

# Energy part 6 AQA Triple Physics

Name:

\_\_\_\_\_

Class:

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Date:

\_\_\_\_\_

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Time: **67 minutes**

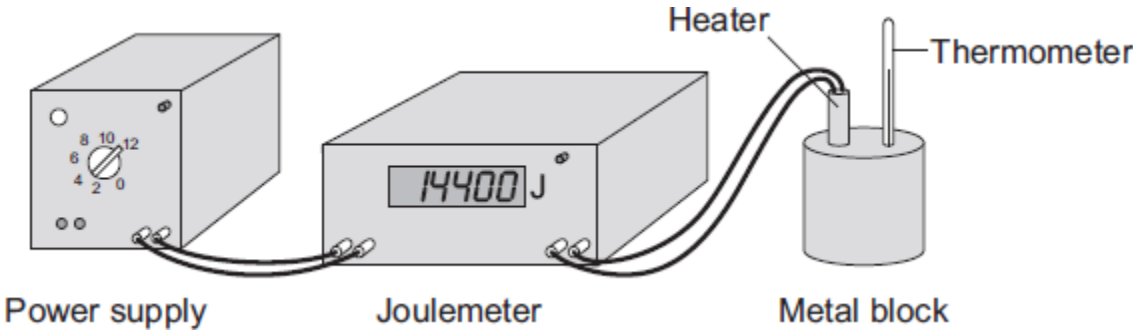
Marks: **67 marks**

Comments:

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1.

A student used an electric heater to heat a metal block. The student measured the energy input to the heater with a joulemeter.



Before starting the experiment, the student reset the joulemeter to zero. The student switched the power supply on for exactly 10 minutes. During this time, the reading on the joulemeter increased to 14 400.

(a) (i) Calculate the energy transferred each second from the power supply to the heater.

Show clearly how you work out your answer.

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Energy transferred each second = \_\_\_\_\_ J/s

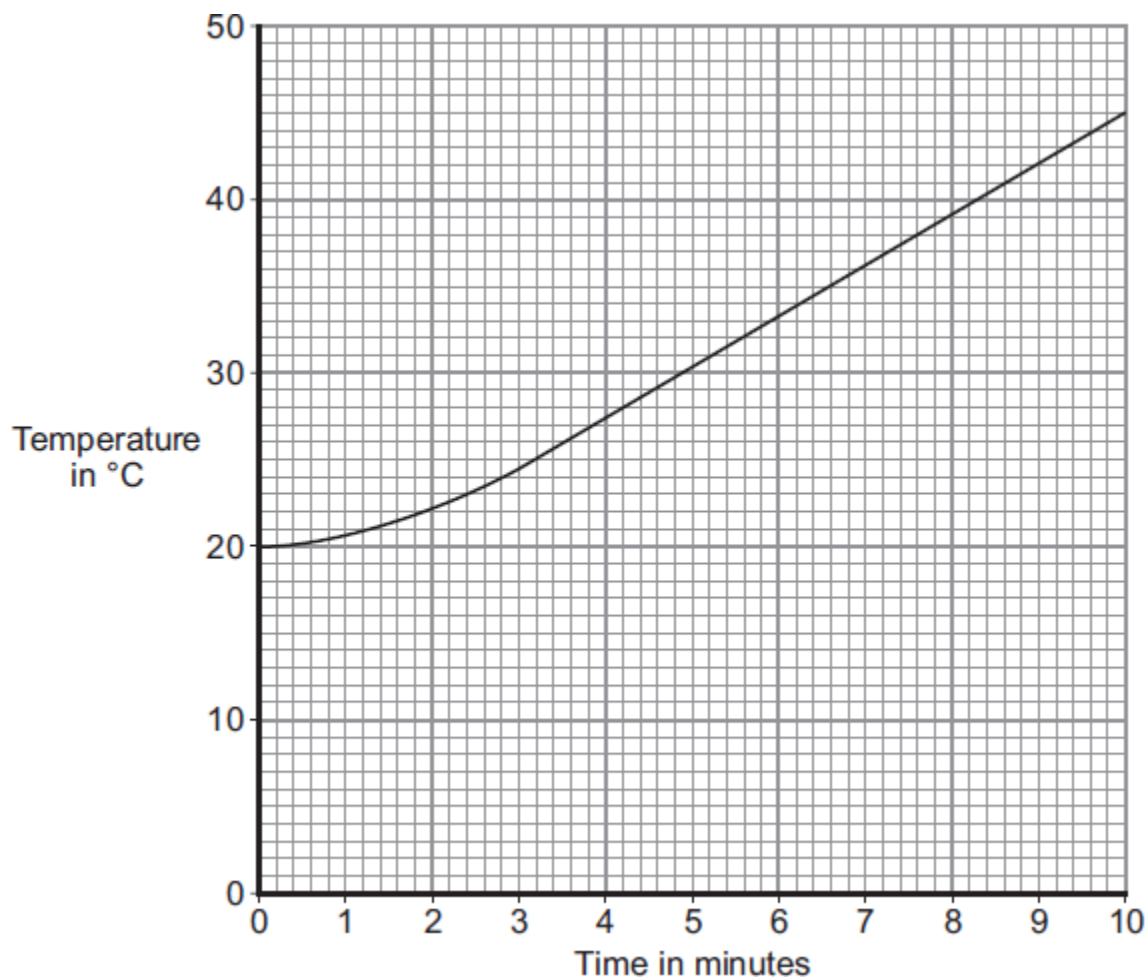
(2)

