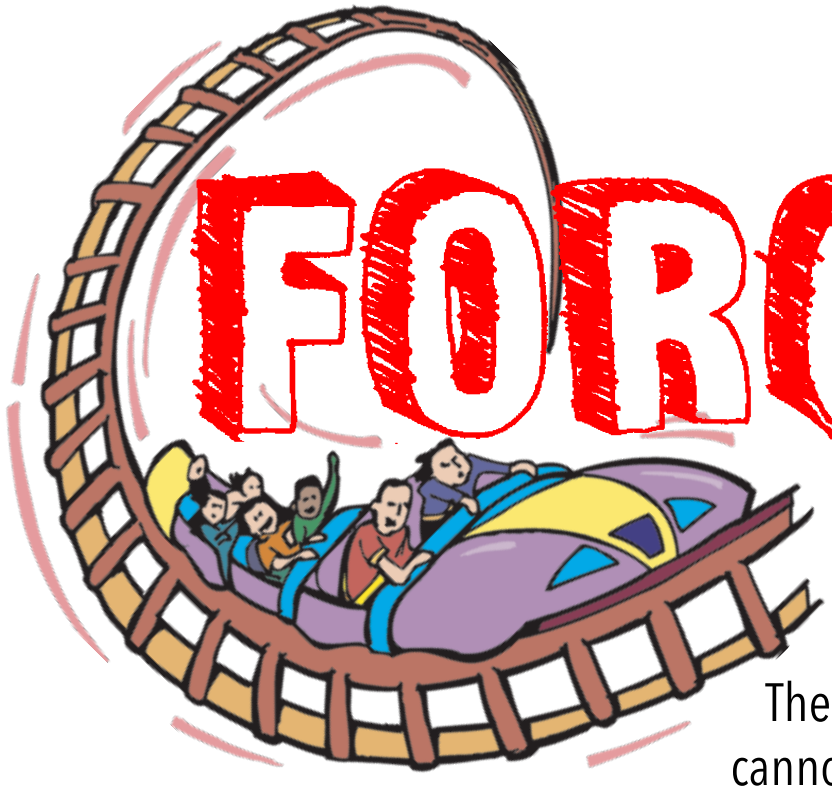


FORCE and motion

The force of creative energy
cannot be stopped, it will flow into direction
it is destined to move.

DREAM BIG
AIM HIGH
NEVER GIVE UP

alina iman arif
Miracles happen everyday

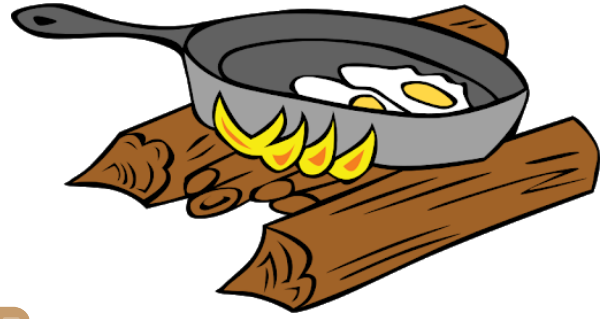
ENERGY

The ability to do work

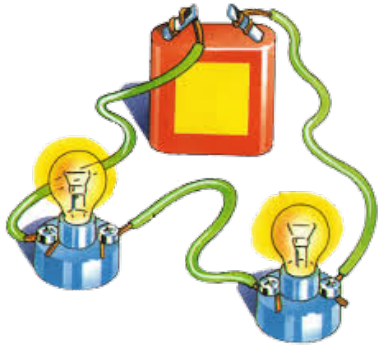
Principle of Conservation of energy

Energy **cannot** be **created** or **destroyed**.
Energy can be **transformed** from one form to another.

NUCLEAR ENERGY



HEAT ENERGY

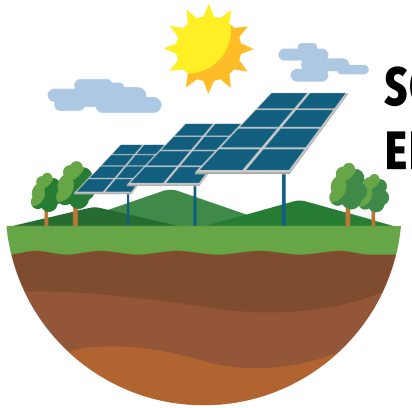


ELECTRICAL ENERGY

CHEMICAL ENERGY

ELASTIC POTENTIAL ENERGY

KINETIC ENERGY

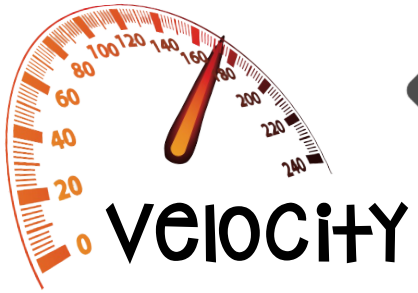


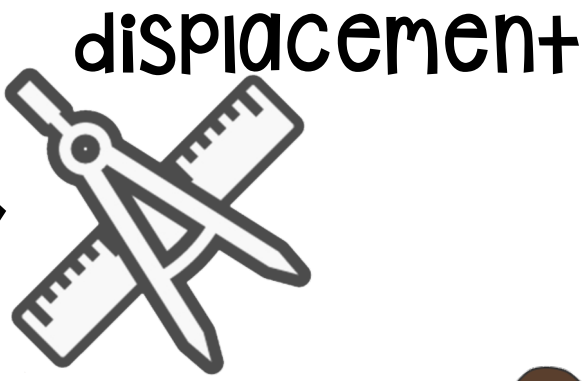
SOLAR ENERGY

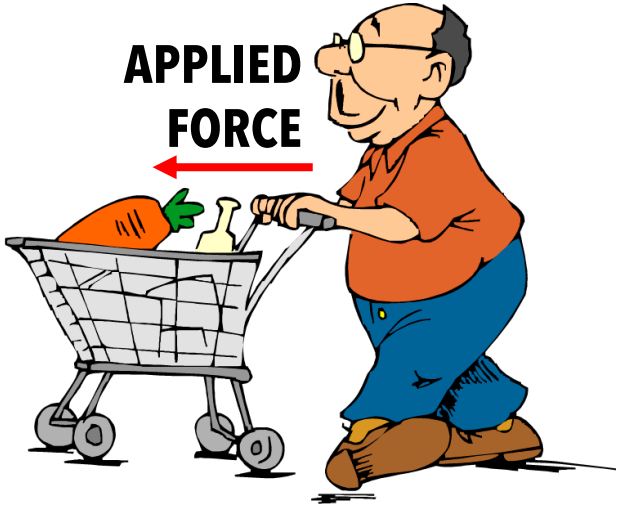
WIND ENERGY

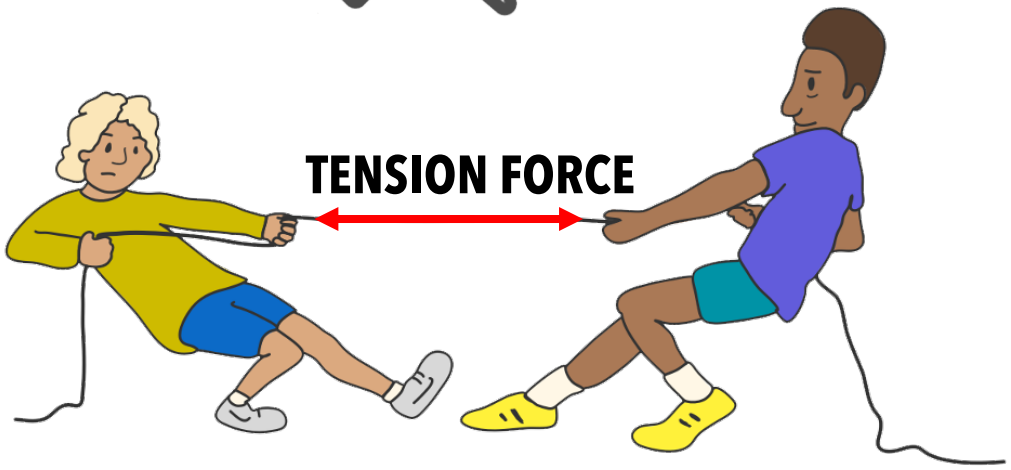
FORCE

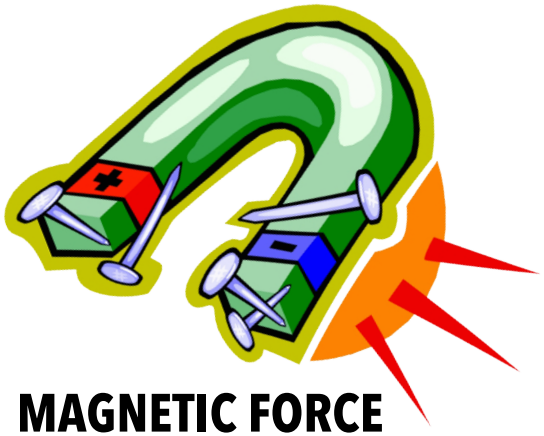
An agent that can change the:











Newton's First Law

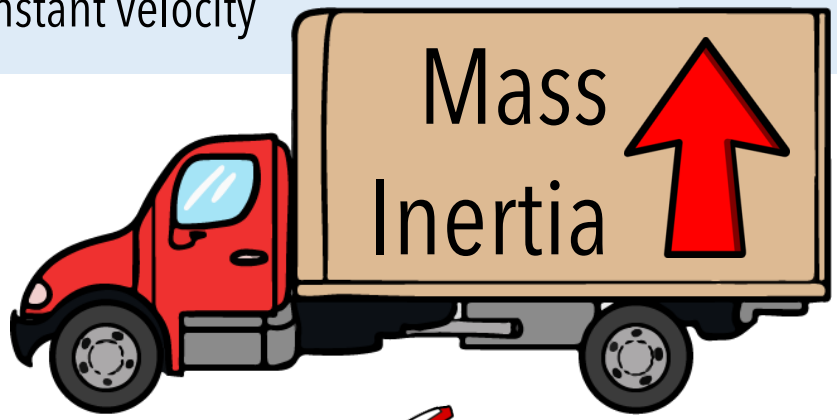
(INERTIA – time take or period)

Objects keep on doing what there are doing

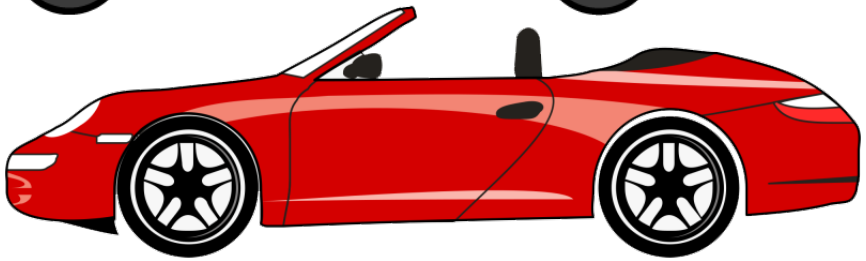
In the absence of external forces, an object at rest remains at rest and an object in motion continues in motion with a constant velocity

