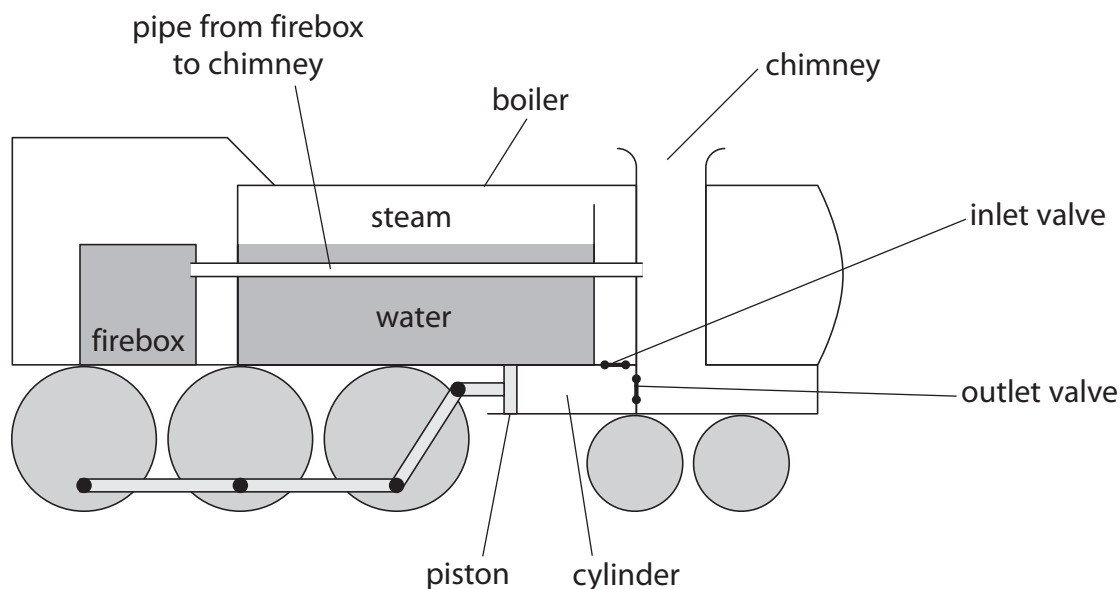


**12** The diagram shows the basic details of a steam engine used in a steam train.



(a) Coal is burned in the firebox to heat up water in the boiler.

Coal is a non-renewable fuel.

Give an example of another non-renewable fuel.

(1)

(b) This is how the steam engine works.

- hot air from the firebox passes through a pipe to the chimney
- water is heated as the pipe passes through the boiler
- the water boils to form steam
- the steam is trapped by the closed inlet valve and continues to be heated

Explain why the pressure of the steam increases as its temperature increases.

(3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- (c) When the inlet valve is opened, the steam moves into the cylinder.

The steam exerts a force on the piston in the cylinder.

- (i) State the equation linking pressure, force and area.

(1)

- (ii) The steam has a pressure of 1.45 MPa.

The piston has an area of 0.0243 m<sup>2</sup>.

Calculate the force exerted on the piston.

(3)

force = ..... N

**QUESTION 12 CONTINUES ON NEXT PAGE**



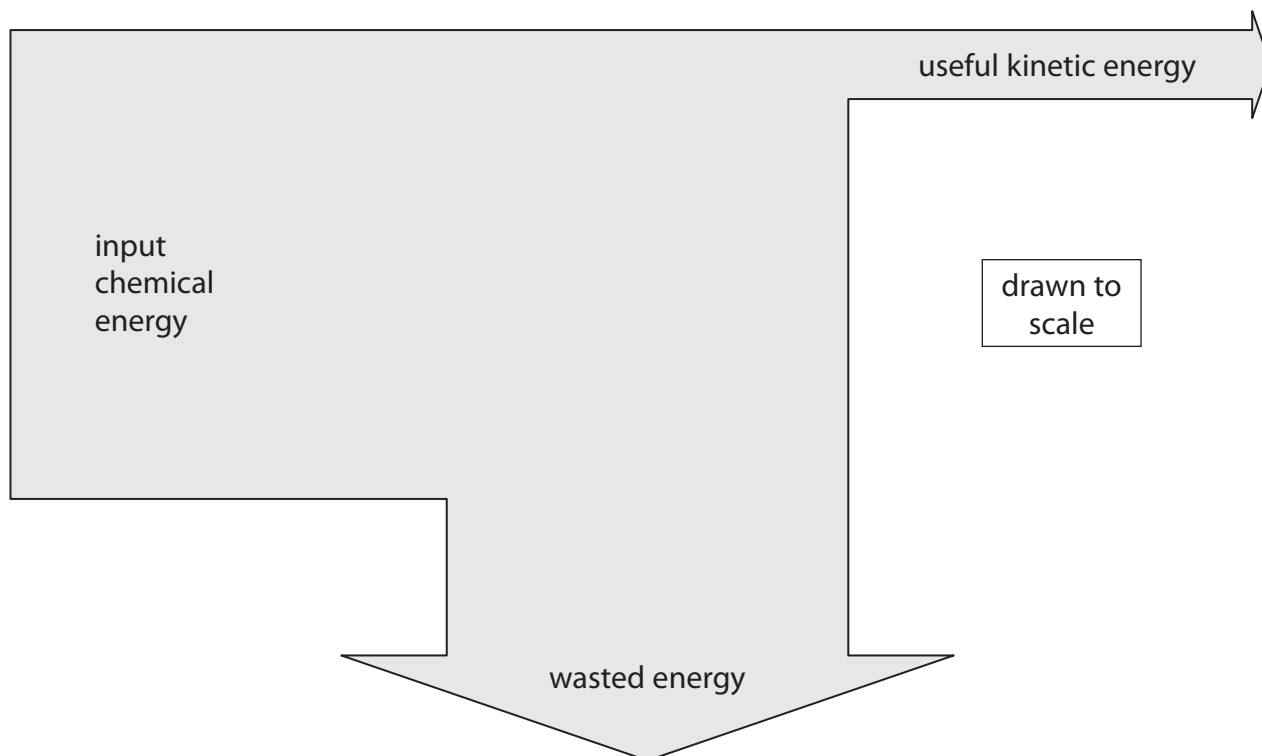
(d) The force pushes the piston so that the wheels turn and the train moves.

This process transfers chemical energy from the coal into useful kinetic energy.

(i) State a type of energy that is wasted in this process.

(1)

(ii) The Sankey diagram shows the energy transfers in the process.



Using the diagram, calculate the efficiency of the steam train.

(4)

efficiency = .....

**(Total for Question 12 = 13 marks)**

**TOTAL FOR PAPER = 120 MARKS**

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