9Adv

Chapter (4)

Chapter 4: forces in 1 dimension

PHYSICS

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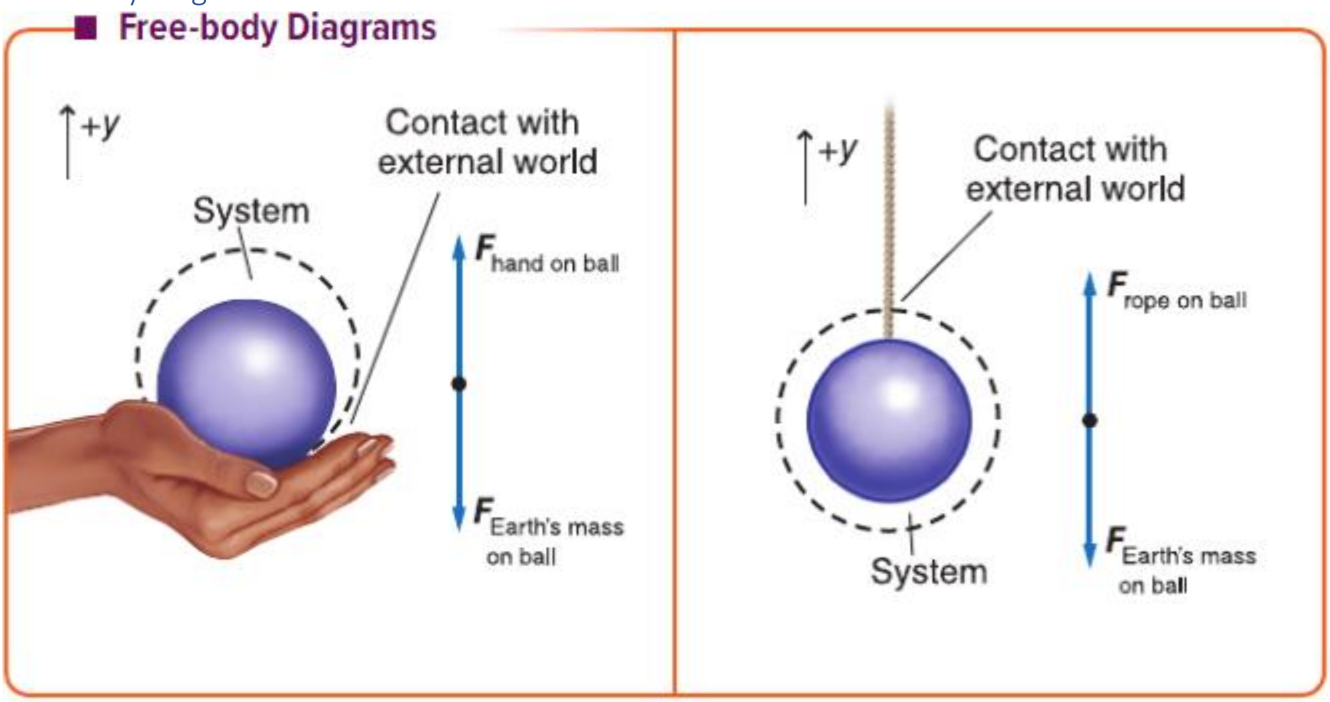
Carve your name on the moon!

