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

Mark Schemes

Q1.

Question Number	Answer		Mark
(a)	Use of $Q = CV$ $Q = 0.18$ C Example of calculation $Q = 150 \times 10^{-6}$ F $\times$ 1200 V $Q = 0.18$ C	**(1)** **(1)**	**2**
(b)	Use of $W = ½ CV^2$ **Or** of $W = ½ QV$ **Or** of $W = ½ Q^2/C$ $W = 110$ J Allow ecf from (a) if $½ QV$ or $½ Q^2/C$ used Example of calculation $W = ½ \times 150 \times 10^{-6}$ F $\times$ (1200 V)^2 $W = 108$ J	**(1)** **(1)**	**2**
(c)(i)	$R = 86$ (Ω) Example of calculation $R = V/I$ = 1200 V / 14 A $R = 85.7$ Ω	**(1)**	**1**
(c)(ii)	$Q = 0.25\ Q_0$ **Or** $Q = 0.045$ C Use of RC (0.013 s) Use of $Q = Q_0\ e^{-t/RC}$ to give $t = 0.018$ s (show that value will give $t = 0.019$ s) [Use of ln 4 gives the correct answer if the − sign is ignored , scores 1 for use of RC use of ¾Q →3.7×10^{-3} s scores 1 mark] **Or** Use of RC Use of $2 \times 0.69 \times RC$ $t = 0.018$ s Example of calculation $Q = 0.25\ Q_0$ $Q = Q_0\ e^{-t/RC}$ $0.25\ Q_0 = Q_0\ e^{-t/RC}$ ln (0.25) = - t/ (86 Ω $\times$ 150 $\times 10^{-6}$ F) $t = 0.0178$ s	**(1)** **(1)** **(1)**	**3**

(c)(iii)	Same charge (flows for shorter time) **OR** (Same charge flows for) shorter time	(1)	1

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
i	• Use of $\ln V = \ln V_o - \frac{t}{RC}$ (1) • Substitution $V = 2.0$ V and $V_o = 8.0$ V (1) • $t = 5.6(1)$ ms (1)	Alternative use of $V = V_o e^{-\frac{t}{RC}}$ Rearrange to $\ln 4 = t / 2700\ \Omega \times 1.5 \times 10^{-6} F$ Example of calculation $t = 2700\ \Omega \times 1.5 \times 10^{-6}$ F $(\ln 8 - \ln 2)$ $t = 5.61$ ms	3
ii	• Use of $W = ½ CV^2$ (1) • $W = 3.0 \times 10^{-6}$ J (1)	Example of calculation $W = \frac{1}{2} 1.5 \times 10^{-6} F \times 2^2\ V^2 = 3.0 \times 10^{-6}$ J	2

Q3.

Question Number	Answer	Mark
(a)	At least three vertical lines spread over symmetrically over more than half of the plate length and touching both plates. (1) (ignore edge ones that might curve) All equispaced and parallel [don't allow gaping to avoid oil drop] (1) Arrow pointing downwards (1)	3
(b)	Negative / - / -ve (1) (negative and/or positive does not get the mark)	1

(c)	Upward force labelled: Electric (force) **Or** Electrostatic (force) **Or** force due to electric field **Or** electromagnetic (force) [do not accept repulsive/attractive force. If EQ used, the symbols must be defined] Downward force labelled: mg, weight, W, gravitational force (for both marks the lines must touch the drop and be pointing away from it. Ignore upthrust if drawn but one mark lost for each extra force added)	**(1)** **(1)**	**2**
(d)(i)	E = 5100 V/ 2 cm Conversion of cm to m Use of $QE = mg$ (1.18×10^{-13} kg) $Q = 4.6 \times 10^{-19}$ C (E = 255 000 (V m^{-1}) scores MP1 & 2. unit conversion missed → $Q = 4.62 \times 10^{-17}$ C scores MP1 & 3 if V is halved → $Q = 9.23 \times 10^{-19}$ C scores MP1 ,2 & 3) <u>Example of calculation</u> $E = V/d$ $F = EQ = mg$ $Q = mg / E = mgd/V$ Q = (1.20×10^{-14} kg × 9.81m s^{-2}× 0.02 m) / (5100 V) Q = 4.62×10^{-19} C	**(1)** **(1)** **(1)** **(1)**	**4**
(d)(ii)	Answer to (d)(i) divided by e 3 electrons **Or** sensible integer number less than 500 (answers with very large numbers of electrons can get MP1 only) <u>Example of calculation</u> Number of electrons = 4.62×10^{-19} C / 1.6×10^{-19} C Number = 2.9 i.e. 3 electrons.	**(1)** **(1)**	**2**
	Total for question		**12**