# Chapter - 3
# Atoms and Molecules

## Multiple Choice Questions

**1.Which of the following correctly represents 360 g of water?**
**(i) 2 moles of H20**
**(ii) 20 moles of water**
**(iii) 6.022 × 1023 molecules of water**
**(iv) 1.2044×1025 molecules of water**

**(a) (i)**
**(b) (i) and (iv)**
**(c) (ii) and (iii)**
**(d) (ii) and (iv)**

**Soln:**
Answer is (d) (ii) and (iv)

**Explanation:**

$$\text{Number of moles} = \frac{\text{Mass of water}}{\text{Molar mass of water}}$$

$$\text{Number of moles} = \frac{360\text{g}}{12\text{g/mol}}$$

Number of moles = 20

Number of molecules = $20 \times 6.022 \times 10^{23} = 1.2044 \times 10^{25}$ molecules of water

Thus, option (d) is correct.

**2. Which of the following statements is not true about an atom?**
**(a) Atoms are not able to exist independently**
**(b) Atoms are the basic units from which molecules and ions are formed**
**(c) Atoms are always neutral in nature**
**d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch**

**Soln:**

Answer is d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch

**Explanation:**

Atoms aggregate in large numbers to form the matter But we cannot see the matter with our naked eyes.

**3. The chemical symbol for nitrogen gas is**
**(a) Ni**
**(b) N2**
**(c) N+**
**(d) N**

**Soln:**

Answer is (b) N2

**Explanation:**
Chemical formula of Nitrogen is N but Nitrogen exist in molecule of two ions hence chemical symbol of Nitrogen is written as N2.

**4. The chemical symbol for sodium is**
**(a) So**
**(b) Sd**
**(c) NA**
**(d) Na**

**Soln:**

Answer is (d) Na

**Explanation:**

Sodium word is derived from Latin word Natrium hence the chemical name of sodium is Na.

**5. Which of the following would weigh the highest?**
**(a) 0.2 mole of sucrose (C12 H22 O11)**
**(b) 2 moles of CO2**
**(c) 2 moles of CaCO3**
**(d) 10 moles of H2O**

**Soln:**
Answer is (c) 2 moles of CaCO3

**Explanation:**

Weight of a sample in grant = Number of moles x Molar mass
(a) 0.2 moles of Ci2H220,, = 0.2 x 342 = 68.4 g
(b) 2 moles of CO is 2 x 44 is. 88 g
(c) 2 moles of CaCO? 2 x IIMI - 200 g (4) 10 moles of I-120 = 10 x 18 - 1St g
Hence, option (c) is correct.

**6. Which of the following has maximum number of atoms?**
**(a) 18g of H2O**
**(b) 18g of O2**
**(c) 18g of CO2**
**(d) 18g of CH4**

**Soln:**
Answer is (d) 18g of CH4

**Explanation:**

Number of atoms = Mass of substance × Number of atoms in the molecule/ Molar mass × NA

(a) 18 g of water =18 x3/18 ×NA = 3 NA

(b) 18 g of oxygen = 18 x2 /32 × NA = 1.12 NA

(c) 18 g of $CO_2$ = 18 x3/44 × NA = 1.23 NA

(d) 18 g of $CH_4$ =18 x5 /16 × NA = 5.63 NA

**Note:** NA = $6.023 \times 10^{23}$

**7. Which of the following contains maximum number of molecules?**

**(a) 1g $CO_2$**

**(b) 1g $N_2$**

**(c) 1g $H_2$**

**(d) 1g $CH_4$**

**Soln:**

**Answer is (c) 1g $H_2$**

**Note:** NA = $6.023 \times 10^{23}$

**Explanation:**

1 g of $H_2$ = ½ x NA = 0.5 NA = 0.5 × 6.022 × 1023 = 3.011 × 1023

**8. Mass of one atom of oxygen is**
**(a) 23 16 g 6.023 10 ×**
**(b) 23 32 g 6.023 10 ×**
**(c) 23 1 g 6.023 10 ×**
**(d) 8u**

**Soln:**

Answer is (a) 23 16 g 6.023 10 ×

**Explanation:**

Mass of one atom of oxygen = Atomic mass/NA = 16/6.023 × 1023 g

**Note:** NA = $6.023 \times 10^{23}$

**9. 3.42 g of sucrose are dissolved in 18g of water in a beaker. The number of oxygen atoms in the solution are**
**(a) $6.68 \times 10^{23}$ (b) $6.09 \times 10^{22}$ (c) $6.022 \times 10^{23}$ (d) $6.022 \times 10^{21}$**

