UCE physics 2012 paper 2

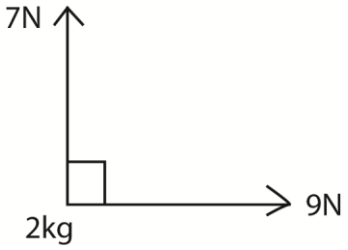
1. (a)(i) What is the difference between vector and scalar quantities? (02marks)

   A vector quantity has both magnitude and direction while a scalar quantity has only magnitude but no direction

   (ii) Give two example of each quantity in (a)(i). (02marks)

   Vector quantities: force, velocity, displacement,
   Scalar quantity: speed, distance, mass, volume

   (iii) Two forces of 7N and 9N act perpendicularly on a body of mass 2kg. Find the acceleration of the body. (04marks)

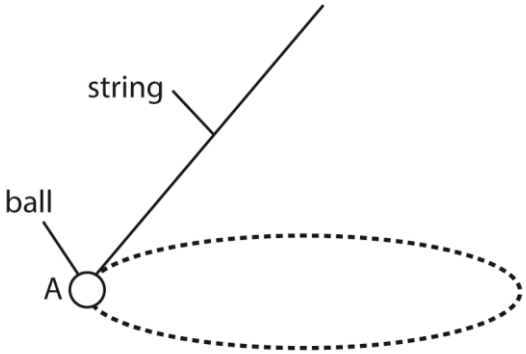


Resultant force = $\sqrt{(7^2 + 9^2)}$ = 11.4N
F= ma
a = $\frac{F}{m} = \frac{11.4}{2} = 5.7ms^{-2}$

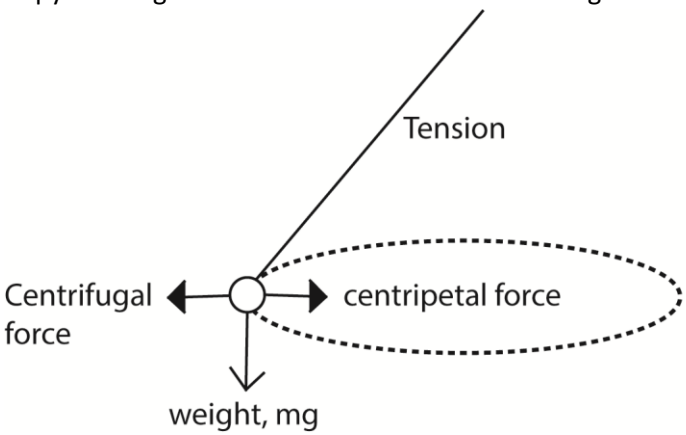
(b) Describe an experiment to determine the center of gravity of an irregular sheet of metal. (04marks)

- make three holes along the edge of the metal sheet.
- Suspend the metal sheet freely from a nail through on of the holes
- Suspend a plumb line from the same nail
- Mark two points on the metal sheet along the string
- Draw a line through the points
- Repeat procedure for the other two holes
- Where the line intersect is the center of gravity.

(c) A ball is whirled in air in horizontal circle as shown below



(i) Copy the diagram and show on it the forces acting on the ball in position A (01mark)

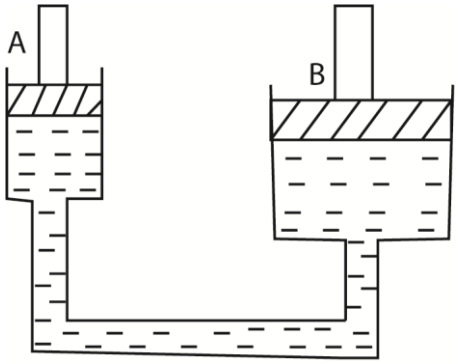


(ii) Explain what happens if the string breaks when the ball is in position A (03marks)
The boy flies off horizontally at a tangent at the circular path at A as centripetal force is broken, thereafter it falls free under gravity.

2. (a) (i) Define pressure (01mark)
Pressure is the force acting normally per unit area.

