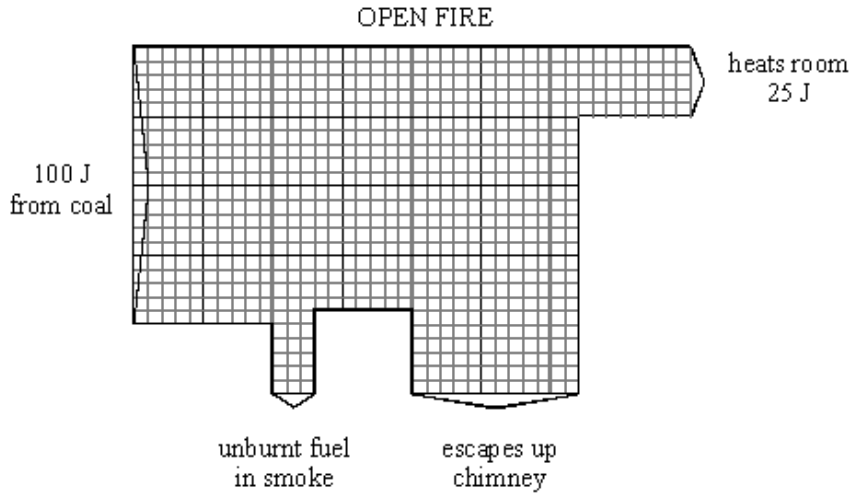
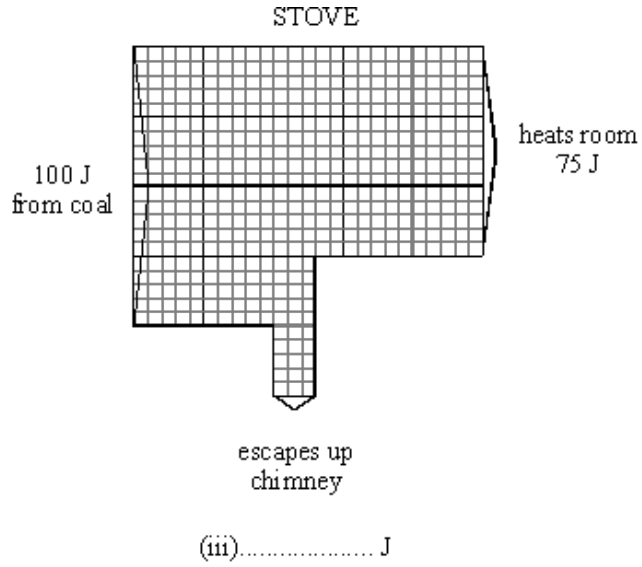
Q1. The diagrams show what happens to each 100 joules of energy from burning coal on an open fire and in a stove.





(a) Add the missing figures to the diagrams.

(3)

(b) Which is more efficient, the open fire or the stove?
Give a reason for your answer.

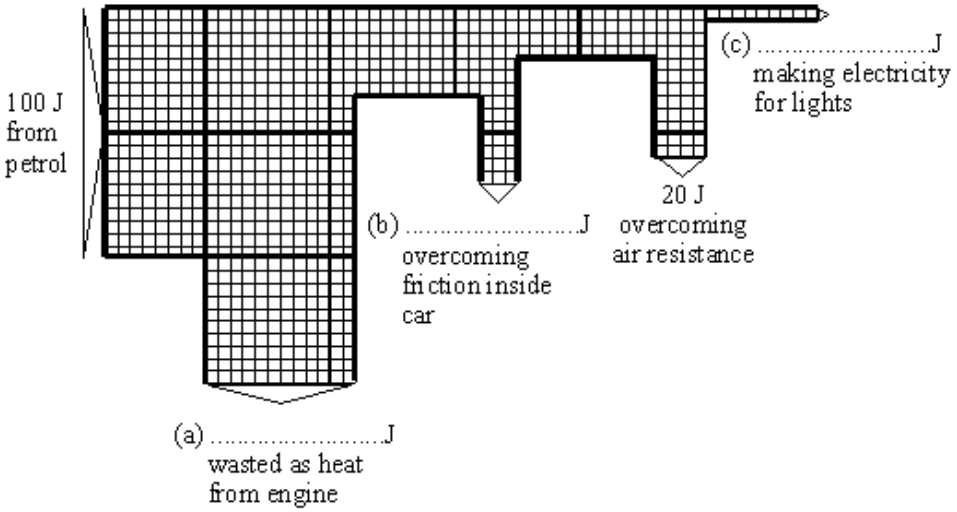
.....

.....

(1)
(Total 4 marks)

Q2. A car burns petrol as it travels along a flat road.

The diagram shows what happens to each 100 joules (J) of energy released by burning the petrol.



Complete the diagram by adding the missing numbers.

(Total 3 marks)

Q3. A gas burner is used to heat some water in a pan.