The bus **stop** suddenly
The boy **jerk forward**

The bus **moves** suddenly
The boy **jerk backward**



Difficult
to move or to stop



Mass
Inertia

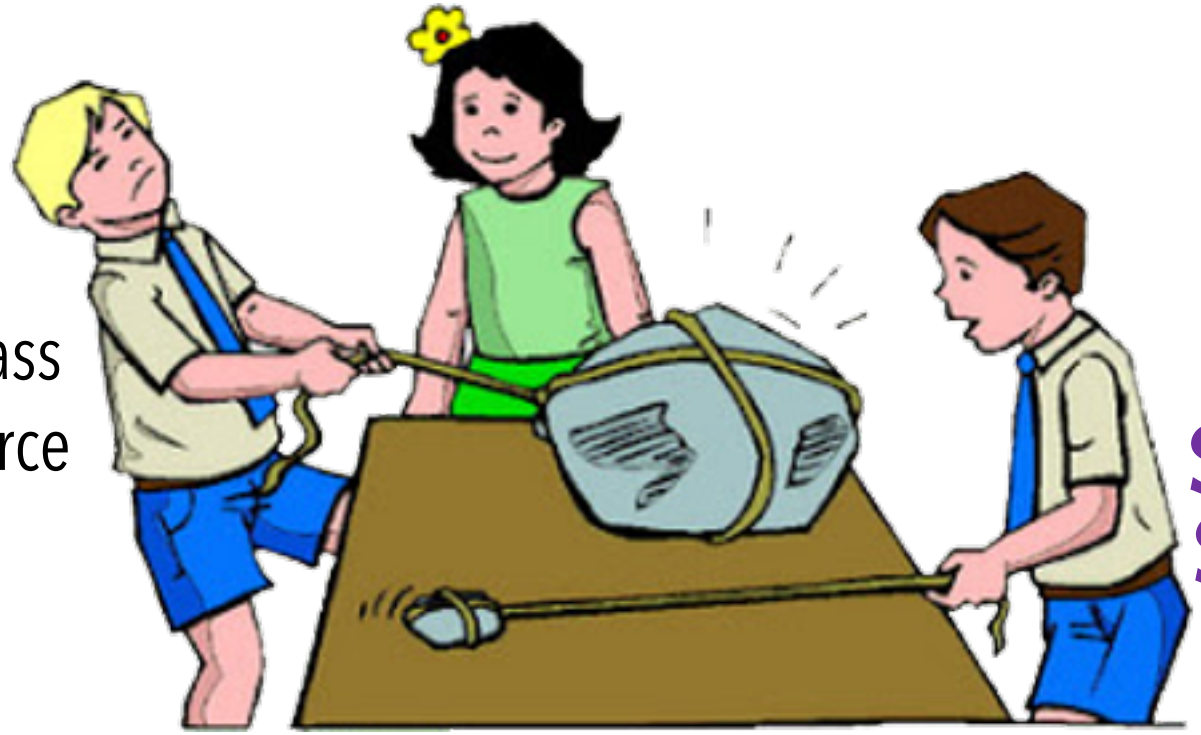
easier
to move or to stop

Newton's SECOND Law

The rate of change of momentum of a body is directly proportional to the resultant force acting on the body and is in the same direction.

$$F = ma$$

Bigger mass
Bigger force

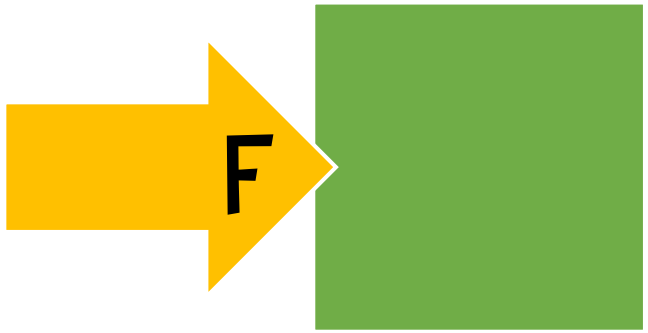


smaller mass
smaller force

Newton's SECOND Law

$$F = ma$$

greater force, **same** mass



greater acceleration

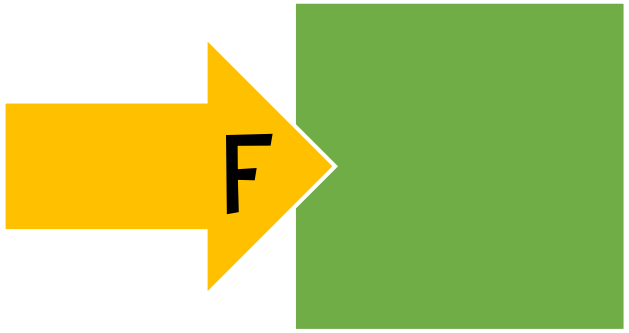
smaller force, **same** mass

smaller acceleration

Newton's SECOND Law

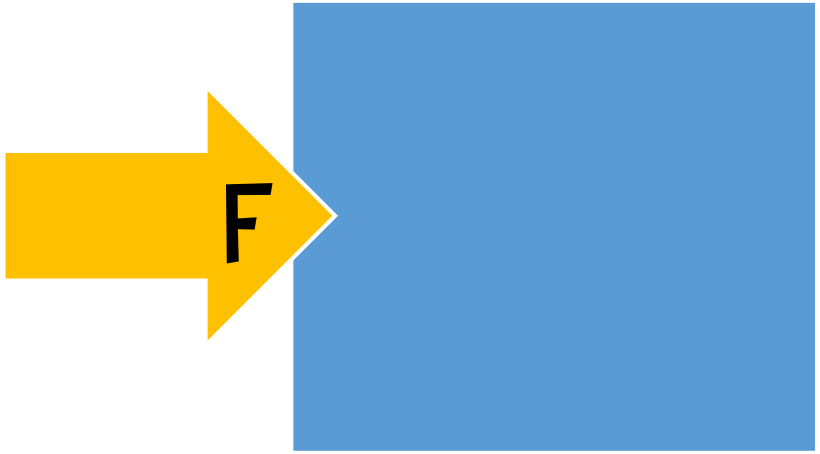
$$F = ma$$

same force,
smaller mass



greater acceleration

same force,
greater mass



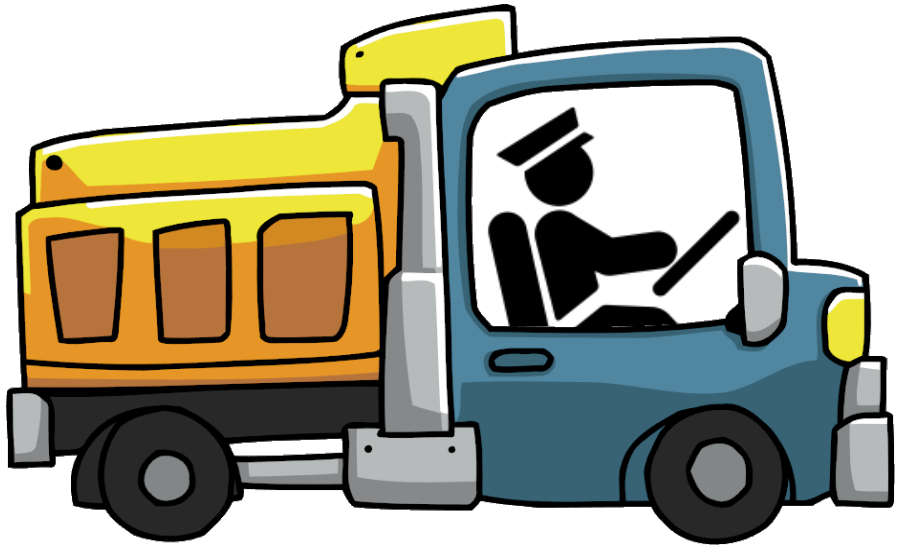
smaller acceleration

Newton's SECOND Law

$$F = ma$$

IDEA & CONCEPT:

same force,
greater mass



smaller acceleration

$F = \mathbf{m}a$

greater force,
same mass

bigger acceleration

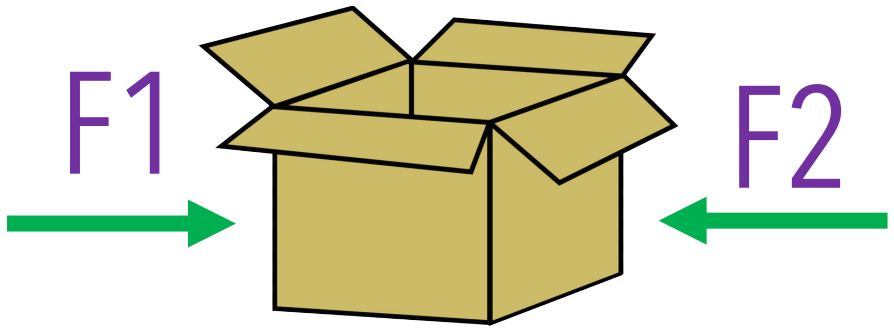
$F = ma$

Newton's SECOND Law

$$F = ma$$

balanced force

Body remain **stationary**
Body move at **constant velocity**
(acceleration = 0 ms^{-2})



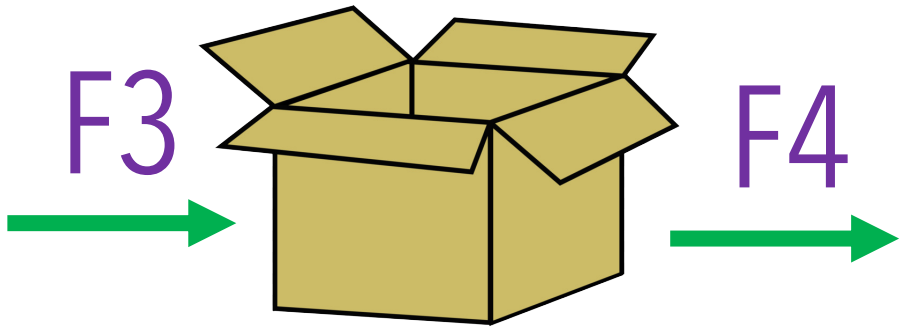
F1 = F2

(at opposite direction)

Net force = 0 N

unbalanced force

Stationary object will **move**
velocity of an object changes
direction of moving object changes



F3 > F4 or F4 > F3

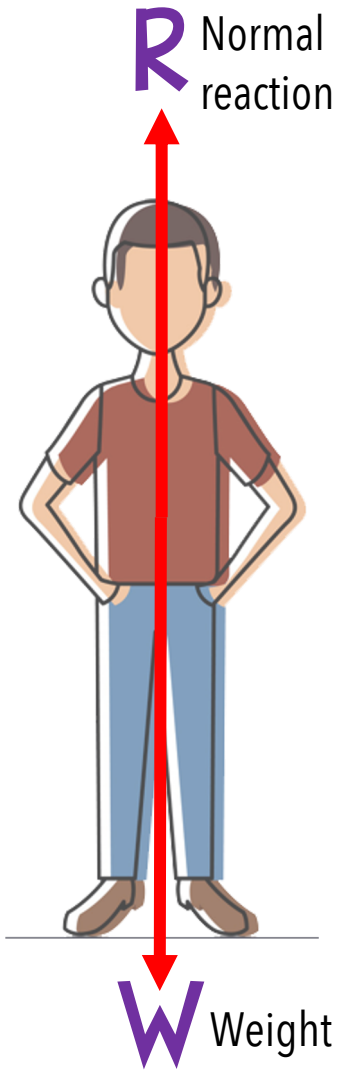
(same direction)

