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P20-0750

Assignment: 4

# Question 16

$m = 3kg$

$t = 2.5\ s$

$x = 5t^2 - 1$

$y = 3t^2 + 2$

**Sol:-**

$$a_x = \frac{d^2x}{dt^2} = \frac{d^2(5t^2 - 1)}{dt^2}$$

$$\boxed{a_x = 10m/s^2}$$

$$a_y = \frac{d^2y}{dt^2} = \frac{d^2(3t^2 + 2)}{dt^2}$$

$$\boxed{a_y = 36m/s^2}$$

By Newton's 2nd Law

$$\Sigma F_x = ma_x = 3kg \cdot 10ms^{-2} = \boxed{30N}$$

$$\Sigma F_y = ma_y = 3kg \cdot 36ms^{-2} = \boxed{108N}$$

**by Pythagorious theorm**

$$F = \sqrt{(\Sigma F_x)^2 + (\Sigma F_y)^2}$$

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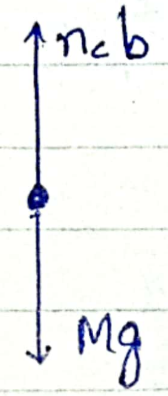
$F = \sqrt{(30)^2 + (108)^2}$

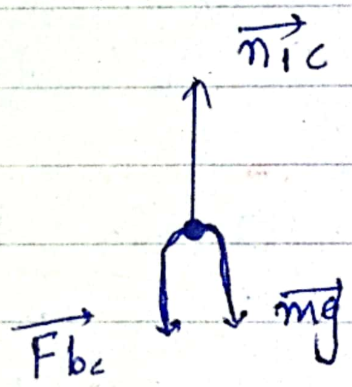
$\boxed{F = 112\ N}$

## Question : 12

a) brick




b) Cohion




c)

1: **Force:** Gravitational force exerted by earth on brick.

**Reaction force:** Gravitational force exerted by brick on earth.

2: **Force:** Gravitational force exerted by earth on Cohion.

**Reaction force:** Gravitational force exerted by Cohion on earth.

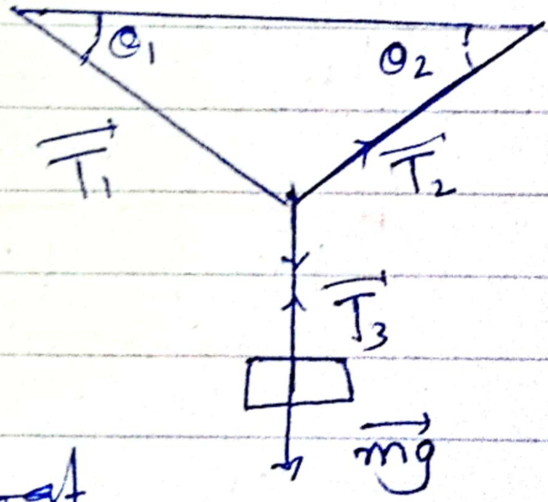
3: **Force**: Normal force exerted by the brick on Cahion.

**Reaction force:** Force exerted by the cahian on the brick.

4: **Force**: Normal force exerted by the brick on the cahion.

**Reaction force:** Force exerted by the Cahion on the brick.

## Question: 20




$mg = 325N$

$\theta_1 = 60°$

$\theta_2 = 25°$

we know that

$T_3 - mg = 0 \Rightarrow T_3 = mg = 325N \rightarrow (i)$

$-T_1 \cos\theta_1 + T_2 \cos\theta_2 = 0 \rightarrow (ii)$

$T_1 \sin\theta_1 + T_2 \sin\theta_2 - T_3 \longrightarrow (iii)$

put $T_3$ in eq (iii)