**Soln:**

Answer is (a) $6.68 \times 10^{23}$

**Explanation:**

1 mol of sucrose ( C12H22O11) contains = 11× NA atoms of oxygen, where NA = $6.023 \times 10^{23}$
0.01 mol of sucrose (C12 H22 O11) contains = 0.01 × 11 × NA atoms of oxygen
= 0.11× NA atoms of oxygen
= 18 g/(1x2+ 16)gmol-1
=18 g /18 gmol-1
= 1mol
1mol of water (H2O) contains 1×NA atom of oxygen
Total number of oxygen atoms =
Number of oxygen atoms from sucrose + Number of oxygen atoms from water
= 0.11 NA + 1.0 NA = 1.11NA
Number of oxygen atoms in solution = 1.11 × Avogadro's number
= 1.11 × 6.022 ×10"$^{23}$ = $6.68 \times 10^{23}$



**10. A change in the physical state can be brought about**
**(a) only when energy is given to the system**
**(b) only when energy is taken out from the system**
**(c) when energy is either given to, or taken out from the system**
**(d) without any energy change**

**Soln:**

**Answer is (c) when energy is either given to, or taken out from the system**

## Short Answer Questions

**11. Which of the following represents a correct chemical formula? Name it.**
**(a) CaCl**
**(b) BiPO4**
**(c) NaSO4**
**(d) NaS**

**Soln:**

Answer is (b) BiPO4, Its name is Bismuth Phosphate

**Explanation:**

Bismuth phosphate is right because Both ions are trivalent Bismuth phosphate(Bi3+- Trivalent anion. anion is an ion that is negatively charged).

**12. Write the molecular formulae for the following compounds**

**(a) Copper (II) bromide**
**(b) Aluminium (III) nitrate**
**(c) Calcium (II) phosphate**
**(d) Iron (III) sulphide**
**(e) Mercury (II) chloride**
**(f) Magnesium (II) acetate**

**Soln:**

Answers are

(a) Copper (II) bromide- CuBr2

(b) Aluminium (III) nitrate = Al(NO3)3

(c) Calcium (II) phosphate - Ca3(PO4)2

(d) Iron (III) sulphide - Fe2S3

(e) Mercury (II) chloride - HgCl2

(f) Magnesium (II) acetate- Mg(CH3COO)2



**13. Write the molecular formulae of all the compounds that can be formed by the combination of following ions $Cu^{2+}$, $Na^{+}$, $Fe^{3+}$, $C1^{-}$ $SO_4^{-2}$ , $PO_4^{-3}$**

**Soln:**

Answers are

$CuCl_2$/ $CuSO_4$/ $Cu_3(PO_4)^2$

NaCl/ $Na_2SO^4$/ $Na_3PO^4$

$FeCl_3$/ $Fe_2(SO_4)^3$ / $FePO_4$

**14. Write the cations and anions present (if any) in the following compounds**

**(a) $CH_3COONa$**

**b) NaCl**

**(c) $H_2$**

**(d) $NH_4NO_3$**

**Soln:**

a) In $CH_3COONa$-$CH_3COO$ is anion and Na is cation.

b) In NaCl-Cl anion Na is cation

**c)** In $H_2$ both the ions are cations as they share electrovalent bond between them

d) In $NH_4NO_{3-}$ $NO_3$ is anion $NH_4$ is cation

**15. Give the formulae of the compounds formed from the following sets of elements**
**(a) Calcium and fluorine**
**(b) Hydrogen and sulphur**
**(c) Nitrogen and hydrogen**
**(d) Carbon and chlorine**
**(e) Sodium and oxygen**
**(f) Carbon and oxygen**

**Soln:**

(b) Hydrogen and sulphur- $H_2S$- Hydrogen Sulphide

(c) Nitrogen and hydrogen- $NH_{3-}$ Ammonia

(d) Carbon and chlorine – $CCl_{4-}$ Carbon Tetra chloride

(e) Sodium and oxygen – $Na_2O$-Sodium Oxide

(f) Carbon and oxygen- $CO_2$ ; CO- Carbon-di-oxide; Carbon Monoxide

**16. Which of the following symbols of elements are incorrect? Give their correct symbols**

**(a) Cobalt CO**

**(b) Carbon c**

**(c) Aluminium AL**

**(d) Helium He**

**(e) Sodium So**

**Soln:**

Cobalt CO is wrong, correct symbol is Co

Carbon c is wrong, correct symbol is C

Alluminium AL is wrong, correct symbol is Al

Helium He is the right symbol

Sodium So is wrong, correct symbol is Na

**17. Give the chemical formulae for the following compounds and compute the ratio by mass of the combining elements in each one of them. (You may use appendix-III).**