(ii) What is the power of the heater?

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(1)

- (b) The student measured the temperature of the metal block every minute. The data obtained by the student is displayed in the graph.



- (i) What range of temperatures did the student measure?

From \_\_\_\_\_ °C to \_\_\_\_\_ °C

(1)

- (ii) Before starting the experiment, the student had calculated that the temperature of the block would go up by 36 °C.

The student's data shows a smaller increase.

Which **one** of the following statements gives the most likely reason for this?

Put a tick (✓) in the box next to your answer.

The student does not read the thermometer accurately.

The block transfers energy to the surroundings.

The power supply is not connected correctly to the joulemeter.

(1)

(Total 5 marks)

2.

- (a) Nuclear fuels and the wind are two of the energy sources used to generate electricity in the UK.

Explain the advantages of using energy from nuclear fuels to generate electricity rather than using energy from the wind.

Include in your answer a brief description of the process used to generate electricity from nuclear fuels.

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(4)

- (b) In the UK, most electricity is generated in power stations that emit carbon dioxide into the atmosphere. The impact of these power stations on the environment could be reduced by the increased use of 'carbon capture' technology.

Describe how 'carbon capture' would prevent the build-up of carbon dioxide in the atmosphere.

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(2)

(Total 6 marks)

3.

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)

4.

- (a) Geothermal energy and the energy of falling water are two resources used to generate electricity.

- (i) What is geothermal energy?

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(1)

- (ii) Hydroelectric systems generate electricity using the energy of falling water.

A pumped storage hydroelectric system can also be used as a way of storing energy for future use.

Explain how.

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(2)

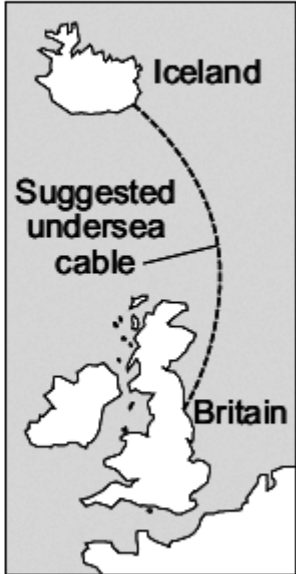
- (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Read the following extract from a newspaper.

**Britain may be switched on by Iceland**

Iceland is the only country in the world generating all of its electricity from a combination of geothermal and hydroelectric power stations. However, Iceland is using only a small fraction of its energy resources. It is estimated that using only these resources, the amount of electricity generated could be increased by up to four times.

To help supply the future demand for electricity in Britain, there are plans to build thousands of new offshore wind turbines. It has also been suggested that the National Grid in Britain could be linked to the electricity generating systems in Iceland. This would involve laying a 700 mile undersea electricity cable between Iceland and Britain.



The map shows the geographical locations of Iceland and Britain. A dashed line, labeled 'Suggested undersea cable', curves across the North Atlantic Ocean to connect the two countries. The labels 'Iceland' and 'Britain' are placed near their respective landmasses.



5.

A wood burning stove is used to heat a room.



Photograph supplied by iStockphoto/Thinkstock

The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

(a) The air next to the stove is warmed by infrared radiation.

How does the design of the stove help to improve the rate of energy transfer by infrared radiation?

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(2)

- (b) Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove.

Show clearly how you work out your answer.

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Efficiency = \_\_\_\_\_

(2)

- (c) Some of the energy from the burning wood is wasted as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

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(1)

- (d) Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1. \_\_\_\_\_

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2. \_\_\_\_\_

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(2)

- (e) The metal case of the stove gets hot when the fire is lit.

Here is some information about the stove.

Mass of metal case	100 kg
Starting temperature of metal case	20 °C
Final temperature of metal case	70 °C
Specific heat capacity of metal case	510 J/kg °C

Calculate the energy required to raise the temperature of the metal case to 70 °C.

Show clearly how you work out your answer and give the unit.

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Energy required = \_\_\_\_\_

(3)

(Total 10 marks)

6.

