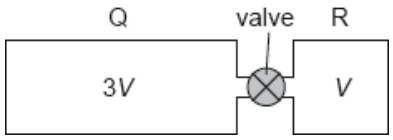
HL Paper 1

Q and R are two rigid containers of volume 3*V* and *V* respectively containing molecules of the same ideal gas initially at the same temperature. The gas pressures in Q and R are *p* and 3*p* respectively. The containers are connected through a valve of negligible volume that is initially closed.



The valve is opened in such a way that the temperature of the gases does not change. What is the change of pressure in Q?

A. $+p$

B. $\frac{+p}{2}$

C. $\frac{-p}{2}$

D. $-p$

Two containers, X and Y, are each filled by an ideal gas at the same temperature. The volume of Y is half the volume of X. The number of moles of gas in Y is three times the number of moles of the gas in X. The pressure of the gas in X is P_X and the pressure of the gas in Y is P_Y.

What is the ratio $\frac{P_X}{P_Y}$?

A. $\frac{1}{6}$

B. $\frac{2}{3}$

C. $\frac{3}{2}$

D. 6

What are the conditions of temperature and pressure at which the behaviour of a real gas approximates to the behaviour of an ideal gas?

A. Low pressure and low temperature
B. Low pressure and high temperature
C. High pressure and low temperature
D. High pressure and high temperature

Which of the following is numerically equal to the specific heat capacity of the substance of a solid body?

A. The thermal energy required to melt the body

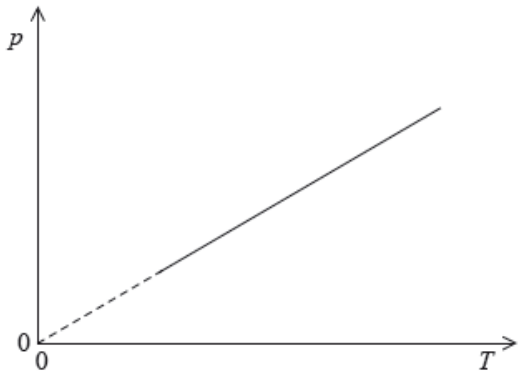
B. The thermal energy required to increase the temperature of unit mass of the body by 1K

C. The thermal energy required to increase the temperature of the body by 1K

D. The total kinetic and potential energy of all the molecules in the body

---

The graph shows the variation with absolute temperature T of the pressure p of a fixed mass of an ideal gas.



Which of the following is correct concerning the volume and the density of the gas?

	Volume	Density
A.	constant	constant
B.	constant	increasing
C.	increasing	constant
D.	increasing	increasing

An ideal gas has a volume of 15 ml, a temperature of 20 °C and a pressure of 100 kPa. The volume of the gas is reduced to 5 ml and the temperature is raised to 40 °C. What is the new pressure of the gas?

A. 600 kPa

B. 320 kPa

C. 200 kPa

D. 35 kPa

The molar mass of magnesium is 24g. 12g of magnesium contains the same number of particles as

A. 6 g of carbon-12.

B. 12 g of carbon-12.

C. 24 g of carbon-12.

D. 6.02×10^{23} g of carbon-12.

Two objects are in thermal contact, initially at different temperatures. Which of the following determines the transfer of thermal energy between the objects?

I. The mass of each object
II. The thermal capacity of the objects
III. The temperature of the objects

A. I only

B. I and II only

C. II and III only

D. III only

An ideal gas and a solid of the same substance are at the same temperature. The average kinetic energy of the gas molecules is E_{g} and the average kinetic energy of the solid molecules is E_{s}. What is the comparison between E_{g} and E_{g}?

