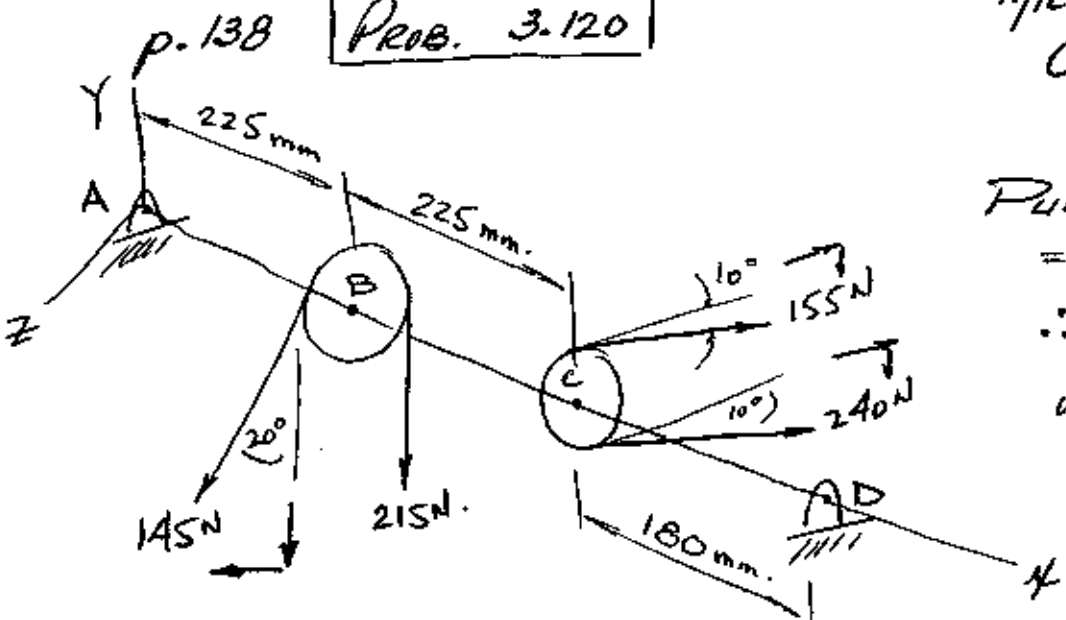


PROB. 3.120



PULLEY DIAM.  
= 150 mm.  
∴ r = 75 mm.  
in Y-Z PL

EQUIVALENT FORCE-COUPLE SYSTEM @ A

1st.

FIND RESULTANT FORCE,  $\vec{R} = 0\hat{i} + ?\hat{j} + ?\hat{k}$   
BREAK UP ALL APPLIED FORCES.

$$145 \text{ N} \Rightarrow -145 \cos 20^\circ \hat{j} + 145 \sin 20^\circ \hat{k}$$

$$-136.26 \hat{j} + 49.6 \hat{k}$$

$$215 \text{ N} \Rightarrow -215 \hat{j}$$

$$155 \text{ N} \Rightarrow -155 \sin 10^\circ \hat{j} - 155 \cos 10^\circ \hat{k}$$

$$-26.92 \hat{j} - 152.65 \hat{k}$$

$$240 \text{ N} \Rightarrow -240 \sin 10^\circ \hat{j} - 240 \cos 10^\circ \hat{k}$$

$$-41.68 \hat{j} - 236.35 \hat{k}$$

$$\vec{R} = \sum \vec{F} = -136.26 \hat{j} + 49.6 \hat{k}$$

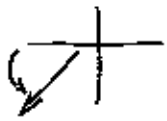
$$-215 \hat{j} - 152.65 \hat{k}$$

$$-41.68 \hat{j} - 236.35 \hat{k}$$

$$-419.86 \hat{j} - 339.4 \hat{k}$$

$$\text{MAG.} = \sqrt{(419.86)^2 + (339.4)^2} = 539.88 \text{ N} \approx \boxed{540 \text{ N}}$$

ORIENTATION  $\theta = \arctan \frac{419.86}{339.4} = 51.05^\circ \approx 51^\circ$



2<sup>nd</sup>. DETERMINE MOMENTS @ B and C  
due to pulley forces. ASSUME CCW +

$$M_B = (145 \text{ N})(75 \text{ mm}) - (215 \text{ N})(75 \text{ mm}) = -5250 \text{ Nmm}$$

∴ CW

$$M_C = -(155 \text{ N})(75 \text{ mm}) + (240 \text{ N})(75 \text{ mm}) = +6375 \text{ Nmm}$$

CCW

$$\left( \perp Y-Z \text{ plane} \right) \quad = 1125 \text{ Nmm}$$

CCW (+)

3<sup>rd</sup> DETERMINE MOMENTS ABOUT A  
due to each force component

$$M_A = (225 \hat{i}) \times [-136.26 \hat{j} + 49.6 \hat{k}] = -30,658.5 \hat{k} - 11,160 \hat{j}$$

$$+ (225 \hat{i}) \times [-215 \hat{j}] = -48,375 \hat{k}$$

$$+ (450 \hat{i}) \times [-26.92 \hat{j} - 152.65 \hat{k}] = -12,114 \hat{k} + 68,692.5 \hat{j}$$

$$+ (450 \hat{i}) \times [-41.68 \hat{j} - 236.35 \hat{k}] = -18,756 \hat{k} + 106,357.5 \hat{j}$$

$$-109.9 \hat{k} + 163.89 \hat{j} \text{ N-m.}$$

$$\therefore M_{TOT A} = +1.125 \hat{i} + 163.89 \hat{j} - 109.9 \hat{k} \text{ N-m.}$$

$$\text{with } \vec{R} = -419.86 \hat{j} - 339.4 \hat{k} \text{ N.} \approx \underline{540 \text{ N.}}$$

What does this all mean?