TOPIC : MATHEMATICAL TOOLS IN CHEMISTRY

EXERCISE # 1

SECTION (A)

3. (vii) centi (3) – 10^{-2} (viii) deci (4) – 10^{-1}

12. (1) 95 tors = $\frac{95}{760} = \frac{1}{8}$ atom (3) 190 mm = $\frac{1}{4}$ atom

(2) 1.013 × 10^4 pascal = $\frac{1}{10}$ atom (4) 0.2 atm = $\frac{1}{5}$

17. $P = \frac{nRT}{V} = \frac{2 \times 0.0821 \times 546}{44.8l} = 2$ *atm*.

18. V_1 = 100 ml V_2 = 80 ml

T_1 = 300 K T_2 = ?

P_1 = 740 mm P_2 = 740 mm

Applying charles law $V \propto T$

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow \frac{100}{300} = \frac{80}{T_2}$

$T_2 = \frac{300 \times 80}{100}$ = 240 K = 24 – 273 = 240 – 273ºC = – 33ºC.

19. $\frac{V_1}{V_2} = \frac{T_1}{T_2} \because V_2 = \frac{T_2}{T_1} V_1 \quad = \frac{546^o K}{273^o K} \times 0.2L = 0.4L.$

20. $\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2} \therefore n_2 = \frac{P_2 V_2 T_1}{P_1 V_1 T_2} n_1$

at STP n_1 = one mole. at $T = 273^o + 30^o = 303^o K$

P_1 = 1 *atm*. P_2 = 1 *atm*

V_1 = 22.4 *lt* $V_2 = 22.4$

T_1 = 273º*K*

$n_2 = \frac{1}{1} \times \frac{22.4}{22.4} \times \frac{273}{303} \times 1 = 0.9$ moles

21. Here V_1 = 10 L, V_2 = 2 L

P_1 = 1 atm, P_2 = 1 atm

T_1 = 300 K, T_2 = ?

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow \frac{1 \times 10}{300} = \frac{1 \times 2}{T_2} \Rightarrow T_2 = \frac{300 \times 2}{10}$ = 60 K

22. 1 Torr = 1 mm.

24. This is the required relation in Centigrade and Fahrenheit scales.

25. $\frac{F - 32}{9} = \frac{C}{5}$ Let temperature be t, same on two scale.

$\therefore$ $t - 32 = \frac{9t}{5}$ or $t = -40$

27. R = 2 can K^{-1} mol^{-1} = 8.314 JK^{-1} mol^{-1} = 8.314 × 10^7 erg K^{-1} mol^{-1} = 0.0821 litre atm K^{-1} mol^{-1}.

28. Follow answer 1 in SI units.

SECTION (B)

1. $\text{mole} = \frac{\text{mass}}{\text{at. wt.}} = \frac{46}{23} = 2$ mole.

3. We know that, 1 amu = $\frac{1}{12}$ × weight of one ^{12}C atom

or weight of one ^{12}C atom = 12 amu (at. wt. of C = 12 amu).
Similarly, as the atomic weight of He is 4 amu,
weight of one He atom = 4 amu.

Thus, the number of atoms in 100 amu of He = $\frac{100}{4} = 25$.

4. In 18 g, no. of molecules = N_A

So in 0.09 g no. of molecules = $\frac{N_A}{18} \times 0.09 = \frac{N_A}{2 \times 100} = 3.01 \times 10^{21}$.

5. mole = $\frac{w}{m} = \frac{1}{m}$

for largest no. of molecule m should be lowest.

8. 17 g NH_3 = N_A molecules

9. 1 mole P_4 = N molecules of P_4 = 4 N atoms of P_4.

10. 4 g He = N_A atoms

11. Mole of Aluminium = $\frac{54}{27} = 2$ mole.

Al and Mg have same number of atoms (given). Hence same moles also.

$\therefore$ Mass of magnesium = 2 × 24 = 48 g.

12. 558.5 g Fe = $\frac{558.5}{55.85}$ mole Fe = 10 mole Fe = 2×5 mole C = 2× $\frac{60}{12}$ mole C

17. Mole of element × At. Mass of element = Mass of element

$\left(\frac{1.5 \times 10^{22}}{N_A}\right)$ × At. Mass of element = 0.9 $\therefore$ At. Mass of element = 36 u.

SECTION (C)

4.	(1)	3×10^{-2}	1.52	$\frac{10^{-12}}{3} = 3.3 \times 10^{-13}$	12.48
	(2)	5×10^{-7}	6.3	$\frac{10^{-7}}{5} = 2 \times 10^{-8}$	7.7
	(3)	$\frac{10^{-10}}{2} = 5 \times 10^{-11}$	10.3	2×10^{-4}	3.7
	(4)	5×10^{-10}	9.3	2×10^{-5}	4.7

SECTION (D)

5. $E = \frac{6.62 \times 10^{-34} \times 3 \times 10^{8}}{6.62 \times 10^{-10}} = 3 \times 10^{-16}$ J

6. $E = \frac{12400\,ev}{3100Å}$

7.

(1)	3Å	$\frac{10^{10}}{3} = 3.3\times10^{9}$	6.62×10^{-16}J	1
(2)	30Å=3000 Pm	3.3×10^{8}	6.62×10^{-16}J $\left(n\frac{hc}{\lambda}\right)$	10
(3)	5×10^{-10} Pm	2×10^{9}	2.38×10^{8} J	N_A

8. $\frac{1}{\lambda} = \frac{1}{2000} + \frac{1}{4000} = \frac{2+1}{4000}$ $\lambda = \frac{4000}{3}$

10. $\lambda = \frac{12400}{2} A^o = 6200\ A^o$

11. $\nu = \frac{c}{\lambda} = \frac{3\times10^{8}\ \ ms^{-1}}{600\times10^{-9}m} = 5.0\times10^{14}Hz$

SECTION (E)

2. 10 gm solute …… Solution 100 gm
50 gm …….. 500 gm
Solvent = 500 – 50 = 450

7. (1) 25%
(2) 25 ml
(3) 50 %

8. (i) 40 atm
(ii) 1.375 KP_a
(iii) 90 L
(iv) 300 K
(v) 0.216 mol

9.

Substance	Moles	Mass	No. of particles
CO_2	0.25	11 g	1.5×10^{23}
NaOH	0.25	10g	1.5×10^{23}
He	0.13	0.52	7.8×10^{22} atoms
$CaCO_3$	1.50 mol	150 gm	9×10^{23}
C_8H_{18}	0.2	22.8g	1.2×10^{23}
$Ca_3(PO_4)_2$	2.50 mol	775 gm	15×10^{23}