## UCE physics 2010 paper 2

1. (a) (i) State Newton's laws of motion
   - A body continues in its state of rest or uniform motion in straight line, unless an external force acts on it
   - The rate of change of momentum is proportional to the force applied and takes place in the direction of force applied
   - T every action there is an equal but opposite reaction

   (ii) Explain what happens to a person seated in vehicle it suddenly brought to rest.
       The person jerks forward because of inertia.

   (b) Explain what happens to a parachutist who jumps from a high flying plane.
   Initially a parachutist accelerates because weight is greater than upthrust of air and viscous force. Later moves at constant terminal velocity when weight is equal upthrust plus viscous force.

   (c) The figure below shows a velocity – time graph for a vehicle in motion
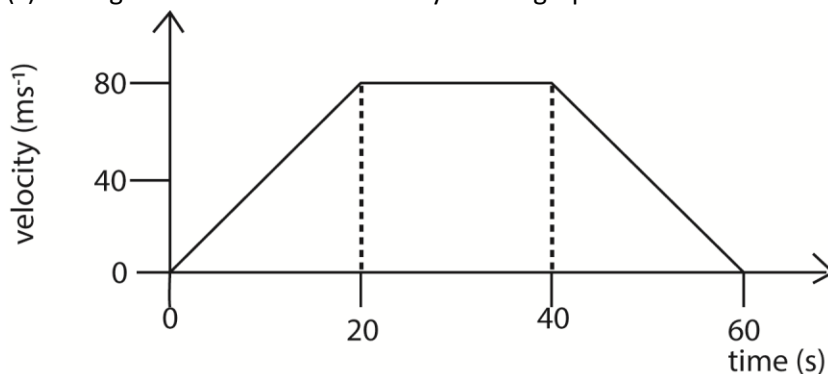
   (i)   Find the total distance the vehicle moved
          Total distance = area under the curve
          $$= \frac{1}{2} \ x \ 20 \ x \ 80 + 20 \ x \ 80 + \frac{1}{2} \ x 20 \ x \ 80$$
          = 3200m

   (ii)   Calculate the retardation of the vehicle
          Retardation = $\frac{change\ in\ velocity}{time} = \frac{80-0}{60-20} = \frac{80}{20}$ = 20ms^{-2}

2. (a) State the following
   (i)   Archimedes principle
          Archimedes' principle state that when a body is wholly or partially immersed in a fluid it experiences an upthrust equal to the weight of the fluid displaced.
   (ii)   The law of floatation
          The law of floatation states that a floating body displaces its own weight of the fluid in which it floats.

(b) A wooden sphere of mass 6kg and volume 0.02m³ floats on water. Calculate

 (i) volume of the sphere below the surface of water

Weight of water displaced = weight of the sphere

Volume = $\frac{mass}{density} = \frac{6}{1000} = 0.006m^{-3}$

(ii) density of wood

Density = $\frac{mass}{volume} = \frac{6}{0.02} = 300mkg^{-3}$

(iii)   Fraction of the volume of the sphere that would be submerged if it floats in a liquid
of density 800kgm⁻³.
Volume of the liquid displaced = $\frac{mass}{density} = \frac{6}{800} = 0.0075m^{-3}$
Fraction of the solid submerged = $\frac{0.0075}{0.02}$ = 0.375

(c) Explain why a cork stopper held below the surface of water rises when released.

 Because the density of cork is less than that of water

(d) Describe an experiment to measure atmospheric pressure.

- A glass tube about 1m closed at one end is filled with mercury and inverted in a dish of mercury leaving no is inside
- Atmospheric pressure is equal to H above the mercury surface

3. (a) define the following
    (i)   Hard magnetic material
            Hard magnetic material are those that are not easy to magnetize or demagnetize
    (ii)   Soft magnetic material
   Soft magnetic material are those that are easy to magnetize and demagnetize.

(b) (i) Describe the electrical method of magnetising a steel bar.

