6 **(a)** A children's outdoor paddling pool is 4.0 m in diameter and 20.0 cm deep. Cold water is allowed to flow in to one side of the pool at a rate of 20 litres per minute, and the same amount of water overflows from the other side of the pool (1 litre = 1kg of water). The water in the pool mixes evenly so that it is all heated by the energy from the sun.

On a good sunny day, the sun provides energy to raise the temperature of the water between entering and leaving the pool. The temperature rise is 3.0 K.

(i) Given that the specific heat capacity of water is 4200 J kg^{-1} K^{-1}, show that the energy from the sun received by the 20 litres of water, between entering and leaving the pool, in one minute, is 252 kJ. [1]

(ii) Hence, calculate the solar power per square metre falling on the surface of the pool.

Power per square meter = ……W m^{-2} [2]

(iii) Suggest why the value calculated in **(a)(ii)** is likely to be too low.

.....
.....

…….[1]

(b) An electrical (photovoltaic) solar cell (see **Fig. 6.2**)is connected in a simple circuit, as shown in **Fig. 6.1**. The solar cell is placed in the **same** sunlight as in (a). A *solar cell*, or *photovoltaic cell*, is a device that

converts light energy directly into electrical energy. It produces a voltage when exposed to light.

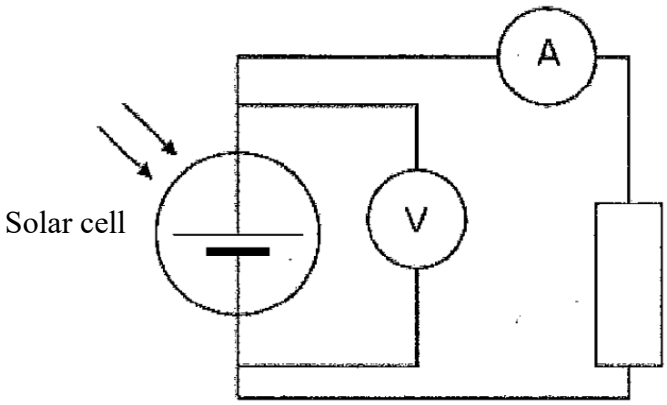

Fig. 6.1

Fig. 6.2

The following information is available:
Dimensions of solar cell = 15 cm x 15 cm
Current in circuit = 200 mA
Voltage across solar cell = 7.0 V

(i) Calculate the power per square metre generated by the solar cell.

Power per square metre = ……. W m^{-2} [1]

(ii) Assuming that the value for the solar power per square metre, calculated in **(a)(ii),** is the correct value, calculate the efficiency of the solar cell.

Efficiency = …….. %[1]

(c) **(i)** Above the atmosphere, the intensity (I) of the solar radiation is about 1.4 kW m^{-2}. Given that the distance from the Sun to the Earth is $r = 150 \times 10^6$ km, calculate the power output of the sun.

Power output = ……. W[2]

(ii) Assuming that the electrical solar panels of a satellite in orbit around the Earth are 40% efficient, calculate the surface area of the solar panels required to produce an electrical output power of 200 W.

Surface area = …….. m^2[2]