Of the energy released by the burning gas by the time the water starts to boil:

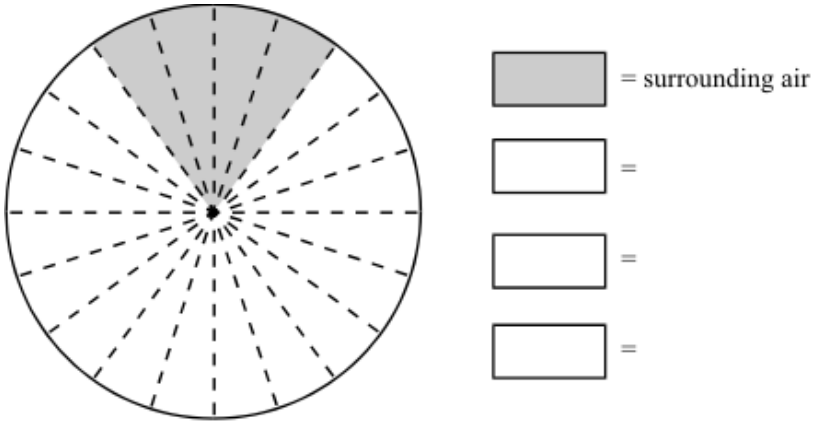
60% has been transferred to the **water**.

20% has been transferred to the **surrounding air**.

13% has been transferred to the **pan**.

7% has been transferred to the **gas burner** itself.

(a) Use the above information to complete the pie-chart.



(3)

(b) Some of the energy released by the burning gas is wasted.

(i) What happens to this wasted energy?

.....

.....

(2)

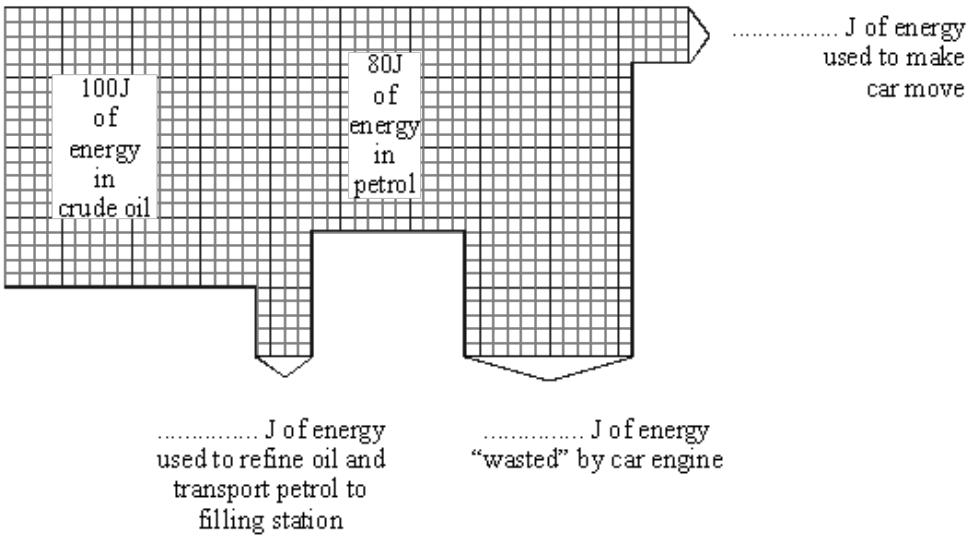
(ii) What percentage (%) of the energy from the gas is wasted? Answer: ..... %

(1)

(Total 6 marks)

Q4. The diagram shows what happens to each 100 joules of energy from crude oil when it is used as petrol in a car.

The widths of the arrows show exactly how much energy is transferred in each particular way.



(a) Complete the diagram by adding the correct energy value alongside each arrow.

(3)

(b) Calculate how efficient the car engine is at transferring the energy **from petrol** into useful movement.

[Show your working].

.....

.....

.....

(2)

(c) Two students are discussing the diagram.

The first says that **none** of the energy released from the crude oil is really lost.

The other says that **all** of the energy released from the crude oil is really lost.

What do you think?

Explain your answer as fully as you can.

.....

.....

.....

