Q1. (a) Solar energy is a *renewable* energy source used to generate electricity.

(i) What is meant by an energy source being *renewable?*

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(1)

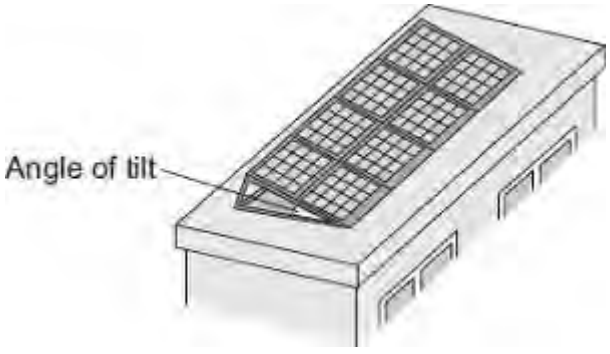
(ii) Name **two** other renewable energy sources used to generate electricity.

1 .....

2 .....

(1)

(b) A householder uses panels of solar cells to generate electricity for his home. The solar cells are tilted to receive the maximum energy input from the Sun.



The data in the table gives the average energy input each second (in J/s), to a 1 m^2 area of solar cells for different angles of tilt and different months of the year.

Month	**Angle of tilt**			
	20°	30°	40°	50°
February	460	500	480	440
April	600	620	610	600
June	710	720	680	640
August	640	660	640	580
October	480	520	500	460

December	400	440	420	410

(i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

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(2)

(ii) The total area of the solar cell panels used by the householder is 5 m^2.

The efficiency of the solar cells is 0.18.

Calculate the average **maximum** electrical energy available from the solar cell panels each second in June.

Show clearly how you work out your answer.

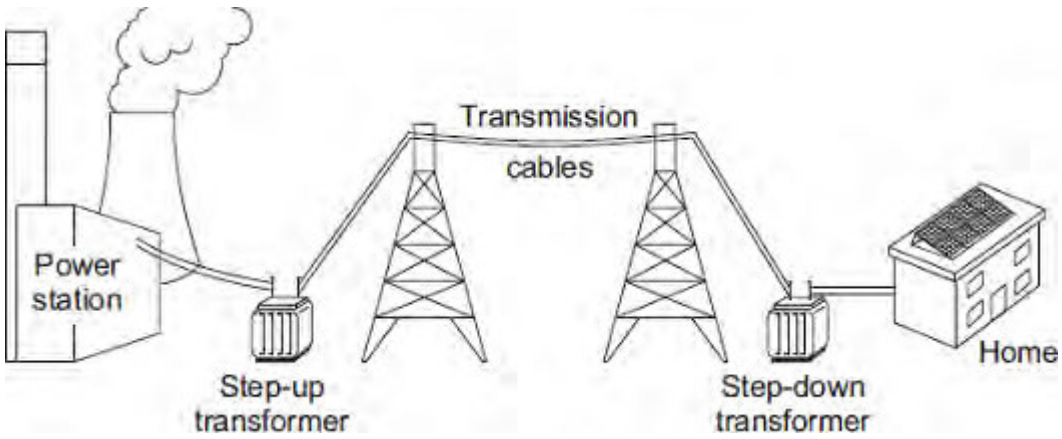
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Maximum energy = ... joules/second

(3)

(c) The diagram shows part of the National Grid.



(i) Even though the householder uses solar cells to generate electricity for his home, the home stays connected to the National Grid.

Give **one** reason why the householder should stay connected to the National Grid.

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(1)

(ii) The step-up transformer increases the efficiency of the National Grid.

Explain how.

