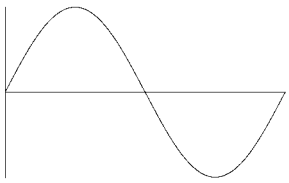
Waves, cycles and oscillations



1 wave = 1 cycle = 1 oscillation

Frequency (f) S.I. unit: Hertz (Hz)

Definition:

It is the number of waves in _____ second.

If 5 waves are generated in one second, then the frequency = _____.

If 100 waves are generated in one second, then the frequency = _____.

The frequency of a wave can only change if the frequency of the source changes.

If you dip your finger in water 3 times in 1 second, your frequency (the source) is 3Hz and the frequency of the waves is also 3Hz as 3 waves are produced every second. If the waves move in deep or shallow water the frequency will still be 3Hz as you would still be producing 3 waves in one second. Unless you change your frequency (source), the frequency of the waves will not change.

Periodic Time (T) S.I. unit: seconds (s)

Definition:

It is the time taken to complete one wave.

If it takes 3 seconds to complete one wave, then the periodic time = _____.

If it takes 0.2 seconds to complete one wave, then the periodic time = _____.

$$f = \frac{1}{T} \quad \text{and} \quad T = \frac{1}{f}$$

Example:

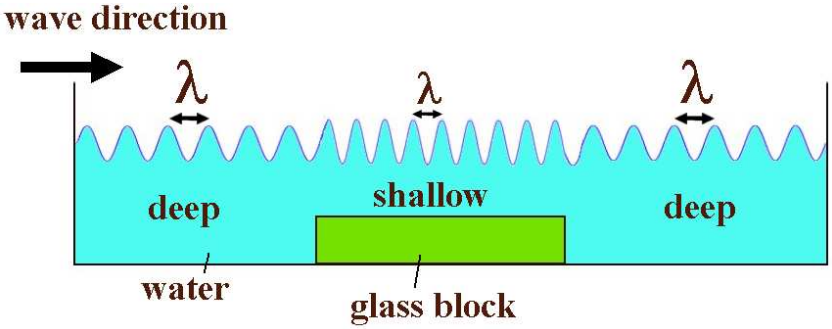
If 5 waves are produced in one second, find: a) the frequency, b) the periodic time.

_____

_____

Refraction of water waves

http://www.youtube.com/watch_popup?v=r0088hYFuws

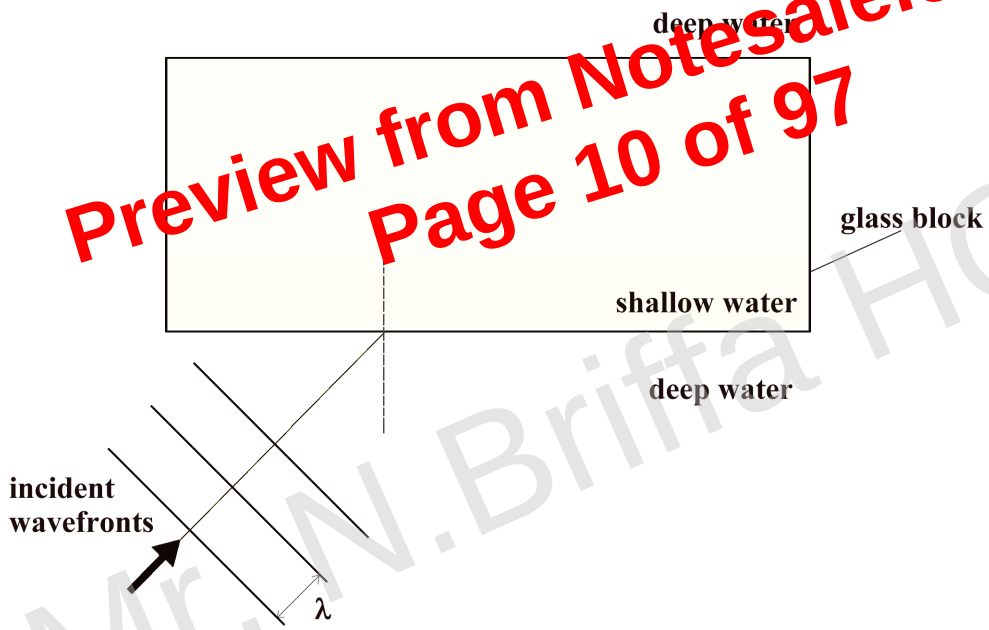


When water waves change the depth, they change direction because they change their _____.

Underline the correct answer:

When the wavefronts pass from **deep water to shallow water**:

- the wavelength (increases, remains the same, decreases)
- the frequency (increases, remains the same, decreases)
- the velocity (increases, remains the same, decreases)
- the wave changes direction and is refracted (towards, away from) the normal.

