



Dept. of Physics

## PCS 211 – Fall 2021 Tutorial Report Cover Page

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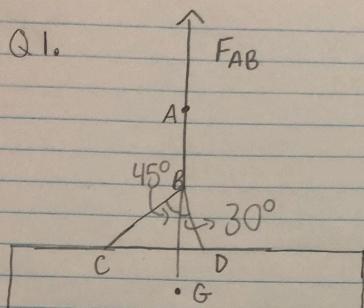
Tutorial Number : 2

Tutorial Date : September 28th, 2021

Tutorial TA Name : Matt Bielecki

<https://drive.google.com/file/d/122UIQUWlgFwj08RPOLTJ5yy2DrpNFWw/view>

1.



$$20\text{KN} = 20000\text{N} = F_{BD}$$

$$m = ? \quad W = ma = m \cdot g \cdot \sin^2\theta = F_{AB} = (9.8 \text{ m/s}^2)(m)$$

$$(1) x: -F_{BC} \sin 45^\circ + F_{BD} \sin 30^\circ = 0$$

$$(2) y: -F_{BC} \cos 45^\circ - F_{BD} \cos 30^\circ + (9.8 \text{ m/s}^2)m$$

$$F_{BC} = F_{BD} \frac{\sin 30^\circ}{\sin 45^\circ} \quad (3)$$

Substitute (3) into (2):

$$0 = -\left(\frac{\sin 30^\circ}{\sin 45^\circ}(20,000\text{N})\right)\cos 45^\circ - (20,000\text{N})\cos 30^\circ + (9.8 \text{ m/s}^2)m$$

$$m = 2787.79$$

$$m = 2800 \text{ kg} \rightarrow 2 \text{ sig digs}$$

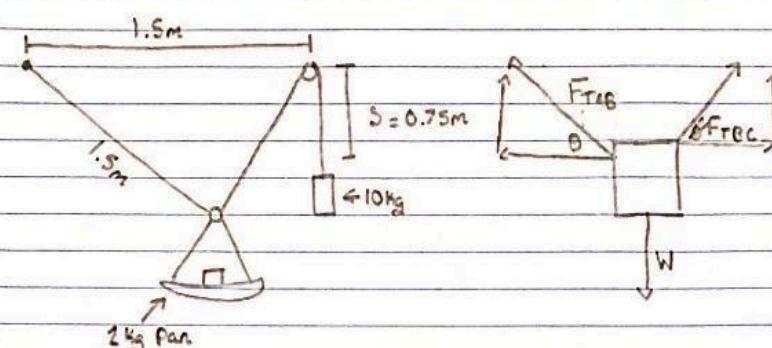
$\therefore$  The maximum mass of the grinder is 2800kg.

2.)

Tutorial #2

Sep 28/21

2.)



$$F_{TAB} = \frac{mg}{\cos \theta}$$

$$F_{TBC} = \frac{mg}{\cos \theta}$$

$$2 - 0.75m = 1.25m$$

$$\begin{aligned} F_{TBC} &= mg \\ &= (10 \text{ kg})(9.81 \text{ m/s}^2) \\ &= 98.1 \text{ N} \end{aligned}$$

$$\left. \begin{aligned} r^2 &= x^2 + y^2 \\ 1.5^2 &= x^2 + y^2 \\ 1.5^2 - x^2 &= y^2 \\ ① \quad y^2 &= 1.5^2 - x^2 \end{aligned} \right\}$$

$$\begin{aligned} F_y: \quad F_{TABy} + F_{TBCy} - W &= 0 \\ F_{TAB} \sin \theta + (98.1 \text{ N}) \sin \theta - mg &= 0 \end{aligned}$$

$$② \quad 1.25^2 = (1.5 - x)^2 + y^2$$

$$\begin{aligned} F_x: \quad F_{TBCx} - F_{TABx} &= 0 \\ (98.1 \text{ N}) \cos \theta - F_{TAB} \cos \theta &= 0 \end{aligned}$$