(ii) Explain what happens when an inflated balloon is released in air. (03marks)
Initially the balloon rises because the upthrust on it due to air exceeds the weight. As it rises, the external pressure is decreasing, so the volume of the hydrogen increases, ultimately the balloon may burst (float) because the rubber cannot withstand tension or float when U = W

(b) The figure below shows a hydraulic press. A and B are cylindrical pistons of radii 2cm and 4cm respectively



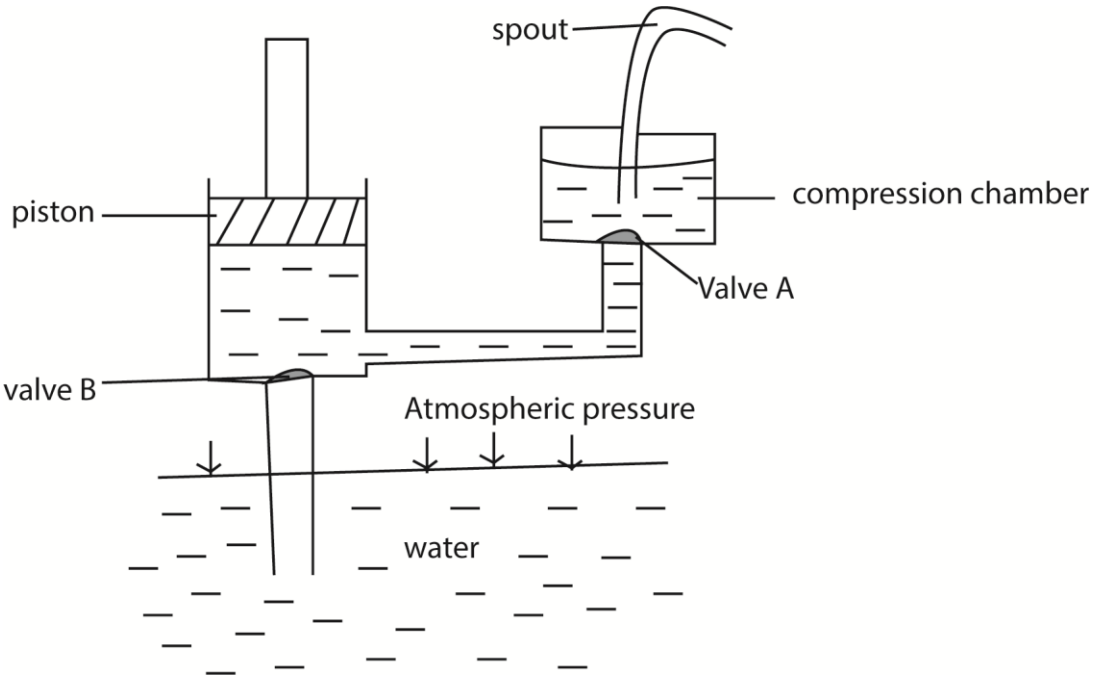
Calculate the maximum force at B that can be overcome by a force of 78N applied at A

$\frac{F_A}{A_A} = \frac{F_B}{A_B}$

$F_B = \frac{78\ x\ \pi\ x\ 4^2}{\pi\ x\ 2^2}$ = 312N

(c) Describe with a labelled diagram, how a force pump works. (05mark)

The force pump



- Upstroke, a vacuum forms under the piston and atmospheric pressure forces water through valve B to fill the space, valve A closes at the same time.
- Down stroke, valve B closes as the plunger comes down. Water is forced into compression chamber through valve A, compressing air in the upper part of the chamber.
- The air acts as a cushion, forcing water out of the spout

(d)(i) State the law of conservation of energy. (01mark)

Energy can neither be created nor destroyed, it can be transformed from one form to another.

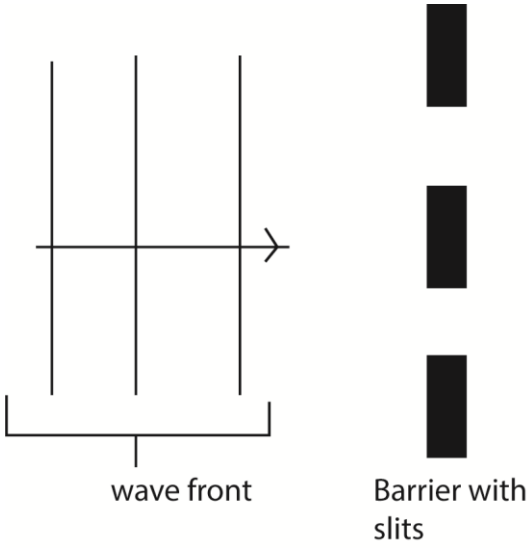
(ii) A stone of mass 0.2kg is through vertically upwards attaining maximum potential energy of 16J. Calculate its initial velocity (03marks)

