

- 1 Two flasks P and Q contain an ideal gas and are connected with a tube of negligible volume compared to that of the flasks. The volume of P is triple the volume of Q.



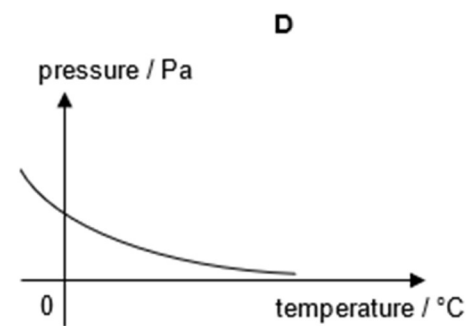
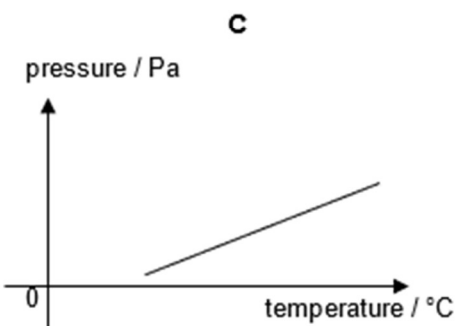
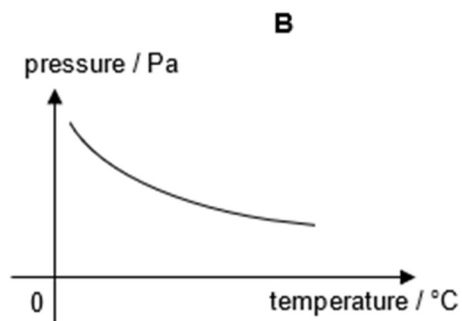
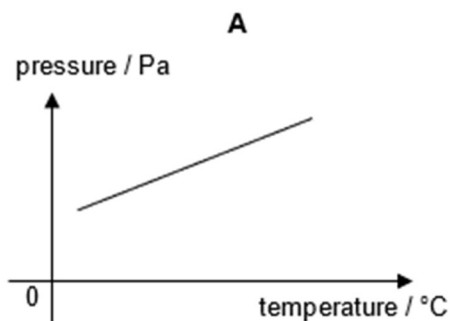
P is held at a temperature of 200 K and Q is held at a temperature of 600 K.

What is the $\frac{\text{mass of gas in P}}{\text{mass of gas in Q}}$?

- A $\frac{1}{9}$ B $\frac{1}{3}$ C 3 D 9

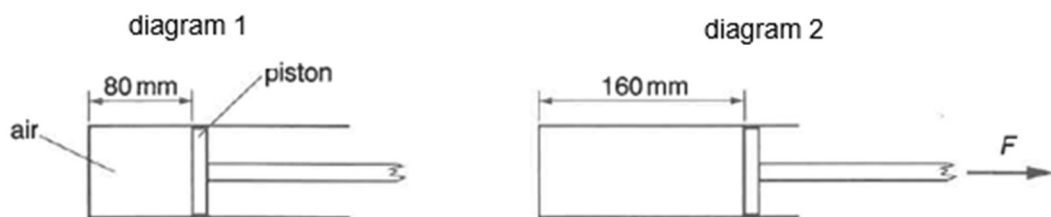
- 2 A fixed mass of an ideal gas is trapped in a cylinder of constant volume and its temperature is varied.

Which graph shows the variation of the pressure of the gas with temperature in degrees Celsius?



- 3 Air is enclosed in a cylinder by a gas-tight, frictionless piston of cross-sectional area $3.0 \times 10^{-3} \text{ m}^2$. When atmospheric pressure is 100 kPa , the piston settles 80 mm from the end of the cylinder (see diagram 1).

The piston is then pulled out until it is 160 mm from the end of the cylinder (see diagram 2) and is held there. The temperature of the air in the cylinder returns to its original value.



What is the force F required to hold the piston in its new position?