$$1.25^2 = (1.5 - x)^2 + (1.5^2 - x^2)$$

$$1.5625 = 1.5^2 - x^2 + (1.5 - x)(1.5 - x)$$

$$1.5625 = 1.5^2 - x^2 + 2.25 - 1.5x - 1.5x + x^2$$

$$1.5625 = 2.25 + 2.25 - 1.5x - 1.5x - x^2 + x^2$$

$$1.5625 = 4.5 - 3x$$

$$3x = 4.5 - 1.5625$$

$$3x = 2.4375$$

$$x = 0.97917 \text{ m}$$

$$y^2 = 1.5^2 - (0.97917)^2$$

$$y^2 = 2.25 - 0.9604$$

$$y^2 = 1.2896$$

$$y = \sqrt{1.2896}$$

$$y = 1.1356 \text{ m}$$

Hilary

$$\textcircled{1} \quad y = 1.1356 \text{ m}$$

$$r = 1.5 \text{ m}$$

$$\theta = \sin^{-1} \left( \frac{1.1356 \text{ m}}{1.5 \text{ m}} \right)$$

$$\textcircled{2} \quad y = 1.1356 \text{ m}$$

$$r = 1.25 \text{ m}$$

$$= 49^\circ$$

$$\delta = \sin^{-1} \left( \frac{1.1356 \text{ m}}{1.25 \text{ m}} \right)$$

$$\delta = 65^\circ$$

$$F_x: (98.1 \text{ N}) \cos \theta - F_{TAB} \cos \theta = 0$$

$$(98.1 \text{ N}) \cos 65^\circ - F_{TAB} \cos 49^\circ = 0$$

$$41.46 \text{ N} - F_{TAB} \cos 49^\circ = 0$$

$$41.46 \text{ N} = F_{TAB} \cos 49^\circ$$

$$F_{TAB} = \frac{41.46 \text{ N}}{\cos 49^\circ}$$

$$F_{TAB} = 63.2 \text{ N}$$

$$F_y: F_{TAB} \sin \theta + (98.1 \text{ N}) \sin \theta - mg = 0$$

$$63.2 \text{ N} \sin 49^\circ + 98.1 \text{ N} \sin 65^\circ - m(9.81 \text{ m/s}^2) = 0$$

