

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.

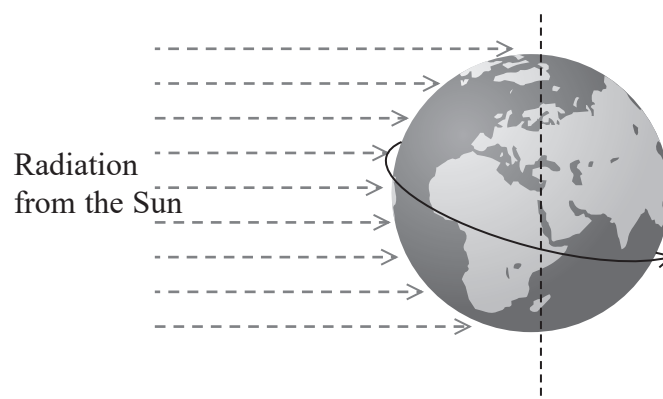
radius of Sun = $6.96 \times 10^8 \text{ m}$

surface temperature of Sun = 5790 K

distance from Sun to Earth = $1.50 \times 10^{11} \text{ m}$

(4)

- (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} .



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- (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.

(4)

- (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%

(4)

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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.

(2)

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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

(4)

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$h =$

(Total for Question 11 = 18 marks)

TOTAL FOR PAPER = 120 MARKS



(b) Explain how the principle of conservation of energy applies to this collision.

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(Total for Question 7 = 8 marks)

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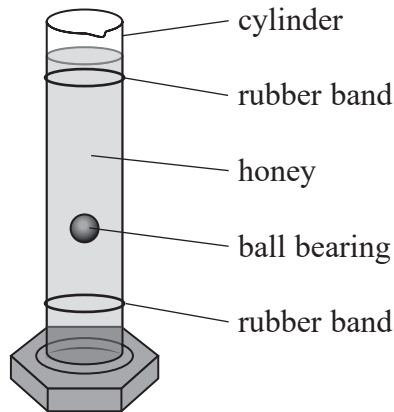
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P 6 9 4 4 4 A 0 1 3 3 6

- 10 A student carried out an experiment to determine the viscosity of some honey. He filled a tall glass cylinder with honey as shown, and timed a ball bearing as it fell through the honey.



- (a) The student placed rubber bands near the top and bottom of the cylinder. He started a stopwatch when the ball bearing passed the first band and stopped the stopwatch when the ball bearing passed the second band. He repeated this several times to determine a mean time.

Criticise the student's method.

(2)

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- (b) The time t for the sphere to fall through a distance of 25.0 cm is shown in the table.

t/s			
6.40	6.35	6.36	6.38

- (i) Show that the mean velocity v of the ball bearing is about 0.04 m s^{-1} .

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- (ii) The student had three different types of honey available.

Viscosity η is given by the following expression

$$\eta = \frac{2r^2g(\rho_B - \rho_H)}{9v}$$

radius r of ball bearing = 5.50×10^{-3} m

density of ball bearing $\rho_B = 7750 \text{ kg m}^{-3}$

density of honey $\rho_H = 1360 \text{ kg m}^{-3}$

Viscosity (at 20°C)/Pa s		
Honey A	Honey B	Honey C
10.6	12.5	13.6

Deduce which honey the student used.

(2)

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(Total for Question 10 = 7 marks)

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