Ryerson University

Dept. of Physics

PCS 211 – Fall 2021
Tutorial Report Cover Page

Group's Students Info

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Tutorial Number : ____2________

Tutorial Date : ____September 28th, 2021_____________

Tutorial TA Name : _______Matt Bielecki________________

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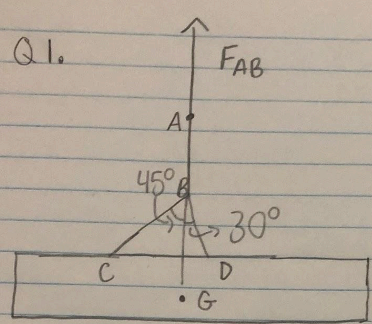
1.

Q1.



$20KN = 20\,000N = F_{BD}$

$m = ?$ $\quad W = ma = m9.8m/s^2 = FAB = (9.8\,m/s^2)(m)$

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

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

$F_{BC} = F_{BD}\dfrac{\sin 30°}{\sin 45°}$ (3)

substitute (3) into (2):

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

$m = 2787.79$

$m = 2800\ kg \rightarrow 2$ sig digs

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

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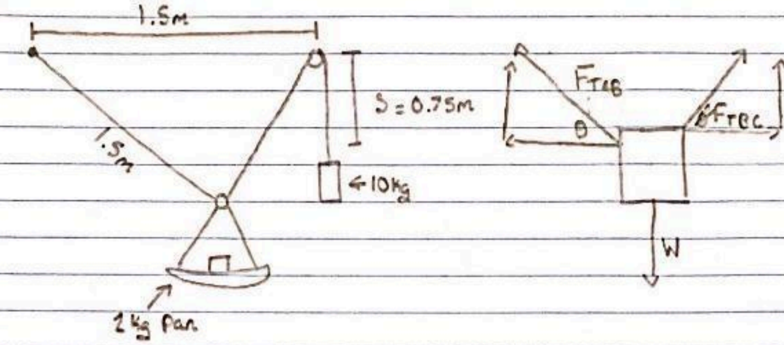
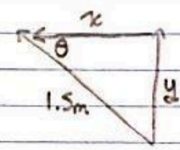
2.)

Tutorial #2 Sep 21/21

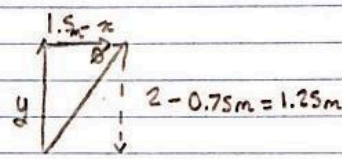
2.)



F_{TAB} =



F_{TBC} =



$F_{TBC} = mg$
$= (10kg)(9.81 m/s^2)$
$= 98.1N$

Fy: $F_{TABy} + F_{TBCy} - W = 0$
$F_{TAB}\sin\theta + (98.1N)\sin\varnothing - mg = 0$

Fx: $F_{TBCx} - F_{TABx} = 0$
$(98.1N)\cos\varnothing - F_{TAB}\cos\theta = 0$

$r^2 = x^2 + y^2$
$1.5^2 = x^2 + y^2$
$1.5^2 - x^2 = y^2$
① $y^2 = 1.5^2 - x^2$

② $1.25^2 = (1.5 - x)^2 + y^2$

$1.25^2 = (1.5 - x)^2 + (1.5^2 - x^2)$
$1.5625 = 1.5^2 - x^2 + (1.5 - x)(1.5 - x)$
$1.5625 = 1.5^2 - x^2 + 2.25 - 1.5x - 1.5x + x^2$
$1.5625 = 2.25 + 2.25 - 1.5x - 1.5x \cancel{-x^2} \cancel{+x^2}$
$1.5625 = 4.5 - 3x$
$3x = 4.5 - 1.5625$
$3x = 2.4375$
$x = 0.97917m$

$y^2 = 1.5^2 - (0.97917)^2$
$y^2 = 2.25 - 0.9604$
$y^2 = 1.2896$
$y = \sqrt{1.2896}$
$y = 1.1356m$

Hilary

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① $y = 1.1356m$
$r = 1.5m$

② $y = 1.1356m$
$r = 1.25m$

$\theta = \sin^{-1}\left(\frac{1.1356m}{1.5m}\right)$
$= 49°$

$\emptyset = \sin^{-1}\left(\frac{1.1356m}{1.25m}\right)$
$\emptyset = 65°$

F_x: $(98.1N)\cos\emptyset - F_{TAB}\cos\theta = 0$
$(98.1N)\cos 65° - F_{TAB}\cos 49° = 0$
$41.46N - F_{TAB}\cos 49° = 0$
$41.46N = F_{TAB}\cos 49°$
$F_{TAB} = \frac{41.46N}{\cos 49°}$
$F_{TAB} = 63.2N$