Section 1: Forces and motion

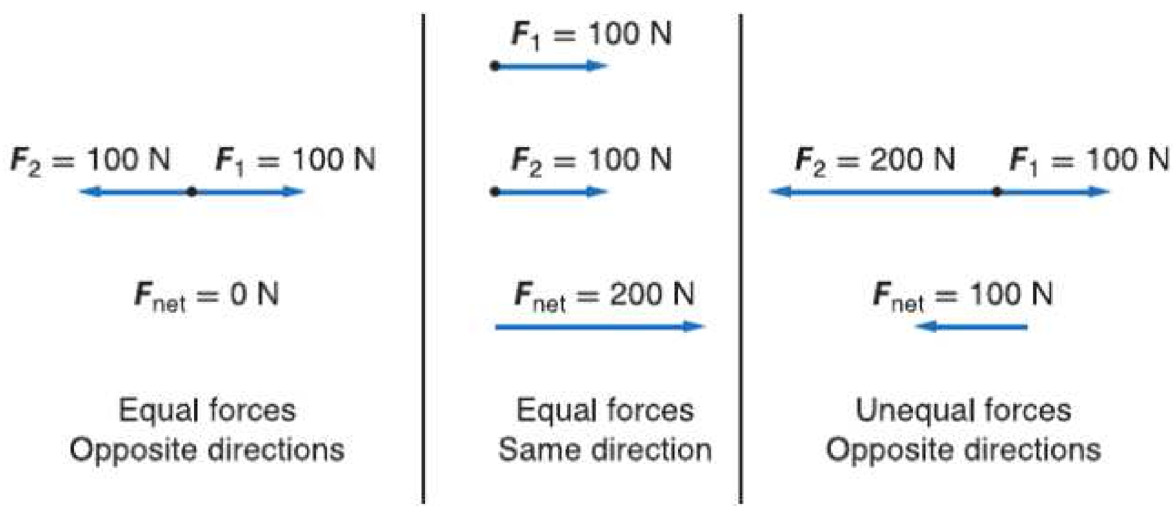
Force: push or pull (gravity , magnet…..)

Contact forces	Field forces
Push or bull	Magnetic force
Friction	Electric force
Air resistance……..	Gravity
Spring force, tension force	

Free body diagram:



Net force: the vector sum of all forces (addition or subtraction)



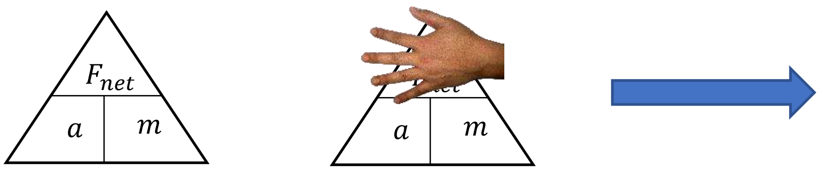
When the net force $F_{net} = 0$ there is no acceleration (balanced system, equilibrium)

The unit for force is N (Newton)

Newton's 2nd law

$$a = \frac{F_{net}}{m}$$

a: acceleration m: mass F_{net}: net force



$F_{net} = ma$

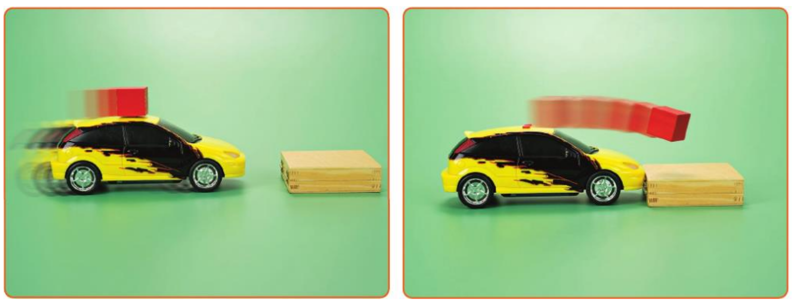
Newton's 1st law

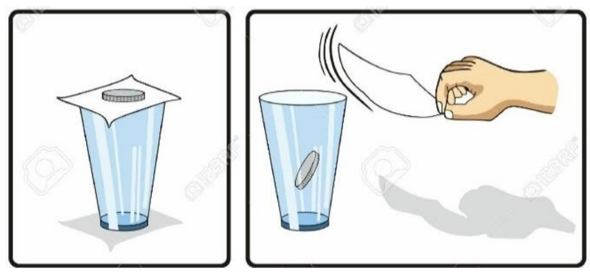
An object that is at rest will remain at rest and an object moving with constant speed will continue at the same speed if and only if the net force is zero.

Inertia

The tendency of an object to resist change in velocity.

Examples:





Section 2: weight and drag force

$$mass \neq weight$$

Mass	weight
Measured in **kg**	Measured in Newton (**N**)
My mass is 40 kg	My weight is 400 N
Not a force	Is a **force**

Weight: the force by gravity on a mass. for example, my mass is 40kg and the earth gravity force on me is 400 N(weight)

We know that $F_{net} = ma$ but in the gravity the acceleration $a = 9.8\ m/s2$ downward or $a = g$

So the weight (F_g) can be found using : $F_g = mg$

g is also called the **gravitational field**

See questions 16-20 on page 101.

