Practice Question Set For A-Level
Subject : Physics
Paper-3 Topic: Section B (Section 13_ Electronics)

Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

Q1.

(a) (i) There is a (constant) force acting which is (always) at right angles / perpendicular to the path / motion / velocity / direction of travel / to the beam
Or mentions a centripetal force ✓

First mark is for condition for circular motion

Not speed

Second mark is for a statement relating to the origin of the force

Force is at right angles to the magnetic field and the electron motion
Or
direction given by left hand rule ✓

Any mention of attraction to the plates is talk out (TO)

2

(ii) States $Bev = \frac{mv^2}{r}$ and evidence of correct intermediate stage showing

manipulation of the formula
or

Quotes $r = \frac{mv}{Be}$ from formula sheet and change of subject to $v = Ber / m$ seen

Accept delete marks

or rewrite as $Be = \frac{mv}{r}$

or rearrangement as $\frac{v^2}{v} = \frac{Ber}{m}$

1

(iii) States $Bev = \frac{eV}{d}$

or $F = Bev$ $F = \frac{eV}{d}$ (or $F = Ee$ *and* $E = \frac{V}{d}$ in any form)

Allow use of e *or* Q

and

states $v = \frac{V}{Bd}$ ✓

No mark for just quoting final equation. There must be evidence of useful starting equations

1

(b) Equates the formulae for *v* and shows $\frac{e}{m}$ equated to $\frac{V}{B^2rd}$

Must include 'e / m =' not just 'specific charge ='

Note there is no ecf. Candidates who use an incorrect equation in (a) (iii) will lose this mark unless they restart from first principles

Condone Q / m

1

(c) Using band marking

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.
Level 1 (1−2 marks)
Answer is largely incomplete. It may contain valid points which are not clearly linked to an argument structure. Unstructured answer. Errors in the use of technical terms, spelling, punctuation and grammar or lack of fluency.
Level 2 (3−4 marks)
Answer has some omissions but is generally supported by some of the relevant points below: - the argument shows some attempt at structure - the ideas are expressed with reasonable clarity but with a few errors in the use of technical terms, spelling, punctuation and grammar.
Level 3 (5−6 marks)
Answer is full and detailed and is supported by an appropriate range of relevant points such as those given below: - argument is well structured with minimum repetition or irrelevant points - accurate and clear expression of ideas with only minor errors in the use of technical terms, spelling and punctuation and grammar.

A

Measure the terminal speed of the falling droplet

At the terminal speed weight = viscous force (+ upthrust)

$mg = 6\pi\eta rv$ and $m = 4\pi r^3\rho / 3$ so $r^2 = \frac{9\eta v}{2}$
r could be determined as density of drop, viscosity of air and g are known (r is the only unknown)

B
m can be determined if r is known
Apply pd between the plates so electric field = V / d and adjust until droplet is stationary
$QV / d = mg$ so Q can be found

C
Make a number of measurements to find Q
Results for Q are in multiples of 1.6×10^{-19}C so Q can be found

e.g.

1-2

Superficial with some sensible comments about the procedure with significant errors in attempts at use of equations. May do one part of A B or C reasonably well. Relevant Equations without little explanation may be worth 1

3-4

Should cover most of the point in two of A, B & C coherently

A & B may be well done in an answer that is easy to follow

OR B and C may be well explained but there may be significant errors or omissions in the determination of r

OR a bit of all A B and C with significant errors or omissions

5-6

Will cover the points made in A B & C with few omissions in an answer that is easy to follow

The candidate will define some terms used in equations

1-2

Attempt to explain how to determine radius with detail of how to use data

OR

Makes a relevant point about some part of the procedure about the determination

3-4

Radius determination explained with sensible equations

Explanation of how to use data to find mass of the drop

Idea of holding the drop stationary

5-6

Answer includes all steps to determine the charge of a droplet with correct equations showing how to use the measurements

For highest mark the answer should include idea of interpreting results of many measurements

6

[11]

Q2.

(a) They expected the time taken for the light to travel in one direction to be different from the other ✓
or
Expected light to travel at different speeds in the two directions

However expressed e.g. in terms of the different times taken parallel and at right angles to the Earth's motion (through the Aether)

There would be a phase shift / change in the phase relationship

Not
longer / different paths
or
path difference

2

(b) (i) Speed through aether

$$= \frac{\text{circumference of Earth orbit around the Sun}}{\text{time for one orbit (1 year)}}$$

Need to be clear about the distance and time

or $v = (GM / r)^{1/2}$ with M and r defined

Watch out for confusion between Earth's orbit around the Sun and Earth's rotation on its axis

1

(ii) 11 m

1

(c) Experiment showed speed of light from moving object is same as that from stationary object or
Speed of light in direction of motion is same as in perpendicular direction or
Speed of light does not depend on speed of source or observer
Speed of light being invariant
or
Aether theory incorrect / no aether / no absolute motion

Allow is always 3×10^8 m s^{-1} in air or vacuum instead of invariant

It was a postulate / assumption of the theory of special relativity
Or this supports the theory ✓

Second mark is for explicitly linking the observation to Einstein's theory

2

[6]