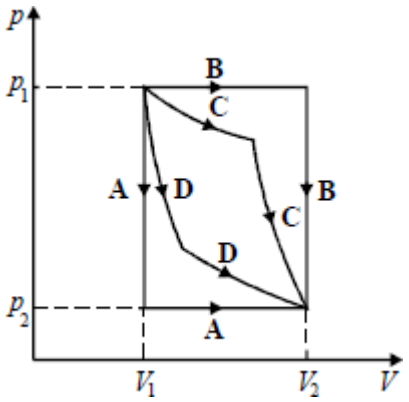
Thermal Energy Transfer

TOPIC QUESTIONS

Level	A Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min

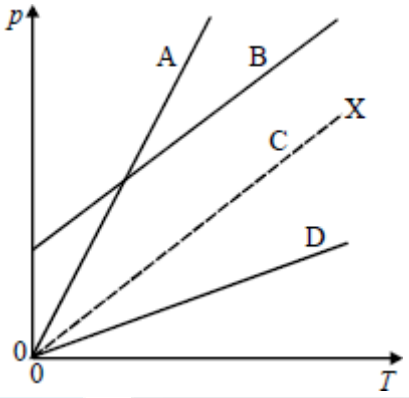
1. The diagram shows a p-V graph for a fixed mass of gas. The volume increases from V_1 to V_2 while the pressure falls from p_1 to p_2.



Which one of the paths **A**, **B**, **C** or **D** will result in the greatest amount of work being done by thegas?

2. In the diagram the dashed line **X** shows the variation of pressure, p, with absolute temperature, T, for 1 mol of an ideal gas in a container of fixed volume.

   Which line, **A**, **B**, **C** or **D** shows the variation for 2 mol of the gas in the same container?



3. A raindrop of mass m falls to the ground at its terminal speed v. The specific heat capacity of wateris c and the acceleration of free fall is g. Given that 25% of the energy is retained in the raindrop when it strikes the ground, what is the rise in temperature of the raindrop?

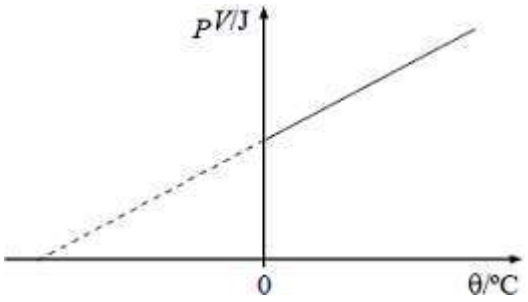
   A $\frac{mv^2}{8c}$

   B $\frac{v^2}{4mc}$

   C $\frac{mg}{4c}$

   D $\frac{v^2}{8c}$

4. The graph shows the relation between the product *pressure* × *volume*, pV, and temperature, θ, indegrees celsius for 1 mol of an ideal gas for which the molar gas constant is R.



Which one of the following expressions gives the gradient of this graph?

A $\frac{1}{273}$

B $\frac{pV}{\theta}$

C $\frac{pV}{(\theta - 273)}$

D R

5. At a certain temperature, the root-mean-square speed of the molecules of a fixed volume of anideal gas is c. The temperature of the gas is changed so that the pressure is halved. The root-mean-square speed of the molecules becomes

A $\frac{c}{4}$

B $\frac{c}{2}$

C $\frac{c}{\sqrt{2}}$

D 2c

6. Which statement is true about an experiment where Brownian motion is demonstrated usingsmoke particles in air?

A The experiment makes it possible to see the motion of air molecules.

B The motion is caused by the collisions of smoke particles with each other.

C The motion is caused by collisions between air molecules and smoke particles.

D The motion occurs because air is a mixture of gases and the molecules have different masses.

7. Which is **not** an assumption about gas particles in the kinetic theory model for a gas?

A They collide elastically with the container walls.

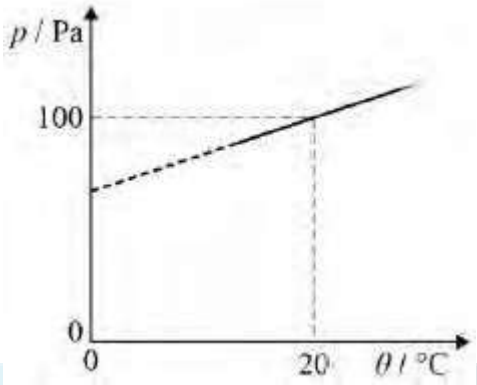
B They have negligible size compared to the distance between the container walls.