F_y: $F_{TAB}\sin\theta + (98.1N)\sin\emptyset - mg = 0$
$63.2N\sin 49° + 98.1N\sin 65° - m(9.81m/s^2) = 0$
$47.70N + 88.91N - m(9.81m/s^2) = 0$
$136.61N = m(9.81m/s^2)$
$m = \frac{136.61N}{9.81m/s^2}$
$m = 13.9kg$

$m = 13.9kg - 2kg$
$= 11.9kg$

∴ The mass D in the pan is 11.9kg

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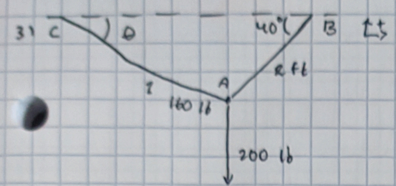
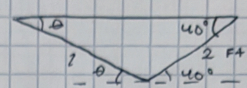
3).

3)





$\Sigma F_x = 0$

$-160\cos\theta + AB\cos 40 = 0$

$AB = \dfrac{160\cos\theta}{\cos 40}$

$\Sigma F_y = 0$

$160\sin\theta + AB\sin 40 - 200$

$AB = \dfrac{200 - 160\sin\theta}{\sin 40}$

$$\frac{200-160\sin\theta}{\sin 40} = \frac{160\cos\theta}{\cos 40}$$

$\sin^2\theta + \cos^2\theta = 1$

$\cos\theta = \sqrt{1-\sin^2\theta}$

$311.144765 - 248.915812\sin\theta = 208.865166\cos\theta$

$311.144765 - 248.915812\sin\theta = 208.865166\sqrt{1-\sin^2\theta}$

$1.48969199 - 1.19175359\sin\theta = \sqrt{1-\sin^2\theta}$

$2.21918223 - 3.550691554\sin\theta + 1.420276619\sin^2\theta = 1 - \sin^2\theta$

$1.21918223 - 3.550691554\sin\theta + 2.420276619\sin^2\theta = 0$

Let $x = \sin\theta$

$1.21918223 - 3.550691554x + 2.420276619x^2 = 0$

quad eq'n

$$x = \frac{3.55\ldots \pm \sqrt{3.55^2\ldots - 4(2.420\ldots)(1.219\ldots)}}{2(2.420\ldots)}$$

$a = 2.420\ldots$

$b = -3.55\ldots$

$c = 1.219\ldots$

$x = 0.548247$ or $x = 0.918813$

$\sin\theta = 0.548247$

$\theta = 33.2$

$\sin\theta = 0.918813$

$\theta = 66.8$

if $\theta = 33.2$

$AB = \dfrac{160\cos 33.2}{\cos 40}$

$= 174.77$ lbs

$\dfrac{2}{\sin 33.2} = \dfrac{l}{\sin 40}$

$l = 2.35$ ft

if $\theta = 66.8$

$AB = \dfrac{160\cos 66.8}{\cos 40}$

$= 82.28$ lbs

$\dfrac{2}{\sin 66.8} = \dfrac{l}{\sin 40}$

$l = 1.40$ ft

∴ The longest length of cord AC is 2.35 ft, or 2 ft which would give cord AB a force of 174.77 lbs or 200 lbs

1 sig dig

1 sig dig

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4.

Q4) Position vectors:

$AB = (6\hat{i} + 2.5\hat{k})\,m$

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

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

Force vectors:

$\vec{F}_{AB} = \vec{F}_{AB}\dfrac{AB}{|AB|} = \vec{F}_{AB}\dfrac{(6\hat{i} + 2.5\hat{k})}{\sqrt{6^2 + 2.5^2}} = \vec{F}_{AB}(0.923\hat{i} + 0.385\hat{k})$

$\vec{F}_{AC} = \vec{F}_{AC}\dfrac{AC}{|AC|} = \vec{F}_{AC}\dfrac{(-6\hat{i} - 2\hat{j} + 3k)}{\sqrt{(-6)^2 + (-2)^2 + (3)^2}} = \vec{F}_{AC}(-0.857\hat{i} - 0.286\hat{j} + 0.4286\hat{k})$

