DPP - Daily Practice Problems

Name : Date :

Start Time : End Time :

CHEMISTRY 08

SYLLABUS : States of Matter-1 (Gas laws, ideal gas equation, kinetic theory of gases, concepts of average root mean square and most probable speed)

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 Calculate the weight of CH_4 in a 9 litre cylinder at 16 atm and 27°C (R = 0.08 lit. atm/K).

(a) 96gm (b) 86gm
(c) 80gm (d) 90gm

Q.2 What is the density of sulphur dioxide (SO_2) at STP ?

(a) 2.86 gm/lit (b) 1.76 gm/lit
(c) 1.86gm/lit (d) None of these

Q.3 What is the pressure of a mixture of 1g of dihydrogen and 1.4 g of dinitrogen stored in a 5 litre vessel at 127°C ?

(a) 5.50 atm. (b) 3.61 atm.
(c) 4.40atm. (d) 4.50 atm.

Q.4 0.333 grams of alcohol displaced 171 c.c. of air measured over water at 15°C in a Victor Meyer apparatus. The barometric pressure was 773 torr. Calculate the molecular weight of alcohol - (Aqueous tension at 15°C = 13 torr.)

(a) 33.34 g/ mol. (b) 28.80 g/ mol.
(c) 46.0 g/ mol. (d) 13.0 g/mol.

Q.5 Atmospheric air contains 20% O_2 and 80% N_2 by volume and exerts a pressure of 760 mm. Calculate the partial pressure of each gas.

(a) 152mm, 608mm (b) 608mm, 152mm
(c) 760mm both (d) None of these

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

Q.6 2.8 g of N_2, 2.8 g CO, 4.4 g CO_2 are found to exert a pressure of 700 torr. Find partial pressure of N_2 gas in the mixture.
(a) 280.8 torr (b) 233.3 torr
(c) 300torr (d) None of these

Q.7 Calculate the relative rates of diffusion of $^{235}UF_6$ and $^{238}UF_6$ in the gaseous state (At. mass of F = 19).
(a) 1.0043 : 1.0000 (b) 1.0000 : 1.0043
(c) 1.349 : 1.352 (d) 1.352 : 1.349

Q.8 The densities of CH_4 and O_2 are in the ratio 1 : 2. Calculate the ratio of rates of diffusion of oxygen and methane.
(a) 1.414 : 1 (b) 1: 1.414 (c) 1.614 : 1 (d) 1.614: 1

Q.9 Calculate the molecular weight of a gas which diffuses through a porous plug at 1/6th of the speed of hydrogen under same conditions.
(a) 36 (b) 76 (c) 72 (d) 63

Q.10 The vapour density of gas A is thrice that of the gas B. If the molecular weight of B is M, then calculate the molecular weight of A.
(a) M (b) 3 M
(c) M/3 (d) None of these

Q.11 3 moles of a gas are present in a vessel at a temperature of 27°C. Calculate the value of gas constant (R) in terms of kinetic energy of the molecules of the gas.
(a) 7.4×10^{-4} KE per degree kelvin.
(b) 9.4×10^{-5} KE per degree kelvin.
(c) 4.5×10^{-6} KE per degree kelvin.
(d) None of these

Q.12 Calculate average kinetic energy, in joules, of the molecules in 8.0 g of methane at 27°C.
(a) 8169.75 Joules (b) 1869.75 Joules
(c) 6189.57 Joules (d) 9186.57 Joules

Q.13 A gas occupies a volume of 2.4 litres at a pressure of 740 mm of mercury. Keeping the temperature constant, calculate its volume at standard pressure.
(a) 2.4litres (b) 2.34 litres
(c) 2.5 litres (d) None of these

Q.14 A gas occupies 3 litres at 32°C and one atmospheric pressure. What volume will it occupy if the temperature is changed to 18°C, the pressure remaining constant?
(a) 2.91 litres (b) 2.86 litres
(c) 2.30 litres (d) None of these

Q.15 A gaseous mixture contains 4 molecules with a velocity of 6 cm s^{-1}, 5 molecules with a velocity of 2 cm s^{-1} and 10 molecules with a velocity of 3 cm s^{-1}. What is the RMS velocity of the gas?
(a) 2.5 cm s^{-1} (b) 1.9 cm s^{-1}
(c) 3.6 cm s^{-1} (d) 4.6 cm s^{-1}