Maximum potential energy = maximum kinetic energy

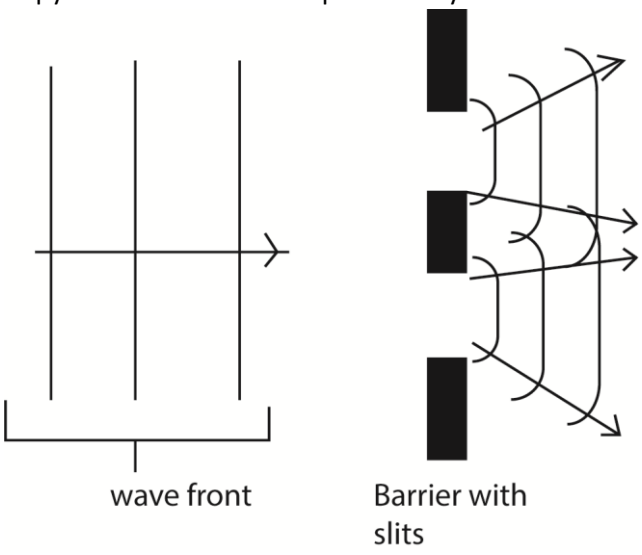
16 = $\frac{1}{2}\ x\ \ 0.2\ x\ v^2$

v = 12.6ms^{-1}

3. (a) What is meant by diffraction of waves?
Diffraction is the spreading/bending of waves when they pass around the edge of a barrier.
(b) The figure below shows plane wave fronts incident on a barrier with two slits



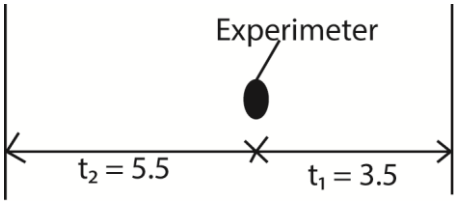
(i) Copy and sketch the wave pattern beyond the barrier. (02marks)



(ii) Describe what happens if the slits are narrowed? (02marks)
The diffracted waves become more circular and interference increases.

(iii) Explain why the speed of sound at the top of a high mountain is different from that at the sea-level. (03marks)
On the top of the mountain air density is very low and the speed of sound is low while at the sea level the density of air is higher and the speed of sound is higher.

(d) An experimenter standing between two high walls produces sound by hitting two pieces of wood. If the first echo heard after 3.5s and the second echo 2s later, find the distance between the walls (04marks) (speed of sound in air = 330ms^{-1})



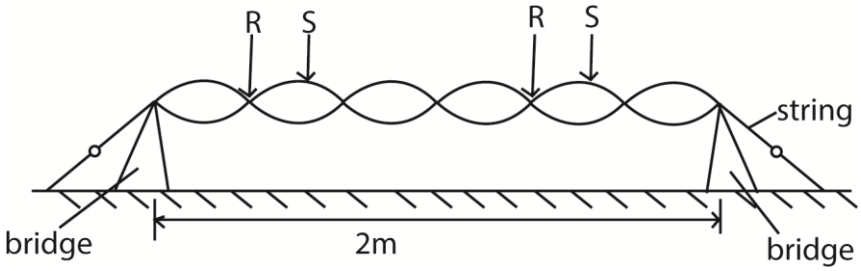
D = vt

Total distance = $\frac{330\ x\ 3.5}{2} + \frac{330\ x\ 5.5}{2}$ = 1485m

(e) What is meant by standing wave? (01mark)

A standing wave is one which is produced when two identical waves travelling in opposite direction superpose

(f) The figure below shows a string stretched between two bridges, when is is plucked at some point it vibrates as shown.



(i) Name the points marked R and S. (01mark)

R – nodes

S- antinodes

(ii) Calculate the wavelength of the wave in the string (02marks)

There 3 waves in 2m

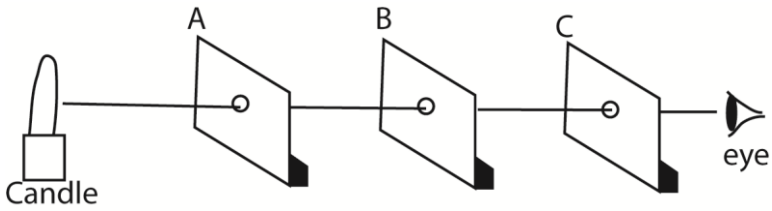
∴ 3λ = 2

$\lambda = \frac{2}{3}$

4. (a) (i) What is meant by light?