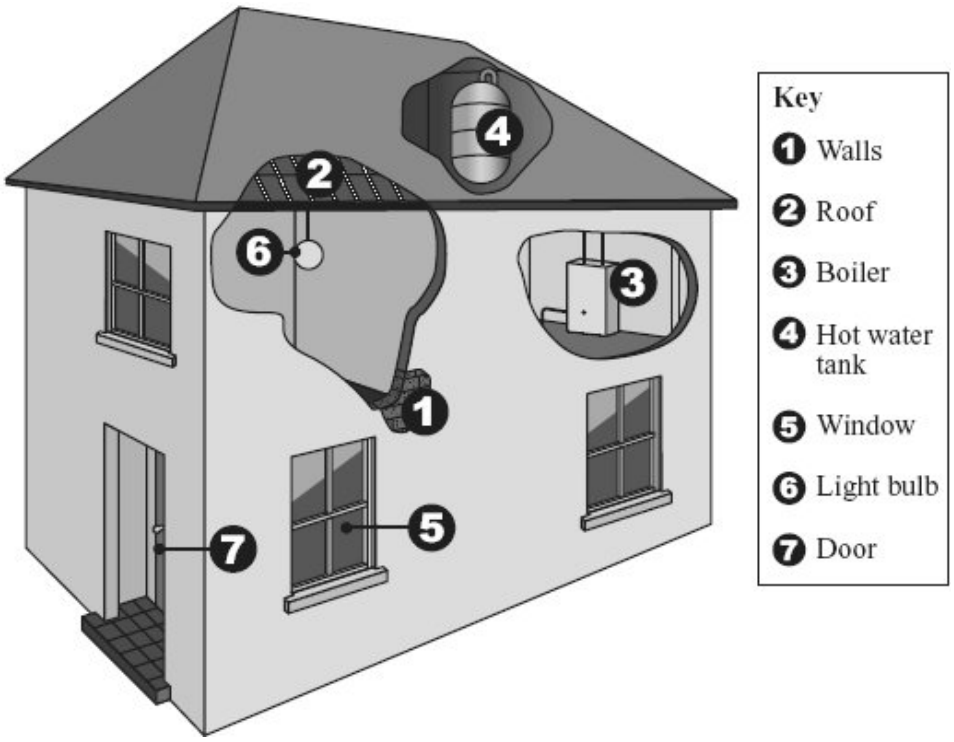
.....

.....

(4)

(Total 9 marks)

Q5. The drawing shows parts of a house where it is possible to reduce the amount of energy lost.



(a) Give **one** way in which the amount of energy lost can be reduced from each of the following parts of the house.

1, **2** and **4** .....

5 .....

7 .....

(3)

(b) Energy consumption can be reduced by using a more efficient boiler or more efficient light bulbs.

What is meant by a *more efficient* light bulb?

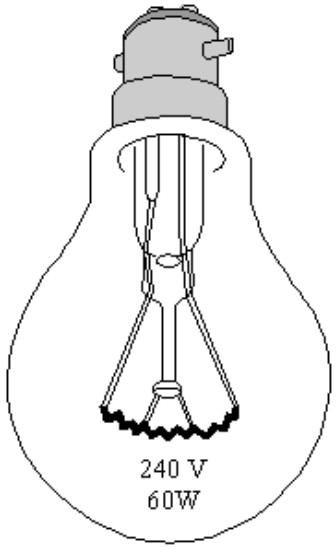
.....

.....

(1)

(Total 4 marks)

Q6. The diagram below shows a 60 watt electric light bulb.



(a) 60 W means that 60 joules of energy are transferred into the bulb each second.
In use, how much energy is given **out** by the bulb each second?

..... J

(1)

(b) Describe the energy transfers which occur as it is used.

..... energy is transferred into ..... energy

and ..... energy.

(2)

(c) Some of the energy given out is wasted. Why is some of the energy wasted?

.....

.....

(1)
(Total 4 marks)

Q7. (a) In winter, energy is transferred from the warm air inside a house to the air outside.

(i) What effect will the energy transferred from the house have on the air outside?

.....

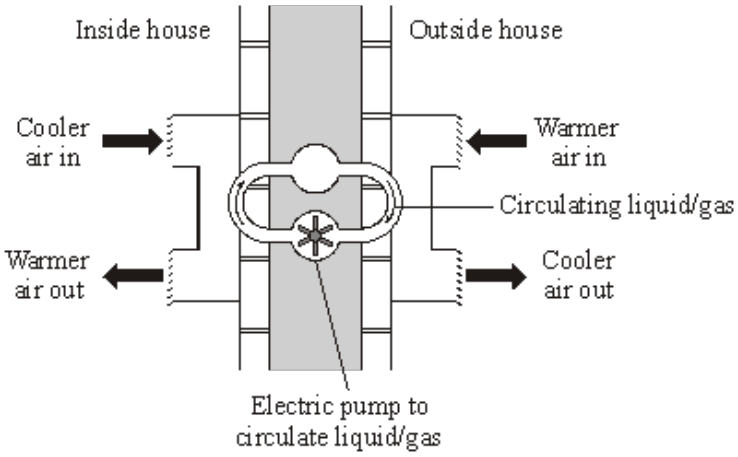
(1)

(ii) What would happen to the energy transfer if the temperature inside the house were reduced? Assume the temperature outside the house does not change.

.....

(1)

(b) To increase energy efficiency, a householder installs a heat exchanger to an outside wall of the house. The heat exchanger uses heat from the air outside to warm the inside of the house. The diagram shows the idea of the heat exchanger.