$T_1 \sin\theta_1 + T_2 \sin\theta_2 - mg = 0$

and

$$T_1 \cos\theta_1 = T_2 \cos\theta_2$$

$$T_1 \sin\theta_1 = mg - T_2 \sin\theta_2$$

$$\tan\theta_1 = \frac{mg - T_2 \sin\theta_2}{T_2 \cos\theta_2}$$

$$T_2 \cos\theta_2 \tan\theta_1 = mg - T_2 \sin\theta_2$$

$$T_2 (\cos\theta_2 \tan\theta_1 + \sin\theta_2) = mg$$

$$T_2 = \frac{mg}{\cos\theta_2 \tan\theta_1 + \sin\theta_2}$$

$$\boxed{T_2 = 163 N}$$

$$T_1 \cos\theta_1 = T_2 \cos\theta_2$$

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

$$\boxed{T_1 = 296 N}$$

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## Question: 21

$$\Sigma F_{y_1} = T_3 - F_g = 0$$

$$T_3 = F_g \longrightarrow (i)$$

$$\Sigma F_{y_2} = T_1 \sin\theta_1 + T_2 \sin\theta_2 - T_3 = 0$$

$$T_1 \sin\theta_1 + T_2 \sin\theta_2 = T_3 \rightarrow (ii)$$

$$\Sigma F_x = T_2 \cos\theta_2 - T_1 \cos\theta_1 = 0$$

$$T_2 = \frac{T_1 \cos\theta_1}{T_2 \cos\theta_2} \longrightarrow (iii)$$

from (i) and (ii)

$$F_g = T_1 \sin\theta_1 + T_2 \sin\theta_2 \rightarrow (iv)$$

from (iii) and (iv)

$$F_g = T_1 \sin\theta_1 + \frac{T_1 \cos\theta_1}{\cancel{T_2} \cos\theta_2} \sin\theta_2$$

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

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

$\because \sin\theta_1 \cos\theta_2 + \cos\theta_1 \sin\theta_2 = \sin(\theta_1 + \theta_2)$

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

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

**Question : 23**

a) The force applied to the Spring balance is the tension of the force

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

b) Force balance by reaction of wall

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

c) Force of the Scale is balanced by the reaction is equal to weight of two block.

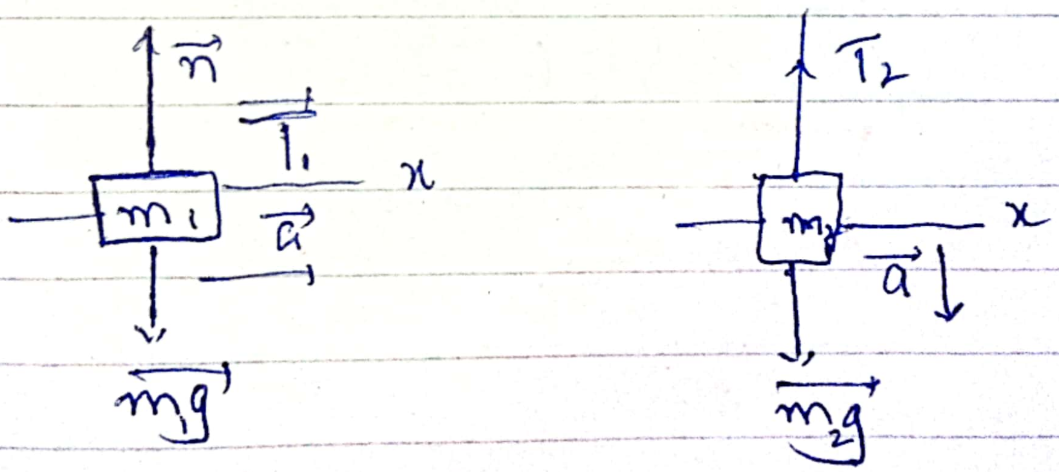
$$F = 2mg$$

$$= 2(5) \times (9.8) = \boxed{98N}$$

d) force on the scale is the component of weight parallel to initial plane.

$$F = mg\sin\theta$$
$$= 5 \times 9.8 \sin\theta$$
$$= 5 \times 9.8 \sin 30°$$
$$\boxed{F = 24.5\ N}$$