C They travel between the container walls in negligibly short times.

D They collide with the container walls in negligibly short times.

8. The graph shows the variation of pressure p with temperature θ for a fixed mass of an ideal gasat constant volume.

What is the gradient of the graph?



A 0.341

B 0.395

C 2.93

D 5.00

9. Two flasks **X** and **Y** are filled with an ideal gas and are connected by a tube of negligible volume compared to that of the flasks. The volume of **X** is twice the volume of **Y**.
X is held at a temperature of 150 K and **Y** is held at a temperature of 300 K

What is the ratio $\frac{\text{mass of gas in X}}{\text{mass of gas in Y}}$?

A 0.125

B 0.25

C 4

D 8

10. The average mass of an air molecule is 4.8×10^{-26} kg

What is the mean square speed of an air molecule at 750 K?

A 3.3×10^{5} m^{2} s^{-2}

B 4.3×10^{5} m^{2} s^{-2}

C 6.5×10^{5} m^{2} s^{-2}

D 8.7×10^{5} m^{2} s^{-2}

11. A liquid flows continuously through a chamber that contains an electric heater. When the steady state is reached, the liquid leaving the chamber is at a higher temperature than the liquid entering the chamber. The difference in temperature is Δt.

Which of the following will increase Δt with no other change?

A Increasing the volume flow rate of the liquid

B Changing the liquid to one with a lower specific heat capacity

C Using a heating element with a higher resistance

D Changing the liquid to one that has a higher density

12. The temperature of a hot liquid in a container falls at a rate of 2 K per minute just before it begins tosolidify. The temperature then remains steady for 20 minutes by which time all the liquid has all solidified.

What is the quantity $\frac{\text{Specific heat capacity of the liquid}}{\text{Specific latent heat of fusion}}$?

A $\frac{1}{40}\,\text{K}^{-1}$

B $\frac{1}{10}\,\text{K}^{-1}$

C $10\ \text{K}^{-1}$

D $40\ K^{-1}$

13. A fixed mass of gas occupies a volume V. The temperature of the gas increases so that the rootmean square velocity of the gas molecules is doubled.
What will the new volume be if the pressure remains constant?

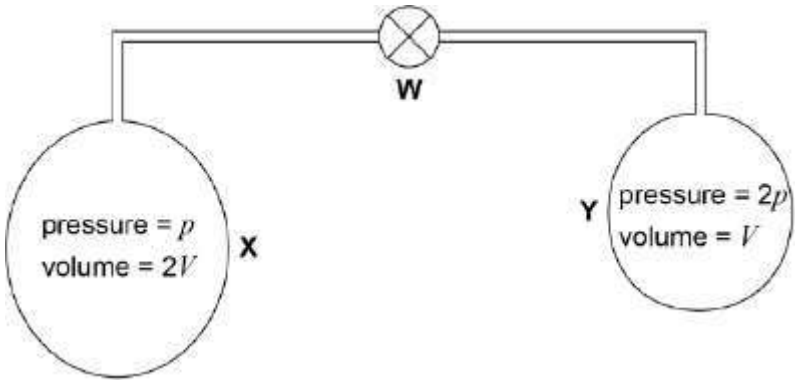
A $\frac{V}{2}$

B $\frac{V}{\sqrt{2}}$

C $2V$

D $4V$

14. X and Y are two gas bottles that are connected by a tube that has negligible volume compared withthe volume of each bottle.



Initially the valve W is closed.

X has a volume $2V$ and contains hydrogen at a pressure of p. Y has a volume V and contains hydrogen at a pressure of $2p$. X and Y are both initially at the same temperature.

W is now opened. Assuming that there is no change in temperature, what is the new gaspressure?

