Bangladesh International Tutorial Limited

Physics Worksheet

Class-XII

Worksheet- 05

Subject Teacher- P.K. Saha

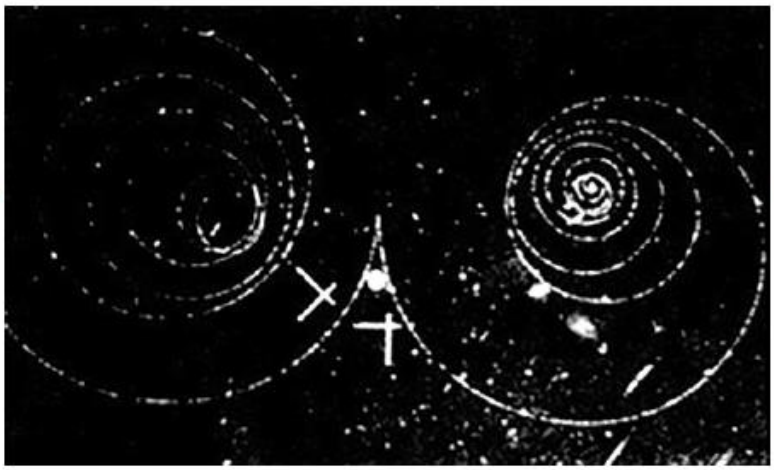
Total Marks- 40

Name: _____

1.

A high-energy gamma photon enters a bubble chamber and produces an electron-positron pair.

The photograph shows the tracks of the electron and the positron. The gamma photon enters from the top of the photograph.

A  B

(a) State why the photon leaves no track.

(1)

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(b) The magnetic field acts into the page.

State with justification whether track A or track B is the track of the electron.

(1)

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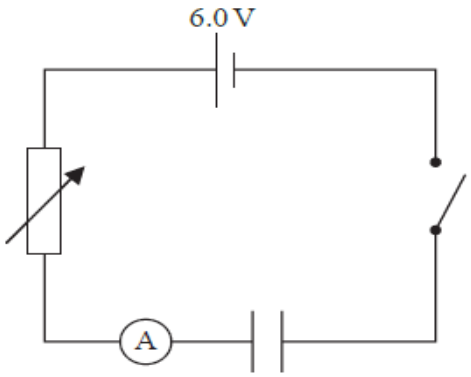
*(c) Explain the shape of the electron-positron tracks.

(5)

2.

A student is investigating capacitance. She sets up the circuit shown.

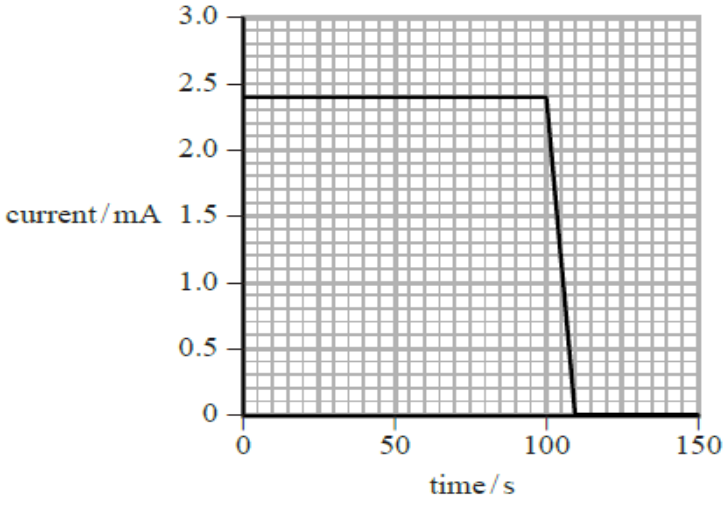


(a) When the switch is closed there is a maximum current, which decreases to zero over a period of time as the capacitor charges. Explain why.

(3)

(b) The student discharged the capacitor. She set the variable resistor to its maximum resistance and closed the switch. As the capacitor charged, the student decreased the resistance of the variable resistor so that the current remained constant until the capacitor was fully charged.

A graph of current against time is shown.



(i) Determine the capacitance of the capacitor.

(3)