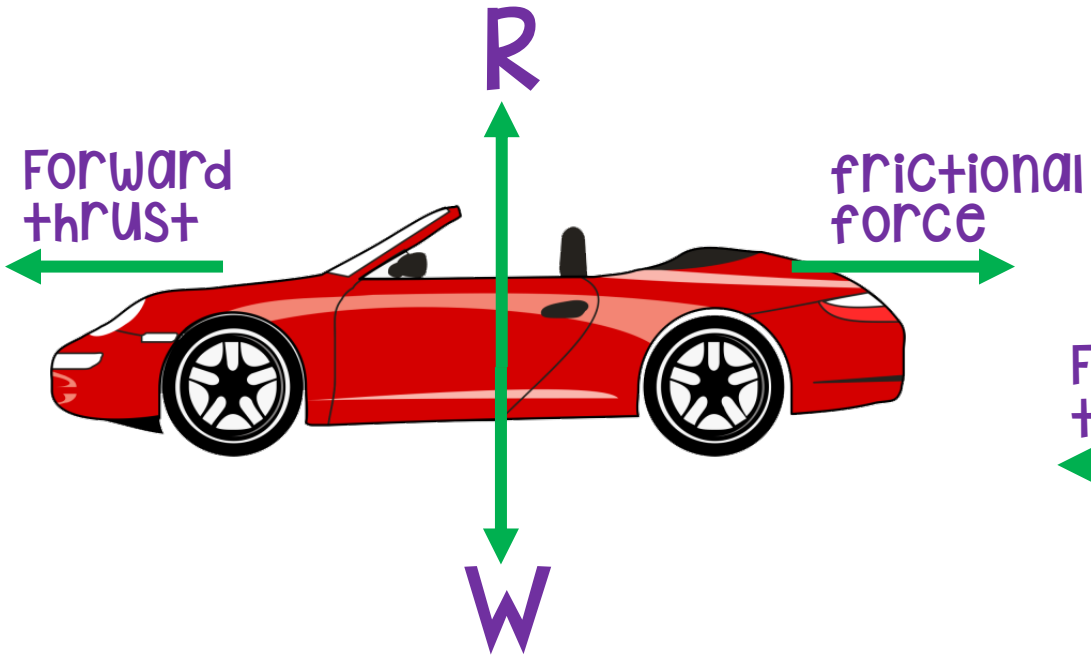
Net force = F3 + F4 or F4 + F3

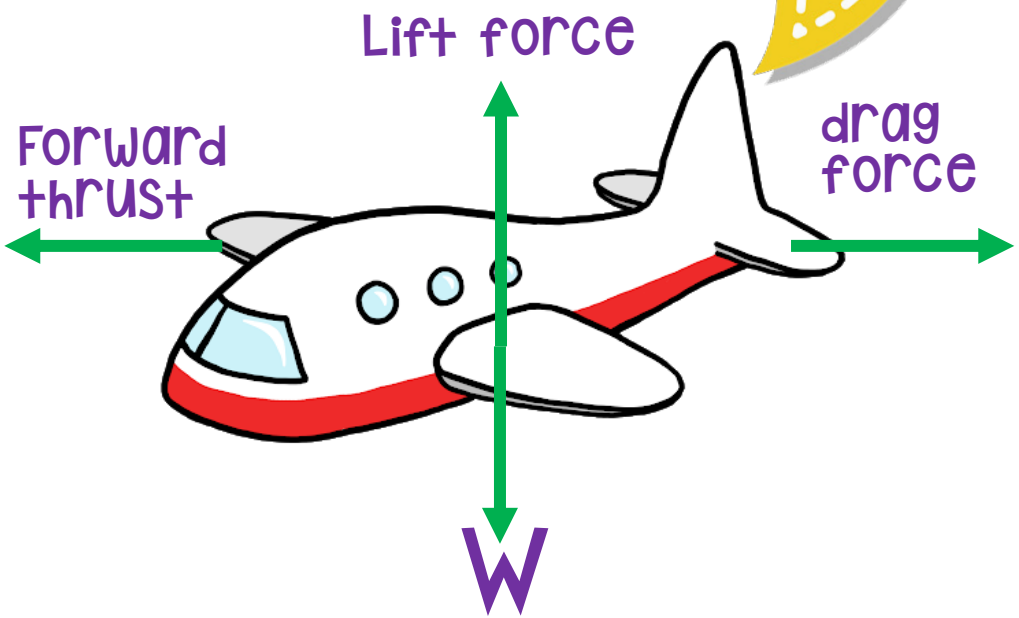
Newton's third Law

for every force, there is a reaction force with the same magnitude but in the opposite direction

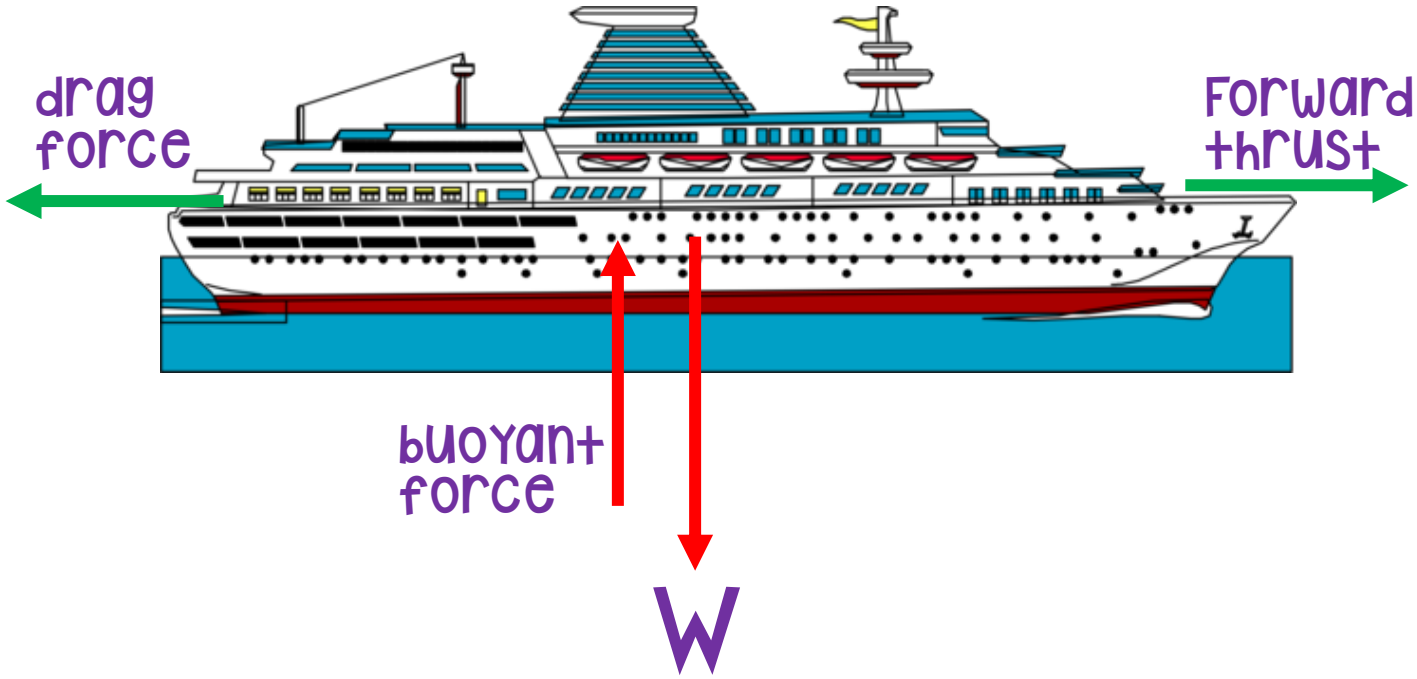
IDEA & CONCEPT:

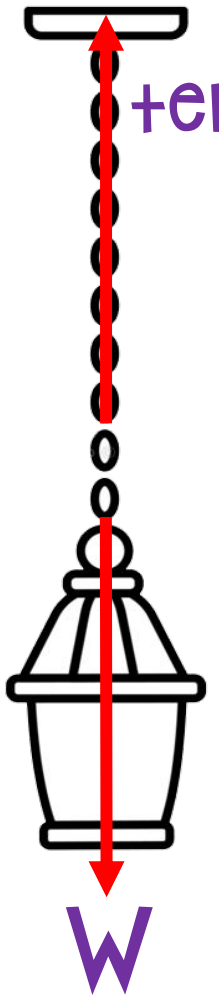






Newton's third Law



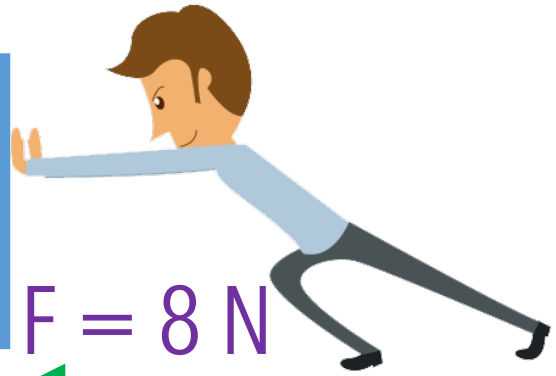


IDEA & CONCEPT:

YOUR MIND
IS A POWERFUL THING.
WHEN YOU FILL IT WITH
POSITIVE THOUGHTS,
YOUR LIFE WILL START TO CHANGE.

Problem solving

m = 2 kg



F = 8 N

$$F = ma$$

$$a = \frac{F}{m} = \frac{8}{2}$$

$$a = 4\ m\ s^{-2}$$

unbalanced force

F = 2 N → m = 10 kg ← F = 18 N

$$F = ma$$

$$(18 - 2) = 10a$$

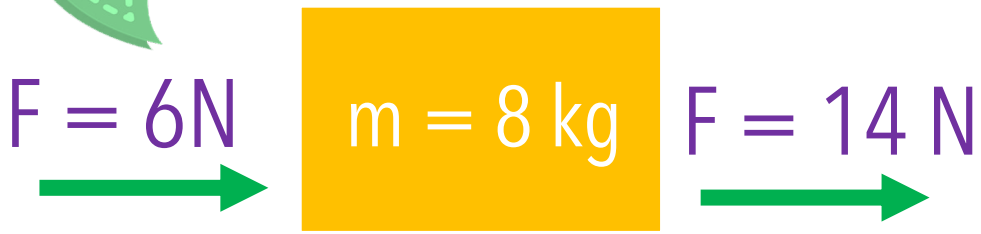
$$16 = 10a$$

$$a = \frac{16}{10}$$

$$a = 1.6\ m\ s^{-2}$$

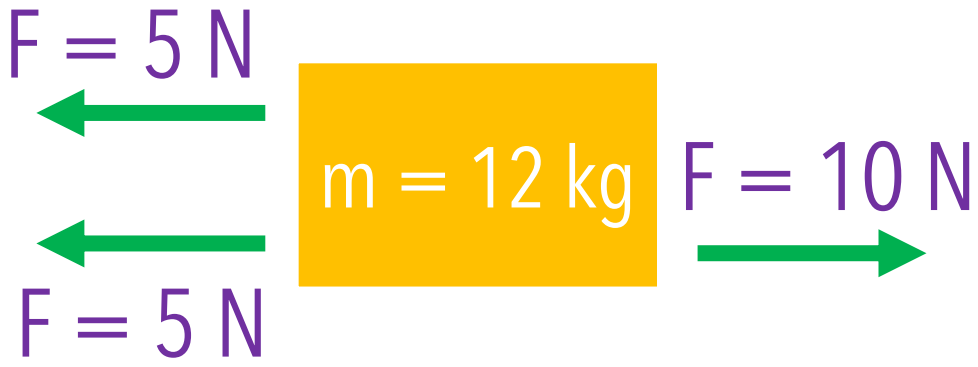
unbalanced force

Problem solving



$$F = ma$$
$$(14 + 6) = 8a$$
$$20 = 8a$$
$$a = \frac{20}{8}$$
$$a = 2.5\ m\ s^{-2}$$

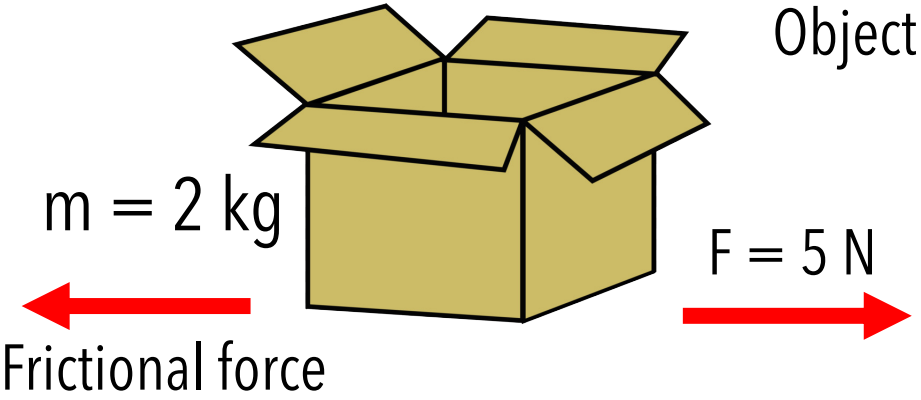
unbalanced force



$$F = ma$$
$$10 - (5+5) = 12a$$
$$0 = 12a$$
$$a = \frac{0}{12}$$
$$a = 0\ m\ s^{-2}$$

balanced force

Problem solving



Object move at constant velocity

(a) What is the frictional force?

Object move at constant velocity

$\therefore a = 0\ m\ s^{-2}$

$F = ma$

(5- frictional force) = 2(0)

(5- frictional force) = 0

frictional force = 5 N

(b) Calculate the acceleration if F = 17 N

frictional force = 5 N

$F = ma$

$(17 - 5) = 2a$

$12 = 2a$

$a = \frac{12}{6}$

$a = 6\ m\ s^{-2}$

Problem Solving

mass of bus = 2 000 kg
u = 40 m s $^{-1}$
v= 0 m s $^{-1}$ (stop)
s = 2 500 m

(a) What is the average deceleration of the bus?