**(a) Ammonia**

**(b) Carbon monoxide**

**(c) Hydrogen chloride**

**(d) Aluminium fluoride**

**(e) Magnesium sulphide**

**Soln:**

| Sl. No. | Compounds | Chemical formula | Ratio by mass of the combining elements |
|---|---|---|---|
| (a) | Ammonia | $NH_3$ | N:H=14:3 |
| (b) | Carbon monoxide | CO | C:O= 12:16=3:4 |
| (c) | Aluminium fluoride | HCl | H:Cl= 1:35.5 |
| (d) | Aluminium fluoride | $AlF_3$ | Al:F=27:57=9:19 |
| (e) | Magnesium sulphide | MgS | Mg:S= 24:32=3:4 |

**18. State the number of atoms present in each of the following chemical species**

**(a) $CO3^{-2}$**

**(b) $PO4^{-3}$**

**(c) $P_2 O^5$**

**(d) CO**

**Soln:**

(a) $CO3^{-2}$ **- 1+3=4**

(b) $PO4^{-3}$ **-1+4=5**

(c) $P_2 O^5$ – **2+5=7**

(d) CO – **1+1=2**

**19. What is the fraction of the mass of water due to neutrons?**

**Soln:**

Mass of 1 mole of a substance is equal to its relative atomic or molecular mass in grams.

Mass of one mole (Avogadro Number) of neutrons =1g

Mass of one neutron = 1/ Avogadro number(NA) g

Mass of one molecule of water = Molar mass / NA = 18/ NA g

The molar mass of water is 18.015 g/mol. This was calculated by multiplying the atomic weight of hydrogen (1.008) by two and adding the result to the weight for one oxygen (15.999)

Mass of one molecule of water = Molar mass / NA = 18/ NA g

Avogadro number(NA) =6.022 x 1023mol¯1

There are 8 neutrons in one atom of oxygen

Number of neutrons in oxygen= number of oxygen - Atomic number of oxygen

Oxygen's atomic weight= 15.9994
increases with an increase in temperature.
Therefore the mass is 16

Therefore number of neutrons= 16 - 8 = 8

Mass of one neutron = 1/ Avogadro number(NA) g

Mass of 8 neutrons = 8/ Avogadro number(NA) g

Fraction of mass of water due to neutrons = 8/18 g

**20. Does the solubility of a substance change with temperature? Explain with the help of an example.**

**Soln:**

Solubility is the ability of a solute to get dissolved in 100g solvent. Solubility of a given solute to dissolve in specific solvent depends on the temperature. With Increase in temperature solubility of liquids and solids increase. In the same way solubility of gases decreases with increase in temperature.

**Ex:** Sugar dissolves faster in hot water than in cold water.

**21. Classify each of the following on the basis of their atomicity.**
**(a) F2**
**(b) NO2**
**(c) N2O**
**(d) C2H6**
**(e) P4**
**(f) H2O2**
**(g) P4O10**
**(H) O3**
**(i) HCl**
**(j) CH4**
**(k) He**
**(l) Ag**

**Soln:**

a) Monoatomic are inert gases that do not combine and exist as monoatomic gases
b) Diatomic- (a) 2- diatomic- $NO_2$ = 1+ 2 = 3., HCl = 1+ 1 = 2
c) Triatomic-$N_2O$ = 2 + 1 = 3., $NO_2$ = 1+ 2 = 3, $O_3$ = 3
d) Tetraatomic- $H_2O_2$ = 2 + 2 = 4, $P_4O_{10}$ = 4 + 10 = 14, $P_4$ = 4, $CH_4$ = 1+ 4= 5
e) Octa atomic- $C_2H_6$ = 2 + 6 = 8
f) Polyatomic.

**22. You are provided with a fine white coloured powder which is either sugar or salt. How would you identify it without tasting?**

**To examine if the fine white coloured powder is sugar pr salt we can conduct two experiments.**

**Soln:**

**1. Heating:** Upon heating sugar melts to liquid form because sucrose has a decomposition point and melting point at temperatures between 190 to 192 degrees Celsius. This will turn sugar to light brown colour. Upon heat further sugar gets charred to black colour.

Salt has a melting point of 841 degrees Celsius and 1545.8 degrees Fahrenheit. If we don't heat it to that point nothing change is observed.