Q.16 Calculate average velocity and RMS velocity for a group of six particles having speeds 11.2, 9.0, 8.3, 6.5, 3.7 and 1.8 ms^{-1}.
(a) 6.75 ms^{-1}, 7.47 ms^{-1} (b) 7.47 ms^{-1}, 6.75 ms^{-1}
(c) 7.65 ms^{-1}, 8.47 ms^{-1} (d) None of these

Q.17 A gas occupies 300 ml at 27°C and 730 mm pressure. What would be its volume at STP?
(a) 162.2 ml (b) 262.2 ml
(c) 362.2 ml (d) 462.2 ml

Q.18 A truck carrying oxygen cylinders is filled with oxygen at –23°C and at a pressure of 3 atm. in Srinagar, Kashmir. Determine the internal pressure when the truck drives through Madras, Tamil Nadu, where the temperature is 30°C.
(a) 2.64 atm. (b) 1.64 atm.
(c) 1 atm. (d) 3.64 atm.

Q.19 The odour from a gas A takes 6 seconds to reach a wall from a given point. If the molecular weight of gas A is 46 grams per mole and the molecular weight of gas B is 64 grams per mole how long will it take for the odour from gas B to reach the same wall from the same point? Assuming that volume of both gases is same.
(a) 6 sec (b) 7 sec
(c) 8 sec (d) 9 sec

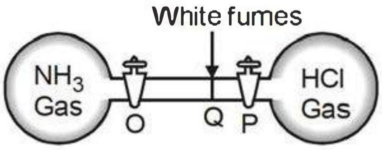
RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	

Space for Rough Work

Q.20 1 litre of dioxygen effuses through a small hole in 60 min. and a litre of helium at the same temperature and pressure effuses through the same hole in 21.2 min. What is the atomic weight of helium ?

(a) 2.99 (b) 3.99 (c) 2.08 (d) 1.99

Q.21 In the following diagram, container of NH_3 gas and container of HCl gas, connected through a long tube, are opened simultaneously at both ends; the white NH_4Cl ring first formed will be at Q point. If OP = 40 cm, then find OQ -



(a) 35 cm (b) 23.74 cm (c) 30 cm (d) 31.25 cm

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct

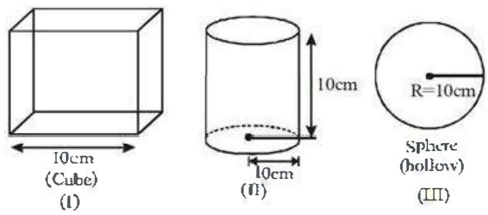
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 If the pressure of the gas contained in a closed vessel is increased by 20% when heated by 273°C then it's initial temperature must have been

(1) 2184°C (2) 2457 K

(3) 1365°C (4) 1029 K

Q.23 There are three closed containers in which equal amount of the gas is filled.



If the containers are placed at the same temperature, then find the correct options –

(1) Pressure of the gas is minimum in (III) container

(2) Pressure of the gas is maximum in (I)

(3) The ratio of pressure in II and III containers is 4 : 3

(4) Pressure of the gas is equal in I and II containers

Q.24 If the rms velocities of nitrogen and oxygen molecules are same at two different temperatures and same pressures then–

(1) average speed of molecules is also same

(2) density (gm/litre) of nitrogen and oxygen is also equal

(3) most probable velocity of molecules is also equal

(4) number of moles of each gas is also equal

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

According to Dalton's law of partial pressure,

"When two or more gases, which do not react chemically are kept in a closed vessel, the total pressure exerted by the mixture is equal to the sum of the partial pressures of individual gases."

Thus, $P_{total} = P_1 + P_2 + P_3 + ...$

Where P_1, P_2, P_3 .... are partial pressures of gases, number 1, 2, 3 ....

Partial pressure is the pressure exerted by a gas when it is present alone in the same container and at the same temperature.

Partial pressure of a gas

$$(P_1) = \frac{\text{Number of moles of the gas } (n_1) \times P_{Total}}{\text{Total number of moles } (n) \text{ in the mixture}}$$

$$= \text{Mole fraction } (x_1) \times P_{Total}$$

Q.25 A mixture of gases at 760 mm Hg pressure contains 65% nitrogen, 15% oxygen and 20% carbon dioxide by volume. What is the partial pressure of each in mm ?