$v^2 = u^2 + 2as$

$0 = (40)^2 + 2(a)(2\ 500)$

$a = -0.32$ m s $^{-1}$

(b) Calculate the average force

$F = ma$

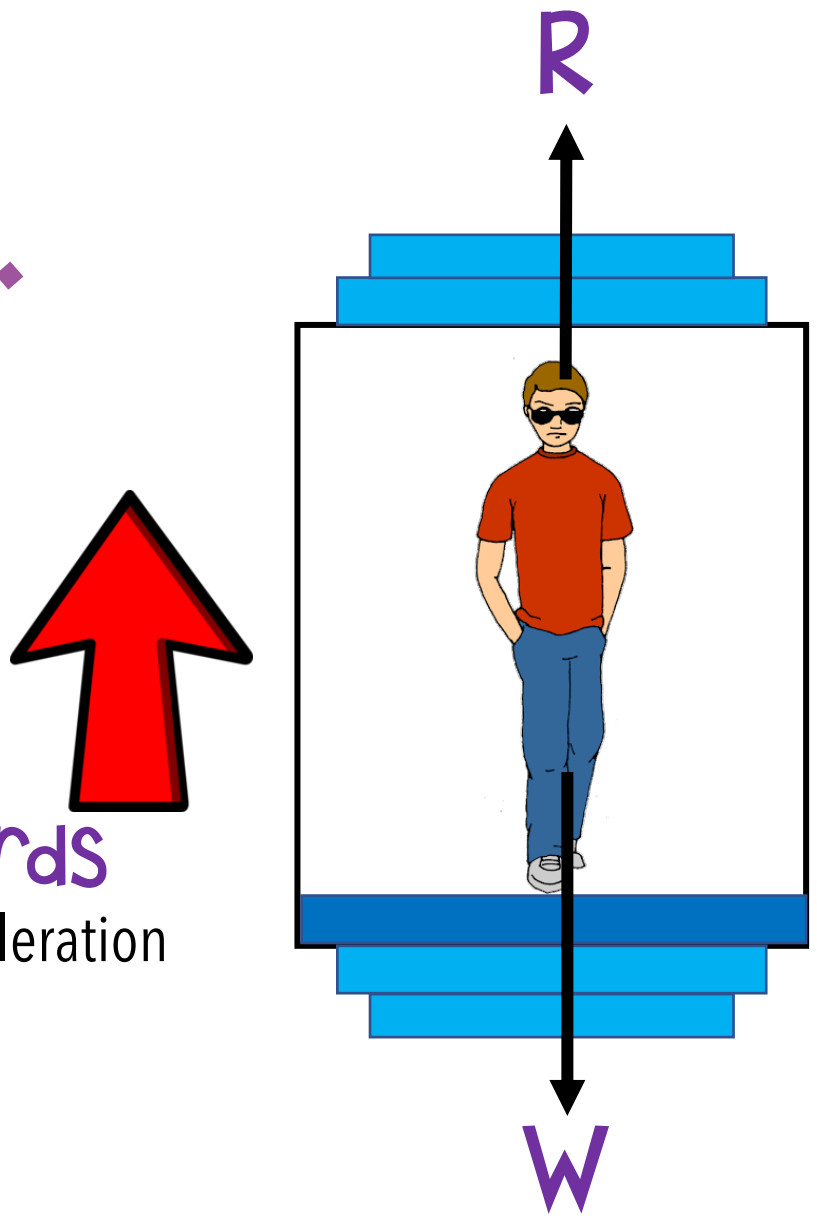
$F = 2\ 000\ (-0.32)$

$F = -640$ N

Negative means:
force resist the motion

Resultant force and the principle of resolution of forces

LIFT



Moving **upwards** with acceleration of $a\ m\ s^{-2}$

upwards

$R > W$

$R > mg = ma$

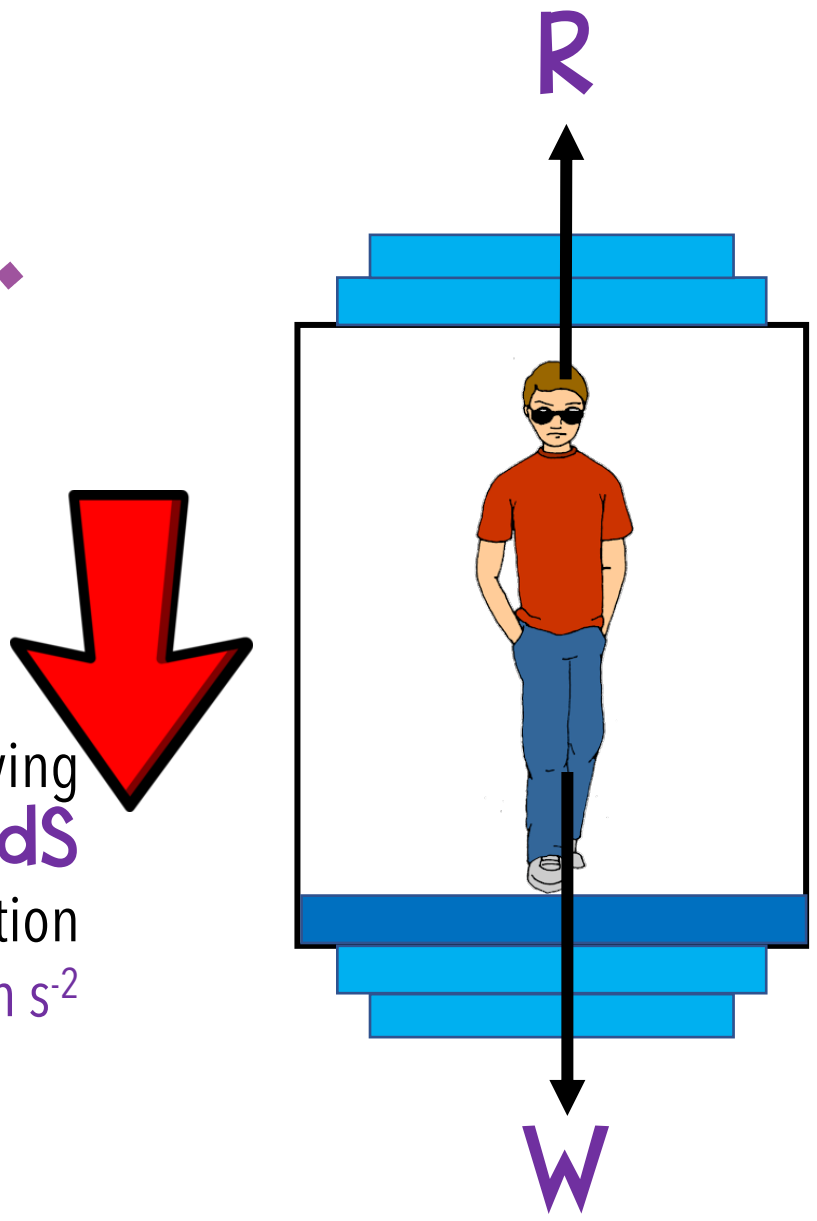
$R - mg = ma$

$R = ma + mg$

*R = reading of the weighing scale

Resultant force and the principle of resolution of forces

LIFT



Moving **downwards** with acceleration of $a\ m\ s^{-2}$

downwards

$W > R$

$W > R = ma$

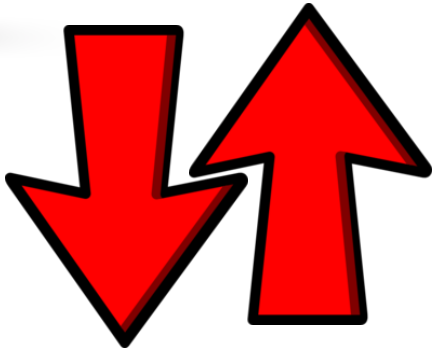
$mg - R = ma$

$R = mg - ma$

*R = reading of the weighing scale

Resultant force and the principle of resolution of forces

LIFT

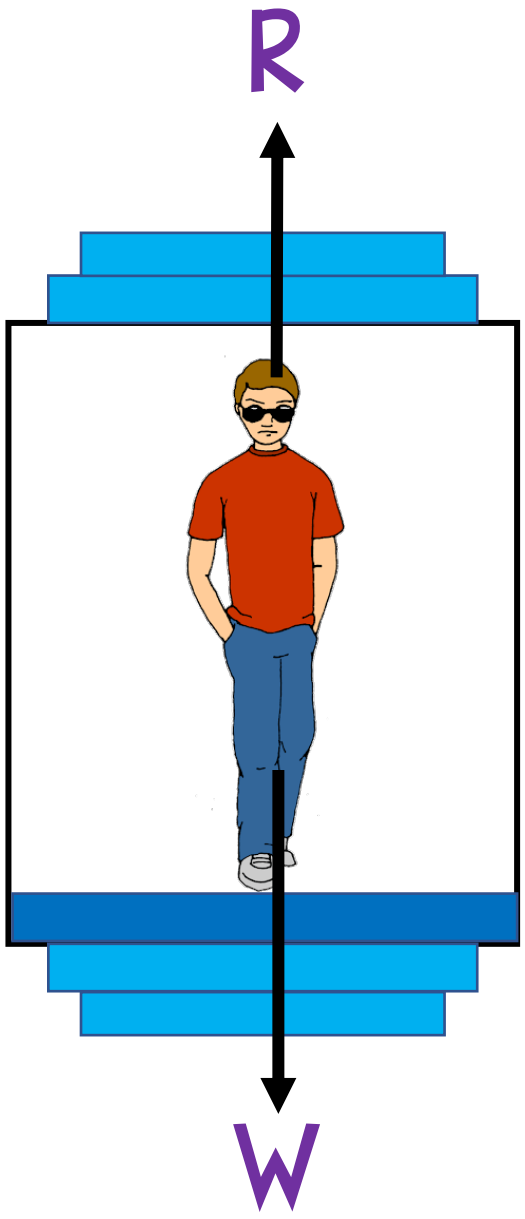


Stationary

lift of moving

upwards & downwards

at constant velocity



$a = 0\ m\ s^{-2}$ (constant velocity)

$F_{net} = 0\ N$

R > W

$R > mg = ma$

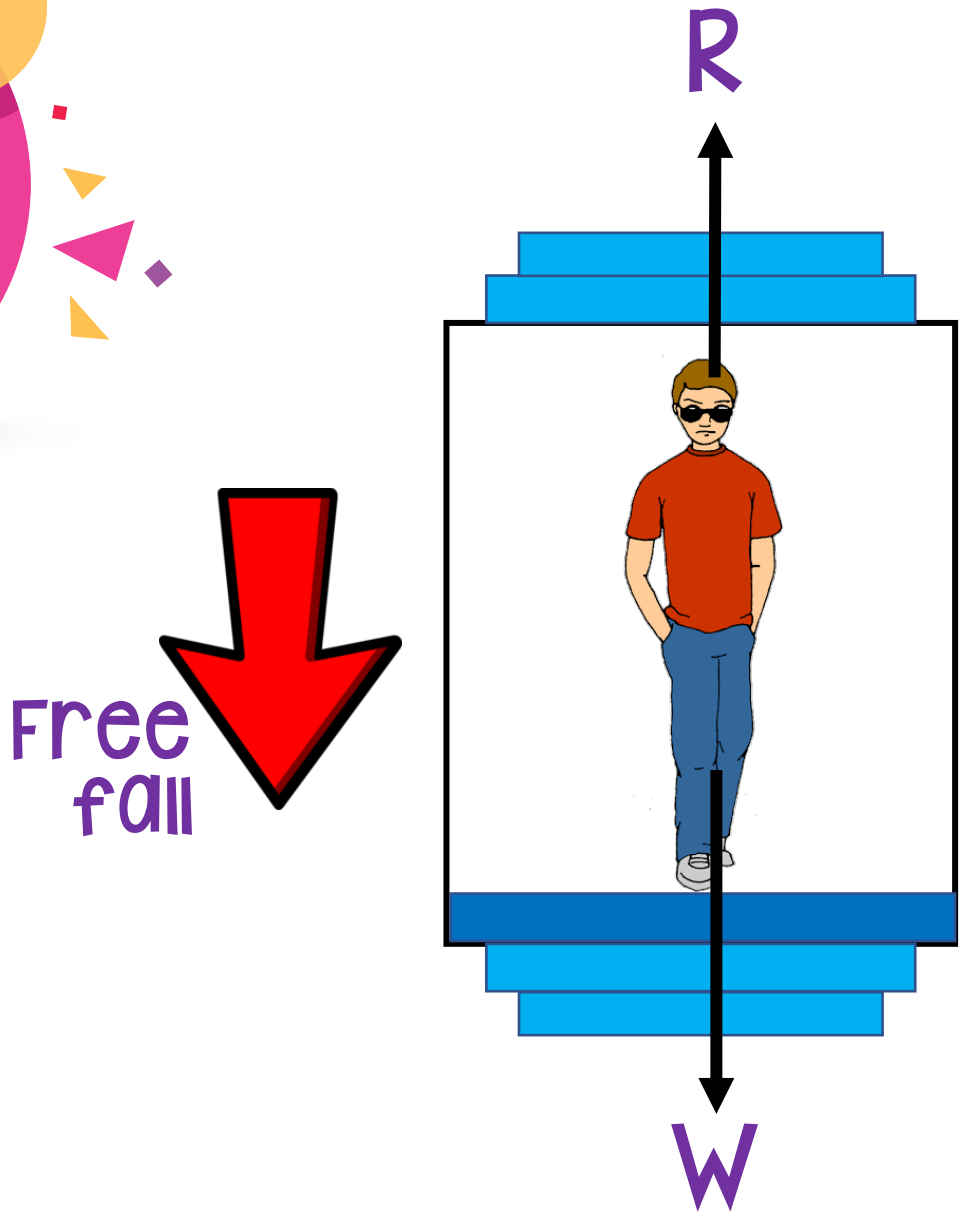
$R - mg = 0$

$R = mg$

*R = reading of the weighing scale

Resultant force and the principle of resolution of forces

LIFT



Free fall

a = g (gravitational acceleration)

