Electrical Quantities MS1

Question Number	Answer	Mark
1	Use of power = radiation flux × area (1) Use of efficiency = useful output / total input (1) Output power = 1460 (W) (1) (Reverse show that from 1500 W gives 607 W m^{-2} scores max 2) <u>Example of calculation</u> Power = 590 W m^{-2} × 9.5 m^2 = 5600 W Useful output = 5600 × 26% = 1457 W	**3**
	Use of power = current × p.d. (1) Current = 91 (A) (allow ecf for power) (1) (Use of 590 W m^{-2} gives 93.8 A) <u>Example of calculation</u> Current = 2 × 1460 W ÷ 32 V = 91.25 A	**2**
	Use of charge = current × time (1) Time = 2000 s **Or** 33 minutes **Or** 0.55 hours (allow ecf for current) (1) (Accept Time = 4000 s **Or** 66 minutes **Or** 1.1 hours (allow ecf for current)) <u>Example of calculation</u> Time = 180 000 C ÷ 90.6 A = 1987 s	**2**
	Valid physics suggestion, for example: Indication that the radiation flux may decrease, Some of the current is drawn for the components of the orbiter, Heating effect of current increases resistance and decreases current, Because current is maximum **and** $t = Q/I$	**1**

2	Use of $R = \rho l/A$ (1) Correct sides used for area (1) ρ = 13 Ω m (1) (Accept 1300 Ω cm) <u>Example of calculation</u> 1200 Ω = ρ × 0.135 m / (0.030 m × 0.050 m) ρ = 13.3 Ω m	**3**
	Use of $E = VIt$ (1) E = 11 J (1) <u>Example of calculation</u> E = 45 V × 0.12 A × 5 × 10^{-3} s × 400 = 10.8 J	**2**

Question Number	Answer		Mark
3	Current zero for negative V **Or** current zero when reverse bias (accept current doesn't flow **or** no current) **Max 2 for additional points from** Current only in one direction because resistance infinite in other direction (accept very high resistance) small (positive) p.d. before there is a current (accept reference to threshold voltage, 0.6 V or 0.7 V) as V increases, resistance of diode decreases **Or** as I increases, resistance of diode decreases	**(1)** **(1)** **(1)** **(1)**	**3**

Question Number	Answer		Mark
4	Use of power = flux × area Power = 0.31 (W) [no ue] <u>Example of calculation</u> Power = 49 W m^{-2} × 6.4 × 10^{-3} m^2 P = 0.314 W	**(1)** **(1)**	**2**
	Use of $P = IV$ Use of efficiency = (output power/input power) × 100% Efficiency = 12 % **or** 0.12 Allow ecf from (i) <u>Example of calculation</u> P = 0.0068 A × 5.6 V = 0.038 W efficiency = (0.038 W /0.31 W) × 100% = 12 % (OR 0.12)	**(1)** **(1)** **(1)**	**3**
	Use of $Q = It$ Use of $W = QV$ Maximum energy = 19 000 J **Or** Use of $P = IV$ Use of $W = Pt$ Maximum energy = 19 000 J (**Or** Use of $W = VIt$ scores 2 Maximum energy = 19 000 J) <u>Example of calculation</u> Q = 1.5 A × (60 × 60) s = 5400 C W = 5400 C × 1.2 V × 3 = 19 400 J	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**3**
	$W = IVt$, and W is the same for each (rechargeable) cell (and V varies in the same way) Because the (6.8 mA) current undivided for cells in series, the current is greater so the time is shorter (accept charges more quickly) **Or** reverse argument for parallel	**(1)** **(1)**	**2**

Question Number	Answer	Mark
5	cross-sectional area = 9.2×10^{-7} m^2 (1) <u>Example of calculation</u> $A = \pi \times (0.00108 \text{ m} \div 2)^2$ $= 9.2 \times 10^{-7}$ m^2	1
	Use of $\rho l/A = R$ (1) Length = 16.4 m (1) <u>Example of calculation</u> $l = RA/\rho$ $= 0.3\ \Omega \times 9.2 \times 10^{-7}\ \text{m}^2 \div 1.68 \times 10^{-8}\ \Omega\ \text{m} = 16.4$ m	2
	Comparison based on answer to (a) (ii), e.g. 2 m / 13% out so not very good (1)	1
	Resistance only to nearest 0.1 Ω (accept 1 sig fig) **Or** diameter to nearest 0.01mm (accept 3 sig fig) (1) For resistance that is plus or minus 17% (accept 33%) **Or** for diameter that is plus or minus 0.5 % (accept 1%) (1) Comparison of the percentage uncertainty of the diameter with percentage uncertainty of the resistance (1)	3
	(Apply pd and) measure pd and current with voltmeter and ammeter (accept circuit diagram if power supply shown and meters correctly placed) (1) Calculate resistance using $V = IR$ **Or** Plot V against I and use gradient (of the straight line) for R (1) The meters will give more sig figs (than the ohmmeter reading) **Or** there can be a lower percentage uncertainty with the meters **Or** you can select a pd and current much larger than the uncertainty generated by the limit of precision (accept graph would reduce the effect of random errors) (1)	3
	Use of $P = IV$ (1) $I = 5.2$ A (1) <u>Example of calculation</u> $1200\ \text{W} = I \times 230\ \text{V}$ $I = 5.22$ A	2
	Use of $P = I^2R$ (1) $P = 8.1$ W Allow ecf from (b)(i) (1) <u>Example of calculation</u> $P = (5.2\ \text{A})^2 \times 0.3\ \Omega$ $P = 8.1$ W	2

Question Number	Answer		Mark
6	Use of $R = \rho l/A$ $A = 1.3 \times 10^{-11}$ m^2 <u>Example of calculation</u> $A = \rho l/R$ $A = 3.5 \times 10^{-5}\ \Omega$ m $\times$ 0.02 m / 55 000 Ω $A = 1.3 \times 10^{-11}$ m^2	**(1)** **(1)**	**2**
	Use of $V = IR$ Use of $I = nAvq$ (allow ecf for A) Correct use of factor of 2 (factor of 2 may be introduced at any point) v = 31 m s^{-1} (use of 'show that' value 1×10^{-11} m^{2}gives answer 39 m s^{-1}) <u>Example of calculation</u> $I = V \div R$ I = 6.0 V ÷ 55 000 Ω = 1.1×10^{-4} A For 100%, 1.1×10^{-4} A = 3.5×10^{24} m^{-3} $\times$ 1.3×10^{-11} m^2 $\times$ v $\times$ 1.6×10^{-19} C $v = 1.1 \times 10^{-4}$ A ÷ (0.5 × 3.5×10^{24} m^{-3} × 1.3×10^{-11} m^2 × 1.6×10^{-19} C)	**(1)** **(1)** **(1)** **(1)**	**4**
	Softer pencil would make a thicker shape **Or** make a shape with a larger cross-sectional area **Or** has more charge carriers Resistance would be lower	**(1)** **(1)**	**2**