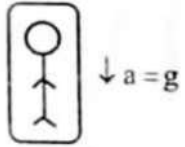


# Weight of a body is zero, where 'g'?

## Dynamics

### నిన్నటి తరువాయి

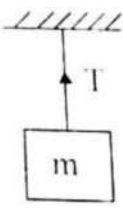
Case IV :When the lift is falling freely (i.e., $a=g$ ), apparent weight of the man =  $m(g - g) = 0$ .



i.e., Apparent weight becomes equal to zero.

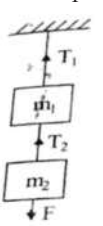
Note :

- When break force is applied for a while it is going up, the apparent weight of the man in a lift decreases. If the lift is moving down the apparent weight of the man in the lift increases.
- Apparent weight of a body in an orbiting satellite is zero.
- A body of mass 'm' is suspended vertically from a rigid support with the help of string as shown in figure.



- The tension in the string,  $T = mg$
- If the string is pulled upwards with an acceleration 'a' then tension in the string,  $T = m(g + a)$ .
- If the string is lowered down with an acceleration 'a' then tension in the string,  $T = m(g - a)$
- If the string goes down with an acceleration 'g' then tension in the string  $T = 0$ .

- Two blocks of masses  $m_1$  and  $m_2$  are suspended vertically from a rigid support with the help of a Strings as shown in figure. The mass  $m_2$  is pulled down with a force F.
- The tension between the masses  $m_1$  and  $m_2$  will be  $T_2 = F + m_2g$ .
- Tension between the rigid support and mass  $m_1$  will be  $T_1 = F + (m_1 + m_2)g$ .



Mass and weight of a body : The mass of a body is an

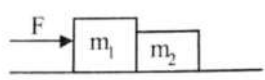
## PHYSICS

### IIT/NEET Foundation

intrinsic property of the body which measures inertia of the body whereas the weight of a body is the force with it is attracted by the earth towards its centre.

- Mass is a scalar quantity. Weight is a vector quantity. Weight of body is 'mg'.
- The mass remains same at all points. But weight depending upon 'g' varies from place to place.
- The mass of body is measured with a common balance whereas the body weight is measured by a spring balance.
- Weight of a body is zero where  $g = 0$ .
- Weight of body is maximum where 'g' is maximum.
- If mass is measured as  $m = \frac{F}{a}$ , the mass is called Inertial mass.
- If mass is measured as  $m = \left(\frac{W}{g}\right)$ , the mass is called gravitational mass.
- Inertial and gravitational masses are equal.

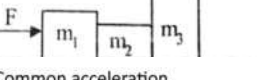
#### Two bodies in contact :



- Acceleration of both the blocks,  $a = \left[\frac{F}{m_1+m_2}\right]$
- If 'f' is the constant force between  $m_2$  and  $m_1$  then  $f = \frac{m_2 F}{m_1+m_2}$ .
- If applied force F acts on  $m_2$  then  $f = \frac{m_1 F}{m_1+m_2}$ .

#### Three bodies in contact : Case - I :

If force F acts on a body of mass  $m_1$  then



- Common acceleration,  $a = \frac{F}{m_1+m_2+m_3}$
- If 'f' is the contact force between  $m_2$  and  $m_1$  then  $f = \frac{(m_2+m_1)F}{m_1+m_2+m_3}$ .
- If  $f^1$  is the contact force between  $m_3$  and  $m_2$  then  $f^1 = \frac{m_3 F}{m_1+m_2+m_3}$ .

#### Case-II :

If the force F acts on body of mass  $m_3$  and  $m_2$  then

- Common acceleration,  $a = \frac{F}{m_1+m_2+m_3}$
- If f is the contact force between  $m_2$

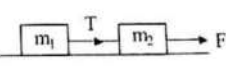


and  $m_3$  then  $f = \frac{(m_2+m_1)F}{m_1+m_2+m_3}$

c) If  $f^1$  is the contact force between  $m_1$  and  $m_2$  then  $f^1 = \frac{m_2 F}{m_1+m_2+m_3}$ .

Connecting bodies : Case - (i) : Two bodies of masses  $m_1, m_2$  are connected by tight string and lying on a smooth horizontal surface,  $m_2$  is pulled forward by a force F.

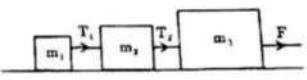
i) The common acceleration,  $a = \frac{F}{m_1+m_2}$



ii) Tension,  $T = \frac{m_1 F}{m_1+m_2}$ .

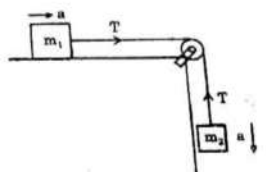
Case - II : Three blocks of masses  $m_1, m_2, m_3$  are connected by tight string and lying on a smooth horizontal surface,  $m_3$  is pulled forward by a force F.

i) The common acceleration,  $a = \frac{F}{m_1+m_2+m_3}$



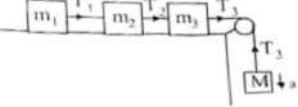
ii) Tension,  $T_1 = \frac{m_1 F}{(m_1+m_2+m_3)}$   
 iii) Tension,  $T_2 = \frac{(m_1+m_2)F}{(m_1+m_2+m_3)}$ .