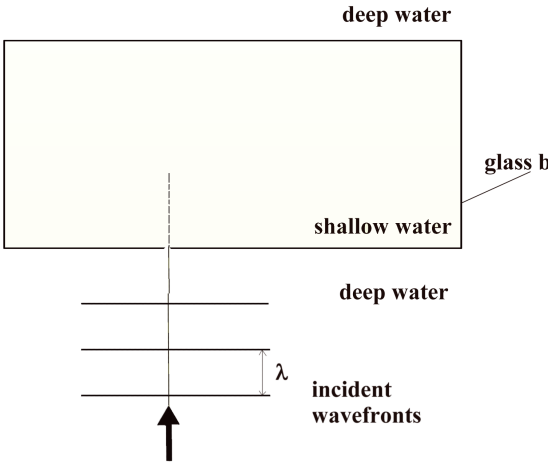


Underline the correct answer:

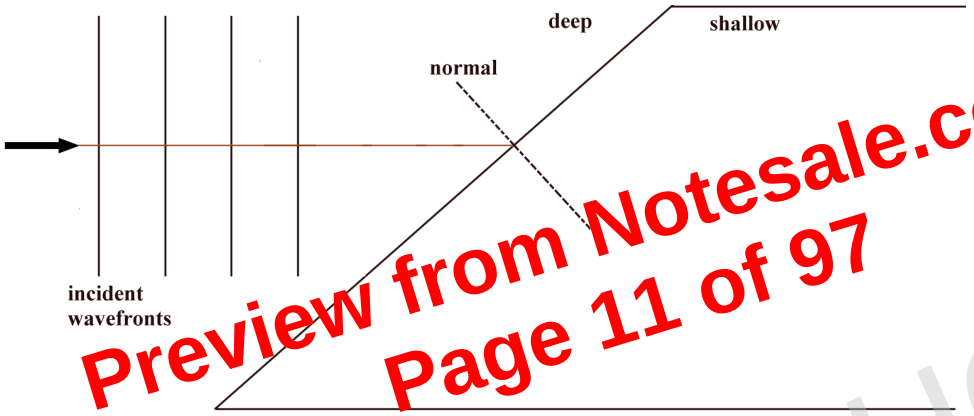
When the wavefronts pass from **shallow water to deep water**:

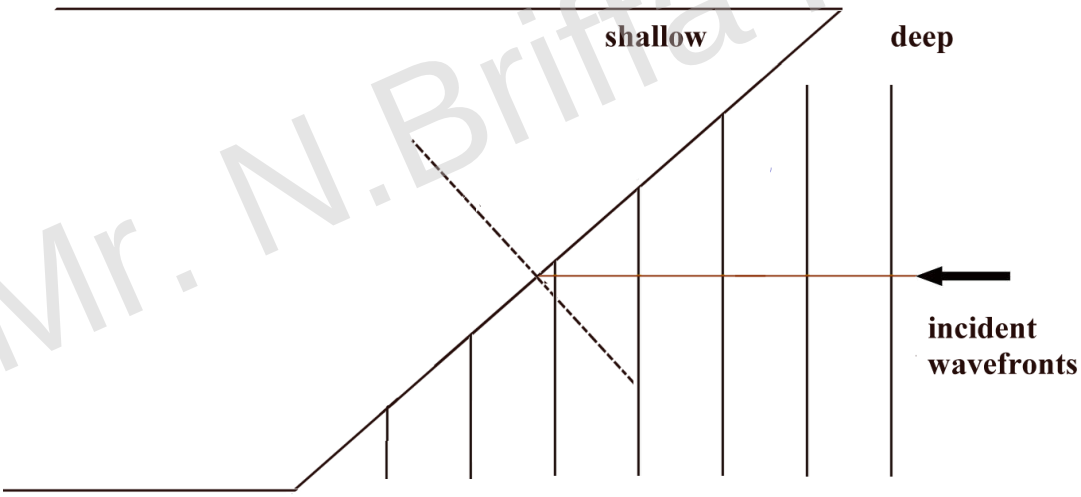
- the wavelength (increases, remains the same, decreases)
- the frequency (increases, remains the same, decreases)
- the velocity (increases, remains the same, decreases)
- the wave changes direction and is refracted (towards, away from) the normal.

Complete the diagrams below.



If the wavefronts enter the shallow water along the normal, they are not refracted. However the wavelength and the speed still _____ in shallow water and _____ in deep water. The frequency does not change.





http://www.youtube.com/watch_popup?v=stdi6XJX6gU

8. (a) Diagram 1 shows a ray of light passing through a block of perspex.

(i) Complete the path of the ray of light out of the perspex. (2)

(ii) Name the angles marked X and Y on Diagram 1.

angle X _____

angle Y _____ (2)

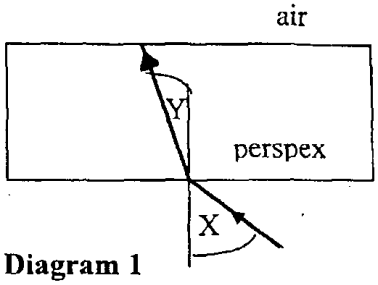


Diagram 1

(b) When the same ray of light is shone onto a semicircular perspex block, as shown in Diagram 2, the emerging ray is at 90° to the normal.

(i) Give **one** reason why the ray of light is undeviated at point O.