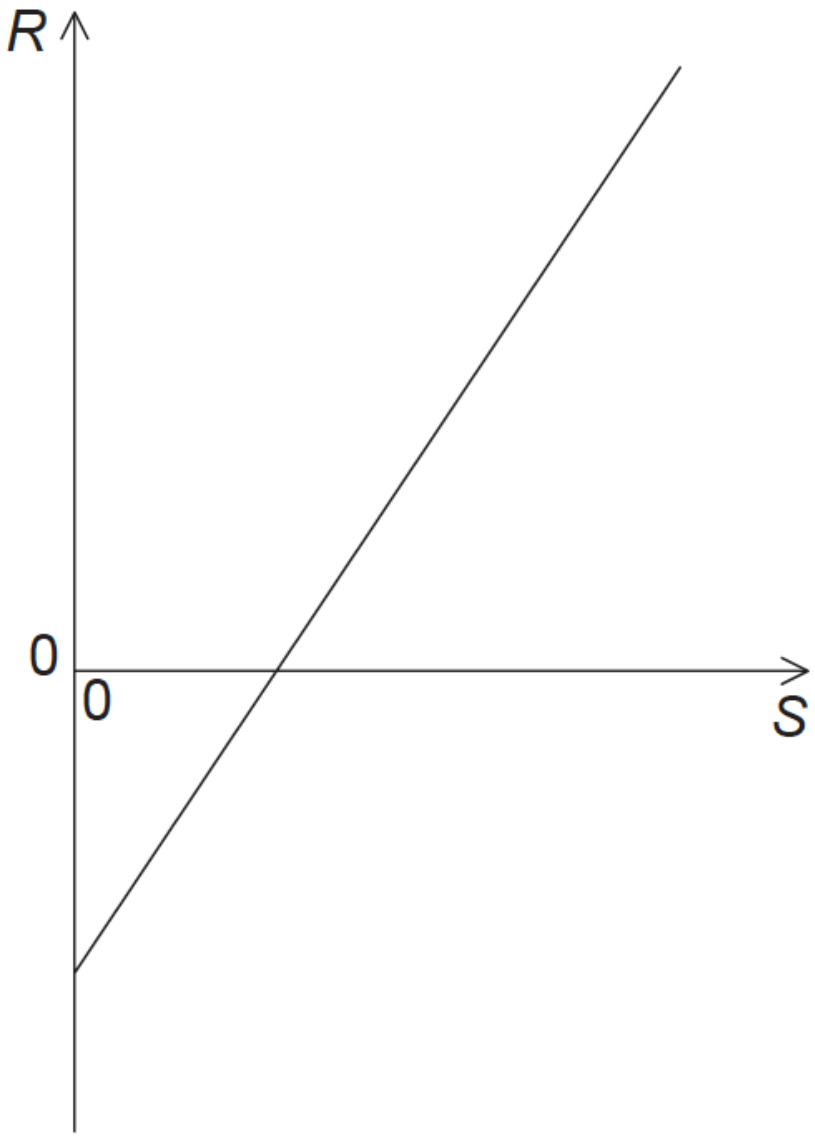
A. E_{g} is less than E_{s}.

B. E_{g} equals E_{s}.

C. E_{g} is greater than E_{s}.

D. The relationship between E_{g} and E_{s} cannot be determined.

A fixed mass of an ideal gas has a constant volume. Two quantities, *R* and *S*, of the gas vary as shown by the graph below.



What quantities do *R* and *S* represent?

	R	***S***
A.	pressure	temperature in kelvin
B.	pressure	temperature in degree Celsius
C.	temperature in kelvin	pressure
D.	temperature in degree Celsius	pressure

A fixed mass of an ideal gas is at temperature T. The pressure is doubled and the volume is halved. What is the temperature after these changes?

A. $\frac{T}{2}$

B. T

C. $2T$

D. $4T$

The fraction of the internal energy that is due to molecular vibration varies in the different states of matter. What gives the order from highest fraction to lowest fraction of internal energy due to molecular vibration?

A. liquid > gas > solid

B. solid > liquid > gas

C. solid > gas > liquid

D. gas > liquid > solid

Which of the following correctly identifies the properties of the molecules of a substance that determine the substance's internal energy?

