CBSE Class 9 Science

Important Questions

Chapter 3

Atoms and Molecules

1 Marks Questions

1. Atomic radius is measured in nanometers and

(a) 1nm = 10^{-10} **m**

(b) 1m = 10^{-10} **nm**

(c) 1m = 10^{-9} **nm**

(d) 1nm = 10^{-9} **m**

Ans. (c) 1m = 10^{-9}nm

2. Symbol of Iron is :-

(a) Ir

(b) I

(c) Fe

(d) None of these

Ans. (c) Fe

3. Atomicity of chlorine and Argon is

(a) Diatomic and Monoatomic

(b) Monoatomic and Diatomic

(c) Monoatomic and Monoatomic

(d) Diatomic and Diatomic

Ans. (a) Diatomic and Monoatomic

4. Molecular mass of water (H_2O) is

(a) 18g

(b) 8g

(c) 33g

(d) 34g

Ans. (a) 18g

5. 1 Mole of a compound contains –

(a) 6.023×10^{23} atoms

(b) 6.023×10^{24} atoms

(c) 60.23×10^{23} atoms

(d) 6.023×10^{25} atoms

Ans. (a) 6.023×10^{23} atoms

6. Oxygen is –

(a) Monovalent

(b) Bivalent

(c) Trivalent

(d) Tetravalent

Ans. (a) Monovalent

7. What is the molecular formula for Calcium Hydroxide?

(a) Ca OH_2

(b) Ca OH

(c) Ca_2 **OH**

(d) Ca H_2

Ans. (b) Ca OH

8. Neutron is

(a) Chargeless and Massless

(b) Chargeless and has Mass

(c) Has charge and Mass

(d) Has charge and Massless.

Ans. (b) Chargeless and has Mass

9. Which of the following statements is correct?

(a) Cathode rays travel in straight line and have momentum.

(b) Cathode rays travel in straight line and have no momentum

(c) Cathode rays do not travel in straight line but have Momentum.

(d) Cathode rays do not travel in straight line and have no momentum.

Ans. (a) Cathode rays travel in straight line and have momentum.

10. β**–particles are represented as :-**

(a) ${}^{0}_{-1}e$

(b) ${}_{+1}e$

(c) ${}^{1}_{-1}e$

(d) ${}^{1}_{0}e$

Ans. (a) ${}^{0}_{-1}e$

11. ${}^{40}_{18}Ar$ **and** ${}^{40}_{20}Ca$ **are**

(a) Isotopes

(b) Isobars

(c) Isotones

(d) Both b and c

Ans. (b) Isobars

12. The maximum number of electrons in L shell is

(a) 8

(b) 18

(c) 28

(d) 38.

Ans. (a) 8

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(d) ${}^{1}_{0}e$

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(c) 28

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Ans. (a) 8

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3 Marks Questions

1. Define the atomic mass unit.

Ans. According to the latest recommendations of International Union of Pure and Applied Chemistry (IUPAC) the atomic mass unit (amu) is abbreviated as u or unified mass.
For chemical calculations the atomic masses of elements are expressed by taking the atomic mass of one atom of an element as the standard mass. Like the atomic mass of carbon is taken as 12 units and each unit is called as 1 a.m.u i.e.
1 amu = 1/12 of atomic masses of ${}_6C^{12}$.

2. Write down the formulae of
(i) sodium oxide
(ii) aluminium chloride
(iii) sodium suphide
(iv) magnesium hydroxide

Ans.

Compound	**Formula**
Sodium oxide	Na_2O
Aluminium Chloride	$AlCl_3$
Sodium Sulphide	Na_2S
Magnesium Hydroxide	$Mg(OH)_2$

3. Write down the names ofcompounds represented byfollowing formulae:
(i) $Al_2(SO_4)_3$
(ii) $CaCl_2$
(iii) K_2SO_4

(iv) KNO_3
(v) CaCO_3 .

Ans.