Motion of bodies connected by string passing over a pulley : A block of mass  $m_1$  tied to another block of mass  $m_2$  by light string passing over a pulley.  $m_2$  is hanging freely and  $m_1$  is on horizontal surface.



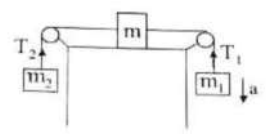
- The acceleration of system,  $a = \frac{m_2 g}{m_1+m_2}$
- Tension  $T = \frac{m_1 m_2 g}{(m_1+m_2)}$
- Thrust on pulley =  $\sqrt{2}T$

#### Case II :



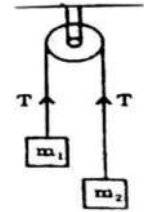
- The acceleration of system,  $a = \frac{Mg}{(m_1+m_2+m_3+M)}$
- Tension,  $T_1 = \frac{m_1 Mg}{(m_1+m_2+m_3+M)}$
- Tension  $T_2 = \frac{(m_1+m_2)Mg}{(m_1+m_2+m_3+M)}$
- Tension  $T_3 = \frac{(m_1+m_2+m_3)Mg}{(m_1+m_2+m_3+M)}$

#### Case III :



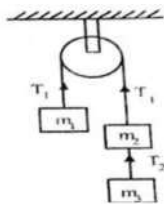
- The acceleration of system,  $a = \frac{(m_2-m_1)g}{(m_1+m_2+M)}$
- Tension  $T_1 = \frac{m_1 g(2m_2+M)}{(m_1+m_2+M)}$
- Tension  $T_2 = \frac{m_2 g(2m_2+M)}{(m_1+m_2+M)}$

At wood's Machine : Two bodies of masses  $m_1$  and  $m_2$  ( $m_2 > m_1$ ) are connected by light inextensible string passing over a mass less pulley.



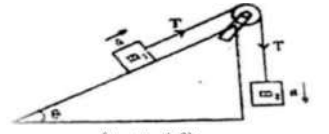
- Acceleration of the system,  $a = \frac{(m_2-m_1)g}{(m_1+m_2)}$
- Tension,  $T = \frac{2m_1 m_2 g}{(m_1+m_2)}$
- Thrust on pulley =  $2T = \frac{4m_1 m_2 g}{(m_1+m_2)}$
- If pulley accelerates up then  $a^1 = \frac{(m_2-m_1)(g+a)}{(m_1+m_2)}$  and  $T^1 = \frac{2m_1 m_2 (g+a)}{(m_1+m_2)}$

- Three bodies of masses  $m_1, m_2$  and  $m_3$  are connected by light inextensible string passing over a mass less as shown in fig.



- Acceleration of system,  $a = \frac{(m_2+m_1-m_3)g}{(m_1+m_2+m_3)}$
- Tension  $T_1 = m_1(a+g)$
- Tension  $T_2 = \frac{2m_1 m_3 g}{(m_1+m_2+m_3)}$

Two bodies of masses  $m_1$  and  $m_2$  are connected by a string passing over pulley.



- $a = \frac{(m_2-m_1 \sin \theta)g}{(m_1+m_2)}$
- Tension in the string is  $T = m_2(g-a)$
- Thrust on pulley  $= \sqrt{T^2 + T^2 + 2T^2 \cos(90-\theta)} = \sqrt{2T^2(1+\sin \theta)}$

- A block of mass M is pulled by a rope of mass m by a force F on a smooth horizontal plane.

- Acceleration of the block,  $a = \frac{F}{(M+m)}$
- Force exerted by the rope on the block =  $\frac{MF}{(M+m)}$

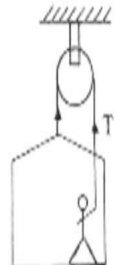
#### Examples :

- Two masses  $m_1$  and  $m_2$  are connected by light string passing over a smooth pulley. When set free  $m_1$  moves downwards by 1.4m in 2s then find the ratio between  $m_1$  and  $m_2$ .

Sol :  $a = \left[\frac{m_1-m_2}{m_1+m_2}\right]g$   
 We know that,  $s = \frac{1}{2}at^2$   
 $1.4 = \frac{1}{2} \left[\frac{m_1-m_2}{m_1+m_2}\right] \times 9.8 \times (2)^2$   
 $\therefore \frac{m_1}{m_2} = \frac{15}{13}$

- A painter in a crate which hangs from a pulley. Mass of the painter is 100kg. when he pulls the rope, the force exerted by him on the floor of the crate is 450N. If the crate weight 25kg then find acceleration of the rope. ( $g = 10 \text{ m/s}^2$ )

Sol : For the painter



$T + 450 - 100 = 100 a$   
 $\therefore T - 550 = 110 a \dots\dots(1)$

For the crate system,  
 $2T - 125g = 125 a \dots\dots(2)$   
 From (1) and (2) Eq. s;  $a = 2 \text{ms}^{-2}$

**Varaprasad**  
 Founder/CEO  
 The Scholar-Edu-tech  
 for IIT/NEET  
 Foundation  
 6309824365