determine where the line of action of this force crosses the x and y axis.



$$R_x = \sum F_x = +120 + 80 = +200\text{ N} \quad \vec{R}_x = 200\text{ N} \rightarrow$$

$$R_y = \sum F_y = -1000\text{ N} \quad \vec{R}_y = 1000\text{ N} \downarrow$$

$$M_{OR} = -80(46.67) - 120(30) = -7333.33\text{ N}\cdot\text{m}$$

$$\vec{M}_{OR} = 7333.33\text{ N}\cdot\text{m} \curvearrowright$$

a) Equivalent Force-Couple at O

b)

$$\sum M_{P_1} = 0$$

$$-7333.33 + 1000x = 0$$

$$x = +7.33\text{ m}$$

$$\sum M_{P_2} = 0$$

$$-7333.33 + 200y = 0$$

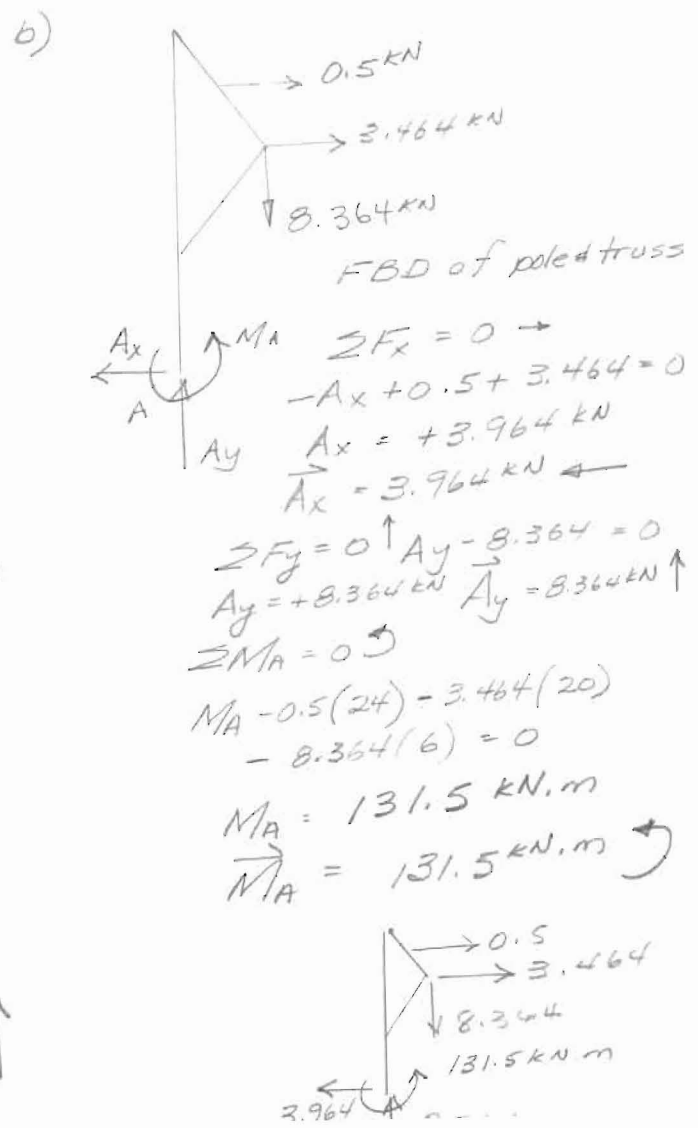
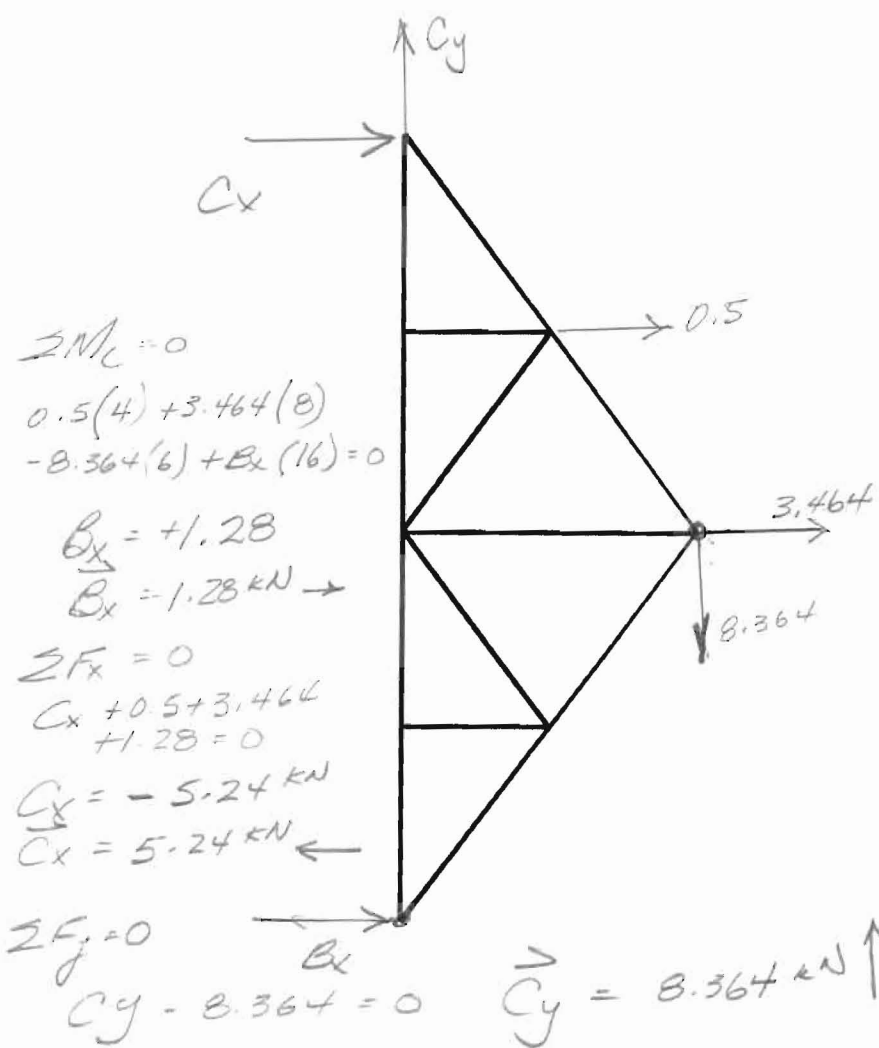
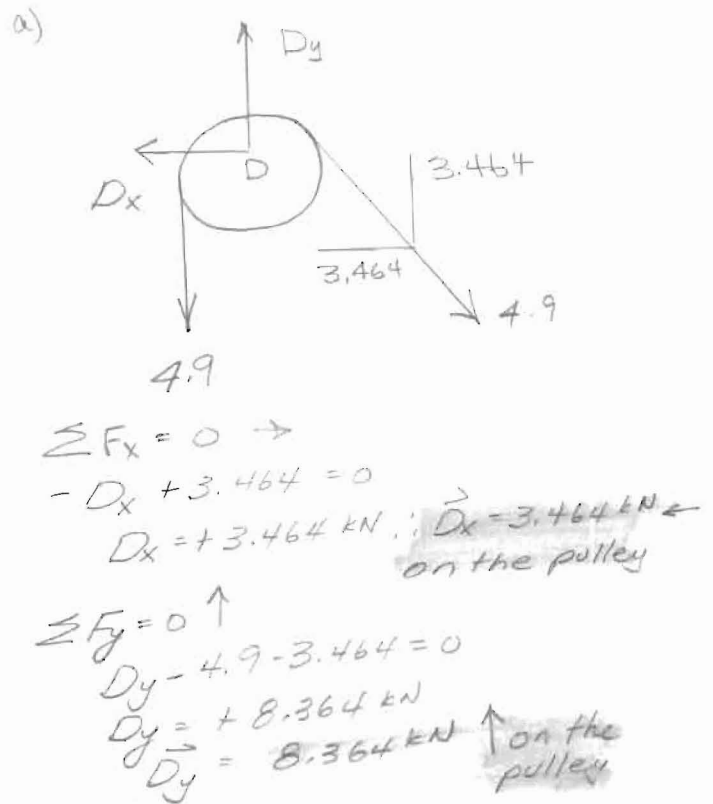
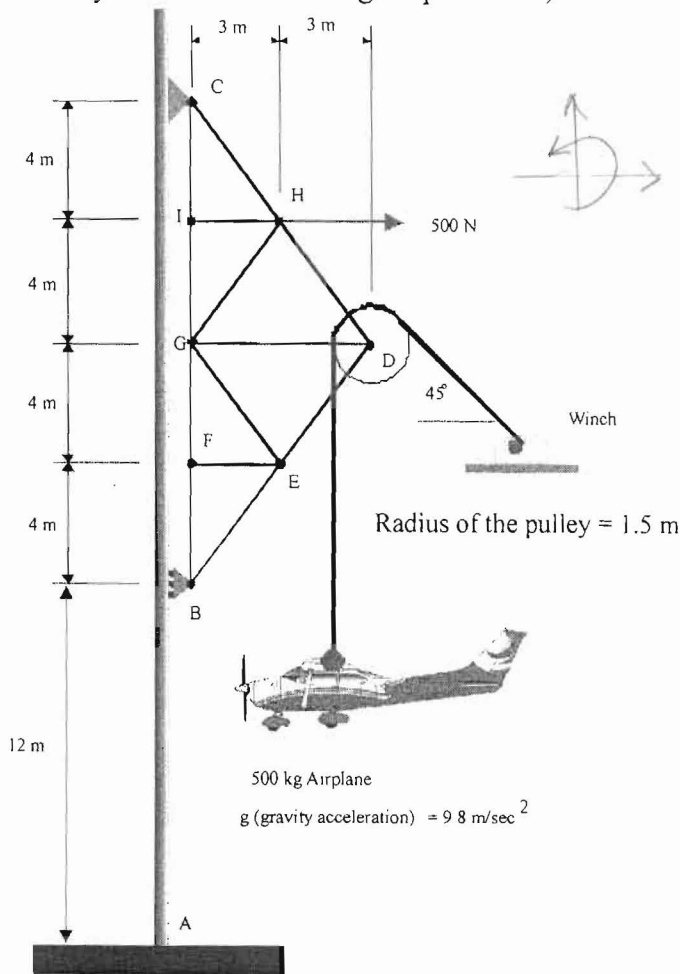
$$y = \frac{7333.33}{200} = 36.67\text{ m}$$