(a) 494, 114, 252 (b) 494,224, 152

(c) 494, 114, 152 (d) None of these

RESPONSE GRID	
	20.ⓐⓑⓒⓓ 21.ⓐⓑⓒⓓ 22.ⓐⓑⓒⓓ 23.ⓐⓑⓒⓓ 24. ⓐⓑⓒⓓ
	25.ⓐⓑⓒⓓ

Space for Rough Work

Q.26 0.45 gm of a gas 1 of molecular weight 60 and 0.22 gm of a gas 2 of molecular weight 44 exert a total pressure of 75 cm of mercury. Calculate the partial pressure of the gas 2 -

(a) 30 cm of Hg (b) 20 cm of Hg
(c) 10 cm of Hg (d) 40cm of Hg

Q.27 The total pressure of a sample of methane collected over water is 735 torr at 29°C. The aqueous tension at 29°C is 30 torr. What is the pressure exerted by dry methane ?

(a) 605 torr (b) 205 torr
(c) 405torr (d) 705torr

DIRECTIONS (Q. 28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement-1 is False, Statement-2 is True.

(d) Statement-1 is True, Statement-2 is False.

Q.28 Statement 1 : Carbon dioxide has greater value of root mean square velocity μ_{rms} than carbon monoxide.

Statement 2 : μ_{rms} is inversely proportional to molar mass.

Q.29 Statement 1 : $1/4^{th}$ of the gas is expelled in air present in an open vessel is heated from 27°C to 127°C.

Statement 2 : Rate of diffusion of a gas is inversely proportional to the square root of its molecular mass.

Q.30 Statement 1 : Effusion rate of dioxygen is smaller than that of dinitrogen.

Statement 2 : Molecular size of nitrogen is smaller than oxygen.

RESPONSE GRID	26.ⓐⓑⓒⓓ	27.ⓐⓑⓒⓓ	28.ⓐⓑⓒⓓ	29.ⓐⓑⓒⓓ	30.ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 8 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	32	Qualifying Score	56
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS (08)

(1) (a) Given P = 16 atm, V = 9 litre.

T = 300 K, m_{CH_4} = 16, R = 0.08 litre atm/K.

$PV = \frac{w}{m} \times R \times T$

$16 \times 9 = \frac{w}{16} \times 0.082 \times 300$

w = 96 gm.

(2) (a) The gram molecular weight of SO_2 = 64 gm/mole.
Since 1 mole of SO_2 occupies a volume of 22.4 litres at S.T.P.
Density = mass / volume

$\therefore$ Density of SO_2 at STP $= \frac{64}{22.4} = 2.86$ gm/lit.

(3) (b) No. of moles of $H_2 = \frac{1}{2} = 0.5$

$\left(\text{no. of moles} = \frac{\text{mass}}{\text{molar mass}}\right)$

No. of moles of $N_2 = \frac{1.4}{28} = 0.05$

$\therefore$ Total number of moles of gas (n) = 0.5 + 0.05 = 0.55
Using PV = nRT

$P = \frac{nRT}{V} = \frac{0.55 \times 0.0821 \times 400}{5} = 3.61$ atm.

(4) (c) $P_{dry\ gas} = 773 - 13 = 760\text{ torr} = \frac{760}{760} = 1$ atm

using PV = nRT

$1 \times \frac{171}{1000} = \frac{0.333}{M.wt.} \times 0.0821 \times 288$

($\because$ 1 cc = 10^3 cm^3)

M = 46 g. per mol.

(5) (a) Partial Pressure = Mole fraction × Total pressure
= Vol. fraction × Total pressure

$\therefore P_{O_2} = 0.2 \times 760 = 152$ mm

$\therefore P_{N_2} = 0.8 \times 760 = 608$ mm

(6) (b) P_{N_2} = Mole fraction × P_{total}

$= \frac{2.8/28}{\frac{2.8}{28} + \frac{2.8}{44} + \frac{4.4}{44}} \times 700 = \frac{0.1}{0.3} \times 700$

= 233.3 Torr.

(7) (a) Mol. mass of $^{235}UF_6 = 235 + 6 \times 19 = 349$
Mol. mass $^{238}UF_6 = 238 + 6 \times 19 = 352$
From Graham's law of diffusion

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{352}{349}} = 1.0043$

$r_1 : r_2 :: 1.0043 : 1.0000$

(8) (b) $\frac{r_{O_2}}{r_{CH_4}} = \sqrt{\left(\frac{d_{CH_4}}{d_{O_2}}\right)} = \sqrt{\left(\frac{1}{2}\right)}$

= 1 : 1.414

(9) (c) $\sqrt{\left(\frac{M_{gas}}{M_{H_2}}\right)} = \frac{\text{Rate of diffusion of } H_2}{\text{Rate of diffusion of gas}}$