**2. Electric conductivity:**

If we dissolve the given substance in water we can check for electric conductivity to check whether the substance is sugar or salt. If it is salt it conducts electricity. Because salt (NaCl) has positive sodium ions and negative chloride ions hence salt conducts electricity. But sugar don't conduct electricity as sugar has only positive ions.



**23. Calculate the number of moles of magnesium present in a magnesium ribbon weighing 12 g. Molar atomic mass of magnesium is 24g mol–1.**

**Soln:**

Number of moles = $\frac{\text{weight}}{\text{atomic weight}}$

= $\frac{12}{24}$ = 0.5 moles

## Long Answer Questions

**24. Verify by calculating that (a) 5 moles of $CO_2$ and 5 moles of $H_2O$ do not have the same mass. (b) 240 g of calcium and 240 g magnesium elements have a mole ratio of 3:5.**

**Soln:**

(a) Molar mass of $CO_2$ =12 + 2 x 16= 12 + 32 = 44 g $mol^{-1}$

5 moles of $CO_2$ have mass = 44 x 5 = 220 g

Similarly, molar mass of $H_2O$ = 2x 1 + 16 = 18 g $mol^{-1}$

5 moles of H2O have mass =18 x 5 = 90 g

It is verified that 5 moles of $CO_2$ and 5 moles of $H_2O$ are not same.

(b) Number of moles = w/ atomic weight

Atomic weight of Ca= 40 amu

Number of moles in 240g Ca metal 240/ 40 = 6

Number of moles in 240g of Mg metal 240/ 24 = 10

Atomic weight of Mg = 24amu

Ratio 6:10

**25. Find the ratio by mass of the combining elements in the following compounds. (You may use Appendix-III) (a) CaCO3 (d) C2H5OH (b) MgCl2 (e) NH3 (c) H2SO4 (f) Ca(OH)2**

**Soln:**

a) CaCO3

Ca: C : O × 3

40 : 12 : 16 × 3

40: 12 : 48

10 : 3 : 12

(b) MgCl2

Mg : Cl × 2

24: 35.5 × 2

24: 71

(c) H2SO4

H x 2 : S : O × 4

2: 32 : 16 × 4

2 : 32 : 64

1: 16: 32

(d) C2H5OH

C × 2 : H × 6 : O

12 × 2 : 1 × 6 : 16

24 : 6 : 16

12 : 3 : 8

(e) $NH_3$

N : H × 3

14 : 1 × 3

14: 3

(f) $Ca(OH)_2$

Ca : O × 2 : H × 2

40 : 16 × 2 : 1 × 2

40 : 32 : 2

20 : 16 : 1

**26. Calcium chloride when dissolved in water dissociates into its ions according to the following equation. $CaCl_2 (aq) \rightarrow Ca^{2+} (aq) + 2Cl^- (aq)$ Calculate the number of ions obtained from $CaCl_2$ when 222 g of it is dissolved in water.**

**Soln:**

1 mole of calcium chloride = 111g
Therefore 222g of $CaCl_2$ is equivalent to 2 moles of $CaCl_2$
Since 1 formula unit $CaCl_2$ gives 3 ions,
therefore, 1 mol of $CaCl_2$ will give 3 moles of ions 2 moles of $CaCl_2$ would give 3×2=6 moles of ions.
No. of ions = No. of moles of ions × Avogadro number
$= 6 \times 6.022 \times 10^{23}$
$= 36.132 \times 10^{23}$
$= 3.6132 \times 10^{24}$ ions



**27. The difference in the mass of 100 moles each of sodium atoms and sodium ions is 5.48002 g. Compute the mass of an electron.**

**Soln:**
Sodium atom and ion differ by one electron. For 100 moles each of sodium atoms and ions there would be a difference of 100 moles of electrons.
Mass of 100 moles of electrons= 5.48002 g
Mass of 1 mole of electron = 5.48002 / 100 g
Mass of one electron = $5.48002 / 100 \times 6.022 \times 10^{23}$
$= 9.1 \times 10^{28}$ g
$= 9.1 \times 10^{-31}$ kg

**28. Cinnabar (HgS) is a prominent ore of mercury. How many grams of mercury are present in 225 g of pure HgS? Molar mass of Hg and S are 200.6 g mol–1 and 32 g mol–1 respectively.**

**Soln:**
Molar mass of HgS = The molar mass of Hg + the molar mass of S
= 200.6 + 32 = 232.6 g $mol^{-1}$
1molecule of HgS contains 1 atom of Hg
232.6 g of HgS contains 200.6 g of Hg
Therefore, Mass of Hg in 225 g of HgS = $\frac{200.6}{232.6}$ X 225 = 194.04g