- (a) By 2023, nearly all of the existing nuclear power stations in the UK will be closed down.

- (i) Before a nuclear power station can be demolished, the remaining nuclear fuel, radioactive waste materials and reactor must be carefully removed.

What is this process called?

Put a tick (✓) in the box next to your answer.

decommissioning

decontaminating

dismantling

(1)

- (ii) The workers are exposed to radiation as they remove the reactor. One of the biggest risks is from the isotope cobalt-60, which has a half-life of 5.3 years.

Explain the advantage of waiting 11 years after a nuclear power station has closed down before starting to remove the reactor.

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(2)

- (b) It is almost certain that new nuclear power stations will be built in the UK.

The table shows the results of surveys asking people in the UK whether they were in favour of, or against, the building of new nuclear power stations.

	2001	2005	2007
<b>Percentage (%) in favour</b>	20	41	65
<b>Percentage (%) against</b>	60	28	20
<b>Percentage (%) not sure</b>	20	31	15

- (i) From these surveys, how did public opinion on the building of new nuclear power stations change between 2001 and 2007?

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(1)

- (ii) Suggest a reason why some people may think that the results from these surveys are unreliable.

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(1)

- (iii) Give **one** reason in favour of building new nuclear power stations.

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(1)

- (c) The government of one Middle Eastern country has decided to build its first nuclear power station. The oil that would have been used to generate electricity can then be sold to other countries.

On what is this decision based?

Put a tick (✓) in the box next to your answer.

economic issues

ethical issues

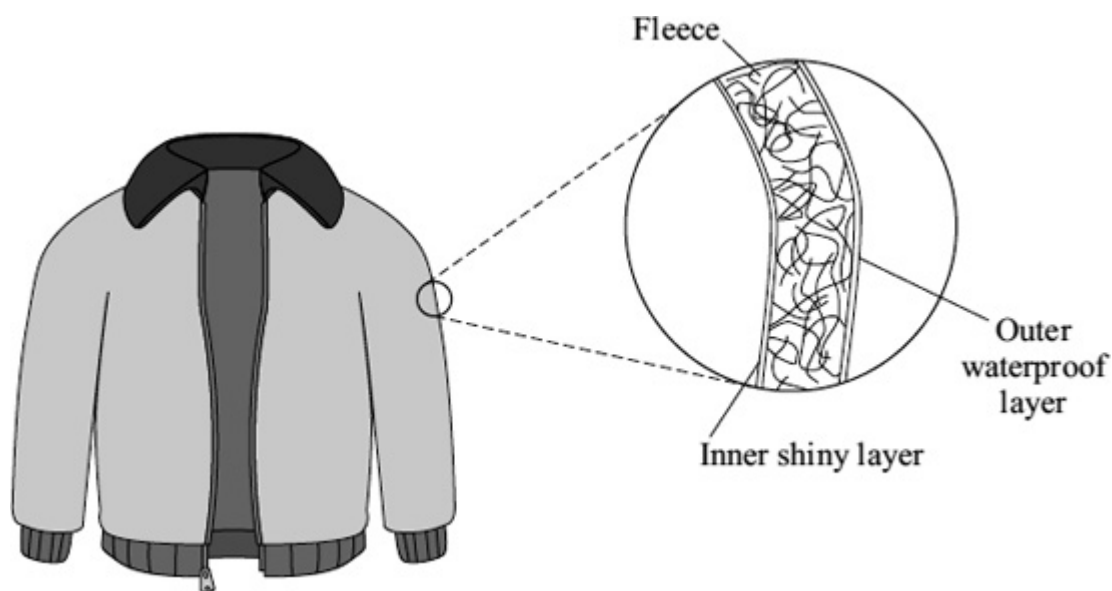
social issues

(1)

(Total 7 marks)

7.

- (a) The diagram shows a ski jacket that has been designed to keep a skier warm. The jacket is made from layers of different materials.



- (i) The inner layer is shiny to reduce heat transfer.

Which process of heat transfer will it reduce?

\_\_\_\_\_

(1)

(ii) Why is the layer of fleece good at reducing the transfer of heat from a skier's body?

