Intensity of Radiation - Mark Scheme

Q1.

Question Number	Answer		Mark
a	Use of $I = P/A$	(1)	
	Use of $A = 4\pi r^2$	(1)	
	$r = 1.47 \times 10^{11}$ m	(1)	3
	(MP3 can only be awarded if 1410 W m^{-2} has been used)		
	Example of calculation $4\pi r^2 = (3.83 \times 10^{26}$ W) / 1410 W m^{-2} $r = 1.47 \times 10^{11}$m.		
b	Mars orbits at a greater distance from the Sun than the Earth as the intensity is lower	(1)	
	Mars has a more elliptical orbit than the Earth	(1)	
	The (relative) difference between the maximum and minimum intensity for Mars is greater.	(1)	3
	(All 3 marking points need to be comparisons)		
	Total for question		**6**

Q2.

Question Number	Answer	Mark
	D is the correct answer as efficiency is the useful power output (250W) divided by the total power input (Intensity x Area). A is not the correct answer as this is (Power × Area) / Intensity B is not the correct answer as this is Intensity / (Power × Area) C is not the correct answer as this is the reciprocal of the efficiency equation	**(1)**

Q3.

Question Number	Answer		Mark
ai	Use of $I = P/A$ Maximum energy received in one hour = 3.6×10^{19} J <u>Example of calculation</u> $P = I \times A = (1100\ \mathrm{Wm^{-2}}) \times (9.2 \times 10^{12}\ \mathrm{m^2}) = 1.0 \times 10^{16}$ W $E = P \times t = (1.0 \times 10^{16}\ \mathrm{W}) \times (60 \times 60) = 3.6 \times 10^{19}$ J	(1) (1)	**(2)**
aii	Calculates total energy usage in 2014 **Or** Calculates total energy received by solar panels in 1 year Comparison of energies (hours with hours or years with years) to come to a correct conclusion. Allow e.c.f. from values in (a)(i) Possible comparisons: (see table below) <u>Example of calculation</u> Total E worldwide in 1 year = 23,800 × (3.6×10^{15} J) = 8.6×10^{19} J 8.6×10^{19} J / 3.6×10^{19} J = 2.4 (hours), so worldwide electrical energy consumption for 2014 would be produced in less than 3 hours	(1) (1)	**(2)**
b	**MAX 2** from: Sand(storms) reduce amount/intensity/energy/power of light Fewer electrons released in the (solar) panel Sand(storms) absorbs/blocks/reflects some light Sand(storms) reduces area of panel/desert	 (1) (1) (1) (1)	**(2)**

Possible comparisons:

Total energy worldwide in 2014	Total energy received by solar panels
23800 TWh (in a year)	87,600,000 TWh (if using 24 hours)
23800 TWh (in a year)	43,800,000 TWh (if using 12 hours)
8.6×10^{19} J (in a year)	3.2×10^{23} J (if using 24 hrs)
8.6×10^{19} J (in a year)	1.6×10^{23} J (if using 12 hrs)
9.8×10^{15} J (in an hour)	3.6×10^{19} J (in an hour)