**29. The mass of one steel screw is 4.11g. Find the mass of one mole of these steel screws. Compare this value with the mass of the Earth ($5.98 \times 10^{24}$kg). Which one of the two is heavier and by how many times?**

**Soln:**
One mole of screws weigh = $2.475 \times 10^{24}$g
= $2.475 \times 10^{21}$ kg

Mass of the Earth / Mass of 1 mole of screws = $\frac{5.98 \times 10^{24} \text{ kg}}{2.475 \times 10^{21}}$

= 2.4 ×10

Mass of earth is $2.4 \times 10^{3}$ times the mass of screws
The earth is 2400 times heavier than one mole of screws

**30. A sample of Vitamin C is known to contain 2.58 ×1024 oxygen atoms. How many moles of oxygen atoms are present in the sample?**

**Soln:**

We know,
1 mole = $6.022 \times 10^{23}$
The number of moles= $\frac{\text{Given number of particles}}{\text{Avogadro Number}}$

$$n = \frac{2.58 \times 10^{24}}{6.022 \times 10^{23}}$$

n= 4.28 mol

**31. Raunak took 5 moles of carbon atoms in a container and Krish also took 5 moles of sodium atoms in another container of same weight.**
**(a) Whose container is heavier?**
**(b) Whose container has more number of atoms?**

**Soln:**

a) Mass of sodium atoms carried by Krish = (5 ×23) g = 115 g
Atomic weight of Na = 23
While mass of carbon atom carried by Raunak = (5 ×12) g = 60g

b) Thus, Krish's container has more number of atoms

**32. Fill in the missing data in the Table 3.1**

| **Species property** | **$H_2O$** | **$CO_2$** | **Na atom** | **$MgCl_2$** |
|---|---|---|---|---|
| **No of Moles** | **2** | **-** | **-** | **0.5** |
| **No of particles** | **-** | **$3.011x10^{23}$** | **-** | **0** |
| **Mass** | **36g** | **-** | **115g** | **0** |

**Soln:**

| Species property | $H_2O$ | $CO_2$ | Na atom | $MgCl_2$ |
|---|---|---|---|---|
| No of Moles | 2 | 0.5 | 5 | 0.5 |
| No of particles | $12.044x10^{24}$ | $3.011x10^{23}$ | $3.011x10^{23}$ | $3.011x10^{23}$ |
| Mass | 36g | 22g | 115g | 47.5g |



**33. The visible universe is estimated to contain 1022 stars. How many moles of stars are present in the visible universe?**

**Soln:**
Number of moles of stars $= \frac{1022}{6.023 \times 1023}$
= 0.0166 moles

**34. What is the SI prefix for each of the following multiples and submultiples of a unit?**
**(a) 103**
**(b) 10–1**
**(c) 10–2**
**(d) 10–6**
**(e) 10–9**
**(f) 10–12**

**Soln:**

a) 103 = 1000= kilo

(b) 10–1 =1/10= 0.1= deci

(c) 10–2 =1/100 = 0.01= centi

(d) 10–6 = 0.000 001= micro

(e) 10–9 =0.000 000 001 = nano

(f) 10–12=0.000 000 000 001 = pico

**35. Express each of the following in kilograms**
**(a) 5.84×10-3 mg**
**(b) 58.34 g**
**(c) 0.584g**
**(d) 5.873×10-21g**

**Soln:**

(a) 5.84 × $10^{-3}$ mg = 5.84 ×$10^{-9}$ kg

(b) 58.34 g =5.834 ×$10^{-2}$ kg

(c) 0.584g =5.84 ×$10^{-4}$ kg

(d) 5.873×$10^{-21}$g=5.873 ×$10^{-24}$ kg

**36. Compute the difference in masses of 103 moles each of magnesium atoms and magnesium ions. (Mass of an electron = 9.1×10–31 kg)**

**Soln:**

Mg2+ ion and Mg atom differ by two electrons.
103 moles of Mg2+ and Mg atoms would differ by
$10^3$ × 2 moles of electrons
Mass of 2 ×$10^3$ moles of electrons = 2×103 × 6.023 ×1023 × 9.1 ×$10^{-31}$ kg
2×6.022 × 9.1×$10^{-5}$kg
109.6004 ×$10^{-5}$ kg
1.096 × $10^{-3}$kg

