unit one Force and Motion

lesson one Motion in one direction

In 1964, Japan operated the first fast electric train. The speed of this train reaches 200 kilometers / hour. This train was developed afterwards so that its speed reached 270 kilometers / hour, and it was named " The Bullet Train ". The difference between this " bullet train " and other trains is that each of its carts is operated by an engine of its own. In this way, the train can move at extreme speeds more than the train that consists of a chain of carts pulled by one engine. The "bullet train" can move at an increasing velocity not a decreasing one.
The question is: At what distance from the station does the train start to slow down to stop directly at the platform?

In our daily life, we describe the movement of some objects around us as fast and some others as slow. To compare the movement of objects, we should refer to the physical quantity that distinguishes this description. This quantity is called "speed".

The motion:- it is the change of object's location as time passes according to the location of another object.

Example:

- If two cars – black car and white car – move on the same road (path,) black car takes a time (t1) in covering this path while white car takes time (t2).
- If the time span (t1 second) is less than the time span (t2 second), which of these two cars is faster than the other?

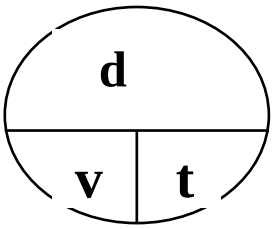
Speed *is a physical quantity which is used to describe and measure the motion of object.*

The two factors necessary for the description of motion

1- The distance that covered by the motion
2- The time taken by the moving body to cover this distance

Speed: *it is the distance moved through a unit time.*

$$V = \frac{d}{t}$$



The measuring unit of **Speed** =m/s
=km/h

G.R. the object's speed increases as time decreases to cover the same distance?

Because $V = \frac{d}{t}$ so the speed of object is inversely proportional with time

G.R. the object's speed increases by increasing the covered distance at constant time?

Because $V = \frac{d}{t}$ so the speed of object is directly proportional with covered distance

What the meant by

1-A train covers a distance 240 km in two hours

This means that the train moves with speed equals 120 km/h

2- A car moves with speed 150km/h

This means that the car covers a distance 150 km in one hour

3- The speed of a car equals zero

This means that the car is at rest

Problems

1- Calculate the speed of runner who run 240 m in one minute?

Solution $V = \frac{d}{t} = \frac{240}{60} = 4$ m/s

2- Find the distance covered by car its speed 20 m/s the time is 20 seconds?

Solution $V = \frac{d}{t} = d = v \times t = d = 20 \times 20 = 400$ m

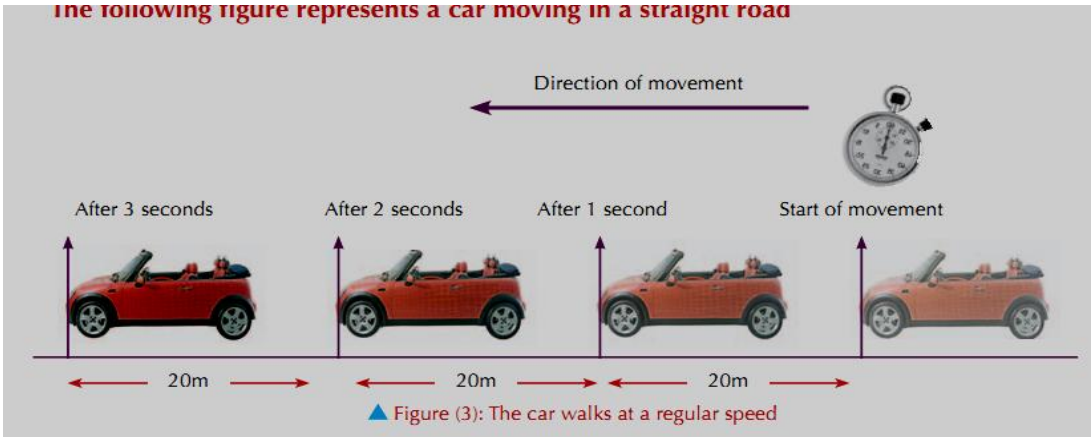
Cars and planes are usually provided with a group of counters as speedometer, mileage, hour timer and compass.

The speedometer helps us in identifying the speed of the car directly

Kinds of speed

1- Regular (uniform) speed

If the speedometer's indicator points to 70, this means that the car's speed is 70 kilometer/hour which is approximately 20 meters/second. If this reading stays constant during travel, we say that the car moves at regular (uniform) speed. This means that the car covers equal distances at equal periods of time.



▲ Figure (3): The car walks at a regular speed

Regular speed

The car covered equal distances in equal periods of time

Or it the change of object's position by equal distances at equal period of time

The Regular speed **can be calculate from the relation**	$V = \frac{\Delta d}{\Delta t}$

Δd is the distance moved during a period of time Δt

What the meant by

1-An object moves at regular speed 400 km/h

This means that the object covers 400 kilometer each 1 hour

Problems

1- Calculate the distance covered by an object moves at regular speed 240 km/h during2 hours ?

Solution $V = \frac{\Delta d}{\Delta t}$ = $\Delta d = v \times \Delta t$ $= 240 \times 2 = 480$ m

2- Calculate the time needed for body moves at regular speed 50 km/h to cover distance of 500km ?

Solution $V = \frac{\Delta d}{\Delta t}$ = $\Delta t = \frac{\Delta d}{v}$ = $\Delta t = \frac{500}{50}$ =10 hours

2- Irregular (non-uniform) speed

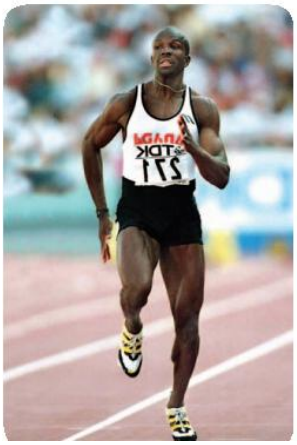
Or the change of object's position by unequal distances at equal periods of time.
Or the change of object's position by equal distances at unequal periods of time

$$\text{Average speed } (\bar{V}) = \frac{\text{total distance moved (D)}}{\text{total time (T)}}$$

Average speed $\bar{V} = \frac{d}{t}$

Average speed السرعة المتوسطة

It the total distance covered by moving object divided by the total time taken to cover this distance



Problems

1- A car record a distance of 100 meters of a straight track in 10 seconds then he returned back waking he took 80seconds to come back to the starting point of running
Calculate the racer's average speed while running and returning ?

Solution

The racer's average speed while running $V = \frac{d}{t} = \frac{100}{10} = 10$ m/s

The racer's average speed while returning $V = \frac{d}{t} = \frac{100}{80} = 1.25$ m/s

The racer's average speed during the whole $V = \frac{d}{t} = \frac{200}{90} = 2.2$ m/s

What the meant by

1-the average speed of a moving car is 40km/h
This means that the total distance covered by the car divided by the total time taken to cover this distance equals 40

Relative speed السرعة النسبية

If there is a person in a car that moves at 80 kilometers in a certain direction. Then, a car moves at 90 kilometers passed him in the same direction. This means that if there is a person standing on the side of the road and he observes the speed of the moving cars (this person is called the observer).

Therefore:

1-The speed of the slow car relative to the observer standing on the ground = 80 km /hour

2-The speed of the fast car relative to the observer standing on the ground = 90 km /hour.

3-As for the fast car relative to the passenger in the slow car is 10 km /hour

The amount of the car's speed differ in relative to the change in the observer's position

Relative speed

It is the speed of moving object relative to an observer

Notices,

1-Measuring speeds depends on the position of the observer who determines the magnitude of this speed. This means that relative speed is the speed of moving object relative to the observer.

We can conclude that:

2-The value of the car's speed relative to the observer standing on the ground differs from the value of the car's speed relative to an observer in another moving car

What the meant by

1- The Relative speed of a moving object to an observer equals its real speed?

This means that the observer is at rest

2-The Relative speed of an object to moves at 70 km/h to an observer equal 100 km/h?

This means that the observer moves in the opposite direction to the moving object with a speed equals 30 km/h

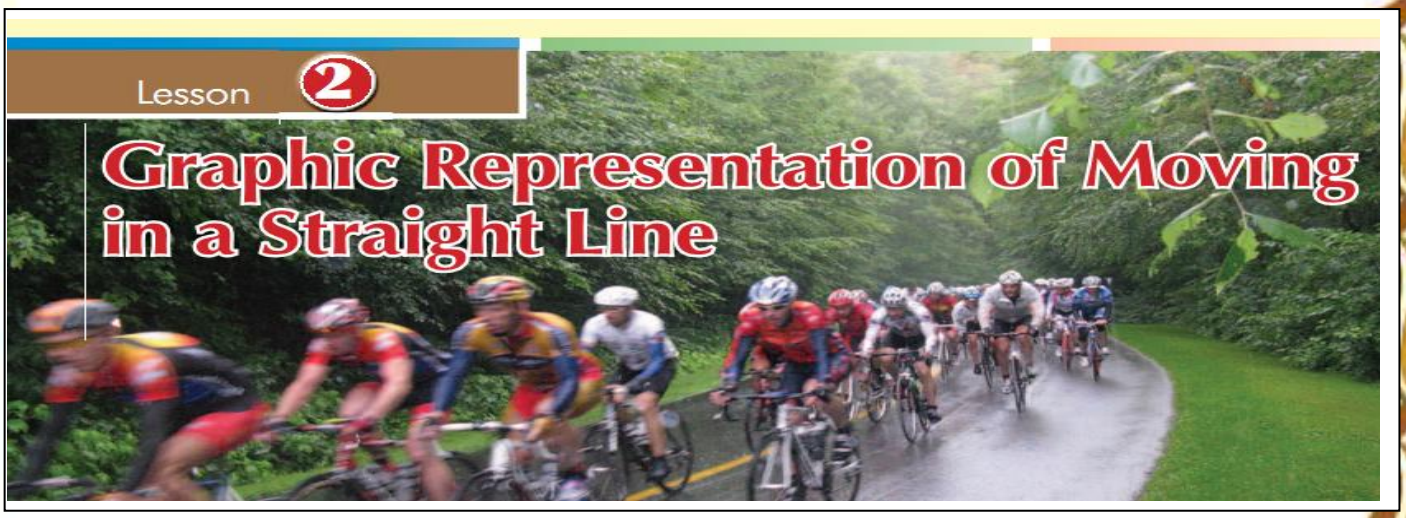
G.R.

