BSSE 23058
Section A
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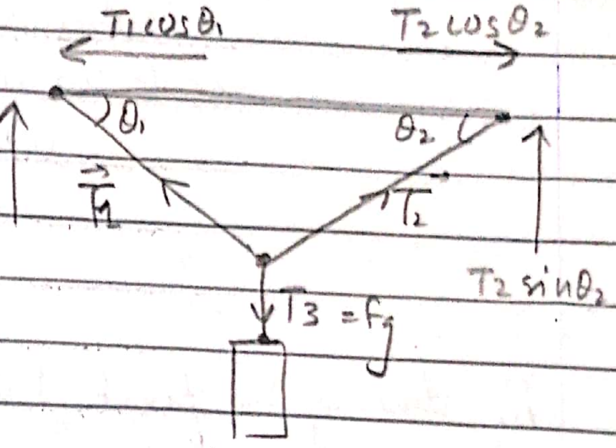
"Applied Physics"
Assignment # 2



Q1

$$T_1 \cos\theta_1 = T_2 \cos\theta_2 \quad \text{--- (1)}$$

$$T_1 \sin\theta_1 + T_2 \sin\theta_2 = T_3$$

$$T_1 \sin\theta_1 + T_2 \sin\theta_2 = F_g \quad \text{--- (2)}$$

$$T_2 = \frac{T_1 \cos\theta_1}{\cos\theta_2}$$

$$T_1 \sin\theta_1 + \left(\frac{T_1 \cos\theta_1}{\cos\theta_2}\right) \sin\theta_2 = F_g$$

$$T_1 \sin\theta_1 \cos\theta_2 + T_1 \cos\theta_1 \sin\theta_2 = F_g \cos\theta_2$$

$$T_1 (\sin\theta_1 \cos\theta_2 + \cos\theta_1 \sin\theta_2) = F_g \cos\theta_2$$

Trig identity $\sin(\theta_1+\theta_2) = \sin\theta_1 \cos\theta_2 + \cos\theta_1 \sin\theta_2$

$$T_1 (\sin(\theta_1+\theta_2)) = F_g \cos\theta_2$$

$$T_1 = \frac{F_g \cos\theta_2}{\sin(\theta_1+\theta_2)}$$

Q2 a. Magnitude of acceleration = ?

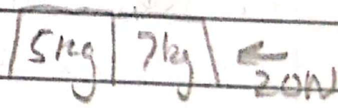
According to Newton's second law

$$F = ma$$

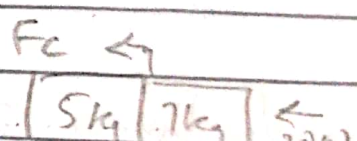
$$20 = (5+7) \times a$$

$$\frac{20}{12} = a$$

$$1.67\,m/s^2 = a$$



b. Magnitude of the contact force = ?



$$F_c = ma$$

$$= 5 \times 1.67$$

$$= 8.35\,N$$

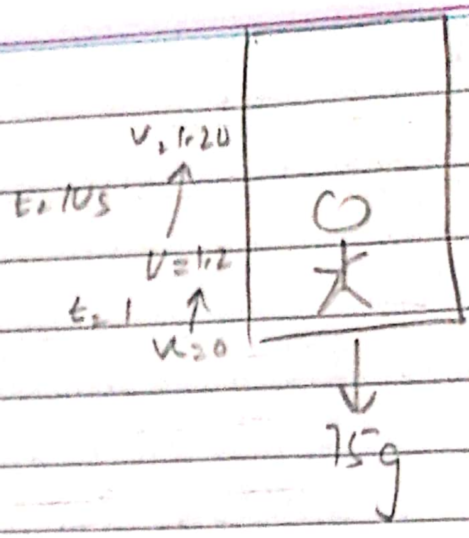
Q3 a. When elevator is at rest.

when $v = 0\,m/s$, the scale reads the mans weight.

$W = mg$

$= 75 \times 10$

$= 750N$



b. during the first 1.0s ?

$u = 0\,m/s$

$v = 1.20\,m/s$

$t = 1.0s$

$a = ?$

$a = \frac{v-u}{t} = \frac{1.20-0}{1}$

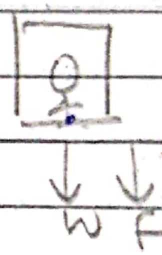
$= 1.20\,m/s^2$

According to Newtons 2nd Law. (Normal force)

(normal) (Net) force acting on the man.