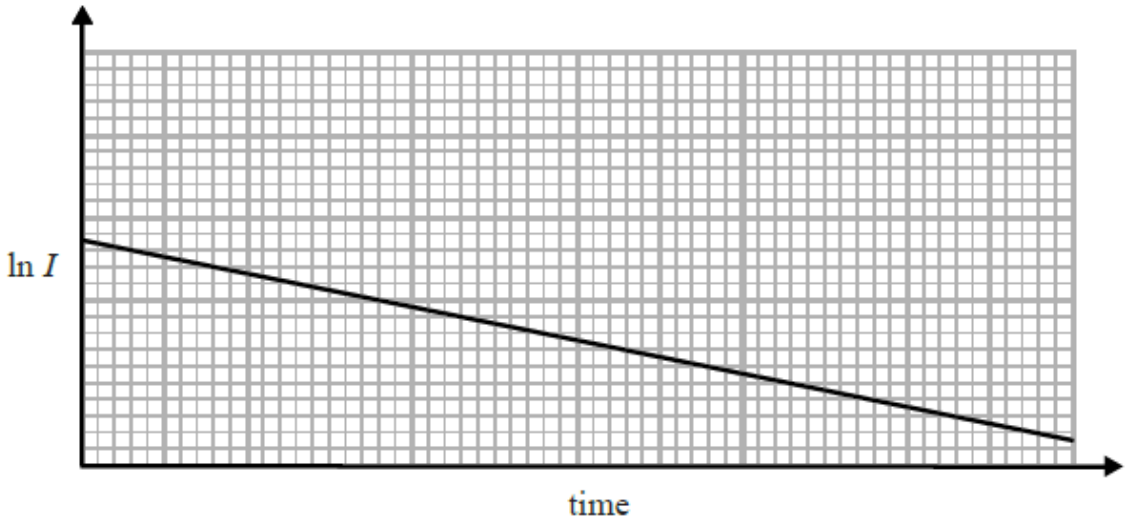
Capacitance = ...

(ii) Hence determine the energy stored by the capacitor when it is fully charged.

(2)

Energy stored = ...

(c) Capacitance can also be determined by measuring the current I at regular time intervals, as a capacitor discharges through a resistor, and plotting a graph of ln I against time.



(i) Explain how capacitance can be determined using this graph.

(3)

(ii) A capacitor was discharged through a 390 Ω resistor. The capacitance of the capacitor was calculated as 2200 μF.

Explain why the data for the graph for this circuit would be difficult to obtain using an ammeter. Your answer should include a calculation.

(3)

3.

In a large-angle alpha particle scattering experiment, alpha particles were directed at thin gold foil and their paths observed. Most of the alpha particles passed straight through the foil or were deflected through a small angle. A very small number were deflected through an angle greater than 90°.

(a) State what can be deduced about the atom given that most alpha particles passed straight through the foil.

(1)

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(b) The point below represents a gold nucleus.

Add lines to show the electric field due to the gold nucleus.

(2)

(c) An alpha particle that is moving directly towards a gold nucleus is deflected back along its original path. The minimum separation between the alpha particle and the gold nucleus is 3.8×10^{-14} m.

atomic number of gold = 79

(i) Calculate the electrostatic force on the alpha particle when it is at the minimum separation from the gold nucleus.

(2)

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Force on alpha particle = ...

(ii) The initial kinetic energy of the alpha particle is 6.0 MeV.

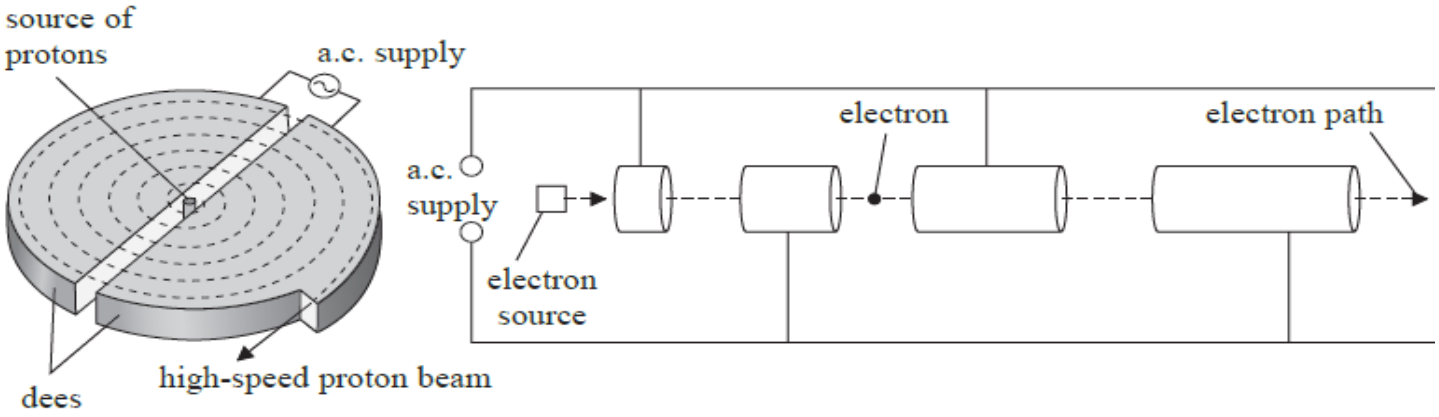
Calculate the change in momentum of the alpha particle, in N s, as it travels to its minimum separation from the gold nucleus.

(3)

Change in momentum = ... N s

4.

The diagrams show two particle accelerators, the cyclotron and the linac.



(a) Describe two similarities and two differences in how the accelerators operate.

(4)

Two similarities .....

