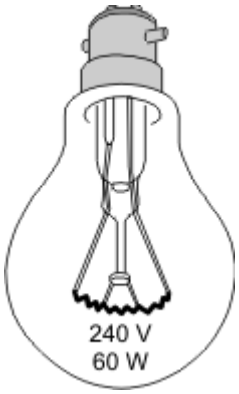
Energy and efficiency and the usefulness of electrical appliances

1. 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)

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

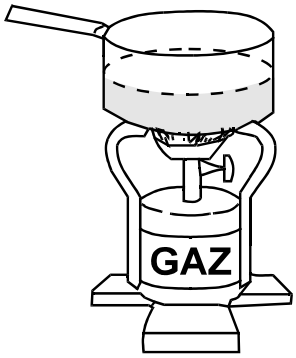
Of the energy released by the burning gas by the time the water starts to boil:

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.



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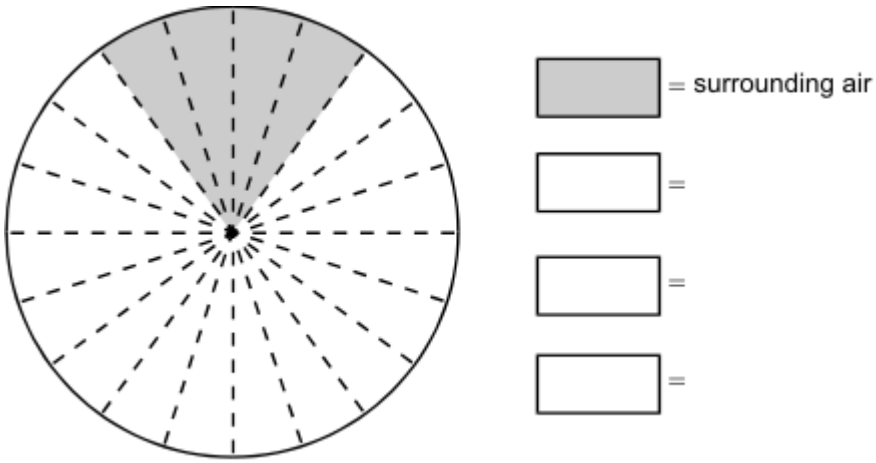
(a) Use the above information to complete the pie-chart.



(3)

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

(i) What happens to this wasted energy?

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.....

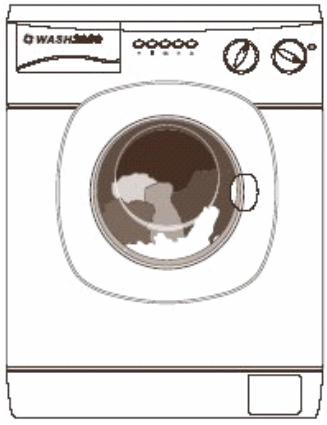
(2)

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

(1)

(Total 6 marks)

3. (a) The picture shows a new washing machine.



Complete the following sentence using **one** of the words in the box.

kinetic	**light**	**sound**

A washing machine is designed to transform electrical energy into heat and

..... energy

(1)

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(b) The instruction booklet for the washing machine contains the following information.

Wash cycle	Average power during cycle	Time taken to run cycle
HOT	1.5 kW	2 hours
COOL	1.1 kW	1½ hours
FAST	1.0 kW	¾ hour

(i) Use the following equation to calculate the energy transferred, in kilowatt-hours, to the washing machine during the HOT wash cycle. Show how you work out your answer.

energy transferred = power × time

.....

.....

Energy transferred = ... kWh

(2)

(ii) Why does it cost more to use the washing machine on the HOT cycle than on the COOL or FAST cycle?

.....

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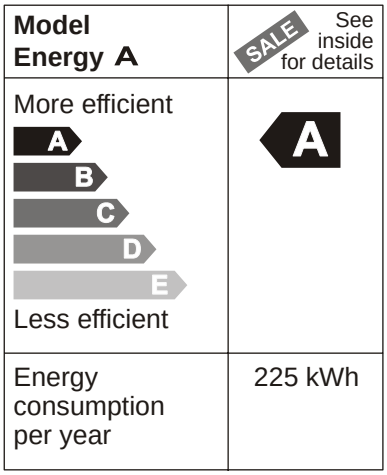
(1)
(Total 4 marks)

4. 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.

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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.

.....