$\therefore \sqrt{\left(\frac{M_{gas}}{2}\right)} = \left(\frac{1}{1/6}\right)$

or $M_{gas} = 2 \times 36 = 72$

(10) (b) $\frac{VD_A}{VD_B} = \frac{M_A}{M_B}$ [$\because$ M = 2×V D]

$\therefore \frac{3}{1} = \frac{M_A}{M_B} = \frac{M_A}{M}$

So Mol. wt of A(M_A) = 3 M

(11) (a) K.E. for 1 mole $= \frac{3}{2}RT$

K.E. for 3 moles $= \frac{9}{2}$ RT

or $R = \frac{2}{9T}$ KE $= \frac{2}{9(300)}$ KE

$= 7.4 \times 10^{-4}$ KE per degree kelvin.

(12) (b) Average KE $= \frac{3}{2}nRT = \frac{3}{2} \times \frac{8}{16} \times 8.314 \times 300$

= 1869.75 Joules

(13) (b) Initial volume (V_1) = 2.4 L,
Initial pressure (P_1) = 740 mm.
Final volume (V_2) = ?
Final pressure (P_2) = 760 mm.
From Boyle's law, $P_1V_1 = P_2V_2$

$\therefore V_2 = \frac{740 \times 2.4}{760} = 2.34$ litres.

(14) **(b)** According to Charle's law,

$$\frac{V_1}{T_1}=\frac{V_2}{T_2} \text{ or } V_2=\frac{V_1T_2}{T_1}$$

$$\frac{3L}{(273+32)\,K}=\frac{V_2}{(273+18)\,K}$$

$$\text{or } V_2=\frac{3\times 291}{305}=2.86 \text{ litres}$$

(15) **(c)** RMS velocity, $u=\sqrt{\left(\frac{n_1u_1^2+n_2u_2^2+n_3u_3^2+.......}{n}\right)}$

$$=\sqrt{\left(\frac{4\times(6)^2+5\times(2)^2+10\times(3)^2}{19}\right)}$$

$$=\sqrt{\left(\frac{4\times 36+5\times 4+10\times 9}{19}\right)}$$

$$=\sqrt{\left(\frac{254}{19}\right)}=3.6 \text{ cm s}^{-1}$$

(16) **(a)** Average velocity (v) is the average of different speeds of all the molecules

$$\therefore v=\frac{11.2+9.0+8.3+6.5+3.7+1.8}{6}$$

$$=\frac{40.5}{6}=6.75\text{ms}^{-1}$$

Also, v = 0.921 u where 'u' is RMS velocity

$$\therefore \text{ RMS velocity(u)}=\frac{6.75}{0.9213}=7.47\text{ ms}^{-1}$$

(17) **(b)** $T_1=300K, T_2=273$ K (STP)

$$V_1=300\text{ ml}=\left(\frac{300}{1000}\right)\text{litre},$$

$$P_1=\left(\frac{730}{760}\right)\text{atm; } P_2=1 \text{ atm.,} \qquad V_2=?$$

$$\text{using } \frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2},$$

$$\frac{730\times 300}{760\times 1000\times 300}=\frac{1\times V_2}{273}$$

$\therefore V_2=0.2622$ litre $=262.2$ ml.

(18) **(d)** $P_1=3$ atm., $P_2=?$

$T_1=-23+273=250K$

$T_2=273+30=303$ K.

$$\text{using } \frac{P_1}{T_1}=\frac{P_2}{T_2}$$

$$\frac{3}{250}=\frac{P_2}{303}$$

$$P_2=\frac{3\times 303}{250}=3.64\text{atm.}$$

(19) **(b)** $\frac{r_A}{r_B}=\sqrt{\frac{M_B}{M_A}}$ (from Graham's law of diffusion)

$$\frac{r_A}{r_B}=\sqrt{\frac{64}{46}}=1.18 \Rightarrow \frac{V_A/t_A}{V_B/t_B}=1.18$$

$\therefore t_B=1.18\times t_A$

Time taken for the odour of B to reach the wall (t_B)

$=1.18\times 6=7.08$ sec $\cong$ 7 sec.