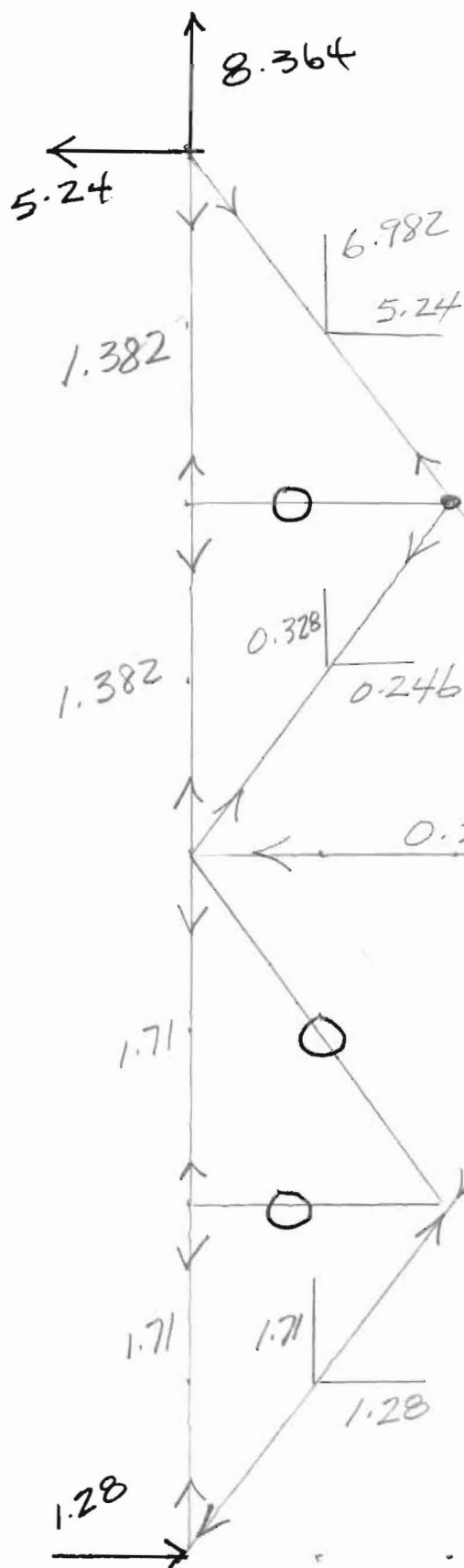
QUESTION 2

The pole has a fixed support at *A*. A truss is supported by the pole by a pin support at *C* and a roller support at *B*. A winch is used to lift a small airplane that has a mass of 500 kg (use $g = 9.8 \text{ m/sec}^2$). The cable attached to the winch goes over a pulley that is attached to the truss at *D*. A 500 N load is also applied to the truss at *H*.

Determine:

- The reactions of the pulley on the truss at *D*,
- The reactions at the fixed support at *A*, and
- The force in each member of the truss and state whether it is in tension or compression. (Show all of your results on the figure provided.)





check $\Sigma M_o = 0$

$$-8.364(6) + 5.24(8)$$

$$-0.5(4) + 1.28(8) = 0$$

$$-0.024 \approx 0$$

close enough

↔ comp
→ ← tens

$$\Sigma F_x: 0.5 + 4.99 - 0.246 - 5.24 = 0.004 \approx 0 \checkmark$$

$$\Sigma F_y: 6.982 - 0.328 - 6.654 = 0$$

$$0 = 0$$

$$\frac{1.28}{6} = \frac{y}{8} \quad y = 1.71$$

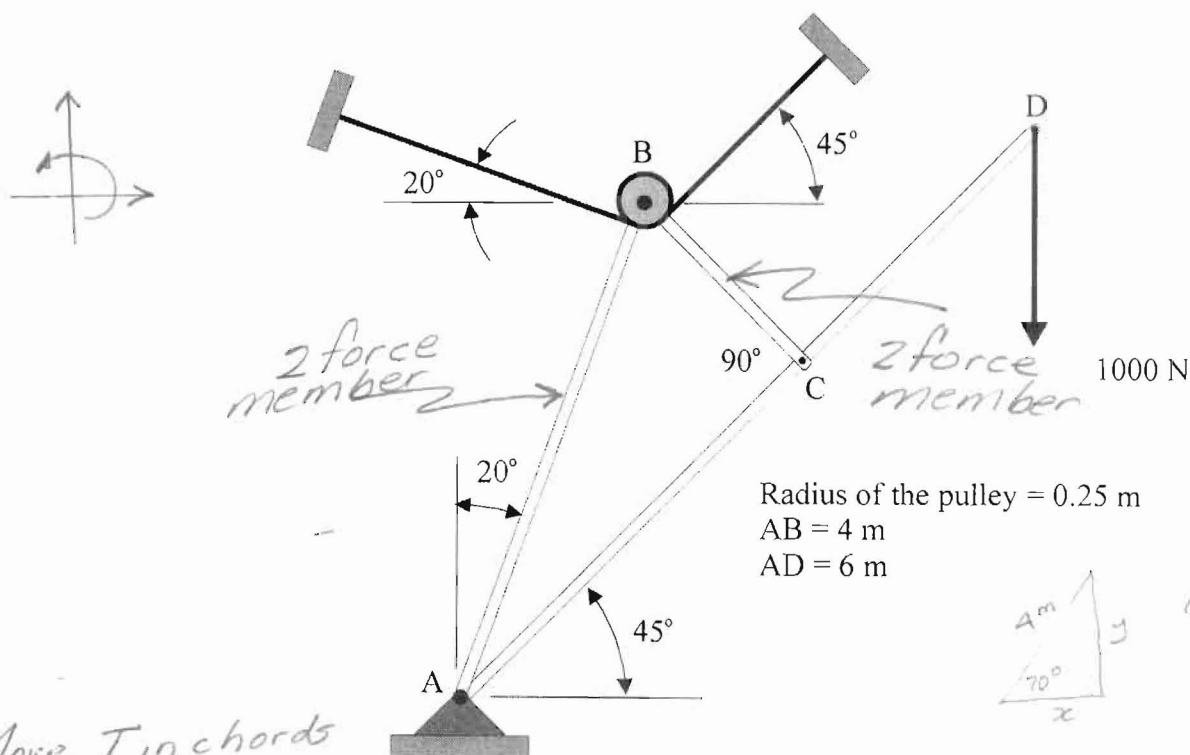
$$\frac{6.654}{8} = \frac{x}{6} \quad x = 4.99$$