$F = ma$

$= 75 \times 1.20 = 90N$



The scale shows $= F + W$

$= 90 + 750$

$= 840\,N$

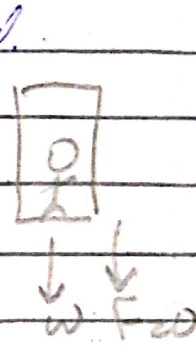
c. When elevator is travelling at constant speed?

$a = 0\,m/s^2$ as elevator is travelling at constant speed.

Scale shows $= F + W$

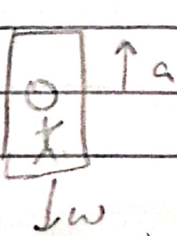
$= 0 + 750$

$= 750N$



d. During the time it is slowing down ?

$a = \frac{0 - 1.20}{1.7} = -0.706\,m/s^2$



The sale shows $= F + W$

$= (-0.706 \times 75) + 750$

$= 697.05$

$\approx 697\ N.$

Q4

Workdone by driving force + K.E Initial + P.E Initial = K.E final + P.E final + Workdone by friction force.

$Fd + \frac{1}{2}mu^2 + mgh_i = \frac{1}{2}m(v)_f^2 + mgh_f + Fd.$

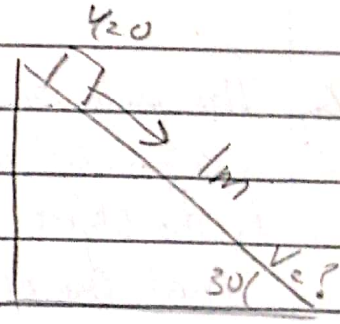
$0 + \frac{1}{2} \times (0)^2 \times 3 + 3 \times 9.81 \times 0.5 = \frac{1}{2} \times 3 \times V^2 + 3 \times 9.81 \times 0 + 5 \times 1$

$0 + 0 + 14.715 = 1.5V_f^2 + 0 + 5$

$\frac{14.715 - 5}{1.5} = V_f^2$

$\sqrt{\frac{14.715 - 5}{1.5}} = V_f$

$2.54\ m/s = V_f$



Q5 $X = -5.0m \sin \boxed{?} t$ $\qquad$ $Y = (4.00m) - (5.00m)\cos \boxed{?} t$

a. $X = -5.0m \sin(wt)$ $\qquad$ $Y = (4.00m) - (5.00m)\cos(wt)$

$V_x = -5.0w\cos(wt)$ $\qquad$ $V_y = 0 - 5.00w \times -\sin wt$

$= +5.0w\sin(wt)$

$V_{x_{t=0}} = -5.0w\cos(w \times 0)$ $\qquad$ $V_{y_{t=0}} = 5.0w\sin(w \times 0)$

$= -5.0w$ $\qquad$ $= 0$

$a_x = -5.0w^2 \times -\sin(wt)$ $\qquad$ $a_y = 5.0w^2\cos(wt)$

$= +5.0w^2\sin(wt)$ $\qquad$ $a_{y_{t=0}} = 5.0w^2\cos(w \times 0)$

$a_{x_{t=0}} = +5.0w^2\sin(w \times 0)$ $\qquad$ $= 5.0w^2$

$= 0$

b. Position vector $P(t)$

$$P(t) = X(t)i + Y(t)j + Z(t)k$$
$$= (5.0\sin wt)i + (4.0 - 5.0\cos wt)j + 0k.$$

Velocity vector $V(t)$

$$V(t) = V_x(t)i + V_y(t)j + V_z(t)k.$$
$$= (-5.0w\cos wt)i + (+5.0w\sin wt)j + 0k.$$

Acceleration vector $a(t)$.

$$a(t) = a_x(t)i + a_y(t)j + a_z(t)k.$$
$$= (+5.0w^2\sin wt)i + (5.0w^2\cos wt)j + 0k.$$

c. The path of an object on the xy graph follows a ~~sinuso~~ sinusoidal path. $X = -5\sin wt$ represents the horizontal position of the object as a function of time (t). The negative sign indicates that the object oscillates horizontally back & forth along the x-axis. The frequency of the graph depends on w. $Y = 4 - 5\cos(wt)$ represents the vertical position. The constant term 4 means that the graph is centred around y-coordinate four. The ~~xy graph~~ Amplitude of both x & Y is 5 units.