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

Mark Schemes

Q1.

Question Number	Answer		Mark
(a)	Use of $Q = It$ $Q = 2.8$ C Example of calculation $Q = 2.0 \times 10^{3}$ A $\times$ 1.4×10^{-3} s $Q = 2.8$ C	**(1)** **(1)**	**2**
(a)(ii)	See $\tau = RC$ $\tau = 3.0 \times 10^{-4}$ (s) Relates time constant to the time for which current is required Example of calculation $\tau = 0.50\Omega \times (600 \times 10^{-6}$ F) $\tau = 3.0 \times 10^{-4}$ s 1.4×10^{-3}s / 3.0×10^{-4} s = 4.7RC	**(1)** **(1)** **(1)**	**3**
(b)(i)	Use of $Q = CV$ $V = 4700$ V (e.c.f from (a)(i)) Example of calculation $V = 2.8$V / $(600 \times 10^{-6}$ F) $V = 4670$ V	**(1)** **(1)**	**2**
(b)(ii)	Use of $W = ½ QV$ **Or** $W = ½ Q^2/C$ **Or** $W = ½ CV^2$ Use of $P = W/t$ $P = 4.7$ MW (e.c.f. from (a)(i) and/or (b)(i)) Example of calculation $P = (2.8$ C $\times$ 2.8 C) / $(2 \times 600 \times 10^{-6}$ F $\times$ 1.4×10^{-3} s) $P = 4.7$ MW	**(1)** **(1)** **(1)**	**3**
	Total for question		**10**

Q2.

Question Number	Answer		Mark
(a)(i)	Use of $Q = CV$ $Q = 3900$ (C) Example of answer $Q =$ 1500 F × 2.6 V $Q = 3900$ C	**(1)** **(1)**	**2**
(a)(ii)	Straight line through the origin Passing through 2.6 V and answer to (a)(i) or 4000 C	**(1)** **(1)**	**2**
(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**
(b)(i)	Exponential decay Current decreases by equal fractions in equal time intervals	**(1)** **(1)**	**2**
(b)(ii)	See attempt of I_0/e Finds time (accept 0.75-0.80s) Use of $\tau = RC$ $R = 0.0005\ \Omega$ **Or** Finds the time for I_o to half Uses $t_{1/2} = \tau \ln 2$ Use of $\tau = RC$ $R = 0.00050 - 0.00053\ \Omega$ **Or**	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	

	See attempt of 37% of 5400 A	(1)	
	Finds time (accept 0.75 to 0.80 s)	(1)	
	Use of $\tau = RC$ $R = 0.0005 - 0.00053\Omega$	(1)	
	Or	(1)	
	Draws tangent at $t = 0$ to meet time axis.		
	Records intercept of tangent with axis (accept 0.6 s - 0.9 s)	(1)	**4**
	Use of $\tau = RC$	(1)	
	$R = 0.0004\ \Omega - 0.0006\ \Omega$	(1)	
	Or	(1)	
	reads a value off the y-axis and corresponding time		
	Subs into formula using 5400 (A) to find RC	(1)	
	Substitutes for C to find R	(1)	
	$R = 0.00050\ \Omega - 0.00058\ \Omega$	(1)	
		(1)	
	<u>Example of calculation</u>		
	37% of 5400 A is 1998 A	(1)	
	Time to fall to this value is 0.75 s	(1)	
	$RC = 0.75$ s	(1)	
	$R = 0.75$ s / 1500 F = 0.0005 Ω	(1)	

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