Formula	Compound
$Al_2(SO_4)_3$	Aluminium sulphate
CaCl_2	Calcium chloride
K_2SO_4	Potassium sulphate
KNO_3	Potassium nitrate
CaCO_3	Calcium carbonate

4. What is meant by the term chemical formula?

Ans. A chemical formula is the representation of elements present in a compound with the help of symbols and also the number of atoms of each element with those numbers only. For e.g.: A molecule of water (compound) contains 2 atoms of hydrogen and one atom of oxygen hence its chemical formula is H2O.

5. What are polyatomic ions? Give examples.

Ans. When two or more atoms in a group is having a charge, such is called a polyatomic ion. For e.g. : NH_{4^+} , NO_{3^-} etc.

6. Write the chemical formulae of the following.
(a) Magnesium chloride
(b) Calcium oxide
(c) Copper nitrate
(d) Aluminium chloride
(e) Calcium carbonate.

Ans.

Compound	Chemical formula
Magnesium chloride	MgCl_2

Calcium oxide	CaO
Copper nitrate	CuNO_3
Aluminium chloride	AlCl_3
Calcium carbonate	CaCO_3 O3

7. Give the names of the elements present in the following compounds.

(a) Quick lime

(b) Hydrogen bromide

(c) Baking powder

(d) Potassium sulphate.

Ans.

Compound	**Formula**	**Elements present**
Quick lime	CaO	Calcium and oxygen
Hydrogen bromide	HBr	Hydrogen and bromine
Baking powder	NaHCO_3	Sodium, hydrogen, carbon and oxygen
Potassium sulphate	K_2SO_4	Potassium, sulphur and oxygen

8. Calculate the molar mass of the following substances.

(a) Ethyne, C_2H_2

(b) Sulphur molecule, S_8

(c) Phosphorus molecule, P_4 **(Atomic mass of phosphorus= 31)**

(d) Hydrochloric acid, HCl

(e) Nitric acid, HNO_3

Ans. (a) Ethyene = C_2H_2 = 12x2 + 1x2 =24 + 2= 26 u =26 g

(b) Sulphur molecular = S_8 = 32 x 8 = 256 u= 256 g

(c) Phosphorus molecule = P_4 = 31 x4 = 124 u= 124 g

(d) Hydrochloric acid = HCl = 1+ 35.5 = 36.5 u= 36.5 g

(e) Nitric acid = HNO_3 = 1 + 14 + (16x3) = 15 + 48 = 63 u =63 g

9. What is the mass of—

(a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms (Atomic mass of aluminium= 27)?
(c) 10 moles of sodium sulphite (Na_2SO_3)?

Ans. (a) Atomic mass of nitrogen is 14 u.
therefore 1 mol of N = 14g

(b) Atomic mass of aluminium = 27u
therefore 1 mol of Al = 27g and so 4 mol of Al = 27x4 = 108g

(c) molecular mass of Na_2SO_3 = 23x2 + 32 + 16x3 = 46 + 32 + 48 = 126 u
therefore 1 mol of Na_2SO_3 has weight/mass 126g.
hence, 10 mol of Na_2SO_3 = 10x126 = 1260g

10. Convert into mole.
(a) 12 g of oxygen gas
(b) 20 g of water
(c) 22 g of carbon dioxide.

Ans. (a) molecular mass of O_2 = 32 u= 32g(1 mole)
since 32 g of O_2 =1mole then 12g of O_2 = 1x12/32 =0.375mole.

(b) molecular mass of H_2 O = 1x2 + 16 = 18 u= 18g(1mole)
20g H_2 O = 1x20/18 = 1.11mole.

(c) molecular mass of CO_2 = 12 + 16x2 = 12 + 32 = 44 u= 44g (1mole)
22g of CO_2 = 1x22/44 = 0.5mole.

11. State the Postulates of Dalton Theory?

Ans. The postulates of Dalton theory are

a) All matter is made of vary tiny particles called atom
b) Atoms are indivisible particle; they cannot be created or destroyed during a chemical reaction
c) Atoms of a \given element are identical in mass and chemical properties
d) Atoms of different elements have different mass and chemical properties.

e) Atom combines in the ratio of their whole number to form compounds

f) The relative number and kinds of atoms are constant in a compound.

