Name of the Student:_____
Max. Marks : 26 Marks **Time : 26 Minutes**

Mark Schemes

Q1.

Question number	Acceptable answers	Additional guidance	Mark
	Either • Use $Q = 2.6$ to read time constant from graph **(1)** **OR** draw tangent to curve at t = 0 and obtain time constant from intercept on x axis **(1)** • $t = 17 - 18$ (ms) **(1)** • Use of $T = RC$ with their T **(1)** • $C = 0.019$ - 0.021 mF **(1)** **OR** • $Q_0 = 7$ (mC) read from graph **(1)** • Any corresponding values of Q and t read from graph **(1)** • Use of $Q=Q_0 e^{-t/RC}$ with their values for Q_0, Q and t **(1)** • $C = 0.0195 - 0.0196$ mF **(1)** **OR** • $Q_0 = 7$ (mC) read from graph **(1)** • $Q=3.5$ (mC) when $T_{1/2} = 12.3$ (ms) **(1)** • Use of $T_{1/2} = RC \ln 2$ **(1)** • $C = 0.0195 - 0.0196$ mF **(1)**	Example of calculation: $T = 19$ (ms) $C = 19 \times 10^{-3}/900 =$ 0.021 mF	**4**

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of $V = Q/4\pi\varepsilon_0 r$ **(1)** • Conversion MeV to J **(1)** • Use of $V = W/Q$ **(1)** • $r = 3.0 \times 10^{-14}$ m **(1)**	allow for $Q = 2$ or 79, accept $V = kQ/r$ Must use $e = 1.6 \times 10^{-19}$ C to convert atomic number to C Example of calculation: 7.7×10^6 eV $\times 1.6 \times 10^{-19}$ J eV^{-1} $= 8.99 \times 10^9$ N m^{2}C^{-2} $\times 2 \times 79 \times$ $(1.6 \times 10^{-19}$ C$)^2 \div r$ $r = 2.27 \times 10^{-7} \div 7.7 \times 10^6$ $r = 2.95 \times 10^{-14}$ m	**4**

Q3.

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)**

Q4.

Question Number	Answer		Mark
(a)(i)	Capacitor, resistor, supply and switch all in series (ignore voltmeter) Voltmeter directly across capacitor	**(1)** **(1)**	**2**
(a)(ii)	Datalogger allows large number of readings to be taken **Or** graph can be plotted directly/automatically **Or** simultaneous reading of t and V can be taken **Or** idea that people can't record quickly enough, (treat as neutral accuracy, precision misreading or human reaction time)	**(1)**	**1**
(b)	Use of $C = Q/V$ $Q = 5.0 \times 10^{-4}$ C Example of calculation $Q = 100 \times 10^{-6}$ F $\times$ 5.0 V $Q = 5.0 \times 10^{-4}$ C	**(1)** **(1)**	**2**
(c)(i)	Use of $I = \Delta Q / \Delta t$ e.c.f their value of C from (b) $I = 0.05$ A (accept recalculation of Q using $V = 4.90$ or 4.95 V) Example of calculation $I = 5.0 \times 10^{-4}$ C / 10×10^{-3} s $I = 0.05$ A	**(1)** **(1)**	**2**
(c)(ii)	tangent drawn at t = 0 $\Delta V / \Delta t = 2000$ - 3300 V s^{-1} Initial current = 0.22 - 0.28 A (MP2 & 3 can be scored even if no tangent drawn) (No credit for exponential calculation) Example of calculation $\Delta V / \Delta t = 1.1$ V/ 0.5 ms = 2200 V s^{-1} $I = (\Delta V / \Delta t) \times C$ $I = 2200$ V $s^{-1} \times 100 \times 10^{-6}$ F $I = 0.22$ A	**(1)** **(1)** **(1)**	**3**
(c)(iii)	Use of $V = IR$ using answer from (ii) correct evaluation of R (5V used with current range in (ii) gives 18 - 23 Ω) Example of calculation 5 V = 0.22 A $\times$ R $R = 23$ Ω	**(1)** **(1)**	**2**
	Total for question		**12**