1- The moving car seems stable to an observer moves with the same speed and direction?

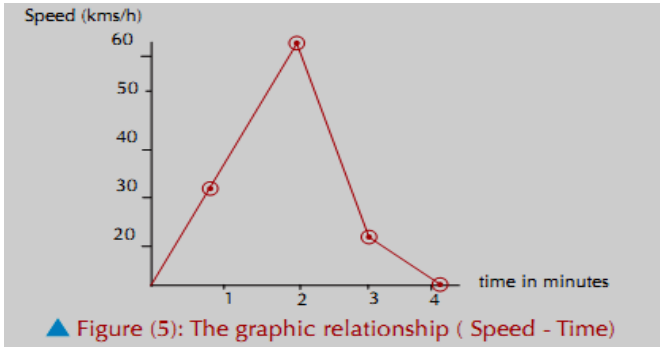
Because the relative speed equals zero (V_1-V_2=zero)

lesson two Graphic representation of moving in a straight line

التمثيل البيانى للحركة فى خط مستقيم



Graphics can possibly represent the relation between speed and time in a moving car.
If the car starts moving from rest (speed = zero) and after one minute its speed becomes 30 km/hour. After another minute, its speed increases to 60 Km/hour.
Then, the motorist had to use the brakes to slow down the car's speed to 20 km/hour in the third minute and he stops completely after another minute. It is possible to represent the movement graphically



▲ Figure (5): The graphic relationship (Speed - Time)

1-Regular speed

Activity

To discover: representing uniform speed graphically

Tools:

A toy car operated by a battery – a smooth wooden board of about 3 meters – a metric ruler or a metric strip – a stop watch

▲ Figure (6) the relation between distance and time

Procedures:

Collaborate with your classmates to do the following activity:

1-Place the wooden board at a horizontal position. Put two marks at a known distance on the wooden board Measure the distance between them (d).

2- Operate the car, and during that, another student calculates the time (t) necessary to cover this distance.

3-A third student repeats the experiment changing the two marks.

4-Exchange tools with your colleagues and repeat the experiment.

5-Write the results in a table.

6-In each time, calculate the speed of the car from the relation: V= d/t.

The following table illustrates some readings that a group of students made:

Time of trial	Covered distance (d) meter	Time covering distance (t) second	Speed V = d/t M/S
1	0.4	5	0.08
2	0.6	7.5	0.08
3	0.8	10	0.08
4	1.0	12.5	0.08

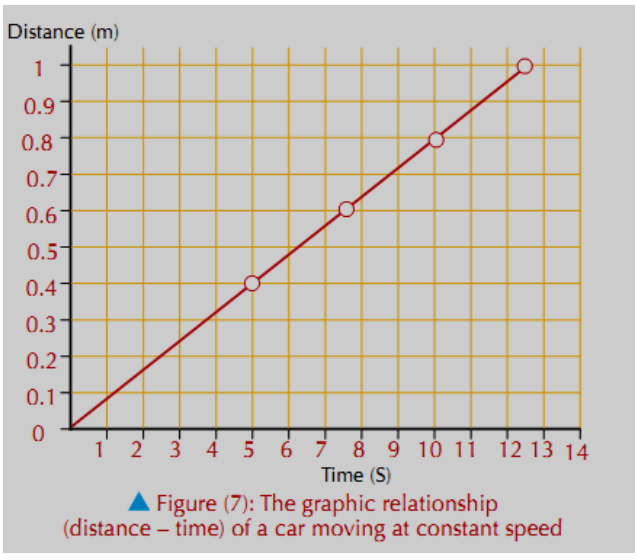
To illustrate

THE RELATION BETWEEN DISTANCE (D) AND TIME (T),

We can draw a graph of the measured quantities. We use distance (d) on the vertical axis (Y axis) and time on the horizontal axis (X axis)

Then, we place the reading in the table in the shape of dots.

When we match these dots together, we find that they are located on a straight line passing the intersection point of the two axes. (the origin point)



▲ Figure (7): The graphic relationship (distance – time) of a car moving at constant speed

Observation

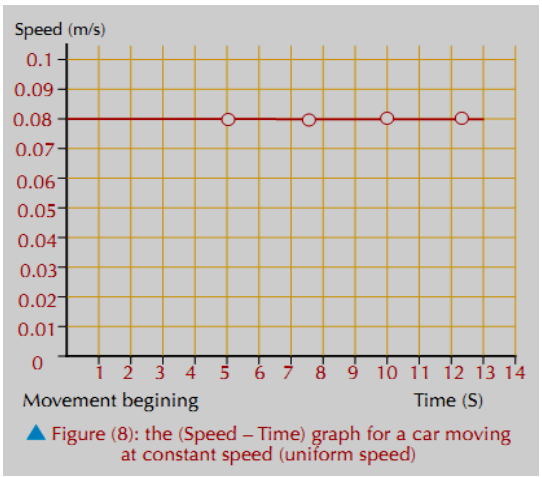
All points lie on a straight line passing the intersection point of two axes (origin point)

Conclusion

- The distance (d) is directly proportional to the time (t)
- The ratio ($\frac{d}{t}$) is constant value which represents the regular speed
- The distance-time) graph for an object moves with uniform speed is straight line passing through the origin point

DRAW THE RELATION BETWEEN SPEED (V) AND TIME (T), we get a graphic relation as shown in the figure.

Use the previous table to draw the graphic relationship between speed (V) and time (t)



▲ Figure (8): the (Speed – Time) graph for a car moving at constant speed (uniform speed)

Observation

All points lie on a straight line parallel To the time (X) axis

Conclusion

- The speed remains constant as time passes
- The (speed-time)graph for an object moves with regular (uniform) speed is a is straight line parallel to the time axis

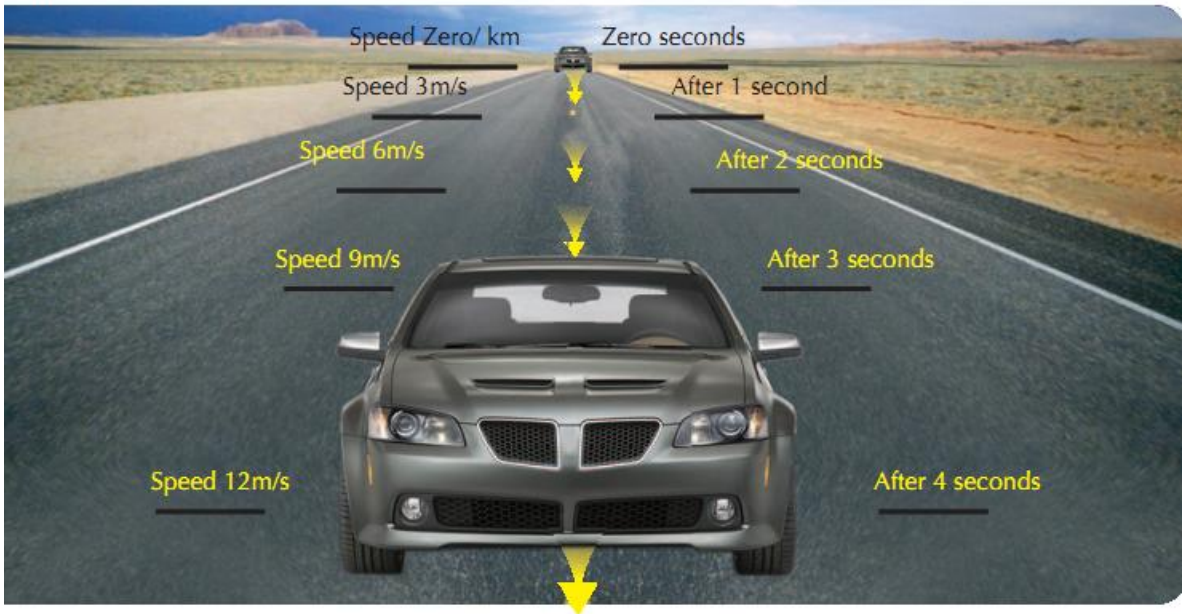
Some facts are clarified about regular movement in a straight line.

1- The (distance-time) graph for regular motion at constant speed is represented by a straight line passing through the origin point
2- The (speed –time) graph for regular motion at constant speed is represented by a straight line parallel to the time axis

2-Irregular speed

What is the concept of acceleration?

If you sit in a car next to the driver and the car starts moving from rest (V=zero) on a straight road,
Notice that the car's speed increases by time. So, after a second the speed equals 3 meters/second.
After two seconds, the speed is 6 meters/second and after three seconds the speed becomes 9 meters/second.
After four seconds, the speed becomes 12 meters/second. To describe the movement of the car in this case, we use a physical quantity that expresses the change in the car's speed in one second. We call it "acceleration"
The car's speed increases at a constant rate (in a specific direction) and this case the movement is described as "accelerating motion". But, if the car's speed decreases each second until it stops, the movement is described as a deceasing acceleration. Acceleration is the result of dividing the change in the car's speed ΔV and the time Δt in which the change occurs



▲ Figure (9): What is the amount of acceleration that the car move with?

$$\text{Acceleration (a)} = \frac{\text{Change in speed } (\Delta V)}{\text{Time } (\Delta t) \text{ in which change occurs}}$$

This means that:

$$\text{Acceleration (a)} = \frac{\text{Final speed (V2)} - \text{initial speed (V1)}}{\text{Time } (\Delta t)}$$

Acceleration

It is the value of change of an object's speed in one second

Notice

A car whose movement starts from rest and then its speed increases to 60 km/h thought 5 seconds.
Another car whose movement starts from rest and then its speed increases to 80 Km /h through 10 seconds.
Which of the two cars is moving at greater acceleration?