12. Find the percentage of water of crystallization in feSO_4 . 7H_2 O.

Ans. The RMM of FeSO_4 .7H_2 O= 55.9 + 32.0 + 4 × 16 + 7(18)

= 55.9 + 32 + 64 + 126

= 277.9 g/mol.

277.9 g/mol of FeSO_4 contain 126g of water

∴ 100g of crystal will contain $\frac{100\times126}{277.9}g$ of water of crystallization

This is 45.34 of water of crystallization

The amount of water of crystallization in FeSo_4 .7H_2 O = 45.34% by mass.

13. 2.42g of copper gave 3.025g of a black oxide of copper, 6. 49g of a black oxide, on reduction with hydrogen, gave 5.192g of copper. Show that these figures are in accordance with law of constant proportion?

Ans. The percentage of copper is first oxide

$= \frac{2.43\times100}{3.025} = 80.0$

The percentage of copper is second oxide = $\frac{5.192\times100}{6.49}$

=80.02

As the percentage of copper in both the oxides is same, thence law of constant composition is verified.

14. A compound was found to have the following percentage composition by mass Zn = 22.65%, S = 11.15%, H = 4.88%, O = 61.32%. The relative molecular mass is 287g/mol. Find the molecular formula of the compound, assuming that all the hydrogen in the compound is present in water of crystallizations.

Ans. Zn : S:O:H = $\frac{22.65}{65} : \frac{11.15}{32} : \frac{61.32}{10} : \frac{4.88}{1}$

$= 0.3485 : 0.3484 : 3.833 : 4.88$

To obtain an integral ratio, we divide by smallest number

$= \frac{0.3485}{0.3484} : \frac{0.3484}{0.3484} : \frac{03.833}{0.3484} : \frac{4.88}{0.3484}$

= 1 : 1 : 11 : 14

∴ empirical formula is Zn S$O_{11}H_{14}$
Let Molecular formula be $(ZnSO_{11}H_{14})_n$
RMM for the molecular $= n(65 + 32 + (11 \times 16) + 14$
Formula = 287
287n = 287
n = 1
∴ Molecular formula is Zn S$O_{11}H_{14}$

15. Which element will be more reactive and why → the element whose atomic number is 10 or the one whose atomic number is 11?

Ans. Element with atomic number 11 is more reactive than the one with atomic number 10 because electronic configuration of atomic number 11 will be 2, 8, 1 so, it has to loose only 1e- from its outermost shall to be stable which is more easy than the element with atomic number 10 because its electronic configuration is 2, 8 and has 8e- in the outermost shell and hence is already stable.

16. What are the failures of Dalton Atomic theory?

Ans. Failures of Dalton Atomic Theory are :-

1) Atom is not the smallest particle as it is made up of protons, neutrons and electrons.
2) Atom's mass can be cornered to energy (E = mc2) and hence can be created and destroyed.
3) Atoms of one element have been charged into atoms of another element through artificial transmutation of elements.
4) Atoms of same element need not resemble each other in all respects as isotopes (Different of same element) exist.
5) Atoms of different elements need not differ in all respects as isobars (same forms of different elements) exist.

17. Calculate the molecular Mass of
a) Ammonium sulphate $[(NH_4)_2SO_4]$
b) Penicillin $[C_{16}H_{18}N_2SO_4]$
c) Paracetamol $[C_8H_9NO]$

Ans. a) Ammonium Sulphate $[(NH_4)_2SO_4]$

$= [1 \times$ mass of N$+4 \times$ Mass of Hydngen$] \times 2 + 1 \times Mass$ of sulphur $+4 \times$ Mass of c

$= [1 \times 14 + 4 \times 1] \times 2 + 1 \times 32 + 4 \times 16$

$= 18 \times 2 + 32 + 64$

$= 36 + 32 + 64 = 132 g/mol.$

b) Penicillin $[C_{16}H_{18}N_2SO_4]$

=16 × mass of carbon + 18 × Mass of hydrogen + 2 × Mass of Nitrogen + 1 × mass of sulphur + 4 × Mass of oxygen.