W > R

W > R = ma

W > R = mg

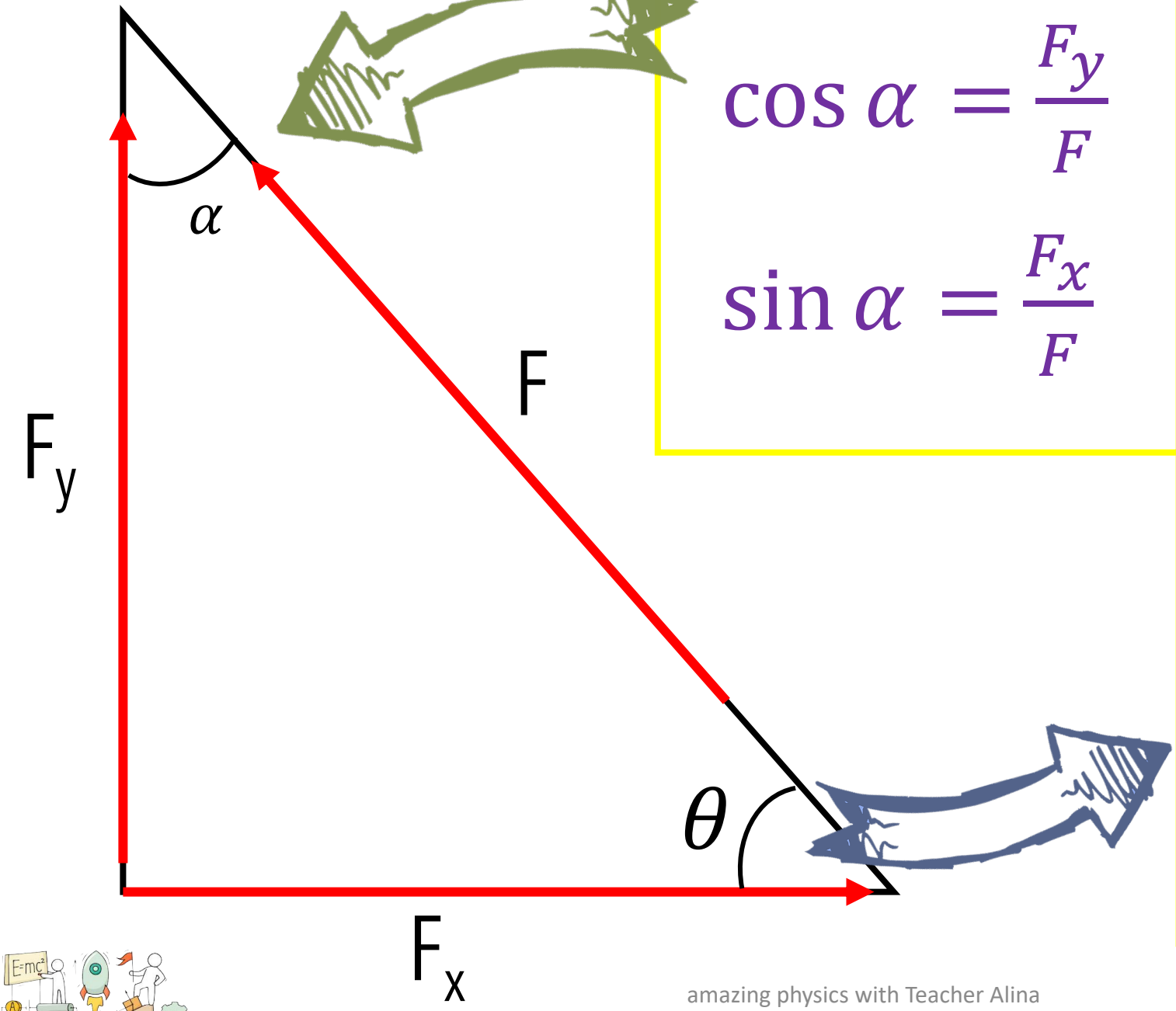
mg – R = mg

R = mg – mg

R = 0 N

*R = reading of the weighing scale

Resultant force and the principle of resolution of forces



$$\cos\alpha = \frac{F_y}{F}$$

$$\sin\alpha = \frac{F_x}{F}$$

$$\cos\theta = \frac{F_x}{F}$$

$$\sin\theta = \frac{F_y}{F}$$

Resultant force and the principle of resolution of forces

$$\cos 30^0 = \frac{F_x}{100}$$

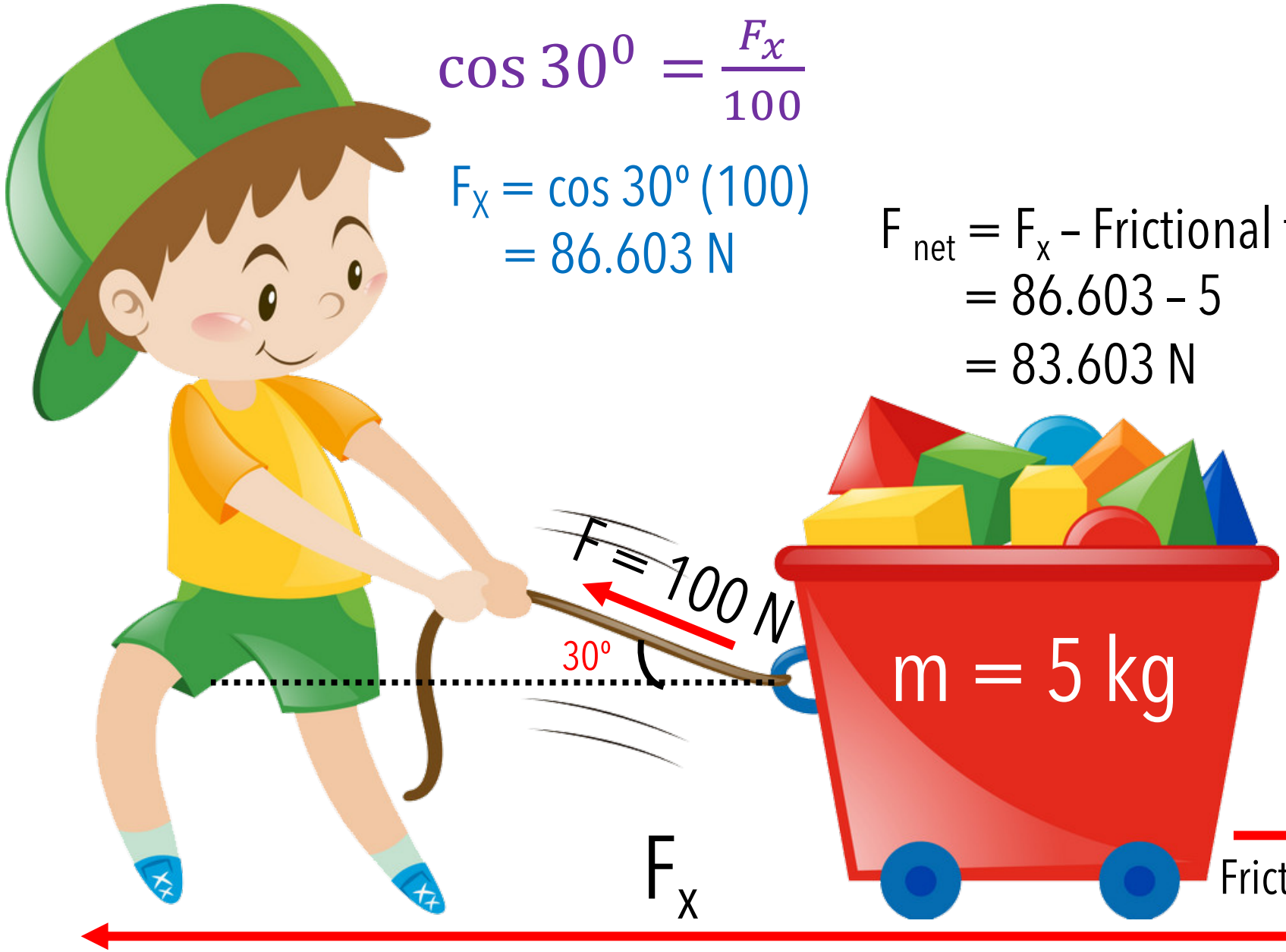
$F_X = \cos 30^0 (100)$

$= 86.603$ N

$F_{net} = F_x$ – Frictional force

$= 86.603 - 5$

$= 83.603$ N



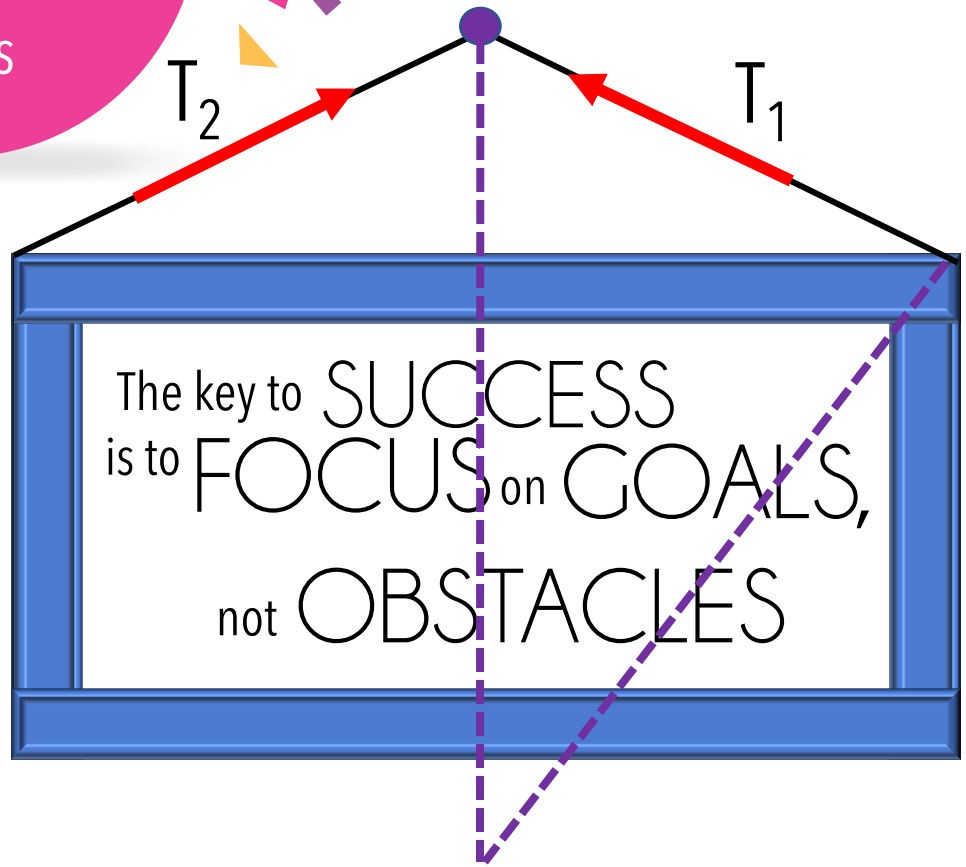
$F = ma$

$F_{net} = 5\,(a)$

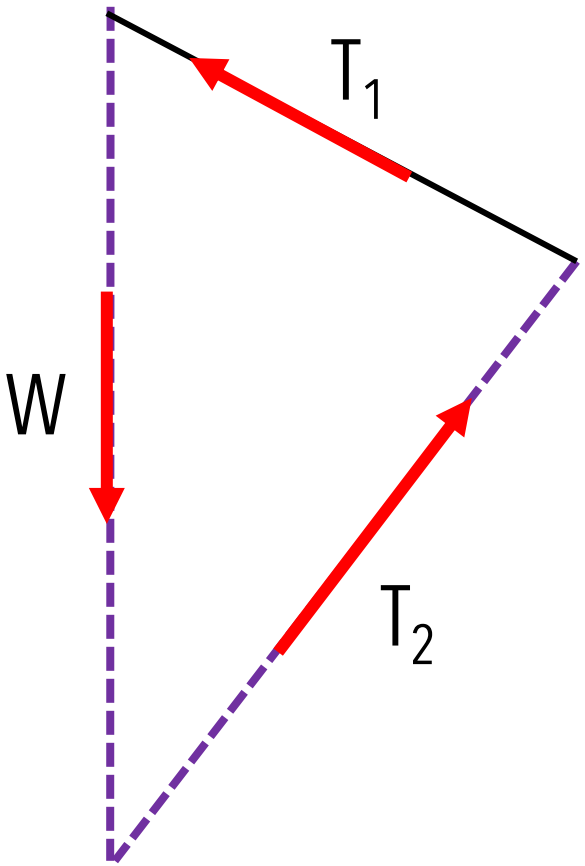
