# Power and Efficiency

## Question Paper

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|---|---|
| **Level** | GCSE |
| **Subject** | Physics (Gateway Science) |
| **Exam Board** | OCR |
| **Topic** | Energy |
| **Sub Topic** | Power and Efficiency |
| **Booklet** | Question Paper |

**Time Allowed:** **65 minutes**

**Score:** **/54**

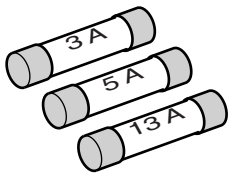
**Percentage:** **/100**

**1** Sheree researches fuses in electrical plugs.

She finds the information below.

**Choosing the correct fuse**

The three main sizes of fuse are 3 amps, 5 amps and 13 amps.




You must use the correct fuse for your appliance.

Sheree has an electric drill with a power rating of 750 W.

It is plugged into the 230 V mains.

There is no fault with the drill but the fuse wire in the plug melts when she switches the drill on.

Sheree decides to use a different fuse.

Use calculations to explain why the original fuse wire melts, and explain which size fuse is the safest to use if the drill develops a fault.

*The quality of written communication will be assessed in your answer to this question.*

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..... **[6]**

**[Total: 6]**

**2** Allan wants to reduce energy losses from his house.

He asks an energy adviser for help.

**(a)** The adviser uses a camera to produce a thermogram of the house.

Explain how the thermogram can be used to compare how much heat energy is lost from different parts of the house.

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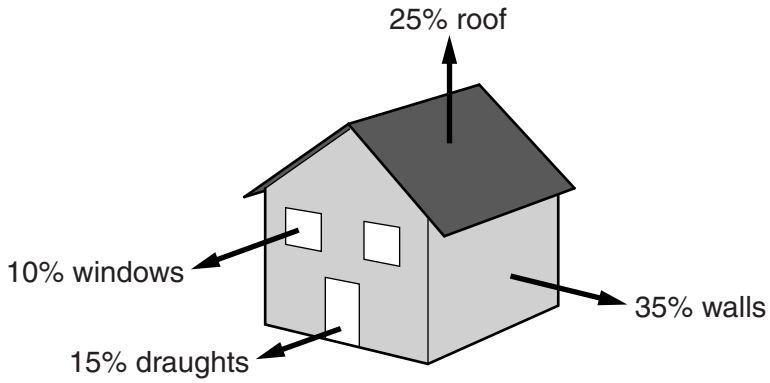
..... **[2]**

**(b)** The energy adviser draws a diagram of Allan's house.

It shows where some of the energy losses happen.




Energy saving methods are used to reduce energy losses from this house.

The table shows some costs and savings for four of these methods.

| | Energy saving method | Cost to fit in £ | Annual saving on energy bills in £ | Payback time in years |
|---|---|---|---|---|
| **A** | double glazed windows | 4800 | 100 | |
| **B** | loft (roof) insulation | 270 | 45 | |
| **C** | draught-proofing | 90 | 30 | |
| **D** | cavity wall insulation | 240 | 120 | |

The adviser tells Allan that he should install methods C and D in his house.

Complete the table and use the information to explain why C **and** D are the best methods for Allan to install.

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**(c)** The energy adviser also suggests that Allan replaces his old central heating boiler.

The Sankey diagram shows energy data for Allan's boiler.


**(i)** Calculate the efficiency of Allan's boiler.

Give your answer as a percentage.

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efficiency ..... % **[3]**

**(ii)** Allan thinks that some of the energy completely disappears.

How could the adviser use the Sankey diagram to explain that this was **not** scientifically correct?

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..... **[1]**

**[Total: 9]**

**3** Amy wants to reduce the cost of using electricity in her flat.

She is thinking of changing electricity supplier to a cheaper one.

| **Distas Electricity Company** | **Skinner Electricity Company** |
|---|---|
| **Cost per unit = 16 p** | **Cost per unit = 14 p** |

**(a)** Her main use for electricity is her central heating.

The average power of her central heating is 6500 W.

It is on for 4 hours each day.

She changes her supply from Distas to Skinner Electricity Company.

The cost per unit is the cost for one kilowatt hour of energy.