Apparent weight (very important)

In an elevator for example our weight will be different (mass does **not** change)

This weight is represented by the scale reading (scale=ميزان).

The weight only change if there is an acceleration which means if the elevator is moving at constant speed ($a = 0$) then $apparent\ weight\ = normal\ weight\ = mg$

<u>When there is an acceleration we can use</u>

$$apparent\ weight = F_{scale} = ma + mg$$

In apparent weight questions only use $g = \ +9.8\ m/s2$ **<u>always</u>**

<u>Keywords: find the apparent weight, find the scale reading, what force would be exerted by the scale on a person…</u>

- Weightlessness: apparent weight = 0

Please solve the apparent weight worksheet that was given as a homework (if you lost it it's on LMS)

Drag force

Drag force: the force by a fluid(سائل أو غاز) on an object.

Example: (air resistance مقاومة الهواء)

The **<u>drag force</u>** increases when the **<u>velocity</u>** increase

As you can see in the picture of a tennis ball falling in air:

At the **beginning** the **velocity is small** so the **drag force** is also **small** (<u>less than the weight F_g</u>)

After some time in the air and because of the free fall acceleration (9.8) the **velocity is increasing** and the **drag force is increasing** also but still <u>less than the weight(F_g).</u>

After some time the ball velocity has increased to a limit where the <u>drag force = weight (F_g)</u> the velocity will not go any bigger this is called the **<u>terminal velocity</u>**

Equations and formulas summary:

Equation	Notes
$a = \frac{F_{net}}{m}$	Can be used to find the force, the acceleration or the mass depending on what is given in the question. F_{net} is found by adding or subtracting all forces (same direction: add, opposite directions: subtract)
$F_g = mg$	Used to find the weight (F_g)
$F_{scale} = ma + mg$	Used to find the apparent weight (F_{scale}) in elevators or when there is acceleration. Remember: in this equation only always substitute $g = \ +9.8\ m/s^2$ (positive)

Section 3: Newton's 3rd law

The force of **A** on **B** is <u>equal in magnitude</u> and <u>opposite in direction</u> of the force of **B** on **A**

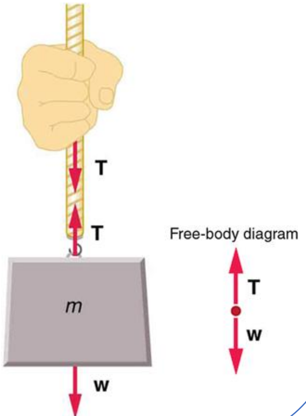
$$F_{A\ on\ B} = -F_{B\ on\ A}$$

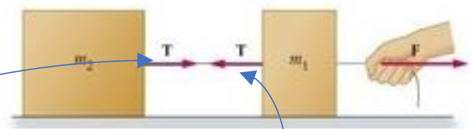
See questions 28-31 on page 108

Solution is on LMS (ch4 section 3 PowerPoint)

Tension (قوة الشد)

Tension (T) is the force in a rope or cable



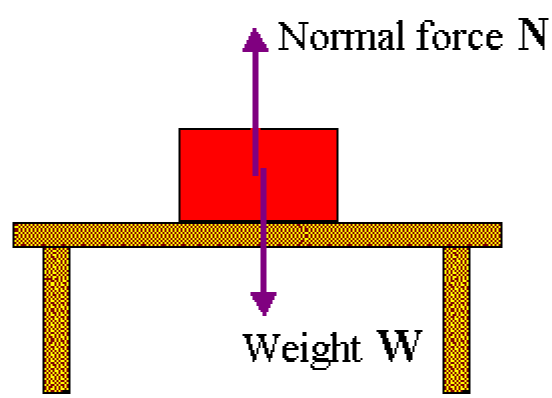


In the same rope T is equal.

Normal force

Normal force (F_N): is the force by the surface on object.

Examples: table on box, cart on suitcase, street on car….



if no other forces are present then ($normal\ force = weight$)

$$F_N = mg$$

Please see example 5 and questions 32-38 on pages 110&111