1. A solar panel transfers energy at a rate of 1.2 kW to liquid passing through it. The liquid has a specific 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}. ⬭

(Total 1 mark)

2. 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 $\frac{u}{2}$ ⬭

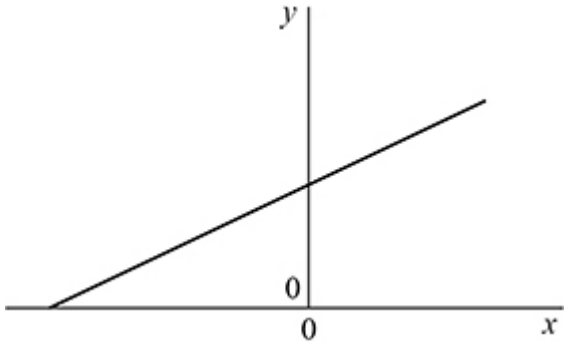
B u ⬭

C $2u$ ⬭

D $4u$ ⬭

(Total 1 mark)

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

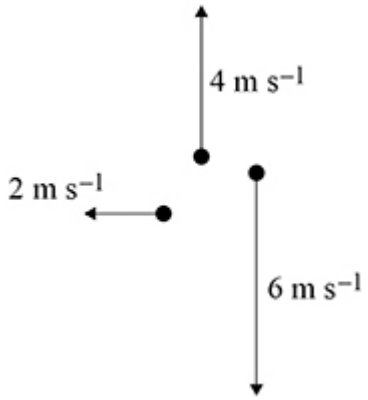


What do x and y represent?

	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	⬭

(Total 1 mark)

4. 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} ⬭

(Total 1 mark)

5. An ideal gas is contained in a cubical box of side length a. The gas has N molecules each of mass 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 $\frac{mN}{3a^3} \times c_{rms}^2$ ⬭

(Total 1 mark)

6. Which statement is true about an experiment where Brownian motion is demonstrated using smoke 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. ⬭

(Total 1 mark)

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. ⬭

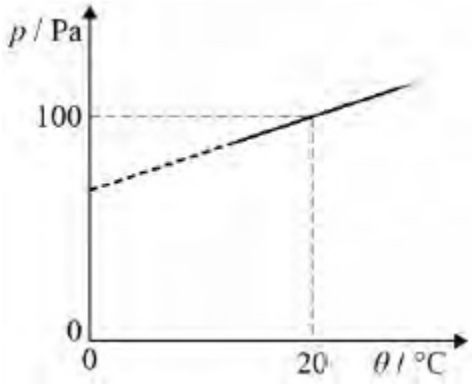
C They travel between the container walls in negligibly short times. ⬭

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

(Total 1 mark)

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

What is the gradient of the graph?



A 0.341 ⬭

B 0.395 ⬭

C 2.93 ⬭

D 5.00 ⬭

(Total 1 mark)

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 ⬭

(Total 1 mark)

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} ⬭

(Total 1 mark)

11. A transparent illuminated box contains small smoke particles and air.
The smoke particles are observed to move randomly when viewed through a microscope.

What is the cause of this observation of Brownian motion?

A Smoke particles gaining kinetic energy by the absorption of light. ⬭

B Collisions between smoke particles and air molecules. ⬭

C Smoke particles moving in convection currents caused by the air being heated by the light. ⬭

D The smoke particles moving randomly due to their temperature. ⬭

(Total 1 mark)

12. A continuous stream of water falls through a vertical distance of 100 m.
Assume no thermal energy is transferred to the surroundings.
The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

What is the temperature difference of the water between the top and bottom of the waterfall?

A 0.023 K ⬭

B 0.23 K ⬭

C 2.3 K ⬭

D 4.3 K ⬭

(Total 1 mark)

13. A student measures the power of a microwave oven. He places 200 g of water at 23 °C into the microwave and heats it on full power for 1 minute. When he removes it, the temperature of the water is 79 °C.

The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

What is the average rate at which thermal energy is gained by the water?

A 780 W ⬭

B 840 W ⬭

C 1.1 kW ⬭

D 4.6 kW ⬭

(Total 1 mark)

14. Which of the following is **not** used as valid assumption when deriving the equation $P = \frac{1}{3} Nm (c_{rms})^2$ in the simple kinetic theory of gases?

A The molecules suffer negligible change of momentum on collision with the walls of the container. ⬭

B Attractive forces between molecules are negligible. ⬭

C The duration of a collision is negligible compared with the time between collisions. ⬭

D The volume of the molecules is negligible compared with the volume of the gas. ⬭

(Total 1 mark)

15. 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 ⬭

(Total 1 mark)

16. What is the total internal energy of 2.4 mol of an ideal gas which has a temperature of 15 °C?

A 6.0×10^{-21} J ⬭

B 1.4×10^{-20} J ⬭

C 4.5×10^{2} J ⬭

D 8.6×10^{3} J ⬭

(Total 1 mark)

17. The composition of a carbon dioxide (CO_2) molecule is one atom of ${}^{12}_{6}C$ and two atoms of ${}^{16}_{8}O$.

What is the number of molecules of CO_2 in 2.2 kg of the gas?

A 1.0×10^{22} ⬭

B 3.0×10^{22} ⬭

C 3.0×10^{25} ⬭

D 4.7×10^{25} ⬭

(Total 1 mark)

18. Brownian motion

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

B is caused by the collisions of smoke particles. ⬭

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

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

(Total 1 mark)

19. A sample **P** of an ideal gas contains 1 mol at an absolute temperature T.

A second sample **Q** of an ideal gas contains $\frac{2}{3}$ mol at an absolute temperature $2T$.

The total molecular kinetic energy of **P** is E.

What is the total molecular kinetic energy of **Q**?

A $\frac{2}{3}E$ ⬭

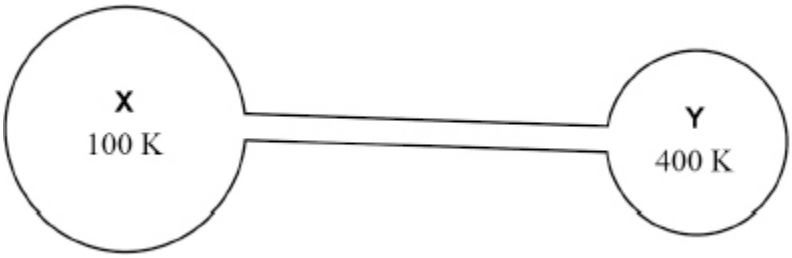
B $\frac{3}{4}E$ ⬭

C $\frac{4}{3}E$ ⬭

D $\frac{3}{2}E$ ⬭

(Total 1 mark)

20. The diagram shows two flasks **X** and **Y** connected by a thin tube of negligible volume.



The flasks contain an ideal gas.

The volume of **X** is twice the volume of **Y**. When **X** is at a temperature of 100 K and **Y** is at a temperature of 400 K there is no net transfer of particles between the flasks.

X contains gas of mass *m*.

What is the mass of gas in **Y**?

A $\frac{m}{8}$ ⬭

B $\frac{m}{2}$ ⬭

C $2m$ ⬭

D $8m$ ⬭

(Total 1 mark)

21. When an ideal gas at a temperature of 27 °C is suddenly compressed to one quarter of its volume, the pressure increases by a factor of 7

What is the new temperature of the gas?

A 15 °C ⬭

B 47 °C ⬭

C 171 °C ⬭

D 252 °C ⬭

(Total 1 mark)