Light is a form of energy that stimulates vision

(ii) Describe an experiment to show that light travels in a straight line (04marks)



- Equal square cards A,B and D are cut from piece of thick paper board each with a hole in the middle.
- When the card are arranged as shown above with their holes in a straight line light passes through and seen on the other end.
- İf the middle card is displaced such that its hole is removed from the line, light is cut of from the other end

(b) Define the following

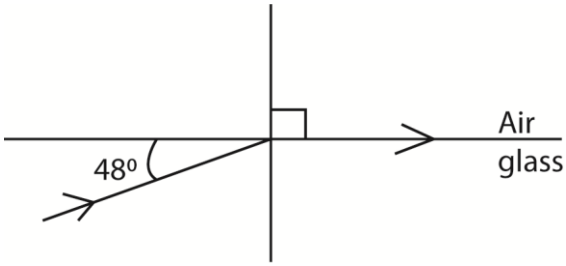
(i) power of a lens (01mark)

Power of a lens is a reciprocal of focal length in metres

(ii) aperture of a lens. (01mark)

The aperture of a lens is the surface of a lens where light passes

(c) The figure below shows light travelling from glass to air

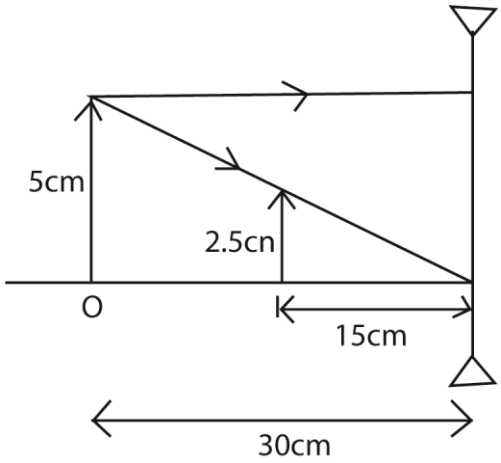


Find the refractive index of glass. (03marks)

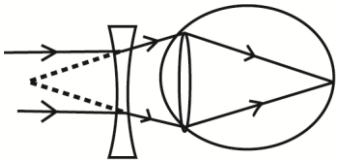
Critical angle, c = 90 - 48 = 42^0C

n = $\frac{1}{\sin c} = \frac{1}{\sin 42}$ = 1.5

(d) An object 5cm high is placed 30cm away from a concave lens. Find graphically the size of the image that is formed 15cm from the lens.



(e) Describe briefly how short sightedness can be corrected. (04marks)



The defect is corrected using a concave mirror

5. (a) Define specific latent heat of vaporization of a substance. (01mark)
Specific latent heat of a substance is the heat required to convert 1kg of a substance from liquid into vapour at constant temperature.

(b)(i) A calorimeter of mass 20g and specific heat capacity 800Jkg^{-1}K^{-1} contains 500g of water at 30^0C, dry steam at 100g is passed through the water in a calorimeter until the temperature of water rises to 70^0C. If the specific latent heat of vaporization of water is 2260000Jkg^{-1}, calculate the mass of steam condensed. (04marks)

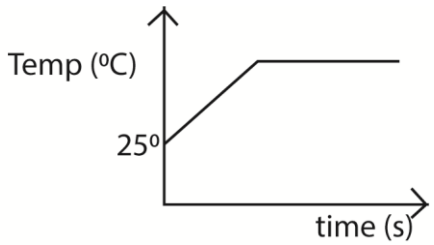
Heat given out by steam = heat gained by water + calorimeter.