How much money will she save each day on her central heating costs?

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..... **[3]**

**(b)** Amy has a TV. It has a label on it, but it does not tell her about the power in kW.

Look at the label.

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|---|
| current = 3 A |
| voltage = 230 V |

Calculate the power of the TV in kW.

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answer ..... kW **[2]**

**(c)** Amy reads about using **off-peak electricity** in her home. This will be cheaper.

Give one disadvantage to Amy of changing to off-peak electricity.

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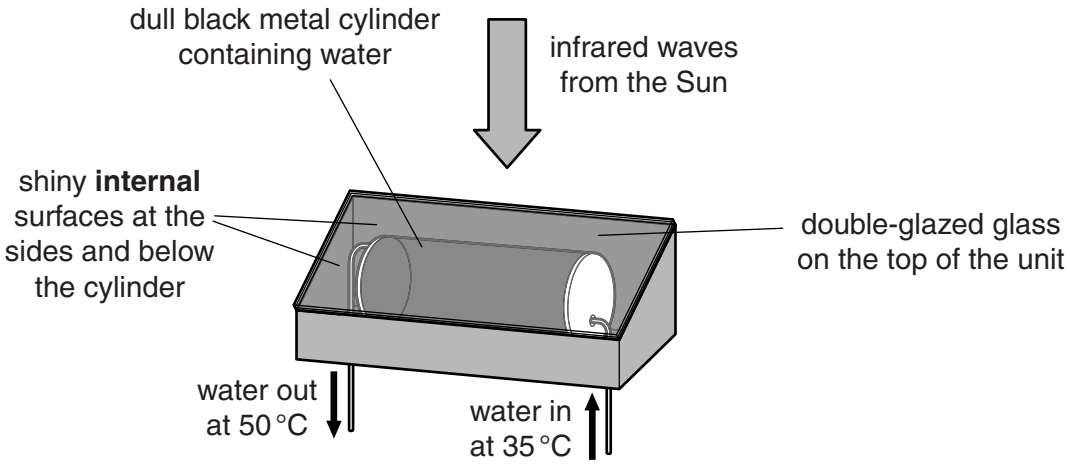
**[Total: 6]**

**4** John installs a solar water-heating unit on the roof of his house.

Look at the diagram of the unit.




**(a)** Energy is transferred through parts of the unit by different methods.

**(i)** What is the main method of energy transfer from above the glass to the surface of the cylinder?

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**(ii)** The black cylinder absorbs energy and transfers it to the water inside.

Explain how the water inside then heats up.

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..... **[2]**

**(b)** **(i)** These solar water-heating units have an efficiency of 85%.

Calculate the useful energy output for every 200 000 J of energy input.

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answer ..... J **[2]**

**(ii)** Describe how **one** feature of the solar water-heating unit has helped to produce this high level of energy efficiency.

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..... **[1]**

**(c) (i)** Some infrared waves have a wavelength of 1 mm.

The speed of electromagnetic waves is $3 \times 10^8$ m/s.

Show, using a calculation, that the frequency of the infrared waves is $3 \times 10^{11}$ Hz.

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**(ii)** The infrared waves which heat the metal cylinder have much shorter wavelengths.

Explain how the energy of these waves is different to those with a wavelength of 1 mm.

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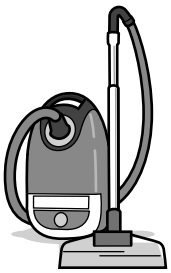
..... **[2]**

**[Total: 10]**

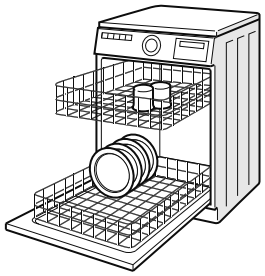
**5** Zack uses many appliances in his home.

Look at the information about the appliances he uses the **most**.