The measurement units of acceleration
We previously learnt that the speed measurement units are meters/second and that time measurement unit is second.
∴ Acceleration units =

$$\text{Acceleration units} = \frac{\text{Speed units}}{\text{Time units}} = \frac{\text{Meters}}{\frac{\text{Second}}{\text{Second}}}$$

Acceleration units = meters/second ^{2} = m/s^2
In the previously mentioned example, acceleration is= $\frac{V_1 - V_2}{t} = \frac{12-0}{3}$
= 3 meters / second^2

Acceleration increases عجلة تزايدية **if the object's speed increases by time.**
Its final speed is greater than its initial speed سرعته النهائية أكبر من السرعة الأولي

Acceleration decreases عجلة تناقصية **if the object's speed decreases by time.**
Its initial speed is greater than its final speed سرعته الأولي أكبر من السرعة النهائية

What the meant by

1- An object moves with positive acceleration =5m/sec²?

This means that the object's speed increase by 5m/sec each one second

2-Abody moves with negative acceleration =-2m/sec²?

This means that the object's speed decrease by 2m/sec each one second

Problems

1- A car (A) starts movement from rest and then its speed increases to 60 m/s through 5 seconds, while car (B) starts movement from rest and then its speed increases to 80 m/s through 10 seconds
Which car of two cars is moving at greater acceleration?

Solution

Acceleration of car (A)= $\frac{V_2 - V_1}{t} = \frac{60 - 0}{5} = 12 m/sec^2$

Acceleration of car (B)= $\frac{V_2 - V_1}{t} = \frac{80 - 0}{10} = 8 m/sec^2$

Car (A) moves with greater acceleration than car (B)

Uniform acceleration

An object starts its movement from rest and in a straight line
Its speed record each 5 seconds

Time (t) second	0	5	10	15	20	25	30
Speed (V) meters/second	0	10	20	30	40	50	60

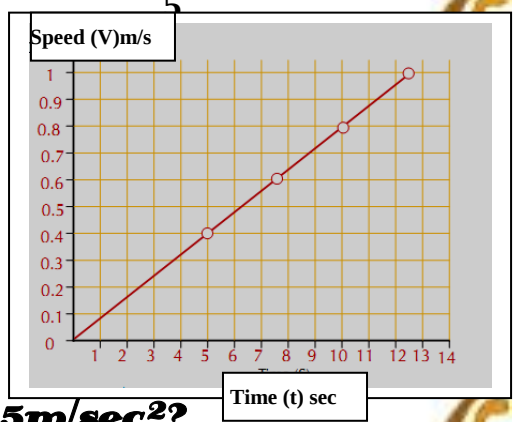
Observation

The object's speed increase during movement
The object's speed increase by 10 m/s every 5 seconds

The object's acceleration in the 1st 5 sec= $\frac{V_2 - V_1}{t} = \frac{10 - 0}{5} = 2 m/sec^2$

The object's acceleration in the 2nd 5 sec= $\frac{V_2 - V_1}{t} = \frac{20 - 10}{5} = 2 m/sec^2$

That means acceleration remains constant



Uniform acceleration

It is change (increase or decrease) of the object's speed by equal values through equal period of time

What the meant by

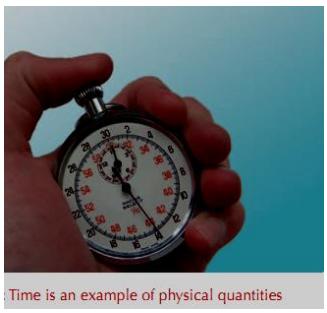
1- A car moves at uniform acceleration =5m/sec²?

This means that the speed changes with 10 m/s each second

lesson three Physical quantities; scalars and vectors

الكميات الفيزيائية القياسية والمتجهة

The description and interpretation of physical phenomena represents the greatest part of physics. To understand these phenomena, it is necessary to deal with physical quantities and mathematical relationships. Each physical quantity is related to a special measurement unit.


Time is an example of physical quantities

Examples of physical quantities are:

Mass – length – time – force…..

ALL PHYSICAL QUANTITIES ARE CLASSIFIED INTO TWO TYPES

1-SCALARS 2- PHYSICAL

1-The Scalar's physical quantities

It is the physical quantity has magnitude only مقدار فقط and has no direction

Scalar physical quantities	Its measuring unit
Mass	Kilogram (kgm)
Length	Meter (m)
Speed	m/s or km/h
Time	Second or hour
Energy	Joule
Temperature	° C or F

2-vectors physical quantities

It is the physical quantity has magnitude مقدار and has direction اتجاه

Vectors physical quantities	Its measuring unit
Acceleration	m/s^2
Force	Newton
Velocity	m/s
Displacement	M
Wight	Newton

▲ Figure (11): Length and mass are examples of standards

Q.R.

1- Length and time are scalar physical quantities?

Because they have magnitude only and have no direction

2- Acceleration and force are vector physical quantities?

Because they have magnitude and direction

Information

- **All scalars are subject to algebraic mathematical operations related to numbers and specially they are added and subtracted if they have the same measurement units.**

تخضع جميع الكميات الفيزيائية القياسية للعمليات الجبرية الحسابية الخاصة بالأعداد فإنها تجمع وتطرح إذا كان لها نفس وحدات القياس

- **All vectors are subject to mathematical operations called vectors algebra.**
- **Vectors have a great importance in different fields of physics, applied sciences like engineering. Understanding various physical phenomena such as gravity, movement of liquids and geometrical establishments depends basically on the main properties of vectors.**

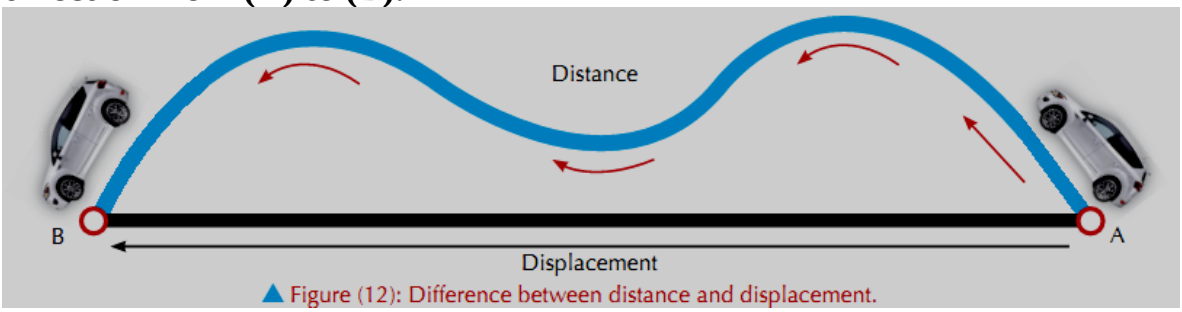
تخضع الكميات الفيزيائية المتجهة لعمليات رياضية تسمى جبر المتجهات

ولها أهمية فى مختلف فروع الفيزياء والعلوم التطبيقية كالهندسة مثل فهم الظواهر الفيزيائية مثل الجاذبية ، والمجالات وحركة السوائل والإنشاءات الهندسية

Distance and displacement المسافة والإزاحة

When a position of an object changes within a period of time, this means that the object has moved. This change accompanying the object does not depend on the path of the moving object but it depends on the shortest path between the start position and the end position where the object stops.

If an object moves from position (A) to position (B) the change in its position is represented by the straight line that starts at point (A) and ends at (B) in the direction from (A) to (B).



▲ Figure (12): Difference between distance and displacement.

▲ Figure (13): The distance difference between Cairo and Tanta.

Exercise:

What is the difference between distance and displacement?

If a person wants to make a trip by car to Tanta starting from Cairo, the distance between

Cairo and Tanta depends on the length of the path that the car takes as in figure (4). Study the previous map and then answer the following questions:

1 If the trip's path is: Cairo – Benha, tanta how long is the covered distance? ..... Kilometer.

2 If the trip's path is: Cairo – Zagazig - Benha, how long is the covered distance? ..... Kilometer.

3 We notice that there is a difference in the value of distance although the two cities Cairo and Tanta are constant.

4 If we assume that the trip between Cairo and Tanta is made directly, the direct distance between is 93 kilometers in a direct line.

In this example:

Cairo represents the start of the trip while Tanta represents the end. Direct movement from Cairo to Tanta represents the change in the position of the moving object. The path (Cairo – Zagazig – Tanta) represents the distance of a possible movement. Also, the path (Cairo – Benha – Tanta) represents another distance of a possible movement.

As for the straight (direct) distance whose start is Cairo and end is Tanta represents the displacement of Tanta from Cairo.

Displacement is characterized by both the magnitude and direction. The displacement of Tanta from Cairo = 93 kilometer in the western north direction.

What is meant by displacement?

It is the length of the shortest straight line between two positions. from the primary position of movement towards the final position. Displacement is the covered distance at a certain direction and it is a vector

What is meant by a distance?

It is the actual length of the path that a moving object takes from the start point of movement to the end point.

