Q12:

Given Date

brick = M

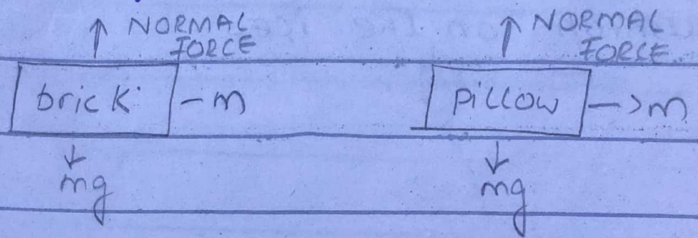
pillow = m

V = 0

TO FIND:-

diagram of brick = ?

diagrem of pillow = ?



(1) Gravitetional force exerted on both by the earth and they also exert force on normal force exerted by the pillow on brick

i) Force: Gravitational force exerted by earth - brick

Reaction force: Gravitetional force exerted by brick on earth

ii) Force: Gravitetional force exerted by the earth on the cushion

Reaction Force: Gravitetional force

exerted by the cushion on the earth

iii) Force: ~~Gravitational~~ normal force exerted by the brick on the cusion

Reaction Force: force exerted by the cushion on the brick

iv) Force: normal force exerted by the ice on the cushion

Reaction Force: force exerted by the cushion on the ice.

Q16

Data

$m = 3\,kg$

$x = 5t^2 - 1$

$y = 3t^2 + 2$

$t = 2s$

$SF = ?$

Sol:

As we know

=> $F = ma$

=> Fist we fird "a" as $x = dx/dt + 10t$

=> $a_x = d^2x/dt = 10\,m/sec^2$

=> $a_y = dy/dt = 9t^2$

=> $a_y = d^2x/dt^2 = 18t\ m/sec^2$

$a_y = 18t$

$\Rightarrow$ $t = 2 \Rightarrow a_y = 18(2) = 36\, m/sec^2$

$F_x = 3(10) \Rightarrow 30N$

$F_y = 3 \times 36 \Rightarrow 108N$

$|F| = \sqrt{(30)^2 + (108)^2}$

$|F| = 112N$

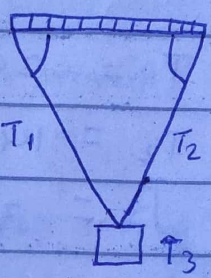
Q20

~~sol.~~ Data

$w = 325N$

$\theta_1 = 60°$

$\theta_2 = 25°$



To find

$T_1, T_2, T_3 = ?$

sol:

As $T_3 = F_g = w = 325N \longrightarrow (i)$

$\Sigma F_x = 0$

$T_{2x} - T_{1x} = 0$

$T_2 \cos 25 - T_1 \cos 60° = 0$

$T_2 = T_1 \left(\frac{\cos 60°}{\cos 25°} \right)$

$T_2 = (0.551) T_1 \quad - (ii)$

now $\quad T_{2y} + T_{1y} - T_3 = 0$

$T_2 \sin 25 + T_1 \sin 60° - 325 = 0$

$T_2 = (0.551) T_1$

$(0.551) T_1 \times (0.422) + T_1 (0.866) = 325$

$T_1 (0.2325 + 0.866) = 325$

$T_1 = 325 / 1.098$

$T_1 = 295 \, N$

now put T_1 in eq (2)

$T_2 = (0.551)(295)$

$\boxed{T_2 = 149.212}$

$\Rightarrow T_1 = 295 N$

$\Rightarrow T_2 = 149.212 N$

$\Rightarrow T_3 = 325 N$

Q21

sol:

show that $T_1 = \dfrac{F_g \cos\theta}{\sin(\theta_1 + \theta_2)}$

to follow above figure

$F_3 = F_g \longrightarrow (i)$

$\Sigma F_y = T_1 \sin\theta_1 + T_2 \sin\theta_2 - T_3 = 0$

$T_3 = T_1 \sin\theta_1 + T_2 \sin\theta_2 \quad \text{---} (ii)$

$\Sigma F_x = -T_1 \cos\theta_1 + T_2 \cos\theta_2$

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

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From eq (i) and (ii)