$83.603 = 5a$

$a = 16.72\ m\ s^{-2}$

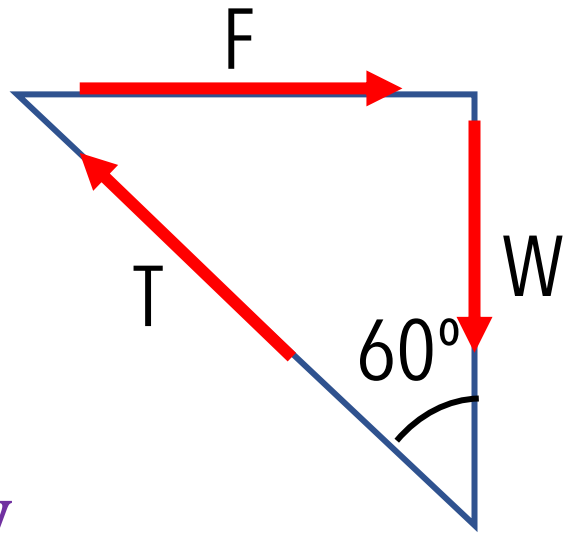
Resultant force and the principle of resolution of forces



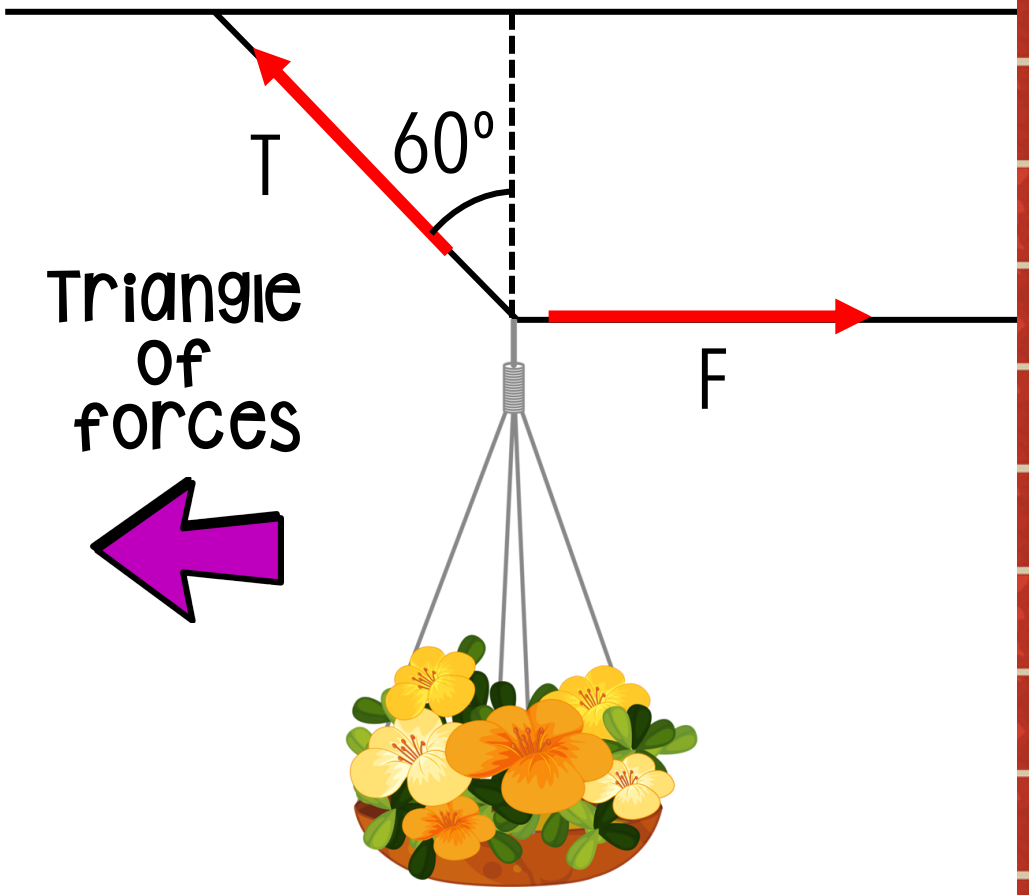
Triangle of forces



Resultant force and the principle of resolution of forces



Triangle of forces



m = 3 kg

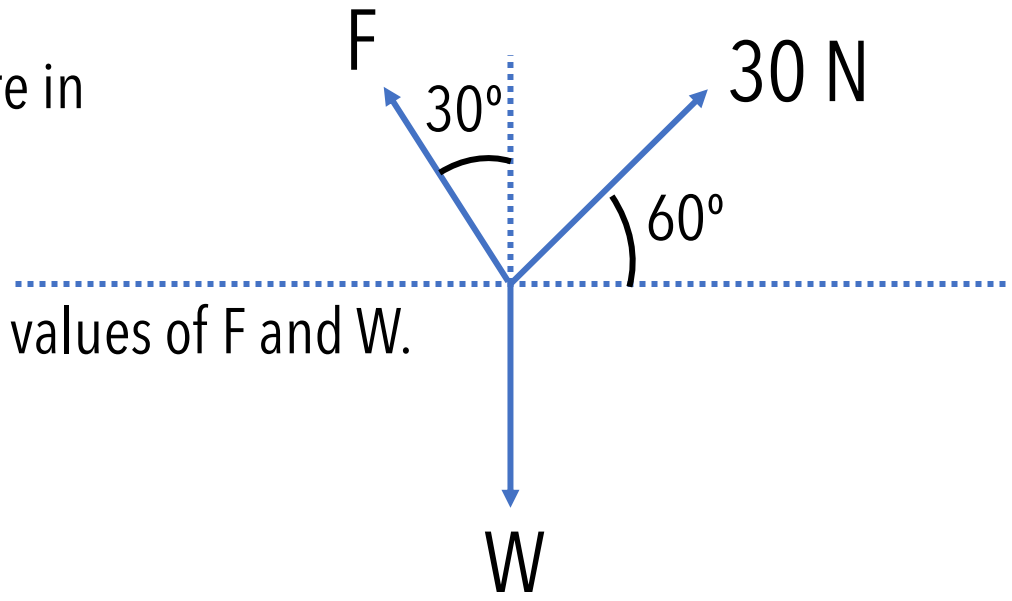
W = 30 N

$$\cos 60^0 = \frac{W}{T}$$

$$T = \frac{W}{\cos 60^o} = \frac{30}{\cos 60^o}$$

$$= 60\ N$$

Three forces, F, 30 N and W are in equilibrium.



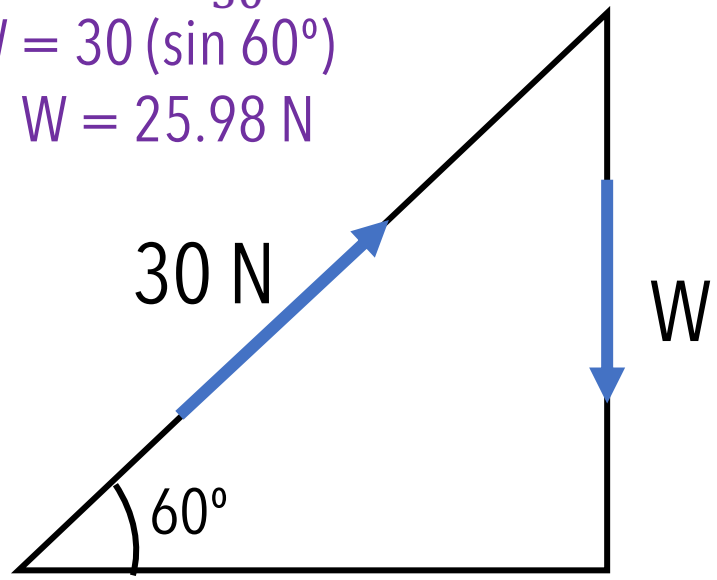
Calculate the values of F and W.

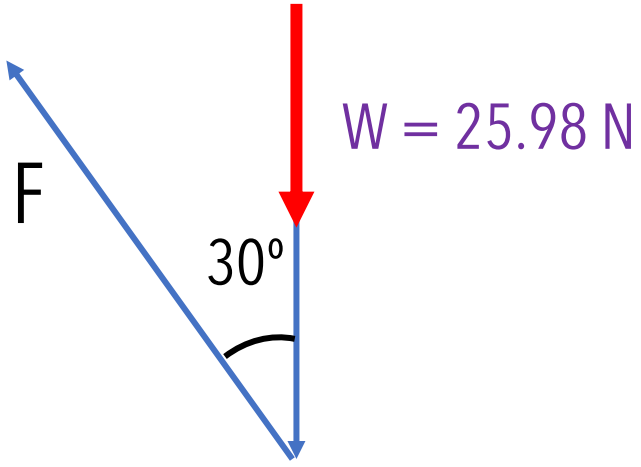
Resultant force and the principle of resolution of forces