Physics Through Applications edited by J Jardine et el (OUP, 1989), copyright © Oxford University Press, reprinted by permission of Oxford University Press.

(i) Why does the heat exchanger cost money to run?

.....

(1)

(ii) The heat exchanger is cost effective in reducing energy consumption. Explain why.

.....

.....

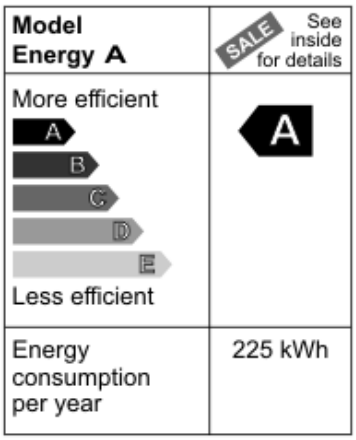
.....

.....

(2)

(Total 5 marks)

Q8. The diagram shows the label from a new freezer.



(a) An old freezer has an energy consumption per year of 350 kWh.

Use the equation in the box to calculate the extra cost of using the old freezer for one year compared with using a new 'A' rated freezer.

total cost = number of kilowatt-hours × cost per kilowatt-hour

Assume 1 kilowatt-hour (kWh) of energy costs 12 p.

Show clearly how you work out your answer.

.....

.....

Extra cost per year = £ .....

(2)

(b) The price of the new freezer was reduced in a sale.

Reducing the price reduces the payback time for replacing the old freezer from 12 years to 9 years.

Calculate, in pounds, how much the new freezer was reduced in the sale.

Show clearly how you work out your answer.

.....

.....

Price reduced by = £ .....

(2)

(c) An advertisement in a shop claims that:

'Replacing an old freezer with a new 'A' rated freezer will benefit the environment.'

Do you agree that replacing the freezer will benefit the environment?

Answer yes or no. .....

Explain the reasons for your answer.

.....

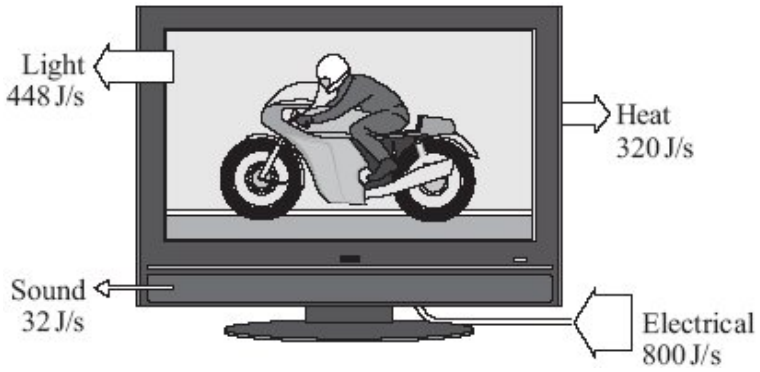
.....

.....

.....

(2)
(Total 6 marks

Q9. (a) The diagram shows the energy transformations produced by a TV.



(i) Use the information in the diagram and the equation in the box to calculate the efficiency of the TV.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2)

(ii) What eventually happens to the useful energy transferred by the TV?

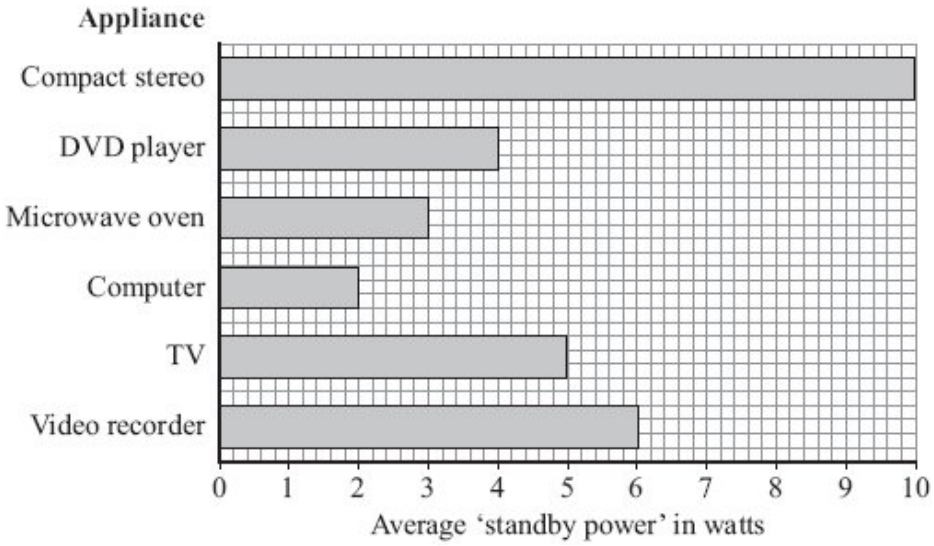
.....