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(2)
(Total 6 marks

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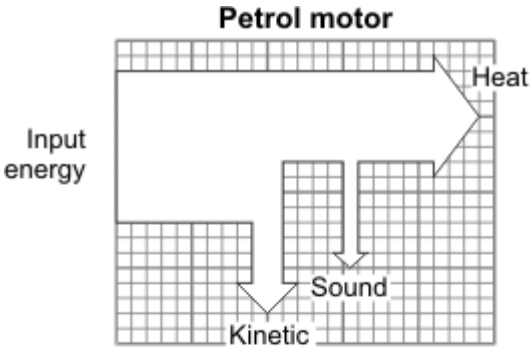
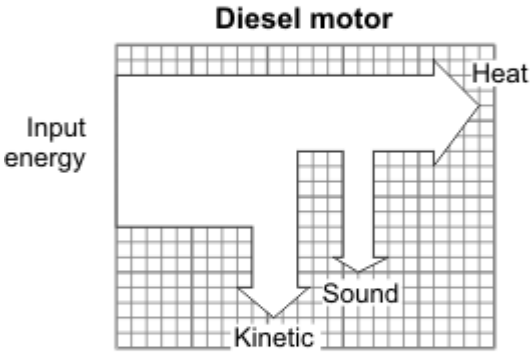
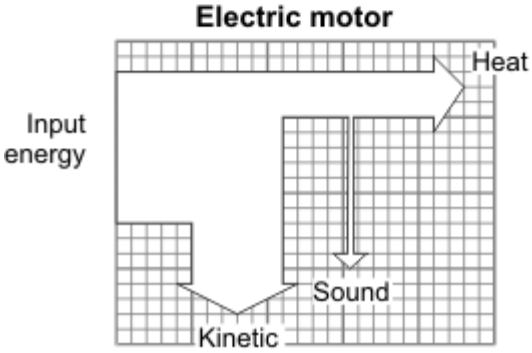
5. (a) The energy transformation (Sankey) diagrams show what happens to the input energy for three different machines.







(i) Which machine is the most efficient?

.....

Give a reason for your answer.

.....

.....

(2)

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(ii) What percentage of the input energy is usefully transformed by the electric motor? Show clearly how you get your answer.

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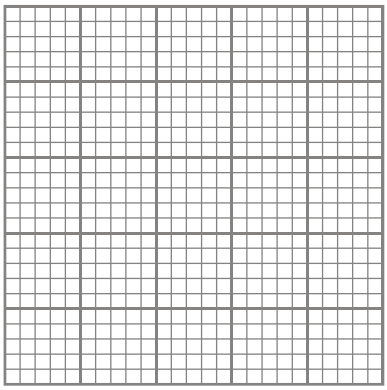
(2)

(b) (i) Draw on the grid a labelled energy transformation (Sankey) diagram for a filament lamp.



(2)

(ii) A pupil wrote the following statement.

> 'Switching lights off does not save energy. Since energy cannot be destroyed, it will always be there so none is wasted.'

Explain carefully what is wrong with the pupil's statement.

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(2)
(Total 8 marks)

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6. (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?

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(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.

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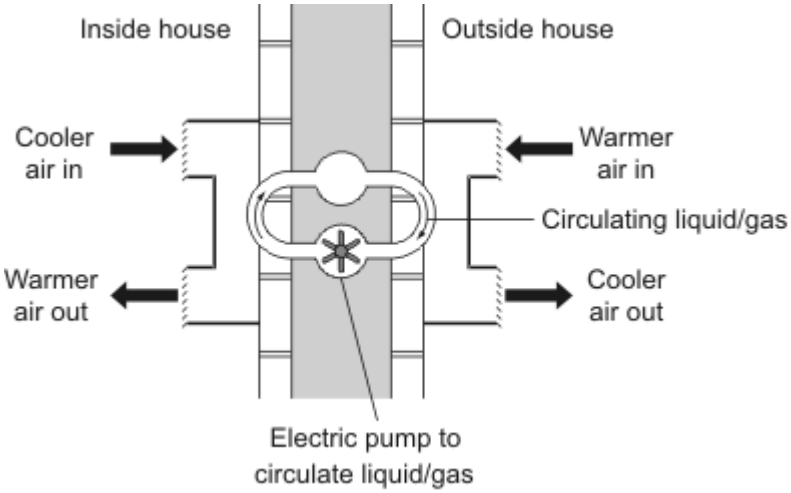
(1)

(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.



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

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(1)

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

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(2)
(Total 5 marks)

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7. (a) The table gives information about some ways of reducing the energy consumption in a house.

Method of reducing energy consumption	Installation cost in £	Annual saving on energy bills in £
Fit a new hot water boiler	1800	200
Fit a solar water heater	2400	100
Fit underfloor heating	600	50
Fit thermostatic radiator valves	75	20

Which way of reducing energy consumption is most cost effective over a 10-year period?

To obtain full marks you must support your answer with calculations.

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(3)

(b) Explain why using an energy-efficient light bulb instead of an ordinary light bulb reduces the amount of carbon dioxide emitted into the atmosphere.

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(2)
(Total 5 marks)

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