Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

Question Number	Answer		Mark
(a)	Use of $C=Q/V$	(1)	
	$V = 15$ V	(1)	
	Use of $W = QV/2$ **Or** $W = CV^2/2$ **Or** $W = Q^2/2C$	(1)	
	$W = 2.5 \times 10^{-5}$ J	(1)	4
	(candidates who use 6.6×10^{-6} C can only score MP1 and MP3)		
	Example of calculation		
	$V = Q/C = 3.3 \times 10^{-6}$ C / 220×10^{-9} F		
	$V = 15$ V		
	$W = QV/2 = (3.3 \times 10^{-6}$ C $\times$ 15 V)/2		
	$W = 2.5 \times 10^{-5}$ J		
(b)	$Q = 0.2\ Q_0$ **Or** $Q = 6.6\times 10^{-7}$ C	(1)	
	Use of $Q = Q_0\ e^{-t/RC}$	(1)	
	$t = 7.1$ s	(1)	3
	(candidates who use $Q = 0.8\ Q_0$ can only score MP2)		
	Example of calculation		
	$Q = 0.2\ Q_0$		
	$Q = Q_0\ e^{-t/RC}$		
	$0.2\ Q_0 = Q_0\ e^{-t/RC}$		
	$\ln(0.2) = -t/ (20\times 10^6\ \Omega \times 220 \times 10^{-9}$ F)		
	$t = 7.1$ s		

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(c)	**Either** refers to $W = Q^2/2C$ **Or** $W \propto Q^2$ (1) If Q halves, $W \rightarrow Q^2/8C$ Or halving Q quarters W (1) (Since W becomes a quarter in the time for Q to half) it takes less time for the energy to halve than the charge to halve. (dependent mark on either MP1 or MP2) (1) **Or** Refers to $W = QV/2$ (1) Q and V both decrease over time (1) W will decrease faster so takes less time to half in value. (dependent mark on either MP1 or MP2) (1)	3
(d)	Synchronous readings **Or** data logger records readings at exact time **Or** voltmeter and stop watch need 2 people and data logger only one (1) More readings can be taken in a shorter time **Or** higher sampling rate (1) (treat as neutral any reference to graph plotting automatically, human reaction time or accuracy)	2
	Total for question	12

Q2.

Question Number	Answer	Mark
(a)(i)	Capacitor, resistor, supply and switch all in series (ignore voltmeter) (1) Voltmeter directly across capacitor (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 $C = Q/V$ (1) $Q = 5.0 \times 10^{-4}$ C (1) <u>Example of calculation</u> $Q = 100 \times 10^{-6}$ F $\times$ 5.0 V $Q = 5.0 \times 10^{-4}$ C	2

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(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 × R $R = 23$ Ω	**(1)** **(1)**	**2**
	Total for question		**12**

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