$$47.70 \text{ N} + 88.91 \text{ N} - m(9.81 \text{ m/s}^2) = 0$$

$$136.61 \text{ N} = m(9.81 \text{ m/s}^2)$$

$$m = \frac{136.61 \text{ N}}{9.81 \text{ m/s}^2}$$

$$m = 13.9 \text{ kg}$$

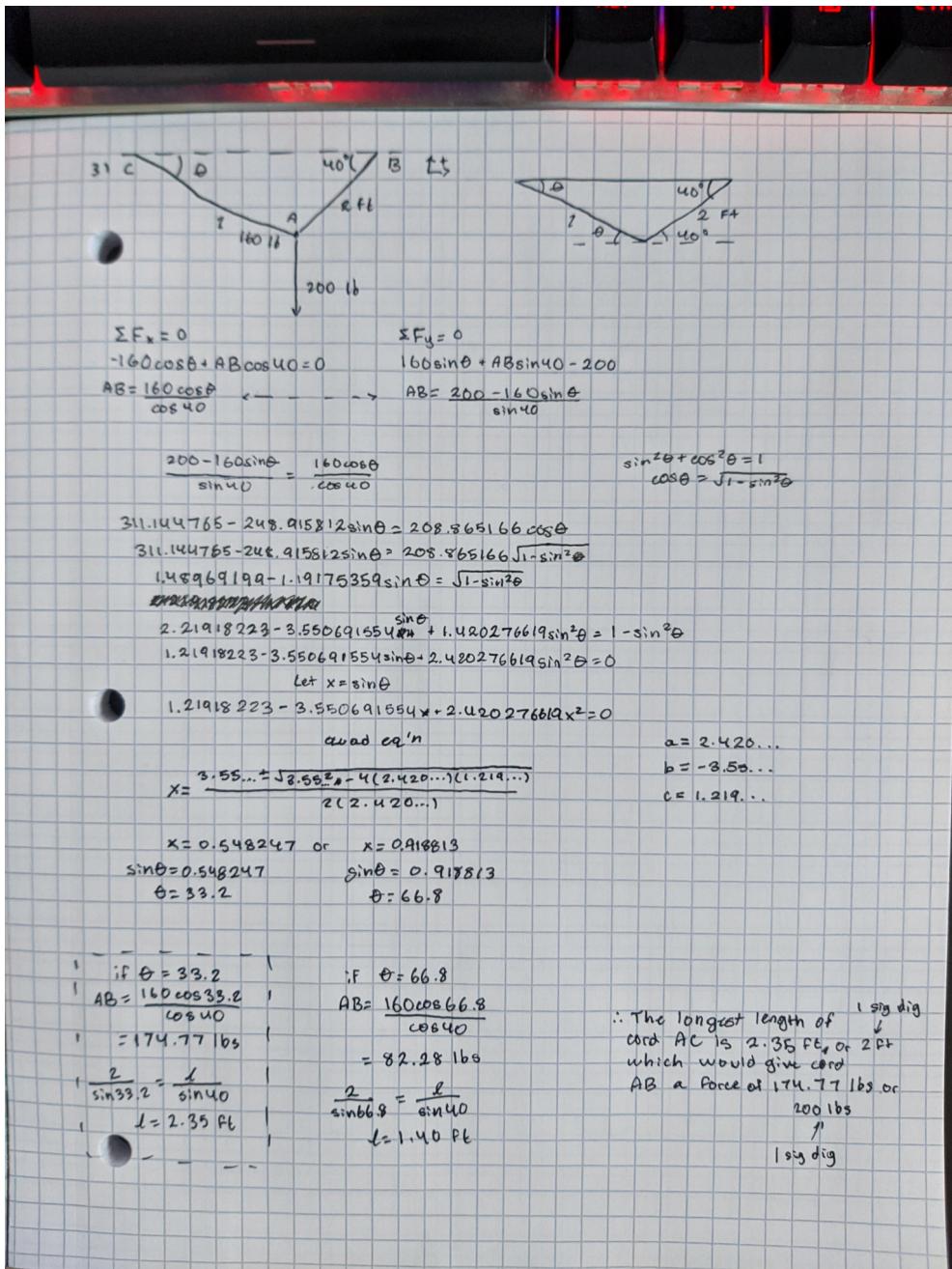
$\therefore$  The mass of the pan is

$$11.9 \text{ kg}$$

$$m = 13.9 \text{ kg} - 2 \text{ kg}$$

$$= 11.9 \text{ kg}$$

3).



4.

(Q4) Position Vectors:

$$\vec{AB} = (6\hat{i} + 2\hat{j} - 5\hat{k}) \text{ m}$$

$$\vec{AC} = (-6\hat{i} - 2\hat{j} + 3\hat{k}) \text{ m}$$

$$\vec{AD} = (-6\hat{i} + 2\hat{j} + 3\hat{k}) \text{ m}$$

Force vectors:

$$\vec{F}_{AB} = \vec{F}_{AB} \frac{\vec{AB}}{|\vec{AB}|}$$

$$= \vec{F}_{AB} \frac{(6\hat{i} + 2\hat{j} - 5\hat{k})}{\sqrt{6^2 + 2^2 + (-5)^2}}$$

$$= \vec{F}_{AB} (0.923\hat{i} + 0.385\hat{j} - 0.4286\hat{k})$$

$$\vec{F}_{AC} = \vec{F}_{AC} \frac{\vec{AC}}{|\vec{AC}|}$$

$$= \vec{F}_{AC} \frac{(-6\hat{i} - 2\hat{j} + 3\hat{k})}{\sqrt{(-6)^2 + (-2)^2 + (3)^2}}$$

$$= \vec{F}_{AC} (-0.857\hat{i} - 0.286\hat{j} + 0.4286\hat{k})$$

$$\vec{F}_{AD} = \vec{F}_{AD} \frac{\vec{AD}}{|\vec{AD}|}$$

$$= \vec{F}_{AD} \frac{(-6\hat{i} + 2\hat{j} + 3\hat{k})}{\sqrt{(-6)^2 + (2)^2 + (3)^2}}$$

$$= \vec{F}_{AD} (-0.857\hat{i} + 0.286\hat{j} + 0.4286\hat{k})$$

$$W = -Wk = -(50 \times 9.8) k = -490$$

$$\vec{F}_{AB} + \vec{F}_{AC} + \vec{F}_{AD} + W = 0$$

$$\vec{F}_{AB} (0.923\hat{i} + 0.385\hat{k}) + \vec{F}_{AC} (-0.857\hat{i} - 0.286\hat{j} + 0.4286\hat{k}) +$$

$$\vec{F}_{AD} (-0.857\hat{i} + 0.286\hat{j} + 0.4286\hat{k}) \cancel{- 490\hat{k}} = 0$$