.....

(1)

(b) Electrical appliances left on standby use energy.

The bar chart shows the power for the appliances that one family leaves on standby when they go on holiday.



The family is on holiday for a total of 175 hours.

(i) Use the information in the bar chart and the equation in the box to calculate the energy wasted by leaving the compact stereo on standby while the family is on holiday.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

Show clearly how you work out your answer.

.....

.....

Energy wasted = ... kilowatt-hours

(2)

(ii) Electricity costs 12 p per kilowatt-hour.

Use the equation in the box to calculate the cost of leaving the compact stereo on standby while the family is on holiday.

total cost = number of kilowatt-hours × cost per kilowatt-hour

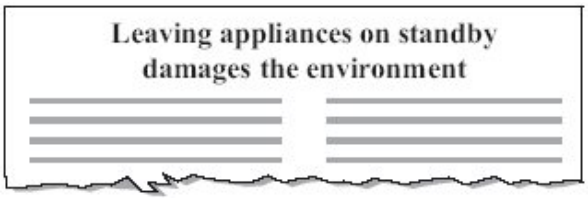
Show clearly how you work out your answer.

.....

Cost = ... p

(1)

(c) A headline from a recent newspaper article is shown below.



Explain why leaving appliances on standby damages the environment.

.....

.....

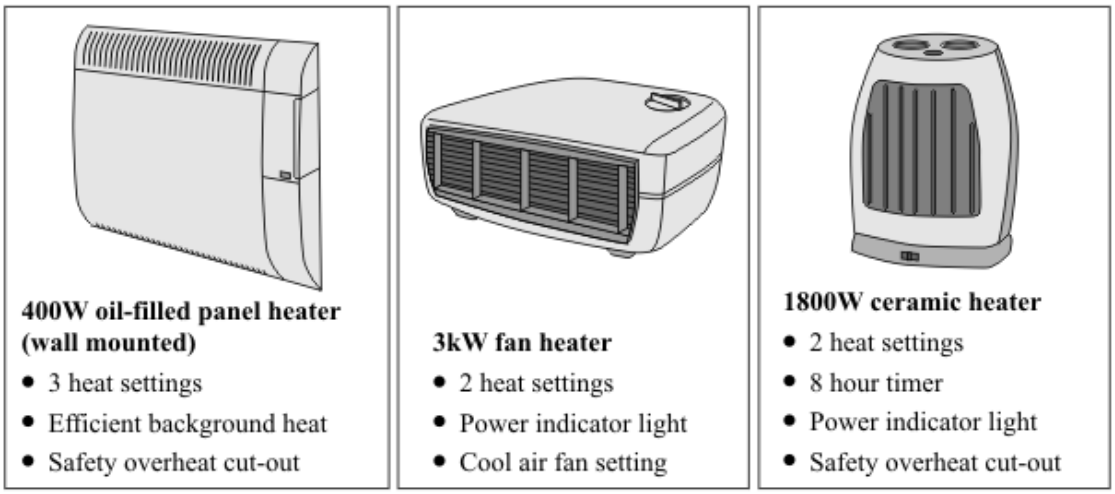
.....

.....

(2)

(Total 8 marks)

Q10. The pictures show three different types of electric heater.



(a) The ceramic heater is run on full power for 5 hours.

Use the following equation to calculate, in kilowatt-hours, the amount of energy transferred from the mains to the heater.

energy transferred = power × time

Show clearly how you work out your answer.

.....

.....

Energy transferred = ... kilowatt-hours

(2)

(b) Which heater will be the most expensive to run on its highest heat setting?

.....

(1)

(c) A heater is needed for a small office.

Comparing each type of heater with the other two, give **one** advantage of using each type of heater in the office.

oil-filled panel heater .....

.....

fan heater .....

.....

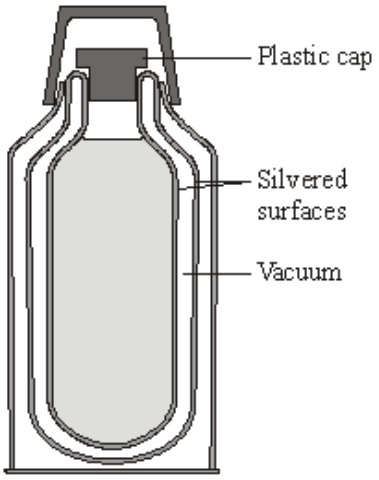
ceramic heater .....

.....

(3)

(Total 6 marks)

Q11. A vacuum flask is designed to reduce the rate of heat transfer.



(a) (i) Complete the table to show which methods of heat transfer are reduced by each of the features labelled in the diagram.

The first row has been done for you.