= 16 × 12 + 18 × 1 + 2 × 14 + 1 × 32 + 4 × 16

= 192 + 18 + 28 + 32 + 64 = 334 g /mol.

c) Paracetamol $[C_8H_9NO]$

= 8 × Mass of carbon + 9 × Mass of hydrogen + 1 × mass of Nitrogen + 1 × mass of oxygen.

= 8 × 12 + 9 × 1 + 1 × 14 + 1 ×16

= 96 + 9 + 14 + 16

= 135 g /mol

18. The following questions are about one mole of sulphuric acid $[H_2SO_4]$?

a) Find the number of gram atoms of hydrogen in it?

b) How many atoms of hydrogen does it have?

c) How many atoms (in grams) of hydrogen are present for every gram atom of oxygen in it?

d) Calculate the number of atoms in H_2SO_4?

Ans. 1 Mole of H2 SO4 = gram molecular Mass = 6.023 × 1023 molecules

a) In H2 So4 → 2 gram atoms of hydrogen are present

b) 6.023×1023 atoms = H2SO4

So, 2H = 2×6.023×1023

= 12.046×1023

c) In H2SO4;

for every 2 hydrogen there ave4 oxygen

so for 1 hydrogen = $\frac{4}{2}$ oxygen are present

= 2 oxygen are present

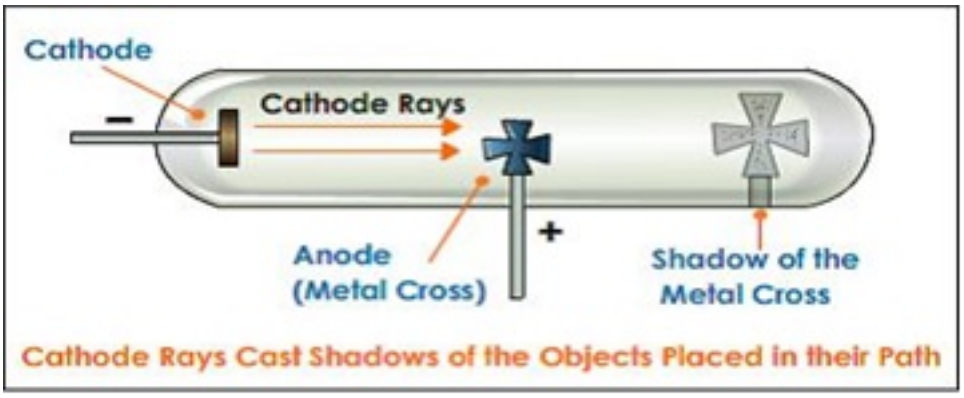
For 1 oxygen = $\frac{2}{4}$ hydrogen one present
= 0.5 Hydrogen are present

d) 1 Mole of H2SO4 = 6.023×1023 atoms.

19. Write an experiment to show that cathode rays travel in straight line?

Ans. Experiment to show that cathode rays travel in straight line:-

a) Take a discharge tube coated with a fluorescent substance
b) Place an opaque object in the path of the cathode rays.
c) When cathode rays were made to pass through the discharge tube then discharge the glowed wherever cathode rays fall except in the region of the shadow of the opaque object.
d) The above experiment shows that cathode rays travel is straight line.



20. What is radioactivity? What are the applications of radioisotopes?

Ans. The spontaneous emission of radiation by a substance is called as radioactivity.

Applications of radioisotopes:-

a) Isotope of CO-60 emits r-radiation which is used in radiotherapy for cancer.
b) Iodine-131 is used in diagnosis and treatment of disease of the thyroid gland.
c) Isotope P-32 is used in treatment of leukemia.
d) Carbon – 14 is used to study biochemical processes.

21. There are 2 elements C and B. C emits an α – particle and B emits a β – particle. How will the resultant elements charge?

Ans. When a α-particle is released, atomic number decreases by 2-units and mass number decrease by 4- units. When a β particle is releases by 1 unit and mass number remains the same.

So, c-emits a α-particle so,

$${}^{A}_{Z}C \rightarrow {}^{A-4}_{Z-2}C + {}^{4}_{2}He$$

The resultant element will have its atomic number decreases by 2 units and mass number decreases by 4 units.

