SOLUTIONS OF INTRODUCTION TO CHEMISTRY

EXERCISE

PART - I

1. 10^{10} grains are distributed in 1 second

$\therefore$ 6.02×10^{23} grains are distributed in $\frac{6.02 \times 10^{23}}{10^{10}}$ sec = $\frac{6.02 \times 10^{23}}{10^{10} \times 60 \times 60 \times 24 \times 365}$ years

= 1.9×10^6 years (approx.)

2. No. of atoms = mole × N_a

$1 = \frac{x}{238} \times N_a$ (x is wt. of uranium)

$x = \frac{238}{6} \times 10^{-23}$

$x = 3.95 \times 10^{-22}$

3. No. of moles of C = $\frac{12.044 \times 10^{23}}{6.022 \times 10^{23}}$ = 2.

Wt. of C atoms = 2 × 12 = 24 g.

4. mass of Si = mole × Atomic mass

= 35 × 28 = 980 g

8. 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.

9. 1 litre Hg metal
volume = 1000

$d = \frac{m}{v}$ mass = d × V = 13.6 × 1000

No of mole of Hg metal = $\frac{13.6 \times 1000}{200}$ = 68 mole

10. Fractional abundance of ^{35}Cl = 0.75, Molar mass = 35.0
Fractional abundance of ^{37}Cl = 0.25, Molar mass = 37.0

$\therefore$ Average atomic mass = (0.75) (35.0 amu) + (0.25) (37.0 amu) = 35.5

11. Let mole % of ^{26}Mg be x.

$\therefore$ $\frac{(21-x)25 + x(26) + 79(24)}{100}$ = 24.31

x = 10%

12. No. of molecules = mole × N_a = $\frac{16}{16}$ × N_a

$N_a = 6.02 \times 10^{23}$

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

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

14. Let the number of C_2H_6 molecules in the sample be n. As given, mass of C_2H_6 = mass of 10^7 molecules of CH_4

$\frac{n}{\text{Av.constant}} \times$ mol. wt. of C_2H_6 = $\frac{10^7}{\text{Av.constant}} \times$ mol. wt. of CH_4

$\frac{n \times 30}{\text{Av.constant}} = \frac{10^7 \times 16}{\text{Av.constant}}$ = 5.34×10^6.

16. No. of moles of $CaCO_3$ = $\frac{\text{no. of molecules}}{\text{Av. cons.}} = \frac{6.022 \times 10^{23}}{6.022 \times 10^{23}} = 1$

Weight of $CaCO_3$ = 1 × 100 = 100 g.

17. Total no. of moles of CO_2 = $\frac{\text{wt. in g}}{\text{mol. wt.}} = \frac{0.2}{44}$ = 0.00454.

No. of moles removed = $\frac{10^{21}}{6.022 \times 10^{23}}$ = 0.00166.

No. of moles of CO_2 left = 0.00454 – 0.00166 = 0.00288.

18. **(a)** mole of H_2SO_4 = $\frac{\text{mass}}{\text{molar mass}} = \frac{196}{98}$ = 2.

1 molecule H_2SO_4 contains 2 atom hydrogen, 1 atom sulphur and 4 atom of oxygen.
Hence, H = $4N_A$ atoms, S = $2N_A$ atoms, O = $8N_A$ atoms

(b) molecule of H_2SO_4 = $\frac{196}{98}$ = 2.

Hence, H = 4 atoms, S = 2 atoms, O = 8 atoms.

(c) 5 mole $H_2S_2O_8$ contains
H = $10N_A$ atoms, S = $10N_A$ atoms, O = 40 N_A atoms

(d) 3 molecules $H_2S_2O_6$ contains
H = 6 atoms, S = 6 atoms, O = 18 atoms.

19. 10 mole NH_3 have mole of 'H' atom = 10 × 3
5 mole of H_2SO_4 have mole of 'H' atom = 10
Total mole of 'H' atom = 40
mole of H_2 = 20
Hence: number of H_2 molecules = $20N_A$

20. no. of atoms = 3 × 11 × N_A
So no. of O_3 molecules formed = 11 N_A

21. Mol. wt. of air = $\frac{78 \times 28 + 21 \times 32 + 0.9 \times 40 + 0.1 \times 44}{78 + 21 + 0.9 + 0.1}$ = 28.964.

(N_2 = 28, O_2 = 32, Ar = 40 and CO_2 = 44)

22. From ideal gas equation, pV = nRT. In SI sytem the parameters of the gas are:
Pressure = p x 1000 (Pa); Volume = V x 10^{-6} (m^3); Temperature = t + 273 (K); moles = w/32

Therefore, R = $\frac{32pV}{1000 \times w \times (t + 273)}$

23. PV = nRT, N = n × N_A

24. PV = nRT,
n = W/M 16 AMU

25. Pressure = 7.6×10^{-10} mm
= 0.76×10^{-10} cm

$\frac{0.76 \times 10^{-10}}{76}$ = atm (1 atom = 76 cm) = 10^{-12} atm.

Volume = 1 litre, R = 0.0821 lit. atm/K/mole, temperature = 273 K.

We know that pV = nRT or $n = \frac{pV}{RT}$

$$n = \frac{10^{-12} \times 1}{0.082 \times 273} = 0.44 \times 10^{-13}.$$

No. of molecules = = $0.44 \times 10^{-13} \times 6.022 \times 10^{23} = 2.65 \times 10^{10}$.