$\vec{F}_{AD} = \vec{F}_{AD}\dfrac{AD}{|AD|} = \vec{F}_{AD}\dfrac{(-6\hat{i} + 2\hat{j} + 3\hat{k}m)}{\sqrt{(-6)^2 + (2)^2 + (3)^2}} = \vec{F}_{AD}(-0.857\hat{i} + 0.286\hat{j} + 0.4286\hat{k})$

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

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

$\vec{F}_{AB}(0.923\hat{i} + 0.385\hat{k}) + \vec{F}_{AC}(-0.857\hat{i} - 0.286\hat{j} + 0.4286k) + \vec{F}_{AD}(-0.857\hat{i} + 0.286\hat{j} + 0.4286\hat{k}) - 490\hat{k} = 0$

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

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

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

$0.385F_{AB} + 0.4286F_{AC} + 0.4286F_{AD} = 490$

$0.923F_{AB} - 0.857F_{AC} - 0.857F_{AD} = 0$

$0.923F_{AB} - 0.857F_{AC} - 0.857F_{AD} = 0$

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

Next page →

$1.86 \times 311.5 = 579.4$

$F_{AB} = 1.86F_{AC}$

$0.385F_{AB} + 0.4286F_{AC} + 0.4286F_{AD} = 490$

$0.385(1.86F_{AC}) + 0.4286F_{AC} + 0.4286F_{AC} = 490$

$1.5733 = 490$

$\boxed{\begin{aligned} F_{AC} &= 311.5\,N \\ F_{AB} &= 579.4\,N \\ F_{AD} &= 311.5\,N \end{aligned}}$

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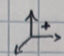
5.

Q5) G: $m = 100\ kg$



$weight = 100(9.81)$

$= 981\ N,\ = -981k\ N$

$z = 600\ mm$ or $0.6\ m$

position vectors from origin

$OA = -zk$

$OB = 0.5j$

$OC = -0.5\cos 30 i - 0.5\sin 30 j$

$= -0.433i - 0.25j$

$OD = 0.5\cos 30 i - 0.5\sin 30 j$

$= 0.433i - 0.25j$

$AB = OB - OA$

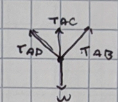
$= 0.5j + zk$

$AC = OC - OA$

$= -0.433i - 0.25j + zk$

$AD = OD - OA$

$= 0.433i - 0.25j + zk$



$$T_{AB} = \frac{AB}{|AB|} \cdot T_{AB}$$

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

$$T_{AC} = \frac{AC}{|AC|} \cdot T_{AC}$$

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

$$T_{AD} = \frac{AD}{|AD|} \cdot T_{AD}$$

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

compile all i values

equilibrium

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

$$\frac{-0.433T_{AC}}{\sqrt{0.25+z^2}} i = \frac{-0.433T_{AD}}{\sqrt{0.25+z^2}} i$$

$T_{AC} = T_{AD}$

compile all j values

$$\frac{0.5T_{AB}}{\sqrt{0.25+z^2}} j - \frac{0.25T_{AC}}{\sqrt{0.25+z^2}} j - \frac{0.25T_{AD}}{\sqrt{0.25+z^2}} i = 0$$

$T_{AC} = T_{AD}$, move to right side

$$\frac{0.5T_{AB}}{\sqrt{0.25+z^2}} i = \frac{0.5T_{AC}}{\sqrt{0.25+z^2}} j$$

$T_{AB} = T_{AC} = T_{AD}$

compile all k terms

$$\frac{zT_{AB}}{\sqrt{0.25+z^2}} k + \frac{zT_{AC}}{\sqrt{0.25+z^2}} k + \frac{zT_{AD}}{\sqrt{0.25+z^2}} k - 981k = 0$$

$$\frac{3zT_{AB}}{\sqrt{0.25+z^2}} = 981$$

$$T_{AB} = \frac{981\sqrt{0.25+z^2}}{3z}$$

$z = 0.6$

$$\frac{981\sqrt{0.25+0.36}}{3(0.6)} = 425.6586$$

$T_{AB} = 425.6586$

∴ The tension in each cable is 425.6586 N each or 400 N ← 1 sig dig