## Question: 26




Now, by applying 2nd Law to m1

$$\Sigma F_x - T = ma$$
$$T = 5a \longrightarrow (i)$$

Apply 2nd Law to $m_2$

$$\Sigma F_y = m_2 g - T = m_2 a$$

$$T = 9g - 9a \longrightarrow (\text{ii})$$

Subtract (ii) from (i)

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

$$a = \frac{9 \times 9.8}{14} = 6.3$$

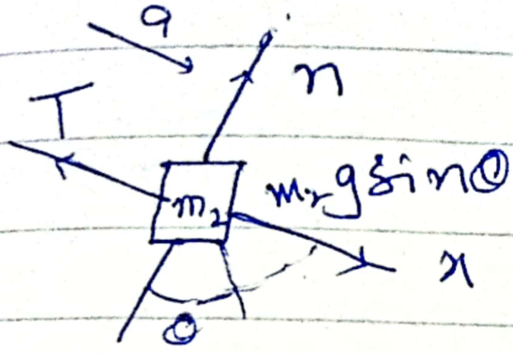
Substitute value of a in (i)

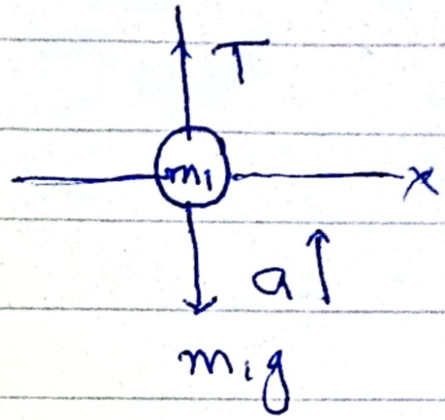
$$T = 5(6.3)$$

$$\boxed{T = 31.5 N}$$

Question : 28

a)




b) Apply Newtons 2nd law to $m_1$ in the vertical:

$$\Sigma F_y = T - m_2 g = m_1 a$$

$$T = m_1 a + m_2 g \quad \text{—— (i)}$$

now, on $m_2$ in the horizontal

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

substituting value of T

$$m_2 g \sin\theta \, m_1 a - m_1 g = m_2 a$$

$$(m_1 + m_2) a = m_2 g \sin\theta - m_1 g$$

Solving for "a"

$$a = \frac{m_2 g \sin\theta - m_1 g}{m_1 + m_2}$$

$$a = \frac{(6 \times 9.8 \sin 25^\circ) - 2 \times 9.8}{2 + 6}$$

$$\boxed{a = 3.57\ m/s^2}$$

c) from eq (i):

$$T_1 = m_1 a + m_1 g = m_1 (a + g)$$

$$= 2(3.57 + 9.8)$$

$$= \boxed{26.7\ N}$$

d) As "a" is constant

So;

$$v_f = v_i + at$$

$$v_f = 0 + 3.57 \times 2$$

$$\boxed{v_f = 7.14\ m/s}$$

## Question: 31

Sol:.

The net of the system is:

$$F_{net} = F_x - m_2 g$$

Acceleration of system is given by

$$a_x = \frac{F_{net}}{m_1 + m_2}$$

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

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

$$\Rightarrow F_x = m_2 g = 2 \times 9.8 = \boxed{19.6\,N}$$

The mass will accelerate upward to

$F_x > 19.6\,N$

b) The tension of the rope.

$$m_1 a = T - m_1 g$$

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

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

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

$$F_x = (-8)(9.8)$$

$$\boxed{F_x = -78.\,N}$$

→ The tension of rope will zero.

