Pearson Edexcel

STUDY PACK 1.2

MOLES, MOLAR VOLUMES & GAS LAWS

Since 2005
Chembase
School of Chemistry

First Edition Jan 2006
Second Edition Jun 2009
Third Edition Jun 2011
Fourth Edition Jun 2021 (Revised New Syllabus)

All Rights Reserved.
Unauthorized duplication contravenes applicable laws.

No part of this publication may be reproduced or utilized in any form or by electronic, mechanical or other means, now known or hereafter invented including photocopying & recording, without the prior permission in writing from the copyright owner.

PUBLISHED BY :

Since 2005 Chembase School of Chemistry

PRODUCER OF WORLD PRIZE & ISLAND TOP AWARD WINNERS SINCE 2005

Pearson Edexcel

UNIVERSITY OF CAMBRIDGE

COPYRIGHT OWNER :

Prof. IMRAN RAZEEK I.Chem.C(P1), M.Ed, Ph.D (Reading)

Honorary Professor | Founder, Chairman & Head of Department of Chembase School of Chemistry | Chief Chemistry Educator

CHEMBASE SCHOOL OF CHEMISTRY

34, 1/2, Galle Road, Dehiwela. SRI LANKA.

+94 754 456 456 | +94 776 534 233

info@chembase.lk

22 YEARS LEGACY OF EXCELLENCE Chembase School of Chemistry 2005-2026

ASIA PACIFIC EXCELLENCE AWARD 2025

JOIN LIVE CLASSES @ WWW.CHEMBASE.LK

ONLINE COURSES @ WWW.CHEMBASEACADEMY.COM

CHEMBASE.LK

CHEMBASE SCHOOL OF CHEMISTRY

CHEMBASE.LK

CHEMBASE SCHOOL OF CHEMISTRY

ACCREDITED & APPROVED BY :

UKIQ | UK International Qualifications

R·S·D·C·A Regional Skill Development & Certification Authority

AN ACCREDITED TEACHING INSTITUTE OF UK INTERNATIONAL QUALIFICATIONS.

Concept of Moles

(01) **A.** What is the unit of measurement of substance?

B. Define the term "**mole**" in terms of particles?

C. What is the relationship between the no. of moles & relative atomic mass (or molar mass) of a substance?

D. Write an equation for the calculation of moles?

E. What is the value & units of Avogadro's constant?

F. If you are aware of the no. of moles of a substance, write an expression to calculate the no. of particles present in that substance?

(02) **A.** Calculate the no. of **moles** present in:

Cu	63.5g	CO_2	44g	Mg	0.024g
Cl	35.5g	F	0.0019g	Ca	4.0g

B. Calculate the no. of **Atoms** present in:

Na	1.25 mol	Cu	0.00635g	$\mathbf{H_2SO_4}$	98g
Al	2.50 mol	Fe	0.0080g	$\mathbf{C_6H_{12}O_6}$	0.18g

C. Calculate in how many **moles** the following no. of Atoms are present?

Ba	6.023×10^{25}	S	12.044×10^{22}
Zn	3.011×10^{20}	Ni	4

D. Calculate the no. of **molecules** & **atoms** in the following moles?

O_3	4 mol	H_2O	2.50 mol
P_4	0.25 mol	HNO_3	1×10^{-20} mol

E. Calculate the **mass** of the following:

Na_2O	0.004 mol	H_2SO_4	1.5 mol	$Na_2S_2O_3.5H_2O$	8 moles

(03) **A.** In 5 mol of H_2SO_4 Calculate,

1. The no. of molecules
2. Total no. of atoms
3. No. of Oxygen atoms

B. In 0.10 mol of N_2O_5 calculate,

1. The no. of molecules
2. Total no. of atoms
3. No. of Oxygen atoms
4. No. of Nitrogen atoms

(04) **A.** Calculate the molar mass & RAM of the substance which has 0.10 mol in 6.3g

B. Calculate the relative atomic mass of Yttrium (Y) 3 mol in 2.6672 kg.

(05) **A.** Mass of a substance "X" which has $1x10^{22}$ molecules is 2g. Calculate the Molar mass of "X"?

B. Calculate mass of one atom of below elements (molar masses are provided)

P, N, U, Cr.

C. Calculate the mass of one molecule of each of the following compounds

CH_4, P_2O_5, CO.

(06) **A.** How many moles does "Mg" atoms 2×10^{24} contain?

B. How many water moles does $3.011x10^{22}$ H_2O molecules contain?

C. Calculate the number of moles of $CuSO_4.5H_2O$ in 100g of the solid?

Answers

Volumes of Gases.

1. What is meant by "**molar volume**" of a gas?

2. What is meant by "**standard state**" of a substance? Why it is important to mention the standard state when mentioning molar volume?

3. What is the value of molar volume of any gas under room temperature (298K) & pressure (1atm) ?

What is the value of molar volume of any gas under standard temperature (223K) & pressure (1atm)? Explain why the above two different values.

