9 A monatomic ideal gas in an expandable chamber is cooled from 50.0 °C to 10.0 °C at constant pressure 3.00×10^5 Pa. Total heat given out by the gas is 1.79×10^4 J.

(a) The specific heat capacity at constant pressure of the gas is 5190 J kg^{-1} K^{-1}. One mole of the gas has mass of 4.0 g.

Determine the number of gas atoms in the chamber.

number of gas atoms = ... [3]

(b) **(i)** Define an ideal gas. Explain all symbols you may have used in your answer.

.....

.....

..... [2]

(ii) Calculate the change in internal energy of the gas when it has been cooled. Explain your answer.

change in internal energy = ... J [2]

(iii) Calculate the percentage change in root–mean–square speed of the gas when it has been cooled.

percentage change = ...% [2]

(c) **(i)** State the *first law of thermodynamics*.

.....

.....

..... [2]

(ii) Use the first law of thermodynamics, or otherwise, to determine the work done by the gas it has been cooled.

work done = ... J [2]

(iii) Determine the heat given out by the gas if it is cooled from 50.0 °C to 10.0 °C at constant volume instead. Explain your working.

heat given out = ... J [2]

(d) **(i)** Calculate the volume of the gas before and after the change in temperature, considering constant pressure.

volume before = ... m^3

volume after = ... m^3 [1]

(ii) Hence, sketch in Fig. 9.1 the pressure – volume graph of the gas as it is being cooled from 50.0 °C to 10.0 °C at constant pressure 3.00×10^5 Pa.

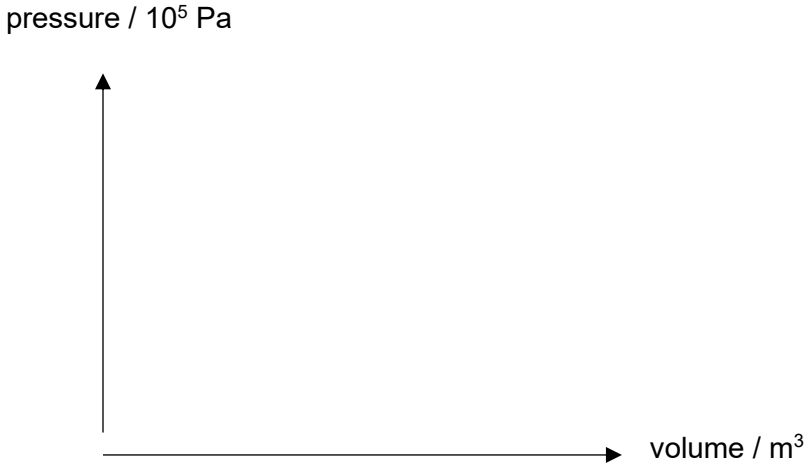

Fig. 9.1

[2]

(e) With reference to the heat given out, comment on the difference in your answer in **(c)(iii)**, if any, with the process when the gas is cooled at constant pressure.

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..... [2]