Do not write outside the box

0 3 **Figure 4** and **Figure 5** show apparatus used in an experiment to confirm the distribution of atom speeds in a gas at a particular temperature.

Figure 4

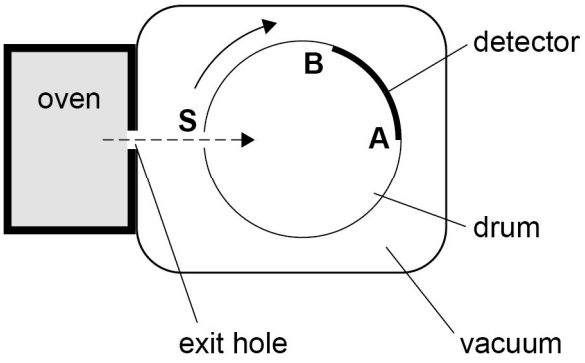
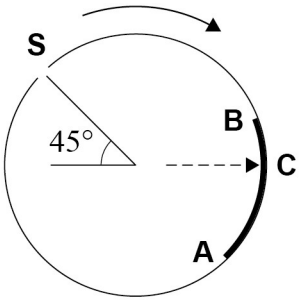


Figure 5



The oven contains an ideal gas kept at a constant temperature. Atoms of the gas emerge from the oven and some pass through the narrow slit **S** in a rapidly rotating drum. The drum is in a vacuum.

0 3 . 1 Explain why the drum must be in a vacuum.

[1 mark]

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One atom leaves the oven, enters the drum through **S** and travels in a straight line across the drum.
In the time taken for the atom to move from **S** to the detector **AB**, the drum rotates through $45°$. The atom hits the detector at point **C**, as shown in **Figure 5**.

drum diameter = distance from **S** to **A** = $0.500\ \text{m}$
drum rotational speed = 120 revolutions per second

0 3 . 2 Show that the atom is moving at a speed of about $500\ \text{m s}^{-1}$.

[2 marks]

0 3 . 3 The speed of the atom in Question **03.2** is equal to c_{rms}, the root mean square speed of the atoms of the gas in the oven.
The molar mass of the gas is $0.209\ \text{kg mol}^{-1}$.

Calculate the temperature of the gas in the oven.

[3 marks]

temperature = _____ K

Question 3 continues on the next page

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0 3 . 4 The oven temperature is kept constant during the experiment but the pressure in the oven decreases as atoms leave through the exit hole.

Explain, using the kinetic theory, why the pressure decreases.

[2 marks]

0 3 . 5 The pressure of gas in the oven is initially 5.0×10^4 Pa.
The volume of the oven is 2.7×10^{-2} m^3.
During the experiment the pressure in the oven decreases to 4.5×10^4 Pa.

Calculate, in mol, the amount of gas that has emerged from the oven.

[1 mark]

amount of gas = _____ mol

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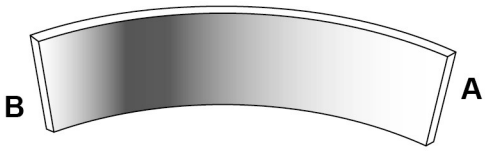
0 3 . 6 Atoms enter the drum every time **S** passes the exit hole. The detector darkens at the point where an atom strikes it.
After a time, the detector is removed from the drum.
Figure 6 shows the appearance of the detector.

Figure 6



A new detector is placed in the drum and the experiment is repeated with a new sample of the same gas at a higher temperature.

Describe and explain the appearance of this detector when the experiment is repeated.

[2 marks]

11

Turn over for the next question

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Section B

Each of Questions **07** to **31** is followed by four responses, **A**, **B**, **C** and **D**.

For each question select the best response.

Only **one** answer per question is allowed.
For each question, completely fill in the circle alongside the appropriate answer.

CORRECT METHOD  WRONG METHODS 

If you want to change your answer you must cross out your original answer as shown. 

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. 

You may do your working in the blank space around each question but this will not be marked. Do **not** use additional sheets for this working.

0 7 A solar panel transfers energy at a rate of $1.2\ \text{kW}$ 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 $3.0\ \text{K}$.

The flow rate of the liquid is

[1 mark]

A $0.10\ \text{kg s}^{-1}$. 

B $1.1\ \text{kg s}^{-1}$. 

C $10\ \text{kg s}^{-1}$. 

D $100\ \text{kg s}^{-1}$. 

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0 8 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?

[1 mark]

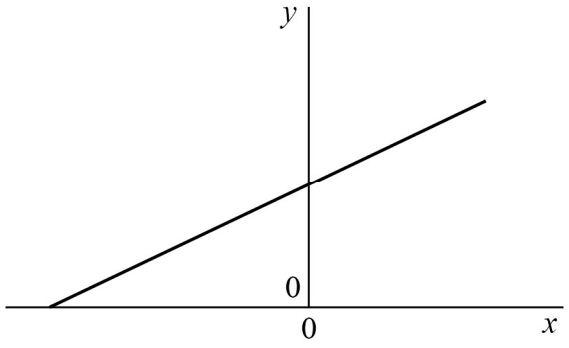
A $\frac{u}{2}$ ⬭

B u ⬭

C $2u$ ⬭

D $4u$ ⬭

0 9 A fixed mass of gas is heated at constant volume. The graph is drawn for this process.



What do x and y represent?

[1 mark]

	x	*y*	
A	pressure in Pa	temperature in °C	⬭
B	temperature in °C	pressure in Pa	⬭
C	pressure in Pa	temperature in K	⬭
D	temperature in K	pressure in Pa	⬭

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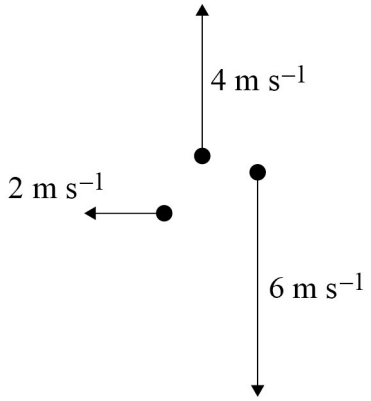
1 0 Three particles are travelling in the same plane with velocities as shown in the vector diagram.



What is the root mean square speed of the particles?

[1 mark]

A 4.3 m s^{-1} ⬭

B 7.5 m s^{-1} ⬭

C 19 m s^{-1} ⬭

D 56 m s^{-1} ⬭

Turn over for the next question