Point of comparison	displacement	distance
definition	It is the length of the shortest straight line between two positions. from the primary position of movement towards the final position.	It is the actual length of the path that a moving object takes from the start point of movement to the end point
It is determined by	Magnitude and direction	Magnitude only
Its kind	Vector quantity	Scalar quantity
Measuring unit	Meter or kilometer	Meter or kilometer
Its simple	d	$\overrightarrow{d}$

Velocity

$$\text{Velocity} = \frac{\text{displacement}}{\text{total time}}$$

It is the rate of change of displacement

Or

It is the displacement covered in one second

▲ Figure (14): The cheetah (the fastest animal in the world)

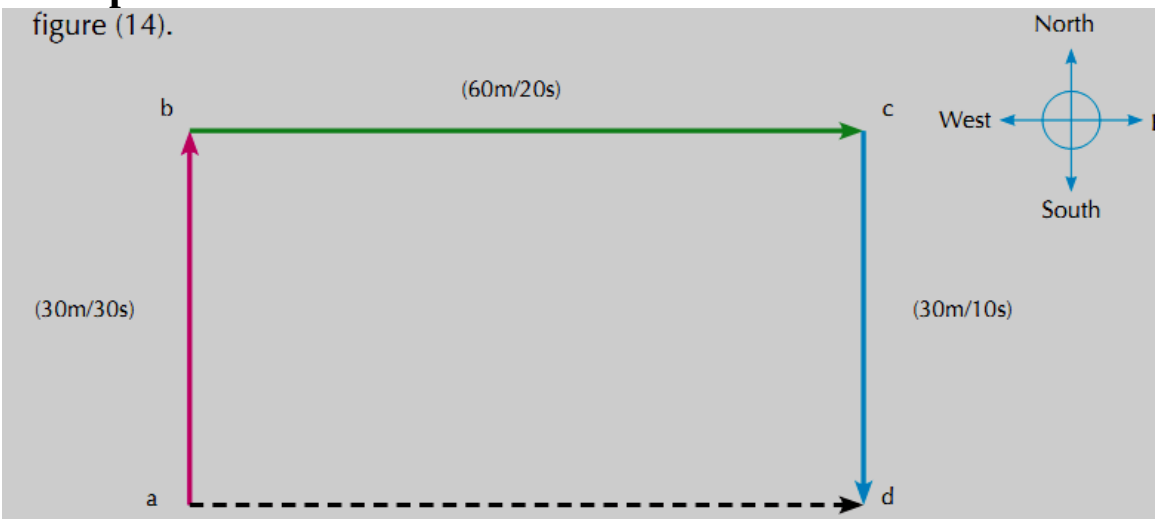
The predator (cheetah) **is one of the fastest animals as it is possible that its speed reaches 27 m/minute. If we want to represent its velocity, we should define the direction of its movement. We say for example that cheetah's velocity = 27meters/minute in the east direction.**

How can we calculate the Velocity?

Based on previous observations, the velocity is a vector quantity. To determine it accurately, it is necessary to identify its magnitude and direction. Calculating the average velocity can be done through the following relationship:

$$\text{Average velocity} = \frac{\text{displacement}}{\text{total time}}$$

This means that the velocity is the displacement in one second.
It has the same speed units (meter / second or kilometer / second)
Example:



Person covered 30 meters from (A to B) within 30 seconds
Then 60 meters eastward from (B to C) within 20 seconds
And 30 meters southward from (C to D) within 10 seconds
The pass of person is A ⟶ B ⟶ C ⟶ D
The start point is (A)
The end point is (D)
The distance covered by the person = 30+60+30=120 m
The total time that the person took to cover this displace =30+20+10=60 sec
The direct dotted منقط line between (A) and (D) in the direction $\overrightarrow{AD}$ represents the displacement
The displacement = 60m in the eastward direction

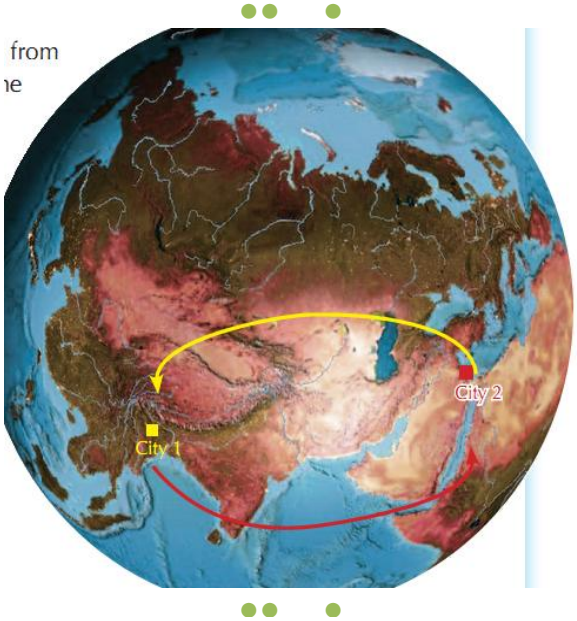
The average speed of the person = $\frac{\text{Total distance}}{\text{total time}} = \frac{120}{60} = 2\text{m/s}$

The average velocity of the person = In the eastward direction $\frac{\text{displacement}}{\text{total time}} = \frac{60}{60} = 1\text{m/s}$

Point of comparison	Speed	Velocity
definition	It is the distance covered in a unit time	It is the displacement covered in a unit time
It is determined by	Magnitude only	Magnitude and direction
Its kind	Scalar quantity	Vector quantity
Measuring unit	m/s or km/h	m/s or km/h

Technological application

The Earth revolves itself in a complete round every 24 hours. The movement of the Earth results in the movement of winds above its surface. On their flights, pilots take into consideration the directing speed of the wind in order to calculate the amount of fuel necessary to complete the trip.



If we assume that a plane flew from city (1) to city (2) and at the same time a plane flew from city (2) to city (1), The first plane flying from city (1) to city (2) takes a longer time than the second plane from city (2) to city (1). This is because the first plane flies in the reverse direction of the wind and consequently wind resistance is greater. So, it needs larger amount of fuel than the second plane although the covered distance is constant for each of the two planes.

unit two Light Energy and light Energy

lesson one Mirrors

▲ Figure (3): The word «ambulance» is laterally inverted, why?

The human being noticed that when he looked at the still water surface, he could see an image of his face in the water, and he also noticed the images of the high buildings that are constructed near the still water. Moreover, if you look at the shinning smooth surface (like the mirror) you can see an image of your face. All this happens as a result of the reflection of light (its bouncing off) on the water surface or the mirror surface.

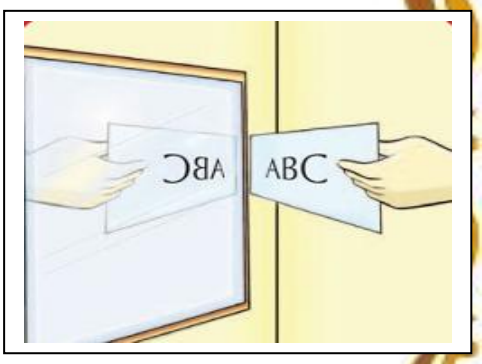
Light Reflection

It is the phenomenonظاهرة of the light bouncing off in the same medium when it meets a reflecting surface

Activity

The properties of the image formed by the plane mirror

The material: A plane mirror -a card with some letters written on it.



The steps:

Collaborate with your colleagues to accomplish this activity by preparing a white carton paper and writing some alphabet letters on it.

1- Place the card in front of the mirror that is fixed vertically.

2 Record your observation on the properties of the image formed in the plane mirror.

The properties of the image of the objects formed by the plane mirror

1- The image is upright
2-The image is equal to the object.
3 -The image is laterally inverted.
4 -The image is a virtual image (cannot be received on a screen)
5 -The distance of the object to the mirror = the distance of its image to the mirror.
6-The straight line connecting the object and its image is perpendicular on the surface of the mirror

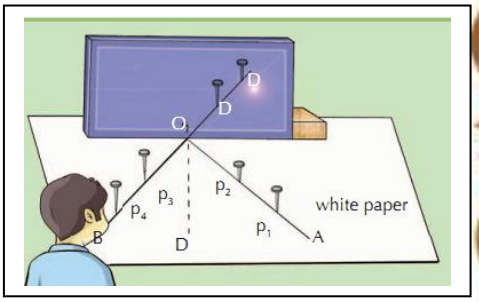
G.R.

1- The word Ambulance is written in a converted way on the Ambulance car ?

To appear in the mirror of the cars in front of Ambulance written in correct way and can be read by the drivers

Activity to discover: The two laws of light reflection

Steps:



1 -Draw a straight line (xy) on the white piece of paper, then place the plane mirror in a perpendicular position where the edge of the reflective surface aligns on the line (XY).
2-Draw a line (OD) perpendicular on the line (xy). This line is called the normal.
3-Draw a straight line (Ao), which represents the incident light ray on the mirror. Make an angle with the column (angle of incidence) and place two pins (p1) and (p2) horizontal on the line.
4-Look at the other side of the mirror and see the images of the pins (p 1) and (p2), and place two pins (p3) and (p4) to be as straight as (p 1) and (p2), .
5-Lift the two pins (p3) and (p4) and connect between their positions with a straight line extending it until it meets the reflecting surface at point (o). This line (Bo) represents the reflecting ray.
6-Measure the angle that (Bo) makes with the normal, and this is the angle of reflection
7-Repeat these steps by changing the value of incidence angle by using the protractor and assign each time the reflection angle.

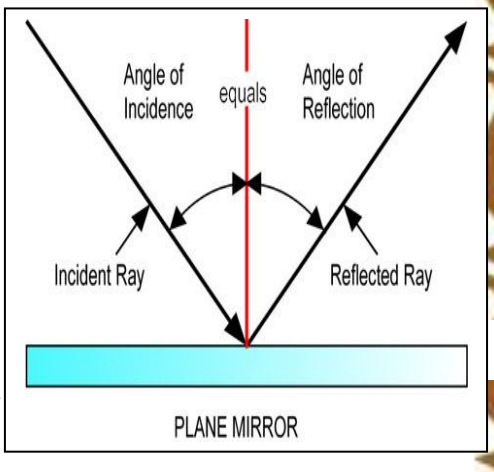
The Results

Laws of the reflection of light.