**37. Which has more number of atoms? 100g of N2 or 100 g of NH3**

**Soln:**

No. of moles of atoms = weight / atomic weight.
For $N_2$
100 gms of $N_2$ = 100/2 x 14 moles = 100/28 moles
Number of molecules = 100 / 28 x 6.022 x $10^{23}$
Molar mass of $N_2$ = 2 x molar mass of monoatomic N
Molar mass of $N_2$ = 2 x 14.0067 = 28 moles.
Number of molecules = 100/28 x 6.022 x $10^{23}$
No. of atoms = 2 x 100/28 x 6.022 x $10^{23}$ = 43.01 x $10^{23}$
For $NH_3$

100 gm of $NH_3$ = 100/17 moles
Number of molecules = 100/17 x
6.022 x $10^{23}$ molecules
No. of atoms in $NH_3$ = (1 + 3) = 4 x 100/17 x 6.022 x $10^{23}$ =
141.69 x $10^{23}$ atoms.
Therefore, $NH_3$ has more atoms than $N_2$.

**38. Compute the number of ions present in 5.85 g of sodium chloride.**

**Soln:**

58.5 g NaCl contains 6.023 x $10^{23}$ molecules
therefore 58.5 g NaCl contains 12.046 x $10^{23}$ ions.
Hence, 5.85 g NaCl contains $\frac{5.85 \times 12.046 \times 10^{23}}{58.5}$
= 1.2046 x $10^{23}$ ions

**39. A gold sample contains 90% of gold and the rest copper. How many atoms of gold are present in one gram of this sample of gold?**

**Soln:**

One gram of gold sample will contain $\frac{90}{100}$ = =0.9g of gold

Number of moles of gold=$\frac{\text{mass of gold}}{\text{atomic mass of gold}}$

$= \frac{0.9}{197}$

= 0.0046

One mole of gold contains NA atoms = $6.022 \times 10^3$

Therefore, 0.0046 mole of gold will contain= $0.0046 \times 6.022$
$=2.77 \times 10^{21}$

**40. What are ionic and molecular compounds? Give examples.**

**Soln:**

While forming some compounds, atoms gain or lose electrons, and form electrically charged particles called ions. Compounds that are formed by the attraction of cations and anions are called as ionic compounds.
Ex : 2Na + Cl2 → 2Na+ Cl- → 2NaCl (sodium chloride- common salt.)
Sodium is a group 1 metal, thus forms a +1 charged cation. Chlorine is a non-metal, and has the ability to form a -1 charged anion.

Compounds formed due to bonding of uncharged ions are called as molecular compounds and the bonding between them is called covalent bonding. Molecular compounds are formed by sharing of electrons between the two atoms and the elements are held together by covalent bonds.

Ex: 2C + O2 → 2CO ( Carbon monoxide)

**41. Compute the difference in masses of one mole each of aluminium atoms and one mole of its ions. (Mass of an electron is 9.1×10–28 g). Which one is heavier?**

**Soln:**

Mass of one mole of Aluminium atom = {13 × mass of each electron + 13 × mass of each proton + 14 × mass of each neutron} × Avogadro's constant.
We know, if atoms convert into ions, only transfer of electrons takes place, in Al+3 ion, Aluminium atom loss three electrons,
So,
Mass of Al+3 ={10× mass of each electron +13 × mass of each proton + 14 × mass of each neutron} Avogadro's constant
Now,
You see mass of aluminium atom is greater than aluminium ion by 3 electrons
Difference in mass =Mass of Aluminium atom -mass of aluminium ion
= 3 × mass of each electron x Avogadro's constant .
= $3 \times 9.1 \times 10^{-28} \times 6.023 \times 10^{23}$
= $27.3 \times 10^{-28} \times 6.023 \times 10^{23}$ g
= $164.4 \times 10^{-5}$ g
= $1.644 \times 10^{-3}$ g
= 0.0016 g

**42. A silver ornament of mass 'm' gram is polished with gold equivalent to 1% of the mass of silver. Compute the ratio of the number of atoms of gold and silver in the ornament.**

**Soln:**
Mass of silver = m g
Mass of gold = m /100g
Number of atoms of silver = Mass/ Atomic mass X NA
= m /108NA Number of atoms of gold
= m/ 100 X197
Ratio of number of atoms of gold to silver = Au : Ag
= m/ 100 X 197 X NA : m/ 108 NA
= 108 : 100×197
= 108 : 19700 =
1 : 182.41

**43. A sample of ethane (C2H6) gas has the same mass as 1.5 ×1020 molecules of methane (CH4). How many C2H6 molecules does the sample of gas contain?**