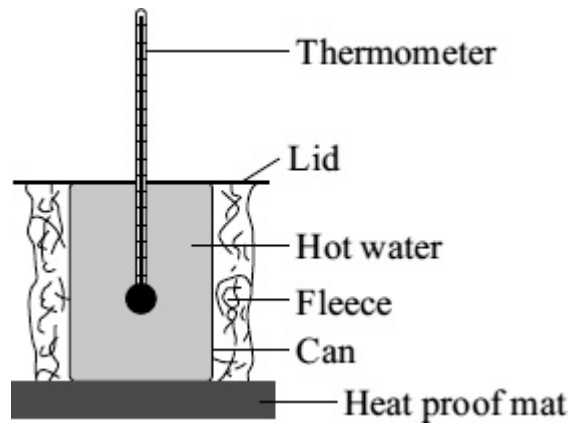
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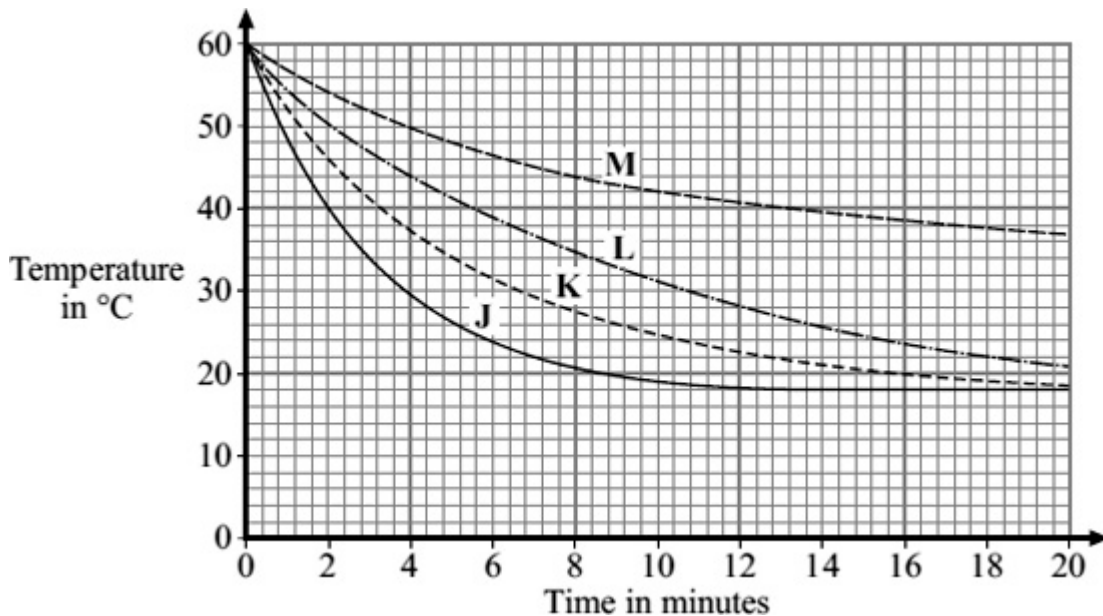
(1)

(b) A student tested four different types of fleece, **J**, **K**, **L** and **M**, to find which would make the warmest jacket. Each type of fleece was wrapped around a can which was then filled with hot water.

The temperature of the water was taken every two minutes for 20 minutes.



The graph shows the student's results.



(i) In each test, the water cooled faster during the first five minutes than during the last five minutes. Why?

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(1)

- (ii) To be able to compare the results, it was important to use the same volume of water in each test.

Give **one** other quantity that was the same in each test.

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(1)

- (iii) Look at the graph line for fleece **K**.

Estimate what the temperature of the water in the can wrapped in fleece **K** would be after 40 minutes.

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(1)

- (iv) Which type of fleece, **J**, **K**, **L** or **M**, should the student recommend to be used in the ski jacket?

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Give a reason for your answer.

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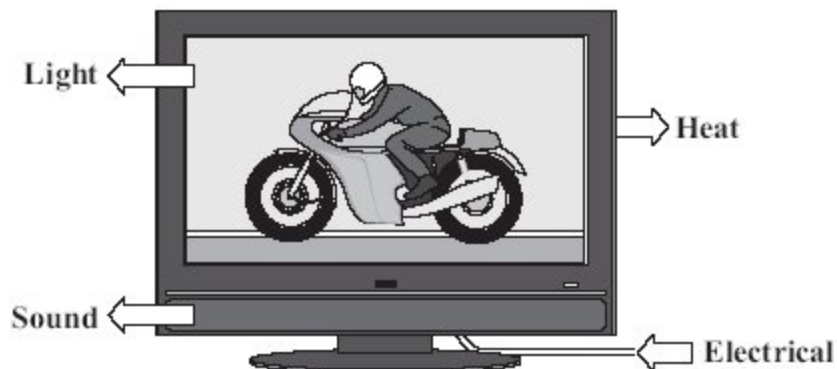
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(2)

(Total 7 marks)

8.

The diagram shows the energy transformations produced by a TV.



- (a) Use words from the diagram to complete the following sentence.

The TV is designed to transform \_\_\_\_\_ energy into light and \_\_\_\_\_ energy.

(2)

(b) Which **one** of the following statements is **false**?

Put a tick (✓) in the box next to the **false** statement.