1 -First law: angle of incident = angle of reflection.
2 -Second law: the incident light ray and the reflected light, Ray and the normal all lie in one plane perpendicular to the reflecting surface

Concepts concerning reflection of light. المفاهيم المتعلقة بانعكاس الضوء

When a ray of light strikes a reflecting surface, it is reflected in the same medium.



1. **The incident ray**: it is the light ray that falls on the reflecting surface.
2. **The reflected ray**: it is the light ray that bounces from the reflecting surface
3. **Angle of incidence**: it is the angle between the incident ray and the normal.
4. **Angle of reflection**: it is the angle between the reflected light ray and the normal.

G.R.

1- The incident ray which falls perpendicular on a reflecting surface reflect on itself ?

Because the angle of incident and the angle of reflecting = zero

- **The spherical mirrors**

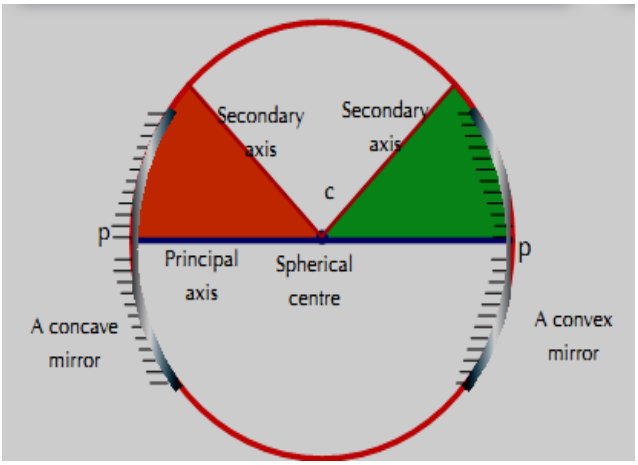
  It is a mirror that its reflecting surface is a part of a hollow sphere, and there are two types of the spherical mirrors. spherical mirrors.

The types of the spherical mirrors

Convex mirror (diverge)	Concave mirror (converge)
its reflective (shinning) surface is a part of the outer surface of the sphere	its reflecting (shinning) surface is a part of the inner surface of the sphere
it collects light rays after reflection	it diverges light rays after reflection

Identify the concave mirror and the convex mirror.

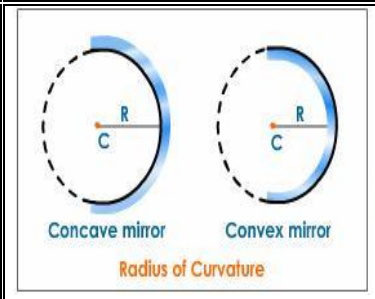
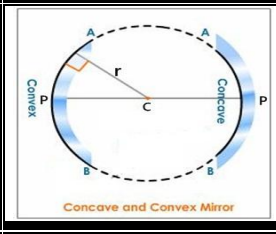
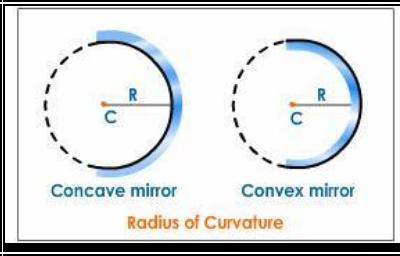
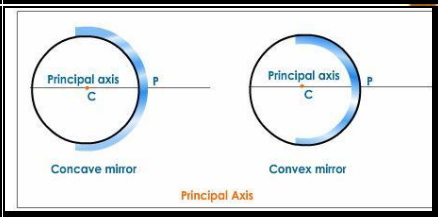
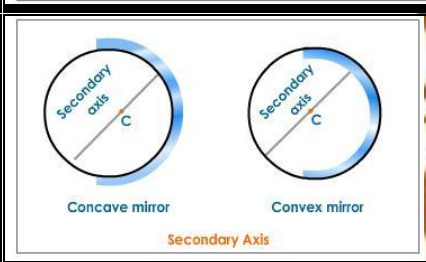
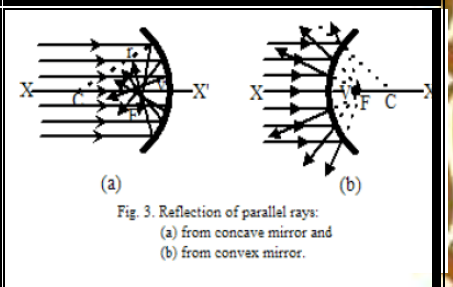
Study the previous figure and identify the concepts that benefits you when are studying how the image is formed by the spherical mirrors:



G.R.

1- The stainless -steel spoon is considered as a spherical mirror?

Because the its inner surface is concave mirror while the its outer surface is convex mirror

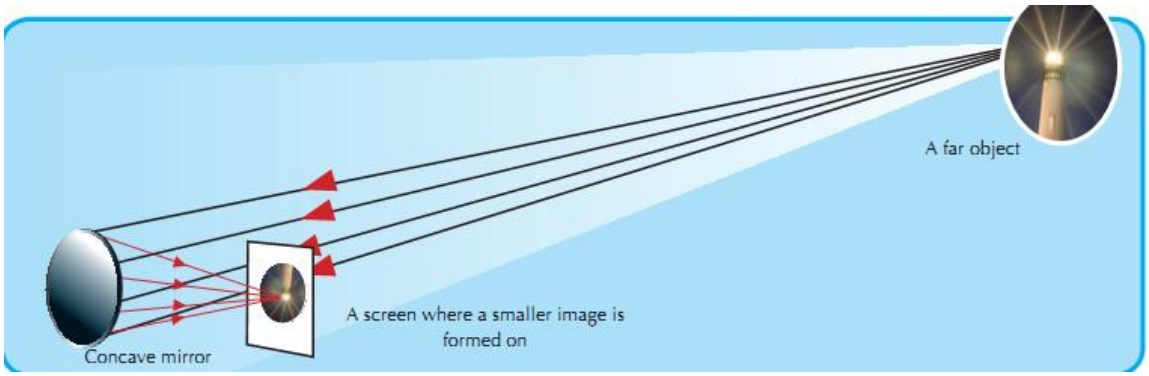
Concept	Definition	Figure
1-Centre of mirror curvature (C).	**Is the Centre of the sphere that the mirror is considered a part of.** The position of the center of curvature of the concave mirror (in front of the reflecting surface In the convex mirror behind the reflecting surface).	
2-The radius of curvature of the mirror (r).	**Is radius of the sphere that the mirror is a part of the radius of curvature of the mirror (r).**	
3-The pole of the mirror (p)	**Is the point that is in the middle o the reflective surface of the mirror**	
4-The principal axis (cp)	**Is the straight line that passes by the pole of the mirror and its center of curvature**	
5-The secondary axis	**Any straight line that passes by the center of curvature of the mirror and any point on its surface besides the pole of the mirror**	
6-The focus of the concave mirror	**it is the point collection of the reflected light rays (in the concave mirror)** **real in case of the concave mirror** **virtual in case of the convex mirror**	 Fig. 3. Reflection of parallel rays: (a) from concave mirror and (b) from convex mirror.
7- focal length of the mirror (f)	**It is the distance between the focus of mirror(f) and its pole(P)**	

Each spherical mirror has uncountable number of secondary axes and only principal axes

Activity to Determine the focal length of the concave mirror.

The materials:

A concave mirror - screen.



The steps:

1-Place a concave mirror facing the sun ray
2-Move the screen in front of the reflecting surface of the mirror to obtain the smallest and clearest image (lit point), it is "the focus of the mirror"
3 -Measure the distance between the lit point and the pole of the mirror, this distance is the focal length (f) of the concave mirror.

Conclusion:

1-The rays after being reflected from the concave mirror collect in one point that can be received on a screen
2-The point of the collection of the parallel rays after being reflected from the concave mirror is called *THE FOCUS OF THE CONCAVE MIRROR*
3-The distance between the focus of the concave mirror and its pole is called *FOCAL LENGTH OF THE MIRROR*

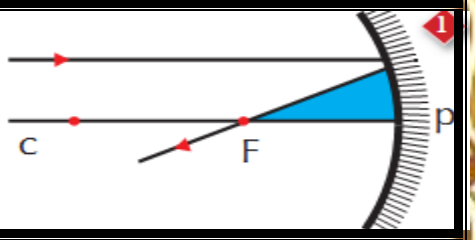
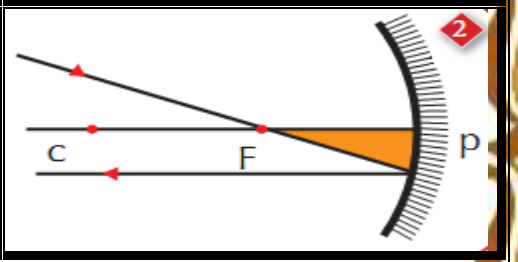
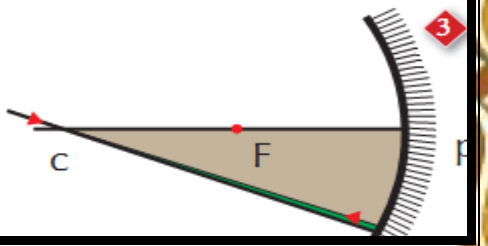
The focus of the concave mirror the point of the collection of the parallel rays after being reflected from the concave mirror

focal length of the mirror The distance between the focus of the concave mirror and its pole

Focal length = 1/2 ×radius of curvature f= 1/2 R

Real image	Virtual image
It is the image that can be received on screen	It is the image that cannot be received on screen
It formed as result of the intersection of reflected light rays	It formed as result of the intersection of extensions light rays
It is always inverted مقلوبة	It is always upright معتدلة

The image formed by the concave mirror

The path of the incident ray	The path of the reflected ray	Explanation Figure
The incident light ray parallel to the principal axis of the mirror.	It reflects passing through the focus F	
The incident light ray passing through the focus F	It reflects parallel to the principal axis	
The incident light ray passing through the Centre of curvature C	It reflects back on itself	

Exercise:

The cases where the images are formed by concave mirror (converge).