$$0.923\vec{F}_{AB} - 0.857\vec{F}_{AC} - 0.857\vec{F}_{AD} = 0$$

$$-0.286\vec{F}_{AC} + 0.286\vec{F}_{AD} = 0$$

~~Free Body Diagram~~

$$\vec{F}_{AC} = \vec{F}_{AD}$$

$$0.385\vec{F}_{AB} + 0.4286\vec{F}_{AC} + 0.4286\vec{F}_{AD} = 490$$

$$0.923\vec{F}_{AB} - 0.857\vec{F}_{AC} - 0.857\vec{F}_{AD} = 0$$

$$0.923\vec{F}_{AB} - 0.857\vec{F}_{AC} - 0.857\vec{F}_{AD} = 0$$

$$\vec{F}_{AB} = 1.86\vec{F}_{AC}$$

Hilary

$$\vec{F}_{AB} = 1.86\vec{F}_{AC}$$

$$0.385\vec{F}_{AB} + 0.4286\vec{F}_{AC} + 0.4286\vec{F}_{AD} = 490$$

$$0.385(1.86\vec{F}_{AC}) + 0.4286\vec{F}_{AC} + 0.4286\vec{F}_{AC} = 490$$

$$1.5733 = 490$$

$$\frac{1.86 \times 311.5}{573.3} = 579.4$$

$$\vec{F}_{AC} = 311.5 \text{ N}$$

$$\vec{F}_{AB} = 579.4 \text{ N}$$

$$\vec{F}_{AD} = 311.5 \text{ N}$$

5.

Q5) G:  $m = 100 \text{ kg}$   
 $\text{weight} = 100(9.81)$   
 $= 981 \text{ N} = 981 \text{ kN}$   
 $z = 600 \text{ mm or } 0.6 \text{ m}$

position vectors from origin

$\overrightarrow{OA} = -zk$   
 $\overrightarrow{OB} = 0.5j$   
 $\overrightarrow{OC} = -0.5\cos 30i - 0.5\sin 30j$   
 $= -0.433i - 0.25j$   
 $\overrightarrow{OD} = 0.5\cos 30i - 0.5\sin 30j$   
 $= 0.433i - 0.25j$

$T_{AB} = \frac{\overrightarrow{AB}}{|AB|} \cdot T_{AB}$   
 $= 0.5T_{AB} \frac{j}{\sqrt{0.25+z^2}} + \frac{z}{\sqrt{0.25+z^2}} k$

$T_{AC} = \frac{\overrightarrow{AC}}{|AC|} \cdot T_{AC}$   
 $= \frac{-0.433T_{AC}}{\sqrt{0.25+z^2}} i - \frac{0.25T_{AC}}{\sqrt{0.25+z^2}} j + \frac{zT_{AC}}{\sqrt{0.25+z^2}} k$

$T_{AD} = \frac{\overrightarrow{AD}}{|AD|} \cdot T_{AD}$   
 $= \frac{0.433T_{AD}}{\sqrt{0.25+z^2}} i - \frac{0.25T_{AD}}{\sqrt{0.25+z^2}} j + \frac{zT_{AD}}{\sqrt{0.25+z^2}} k$

compile all  $i$  values equilibrium  
 $\frac{-0.433T_{AC}}{\sqrt{0.25+z^2}} i + \frac{0.433T_{AD}}{\sqrt{0.25+z^2}} i = 0$   
 $\frac{-0.433T_{AC}}{\sqrt{0.25+z^2}} i = \frac{-0.433T_{AD}}{\sqrt{0.25+z^2}} i$   
 $T_{AC} = T_{AD}$

compile all  $j$  values  
 $\frac{0.25T_{AB}}{\sqrt{0.25+z^2}} j - \frac{0.25T_{AC}}{\sqrt{0.25+z^2}} j - \frac{0.25T_{AD}}{\sqrt{0.25+z^2}} j = 0$   
 $\frac{0.25T_{AB}}{\sqrt{0.25+z^2}} j = \frac{0.25T_{AC}}{\sqrt{0.25+z^2}} j$   
 $T_{AB} = T_{AC} = T_{AD}$

compile all  $k$  terms  
 $\frac{zT_{AB}}{\sqrt{0.25+z^2}} k + \frac{zT_{AC}}{\sqrt{0.25+z^2}} k + \frac{zT_{AD}}{\sqrt{0.25+z^2}} k - 981k = 0$   
 $\frac{3zT_{AB}}{\sqrt{0.25+z^2}} k = 981$   
 $T_{AB} = \frac{981}{3z} \frac{\sqrt{0.25+z^2}}{k} = \frac{981\sqrt{0.25+0.36}}{3(0.6)} = 425.6586$   
 $T_{AB} = 425.6586$

$\therefore$  The tension in each cable is  $425.6586 \text{ N}$  each or  $400 \text{ N}$  1 sig dig