(20) **(b)** $\frac{r_{O_2}}{r_{He}}=\frac{1000/60}{1000/21.2}=\frac{21.2}{60}$ $\left(\because r=\frac{v}{t}\right)$

$$=\sqrt{\frac{M_{He}}{M_{O_2}}}=\sqrt{\frac{M_{He}}{32}}$$

Squaring both of sides

$$\frac{(21.2)^2}{(60)^2}=\frac{M_{He}}{32}$$

$$M_{He}=\frac{(21.2)^2\times 32}{(60)^2}=3.99$$

Since helium is monoatomic so

Atomic weight = Molecular weight = 3.99

(21) **(b)** Let OQ = x cm so QP = (40 – x) cm

Diffused volume of NH_3 gas

= Area of T.S. of tube × Distance travelled by NH_3 gas

$V_{NH_3}=A\times OQ$

$=A\,x$ {where A is area of T.S. of tube}

Similarly in the same time,

Diffused volume of HCl gas

= Area of T.S. of tube × Distance travelled by HCl gas

$V_{HCl}=A\times QP=A\,(40-x)$

From Graham's Law of diffusion

$$\Rightarrow \frac{r_{NH_3}}{r_{HCl}}=\sqrt{\frac{M_{HCl}}{M_{NH_3}}}$$

$$\Rightarrow \frac{V_{NH_3}/t}{V_{HCl}/t}=\sqrt{\frac{36.5}{17}}=1.46$$

$$\Rightarrow \frac{x}{(40-x)}=1.46$$

$\Rightarrow x=23.74$cm

$\therefore$ OQ = 23.74cm

(22) **(b)** Using $\frac{P_1}{T_1}=\frac{P_2}{T_2}$

Let initial pressure = 1 atm

$$\frac{1}{t+273}=\frac{1.2}{t+273+546}$$

$1.2t+273\times1.2=t+273+546$

$\Rightarrow t=2457K$ or $2184°C$

(23) **(a)** n, T same hence $P\propto\frac{1}{V}$,

$V_1=1000\,cm^3$

$V_2=\pi(10)^2\times10=1000\pi\,cm^3$

$V_3=\frac{4}{3}\pi(10)^3=\frac{4}{3}\pi\,1000\,cm^3$

$\therefore$ Pressure of the gas is minimum in (III) container, pressure of the gas is maximum in (I),

The ratio of pressure in II and III container is 4 : 3

(24) **(a)** $(v_{rms})_{N_2}=(v_{rms})_{O_2}$

$$\sqrt{\frac{3RT_{N_2}}{M_{N_2}}}=\sqrt{\frac{3RT_{O_2}}{M_{O_2}}}\;;\;\frac{T_{N_2}}{M_{N_2}}=\frac{T_{O_2}}{M_{O_2}}$$

Then v_{av} and v_{mps} is also same.

$$d_{N_2}=\frac{P_{N_2}M_{N_2}}{RT_{N_2}}\;;\;d_{O_2}=\frac{P_{O_2}M_{O_2}}{RT_{O_2}}$$

If $P_{N_2}=P_{O_2}$ then $d_{N_2}=d_{O_2}$

(25) **(c)** $P'_{N_2}=760\times\frac{65}{100}=494\,mm$

$P'_{O_2}=760\times\frac{15}{100}=114\,mm$

$P'_{CO_2}=760\times\frac{20}{100}=152\,mm.$

(26) **(a)** No. of moles of gas 1 $=n_1=\frac{w_1}{m_1}=\frac{0.45}{60}=0.0075$

No. of moles of gas 2 $=n_2=\frac{w_2}{m_2}=\frac{0.22}{44}=0.0050$

Total no. of moles $=n_1+n_2$

$=0.0075+0.0050=0.0125$

P_2 (partial pressure of gas 2)

$$=\frac{0.0050}{0.0125}\times75=30\text{ cm of Hg.}$$

(27) **(d)** $P_{total}=P_{dry\ methane}+P_{water}$

$735=P_{dry\ methane}+30$

$\therefore P_{dry\ methane}=735-30=705$ torr.

(28) **(c)** $\mu_{rms}=\sqrt{\frac{3RT}{M}}$ i.e., it is inversely related to molecular mass.

Therefore, $\mu_{rms}|CO>\mu_{rms}|CO_2$.

(29) **(b)** $\frac{V_1}{T_1}=\frac{V_2}{T_2}$ (Initial fraction $\frac{V_1}{V_2}=1$ when temperature is 27°C. At 127°C, the new fraction is $\frac{V_1}{V_2}=\frac{300}{400}=\frac{3}{4}$

$\therefore$ air expelled $\Rightarrow 1-\frac{3}{4}=\frac{1}{4}$

(30) **(d)** Statement-1 is true but Statement-2 is false because of effusion rate $\propto\frac{1}{\sqrt{M}}$ but it does not depend on molecular size.