- Place the steel bar inside a solenoid
- Connect the solenoid to a d.c circuit and close the switch and the steel bar will be magnetized after some time

  (ii) State any two ways of demagnetizing a bar magnet

- Hitting the magnet
- Heating the magnet
- Placing a magnet connected to a.c voltage
- Keeping the magnet in east-west direction

(c) Sketch the magnetic field pattern around a bar magnet with its S-pole pointing north in the Earth's field.
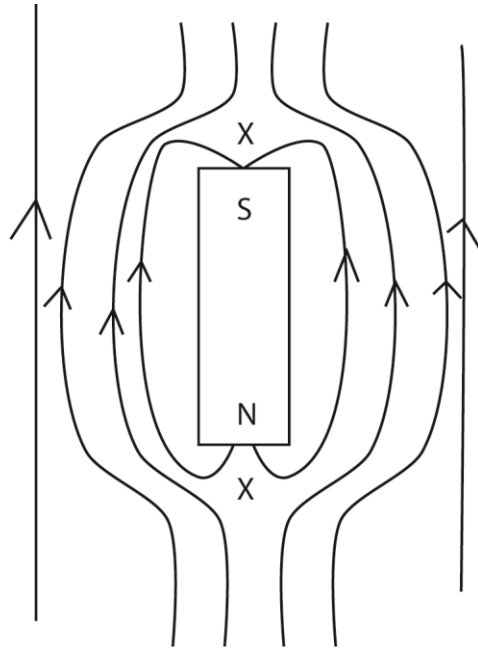
(d) A stiff wire AB is held between opposite poles of two bar magnets and connected to a centre-zero galvanometer as shown in the figure below.
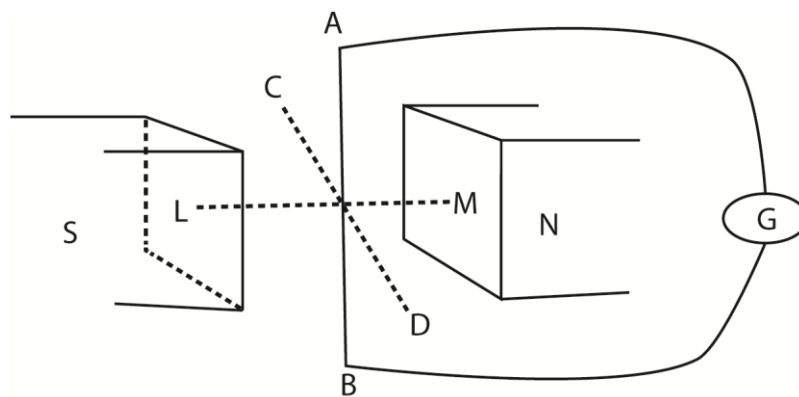
The wire AB is kept vertical and moves horizontally along the line CD.

(i)   Explain what is observed on the galvanometer as the wire AB moves towards C and towards D.
       When the wire s moved towards C, it cuts the magnetic field lines and e.m.f is induced in the wire along AB causing the pointer of the galvanometer to deflect in one direction.
       When the wire is moved towards D, the wire again cuts the magnetic field line causing the galvanometer to deflect in opposite direction.

(ii)   Explain what would be observed if the wire were moved along LM.
       No deflection of the galvanometer occurs because the wire moves parallel to magnetic field lines.
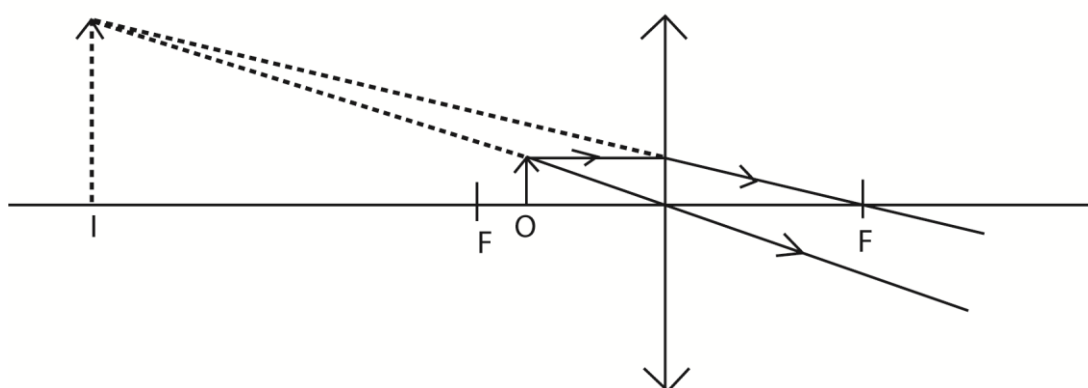
4. (a)(i) What is meant by focal length of a lens?
    Focal length is the distance between the optical centre and principal focus
       (iii)   Calculate the power of a concave lens of 20cm

$$\text{Power of a lens} = \frac{1}{f(m)} = \frac{1}{-0.2} = -5D$$

(b) An object of height 7.5cm is placed at a distance of 15cm from convex lens of focal length 20cm. By scale drawing determine the

(i) height of the image

Image height = 30cm

(ii) image distance

Image distance = 60cm

(iii) linear magnification

$$\text{Magnification} = \frac{image\ height}{object\ height} = \frac{30}{7.5} = 4$$

(c) Describe an experiment to determine the focal length of a convex lens using an illuminated object and plane mirror.