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Two differences .....

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(b) (i) Electrons in an electron beam are moving at a speed of 8.2×10^6 m s^{-1}.

Show that the de Broglie wavelength associated with these electrons is about 9×10^{-11} m.

(2)

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(ii) In the 1950s physicist Robert Hofstadter used electron diffraction to estimate the diameter of the proton. He obtained a value of 5.6×10^{-25} m.

State why electrons moving at 8.2×10^{6} m s^{-1} would not be suitable for this.

(1)

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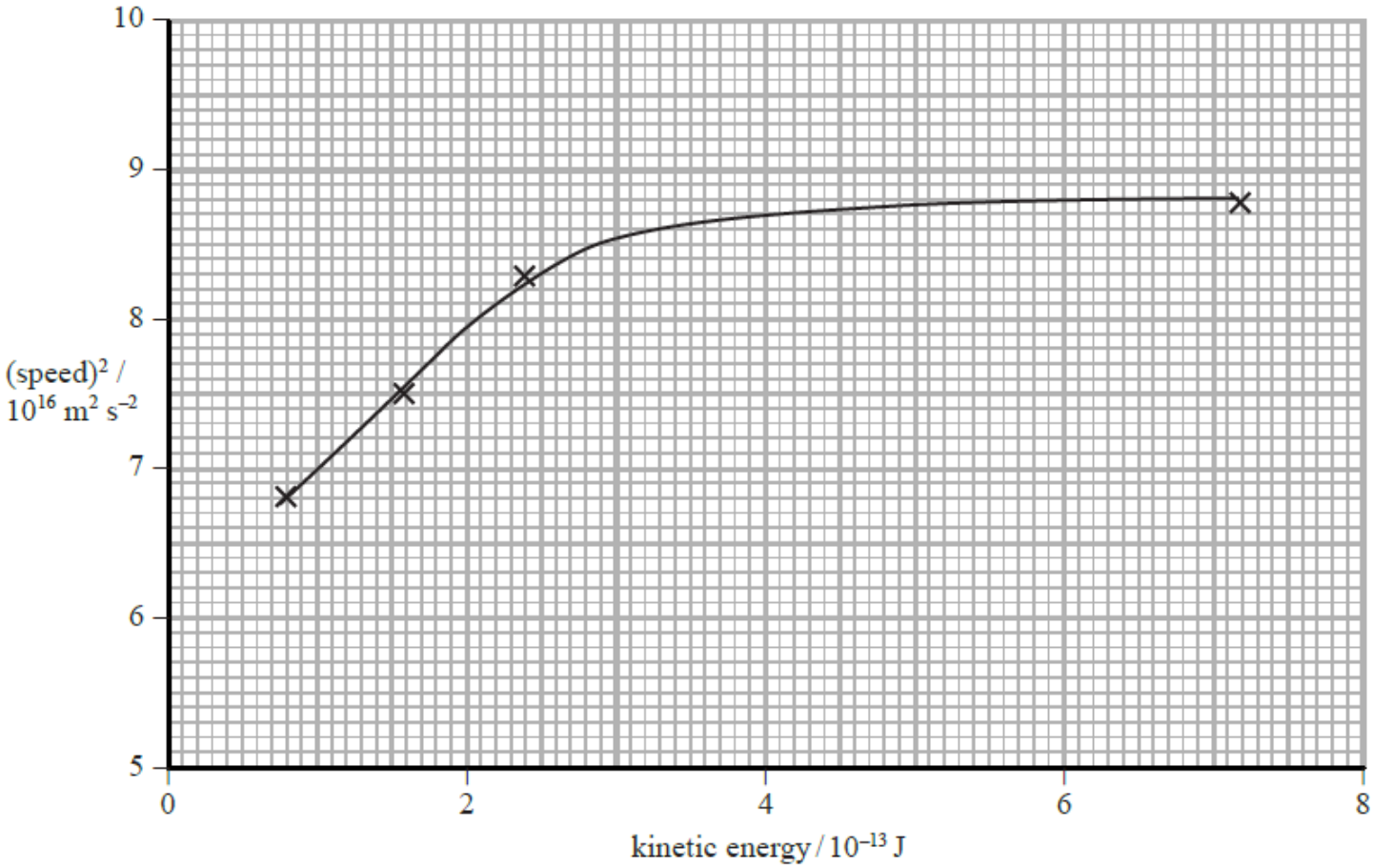
(c) Developments in particle accelerator technology in the 1960s enabled experiments with high-energy electrons to be carried out. At these energies, relativistic effects occur.

The graph below, of (speed)^2 against kinetic energy, shows data from one of these experiments.



(i) Explain why the graph levels out at a value close to 9×10^{16} m^2 s^{-2}.

(2)

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(ii) The non-relativistic equation for kinetic energy, $E_k = \frac{1}{2} mv^2$, does **not** apply for high-energy electrons. Explain how the graph shows this.

(2)

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