PART - II

1. Atoms of an element are alike.

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

6. 4 g He = N_A atoms

7.

	A	B
Atomic mass	40	80
given weight	x gram	2x gram
No. of mole	$\frac{x}{40}$	$\frac{2x}{80}$
No. of Atom	$\frac{x}{40} \times N_A$	$\frac{x}{40} \times N_A$

But according to question = $\frac{x}{40} \times N_A = y$

8. 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.

9. 558.5 g Fe = $\frac{558.5}{55.85}$ mole Fe = 10 mole Fe = 2 × 5 mole C = 2 × $\frac{60}{12}$ mole C

11. 12 g $_6C^{12}$ contains $6N_A$ electrons and 6 N_A neutrons.

12. $M_X = 2 \times 12 = 24$

$M_Y = \frac{M_X}{0.3} = 80.$

13. 1 gram ion = 1 mole
charge on 1 mole Al^{3+} is = 3 × e (N_A).

14. Number of protons in $_6C^{14}$ = 6 ;
Number of neutrons in $_6C^{14}$ = 8 ;
As per given new atomic mass of
$_6C^{14}$ = 12 + 4 = 16

(As the mass of electron negligible as compared to neutron and proton)

% increase in mass = $\frac{16-14}{14}$ × 100 = 14.28

15. Weight of C –14 isotope in 12g sample = $\frac{2\times12}{100}$

No. of isotopes = $\frac{2\times12\times N}{100\times14}$ = 1.032 × 10^{22} atom

17. 114.8 = 115 × 0.95 + M × 0.05
M = 111

19. 17 g NH_3 = N_A molecules

21. Gram mol. wt. of $C_{60}H_{22}$ = 742 gm
i.e. wt. of 6.023 × 10^{23} molecules = 742

so wt. of 1 molecules = $\frac{742}{6.023\times10^{23}}$ = 1.24 × 10^{-21} g.

22. Number of electrons = $\frac{1.8\times10}{18}$ × N_A

23. 1 mole P_4 = N molecules of P_4 = 4 N atoms of P_4.

24. In $(NH_4)_3PO_4$

$\frac{\text{mole of Hatom}}{\text{mole of O atom}} = \frac{12}{4}$

mole of 'O' atom = $\frac{4}{12}$ (mole of H atom) = $\frac{1}{3}$(3.18) = 1.06.

25. (B) 1 Torr = 1 mm.

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

28. $\frac{F-32}{9} = \frac{C}{5}$

Let temperature be t, same on two scale

∴ t – 32 = $\frac{9t}{5}$ or t = –40

30. 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}.

31. Follow answer 1 in SI units.

33. P × 44.8 = 2 × 0.0821 × 540. ∴ P = 1.98 atm.

34. Molar volume, i.e. volume when n = 1 from PV = nRT is RT/P.

37.

	H_2	:	He	:	O_2	:	O_3
Ratio of total no. of molecules =	1	:	1	:	1	:	1
So ratio of total no. of atoms =	2	:	1	:	2	:	3

38. Statement of avogadro's hypothesis.

39. Mol. wt. of gas is = $\frac{16 \times 22.4}{5.6}$ = 64 g

32 + 16x = 64

x = 2

40. $\frac{\text{wt. of 1 litre gas at STP}}{\text{wt of 1 litre } O_2 \text{ at STP}} = \frac{\text{molar mass of gas}}{\text{molar mass of } O_2}$

2.22 = $\frac{M}{32}$

M = 71.

43. 9.108×10^{-21} kg is the wt. of 1 e^- = $\frac{1}{N_A}$ moles of e^-

So 1 kg is the wt. of 1 e^- = $\frac{1}{9.108 \times 10^{-31}} \times \frac{1}{N_A} = \frac{1}{9.108 \times 10^{-31} \times 6.023 \times 10^{23}} = \frac{10^8}{9.108 \times 6.023}$.

44. 560g of Fe No. of moles = $\frac{560\,g}{56\,g}$ = 10 mole

70 g of N

14g = 1 mole atom of N

70g = 5 moles of N

20g H = 20 moles of H-atoms.

45. (A) Moles of C = 24/12 = 2, So no. of atoms = $2N_A$

(B) Moles of Fe = 56/56 = 1, So no. of atoms = N_A

(C) Moles of Al = 27/27 = 1, So no. of atoms = N_A

(D) Moles of Fe = 108/108 = 1, So no. of atoms = N_A

46. The mass of one mole of a substance will remain unchanged.

47. 8 moles of O-atom are contained by 1 mole $Mg_3(PO_4)_2$.

Hence, 0.25 moles of O-atom = $\frac{1}{8} \times 0.25 = 3.125 \times 10^{-2}$ mole $Mg_3(PO_4)_2$.

48. $^{54}Fe \longrightarrow 5\%$

$^{56}Fe \longrightarrow 90\%$

$^{57}Fe \longrightarrow 5\%$

Av. atomic mass = $x_1A_1 + x_2A_2 + x_3A_3$ = 54 × 0.05 + 56 × 0.9 + 57 × 0.05 = **55.95**

51. Number of electron = mole of H × 1 = Mole of O × 8 = Mole of C × 6 = Mole of N × 7

52. Refer Notes.

53. Pressure is same when V/T is constant.

60. Use % by moles = $\frac{M_{avg} - M_1}{M_2 - M_1} \times 100$

% by mass = % by moles × $\frac{M_2}{M_{avg}}$