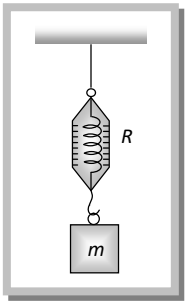
Spring Balance and Physical Balance.

(1) **Spring balance:** When its upper end is fixed with rigid support and body of mass m hung from its lower end. Spring is stretched and the weight of the body can be measured by the reading of spring balance $R = W = mg$

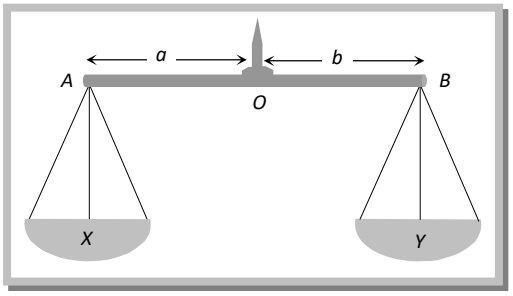


The mechanism of weighing machine is same as that of spring balance.

Effect of frame of reference:Ininertial frame of reference the reading of spring balance shows the actual weight of the body but in non-inertial frame of reference reading of spring balance increases or decreases in accordance with the direction of acceleration

[for detail refer Article (4.13)]

(2) **Physical balance:**In physical balance actually we compare the mass of body in both the pans. Here we does not calculate the absolute weight of the body.



Here X and Y are the mass of the empty pan.

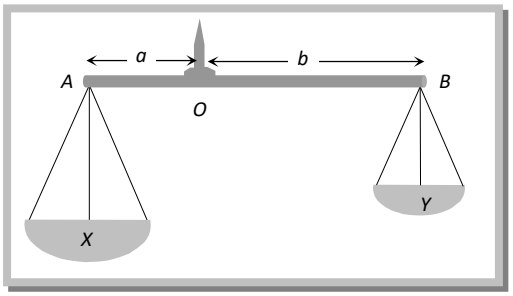
(i) Perfect physical balance:

Weight of the pan should be equal i.e. X = Y

and the needle must in middle of the beam i.e. a = b.

Effect of frame of reference:If the physical balance is perfect then there will be no effect of frame of reference (either inertial or non-inertial) on the measurement. It is always errorless.

(ii) False balance: When the masses of the pan are not equal then balance shows the error in measurement. False balance may be of two types



(a) If the beam of physical balance is horizontal (when the pans are empty) but the arms are not equal

$X > Y$ and $a < b$

For rotational equilibrium about point 'O'

$$Xa = Yb \qquad \text{.....(i)}$$

In this physical balance if a body of weight W is placed in pan X then to balance it we have to put a weight W_1 in pan Y.

For rotational equilibrium about point 'O'

$$(X + W)a = (Y + W_1)b \qquad \text{.....(ii)}$$

Now if the pans are changed then to balance the body we have to put a weight W_2 in pan X.

For rotational equilibrium about point 'O'

$$(X + W_2)a = (Y + W)b \qquad \text{.....(iii)}$$

From (i), (ii) and (iii)

True weight $W = \sqrt{W_1 W_2}$

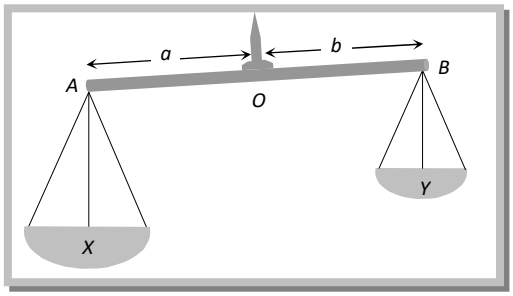
(b) If the beam of physical balance is not horizontal (when the pans are empty) and the arms are equal

i.e. $X > Y$ and $a = b$

In this physical balance if a body of weight W is placed in X Pan then to balance it.

We have to put a weight W_1 in Y Pan

For equilibrium $X + W = Y + W_1$ .....(i)



Now if pans are changed then to balance the body we have to put a weight W_2 in X Pan.

For equilibrium $X + W_2 = Y + W$ .....(ii)

From (i) and (ii)

True weight $W = \dfrac{W_1 + W_2}{2}$