**Soln:**

$6.02 \times 10^{23}$ molecules of methane = 1 mole
Hence $1.5 \times 10^{20}$ molecules of methane = $(1.5 \times 10^{20} \times 1) \div (6.02 \times 10^{23})$ moles
= $2.49 \times 10^{-4}$ moles
Molar mass of Methane ($CH_4$) = 12 + 1x4 = 16 g

Mass of methane = molar mass x no. of moles = 16 x 2.49 x $10^{-4}$ = 3.984 x $10^{-3}$ g (This is the same mass as Ethane)
Ethane ($C_2H_6$) = 12x2 + 1x6 = 30
If 30 g of Ethane has 6.02 x $10^{23}$ molecules
So 3.984 x $10^{-3}$ g = (3.984 x $10^{-3}$ x 6.02 x $10^{23}$) ÷ 30
= 8 x $10^{19}$ molecules of Ethane

**44. Fill in the blanks**
**(a) In a chemical reaction, the sum of the masses of the reactants and products remains unchanged. This is called ————.**
**(b) A group of atoms carrying a fixed charge on them is called ————.**
**(c) The formula unit mass of Ca3 (PO4) 2 is ————.**
**(d) Formula of sodium carbonate is ———— and that of ammonium sulphate is ————.**

**Soln:**

Answers

a) Law of conservation of mass
b) Ions
c) 310

**Explanation**

3 × atomic mass of Ca+ 2 × atomic mass of phosphorus + 8 × atomic mass of oxygen) = 310

3 × 40 + 2 × 31 + 8 × 16 = 120 + 62 + 128 = 310

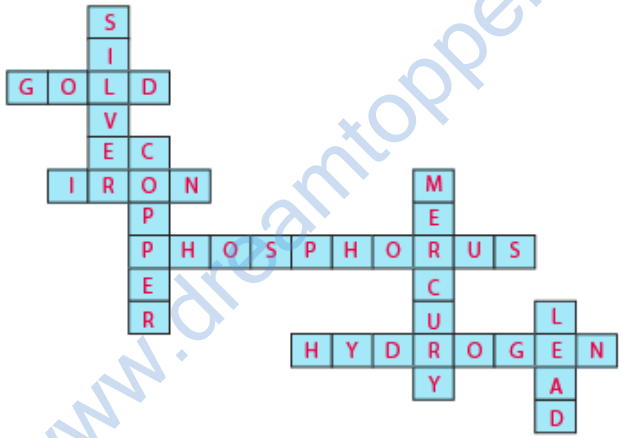
d) $Na_2CO_3$ and $(NH_4)_2SO_4$

**45. Complete the following crossword puzzle (Fig. 3.1) by using the name of the chemical elements. Use the data given in Table 3.2.**

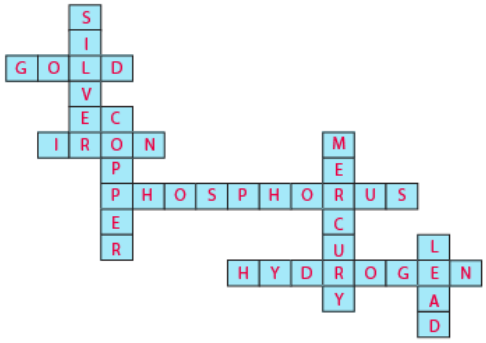
| Across | Down |
|---|---|
| **The element used by Rutherford during his α–scattering experiment** | **A white lustrous metal used for making ornaments and which tends to get tarnished black in the presence of moist air** |
| **An element which forms rust on exposure to moist air** | **Both brass and bronze are alloys of the element** |
| **A very reactive non–metal stored under water** | **The metal which exists in the liquid state at room temperature** |
| **Zinc metal when treated with dilute hydrochloric acid produces a gas of this element which when tested with burning splinter produces a pop sound.** | **An element with symbol Pb** |

2

**Soln:**





**46. (a) In this crossword puzzle (Fig 3.2), names of 11 elements are hidden. Symbols of these are given below. Complete the puzzle. 1. Cl 7. He 2. H 8. F 3. Ar 9. Kr 4. O 10. Rn 5. Xe 11. Ne 6. N**