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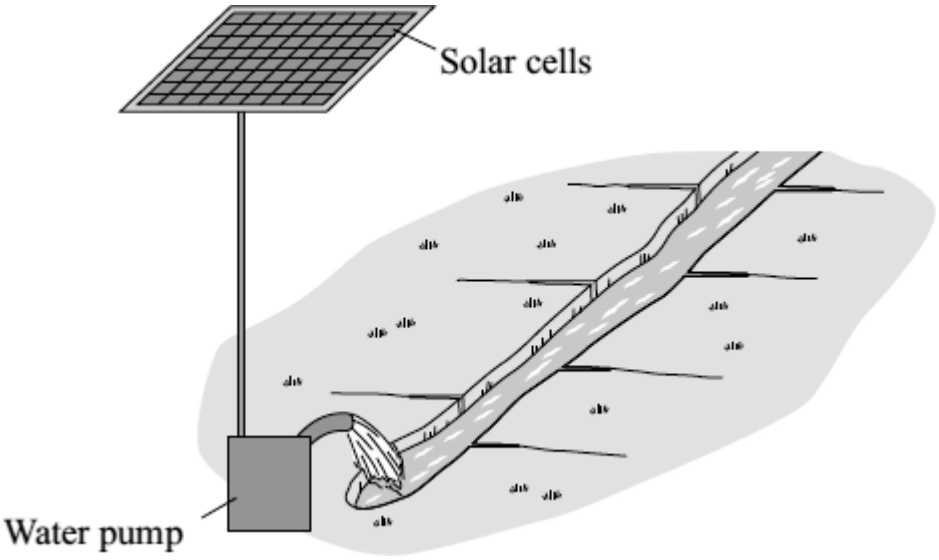
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(2)

(Total 10 marks)

Q2. The farmers in a village in India use solar powered water pumps to irrigate the fields.



On average, a one square metre panel of solar cells receives 5 kWh of energy from the Sun each day.
The solar cells have an efficiency of 0.15

(a) (i) Calculate the electrical energy available from a one square metre panel of solar cells.

Show clearly how you work out your answer.

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Electrical energy = ... kWh

(2)

(ii) On average, each solar water pump uses 1.5 kWh of energy each day.

Calculate the area of solar cells required by one solar water pump.

Area = ... square metres

(1)

(b) Give **one** reason why the area of solar cells needed will probably be greater than the answer to part (a)(ii).

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(1)

(Total 4 marks)

Q3. The table gives data about two types of low energy bulb.

Type of bulb	Power input in watts	Efficiency	Lifetime in hours	Cost of one bulb
Compact Fluorescent Lamp (CFL)	8	20%	10 000	£3.10
Light Emitting Diode (LED)	5		50 000	£29.85

(a) Both types of bulb produce the same useful power output.

(i) Calculate the useful power output of the CFL.

Show clearly how you work out your answer.

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Useful power output = ... W

(2)

(ii) Calculate the efficiency of the LED bulb.

Show clearly how you work out your answer.

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Efficiency = ...

(1)

(b) LED bulbs are expensive. This is because of the large number of individual electronic
LED chips needed to produce sufficient light from each bulb.

(i) Use the data in the table to evaluate the cost-effectiveness of an LED bulb compared to a CFL.

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(2)

(ii) Scientists are developing brighter and more efficient LED chips than those currently used in LED bulbs.

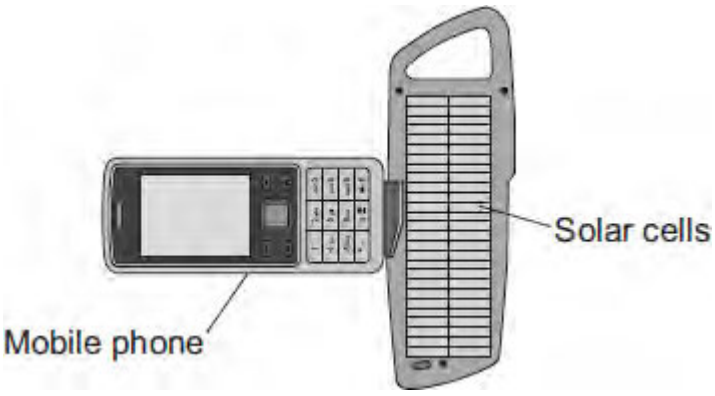
Suggest **one** benefit of developing brighter and more efficient LED chips.

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(1)
(Total 6 marks)

Q4. (a) The diagram shows a solar powered device being used to recharge a mobile phone.



On average, the solar cells produce 0.6 joules of electrical energy each second. The solar cells have an efficiency of 0.15.

(i) Calculate the average energy input each second to the device.

Show clearly how you work out your answer.

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Average energy input each second = ... J/s

(2)

(ii) Draw a labelled Sankey diagram for the solar cells.
The diagram does **not** need to be drawn to scale.

(1)

(b) Scientists have developed a new type of solar cell with an efficiency of over 40 %. The efficiency of the solar cell was confirmed independently by other scientists.

Suggest why it was important to confirm the efficiency independently.

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(1)

(c) The electricity used in homes in the UK is normally generated in a fossil fuel power station.

Outline some of the advantages of using solar cells to generate this electricity.

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(2)
(Total 6 marks)