To determine the position and characteristics of the images formed by the concave mirror, follow the following steps:

1- Use the protractor in drawing a spherical surface and its center is (c) that represents the concave mirror.

2-Draw the principal axis and determine on it the position of the focus then draw a vertical arrow on the principal axis to represent an object. Determine the centre of curvature where the radius of the sphere equals twice the focal length.

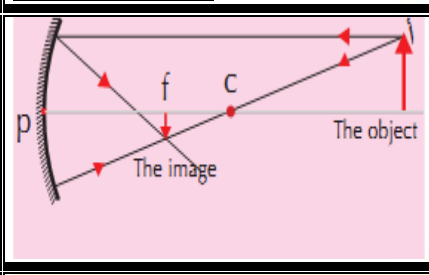
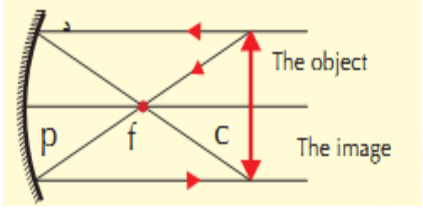
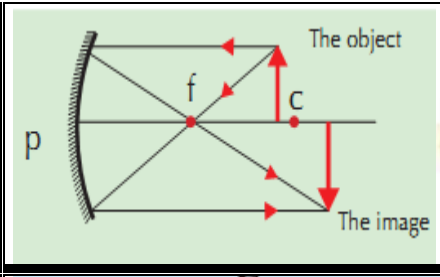
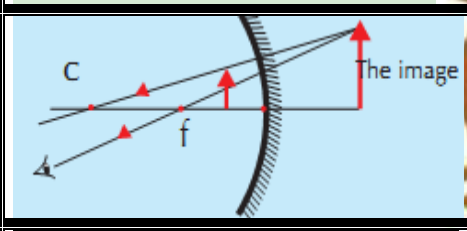
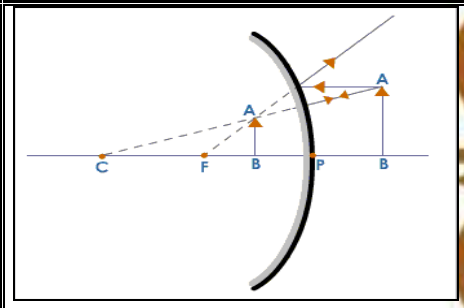
3-Draw the ray from the highest point in the object where it falls parallel to the principal axis and thus reflects passing through the focus.

4- Draw another ray passing through the spherical centre of the mirror then reflects on itself (why does the ray reflect on itself)?.

5- Determine the position where the two reflecting rays meet, which is the image of highest point on the object.

6-Determine the position and characteristics of the images formed in the four cases shown in the following table, and compare the results you obtain with that indicated in the table.

The Properties of the image formed by the mirror

Position of the object	Position of the images	Characteristics of the images	The cases of image formation
At a distance larger than the radius of curvature.	Between the focus and the centre of curvature	Real – inverted – small in the object	
At the centre of curvature of the mirror.	At the centre of curvature of the mirror	Real - inverted. Same size as object	
Between c And (f).	At a distance greater than the radius of curvature.	Real - inverted larger than object	
Between (f) and (p).	Behind the mirror	Virtual upright magnified	
The formation of the images on a convex mirror	The images of the object in front of a convex mirror is always	smaller than the object, upright and virtual (not received on a screen)	

G.R.

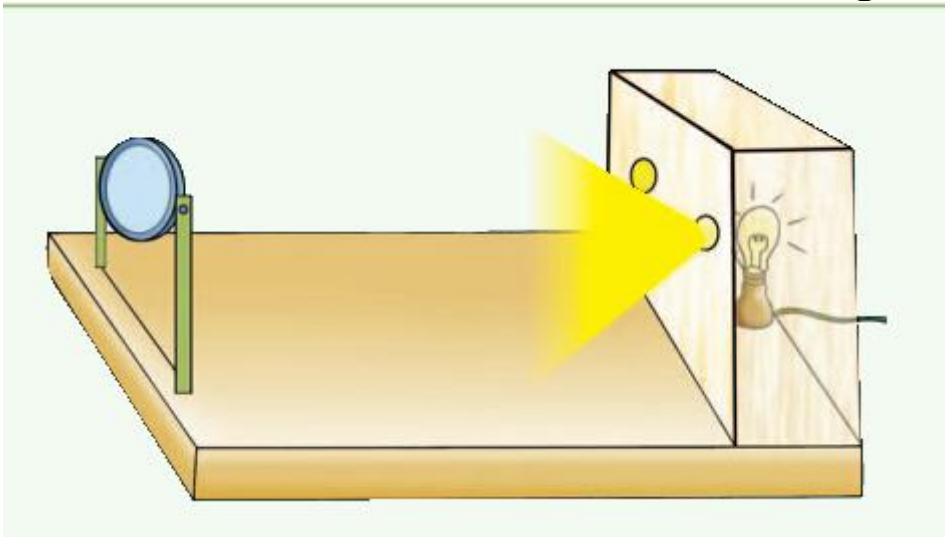
1- Concave mirror is used in solar ovens and solar furnaces الافران الشمسية?

To collect a large amount of solar energy in the focus of mirror for cocking food or melting metals

Activity:
Determine half the radius of the concave mirror.

The materials:

A concave mirror – a holder for the mirror – light box with a hole



The steps

1-Place the mirror on a holder in front of the light source (lit hole).
2-Move the mirror nearer and farther until an image of the hole is formed next to it and is equal to it.
3-Measure the distance between the mirror and the hole, it is equal to the radius of curvature of the mirror.

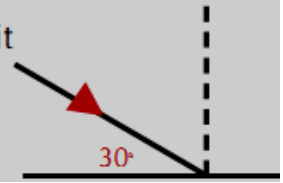
Deduce:

The focal length of the mirror (f) = R/2

The uses of convex mirror

1-on the passing side of car to form an erect and smaller image for the way behind the car
2- It used in the turning off the road and sprking

b A light ray that fell on a plane mirror as in the figure it reflects where the reflection angle equals:
1- 30° 2- 60° 3- 90°



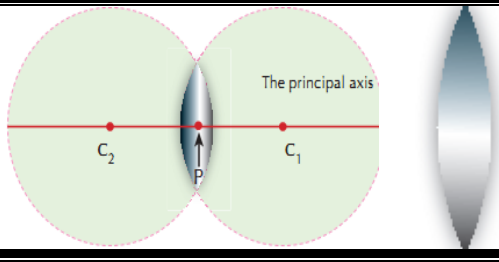
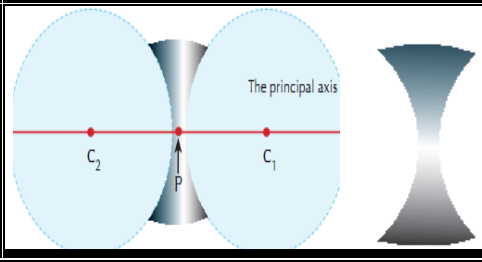
lesson two Lenses

You have noticed that many people need the medical eye glasses either for reading or walking. You could see the person who fixes the watches use a magnifier to see the minute parts of the watch. In the war, the leaders use a magnifying glass to follow the battles.
In all these previous cases the human being uses an important optical piece called "the lens".

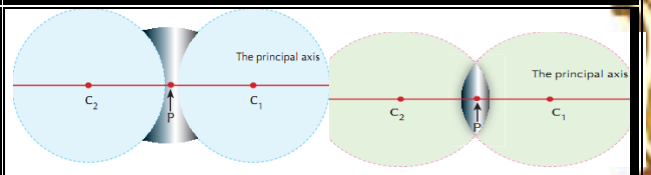
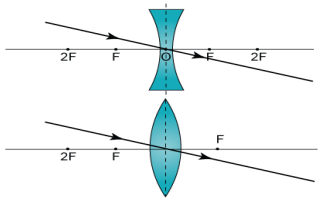
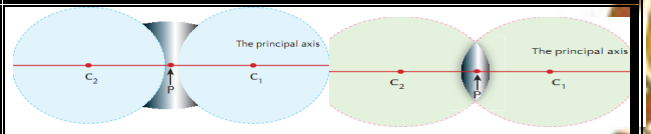
Lens

It is a transparent medium that refracts the light and is defined with two spherical surfaces and is usually made of glass or plastic

The types of lenses:

	Convex lens (converging)	Concave lens (diverging)
Its structure	It is thick at the centre and less thickness at the tips.	It is thin at its centre and thicker at the tips.
Its function	Collect the light rays falling on it so it is called converging lens	diverge the light rays falling on it so it is called diverging lens
		