$M_sL_v + M_sC_w(100- \theta_2) + M_wC_w(\theta_2 - \theta_1) + M_cC_c(\theta_2 - \theta_1)$

M_s x 2260000 + M_s x 4200 x (100 – 70) = 0.5 x 4200 x (70 – 30) + 0.02 x 800 x (70 – 30)

Ms = 0.035kg

(iii) Water initially at 25^0C was heated. Sketch a graph to show how its temperature varied with time. (01mark)



(c) Describe briefly one application of evaporation. (02marks)

During sweating evaporation of sweat causes cooling

(d)(i) What is a notch? (01mark)

A notch is a scratch or small crack or cut on the surface of the material

(ii) State four ways by which damage due to notches may be prevented. (04mark)

- laminating the material
- reinforcing the material
- stopping the notch effect by widening its tip
- creating regions of less density within the material

(e) Why is bicycle from made of hollow cylindrical pipes? (03marks)

- it good at withstanding compression and tensile force
- reduces weight
- reduces cost

6. (a)(i) What is are ferromagnetic material? (01mark)

These are substances that are strongly attracted by the magnet

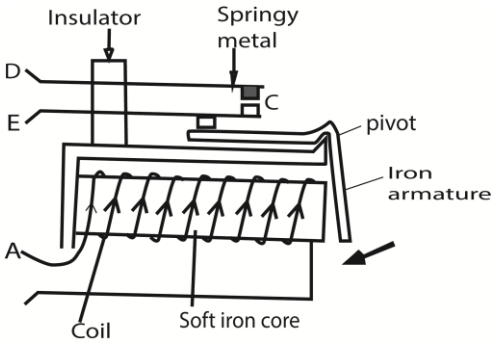
(ii) Give two example of ferromagnetic materials (02marks)

Iron,

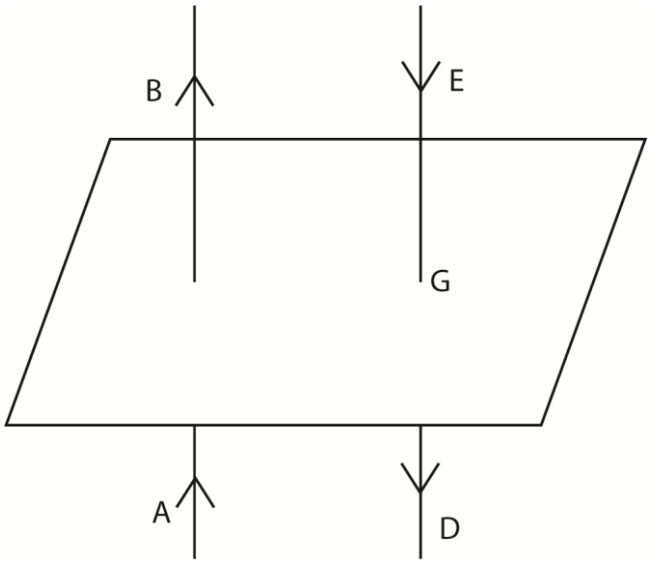
(b) (i) With the aid of a diagram, describe the application of an electromagnet in magnetic relays (01mark)

(a) Relay switch

- This is a switch that is operated by an electromagnet.
- When current flows in the coil, soft iron is magnetized and attracts iron armature which closes the contact at C.
- This completes the circuit connected to DE and current flows in it.

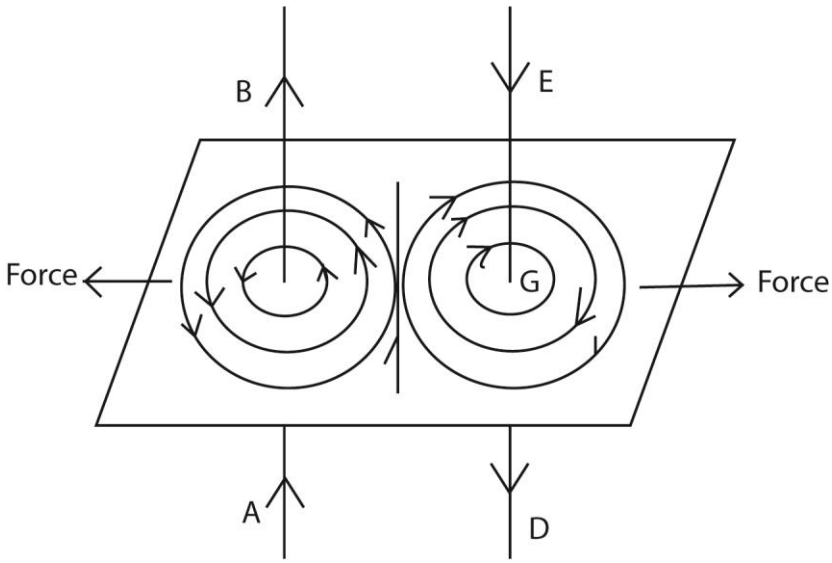


(c) The figure below shows two wires AB and DE placed parallel and close to each other, carrying currents in opposite directions