$\sin 60^\circ = \frac{W}{30}$

$W = 30 (\sin 60^\circ)$

$W = 25.98$ N



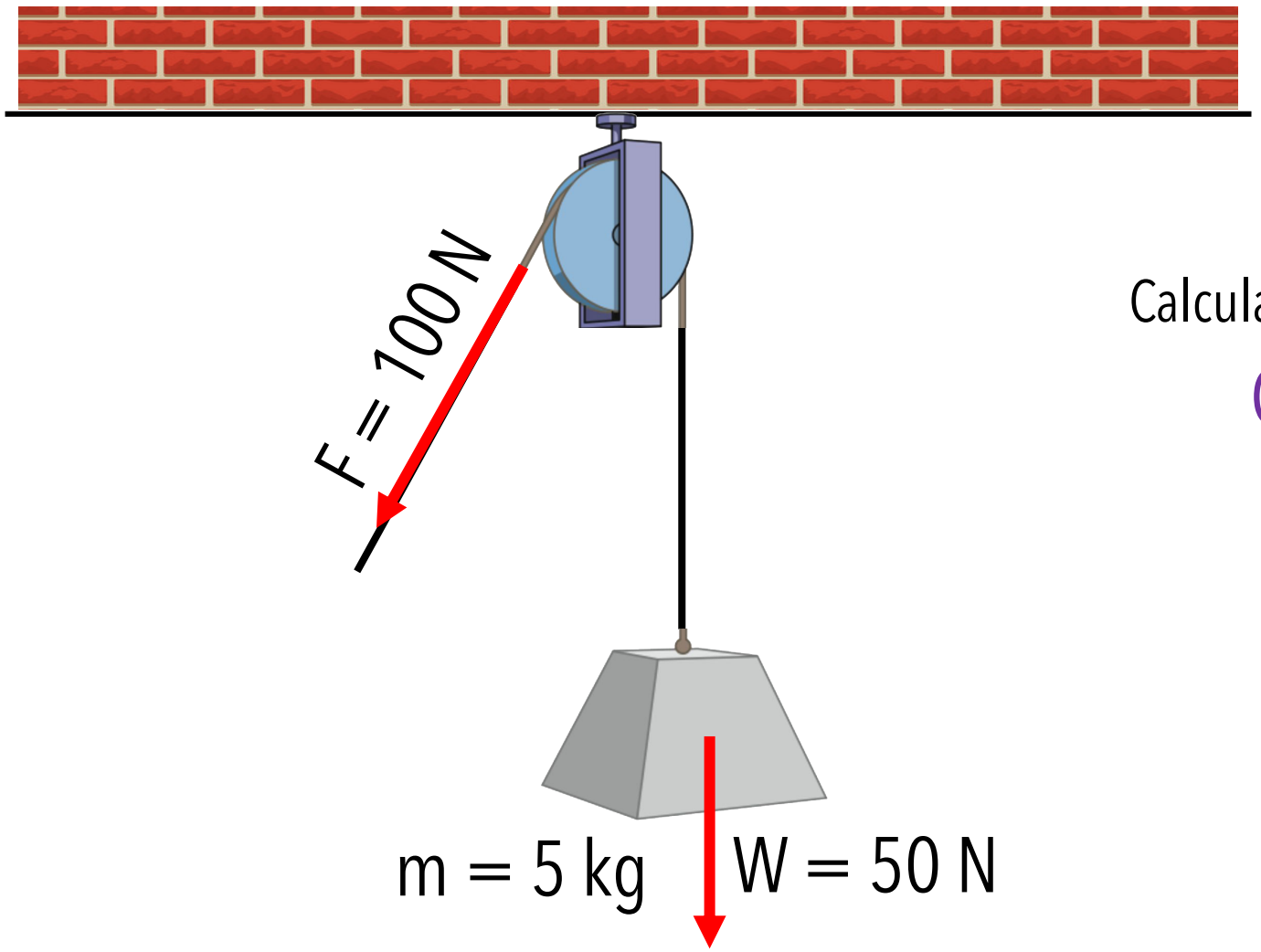


$\cos 30^\circ = \frac{W}{F}$

$F = \frac{25.98}{\cos 30^\circ}$

$F = 30$ N

pulley



Calculate the acceleration of the load

Object will rise up

$F > W$

$F - W = ma$

$100 - 50 = 5a$

$50 = 5a$

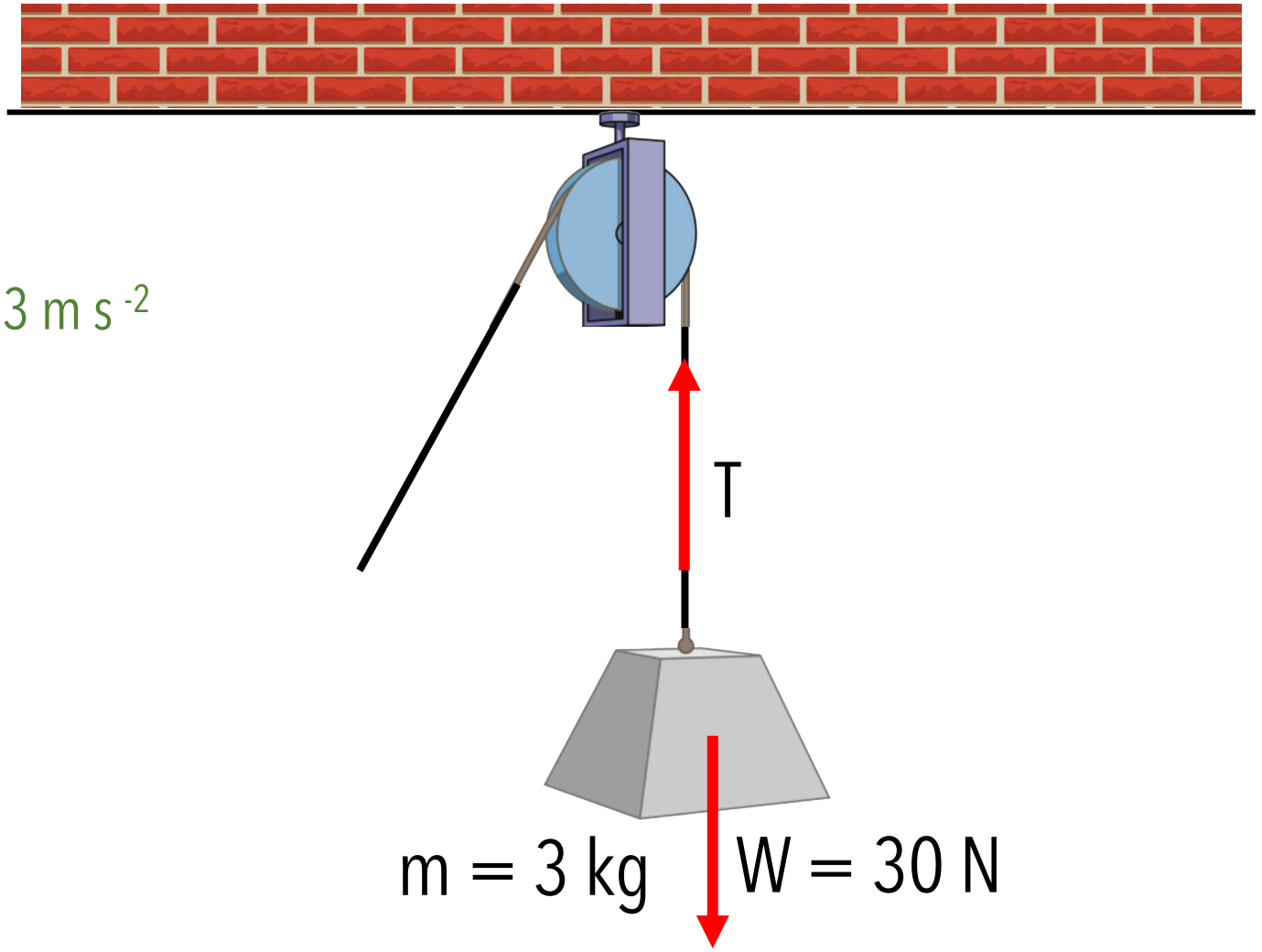
$a = 10\ m\ s^{-2}$

Pulley

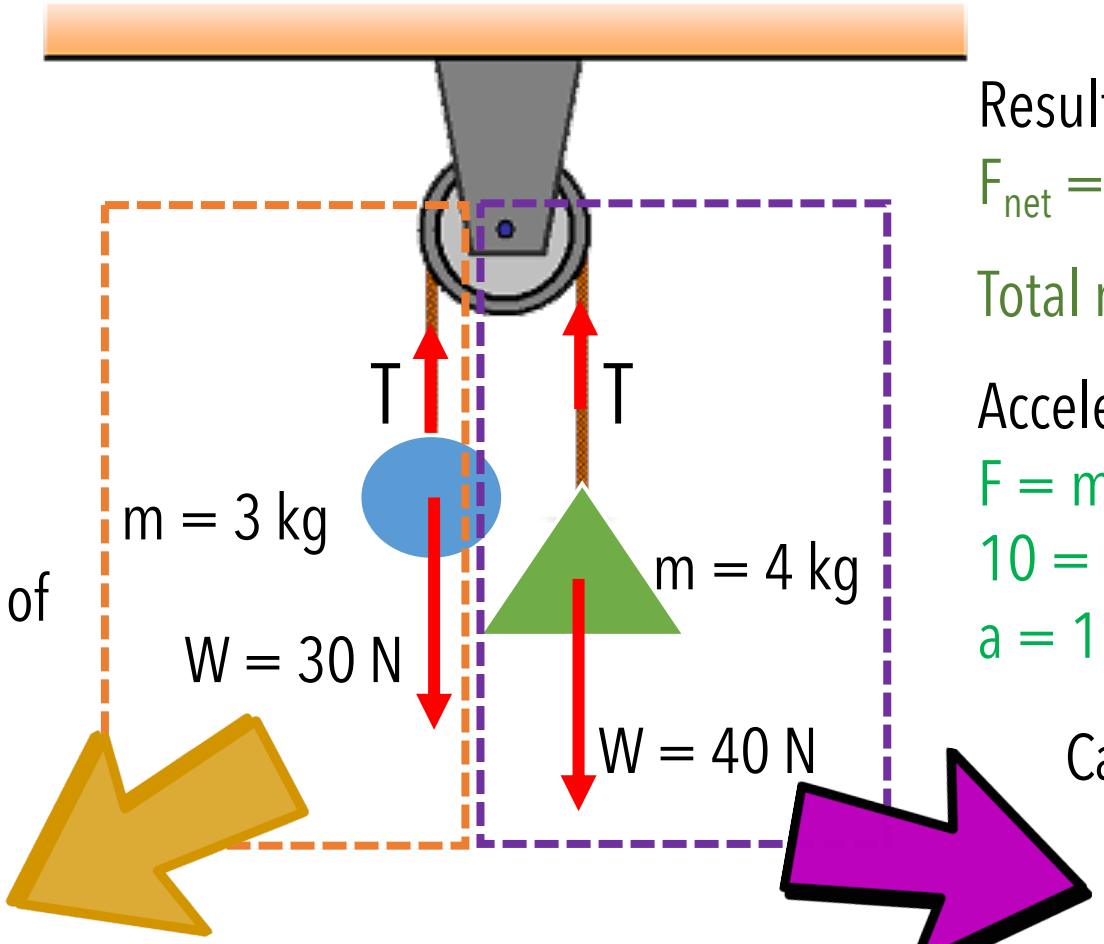
Calculate the Tension of the rope when $a = 3\ m\ s^{-2}$

Object will rises up

$$T > W$$
$$T - W = ma$$
$$T - 30 = 3(3)$$
$$T - 30 = 9$$
$$T = 39\ N$$



pulley



Resultant force

$F_{net} = 40 - 30 = 10$ N

Total mass = 3 + 4 = 7 kg

Acceleration of the object:

F = ma

10 = 7a

a = 1.43 m s^{-2}

Calculate the Tension of the rope

Object will rise up

T > W

T – 30 = ma

T – 30 = 3(1.43)

T – 30 = 4.29

T = 34.29 N

Calculate the Tension of the rope

Object will go down

W > T

W – T = ma

40 – T = 4(1.43)

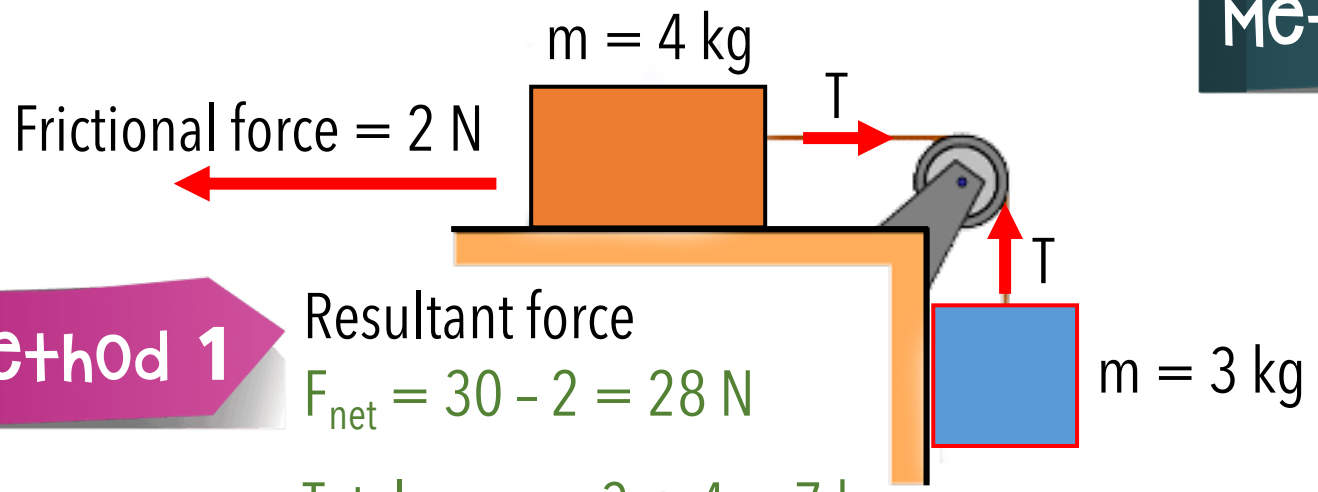
40 - T = 5.72

T = 34.28 N

Pulley

Calculate the acceleration and Tension of the load

*has a **frictional force** acting on the table



Method 1

Resultant force

$F_{net} = 30 - 2 = 28$ N

Total mass = 3 + 4 = 7 kg

Acceleration of the object:

$F = ma$

$28 = 7a$

$a = 4 \text{ m s}^{-2}$

$W > T$

$30 - T = 3a$

$T = 30 - 3(4)$

$T = 30 - 12$

$T = 18$ N

Method 2

$W > T$

$30 - T = 3a$

$T = 30 - 3a$ …equation 1

$T - 2 = 4a$

$T = 4a + 2$ …equation 2

equation 1 = equation 2

$30 - 3a = 4a + 2$

$7a = 28$

$a = 4 \text{ m s}^{-2}$

Insert (a) equation 2

$T = 4a + 2$

$T = 4(4) + 2$

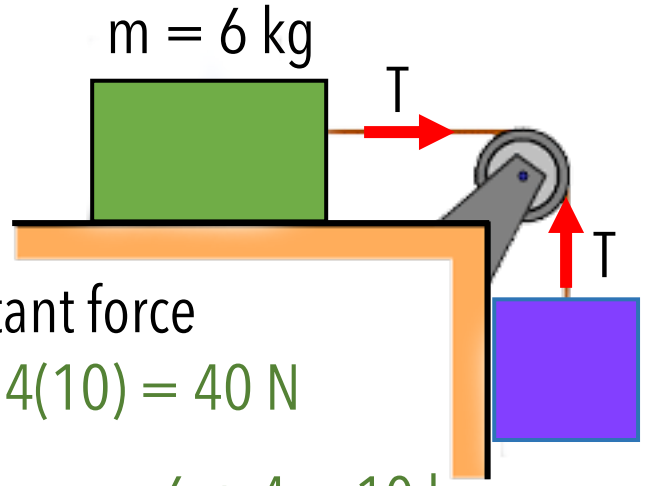
$T = 16 + 2$

$T = 18$ N

Pulley

Calculate the acceleration and Tension of the load

*NO frictional force acting on the table



Method 1

Resultant force

$F_{net} = 4(10) = 40$ N

Total mass = 6 + 4 = 10 kg

Acceleration of the object:

$F = ma$

$40 = 10a$

$a = 4\ m\ s^{-2}$

$W > T$

$40 - T = 4a$

$T = 40 - 4(4)$

$T = 40 - 16$

$T = 24$ N

Method 2

$W > T$

$40 - T = 4a$

$T = 40 - 4a$ …equation 1

$T - 0 = 6a$

$T = 6a$ …equation 2

equation 1 = equation 2

$40 - 4a = 6a$

$40 = 10a$

$a = 4\ m\ s^{-2}$

Insert (a) equation 2

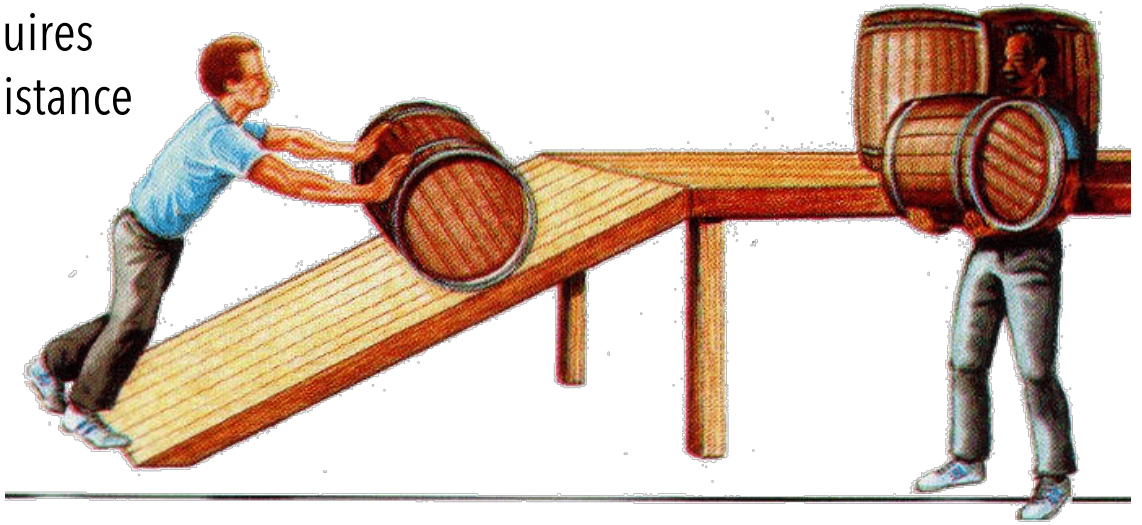
$T = 6a$

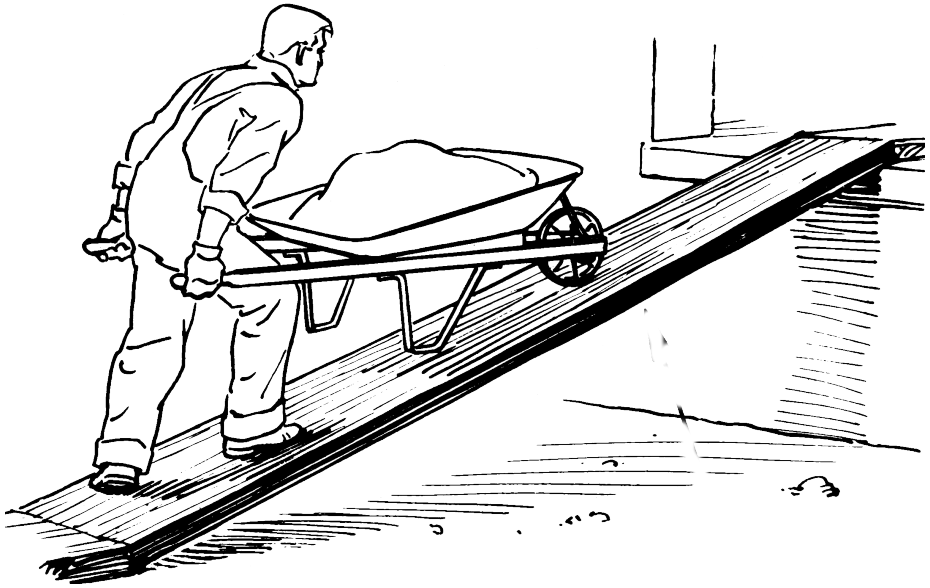
$T = 6(4)$

$T = 24$ N

Inclined plane

Using **inclined plane** requires **less effort** over a longer distance

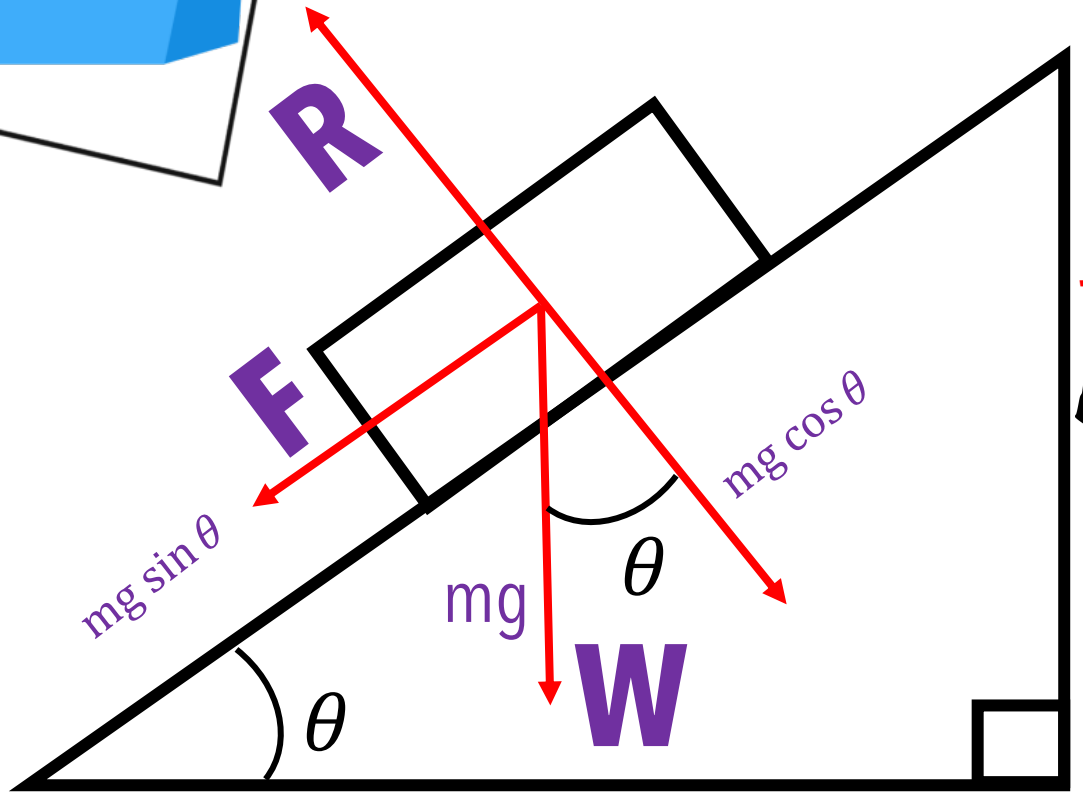




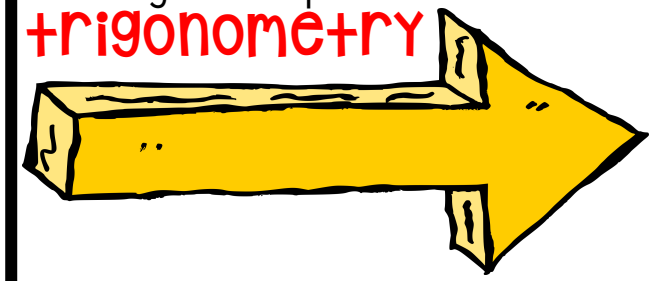
Inclined plane

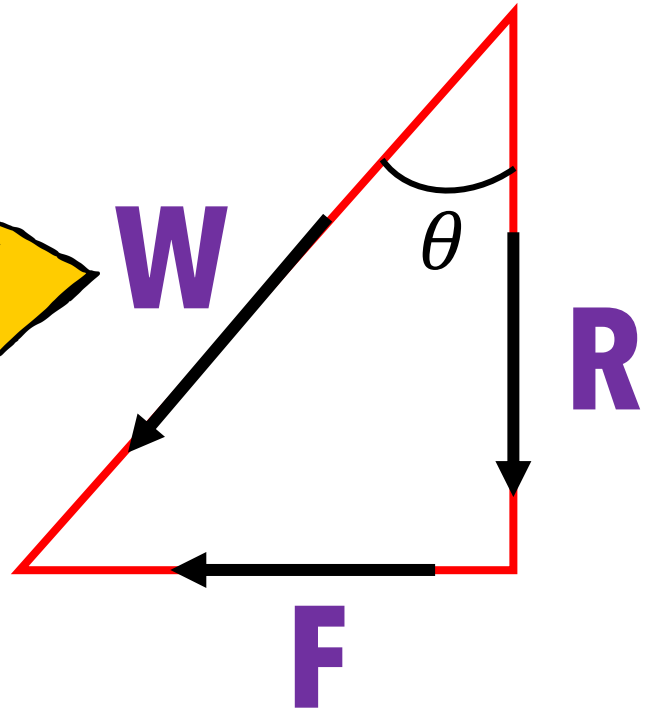
Component **parallel** to the plane: $F = mg \sin\theta$

Component **perpendicular** to the plane: $R = mg \cos\theta$



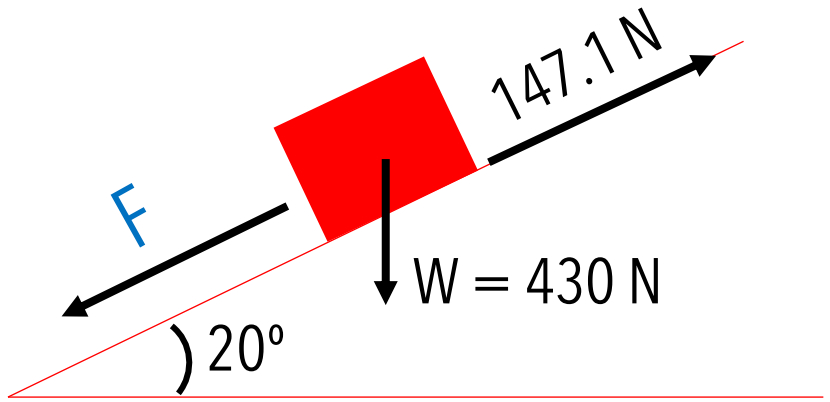
Using a concept of **trigonometry**





Inclined plane

A box of mass 43 kg on a ramp with 20° slope to horizontal.
Frictional force exerted between the box with the ramp is 147.1 N.



Calculate the resultant force, parallel to the ramp.

1 Component **parallel** to the plane:

$$F = mg \sin\theta$$
$$F = 430 (\sin 20°)$$
$$= 147.1 \text{ N}$$

2 **Resultant force**

F_{net} = F- frictional force
= 147.1 – 147.1
= 0 N **stationary (balanced force)**

Enjoy learning physics with teacher Alina