The energy transformed by the TV makes the surroundings warmer.

The energy transformed by the TV becomes spread out.

The energy transformed by the TV will be destroyed.

(1)

(c) Two different makes of television, **A** and **B**, transform energy at the same rate. Television **A** wastes less energy than television **B**.

Complete the following sentence by drawing a ring around the correct line in the box.

Television **A** has

a higher efficiency than  
the same efficiency as  
a lower efficiency than

television **B**.

(1)

(Total 4 marks)

9.

Electricity is generated in power stations. It is then sent to all parts of the country through a network of cables.

(a) Complete the following sentence by using **one** of the words in the box.

Grid

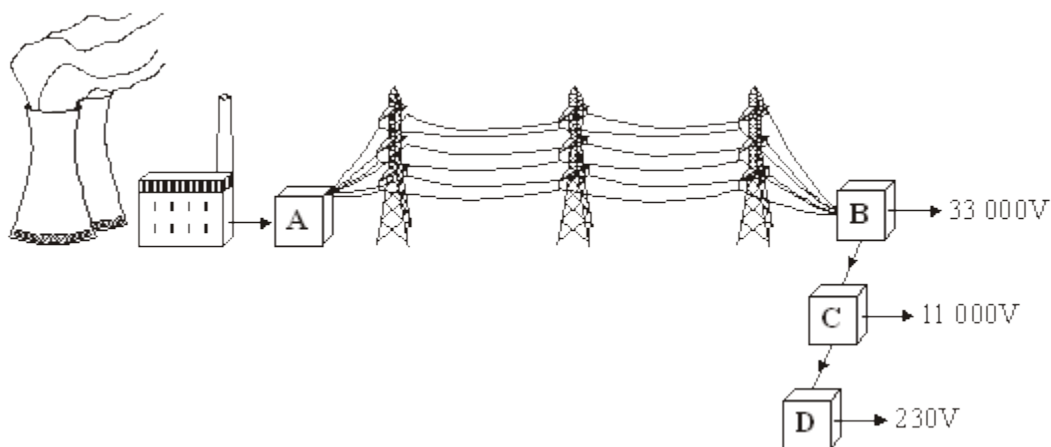
Power

Supply

The network is called the National \_\_\_\_\_ .

(1)

(b) In the diagram, **A**, **B**, **C** and **D** are transformers.



(i) Which transformer, **A**, **B**, **C** or **D**, is a step-up transformer?

Transformer \_\_\_\_\_

(1)

(ii) Which transformer, **A**, **B**, **C** or **D**, will supply homes, offices and shops?

Transformer \_\_\_\_\_

(1)

(c) Complete the following sentence by drawing a ring around the correct line in the box.

In a step-down transformer, the potential difference (p.d.) across the

primary coil is

less than
the same as
more than

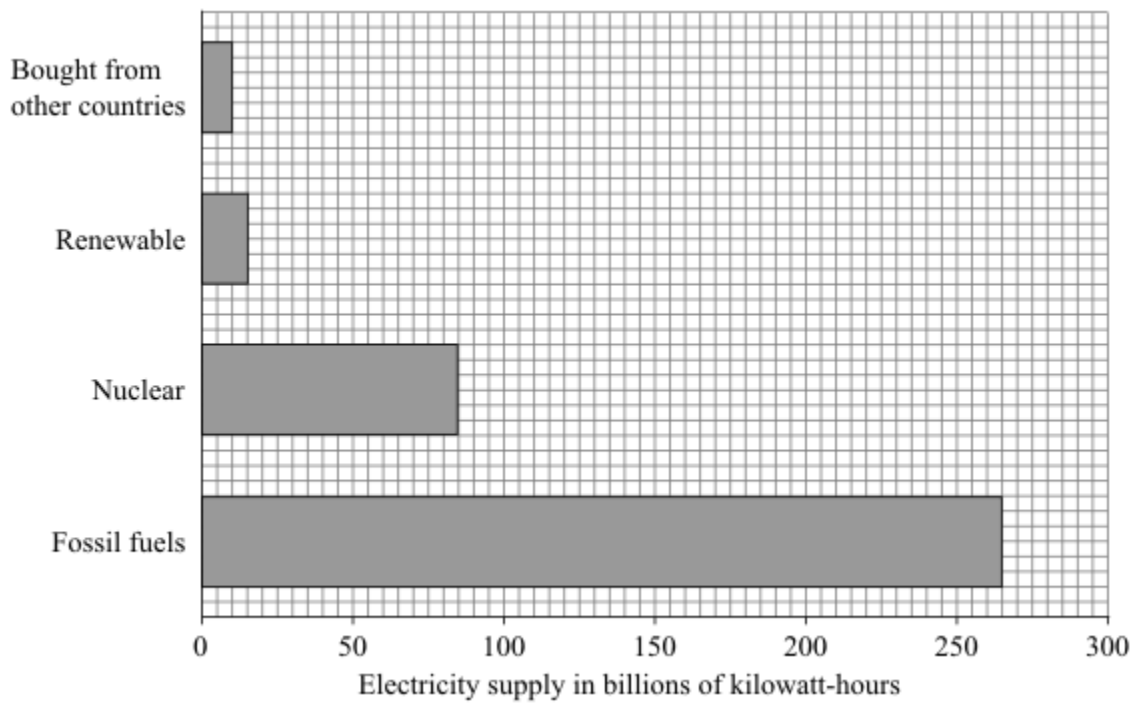
the p.d. across the secondary coil.