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

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

$$\overline{\cos\theta_2}$$

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

$$T_1 (\sin(\theta + \theta_2))$$

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

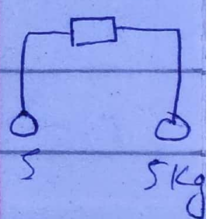
Hence proved

Q23 sol:

a) The force applied to the spring balance in tension of rope

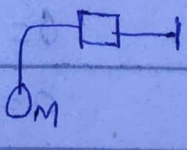
$$T = mg = 5 \times (9.8) \Rightarrow \boxed{49\ N}$$

In first case spring show 49N reading



b) In this case the force will equal applied on both side and T=mg

$$F = mg = 5(9.8) \Rightarrow \boxed{49\ N}$$



c) In this case the force applied in scale is double because of two masses

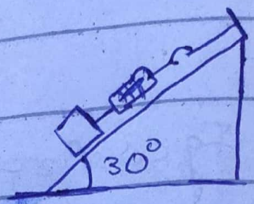
$$F = 2mg \Rightarrow 2 \times 5 \times 9.8 \Rightarrow \boxed{98.1\ N}$$

d) In tho case the force is applied on scale is component of weight of parallel to the inclined plane

$F = mg \sin\theta$

$F = 5 \times 9.8 \sin 30^\circ$

$F = 39.64N$



Q26

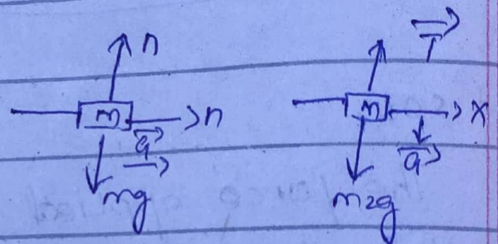
sol: Data

$W_1 = 5.00Kg$

$W_2 = 9.00Kg$

$T = ?$

$a = ?$



solution

Applying Newton law to m_1 in x-direction

$\Sigma F_x = T = m_1 a \Rightarrow T = 5a \rightarrow (i)$

$\Rightarrow T = 9g - 9a \rightarrow (ii)$

$\Rightarrow$ subtract eq (ii) from (i)

$0 = 5a - 9g + 9a$

$a = \frac{9 \times 9.8}{14} = 6.3 m/s^2$

substitute (a) in eq (1)

$T = 5(6.3) = 31.5N$

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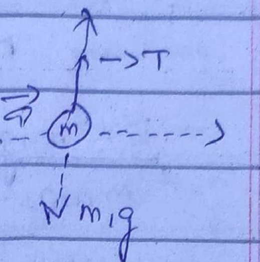
Q28

Data

$m_1 = 2\,kg$

$m_2 = 6\,kg$

$\theta = 55$



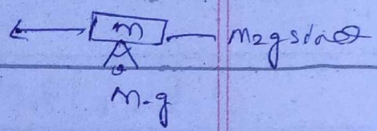
$a = ?$

$T = ?$

$v = ?$

sol. a) $\Sigma F_x = m_2 g \sin\theta - T$

$= m_2 a$



$F - m_1 g = m_1 a$

$$a = \frac{m_2 g \sin\theta - mg}{m_1 + m_2} = 3.57\,m/sec^2$$

b) $T = m_1(a+g) = 26.7N$

c) $v_i = 0$

$v_f = at$

$v_f = (3.57\,m/sec^2)(2.005)$

$v_f = 7.14\,m/sec$

Q31

Data

$m = 8\,kg$

$m = 2\,kg$

$F_x = ?$

$a = ?$

Qu2

a) Free

b) F

sol:

a) $F_{net} = F_x - m_1 g$

$a_{net} = \frac{F_{net}}{m_1 + m_2} = \frac{F_x - m_1 g}{m_1 + m_2}$

$\frac{F_x - m_1 g}{m_1 + m_2} > 0 \Rightarrow F_x > m_1 g \Rightarrow 2(9.8) = 19.6N$