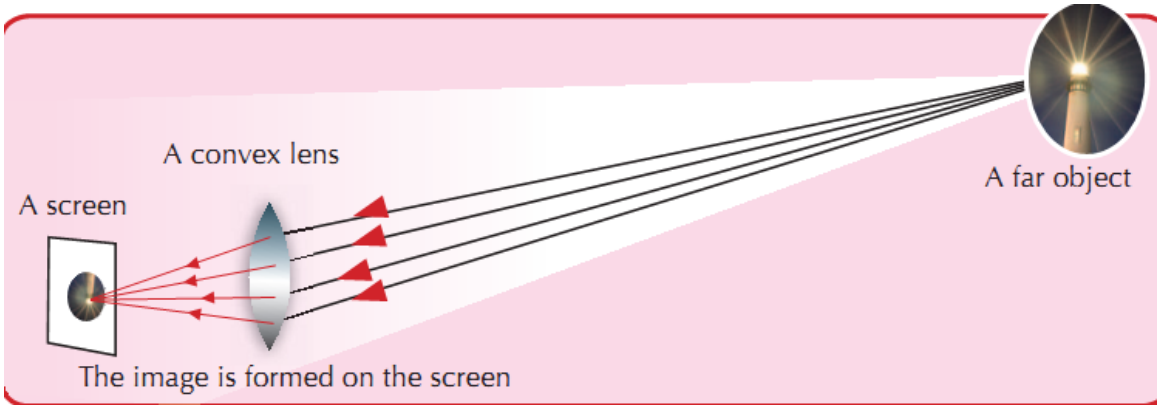
Study the previous figure and identify the following concepts:

Concept	Definition	Figure
1-The centre of curvature of the lens face (c):	Is the centre of the sphere where this face is a part of it .	
2-The optical centre of the lens (p)	Is a point inside the lens placed on the principal axis in the mid distance between its faces .	
3 -The radius of curvature of the face of the lens (p):	Is half the radius of the sphere where the face is a part of	
4-The principal axis	Is the line between the optical centre of the lens passing by the optical centre of the lens	

First: The convex lens

The focus of the convex lens (converging):

If the sun ray or any light from any distant source fall on the lens we notice that ray passing through the lens is collected in one point called "the focus of the lens".



Activity **Determine the focal length of the convex lens**

Materials: A convex lens - screen - lens holder - distance source of light (can use the sun ray)

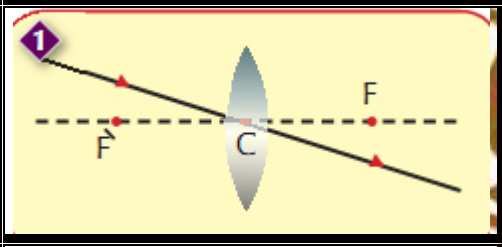
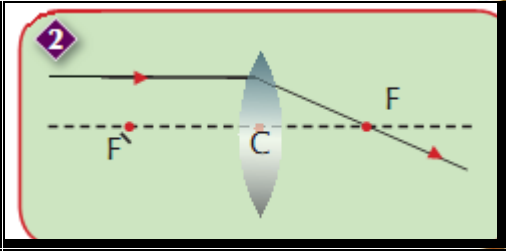
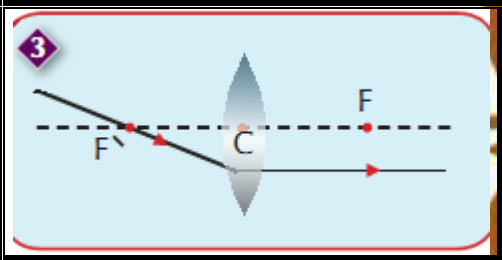
The steps

1- Place the lens on a holder where the distance light source is facing one of its faces.

2 -place a horizontal screen on the other side of the lens and move it closer and farther from the lens until you get the lit point which is the «focus of the lens».

3-Measure the distance between this point and the optical centre of the lens which is the focal length (f) of the convex lens.

The path of rays falling on the concave lenses

The path of the incident ray	The path of the reflected ray	Explanation Figure
The incident light ray passing through the optical centre of the lens continues	pass inside the lens and passes without refraction	
The incident light ray parallel to the principal axis,	exits the lens passing through the focus	
The incident light ray passing through the focus,	exits the lens parallel to the principal axis	

The cases of the formation of the images by the convex lens (collective).

To determine the position and characteristics of the formed image by the convex lens, follow the following steps:

1-Use the protractor and draw the convex lens

2-Draw the principal axis of the lens (it is a straight line passing by the focus and the optical centre of the lens).

3-Determine on it the position of the focus (f) and twice the focal length (c) on the principal axis from both sides of the lens.

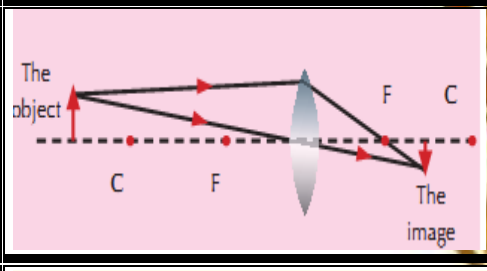
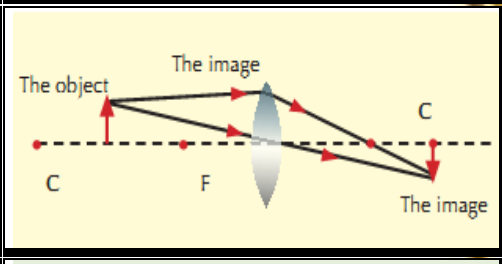
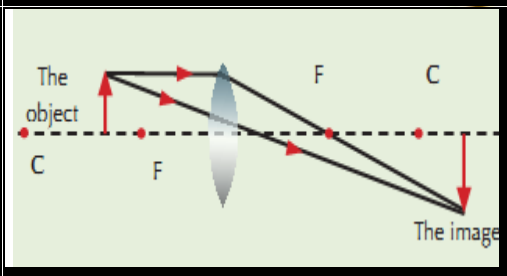
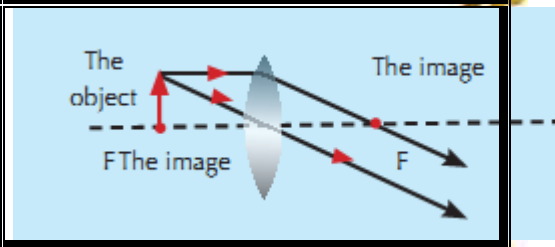
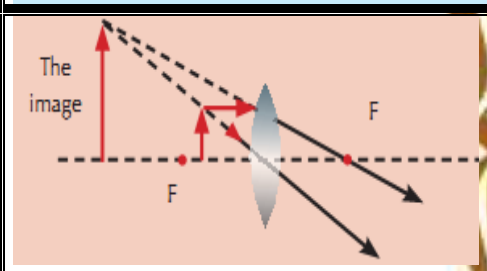
4-Draw a ray coming from the highest point of the object so it falls parallel to the principal axis thus refracts and leaves the lens and passes through the focus

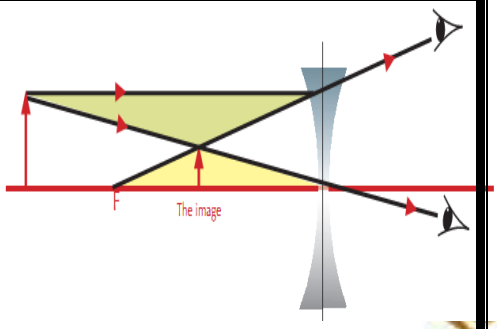
5-Draw a ray from the same point passing by the visual centre of the lens thus leaves with no refraction.

6-To determine the position when two respected of the two penetrating rays determines the image of the lit point.

7-Determine the position and characteristics of the images formed in the six cases shown in the following table and compare the results you obtain to those present in the table.

The Properties of the image formed by the lenses

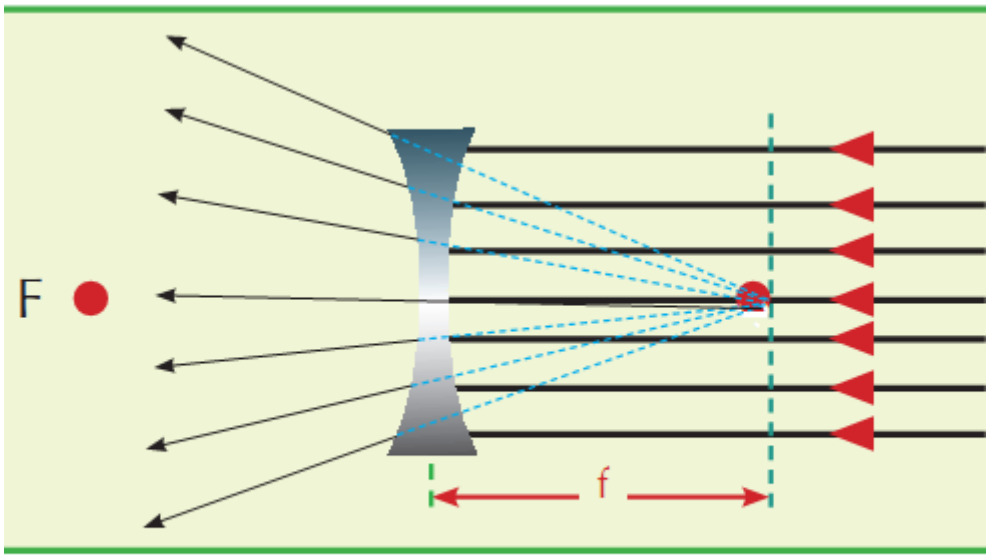
Position of the body	Position of the images	Characteristics of the images	cases of image formation
More than twice the focal length	Between the focus and twice the focal length	Real, inverted, and smaller the object	
At twice the focal length	At twice the focal length	Real, inverted and equal to the object	
Between the focus and twice the focal length	At a distance large than twice the focal length	Real, inverted and enlarge	
At the focus	No image is formed	No image is formed	
At a distance smaller than the focal length	Forms in front of the lens at the object side	Virtual, upright and enlarged	

The image formed by the concave lens: the image of the object is formed		The image formed by the concave lens is always virtual, smaller and erect.	