Feature	Conduction	Convection	Radiation
vacuum	✓	✓	
silvered surfaces			
plastic cap			

(2)

(ii) Explain why the vacuum between the glass walls of the flask reduces heat transfer by conduction and convection.

.....

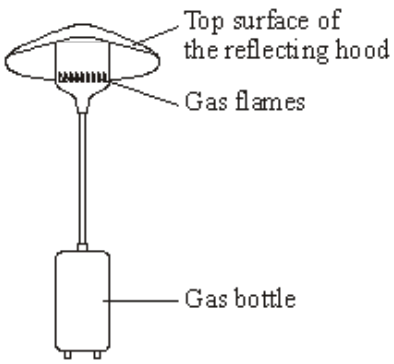
.....

.....

.....

(2)

(b) The diagram shows a gas flame patio heater.



(i) Explain why the top surface of the reflecting hood should be a light, shiny surface rather than a dark, matt surface.

.....

.....

.....

(2)

(ii) Most of the chemical energy in the gas is transformed into heat. A **small** amount of chemical energy is transformed into light.

Draw and label a Sankey diagram for the patio heater.

(2)

(iii) State why the total energy supplied to the patio heater must always equal the total energy transferred by the patio heater.

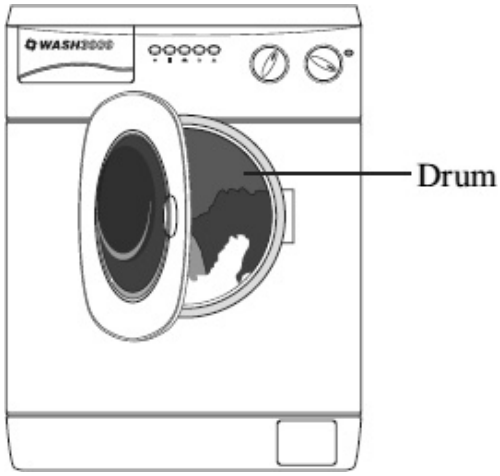
.....

.....

(1)

(Total 9 marks)

Q12. The picture shows a new washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



(a) Complete the following sentences.

(i) An electric motor is designed to transform electrical energy into

..... energy.

(1)

(ii) Some of the electrical energy supplied to the motor is wasted as

..... energy and ..... energy.

(1)

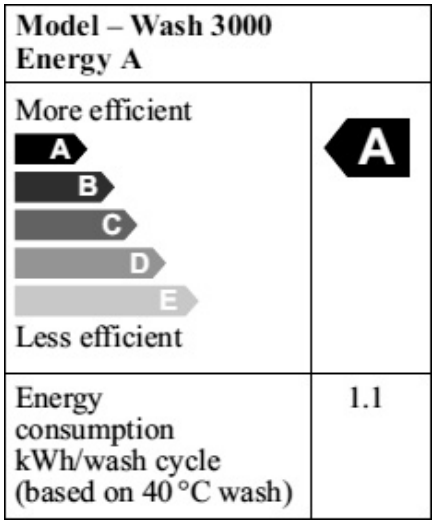
(b) What happens to the energy wasted by the electric motor?

.....

.....

(1)

(c) The diagram shows the label from the new washing machine.



An ‘A’ rated washing machine is *more energy efficient* than a ‘C’ rated washing machine.

Explain what being *more energy efficient* means.

.....

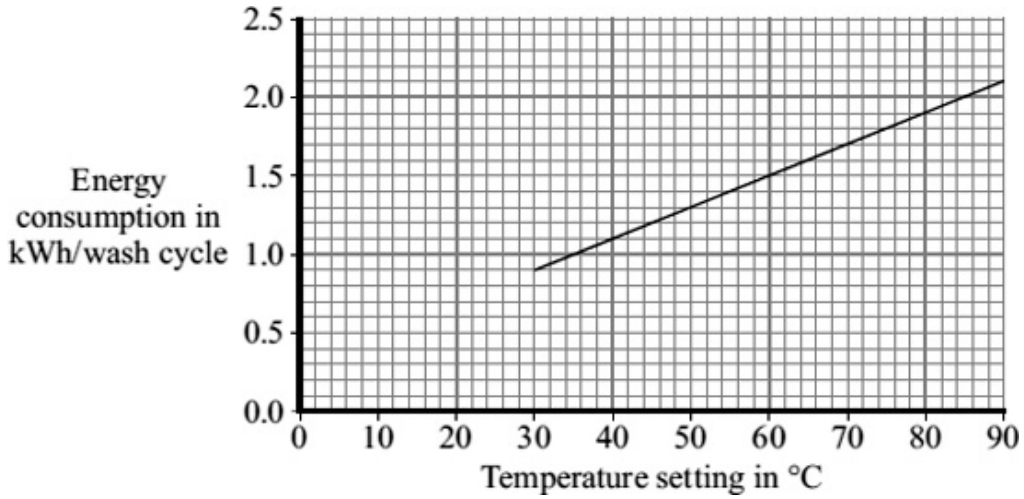
.....

