Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Mark Schemes

Q1.

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: $E = \frac{V}{d} = \frac{135\,\text{V}}{2.5\times10^{-2}\,\text{m}} = 5400\,\text{V m}^{-1}$ $F = EQ = 5400\,\text{V m}^{-1} \times 1.6\times10^{-19}\,\text{C} = 8.6\times10^{-16}\,\text{N}$ $F = BQv = 24.5\times10^{-3}\,\text{T}\times1.6\times10^{-19}\,\text{C}\times2.2\times10^{5}\,\text{m s}^{-1}$ $= 8.6\times10^{-16}\,\text{N}$	4

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	• The curved surface is (analogous to) a radial field (1) • (as $h \propto 1/r$ then) potential (energy) $\propto 1/r$ (1) • compares with $V \propto 1/r$ around a point charge (1)		3

Q3.

Question Number	Acceptable Answer	Additional guidance	Mark
	C	7, 4	**(1)**

Q4.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of $E = \frac{\text{constant}}{r^2}$ **(1)** • Calculates at least one value of the constant **(1)** • Calculates a second value and states that the field is not inverse square law **(1)**	eg writes $Q = 4\pi\varepsilon_0 Er^2$ Or $Q/4\pi\varepsilon_0 = Er^2$ Or $Er^2 = k$ Example of calculation $1200\ \text{N C}^{-1} \times 3^2\ \text{m}^2 = 10800\ \text{V m}$ $100\ \text{N C}^{-1} \times 25^2\ \text{m}^2 = 62500\ \text{V m}$ Or $1200\ \text{N C}^{-1} \times 3^2\ \text{m}^2 \times 4\pi\varepsilon_0 = 1.2 \times 10^{-6}\ \text{C}$ $100\ \text{N C}^{-1} \times 25^2\ \text{m}^2 \times 4\pi\varepsilon_0 = 6.9 \times 10^{-6}\ \text{C}$ Or $1200\ \text{N C}^{-1} \times 3^2\ \text{m}^2 = 10800\ \text{V m}$ $\frac{10800\ \text{V m}}{100\ \text{N C}^{-1}} = 108\ \text{m}^2$ and $\sqrt{108} = 10.4$ not 25	3

Q5.

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	charge not conserved		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(ii)	• both radial fields OR (1) the magnitude of the fields is the same (at a given distance) • different directions (1)		**(2)**

Q6.

Question Number	Acceptable answers	Additional guidance	Mark
	• p.d. across capacitor increases **Or** p.d. across resistor decreases (1) • p.d. across capacitor increases to 5V (1) • p.d. across resistor starts at 5V and reduces to 0V (1) • Exponentially (1)		**4**

Q7.

Question Number	Acceptable answers	Additional guidance	Mark
	D uses $W = \frac{1}{2}CV^2$ so if V is doubled W is 4×	$4W$	**1**
	A divides the energy by 4 (rather than multiply) B forgets to square the potential difference and divides C forgets to square the potential difference		

Q8.

Question Number	Answer	Mark
	D	1

Q9.

Question Number	Acceptable answers	Additional guidance	Mark
	A		1

Q10.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of $\ln V = \ln V_o - \frac{t}{RC}$ **(1)** **Or** Draws initial tangent to curve and uses $T = RC$ **Or** Determines t when V has decreased to approx. 37% • Conversion hours to seconds **(1)** • Calculates resistance in range 2.4×10^{11} to 2.8×10^{11} (Ω) **(1)** • Use of $R = \rho l / A$ **(1)** • Resistivity in range 2.2×10^{15} Ω to 2.6×10^{15} Ω m so yes above 10^{14} Ω m **(1)**	Example of calculation: $ln6 = ln100 - \frac{20 \times 3600\ \text{s}}{R \times 0.1 \times 10^{-6}(\text{s})}$ $R = 2.6 \times 10^{11}\ \Omega$ $2.6 \times 10^{11}\ \Omega = \frac{\rho \times 0.6 \times 10^{-6}\ \text{m}}{5.6 \times 10^{-3}\ \text{m}^2}$ Resistivity = $2.4 \times 10^{15}\ \Omega\ \text{m}$ Using $T = RC$ $7 \times 3600\ \text{s} = 0.1 \times 10^{-6}\ \text{F} \times R$ $R = 2.5 \times 10^{11}\ \Omega$ (allow T in range 7 – 8 hour)	**5**