A. The total potential energy and random kinetic energy
B. The random kinetic energy
C. The total gravitational potential energy and random kinetic energy
D. The total potential energy

Unpolarized light of intensity I_0 is incident on a polarizing filter. Light from this filter is incident on a second filter, which has its axis of polarization at 30° to that of the first filter.

The value of $\cos 30^\circ$ is $\frac{\sqrt{3}}{2}$. What is the intensity of the light emerging through the second filter?

A. $\frac{\sqrt{3}}{2}I_0$

B. $\frac{3}{2}I_0$

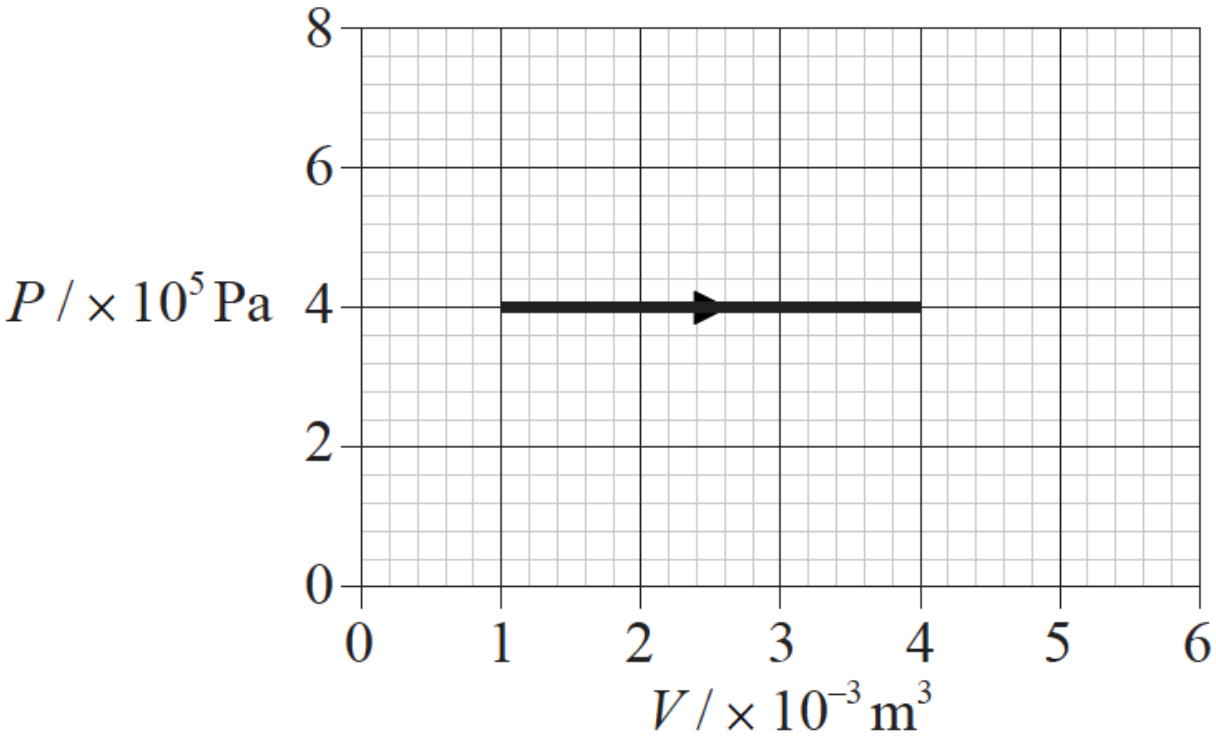
C. $\frac{3}{4}I_0$

D. $\frac{3}{8}I_0$

A fixed mass of an ideal gas undergoes an isochoric (isovolumetric) change. This increases the pressure of the gas. Which describes the change of internal energy of the gas and the direction of transfer of thermal energy?

	Internal energy	Direction of transfer of thermal energy
A.	increase	to the gas
B.	increase	from the gas
C.	decrease	to the gas
D.	decrease	from the gas

An ideal gas expands at constant pressure. The graph shows the relationship between pressure *P* and volume *V* for this change.