~~putting the value of a into eq~~

b) The tension of the rope is given by

$m_1 a = T - m_1 g$

$T = m_1(g + a) = m\left(g + \frac{F_x - m_1 g}{m_1 + m_2}\right)$

$m_1\left(g + \frac{F_x - m_1 g}{m_1 + m_2}\right) = 0$

$g + \frac{F_x - m_1 g}{m_1 + m_2} = 0$

$m_1 g + m_2 g + F_x - m_1 g = 0$

$F = -m_2 g = -(8.00\,kg)(9.81\,m/s^2) = -78.5N$

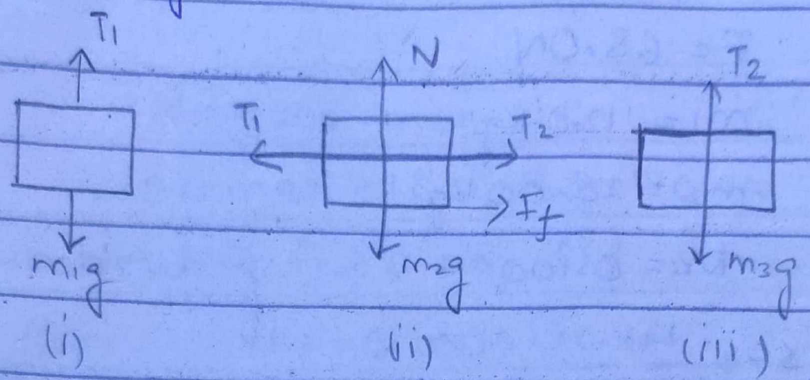
Hence for $F_x = -78.3N$, the tension of the rope will be zero. Here negative sign indicates opposite direction

c) Acceleration is given by

$a_{net} = \frac{F_x - (2.00\,kg)(9.81\,m/s^2)}{(2.00\,kg) + (8.00\,kg)} = (0.1\,kg^{-1})F_x - (1.962\,m/s^2)$

Qu2

a) FREE DIAGRAM ARE:-



b) From The first diagram we have

$m_1 a = m_1 g - T_1$

$(4.00 kg) a = (4.00 kg)(9.81 m/s^2) - T_1$

From the second free diagram we have

$m_2 a = T_1 - T_2 - F_f$

$= T_1 - T_2 - \mu m g$

$(1.00 kg) a = T_1 - T_2 - (0.350)(1.00 kg)(9.81 m/s^2)$

AND From the third free body diagram we have

$m_3 a = T_2 - m_3 g$

$(2.00 kg) a = T_2 - (2.00 kg)(9.8 m/s^2)$

Now solving eq (1), (2), (3) we have

$a = 2.31 m/s^2$, $T_1 = 30.0 N$, $T_2 = 24.2 N$

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Q43

Data

$F = 68.0N$

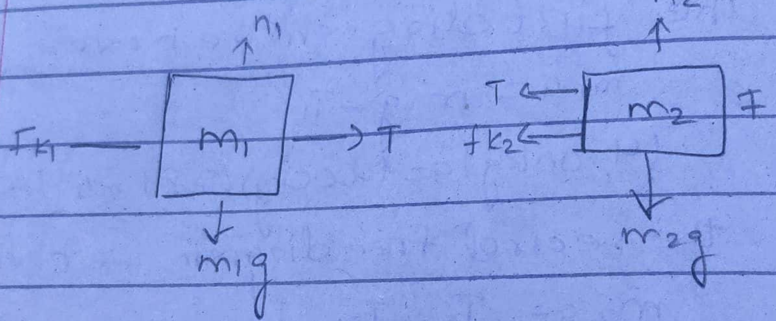
$m_1 = 12.0\ kg$

$m_2 = 18.00\ kg$

$N_k = 0.100$

so

$f_k = N_k n$ —— (i)



By Applying Newton's second law on the m_1

$\Sigma F_y = n_1 - m_1 g = 0$

$n_1 = m_1 g = 12.0 \times 9.8 = 117.0N$

substituting into eq (i) we get

$f_{k1} = 0.100 \times 117.0 = 11.76N$

For the Horizontal direction

$\Sigma F_x = T - f_{k1} = m_1 a$

$T = m_1 a + f_k$

$T = 12.0a + 11.76$ —— (ii)

