Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• Use of Q = CV (1) • Use of $Q = Q_0 e^{-t/RC}$ (1) • Q/Q_0 = 0.01 (1) • t = 11.6 ms (1) • Use of $I = \frac{Q}{t}$ (1) • I = 12 A (1)	Example of calculation: Q=CV = 56 × 10^{-6} F × 2500 V = 0.14 C $\ln\left(\frac{Q}{Q_0}\right) = e^{-t/RC}$ $\ln(0.01) = -\frac{t}{45\Omega \times 56 \times 10^{-6}\text{F}} \therefore t = 0.0116\text{s}$ $I = \frac{Q}{t} = \frac{0.14\text{s}}{0.0116\text{s}} = 12.1\text{A}$	**(6)**

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Q2.

<table>
<tr><th>Question Number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>*</td>
<td>
This question assesses a student's ability to show a coherent and logical structured answer with linkage and fully-sustained reasoning. Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.
The following table shows how the marks should be awarded for indicative content.
<table>
<tr><th>Number of indicative points seen in answer</th><th>Number of marks awarded for indicative points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5-4</td><td>3</td></tr>
<tr><td>3-2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
Indicative content

There is an alternating p.d./E-field
P.d./E-field accelerates protons between dees
Magnetic field perpendicular to plane of dees
Proton path curved by magnetic field
As velocity of protons increases radius of path in dees increases
The time for which a proton is in a dee remains constant
Or the frequency of p.d./E-field is constant

</td>
<td>
Guidance on how the mark scheme should be applied: The mark for The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><th></th><th>Number of marks awarded for structure and lines of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkage between points and is unstructured</td><td>0</td></tr>
</table>
<table>
<tr><th>Number of IC points</th><th>Possible linkage marks</th></tr>
<tr><td>0, 1</td><td>0</td></tr>
<tr><td>2, 3</td><td>1</td></tr>
<tr><td>4, 5, 6</td><td>2</td></tr>
</table>
IC2 accept 'in the gap' for between dees. Accept increases E_k for accelerates

IC3 accept vertical or upwards for perpendicular to plane.

IC5 accept reference to $r = p/BQ$
</td>
<td>6</td>
</tr>
</table>

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Q3.

Question Number	Acceptable Answers	Additional guidance	Mark
	• tangent at correct point (1) • triangle with base at least 0.4 m (1) • 5.3×10^6 (Vm^{-1}) (range 4.9×10^6 to 6.1×10^6) (1) • So would ionise as value greater than 3×10^6 (1) Alternative: • Correct value of V at 30 cm (1) • Use of $E = k\frac{Q}{r^2}$ and $V = k\frac{Q}{r}$ (1) • 5.3×10^6 (Vm^{-1}) (1) • So would ionise as value greater than 3×10^6 (1)	Example of calculation: Gradient = 3200000 / 0.6 $E = 5.3 \times 10^6$ V m^{-1} MP4 to be consistent with calculated value $V = 1.6 \times 10^6$ V m^{-1}	4

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Electric field vertically downwards (from top plate to bottom plate) (1) • Magnetic field into paper (1)		2

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• Use of $E = \frac{V}{d}$ (1) • Use of $F_E = EQ$ (1) • Use of $F_M = BQv$ (1) • Show that these forces are equal (if v is 2.2 x 10^5 m s^{-1}) and hence state that B is suitable (1)	Do not award MP4 if incorrect ion charge used Example of calculation: $E = \frac{V}{d} = \frac{135\text{ V}}{2.5 \times 10^{-2}\text{ m}} = 5400\text{ V m}^{-1}$ $F = EQ = 5400\text{ V m}^{-1} \times 1.6 \times 10^{-19}\text{ C} = 8.6 \times 10^{-16}\text{ N}$ $F = BQv = 24.5 \times 10^{-3}\text{ T} \times 1.6 \times 10^{-19}\text{ C} \times 2.2 \times 10^5\text{ m s}^{-1}$ $= 8.6 \times 10^{-16}\text{ N}$	4

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