_____

_____ (1)

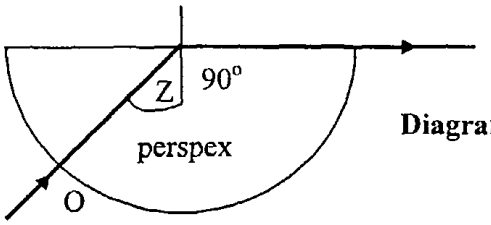


Diagram 2

(ii) What is the name given to angle Z? _____ (1)

(c)

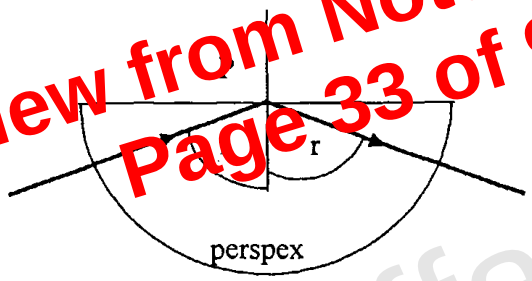


Diagram 3

(i) What type of reflection takes place in Diagram 3 at point P?

_____ (1)

(ii) Give **one** reason when this type of reflection occurs.

_____ (1)

(iii) Comment about angles i and r in Diagram 3.

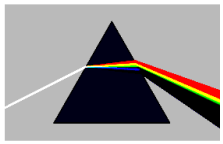
_____ (1)

(iv) Name **one** practical use of this type of reflection.

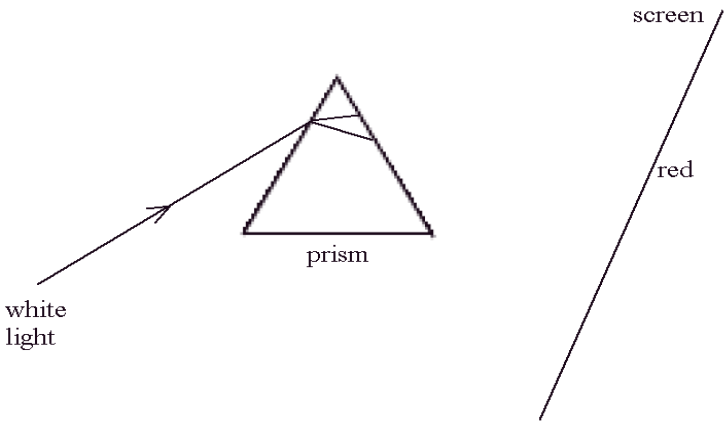
_____ (1)

Dispersion

White light can be split up into a **spectrum** of 7 different colours. This phenomenon is called _____.

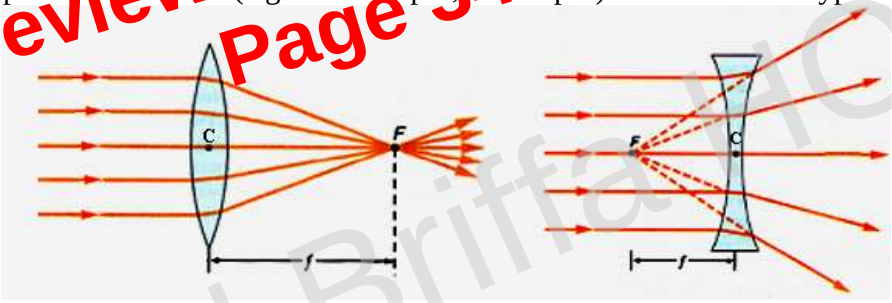


Continue the ray diagram to show the path taken by the different colours.
Mark on the screen where you think might be infra-red and ultraviolet radiation.
Which colour is most refracted? _____
Which colour travels fastest in glass? _____



Lenses

Lenses are used in optical instruments (e.g. microscopes, telescopes). There are two types of lenses:

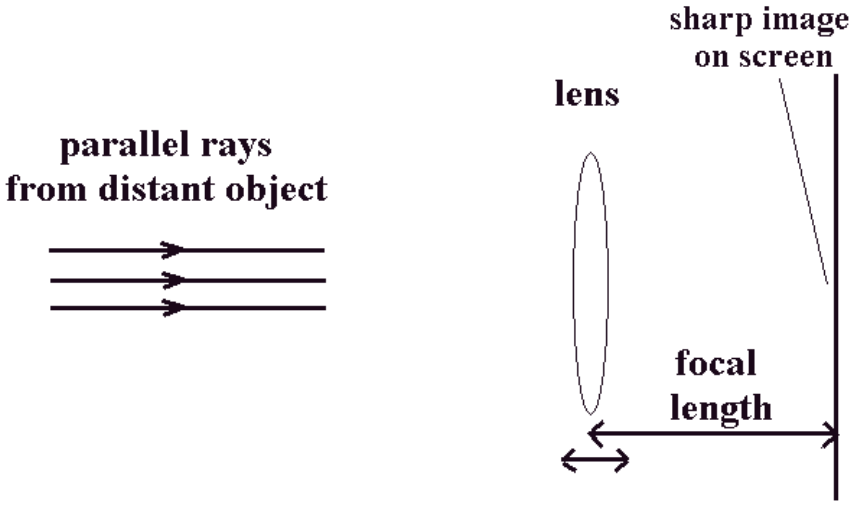


convex (converging) lens **concave (diverging) lens**

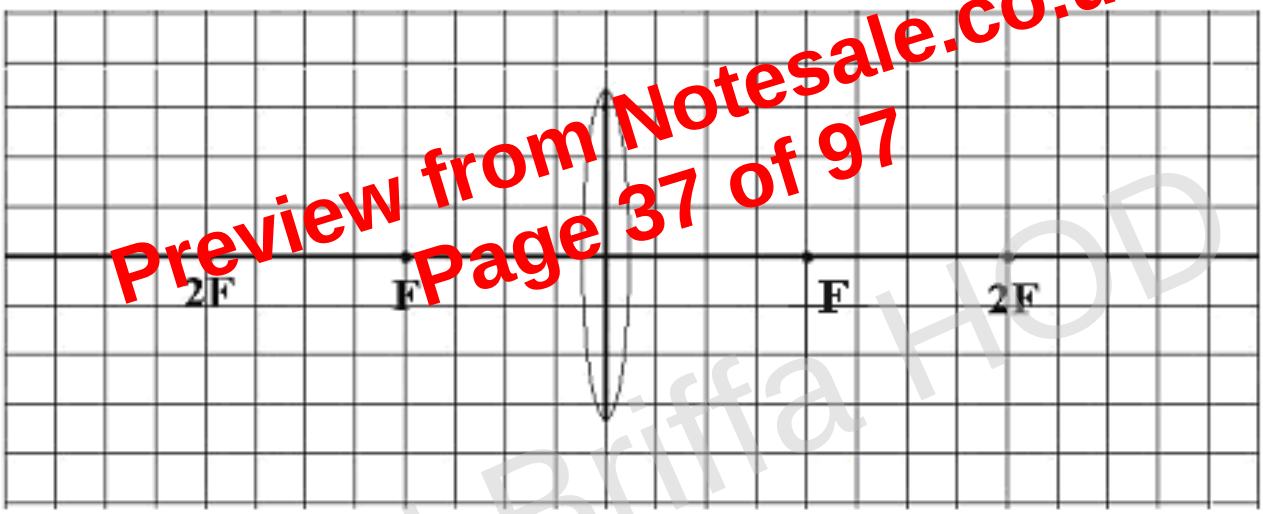
The convex lens is _____ at the centre and it bends light _____.
The diverging lens is _____ at the centre and it bends light _____.
The centre of the lens is called the _____.
The line through C at right angles to the lens is called the _____.
The **focal point** is denoted by the letter F. It is also known as _____.
The **focal length** is the distance between the _____ and the _____ of the lens.

Experiment: Finding the focal length of a converging lens (**approximate** method)

The lens is moved until rays coming from a distant object (e.g. a window) form a sharp image on the wall (screen). The focal length would be the distance between the _____ and the _____ on the wall.



The ray diagram for the above experiment would be the following:

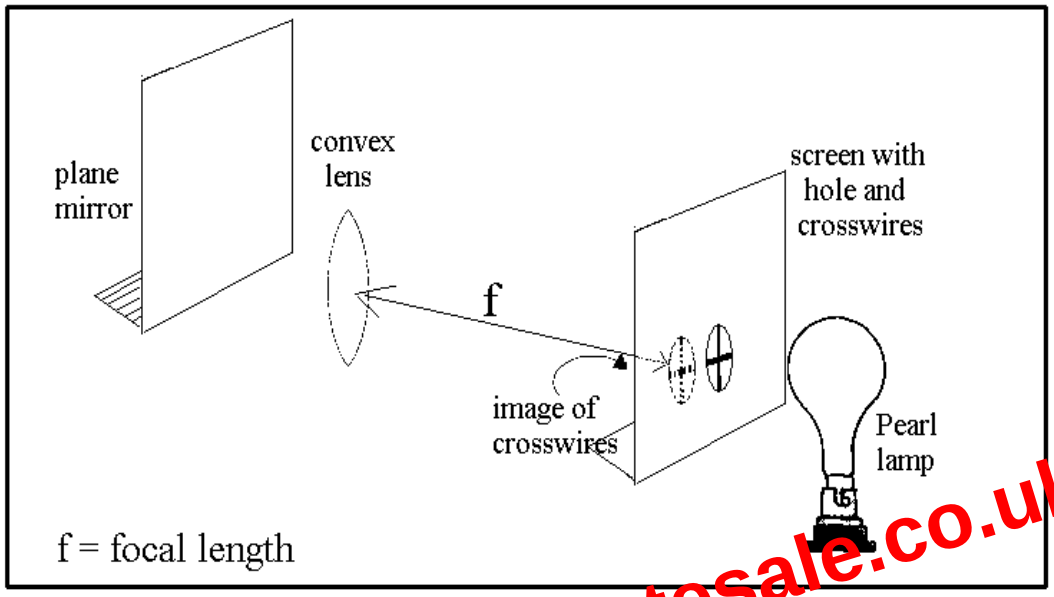


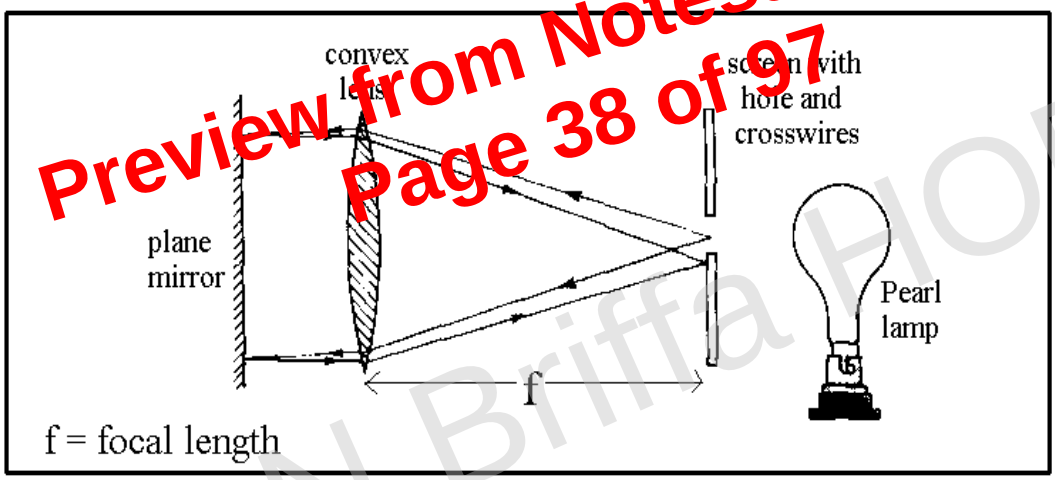
The image is: _____, _____, _____.

This method is approximate because the rays coming from the distant object may not be perfectly parallel.

Experiment: Finding the focal length of a convex lens (**accurate** method)

Light from the lamp passes through the hole in the screen and is refracted by the lens onto the mirror. The mirror reflects the light back to the convex lens producing an image of the hole with crosswires on the screen. The distance between the image and the lens is equal to the focal length of the lens.



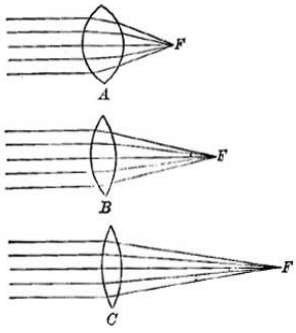


Power of a convex lens

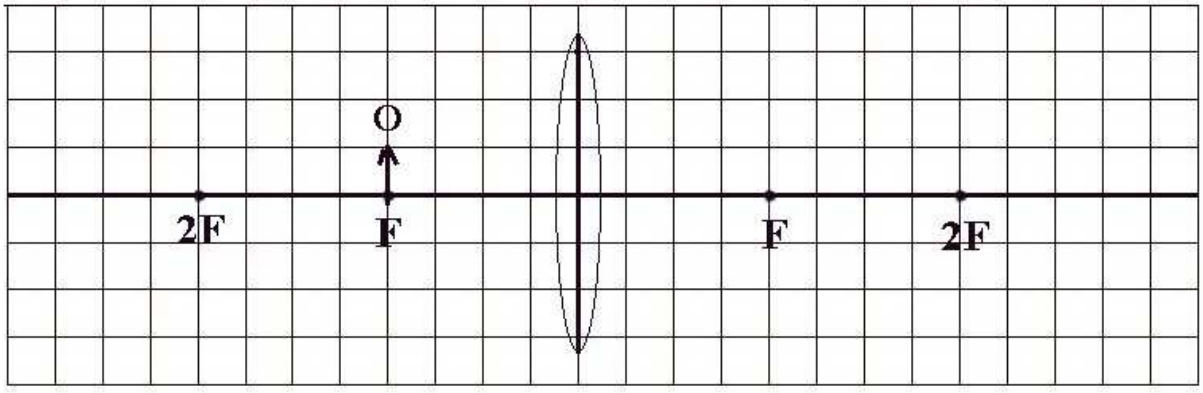
If a convex lens is thick it will be more able to bend parallel rays of light over a short distance. Therefore the shorter the focal length, the greater the power of the lens. Which of the lenses shown has the greatest power A, B or C? Why? _____

_____

_____

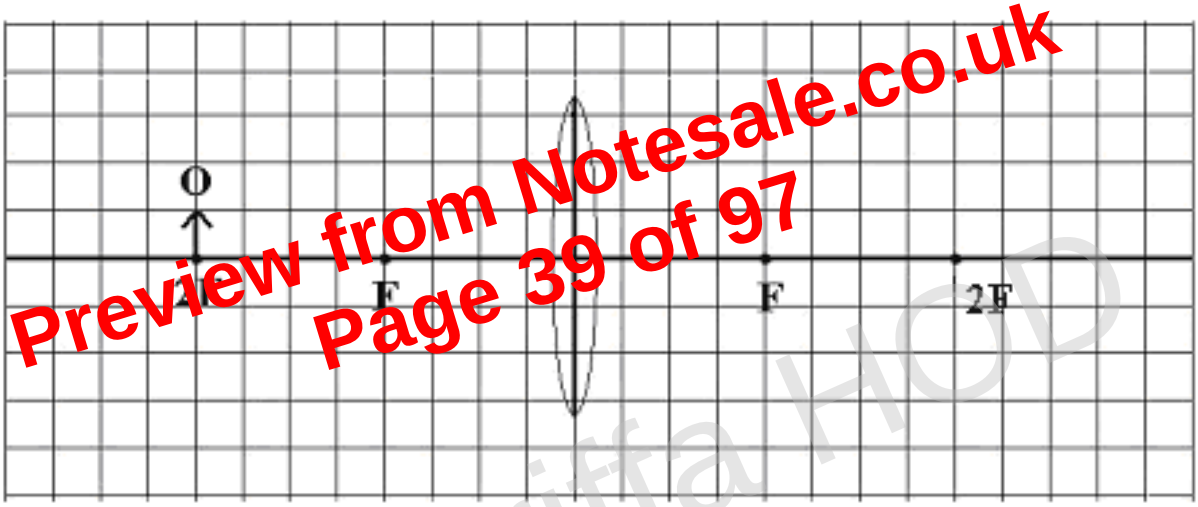


Object on F:



No image forms in this case.

