11 Solar panels consisting of combinations of photovoltaic cells use energy in the radiation received from the Sun to generate electricity.

(a) An advertisement for solar panels claims that the intensity of radiation from the Sun incident at the top of the Earth's atmosphere is more than 2 kW m⁻². Assess the validity of this claim.
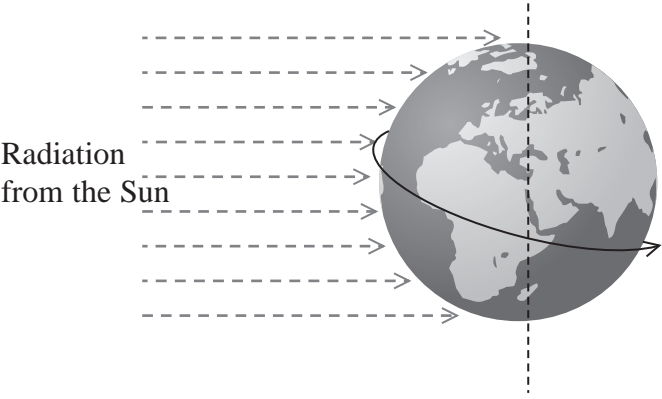
Assess the validity of this claim.

radius of Sun = 6.96×10^8 m

surface temperature of Sun = 5790 K

distance from Sun to Earth = 1.50×10^{11} m

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(b) The average intensity of radiation from the Sun incident at the Earth's surface over a 24-hour period has been determined to be 164 W m⁻².

Radiation from the Sun

(i) The average intensity of radiation from the Sun at the Earth's surface is much less than the intensity incident at the top of the Earth's atmosphere.

Explain why.

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(ii) It is claimed that the area of solar panels needed to generate 100 GW of power is about 0.5% of the surface area of the Earth.

Assess the validity of this claim.

radius of Earth = 6.4×10^6 m

typical efficiency of solar panels = 25%

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(c) Scientists are developing a space station equipped with large solar panels. The space station would be located in a geostationary orbit. The space station would transfer energy to Earth as microwaves.

(i) A space station in a geostationary orbit is above the equator and has a period of 24 hours.

Explain one advantage of locating the space station in a geostationary orbit.

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(ii) Calculate the height h of the space station above the equator when it is in a geostationary orbit.

mass of Earth = 6.00×10^{24} kg

24 hours = 8.64×10^4 s

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$h =$ ....

(Total for Question 11 = 18 marks)