Now apply Newton second law
For the verticle direction

$$\sum F_y = n_2 - m_2 g = 0$$

$$n_2 = m_2 g = 18.0 \times 9.8 = 176.4N$$

substituting into eq (i)

$$f_{k2} = 0.100 \times 176.4 = 17.64N$$

For the horizontal direction, we have

$$\sum F_x = F - T - f_{k2} = m_2 a$$

$$T = F - m_2 a - f_k = 68.0 - 18.0a - 17.64$$

$$T = 50.36 - 18.0a \rightarrow (iii)$$

a) Equating (2) & (3) we get

$$12.0a + 11.76 = 50.36 - 18.0a$$

$$a = \frac{50.36 - 11.76}{12 + 18} = 1.29$$

$$\boxed{a = 1.29 m/s^2}$$

substituting the value of a into eq (3) we get

$$T = 50.36 - (18.0 \times 1.29) = 27.2N$$

$$\boxed{T = 27.2N}$$

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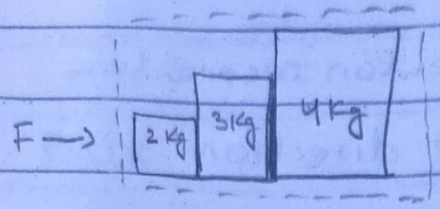
Q54



Three blocks can be assumed to form a system of combined mass 9 kg

Also the surfaces of blocks must stay in contact with eachother

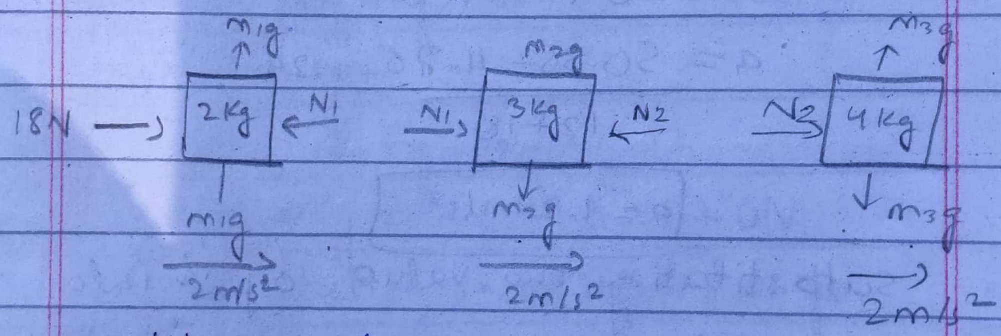
∴ All blocks move with same acceleration

$F = ma$

$18 = 9a$

$a = 2 m/s^2$

DRAWING F.B.D FOR ALL BLOCKS



writing equations

$18 - N_1 = (2)(2)$ $N_1 - N_2 = 3(2)$ $N_2 = 4(2)$

∴ $N_1 = 14N$ $N_2 = 8N$

↳ contact force   ↳ contact force

Resultant Force = 4N rightwards	Resultant Force = 6N rightwards	Resultant Force = 8N rightwards

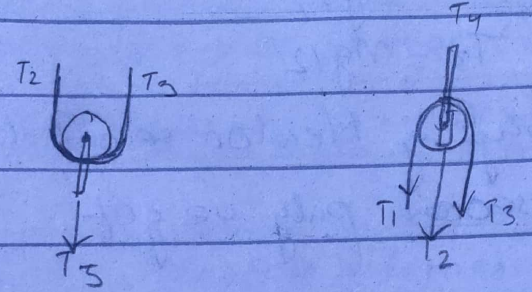
d) As inthe above problem wecan see that contact force decreases aswe add more blocks

The decrease in force lessens thestinging effect.

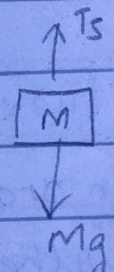
This decrease is a result of "net increase" in the mass of system onwhich the force is being applied.

QS7

a)



b) Applying Newton second law to the block we get



$$\Sigma F_y = T_5 - Mg = 0$$

$$T_5 = Mg$$

Now we apply Newton second law to the pully holding ~~to~~ the block so we get

$$\Sigma F_y = T_2 + T_3 - T_5 = 0$$

$$T_2 + T_3 = T_5 = Mg$$

$$\Sigma F_y = T_2 + T_3 - T_5 = 0$$
$$T_2 + T_3 = T_5 = Mg$$

Since the rope and the pullies have negligble mass then the tension along the rope is uniform so we have

$$T_1 = T_2 = T_3$$
$$T_2 + T_3 = 2T_2 = Mg$$
$$T_2 = Mg/2$$
$$T_1 = Mg/2$$
$$T_3 = Mg/2$$