- A lit bulb is placed behind a screen with hole having cross wire
- A convex lens is placed in front of the screen
- A plane mirror is placed behind the lens facing the screen.
- The screen is moved to and fro along the principal axis until a sharp image is formed besides the cross wire.
- The distance between the lens and the screen is measured and recorded.

(d) What is the main difference between the operation of a lens camera and that of a human eye?

Differences between lens camera and human eye

Lens camera	Human eye
Focal length of the lens is fixed	Focal length is variable
The distance between the lens and film varies	The distance between the lens and the retina is fixed
Artificial	Natural

5. (a)(i) What is meant by the term diffusion?
Diffusion is the spreading of molecules of a substance from a region of high concentration to a region of low concentration

(ii)Explain what is observed when smoke enclosed in an illuminated transparent cell is viewed through a microscope

Smoke particles are seen to move continuously and random because they collide with air molecules in continuous random motion

(iii) State what is observed in (a)(ii) when the cells is placed in an ice block. Give a reason for your answer.

Smoke particles move slower due reduction of average kinetic energy of air particles when the temperature falls.

(b)(i) Describe an experiment to determine the thickness of an oil molecule.
-   Lycopodium powder is sprinkled on water in a large dish.
-   Oil of know volume, V, is dropped and spreads in the middle into a circular patch of radius, r.
-   Thickness of oil molecule $= \dfrac{V}{\pi r^2}$

   (ii) State any assumption(s) made in (b)(i)
-   Oil patch is circular
-   Oil molecule is spherical
-   There no space between oil molecules

(c) (i) State Hooke's law.

The deformation of a material is directly proportional to the applied force provided the elastic limit is not exceeded.

   (ii) When a boy of 50kgstandes at one end of a spring board, it is depressed by 15cm. What would be the depression of the spring board when a man of 80kg stands at the end?

15cm require 50kg

X cm require 80kg

$X = \dfrac{15\ x\ 80}{50}$ 24cm

6.   (a) What is meant by thermionic emission?

Thermionic emission is the liberation of electrons from hot metal surface

(b)(i) Name the three main components of cathode ray oscilloscope, (CRO).
-   Electron gun
-   Deflection system
-   Fluorescent screen

   (ii) Describe the functions of each component you have named in (b)(i)

   Electron gun:

   - Emits electrons from hot cathode
   - Accelerates and focuses electrons into a fine beam by use of anode at high positive potential with respect to the cathode
   - It also alters the brightness of the spot on the screen by use of the control grid.

   Deflection system

   - X-plates deflects the electron beam horizontally
   - Y- plates deflects electron beam vertically

   Screen

   This is where a bright spot is formed.

(iii) give the uses of a CRO
- measures a.c and d.c voltages
- used in TV and computer
- use to study wave forms

(c) State the conditions under which electrons can be used to generate X-rays
Electrons are accelerated at high speed and stopped by metal target to generate X-rays
(d) Give one use of X-rays
- Treatment of cancer
- Identification of fractures
- Study crystal

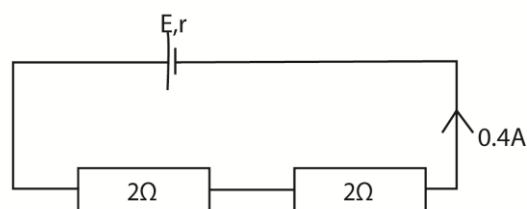7. (a)(i) What is meant by electromotive force?
     e.m.f is the total work done in joules per coulomb of electricity conveyed in a circuit in which it is connected.
  (ii) A dry cell supplies a current of 1.2A through two 2Ω resistor connected in parallel. When the resistors are connected in series, the current flowing in the circuit is 0.4A. Find the electromotive force.
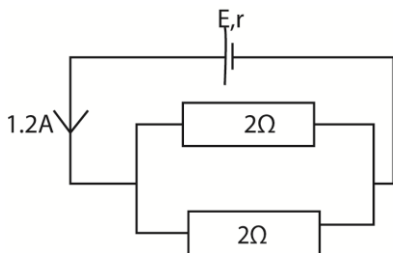
          (i)   (ii)

- effective resistance for resistors in parallel = $\frac{2 \times 2}{2+2} = 1\Omega$