- A** 150 N **B** 200 N **C** 300 N **D** 600 N
- 4 A gas cylinder is fitted with a safety valve which releases a gas when the pressure inside the cylinder reaches $2.0 \times 10^6 \text{ Pa}$.
- Given that the maximum mass of ideal gas the cylinder can contain at 300 K is 2.0 kg , what is the mass of gas that escapes from the cylinder if it is heated to 400 K ?
- A** 0.50 kg **B** 0.75 kg **C** 1.2 kg **D** 1.5 kg
- 5 An ideal gas is heated very gradually. This causes it to expand slowly. During this entire process, the temperature of the gas remains constant.
- Which statement is correct?
- A** As the heat is applied, the internal energy of the gas increases.
- B** The gas does no work in expanding.
- C** The rate of heating and the rate of gas doing work are equal at all times.
- D** The root-mean-square speed of the gas molecules increases as the heat is applied.

6

Which statement about internal energy is correct?

- A When the internal energy of a system is increased, its temperature always rises.
- B The internal energy of a system can be increased without transfer of energy by heating.
- C When two systems have the same internal energy, they must be at the same temperature.
- D The internal energy of a system is the sum of the heat transferred to the system and the work done on the system.

7

An ideal gas is initially at 127°C. It is then heated until the r.m.s. speed of its molecules becomes doubled. The increase in temperature is

- A 381 °C B 508 °C C 1200 °C D 1600 °C

8

A small ice cube of mass 20 g is heated and changes from the solid to the liquid state. During this change in state the temperature of the substance does not change.

Which statement about this change in state is **not** correct?

- A The amount of energy the ice absorbs is equal to the specific latent heat of fusion.
- B The average kinetic energy of the molecules remains unchanged.
- C The average potential energy of the molecules increases.
- D The total mass of ice and water remains constant throughout.

9

Two identical vessels contain two different gases X and Y with molecular mass m_x and m_y respectively. The thermodynamic temperature of gas X is twice that of gas Y and the root-mean-square speed of the molecules in X is three times that of the molecules in Y. What is the ratio of $\frac{m_x}{m_y}$?

- A 2 : 3 B 2 : 9 C 9 : 2 D 3 : 2

10

In the derivation of the relationship $pV = \frac{1}{3}Nm\langle c^2 \rangle$, where N is the number of gas molecules, which statement is **not** an essential assumption?

- A The average kinetic energy of a molecule is proportional to the temperature of the gas.
- B The volume of molecules is negligible compared with the volume occupied by the gas.
- C The molecules exert no intermolecular forces on one another except during collisions.
- D The molecules are in continuous random motion.

-
- 11 A sealed tank of gas contains a mixture of nitrogen and oxygen. The tank is at room temperature.
- What is the same for the particles of nitrogen and oxygen in the tank?
- A** internal energy
B mean square speed
C mean kinetic energy
D root mean square speed
- 12 The density of air is 1.20 kg m^{-3} at a temperature of 20°C and standard atmospheric pressure.
- What is the density of air at a temperature of 27°C and standard atmospheric pressure?
- A** 0.89 kg m^{-3} **B** 1.17 kg m^{-3} **C** 1.23 kg m^{-3} **D** 1.62 kg m^{-3}
- 13 The density of argon at a pressure of $1.00 \times 10^5 \text{ Pa}$ and at a temperature of 300 K is 1.60 kg m^{-3} .
- What is the root mean square speed of argon atoms at this temperature?
- A** 216 m s^{-1} **B** 250 m s^{-1} **C** 306 m s^{-1} **D** 433 m s^{-1}
- 14 A particle oscillates with simple harmonic motion along a straight line with amplitude A . When the displacement of the particle from its equilibrium position is $\frac{A}{2}$, its speed is u .
- What is the speed of the particle when it passes the equilibrium position?
- A** $\frac{2}{\sqrt{3}} u$ **B** $\sqrt{2} u$ **C** $\sqrt{3} u$ **D** $4 u$
- 15 One mole of monoatomic neon gas has a mass of 20.2 g .
- What is the root mean square (r.m.s.) speed of a neon atom at 30°C ?
- A** 19 m s^{-1} **B** 190 m s^{-1} **C** 610 m s^{-1} **D** $370\,000 \text{ m s}^{-1}$
-