Now applying Newton second law to the second pully we get

$$\Sigma F_y = T_4 - T_1 - T_2 - T_3 = 0$$
$$T_4 = T_1 + T_2 + T_3 = 3T_1$$
$$T_4 = 3/2\, Mg$$

c) In order for the system to stay without moving or moving with a constant speed we have

$$F = T_1$$
$$F = Mg/2$$

Q01

Ans we know that when an object is about to move, its friction force is maximum and its magnitude is given by

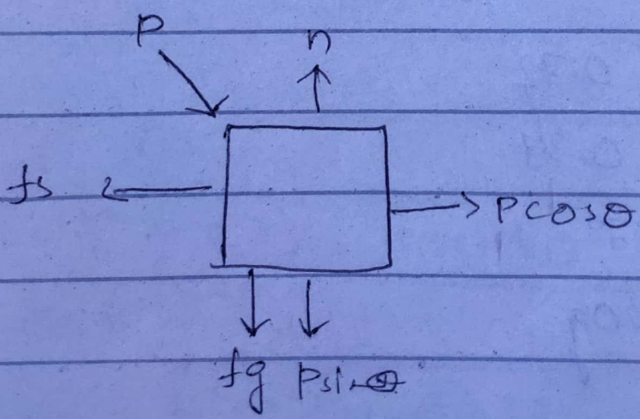
$$f_{s\,max} = \mu_s n \longrightarrow (i)$$

where n is the normal force
so inorder for the block to move the horizontal force acting on it must be equal to or larger than the maximum static force so we have

$$P\cos\theta \geq f_{s\,max}$$

$$P \geq \frac{f_{s\,max}}{\cos\theta}$$

$$P_{min} = \frac{f_{s\,max}}{\cos\theta} \longrightarrow (ii)$$



sol: Applying Newton second law to the block in the verticle direction

we get: $\Sigma F_y = n - F_g - P_{min} \sin\theta$

$n = F_g + P_{min} \sin\theta$

substituting eq (1) we get

$f_{s\,max} = \mu_s \left(F_g + P_{min} \cos\theta \right)$

Now we substitute into eq (2)

$$P_{min} = \frac{\mu_s \left(F_g + P_{min} \cos\theta \right)}{\cos\theta}$$

$$P_{min} = \mu_s F_g \sec\theta + P_{min} \tan\theta$$

$$P_{min} (1 - \tan\theta) = \mu_s F_g \sec\theta$$

$$\boxed{P_{min} = \frac{\mu_s F_g \sec\theta}{1 - \tan\theta}}$$

Q45

Given

$\mu_s = 0.72$

$\mu_k = 0.34$

$\theta = 37^\circ$

$m = 420g$

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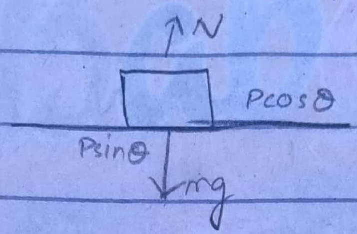
FIND:

Acc=?

P=5N , acceleration, friction=?

P=10N , acceleration =

Acceleration depend on p=?



a) Apply Newton Law

$N = Mg + P\sin 37$

$n = 4.212 + p\sin 37$

with motion impeding we read the equality

$f_s = Nn$

$= 0.72\ (4.12 + p\sin 37)$

$= 2.96N + 0.433P$

$\Sigma F_x = ma_x$

$P\cos 37^\circ - f = 0$

$P\cos 37 - 2.96N - 0.433P = 0$

$P = 8.11N$

$f_x = Nn = 0.34\ (14.12N + P\sin 37)$

$= 1.40N + 0.205P$

$\Sigma F_x = ma_x$

$p\cos 37^\circ - f = 0.42\ kg\ a$

$$a = \frac{p\cos 37^\circ - 1.4 - 0.205P}{0.42}$$

$a = 141p - 3.33$

b) Since 5N is less then 8.11N

c) $f_s \leq N_{sn}$

$5N \cos 37 = 3.99$

friction force = 3.99N

d) $a = 1.41(10) - 3.33$

$= 10.8 m/s^2$ to the right

e) From pont (a)

$f - 1.40 + 0.205(10)$

3.45N to the left