Second: The concave lens

The focus of the concave lens:

If parallel rays fall on the concave lens, the rays passes through the concave lens and leaves from each other (diverging) as if it is produced from a point in front of the lens and is called "The diverging focus of the concave lens" and it is a virtual point (cannot be received on a screen). The lens is also known in this case as the diverging lens because it diverges the rays after they pass through it.



▲ Figure (19): The virtual focus of the concave lens

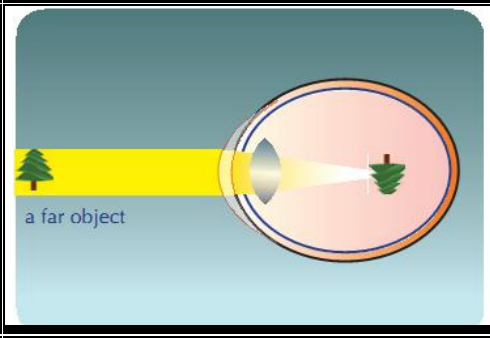
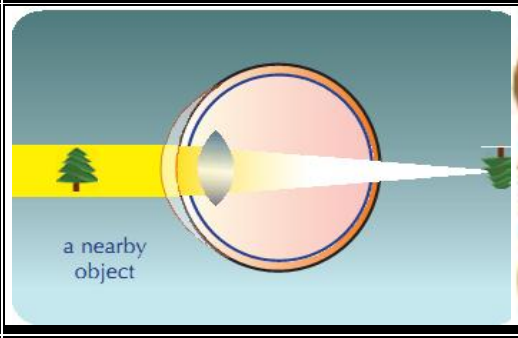
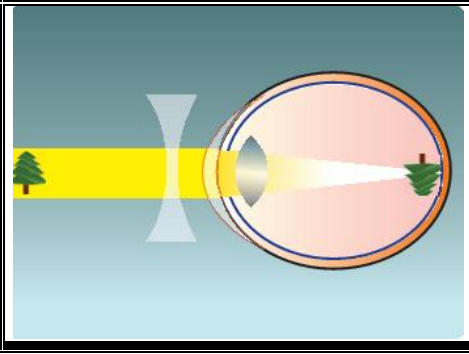
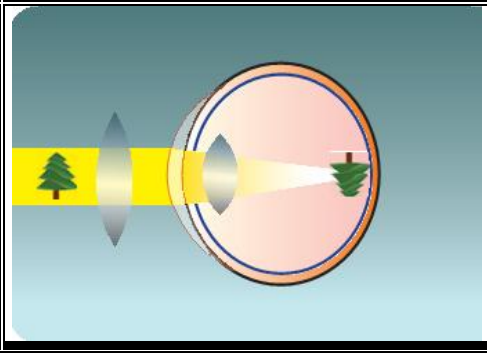
The use of lenses to treat the vision defects

The most important of the vision defects: short-sightedness – long-sightedness.

These defects occur because the eye cornea is not always convex, or the eye is not always spherical. The person with normal vision sees the far object clearly (the far object according the normal eye is present at 6m). This clear vision remains if the object comes closer not less than 25 cm.

The use of lenses to treat the vision defects

استخدام العدسات لعلاج عيوب الرؤية

	Short-sightedness	Long - sightedness
The images of near objects	Can be seen clearly	Cannot be seen clearly
The images of far objects	Cannot be seen clearly	Can be seen clearly
The position of the images concerning the retina شبكية العين	In front of the retina	Behind the retina
4- causes	The diameter of the eyeball is too large Or The lens is too convex	The diameter of the eyeball is too short Or The lens is thin
The correction	By using a concave lens	By using a convex lens
short- Long sightedness		
Correcting short- Long sightedness		

Contact lenses:

The contact lenses are used instead of the glasses. It is very thin lenses made of plastic, and can stick to the eye cornea by the eye fluid

Science, Technology, and Society

Enriching activity

Land measurement.

Land surveyors and topographical scientists use a mirror provided with later ray to determine heights and distances and to make very accurate measurements to calculate the time that a light beam bounced from a distant point and returns to its source.

History

According to the old Greek legend

that Archimedes knew a lot about mirrors and the use of sunlight as a weapon against the Roman fleet that invaded sicily صقلية in ZIZ B.C.

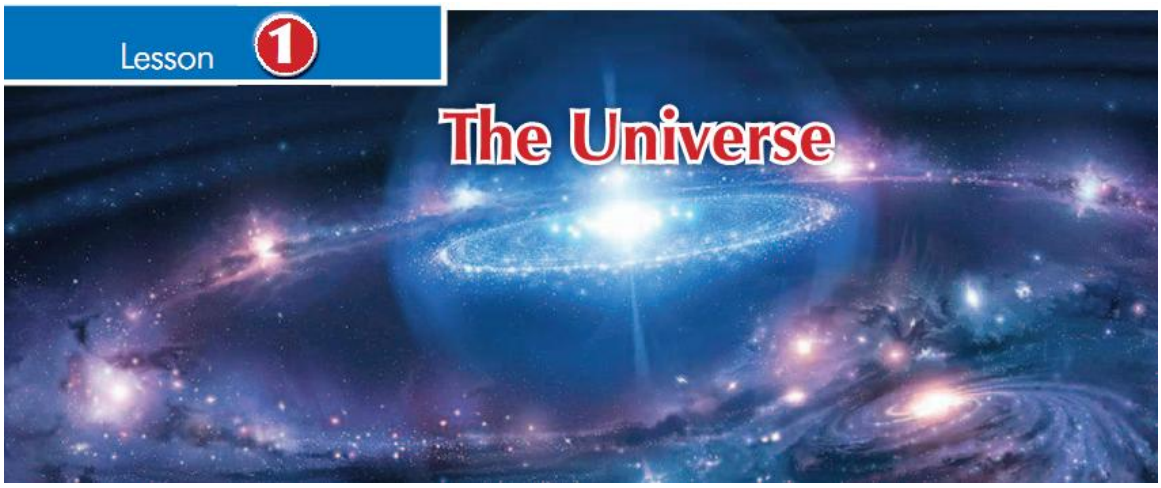
A huge concave mirror was placed to collect the sun ray and directed towards the sails of ships so as to generate extreme heat that led to the burning of these sails and turning them to glazing balls fire.

Science integration (Uedicine)
Cataract

The eye gets injured by same diseases. This is due to some reasons.
Cataract is one of the most dangerous diseases that injure the eye as a result of old age, illness, side effects of drugs in addition to genetic readiness. When the eye gets injured the eye lens becomes dark. Treatment is done through surgery to exchange the eye lens with a plastic lens transplanted permenantly in the eye. In this way, the person can see again and clearly .

unit three
The Universe and the Solar System

lesson one The Universe



Universe الكون

The universe is the space which contains all the galaxies, stars, planets, moons and living organisms and everything.

The universe is vast beyond comprehension. The sun and the earth are a tiny part in the universe.

In the universe groups of stars are gathered to form galaxies . المجرات

The universe contains many galaxies and each galaxy مجرات has a distinctive shape according to the harmony and order of the groups of stars in it. The sun is one of the stars of our galaxy (Milky Way).

The Milky Way درب التبانة

In the centre of the galaxy a lot of old stars gather surrounded by small stars located in the spiral arms of the galaxy. Our sun is a star of millions of stars in this galaxy.

The universe.	**It is a wide and extended space that contains galaxies. The number of galaxies in the universe is about 100,000 million galaxies**
Galaxies.	**Galaxies gather in clusters including the Milky Way which contains the sun.**
The Milky Way	**It contains the sun and the solar system.**
The solar system.	**It is the sun and eight planets revolving around it**
The earth	**The planet of life**

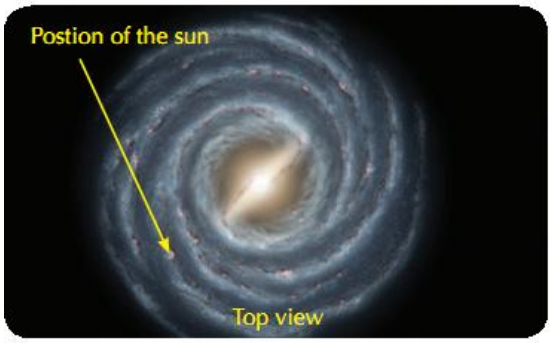
G.R. The Milky Way is given that name?

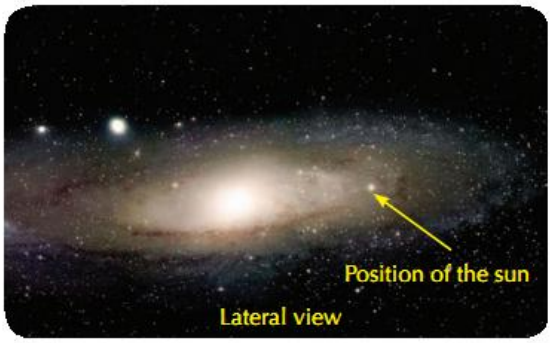
Because it appears in the sky at night as a splashing milk or spreading straw.

The ancient myths explain that by the milk spilled when Hercules the baby was fed from the god's breast.

The solar system

Planets revolve around the sun and the sun and the surrounding planets revolve around the centre of the galaxy (Milky Way). The sun takes about 230 million years to complete one rotation around the centre of the galaxy. The solar system is located in one of the spiral arms of the Milky Way on the edge of the galaxy.





How did the universe originated?

Many scientists believe that the universe emerged from a massive explosion called the Big Bang الانفجار الكبير 15000 million years ago which resulted in all forms of matter, energy, space and time. There was no one to relate what happened. But the outstanding discoveries in physics and astronomy enabled scientists to trace the history of the universe from the first second fraction of its evolution. They believe

that the universe matter was a gaseous ball of high pressure and high temperature in a small volume. It is in a constant expansion. The Big Bang theory had been developed since 1933.