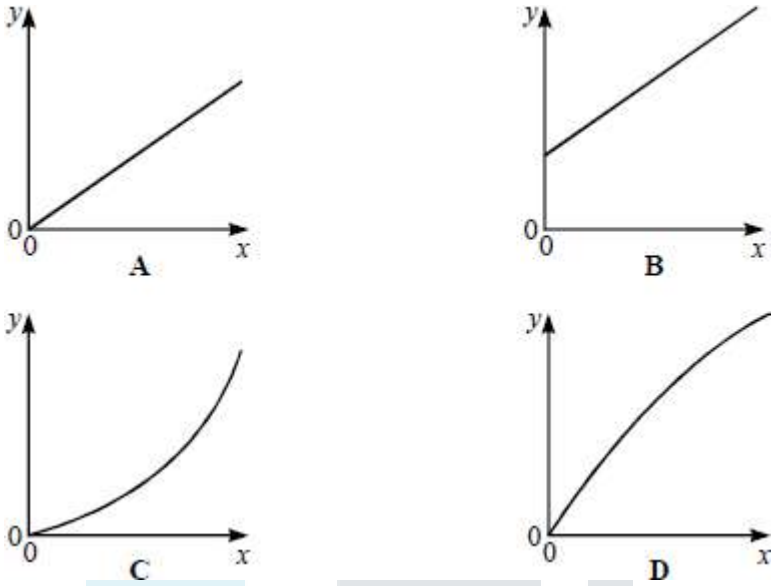
A $\frac{2}{3}p$

B $\frac{5}{3}p$

C $\frac{4}{3}p$

D $\frac{3}{2}p$

15. Which one of the graphs below shows the relationship between the internal energy of an ideal gas (*y*-axis) and the absolute temperature of the gas (*x*-axis)?



16. A solar panel transfers energy at a rate of 1.2 kW to liquid passing through it. The liquid has aspecific heat capacity of 4.0 kJ kg^{-1} K^{-1}.

When the liquid flows through the solar panel, its temperature increases by 3.0 K.The

flow rate of the liquid is

A 0.10 kg s^{-1}.

B 1.1 kg s^{-1}.

C 10 kg s^{-1}.

D 100 kg s^{-1}.

17. A gas occupies a volume V. Its particles have a root mean square speed (c_{rms}) of u.The gas is compressed at constant temperature to a volume $0.5V$.

What is the root mean square speed of the gas particles after compression?

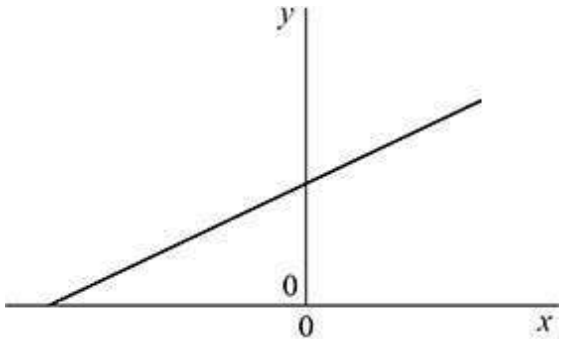
A $\frac{u}{2}$

B u

C $2u$

D 4u

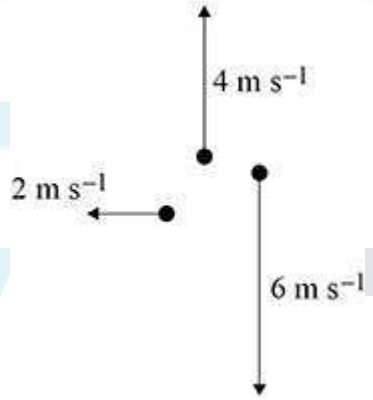
18. A fixed mass of gas is heated at constant volume. The graph is drawn for this process.



What do x and y represent?

	x	y
A	pressure in Pa	temperature in ºC
B	temperature in ºC	pressure in Pa
C	pressure in Pa	temperature in K
D	temperature in K	pressure in Pa

19. Three particles are travelling in the same plane with velocities as shown in the vector diagram.



What is the root mean square speed of the particles?

A 4.3 m s^{-1}

B 7.5 m s^{-1}

C 19 m s^{-1}

D 56 m s^{-1}

20. An ideal gas is contained in a cubical box of side length a. The gas has N molecules each ofmass m.

What is the pressure exerted by the gas on the walls of the box?

A $\frac{mNa^3}{2} \times c_{rms}^2$ **B** $\frac{mNa^2}{2} \times c_{rms}^2$ **C** $\frac{mN}{3a^2} \times c_{rms}^2$ **D**