4. Calculate the **volume** of the number of moles of below stated gases under room temperature & pressure (r.t.p)

a) 2 mol of CO_2

b) 0.5 mol of Cl_2

c) 0.12 mol of HBr

d) 3.4 mol of NO_2

e) 10 mol of C_2H_6

f) 0.45 mol of C_2H_4

g) 8.0 mol of SO_2

h) 3.0 mol of N_2

5. Calculate the number of **moles** of below given volumes of the gases (r.t.p)

a) 500 cm^3 of CO_2

b) 200 ml of C_2H_4

c) 220 ml of NO

d) 20 liters of NO_2

e) 2 liters of H_2

f) 234 cm^3 of SO_3

g) 800 dm^3 of HCl

h) 700 dm^3 of C_2H_6

6. Calculate the **mass** of the volume of Gases stated in the above Question.

7. Calculate the **Volume** of the masses of gases stated below (r.t.p)

a) 20 g of CO_2
b) 100 g of C_2H_4
c) 20 g NO
d) 2.34 g of SO_2
e) 46 g of NO_2
f) 420 g of F_2
g) 56 g of HBr
h) 70 g of NH_3

8. Calculate the **Relative Molecular Mass** of the below given mass & volumes of gases

a) 0.467 g of gas occupy 140cm^3
b) 0.0833 g of gas occupy 1 dm^3
c) 1.63 g of gas occupy 1.4 dm^3
d) 0.0602 g of gas occupy 38 ml
g) 0.175 g of gas occupy 150 cm^3
h) 0.338 g of gas occupy 100 cm^3
i) 0.0513 g of gas occupy 44 ml
j) 0.397 g of gas occupy 280 ml

9. a) If 4.5 g of liquid "**A**" evaporates to give 1.12dm^3 of vapor at room temperature & pressure (s.t.p), What is the Relative Molecular Mass of "**A**"

b) 1.1 g of "**B**" evaporates to give 560 ml at s.t.p. What is the Relative Molecular Mass of "**B**"

10. a) What volume of CO_2 is obtained at r.t.p. if 5 mols of $CaCO_3$ is heated?

b) 1 x 10^6 ml of CO_2 is absorbed by the leaves of a tree every day. How many mols & mass present in this volume?

c) 240 cm^3 of a gaseous oxide of carbon measured at r.t.p. has a mass of 0.35 grams. What mass one mole of this Oxide is obtained?

11. A sample of CO has a volume of 6 liters at room temperature & pressure

a) How many moles of the gas are there in the sample?

b) How many gas molecules are there in the sample?

12. What volume of Oxygen gas is required for the complete combustion of 120 cm^3 of butane (C_4H_{10}) under s.t.p

13. What volume of H_2 at room temperature pressure (s.t.p) is given out when 0.325 g of Zinc (Zn) reacts with dilute HCl

$$Zn + HCl \longrightarrow H_2 + ZnCl_2$$

Answers

1. Molar volume of a gas is the volume occupied by 1 mole of any gas
   Units: dm^3mol^{-1}

2. Standard state of a substance is the stable pure form of a substance under standard atmospheric pressure (1 atm) & specified temperature (0^0C)

   It is important to mention the standard state as the molar volume changes with temperature. The Charles law further explains this. Charles law states that the volume of a gas is directly proportional to the temperature at constant pressure.

3. Room temperature & pressure (RTP) (25^0C, 298K, 1atm) :

   $24dm^3$, 24L, $24000cm^3$, 24000ml

   Standard temperature & pressure (STP) (0C, 273K,1atm) :

   $22.4dm^3$, 22.4L, $22400cm^3$, 22400ml

Answers

Gas Laws

1. State the Charles' Law & plot a graph of volume against temperature for different gases.

2. State the Boyle's law & plot graphs of volume against pressure (V vs. 1/P, V vs.P & PV vs.P)

3. Derive the universal gas equation (General gas equation) from Boyle's & Charle's law. Define each symbol & write the units.

4. Derive the value & unit of gas constant (R) at standard temperature & pressure

5. Modify the universal gas equation to determine the molar mass of a gas.

6. If an ideal gas is at two different conditions of pressure, volume & temperature, derive an equation to show the relationship between the two.

7.

i. If volume of 200ml of a gas was collected at 27 C & 1 atm pressure. Calculate the volume collected at standard temperature & pressure in dm^3

ii. Calculate the number of gas molecules in 5 liters of gas at 5 atm & at 20 C.

iii. A 0.65g sample of a gas takes up a volume of 50 cm^3 at 100 C & $1.52x10^5$ Pa. Cal;culate the molar mass of the gas.

iv. Calculate the density of oxygen gas at 27C & at 1.6 atm pressure

v. Using the ideal gas equation, calculate the pressure in 'Pa'., that NO_2 gas would exert at 25 C. The internal volume of the gas cylinder is 3 liters & it contains 2kg of NO_2

vi. Use the ideal gas equation to calculate the mass of air in 'kg' in a container of 1000m^3 at a temperature of 25 C & a pressure of 1.01×10^5 Pa. The molar mass of air is 29 g mol^{-1}

Chembase - School of Chemistry I All Rights Reserved I www.chembase.lk