$$\frac{0.246}{3} = \frac{y}{4} \quad y = 0.328$$

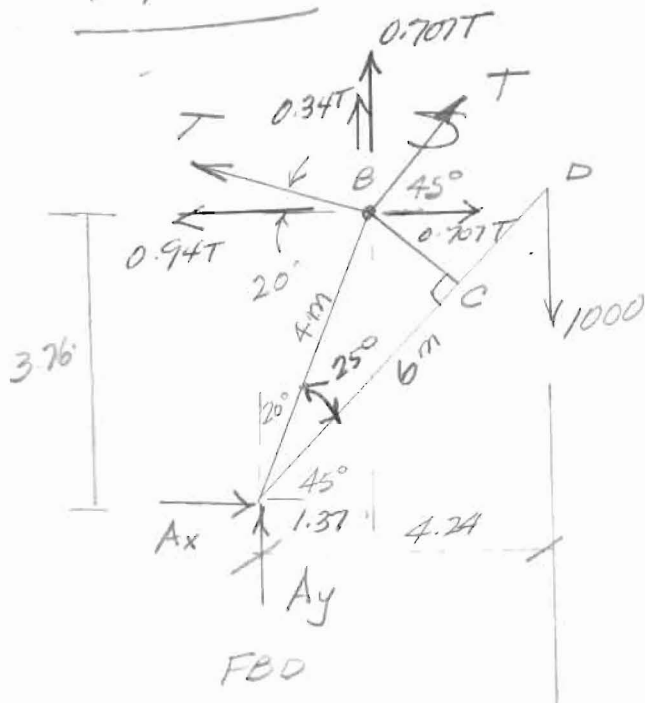
QUESTION 3

For the frame shown in the figure, determine:

- The tension in the support cable and the reaction at the pin support at A, and
- The force in members ACD and AB.



More T in chords
to pin at B



$$\sum M_A = 0$$

$$0.94T(3.76) + 0.34T(1.37) + 0.707T(1.37) - 0.707T(3.76) - 1000(4.24) = 0$$

$$2.31T = 4240 \quad T = 1835.1 \text{ N}$$

$$\sum F_x = 0$$

$$A_x - 0.94(1835.1) + 0.707(1835.1) = 0$$

$$A_x = +427.6 \text{ N} \rightarrow \quad \vec{A}_x = 427.6 \text{ N} \rightarrow$$

