Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

(a) Any two from ✔✔
- Volume of molecules/particles is negligible/small compared to the volume of the container
- Collision time is negligible/small compared to the time between collisions
- Collisions are elastic or kinetic energy is conserved
- There are negligible/no forces between molecules/particles except during collisions

Reference to the volume occupied by the gas must be clear for the first point. So 'volume of gas' is not enough.
Condone missing reference to "except during collisions" in bullet 4.
Condone "Newtonian mechanics apply".

2

(b) There is a change in velocity/momentum for the molecules (at the wall) because the direction has changed ✔$_1$
Relates MP1 to Newton I OR II ✔$_2$

The essence of the Newton law must be given in the context of the gas.
Just quoting a Newton law is not enough for a mark.

(Uses Newton III to) link the force on the wall and the force on the molecule ✔$_3$

Do not accept "rate of change of momentum" in MP1.
Condone "bounces from wall" for "changes direction".
Collision is not a change in direction.
Accept reference to changing velocity/momentum/direction in MP2.

3

(c) Use of $E_k = \frac{3}{2} kT$ to find a temperature
OR
Using
$pV = \frac{1}{3} Nm (C_{rms})^2$ with $E_k = \frac{1}{2} m (C_{rms})^2$ to find N ✔$_1$

✔$_1$ $T = \frac{\frac{2}{3} \times \frac{6.7 \times 10^{-21}}{1.38 \times 10^{-23}}}{}$ = 324 K

Correct substitution into $PV = nRT$ to find n
OR

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Correct substitution into $N = \frac{3}{2}\frac{PV}{E_k}$ to find N (= 1.7 × 10^{25}) ✔2

✔2 *for use of the equation.*

n = $\left(\frac{PV}{RT} = \frac{220\times10^3\times0.35}{8.31\times324}\right)$ or $N = \frac{3}{2}\times\frac{220\times10^3\times0.35}{6.7\times10^{-21}}$

amount of gas = 29 (mol) ✔3 (28.6 mol)

✔3 *no ecf, correct answer only*

If no other marks are awarded, award one mark:

for an unsupported final answer of 1.7 × 10^{25} which is the number of molecules.

OR

for converting a number of molecules into moles using their

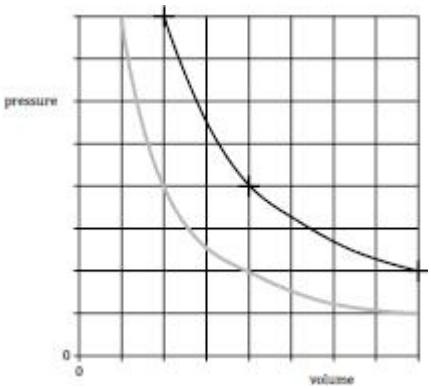
n = $\frac{N}{N_A}$

3

(d) Drawn graph with concave shape always above existing graph passing through at least one of the data points. (data points are shown as crosses on the graph) ✔

Passing through coordinates (2,8), (4,4) and (8,2) ✔
(coordinates refer to cm intervals on the graph)

Drawn line must be ± 1 small square (2 mm) of a data point to count.



Condone a poor quality line.

2

[10]

Q2.

(a) (If not in a vacuum) gas atoms will collide with air atoms, changing their direction or speed distribution. ✔

There must be some indication of a change of the oven gas molecules associated with collisions

If temperature change is mentioned this must be related to speed distribution for the mark

1

(b) Finds time taken for one rev AND/OR time for 1/8 rev ✔

(Uses speed = distance/time to get)

= 0.500 / 1.04 × 10^{-3} = 480 m s^{-1} ✔

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(so about 500 m s^{-1})

1 rev in 1/120 s or 0.00833 s

Time for 45º or 1/8 rev = 1.04 × 10^{-3} s

Must have 2 or more sf answer but 500 m s^{-1} is acceptable as a final answer provided the calculated time for 45º or 1/8 rev is shown and rounded down to 2 sf

2

(c) Mass of one atom = m = 0.209/NA = 3.47 × 10^{-25} kg ✔1

✔1 *May be seen in the substitution of the equation that follows*

✔2 $\frac{m}{3k}$ *(answer (b))*^{2}

Substitutes m and answer (b) in ½$m(c_{rms})^2$ = $\frac{3}{2}kT$ kT and rearranges ✔2

T = 1930 K ✔3

✔3 *Accept 2095 K or 2100 K if 500 m s^{-1} used*

A correct answer also gains the second mark

3

(d) (Pressure is due to collisions of atoms with oven walls) With fewer atoms fewer collisions <u>per second</u> ✔1a

✔1a *There must be a reference to frequency or rate of collision*

but average momentum change per collision stays the same
or
therefore the total momentum change per second falls (so pressure drops) ✔2a

OR

Reference to $pV = \frac{1}{3}Nm(c_{rms})^2$ ✔1b

c_{rms} is constant as T is constant hence p ✔ N (so pressure drops) ✔2b

✔1b *The equation may be in any equivalent kinetic theory form*

$pV = nRT$ *is not acceptable unless a connection is made between* T *and* c_{rms}

2

(e) ($pV = nRT$)

leaked $n = \frac{V((p_1 - p_2)}{RT}$ ✔

= 8.42 × 10^{-3} mol

ecf for T *from* ***(c)***

1

(f) At higher temp atoms will be faster (so drum will not have turned as far) ✔1a

Darkest area will be closer to A ✔2a

✔1 *Accept drawing but allow any degree of maximum darkness. The drawing may be flat or curved.*



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Allow

more atoms will pass through S as it passes the oven, for the first mark

making the dark patch darker, for the second mark. This must be linked to the more atoms

2

[11]

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