1 The International Space Station (ISS) has several solar panels called wings.



The wings convert energy from the Sun into a form useful in the ISS.

(a) The energy reaching the ISS from the Sun is carried by waves which are

(1)

- A transverse and electromagnetic
- B electromagnetic but not transverse
- C transverse but not electromagnetic
- **D** neither transverse nor electromagnetic
- (b) In one second, the useful energy available from one wing is 34.3 kJ. The energy incident on the wing from the Sun is five times this amount.

What is the percentage efficiency of the wing?

(3)

efficiency = ..... %

(d) The diagram shows how a solar cell produces electricity when receiving energy from the Sun.  When energy from the Sun is absorbed in a silicon layer, it makes charges move. This movement of charges produces a current.  external connection  sunlight  Suggest two reasons why the efficiency of this solar cell at producing electricity from sunlight is less than 100%.	<ul><li>(c) A wing is in direct sunlight.</li><li>The ISS is not receiving energy from the wing.</li><li>The temperature of the wing remains constant.</li></ul>	
from the Sun. When energy from the Sun is absorbed in a silicon layer, it makes charges move. This movement of charges produces a current.  external connection  sunlight  silicon layer 1  silicon layer 2  back plate  Suggest two reasons why the efficiency of this solar cell at producing electricity from sunlight is less than 100%.	Explain why the temperature of the wing remains constant in these conditions.	(2)
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external connection  plastic cover silicon layer 2  back plate  Suggest two reasons why the efficiency of this solar cell at producing electricity from sunlight is less than 100%.	from the Sun.	
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Suggest <b>two</b> reasons why the efficiency of this solar cell at producing electricity from sunlight is less than 100%.	silicon layer 2	
from sunlight is less than 100%.	back plate	
from sunlight is less than 100%.	Suggest the reasons why the officions of this color call at producing electricity	
(2)		
		(2)

(Total for Question 1 = 8 marks)

## Power from the wind

A windfarm generates electrical power from the wir	d.	
(a) State <b>one</b> disadvantage of using the wind to	generate electrical power.	(1)
(b) A windfarm generates 322 MW of electrical p	ower.	
The windfarm is connected to a transmission of 132 kV.	line at a potential difference	
(i) Calculate the current from the windfarm.		(3)
	current =	A
<ul><li>(ii) The windfarm produces 322 MW of power The windfarm is to be extended by adding The extended windfarm will then produce</li></ul>	g 75 improved turbines.	
Calculate the power produced by each in	proved turbine.	(0)
		(2)
	nower –	MM

The cables will hang 50 m above the ground from 600 new, taller pylons. Eventually, about 1000 of the old, shorter pylons will be removed.	
Discuss the advantages and disadvantages of this plan.	(6)
(Total for Question 5 = 1	2 marks)

 $^*$ (c) There is a plan to replace the existing transmission line from the windfarm with one at the higher potential difference of 400 kV.

The new transmission line will cross more than 200 km of mountains.

## **Generating electrical energy**

**3** (a) Complete the sentence by putting a cross  $(\boxtimes)$  in the box next to your answer.

Electrical energy can be measured in

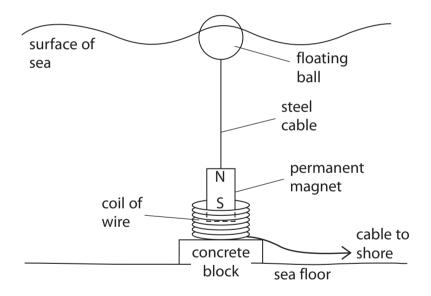
(1)

- A amps
- **B** kilowatt-hours
- C volts
- **D** watts
- (b) Scientists are looking for new ways to produce electricity from renewable resources.

The diagram shows a model of a device to generate electricity from waves.

The coil is fixed to the concrete block.

The magnet can move freely inside the coil.



(i)	Explain how this device produces an electric current.	(3)
(ii)	Describe how the device can be altered to increase the electric current.	(2)

\*(c) Another way of producing electricity from a renewable source is tidal power. A dam is built across the mouth of a river. Tidal water gets trapped behind the dam.



Discuss the advantages and disadvantages of using tidal power rather than other

The trapped water is used to generate electricity.

methods of generating electricity.

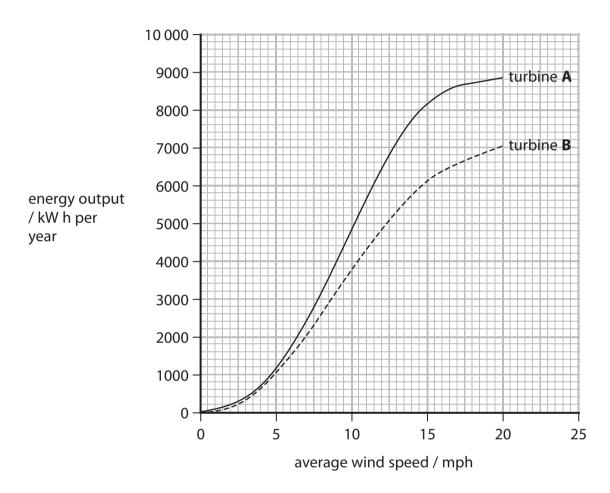
(Total for Ouestion 6 = 12 mark	cs)
	(6)

## **Generating electrical energy**

**4** (a) Eric owns a small farm where chicks are hatched from eggs.

He is considering generating his own electricity to heat and light a barn rather than using electricity from the National Grid.

This graph shows how the energy output varies with wind speed for two different wind turbines, **A** and **B**.



The average wind speed at Eric's farm is 13 mph.

The total heating and lighting in the barn requires 6000 kW h of electrical energy each year.

(i) Use the data in the graph to recommend the best turbine for Eric's barn.

The best turbine is	because

(1)

(ii) Eric pays 14p per kW h for electrical energy supplied by the Na Calculate how much he could expect to save each year by usir from this wind turbine to heat and light the barn.	
	annual saving = £
(iii) Eric looks at the cost of installing the turbine.	
State how he should work out the payback time.	(1)
(iv) The chicks need to be kept warm at all times.  Eric uses halogen lamps to provide heat and light for most of	the day.
Eric thinks about changing his halogen lamps for energy savin Suggest why this might not actually be a benefit.	ng lamps.
suggest why this might not actually be a benefit.	(2)

*(b) There are several large-scale energy resources which are suitable alternatives fossil fuels in some situations.  Two of these alternatives are hydro-electric power and solar power.	to
Compare hydro-electric power with solar power as energy resources for the large-scale generation of electricity.	(6)
(Total for Question 6 = 12	2 marks)