(1)

(Total 4 marks)

10.

The bar chart shows how the UK's electricity demands in 2007 were met.



(a) What proportion of electricity was generated using renewable energy sources?

Show clearly how you work out your answer.

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(2)

(b) By 2020, most of the UK's nuclear reactors and one-third of coal-fired power stations are due to close, yet the demand for electricity is expected to increase.

Four students, **A**, **B**, **C** and **D**, were asked how a demand of 380 billion kilowatt-hours could be met. They made the suggestions given in the table.

Student	Fossil fuels	Nuclear	Renewable	Bought from other countries
<b>A</b>	200	100	40	40
<b>B</b>	80	240	40	20
<b>C</b>	160	80	100	40
<b>D</b>	280	0	100	0

- (i) Which student has made the suggestion most likely to result in the lowest carbon dioxide emissions?

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Give a reason for your answer.

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(2)

- (ii) Suggest **one** realistic way in which a householder could help to reduce the annual electricity demand.

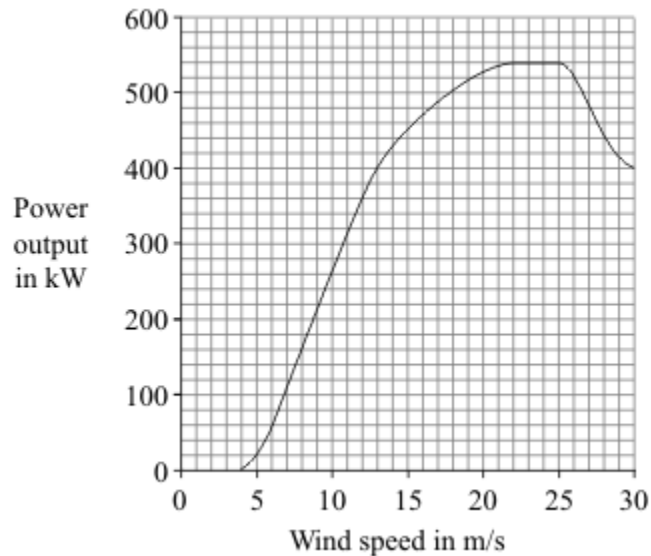
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(1)

- (c) To increase the amount of electricity generated using renewable energy resources would probably involve erecting many new wind turbines.

The graph shows the power curve of a wind turbine.



- (i) Describe, in detail, how the power output of the turbine varies with the wind speed.

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**(3)**

- (ii) Give **one** disadvantage of using wind turbines to generate a high proportion of the electricity required in the UK.

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**(1)**

**(Total 9 marks)**

## Mark schemes

- 1.** (a) (i) 24  
*allow 1 mark for converting time to 600 seconds*  
*or showing method ie 14400/10*  
*or  $\frac{14400}{10 \times 60}$*   
*provided no further steps shown* 2
- (ii) 24  
*ignore any unit*  
**or**  
their (a)(i) 1
- (b) (i) 20 45  
***both** required – either order* 1
- (ii) the block transfers energy to the surroundings 1
- [5]**
- 2.** (a) *answers must be in terms of nuclear fuels*  
concentrated source of energy  
*idea of a small mass of fuel able to generate a lot of electricity* 1
- that is able to generate continuously  
*accept it is reliable*  
**or** *can control / increase / decrease electricity generation*  
*idea of available all of the time / not dependent on the weather*  
*ignore reference to pollutant gases* 1
- the energy from (nuclear) fission 1
- is used to heat water to steam to turn turbine linked to a generator 1
- (b) carbon dioxide is not released (into the atmosphere) 1
- but is (caught and) stored (in huge natural containers) 1
- [6]**

3.

