

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 $4.0 \text{ kJ kg}^{-1} \text{ K}^{-1}$.

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 $2u$

☐

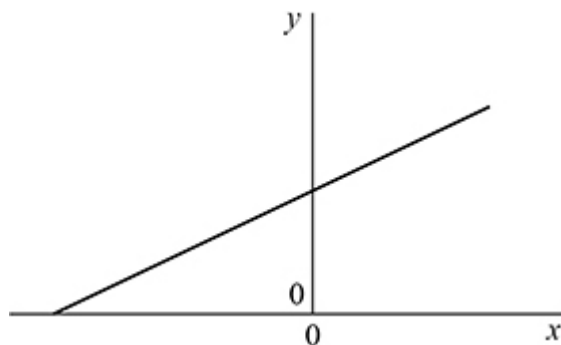
D $4u$

☐

(Total 1 mark)

3.

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



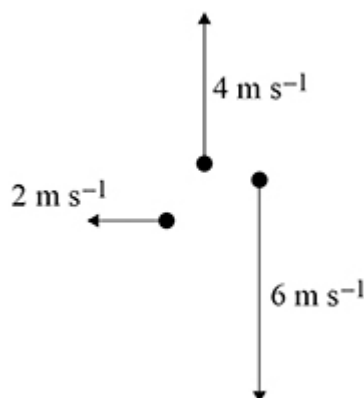
What do x and y represent?

	x	y	
A	pressure in Pa	temperature in $^{\circ}\text{C}$	☐
B	temperature in $^{\circ}\text{C}$	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 $\frac{mNa^3}{2} \times c_{\text{rms}}^2$ ☐

B $\frac{mNa^2}{2} \times c_{\text{rms}}^2$ ☐

C $\frac{mN}{3a^2} \times c_{\text{rms}}^2$ ☐

D $\frac{mN}{3a^3} \times c_{\text{rms}}^2$ ☐

(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. ☐

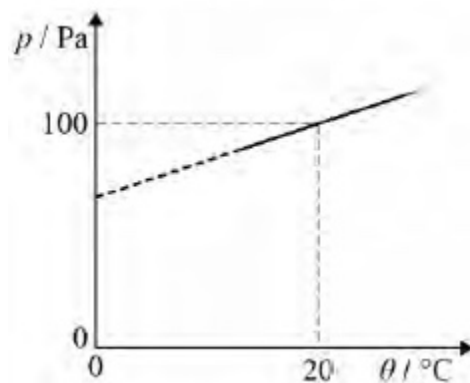
D They collide with the container walls in negligibly short times. ☐

(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 $3.3 \times 10^5 \text{ m}^2 \text{ s}^{-2}$

☐

B $4.3 \times 10^5 \text{ m}^2 \text{ s}^{-2}$

☐

C $6.5 \times 10^5 \text{ m}^2 \text{ s}^{-2}$

☐

D $8.7 \times 10^5 \text{ m}^2 \text{ s}^{-2}$

☐

(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 $4200 \text{ J kg}^{-1} \text{ K}^{-1}$.

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

$$P = \frac{1}{3} Nm (c_{\text{rms}})^2 \text{ in the simple kinetic theory of gases?}$$

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 $^{12}_6\text{C}$ and two atoms of $^{16}_8\text{O}$.

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 $\frac{4}{3}E$

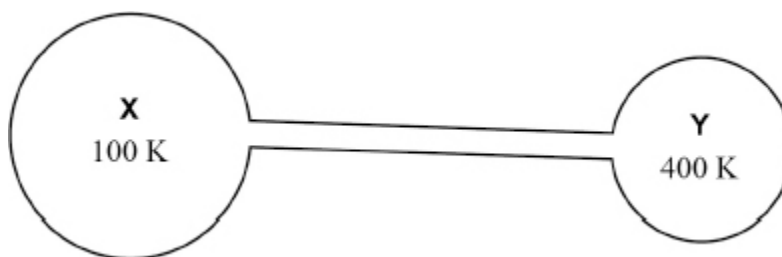
☐

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)