MCQ: 8C, 9B,10B

Question Number	Answer		Mark
2(a)	Use of $C=Q/V$ V= 15 V Use of $W = QV/2$ **Or** $W = CV^2/2$ **Or** $W = Q^2/2C$ $W = 2.5 \times 10^{-5}$ J (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 × 15 V)/2 $W = 2.5 \times 10^{-5}$ J	**(1)** **(1)** **(1)** **(1)**	**4**
2(b)	$Q = 0.2\ Q_0$ **Or** $Q = 6.6\times 10^{-7}$ C Use of $Q = Q_o\ e^{-t/RC}$ t = 7.1 s (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	**(1)** **(1)** **(1)**	**3**
2(c)	**Either** refers to $W = Q^2/2C$ **Or** $W \propto Q^2$ If Q halves, $W \rightarrow Q^2/8C$ Or halving Q quarters W (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) **Or** Refers to $W = QV/2$ Q and V both decrease over time W will decrease faster so takes less time to half in value. (dependent mark on either MP1 or MP2)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**3**
2(d)	Synchronous readings **Or** data logger records readings at exact time **Or** voltmeter and stop watch need 2 people and data logger only one More readings can be taken in a shorter time **Or** higher sampling rate (treat as neutral any reference to graph plotting automatically, human reaction time or accuracy)	**(1)** **(1)**	**2**
	Total for question 15		**12**

Question Number	Answer		Mark
3(a)(i)	Use of $Q = CV$ Q = 3900 (C) Example of answer Q = 1500 F × 2.6 V Q = 3900 C	**(1)** **(1)**	**2**
3(a)(ii)	Straight line through the origin Passing through 2.6 V and answer to (a)(i) or 4000 C	**(1)** **(1)**	**2**
3(a)(iii)	Use of $W = QV/2$ **Or** $W = CV^2/2$ **Or** use of area under graph W = 5.1 kJ (use of 4000 C gives W = 5.2 kJ (allow ecf from (a)(i)) Example of answer W = 3900 C × 2.6 V / 2 W = 5070 J	**(1)** **(1)**	**2**
3(b)(i)	 Exponential decay Current decreases by equal fractions in equal time intervals	 **(1)** **(1)**	**2**
3(b)(ii)	See attempt of I_0/e Finds time (accept 0.75-0.80s) Use of $\tau = RC$ R = 0.0005 Ω **Or** Finds the time for I_o to half Uses $t_{1/2} = \tau \ln 2$ Use of $\tau = RC$ R = 0.00050 – 0.00053 Ω **Or** See attempt of 37% of 5400 A Finds time (accept 0.75 to 0.80 s) Use of $\tau = RC$ R = 0.0005 – 0.00053Ω **Or** Draws tangent at t = 0 to meet time axis. Records intercept of tangent with axis (accept 0.6 s - 0.9 s) Use of $\tau = RC$ R = 0.0004 Ω – 0.0006 Ω **Or** reads a value off the y-axis and corresponding time Subs into formula using 5400 (A) to find RC Substitutes for C to find R R = 0.00050 Ω – 0.00058 Ω Example of calculation 37% of 5400 A is 1998 A Time to fall to this value is 0.75 s RC = 0.75 s R =0.75 s / 1500 F = 0.0005 Ω	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**4**

3(c)	**Max 3** Ultracapacitor used for: overtaking **Or** going up a hill **Or** starting (from rest) **Or** accelerating. **(1)** Because this requires a large current/power. **(1)** Batteries used for travelling at constant speed **(1)** Because this requires a small current/power for a longer time **(1)**	**3**
	Total for question 17	**15**