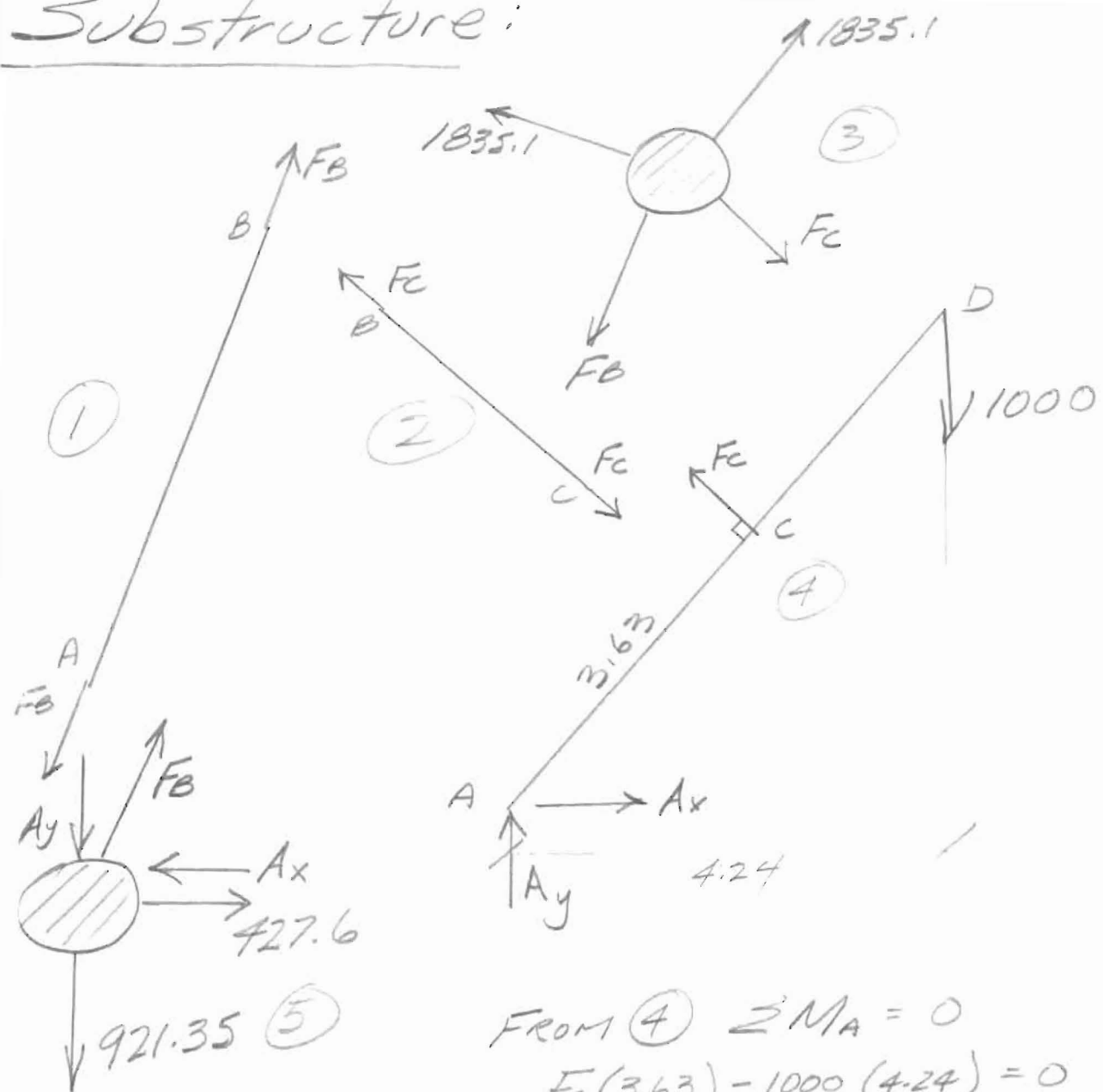
$$\sum F_y = 0$$

$$A_y + 0.34(1835.1) + 0.707(1835.1) - 1000 = 0$$

$$A_y = -921.35 \text{ N}$$

$$\vec{A}_y = 921.35 \text{ N} \downarrow$$

Substructure:



From (4) $\sum M_A = 0$

$$F_C(3.63) - 1000(4.24) = 0$$

$$F_C = +1168 \text{ N}$$

$$\vec{F}_C = 1168 \text{ N} \text{ } \swarrow \text{ on ACD}$$

$$\sum F_x = 0 \quad A_x - \frac{1}{\sqrt{2}}(1168) = 0$$

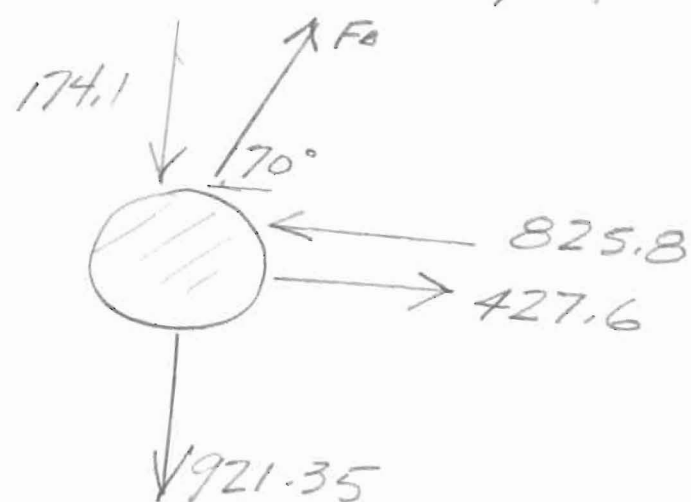
$$A_x = +825.8 \text{ N}$$

$$\vec{A}_x = 825.8 \text{ N} \text{ } \rightarrow \text{ on ACD}$$

$$\sum F_y = 0 \quad A_y + \frac{1}{\sqrt{2}}(1168) - 1000 = 0 \quad A_y = +174.1 \text{ N}$$

$$\vec{A}_y = 174.1 \text{ N} \text{ } \uparrow \text{ on ACD}$$

From ⑤ Re-draw pin

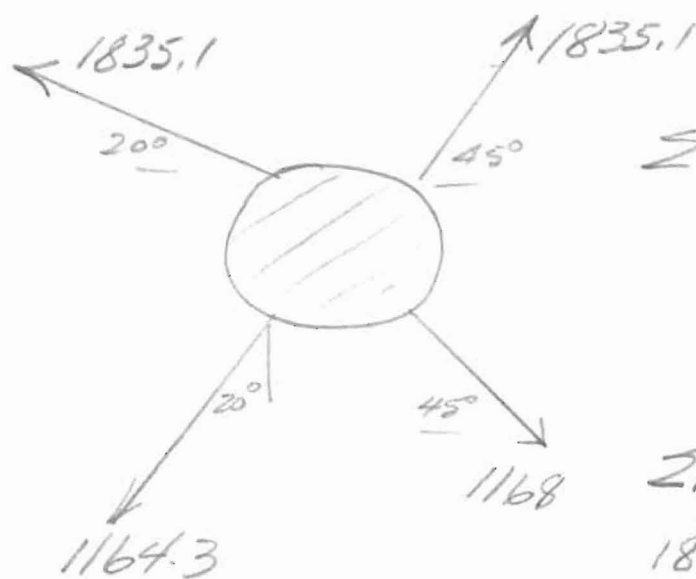


$$\sum F_x = -825.8 + 427.6 + F_B \cos 70^\circ = 0$$

$$F_B = +1164.3 \text{ N}$$

$$\vec{F}_B = 1164.3 \text{ N} \nearrow 70^\circ \text{ on pin at A}$$

Check Pin at B check.



$$\sum F_x = 0$$

$$\begin{aligned} & -1835.1 \cos 20^\circ \\ & + 1835.1 \cos 45^\circ \\ & + 1168 \cos 45^\circ \\ & - 1164.3 \sin 20^\circ = 0 \\ & 0.54 = 0 \checkmark \end{aligned}$$

$$\sum F_y = 0$$

$$\begin{aligned} & 1835.1 \sin 20^\circ + 1835.1 \sin 45^\circ \\ & - 1164.3 \cos 20^\circ - 1168 \sin 45^\circ = 0 \end{aligned}$$

$$5.26 \approx 0 \text{ OK}$$