(a) (i) 
$$\text{efficiency} = \frac{\text{useful energy out} (\times 100\%)}{\text{total energy in}}$$

1.6 (W)

allow 1 mark for correct substitution ie 
$$0.2 / \frac{20}{100} = \frac{\text{output}}{8}$$

2

(ii) 
$$\text{efficiency} = \frac{\text{useful energy out} (\times 100\%)}{\text{total energy in}}$$

32 (%) / 0.32

or

their (a)(i)  $\div$  5 correctly calculated

*ignore any units*

1

(b) (i) any **two** from:

- comparison over same period of time of relative numbers of bulbs required eg over 50 000 hours 5 CFL's required to 1 LED  
*accept an LED lasts 5 times longer*
- link number of bulbs to cost eg 5 CFL's cheaper than 1 LED  
*an answer in terms of over a period of 50 000 hours CFLs cost £15.50 (to buy), LED costs £29.85 (to buy) so CFLs are cheaper scores both marks*  
*an answer in terms of the cost per hour (of lifetime) being cheaper for CFL scores 1 mark if then correctly calculated scores both marks*
- over the same period of time LEDs cost less to operate (than CFLs)

2

(ii) any **one** from:

- price of LED bulbs will drop  
*do **not** accept they become cheaper*
- less electricity needs to be generated  
*accept we will use less electricity*
- less CO<sub>2</sub> produced
- fewer chips needed (for each LED bulb)
- fewer bulbs required (for same brightness / light)
- less energy wasted  
*do **not** accept electricity for energy*

1

[6]

4.

- (a) (i) energy from hot rocks in the Earth

*accept heat that occurs naturally in the Earth*

*accept steam / hot water rising to the Earth's surface*

*accept an answer in terms of the energy released by radioactive decay in the Earth*

*heat energy is insufficient*

1

- (ii) water is pumped / moved

1

up (to a higher reservoir)

*this mark point only scores if first mark point is awarded*

1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the Marking Guidance and apply a 'best-fit' approach to the marking.

**0 marks**

No relevant content

**Level 1 (1-2 marks)**

There is a brief description of at least one advantage or disadvantage for either the planned wind turbines or the suggested electricity power link.

**Level 2 (3-4 marks)**

There is a description of advantages and disadvantages for either the planned wind turbines or the suggested electricity power link.

**or**

A description of the advantages or disadvantages for both the planned wind turbines and the suggested electricity power link.

**Level 3 (5-6 marks)**

There is a clear and detailed description of at least one advantage and one disadvantage for both the planned wind turbines and suggested electricity power link.

**examples of the points made in the response**

## Offshore wind turbines

### advantages

- renewable (energy resource)
- low running costs
- energy is free
- no gas emissions (when in use)
  - accept a named gas eg CO<sub>2</sub>*
  - accept no fuel is burned*
  - accept less dependent on fossil fuels*
- land is not used (up)

### disadvantages

- unreliable – accept wind does not always blow
  - ignore references to destroying or harming habitats*
- hazard to birds / bats
- visual pollution – do not accept noise pollution
  - do **not** allow if clearly referring to onshore wind turbines*
  - do **not** accept spoils landscape*
- difficulty of linking turbines to the National Grid
- large initial cost
- difficult to erect / maintain
  - accept a lot of maintenance needed*
- CO<sub>2</sub> emissions in manufacture (of large number of turbines)

## Suggested Link

### advantages

- income for Iceland
- using Iceland's (available) energy (resources)  
*accept using (Iceland's) renewable energy (resources)*  
*do **not** accept reduce the amount of Iceland's wasted energy*
- provide electricity when wind does not blow / reliable
- provide electricity at times of peak demand
- even out fluctuations in supply
- excess electricity from Britain (windy days) to Iceland and used to pump water up to store energy
- Britain less dependent on fossil fuels  
*accept Britain needs fewer (new) power stations*  
*accept conserves fossil fuels*

### disadvantages

- large initial cost  
*accept expensive (to lay cables)*
- power loss along a long cable
- (engineering) difficulties in laying / maintaining the cable  
*accept difficult to repair (if damaged)*

6

[10]

5.

(a) any **two** from:

- black is a good emitter of (infrared radiation)  
*accept heat for radiation*  
*ignore reference to absorbing radiation*
- large surface (area)
- matt surfaces are better emitters (than shiny surfaces)  
*accept matt surfaces are good emitters*  
*ignore reference to good conductor*

2

(b) 90% or 0.9(0)

$$\text{efficiency} = \frac{\text{useful energy out} (\times 100\%)}{\text{total energy in}}$$

allow 1 mark for correct substitution, ie  $\frac{13.5}{15}$

provided no subsequent step shown

an answer of 90 scores 1 mark

an answer of 90 / 0.90 with a unit scores 1 mark

2

(c) (producing) light

allow (producing) sound

1

(d) any **two** from:

- wood is renewable  
accept wood grows again / quickly  
accept wood can be replanted
- (using wood) conserves fossil fuels  
accept doesn't use fossil fuels
- wood is carbon neutral  
accept a description  
cheaper / saves money is insufficient

2

(e)  $E = m \times c \times \theta$

2 550 000

allow 1 mark for correct substitution

ie  $100 \times 510 \times 50$

provided no subsequent step shown

answers of 1 020 000, 3 570 000 gain 1 mark

2

joules /J

accept kJ / MJ

do **not** accept j

for full credit the unit and numerical answer must be consistent

1

[10]

6.