The acceleration of system.

$$a_{net} = \frac{F_x - 2 \times 9.81}{2 \times 98}$$

$$a_{net} = (0.1\ kg^{-1})F_x - (1.692\ m/s^2).$$

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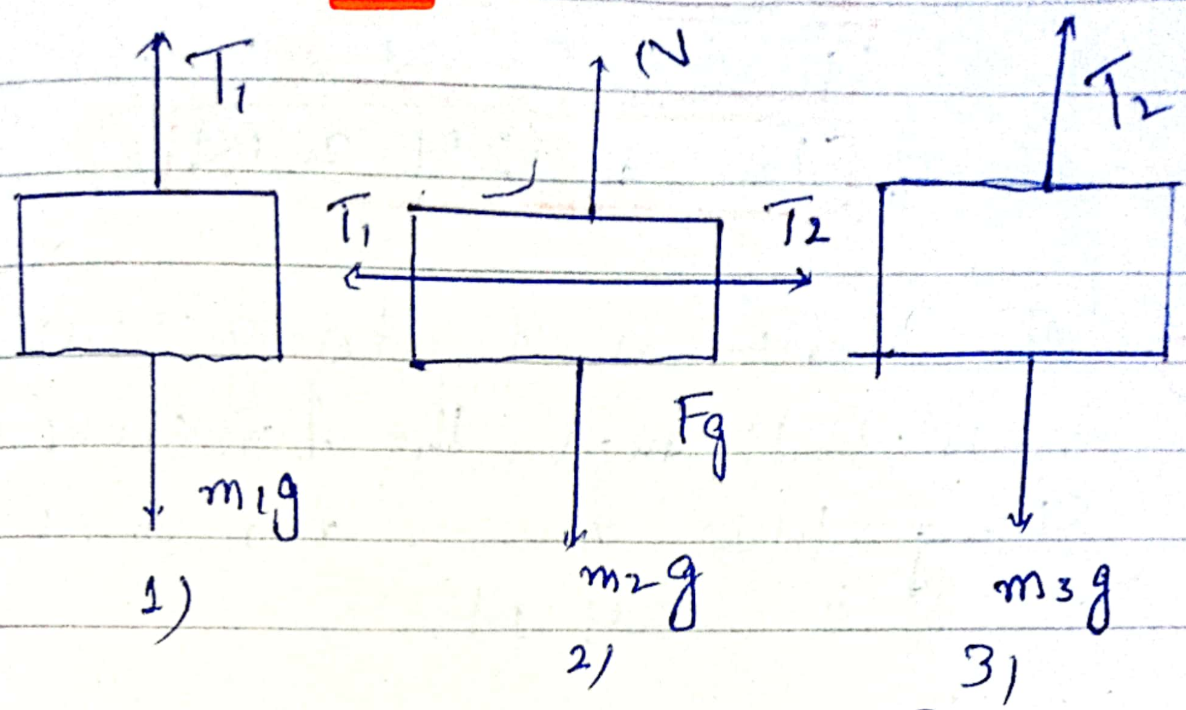
# Question: 42




from the 1st diagram we have

$$m_1 a = m_1 g - T_1$$

$$4 \cdot a = 4 \times 9.8 - T_1 \longrightarrow (i)$$

from 2nd diagram,

$$m_2 a = T_1 - T_2 - F_g$$

$$= T_1 - T_2 - \mu m g$$

$$(1.00\,kg)\, a = T_1 - T_2 - (0.35)(1)(9.8) \longrightarrow (ii)$$

from 3rd:

$$m_3 g = T_2 - m_3 g$$

$$(2.00\,kg)\, a = T_2 - 12.00\,kg \times 9.8 \longrightarrow (iii)$$

by solving (i), (ii) and (iii)

$$\boxed{a = 2.31\ m/s^2}$$
$$\boxed{T_1 = 30\ N}$$
$$\boxed{T_2 = 24.2\ N}$$

c) The tension of string b/w $m_1$ and $m_2$ is 30 N and the tension of the string b/w masses $m_2$ and $m_3$ is 24 N.

d) System is moving towards left. since the table surface is not smooth, a friction force acting towards right, because of the friction. the tension $m_1$ and $m_2$ increases and the tension of $m_2$ and $m_3$ decreases hence if is smooth then b/w $m_1$ and $m_2$ have decreased and the tension between $m_2$ and $m_3$ would increased.