

Physics 12 Equilibrium

1. Statics is the study of forces in equilibrium.
2. Objects can be in translational equilibrium and/or rotational equilibrium.
3. Translational equilibrium results when $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$.
4. Rotational equilibrium results when the $\Sigma \text{torques} = 0$.
7. Torque is the product of force applied along a lever arm (distance).

$$T = F \times d$$

6. When $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$, and $\Sigma \text{torques} = 0$, then the condition of static equilibrium exists.

Example:

A 90kg person stands on a scale and tries to pull himself up off the scale. The person is unable to pull himself off the scale but the scale reading decreases down to 23kg. What force is he exerting?

$$\Sigma F_y = 0$$

$$F_p + F_s - F_g = 0$$

$$F_p = -F_s + F_g$$

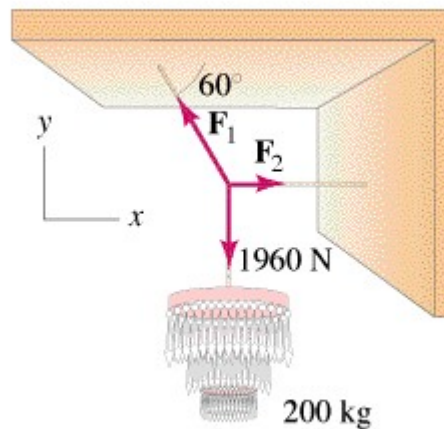
$$F_p = F_g - F_s$$

$$F_p = mg - m_s g$$

$$F_p = 90 \times 9.8 - 23 \times 9.8$$

$$F_p = 660 \text{ N}$$

Example:



A chandelier hangs from the ceiling on two cords. Calculate the tension in the two cords (F_1 and F_2).

$$\Sigma F_x = 0$$

$$\Sigma F_x = F_2 - F_1 \cos 60^\circ = 0$$

$$\Sigma F_y = 0$$

$$\Sigma F_y = F_1 \sin 60^\circ - mg = 0$$

$$F_2 = F_1 \cos 60^\circ \quad \text{from } \Sigma f_x = 0$$

$$F_1 = 200 \times 9.8 / \sin 60^\circ = 2260\text{N} \quad \text{from } \Sigma f_y = 0$$

combine the above two

$$F_2 = \frac{200 \times 9.8 \times \cos 60^\circ}{\sin 60^\circ}$$

1130N

7. Torque is Force x lever arm distance. The force and lever arm must be 90° .

8. Torques can be clockwise (-) or counter clockwise (+).

Example:

A 2.0kg board serves as a seesaw for two children. One child has a mass of 30 kg and sits 2.5m from the pivot point. At what distance from the pivot must a 25 kg child sit in order to balance the seesaw?