    E = 1.2(1+ r) ………………. (a)
- effective resistance of resistors in series = 2 + 2 = 4Ω

    E = 0.4(4 + r) ………………. (b)
    From (a) and (b)
    1.2(1+ r) = 0.4(4 + r)
    r = 0.5Ω
    E = 1.2(1 + 0.5) = 1.8V

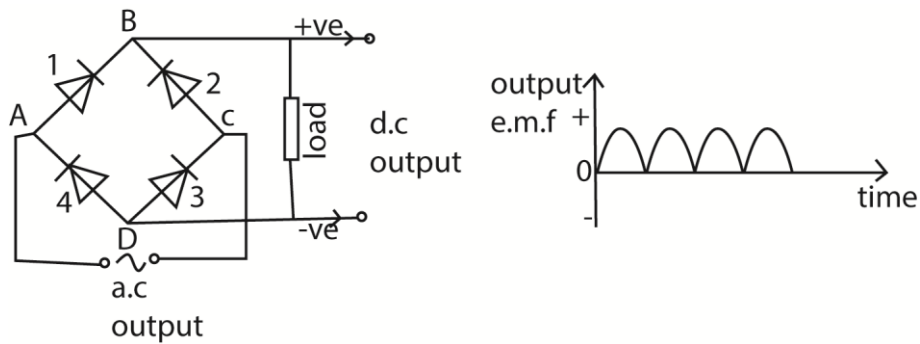(b) An electric lamp is rate12V, 24W.
  (i) Explain what is meant by the statement.
    When the lamp is connected to 12V, it dissipates 24J per second.
  (ii) How much current does the lamp draws when connected across 12V supply.
    $I = \frac{P}{V} = \frac{24}{12} = 2A$

(c) With the aid of a labelled diagram, describe how four semi-conductors diode may be used for full wave rectification.

A and C will alternatively be positive and negative. Output current flows at B

When A is positive diodes 1 and 3 conduct and when A is negative diodes 2 and 4 conduct.

8. (a) Define the following as applied to wave motion
   (i) Frequency
         It is the number of oscillations per second
   (ii) Wavelength
         It is the distance between two successive points in phase

   (b) What are transverse waves?

   A transverse wave is one in which the particles of the medium vibrate perpendicularly to the direction of wave motion

   (c) A radio station transmits signals at a frequency of 103.7MHz. Find, the wavelength of the signals and state any assumptions made
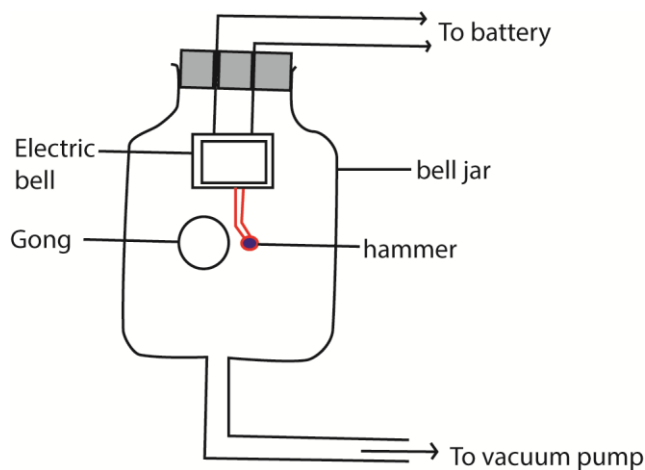
   $$\lambda = \frac{V}{f} = \frac{3 \times 10^8}{103.7 \times 10^6} = 2.89m$$

   (d) Draw a diagram to show the pattern for a straight wave passing through a narrow slit.
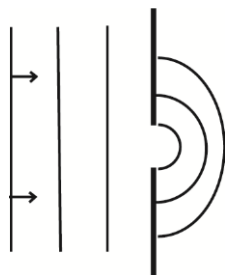
   (e) Describe an experiment to demonstrate that sound wave requires a material medium for their propagation.

Experiment to show that sound needs a material medium for the transmission

Switch on the electric bell
Switching on the electric bell, a loud sound is heard

Removal of air gradually
On gradually removing the air by a vacuum pump, the loudness of sound gradually dies away.

No sound is heard when all the air has been completely removed though the hammer is seen hitting the gong.

This shows sound waves need material medium like air, liquid or solid for transmission.

(f) Explain how sound wave travel through air.

When a source vibrates causes, it causes nearby air molecules to vibrate to and fro about their mean position. The vibration of the nearby air molecules also causes the next air molecules to vibrate.
This causes regions of compression and refraction which transfer sound from one point to another.