.....

.....

(2)

(d) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



(i) Electricity costs 12 p per kilowatt-hour (kWh).
The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

Money saved = ... p

(2)

(ii) Suggest why reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

.....

.....

(1)

(Total 8 marks)

Q13. 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?

.....

.....

.....

.....

(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.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

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.

.....

(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 .....

.....

2 .....

.....

(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.

Use the correct equation from the Physics Equations Sheet.

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

.....

.....

.....

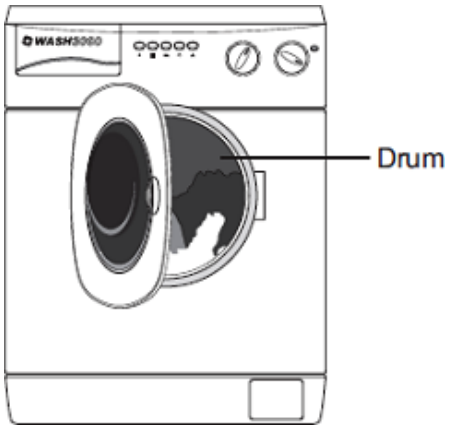
.....

Energy required = ...

(3)

(Total 10 marks)

Q14. The picture shows a washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



(a) Complete the following sentences.

(i) An electric motor is designed to transform electrical energy into

..... energy.

(1)

(ii) Some of the electrical energy supplied to the motor is wasted as

..... energy and ..... energy.

(1)

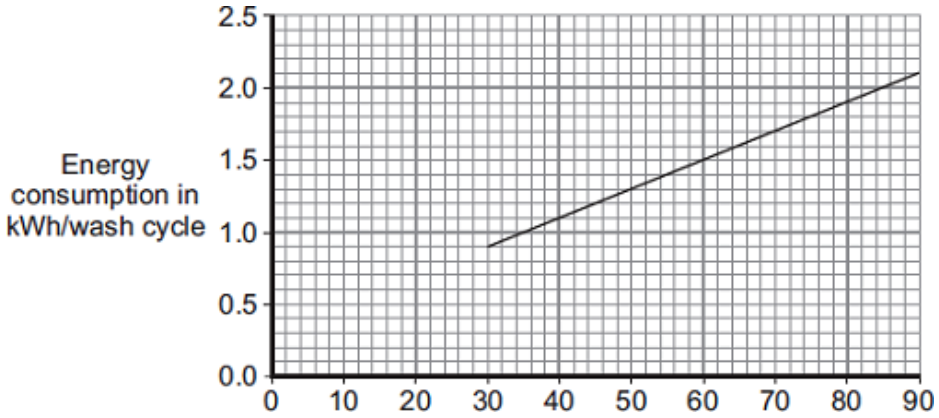
(b) What happens to the energy wasted by the electric motor?

.....

.....

(1)

(c) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



(i) Electricity costs 15p per kilowatt-hour (kWh).

The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

total cost = number of kilowatt-hours x cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

Money saved = ...

(2)

(ii) Reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

Explain why.

.....

.....

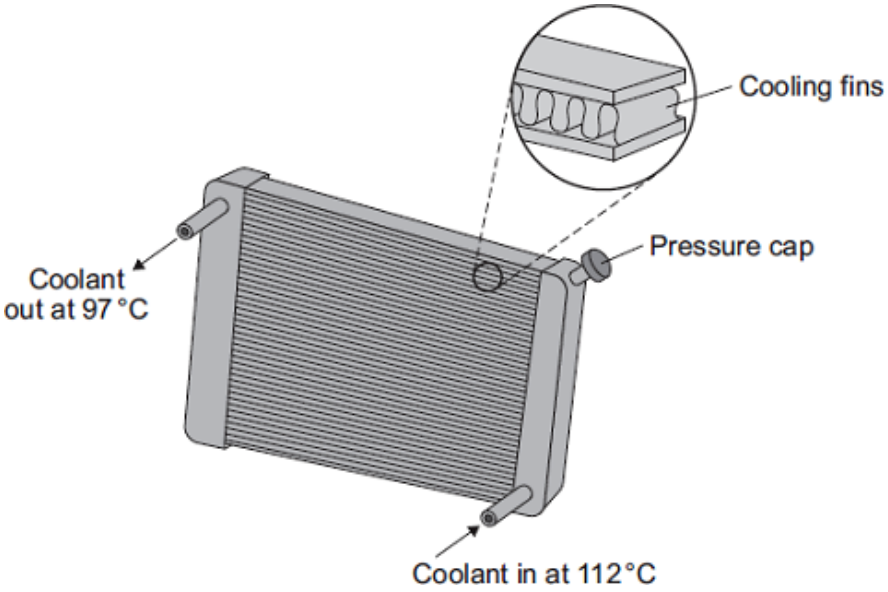
.....