(i) Copy the diagram and sketch the magnetic field pattern between the two wires (02mark)

(ii) Show the direction of the force acting on DE at G due to the current in AB. (01mark)



(d) Describe briefly how one can test for polarity of a magnet. (03marks)

Bring a pole of a magnet near a known pole of a magnet, repulsion means that the poles are the same

7. (a) Define the following terms

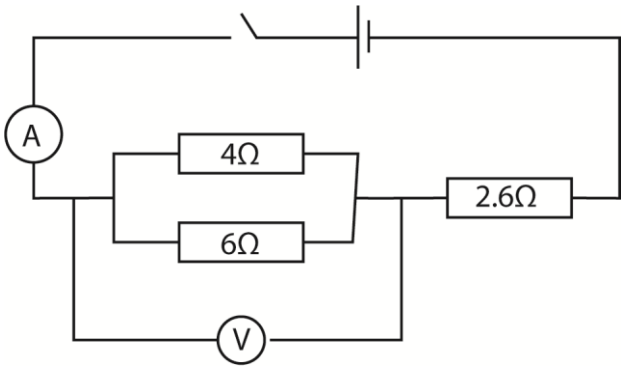
(i) Potential difference (01mark)

P.d is the work done per coulomb of electricity passing from one point to another

(ii) Internal resistance of a cell (01mark)

It opposition offered by the cell to the flow of current through it

(b) A battery of e.m.f 10V is connected to resistor 2.6Ω, 4Ω and 6Ω as shown in the figure below



(i) Calculate the ammeter and voltmeter readings (06marks)

Total resistance = $\frac{4\ x\ 6}{4+6} + 2.6 = 5\Omega$

Ammeter reading, I = $\frac{V}{R} = \frac{10}{5} = 2A$

Effective resistance between 4Ω and 6Ω in parallel = $\frac{4\ x\ 6}{4+6} = 2.4\Omega$

Voltmeter reading, V = IR = 2.4 x 2 = 4.8V

(ii) Find the rate at which electrical energy is converted to heat energy in the 6Ω resistor. (03marks)

Power = $\frac{V^2}{R} = \frac{4.8^2}{6}$ = 3.84W

(d) What is meant by a short circuit? (01mark)

It is the direct connection of the terminals of the source of e.m.f.

(e)(i) Briefly explain how a millimetre can be adopted to measure much higher current. (03marks)

A low resistor called a shunt is connected across (parallel) the terminals of millimetre.

Nearly all the current entering the combination flows through the shunt

(ii) State two ways of increasing the sensitivity of electrical meters

- Increasing the number of turns in the coil
- Using strong magnet

8. (a)(i) Define the term half-life as applied to radioactivity. (01mark)

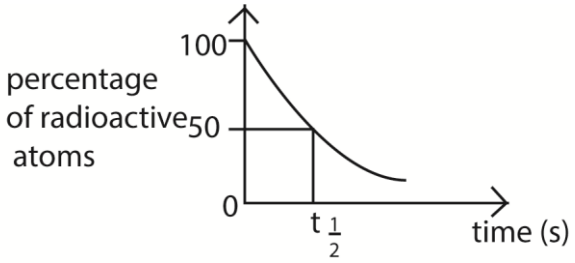
Half-life is the time taken for a radioactive substance to decay to half the original mass.

(ii) A radioactive material has half-life of 5minutes. If the initial mass of the material is 120g, calculate the mass that decays after 20 minutes. (05marks)

Time	Mass remaining
0	120
5	60
10	30
15	15
20	7.5

Mass decayed = 120 – 7.5 = 112.5g

(iii) Sketch a graph of the number of atoms of a radioactive material present against time to show how the half-life is determined from it. (02marks)



(b) Explain the number of the tracks of alpha particles and beta particles in air. (06marks)

Alpha particles produce thick short tracks while beta particles produce thin long wavy tracks because alpha particles are better ionizing particles and heavy that are not easily deflected while beta particles are poor at ionizing and light that they are easily deflected.

(c) How does the passage of beta particle through an electric field differ from that of an X-ray? (02mark)

Beta particles are deflected towards the positive plate because they are negatively charged while X- rays are not deflected because they are uncharged.