Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	• 270K corresponds to a resistivity of 2×10^{-8} (Ω m) (1) • Use of $P=VI$ (1) • Use of $R=\rho l/A$ (1) • Use of $P=I^2R$ (1) • Power losses from copper cables 19 kW so more than 7 kW and that the superconductor would save energy. MP5 dependant on MP2,3,4 (1) (Acceptable range for Power losses: 9.6 kW to 34 kW)	range allow $2 \times 10^{-8}\,\Omega\,\text{m}$ to $2.1 \times 10^{-8}\,\Omega\,\text{m}$ Example of calculation: $40\times10^{6}\ \text{W} = 110\times10^{3}\ \text{V}\times I$ $I = 364\ \text{A}$ $R = \frac{2\times10^{-8}\,\Omega\text{m}\times1.050\times10^{3}\ \text{m}}{145\times10^{-6}\ \text{m}^2} = 0.145\,\Omega$ $P = 364^2\ \text{A}^2 \times 0.145\,\Omega = 19.2\,\text{kW}$	5

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Use of $P = IV$ (1) • Use of $V = \varepsilon - Ir$ Or $V = 180 - 0.036I$ (1) • Converts kW to W and rearranges equation to that shown (1)	Example of derivation: $88\ \text{kW} = I \times V$ $88\ \text{kW} = I \times (180 - 0.036I)$ $88000 = 180I - 0.036I^2$ $0.036I^2 - 180I + 88000 = 0$	3
(ii)	• Use of $Q = It$ (1) • Time that batteries can deliver this power = 40 s so more than 7 s (1)	Example of calculation: $6.1\ \text{A h} = 550\ \text{A} \times \text{t}$ $t = 0.011\ \text{h} = 40\ \text{s}$	2

Q3.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• Use of $I = P/A$ • $P = 0.014$ W	(1) (1)	Example of calculation $P = 7.8\ \text{W m}^{-2} \times 1.8 \times 10^{-3}\ \text{m}^2$ $P = 0.014$ W	2
(ii)	• Use of $P = VI$ • Use of efficiency $= \frac{\text{useful power output}}{\text{total power input}}$ • Efficiency = 0.19 or 0.20 or 19 % or 20 %	(1) (1) (1)	Example of calculation Power input into LED = 3.6 V × 20 × 10^{-3} A = 0.072 W Efficiency = $\frac{0.014\ \text{W}}{0.072\ \text{W}}$ = 0.194 ecf from (i) for the power output of LED	3

Q4.

Question Number	Acceptable answers		Additional guidance	Mark
	• p.d. across capacitor increases **Or** p.d. across resistor decreases • p.d. across capacitor increases to 5V • p.d. across resistor starts at 5V and reduces to 0V • Exponentially	(1) (1) (1) (1)		4