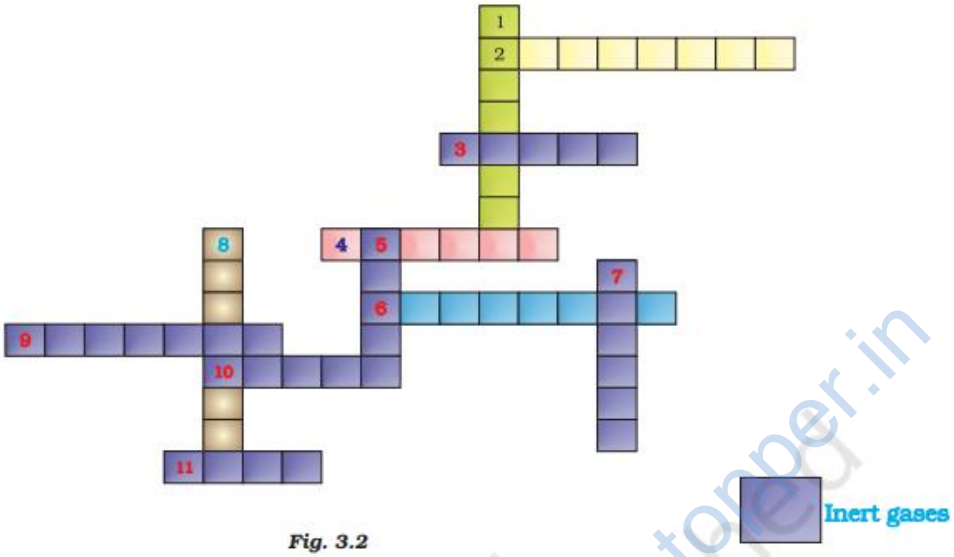
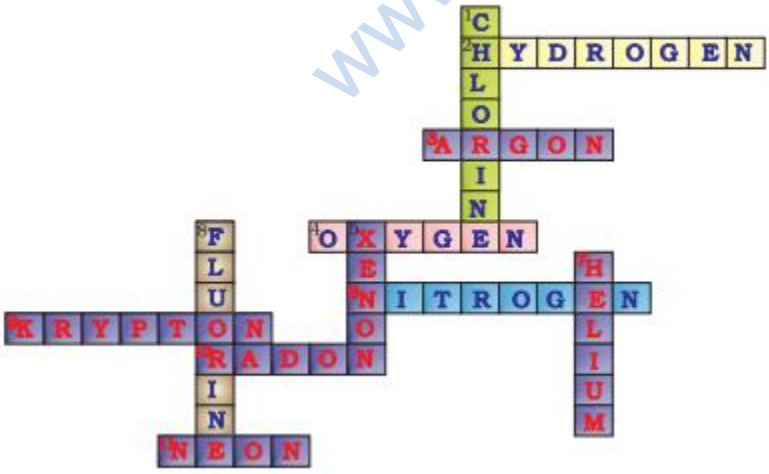



*Fig. 3.2*



**Soln:**

**(a)**




b) Six : Helium (He); Neon ( Ne); Argon (Ar); Krypton (Kr); Xenon (Xe); Radon (Rn).

**47. Write the formulae for the following and calculate the molecular mass for each one of them.**
**(a) Caustic potash**
**(b) Baking powder**
**(c) Lime stone**
**(d) Caustic soda**
**(e) Ethanol**
**(f) Common salt**

**Soln:**

The formulae for the following and calculate the molecular mass for each one of them.

| Sl No | Compound | Formula | Molecular mass |
|---|---|---|---|
| A | Caustic Potash | KOH | 39+16+1=56u |
| B | Baking powder | $NaHCO_3$ | 23+1+12+3x16+84u |
| C | Lime stone | $CaCO_3$ | 40+12+3x16+100u |
| D | Caustic soda | NaOH | 23+16+1+40u |
| E | Ethanol | $C_2H_5OH$ | 2x2+5x1+16+1+46u |
| F | Common Salt | NaCl | 23+35.5=58.5 |

**48. In photosynthesis, 6 molecules of carbon dioxide combine with an equal number of water molecules through a complex series of reactions to give a molecule of glucose having a molecular formula $C_6 H_{12} O_6$ . How many grams of water would be required to produce 18 g of glucose? Compute the volume of water so consumed assuming the density of water to be 1 g $cm^{-3}$.**

**Soln:**

6CO2 + 6 H2 O Chlorophyll /Sunlight → C6 H12 O6 + 6O2
1 mole of glucose needs 6 moles of water 180 g of glucose needs (6×18) g of water 1 g of glucose will need 108/ 180 g of water.
18 g of glucose would need (108 /180) × 18 g of water = 10.8 g
Volume of water used = $\frac{\text{Mass}}{\text{Density}}$
= 10.8 g/ 1g cm-3
=10.8 cm3