Name ..... Class ..... Date .....

Energy and efficiency

Specification references:

- P1.2.2 Efficiency
- MS 1a, 1b, 2a, 3b, 3c

Aims

In this exercise, you will consider the meaning of the term 'efficiency' and apply it to circumstances where energy is usefully transferred or wasted. You will describe ways to increase efficiency and to reduce unwanted energy transfers. You will also calculate the efficiency of a variety of machines based on the useful energy and power that is transferred compared with what is wasted.

Learning objectives

After completing this activity, you should be able to:

- state the efficiency equations using both energy and power
- describe what the word efficiency means
- describe how to increase efficiency
- calculate efficiency using the equations
- $\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}} \times 100\%$
- $\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}} \times 100\%$
- calculate energy and power values based on efficiency values.

Questions

1 The table below shows the amount of energy that is usefully transferred and wasted by a number of different appliances. Put them in order of efficiency from least efficient (wastes the most energy) to most efficient (wastes the least energy). The most efficient device will be number 1 and the least efficient device will be number 5. One of the devices has been completed for you. (*4 marks*)

Device	Useful output energy in %	Wasted output energy in %	Order of efficiency
hairdryer	91		
light bulb	2	98	5 (least efficient)
cell or battery		12	
kettle	94		
microwave oven		32	

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2 Calculate the efficiency of the following devices:

a A lawnmower which converts 143 J out of every 450 J of electrical input energy into sound and heat. The rest of the energy is converted to kinetic energy of the blades attached to the motor.

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..... (*3 marks*)

b A lamp which converts 17 W out of every 20 W into thermal energy. The lamp is being used for the sole purpose of lighting the room.

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..... (*2 marks*)

c An electric motor can usefully convert 18 J of energy each second into kinetic energy to raise a mass above the ground. The motor has an input current of 2.5 A and an operating voltage of 16 V.

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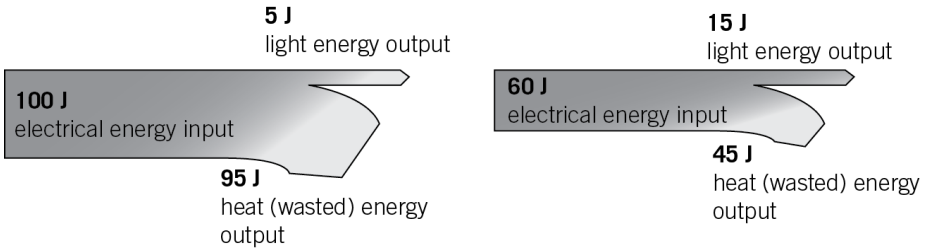
..... (*4 marks*)

3 The diagrams below show the efficiency of two different light bulbs. One of the light bulbs is a conventional filament bulb and the other is an energy saving fluorescent bulb.



a Calculate the efficiency of the two bulbs.

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..... (*2 marks*)

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b State which bulb is the filament lamp and which is the energy saving fluorescent bulb

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(*1 mark*)

c Explain how the energy saving bulb is more efficient in terms of how the electrical energy is transferred.

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(*2 marks*)

4 Explain why it is not possible for any device to be 100% efficient.

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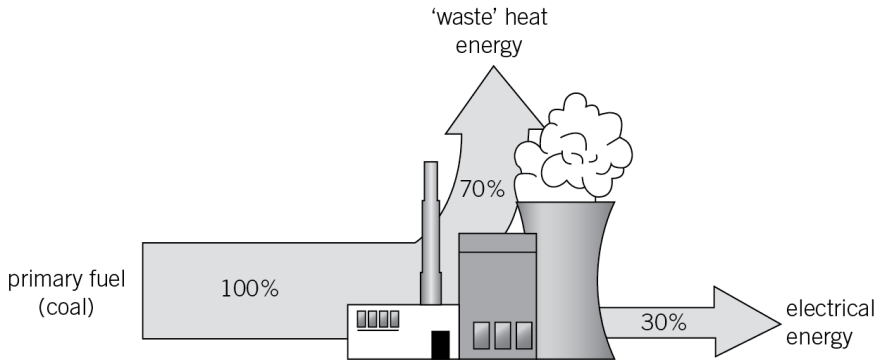
(*1 mark*)

5 Some power stations are designed to convert the chemical energy in fossil fuels into electrical energy. This means that large percentages of the input energy are converted to heat, which is wasted to the surroundings.



Look at the diagram of the power station. Suggest how this power station could be made to be more efficient.

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(*2 marks*)

6 Fill in the missing values in the table below and suggest a device in each case. (*3 marks*)

Device	Efficiency in %	Input	Useful output
		140 kJ	135 kJ
	17		45 J
	36	12 MW	