(a) (i) decommissioning

1

- (ii) level of radiation **or** radiation dose (to workers) decreased  
*accept the isotope / cobalt(-60) has decayed (a lot)*  
*accept the isotope / cobalt(-60) has decayed in 2 half lives*  
*accept exposed to less radiation*  
*do **not** accept no radiation left*

1

less hazardous / dangerous (to workers' health)  
*accept safer*  
*do **not** accept there is no hazard*  
*accept allows reactor to cool (down)*  
*an answer of radiation levels decrease by 75 % or drops to 25 %*  
*gains **2** marks*

1

- (b) (i) more in favour  
**or**  
fewer against  
*quoting figures alone is insufficient*  
*do **not** accept it increases*  
*ignore any reasons given*

1

- (ii) any **one** from:
- sample too small
  - do not know how many (people) were asked
  - different people asked (in different years)
  - sample not representative (of population)
  - people did not understand the questions
  - do not know who carried out the surveys  
*do **not** accept they are biased unless acceptable reason for bias given*
  - do not know if surveys asked same questions

1

(iii) any **one** from:

- no / less pollutant gases produced  
*accept a named gas*  
*accept does not contribute to global warming*
- reliable source (of energy / electricity)
- running out of fossil fuels  
*accept a named fossil fuel*
- conserve fossil fuels  
*accept fossil fuels won't have to be used*
- meet increasing demand
- less reliance on imported fossil fuels / electricity  
*accept named fossil fuel*
- concentrated energy source(s)
- lower transportation costs for fuel
- to replace old nuclear power stations  
*ignore references to efficiency / job creation / local economy / selling electricity*

1

(c) economic issues

1

[7]

7.

(a) (i) radiation

1

(ii) traps (small pockets of) air

*do **not** accept it's an insulator*

*do **not** accept reduces conduction and / or convection*

*do **not** allow it doesn't allow heat to escape*

1

(b) (i) bigger temperature difference (between the water and surroundings)  
at the start (than at the end)

*do **not** accept water is hotter*

1

(ii) starting temperature (of the water)

*accept thickness of fleece*

*do **not** accept same amount of fleece*

*do **not** accept thermometer / can*

*do **not** accept time is the same*

1

(iii) 18 (°C)  
*correct answer only* 1

(iv) **M** 1

smallest temperature drop (after 20 mins)  
*cannot score if M is not chosen*  
*accept it's the best insulator*  
*accept smallest loss in heat*  
*accept keeps heat / warmth in for longer* 1

[7]

**8.** (a) electrical 1

sound  
*correct order only* 1

(b) the energy transformed by the TV will be destroyed 1

(c) a higher efficiency than 1

[4]

**9.** (a) grid  
*accept any unambiguous indication* 1

(b) (i) A (only) 1

(ii) D (only) 1

(c) more than  
*accept any unambiguous indication* 1

[4]

10.

(a) 1/25 or 1:25 or 0.04

accept 4 % or  $\frac{15}{375}$  or  $\frac{3}{75}$  or 1 in 25 for both marks

allow 1 mark for total of 375

allow 1 mark for a clearly correct method using a clearly incorrect total

do **not** accept 1:26

2

(b) (i) **B**

do **not** credit reason if **B** is not chosen

1

(only) burning fossil fuels produces carbon dioxide / carbon (emissions)

**or** nuclear fuels don't produce carbon dioxide

*insufficient – smallest amount of fossil fuels*

*accept less carbon dioxide*

1

(ii) accept anything reasonable eg

increased level of insulation

use energy efficient light bulbs

do not leave appliances on standby

switch thermostats down (1°C)

generate own electricity

install solar panels

*accept insulate*

*accept specific examples eg loft*

1

(c) (i) any **three** from:

- no power output until wind speed exceeds 4m/s
- output rises rapidly after 4m/s
- output begins to level out / rises less rapidly at / after 13m/s
- output peaks at 21 / 22m/s
- output constant between 21 / 22 and 25 / 26 m/s
- output falls (rapidly) after 25 / 26m/s  
*accept for 1 mark goes up then comes down*

3

(ii) any **one** from:

- unreliable energy source
- dilute energy source
- take up too much land  
*accept wind does not always blow*  
*accept need thousands / lots of turbines*  
*ignore reference to visual / noise pollution*  
*ignore reference to kill birds*

1

[9]