The change in the internal energy of the gas during this expansion is 1800 J. What is the amount and the direction of thermal energy transferred?

A. 3000 J into the gas
B. 3000 J out of the gas
C. 600 J into the gas
D. 600 J out of the gas

The behaviour of a monatomic gas such as helium will approximate to that of an ideal gas when it is kept at

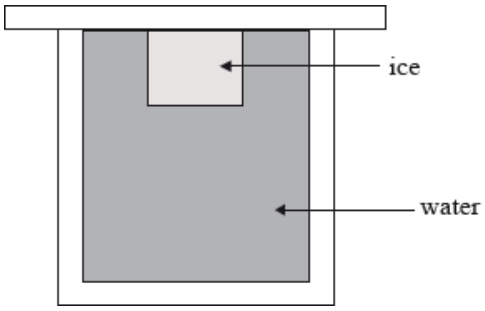
A. a temperature close to absolute zero.

B. low pressure.

C. very high pressure.

D. very high temperature.

Water at a temperature of 0 °C is kept in a thermally insulated container. A lump of ice, also at 0 °C, is placed in the water and completely submerged.



Which of the following is true in respect of both the net amount of ice that will melt and the change in temperature of the water?

	Net amount of ice that melts	Change in temperature of water
A.	all will melt	no change
B.	some will melt	decrease
C.	none will melt	no change
D.	all will melt	decrease

An ice cube and an iceberg are both at a temperature of 0 °C. Which of the following is a correct comparison of the average random kinetic energy and the total kinetic energy of the molecules of the ice cube and the iceberg?

	Average random kinetic energy	Total kinetic energy
A.	same	same
B.	same	different
C.	different	same
D.	different	different

The behaviour of real gases is different from that predicted for ideal gases. Which of the following statements about real gases is **not** correct?

A. Gas molecules have potential energy.

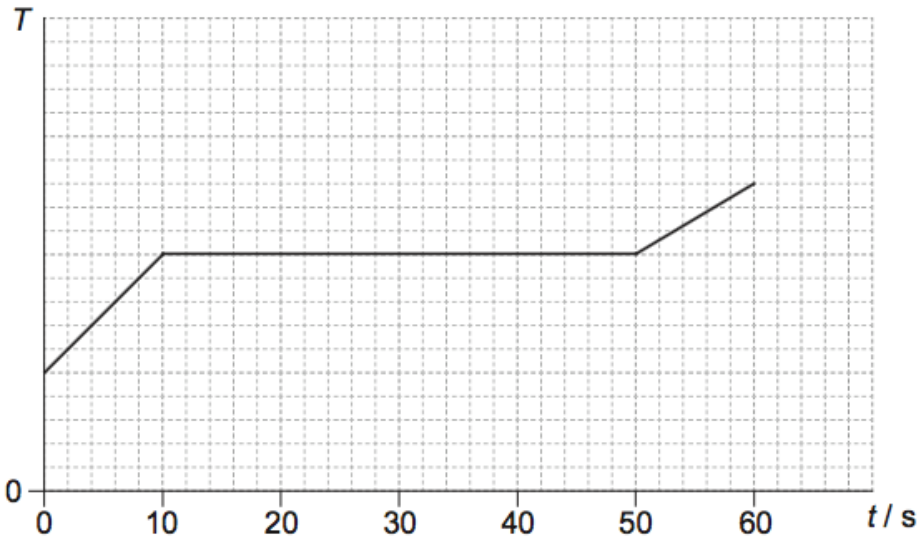
B. Forces between gas molecules are always negligible.

C. Gas molecules have volume.

D. Real gases can liquefy.

A container with 0.60kg of a liquid substance is placed on a heater at time *t=0*. The specific latent heat of vaporization of the substance is 200kJkg^{-1}.

The graph shows the variation of the temperature *T* of the substance with time *t.*



What is the power of the heater?

A. 1200 W

B. 3000 W

C. 4800 W

D. 13 300 W