Object on 2F



The image is: _____, _____, _____.

Example:

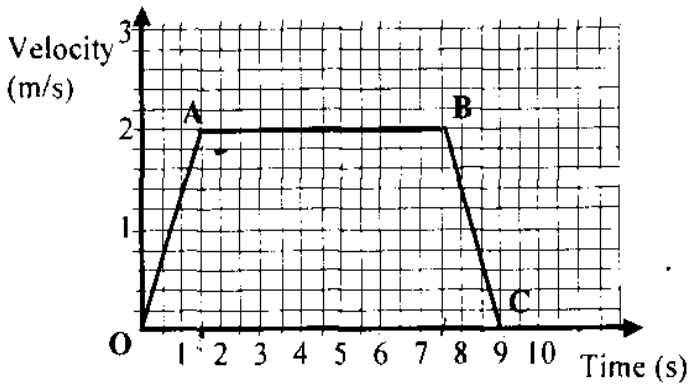
*A slide is placed 8cm away from a convex lens of focal length 12cm. Draw a ray diagram **to scale** to show how the image forms. State the characteristics of the image. Find the image distance and also the magnification.*

1. (a) Give the SI units of :

(i) Distance _____ (ii) Time _____

(iii) Acceleration _____ (iv) Force _____ (2)

(b) A cable-operated lift of total mass **500kg** moves upward from rest in a vertical shaft. The graph below shows how the velocity of the lift varies with time.



(i) Describe the motion of the lift between points:

O and A _____

A and B: _____ (2)

(ii) Describe how you can use the graph to find the distance travelled by the lift.

_____ (1)

(iii) Calculate:

the total distance travelled by the lift. _____

_____ (2)

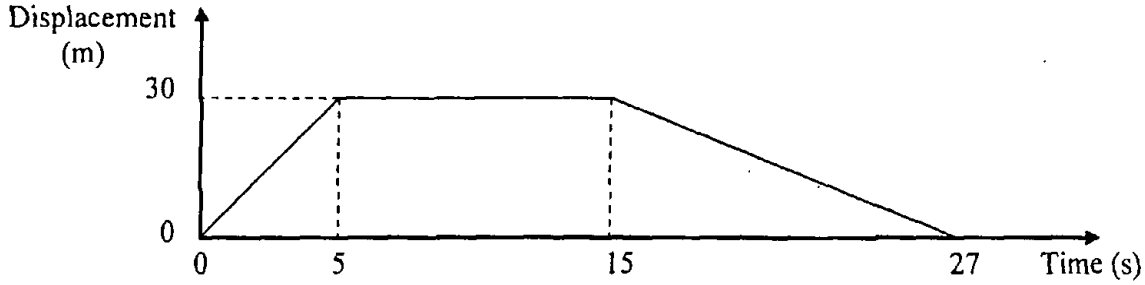
the deceleration of the lift.

_____ (2)

(iv) If the lift was at rest and the cables broke, what would be the acceleration of the lift?

_____ (1)

3. The displacement-time graph below shows the movement of an anchor being lowered from the surface of the sea to the sea-bed and then after some time pulled back.



(a) (i) How deep is the sea-bed from the surface of the sea?

(1)

(ii) How long did it take the anchor to reach the sea-bed?

(1)

(iii) Calculate the average velocity of the anchor as it was lowered to the sea-bed.

(2)

(iv) What happened to the anchor between the 5th and the 15th second?

(1)

(v) How long did it take to raise the anchor from the sea-bed back to the surface?

(1)

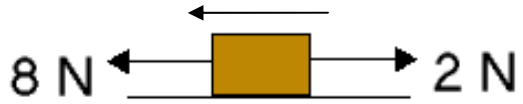
(vi) Calculate the average velocity of the anchor as it was raised to the surface.

(2)

(b) Compare the velocity of the anchor when it is lowered to that when it is raised. Use the graph to explain this difference.

(2)

Example 1:



_____

In this case the object would _____ to the _____.

Example 2:

Name the forces:

F_1 _____

F_2 _____

F_3 _____

Force F_1 is equal to 6,000N, force F_2 is equal to 1,000N and F_3 is equal to 2,000N. Find the resultant force acting on the car in this case.

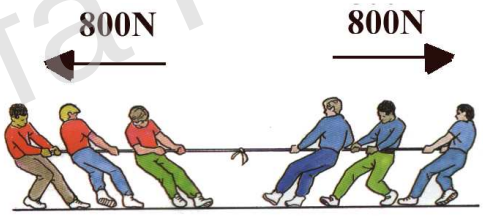
_____

_____

In this case the car would _____ to the _____.