.....

(2)

(Total 7 marks)

Q15. The diagram shows a car radiator. The radiator is part of the engine cooling system.



Liquid coolant, heated by the car engine, enters the radiator. As the coolant passes through the radiator, the radiator transfers energy to the surroundings and the temperature of the coolant falls.

(a) Why is the radiator painted black?

.....

.....

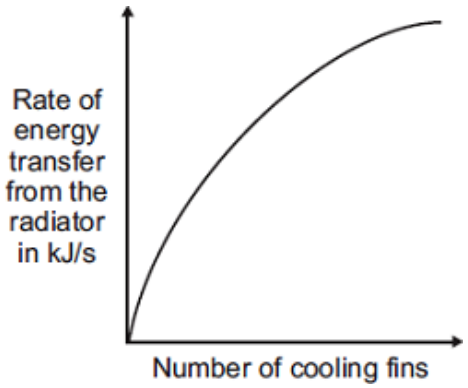
.....

.....

(2)

(b) Different radiators have different numbers of cooling fins along the length of the radiator.

The sketch graph shows how the number of cooling fins affects the rate of energy transfer from the radiator.



The number of cooling fins affects the rate of energy transfer from the radiator.

Explain how.

.....

.....

.....

.....

(2)

(c) When the car engine is working normally, 2 kg of coolant passes through the radiator each second. The temperature of the coolant falls from 112 °C to 97 °C.

Calculate the energy transferred each second from the coolant.

Specific heat capacity of the coolant = 3800 J/kg °C.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Energy transferred each second = ... J

(3)

(d) On cold days, some of the energy transferred from a hot car engine is used to warm the air inside the car. This is a useful energy transfer.

What effect, if any, does this energy transfer have on the overall efficiency of the car engine?

Draw a ring around the correct answer.

decreases the efficiency	**does not change the efficiency**	**increases the efficiency**

Give a reason for your answer.

.....

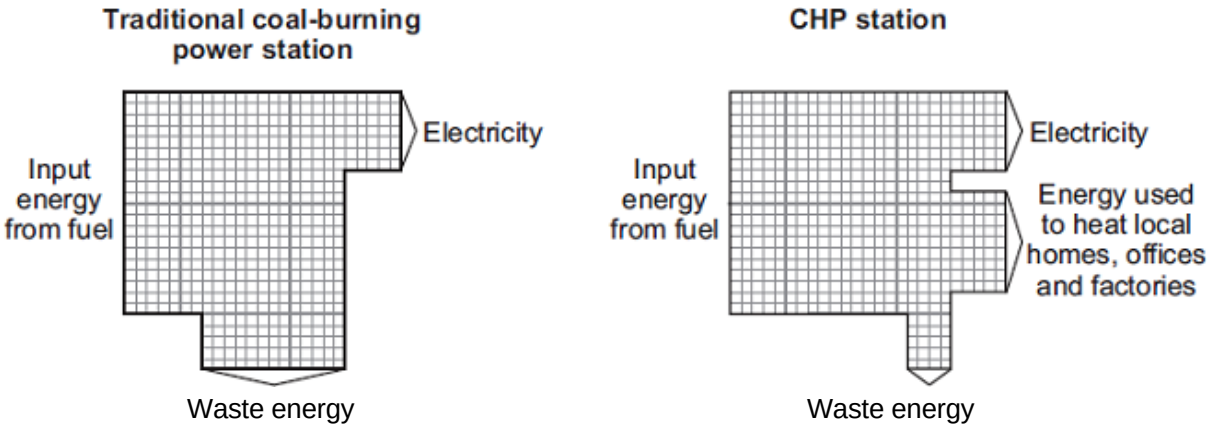
.....

.....

(2)

(Total 9 marks)

Q16. The Sankey diagrams show the energy transfers in a traditional coal-burning power station and a combined heat and power (CHP) station.



(a) What effect does the waste energy from a power station have on the surroundings?

.....

.....

(1)

(b) Calculate the efficiency of the CHP station.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Efficiency = ...

(2)

(c) Why is a CHP station more efficient than a traditional coal-burning power station?

.....

.....

.....

.....

(2)

(d) A CHP station is usually used to meet the demand for electricity within the local area. The electricity is not transmitted and distributed through the National Grid.

(i) What is the National Grid?

Tick (✓) **one** box.

A system of cables and pylons. ☐

A system of cables and transformers. ☐

A system of cables, transformers and power stations ☐

(1)

(ii) Using the electricity locally and not transmitting it through the National Grid increases the overall efficiency of a CHP station by 7%.

Give **one** reason why.

.....

.....

(1)

(Total 7 marks)