

Name of the Student: \_\_\_\_\_

Max. Marks : 22 Marks

Time : 22 Minutes

Mark Schemes

**Q1.**

(a) (i) Use of  $V = \pi r^2 L$

$3.47 \times 10^{-2}$  or  $3.5 \times 10^{-2}$  (m)

*Sub including V and L (condone L=18)*

*Or rearrangement to make r subject of correct equation*

*Condone power 10 error on L*

*1 mark for following answers*

$1.7 \times 10^{-2}$ ,  $1.7 \times 10^{-3}$ ,  $3.5 \times 10^{-3}$  (m)

2

(ii) Use of  $pV = NkT$  or  $T = 19 + 273$  or  $T = 292$  seen

Allow rearrangement making N subject  $N = \frac{pV}{kT}$

Correct use of  $pV = NkT$  substitution

$4.26 \times 10^{21}$  seen or  $4.3 \times 10^{21}$  seen

*Condone sub of 19 for T for 1st mark in either method*

*Or (N =)  $\frac{1.01 \times 10^5 \times 1.7 \times 10^{-4}}{1.38 \times 10^{-23} \times 292}$  seen with  $pV = NkT$  seen*

*Alternative use of  $pV = nRT$  **and**  $N = nN_A$  in first and second marks*

*First mark condone  $T = 19$*

*Second mark  $pV = nRT$  seen with use of and  $7(.08) \times 10^{-3} \times 6(.02) \times 10^{23}$  seen*

3

(iii) ( $NV =$ )  $1.7 \times 10^{-4} \times 7 \times 10^{-4}$  or  $1.19 \times 10^{-7}$  seen

$2.76 \times 10^{-29}$  to  $3.0 \times 10^{-29}$  (m<sup>3</sup>) condone 1 sf here

*Penalise where product does not equal  $1.19 \times 10^{-7}$*

2

- (iv) • the volume of molecule(s) is negligible **compared to** volume occupied by gas
- the particles are far apart / large spaces between particles (compared to their diameter)
- **Therefore** Time during collisions is negligible compared to time between collision
- **Therefore** intermolecular forces are negligible
- Allow volume of one molecule is negligible compared to total volume*

Max 3

- (b) Use of  $\frac{1}{2} m \langle c^2 \rangle = \frac{3}{2} kT$  sub or rearrangement  
 Condone  $c_{rms}$  as subject for 1 mark  
 Condone power 10 error  
 Condone  $T = 19$  in 1st MP  
 Correct sub with  $\langle c^2 \rangle$  as subject including correct power 10  
 $2.57 \times 10^5$  or  $2.6 \times 10^5$  (on answer line)  
 $m^2 s^{-2}$

*Alternatively:*

*use of  $pV = \frac{1}{3} Nm \langle c^2 \rangle$  sub or rearrangement*

*Condone  $c_{rms}$  as subject for 1 mark*

*Condone power 10 error*

*Condone  $T = 19$  in 1st MP*

*Correct sub with  $\langle c^2 \rangle$  as subject including correct power 10*

*$2.7(4) \times 10^5$  (from  $N = 4 \times 10^{21}$ ) (on answer line)*

*$2.57 \times 10^5$  for  $N = 4.26 \times 10^{21}$*

*$2.5(48) \times 10^5$  for  $N = 4.3 \times 10^{21}$*

*$m^2 s^{-2}$*

*condone alternative units where correct:*

*$Pa m^3 kg^{-1}$*

*$J kg^{-1}$*

4

- (c) (i)  $p_1 L_1 = k_1$  and  $p_2 L_2 = k_2$

(consistent power 10)

i.e. 2 sets of **correct** data

seen in sub

allow incomplete sub with 2

similar  $k$  ( $18 \times 10^3$ ) values seen

$$p_1 L_1 = k_1, p_2 L_2 = k_2 \text{ and } p_3 L_3 = k_3$$

(consistent power 10)

i.e. 3 sets of **correct data**

**seen in sub**

Comparison of  $k$  values followed by conclusion

*Presents a factorial of  $L$  leading to an inverse of the factorial change in  $P$  (correct data)*

*Repeats this process for **second** data set for same factorial change (correct data)*

**States** the relationship seen and **states** the conclusion

3

- (ii) Temperature or internal energy

*Allow mass / number of particles / mean square speed (of molecules)*

1

- (d)  $L$  decreases then volume decreases (therefore more particles in any given volume) /  $V = \pi r^2 L$   
 $/ V$  is (directly) proportional to  $L$   
 Decreased volume Increases number of collisions (with walls every second)  
 Decreased volume causes Rate of change of momentum to increase

Increased rate of change of momentum causes force (exerted on walls) to increase (causing an increase in pressure)

*Allow converse argument but must be consistent*

$$p = \frac{\frac{1}{2} N m c^2}{\pi r^2 L} \text{ or equivalent}$$

*must be correct equation with V in terms of L  
with p as subject*