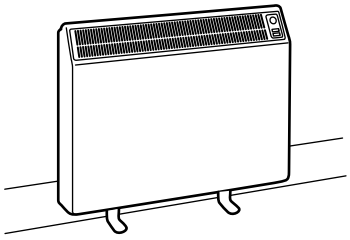
kettle used for 0.5 hours during the day
current of 9 amps



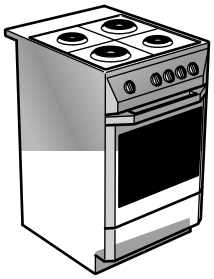
vacuum cleaner used for 0.25 hours during the day
current of 6 amps



dishwasher used for 1.5 hours during the day
current of 9 amps



heater used for 12 hours at night
current of 9 amps



cooker used for 1 hour during the day
current of 14 amps

fridge-freezer on for 12 hours during the day and 12 hours at night
current of 1.8 amps

All the appliances use the 230 V mains voltage. The currents shown are average values.

**(a)** The heater is only used at night.

**(i)** Calculate the power rating for the heater in **kilowatts**.

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power rating ..... kilowatts **[2]**

**(ii)** Calculate the total energy supplied to the heater in one night in **kilowatt hours**.

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total energy supplied ..... kilowatt hours **[2]**

**(b)** Zack pays **12p** per kilowatt hour for electricity he uses during the **day**.

He pays **6p** per kilowatt hour for electricity he uses during the **night**.

He is considering switching to the same cost for **day and night** of **10p**.

This would not save him money.

Suggest reasons why.

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..... **[2]**

**[Total: 6]**

**6** Amrit spends a lot of money on her electricity bills. One of her appliances is an iron.

**(a)** Amrit uses the iron for 0.5 hours. Its power is 1500 W. Electricity costs 18 pence per unit.

Calculate the number of kilowatt hours used by the iron and how much this will cost.

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number of kWh = .....

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cost of using the iron = ..... pence **[3]**

**(b)** Amrit has a fan heater. It has a power rating of 1955 W and a voltage of 230 V.

The fuse in the plug states a 'maximum current of 13 A'.

Amrit wants to find out whether the fuse is suitable.

Calculate the current in the fan heater.

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answer ..... A **[2]**

**(c)** Amrit decides to change to **off-peak** electricity.

Off-peak electricity has advantages for producers and consumers.

**(i)** Write down one advantage and one disadvantage of off-peak electricity **for Amrit**.

advantage.....

disadvantage ..... **[2]**

**(ii)** Power stations produce electricity 24 hours a day.

Producers sell off-peak electricity. This increases their profit.

Explain how using more off-peak electricity can benefit **energy supply**.

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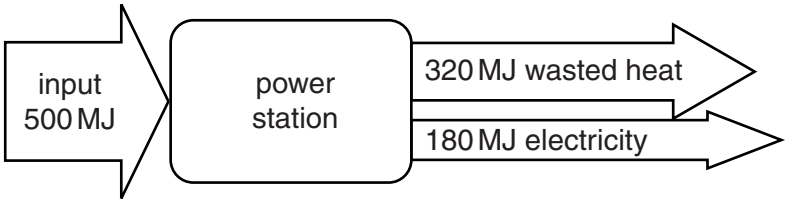
..... **[1]**

**[Total: 8]**

**7** Electricity is generated in power stations from the energy stored in fuels.

Fossil fuel power stations burn coal, oil or gas.

Look at the energy diagram of a power station.




**(a)** Calculate the efficiency of the power station.

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answer ..... **[2]**

**(b)** The power station engineer thinks the power station could be made more energy efficient without increasing the electrical efficiency.

Suggest how the efficiency of the power station could be increased, other than by generating more electricity.

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..... **[2]**

**[Total: 4]**

**8** Electrical power can be generated in many ways.

Look at the data on different types of power generation.

| Power generator | % Efficiency |
|---|---|
| Wind turbine farm | 30 |
| Coal power station | 34 |
| Nuclear power station | 35 |
| Oil power station | 32 |
| Gas power station | 45 |

**(a)** Coal, oil, gas and nuclear are all types of **thermal** power station.

Why are all these called thermal power stations?

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..... **[1]**

**(b)** Thermal power stations are more efficient than wind turbine farms.

Suggest why wind turbine farms are often preferred to thermal power stations.

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..... **[1]**

**(c)** The coal power station has an input power of 500 MW.

Using information in the table, calculate the energy in MJ wasted each **minute** in this power station.

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..... **[3]**

**[Total: 5]**