Example 3:

The resultant force in this case is 0 N.



In this case the object can be either:

a) _____

or

b) _____

Engine force 40,000N **Air resistance 40,000N**

Example 5:

A car starts from rest and reaches a speed of 20m/s in 5 seconds. If it has a mass of 1500kg, Find:

a) the acceleration. _____

b) the resultant force. _____

c) initial momentum. _____

d) final momentum. _____

e) change in momentum. _____

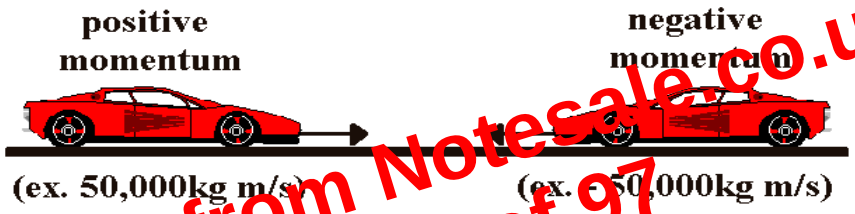
Example 6:

A driver of mass 80kg loses control of his car which is moving at 10m/s, and crashes into a wall. He comes to rest in 0.5 seconds. Find:

a) the deceleration of the driver _____

b) the average decelerating force of the seatbelt on the driver if it is to hold him firmly in his seat.

_____



An object moving to the right has a _____ momentum.

An object moving to the left has a _____ momentum.

Example 7:

High flying birds such as mallard ducks could be a source of danger to aircrafts because if they collide with the windscreen, the resulting impact could cause serious damage to the aircraft. **Fifteen** mallard ducks each of mass 1kg, travelling at 20m/s collide with an aeroplane. The aeroplane of mass 2000kg is travelling with a velocity of 200m/s in the opposite direction.

a) Calculate the momentum of the aeroplane before the collision. _____

b) Calculate the momentum of the ducks before the collision. _____

c) Calculate the total momentum of the plane and mallard ducks before collision. _____

_____

d) One of the mallard ducks hits the aeroplane windscreen. Calculate the impact force on the windscreen, if the collision lasts for 0.001seconds. _____

_____

_____

e) The aeroplane windscreen is designed to withstand an impact force of 5.0×10^4N. Will it break or not?

_____

Newton's 2nd law : (Everyday examples)

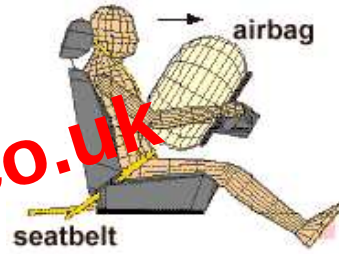
$$F = m\,a \quad \text{and} \quad a = \frac{(v-u)}{t} \quad \text{and so} \quad F = m\,\frac{(v-u)}{t}$$

$$\text{or} \quad F = \frac{mv - mu}{t} = \frac{\text{(change in momentum)}}{\text{time}}$$

Seatbelt

What is the use of a seatbelt?

_____



Why should it stretch a little bit?

_____

_____

Airbag

How does an airbag help to prevent injury?

_____

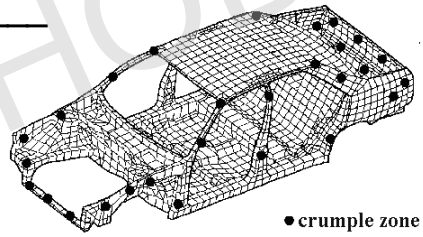
_____

Crumple zones

What are crumple zones?

_____

_____



Catching a ball

Why should the hand be moved slightly backward?

_____

_____

Flexing knees after jumping

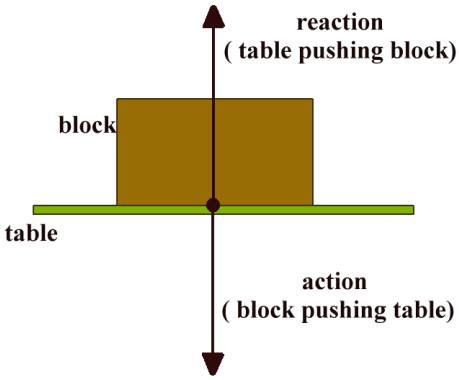
Why should we flex our knees when jumping?

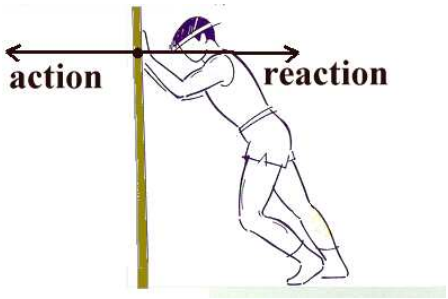
_____

_____

Newton's 3rd law:

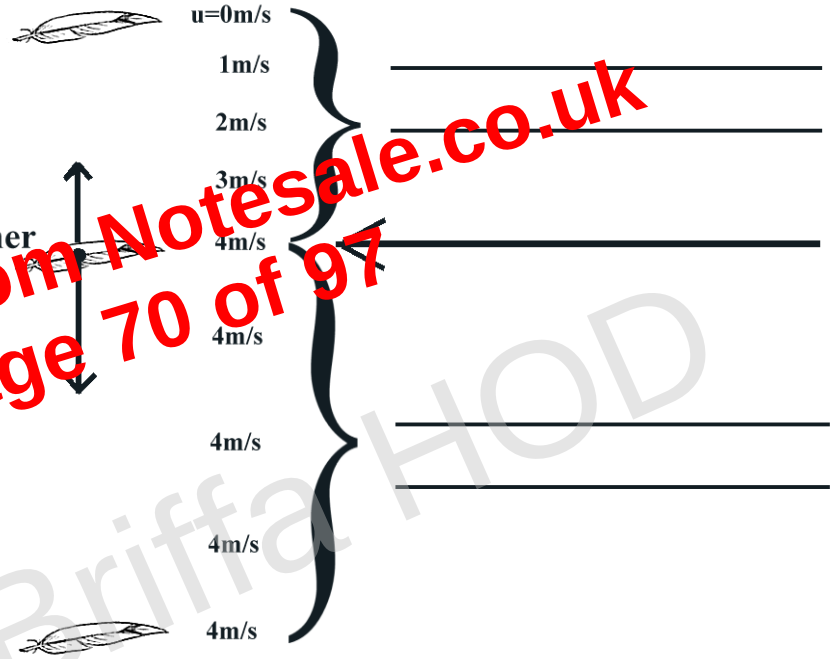
For every _____ there is an equal and opposite _____.





Terminal Velocity

The feather is **dropped** from a certain height. Initially its speed increases and so there is an _____. At this point the _____ of the feather is greater than the _____ _____. However the air resistance increases until it is equal to the _____ of the feather. At this point the resultant force is equal to ___ N. The feather does not accelerate any longer and reaches it maximum constant velocity also known as _____ _____.



Determine whether each of the following will reach terminal velocity.

A table tennis ball falling a height of 30m.	*Yes*
A raindrop.	
An iron ball falling a distance of 5m.	
A parachutist falling down.	
A feather falling a height of 20cm.	
An iron ball falling a distance of 5m in oil.	

Simulation terminal velocity: http://www.physicsclassroom.com/mmedia/newtlaws/sd.html

Example 1:

The velocity of a bullet of mass 5g after being fired is 60m/s. If the mass of the gun is 4kg, find the recoil velocity of the gun.

Momentum bullet = Momentum gun

$m_1v_1 = m_2v_2$

The same question can be asked as follows:

a) What is the total momentum before the gun is fired? Why?

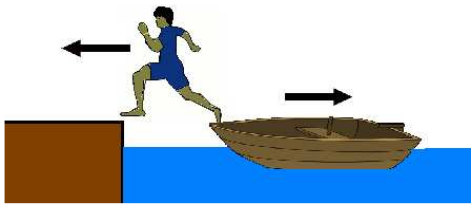
b) What is the total momentum after the gun is fired? Why?

c) Find the momentum of the bullet after it is fired.

d)What is the momentum of the gun after it fires the bullet? Explain

e)Find the recoil velocity of the gun.

Example 2:



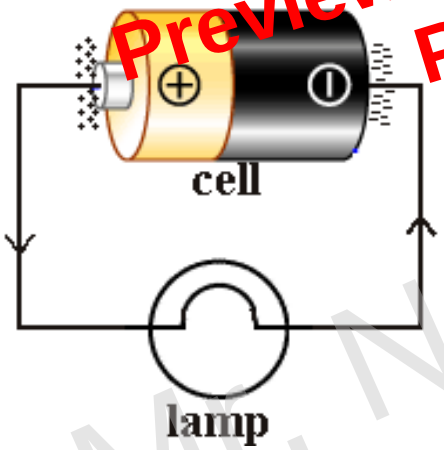
A man of mass 70kg jumps out of a boat with a speed of 3m/s. The boat of mass 300kg moves backwards.

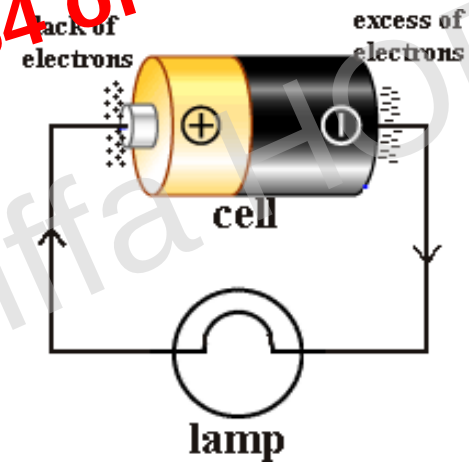
a)Why does the boat move backwards?

b)Find the speed at which the boat moves backwards.

Bulb/Lamp			
Open switch			
Closed switch			
Ammeter			
Voltmeter			
Multimeter			
Resistor			
Variable resistor (rheostat)			

Conventional current and Electron flow





Conventional current is the way **current** flows from the _____ to the _____ terminal of the cell.

Electron flow is the way **electrons** flows from the _____ to the _____ terminal of the cell.

Before electrons were discovered, scientists believed that current flowed from the positive to the negative terminal of a cell. Later, they realized it was a mistake. It was too late to redefine all the electrical Physics, so the inconvenience holds to this day. In the coursework we will use _____.