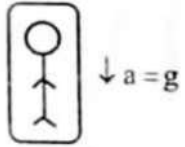


Weight of a body is zero, where 'g'?

Dynamics

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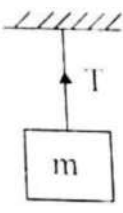
Case IV :When the lift is falling freely (i.e.,a=g), apparent weight of the man = m (g - g) = 0.



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

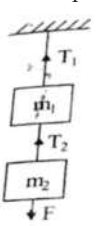
Note :

- 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 m1 and m2 are suspended vertically from a rigid support with the help of a Strings as shown in figure. The mass m2 is pulled down with a force F.
- The tension between the masses m1 and m2 will be T2 = F + m2g.
- Tension between the rigid support and mass m1 will be T1 = F + (m1 + m2)g.



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

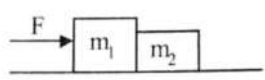
PHYSICS

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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.

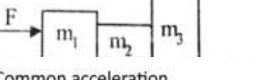
Two bodies in contact :



- Acceleration of both the blocks, $a = \left[\frac{F}{m_1+m_2}\right]$
- If 'f' is the constant force between m2 and m1 then $f = \frac{m_2 F}{m_1+m_2}$.
- If applied force F acts on m2 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 m1 then



- Common acceleration, $a = \frac{F}{m_1+m_2+m_3}$
- If 'f' is the contact force between m2 and m1 then $f = \frac{(m_2+m_1)F}{m_1+m_2+m_3}$.
- If f1 is the contact force between m3 and m2 then $f^1 = \frac{m_3 F}{m_1+m_2+m_3}$.

Case-II :

If the force F acts on body of mass m3 and m2 then

- Common acceleration, $a = \frac{F}{m_1+m_2+m_3}$
- If f is the contact force between m2

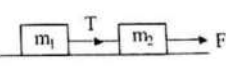


and m3 then $f = \frac{(m_2+m_1)F}{m_1+m_2+m_3}$

c) If f1 is the contact force between m1 and m2 then $f^1 = \frac{m_3 F}{m_1+m_2+m_3}$

Connecting bodies : Case - (i) : Two bodies of masses m1, m2 are connected by tight string and lying on a smooth horizontal surface, m2 is pulled forward by a force F.

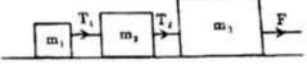
i) The common acceleration, $a = \frac{F}{m_1+m_2}$



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

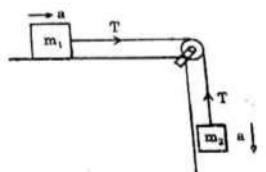
Case - II : Three blocks of masses m1, m2, m3 are connected by tight string and lying on a smooth horizontal surface, m3 is pulled forward by a force F.

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



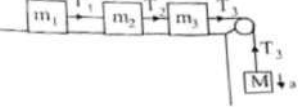
ii) Tension, $T_1 = \frac{m_1 F}{(m_1+m_2+m_3)}$
 iii) Tension, $T_2 = \frac{(m_1+m_2)F}{(m_1+m_2+m_3)}$

Motion of bodies connected by string passing over a pulley : A block of mass m1 tied to another block of mass m2 by light string passing over a pulley. m2 is hanging freely and m1 is on horizontal surface.



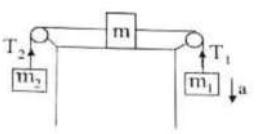
- The acceleration of system, $a = \frac{m_2 g}{m_1+m_2}$
- Tension $T = \frac{m_1 m_2 g}{(m_1+m_2)}$
- Thrust on pulley = $\sqrt{2}T$

Case II :



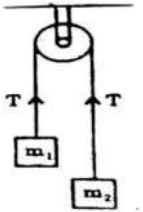
- The acceleration of system, $a = \frac{Mg}{(m_1+m_2+m_3+M)}$
- Tension, $T_1 = \frac{m_1 Mg}{(m_1+m_2+m_3+M)}$
- Tension $T_2 = \frac{(m_1+m_2)Mg}{(m_1+m_2+m_3+M)}$
- Tension $T_3 = \frac{(m_1+m_2+m_3)Mg}{(m_1+m_2+m_3+M)}$

Case III :



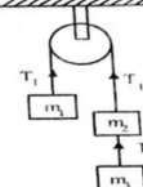
- The acceleration of system, $a = \frac{(m_2-m_1)g}{(m_1+m_2+M)}$
- Tension $T_1 = \frac{m_1 g(2m_2+M)}{(m_1+m_2+M)}$
- Tension $T_2 = \frac{m_2 g(2m_2+M)}{(m_1+m_2+M)}$

At wood's Machine : Two bodies of masses m1 and m2 (m2 > m1) are connected by light inextensible string passing over a mass less pulley.



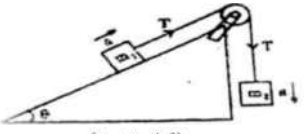
- Acceleration of the system, $a = \frac{(m_2-m_1)g}{(m_1+m_2)}$
- Tension, $T = \frac{2m_1 m_2 g}{(m_1+m_2)}$
- Thrust on pulley = $2T = \frac{4m_1 m_2 g}{(m_1+m_2)}$
- If pulley accelerates up then $a^1 = \frac{(m_2-m_1)(g+a)}{(m_1+m_2)}$ and $T^1 = \frac{2m_1 m_2 (g+a)}{(m_1+m_2)}$

- Three bodies of masses m1, m2 and m3 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 m1 and m2 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.

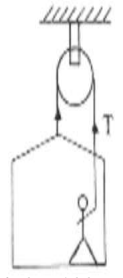
- Acceleration of the block, $a = \frac{F}{(M+m)}$
- Force exerted by the rope on the block = $\frac{MF}{(M+m)}$

Examples :

- Two masses m1 and m2 are connected by light string passing over a smooth pulley. When set free m1 moves downwards by 1.4m in 2s then find the ratio between m1 and m2.

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 m/s²)



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 = 2ms⁻²

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