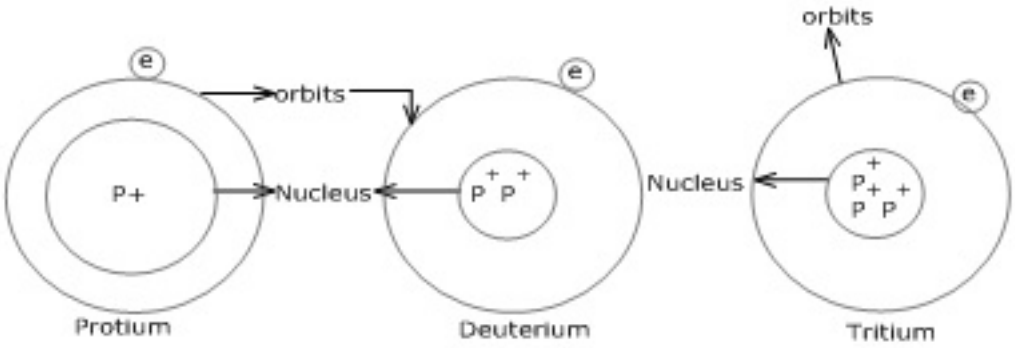
B-emits a β-particle, so,

$${}^{A}_{Z}B \rightarrow {}^{A}_{Z+1}B + {}^{0}_{-1}e$$

The atomic number of B increases by 1 unit and mass number remains same.

22. What are isotopes? Name the isotopes of hydrogen and draw the structure of their atoms?

Ans. Isotopes are atoms of the same element having same atomic number and different mass number.



There are 3 isotopes of hydrogen:-

1) Protium = ${}^{1}_{1}H$

2) Deuterium - ${}^{2}_{1}H$

3) Tritium = ${}^{3}_{1}H$

p+ = Proton

e- = electron.

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5 Marks Questions

1. In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were2.2g of carbon dioxide, 0.9g water and 8.2g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

sodium carbonate + ethanoic acid→ sodium ethanoate + carbondioxide + water

Ans. According to law of conservation of mass :

mass of reactants = mass of products

Lets calculate and find out both results –

mass of reactants = mass of sodium carbonate +mass of ethanoic acid

= 5.3g + 6g

= 11.3g

mass of products = mass of sodium ethanoate + mass of carbon dioxide + mass of water

= 8.2g +2.2g + 0.9g = 11.3g

Hence it is proved that these observations are in agreement with the law of conservation of mass.

2. Calculate the molecular masses of

1. H_2
2. O_2
3. Cl_2

4. CO_2
5. CH_4
6. C_2H_6
7. C_2H_4
8. NH_3
9. CH_3OH

Ans.

1. Molecular mass of H_2
   = atomic mass of H x 2= 1 x 2= 2u.
2. Molecular mass of O_2
   = atomic mass of O x 2 = 16 x 2= 32u.
3. Molecular mass of Cl_2
   = atomic mass of Cl x 2 = 35.5 x 2 =71u.
4. Molecular mass of CO_2
   = atomic mass of C + (atomic mass of O x 2)
   = 12 + (16 x 2)
   = (12 + 32) = 44 u
5. Molecular mass of CH_4 = 12 + atomic mass of hydrogen x 4
   = 12 + (1x4)
   = 12 + 4 = 16 u
6. Molecular mass of C_2H_6
   = (12 x 2) + (1x6) = 24+6 = 30 u
7. Molecular mass of C_2H_4
   = (12x2) + (1x4) = 24 + 4 = 28 u
8. Molecular mass of NH_3
   = 14 + (1x3) = 14 + 3= 17 u
9. Molecular mass of CH_3 OH
   = 12 + (1x3) + 16 + 1 = 12+3+16+1 = 32 u

3. If one mole of carbon atoms weighs 12 grams, what is the mass (in grams) of 1 atom of carbon?

Ans. Weight of one mole of carbon = atomic mass of carbon (1 atom of carbon) = 12 u

Therefore one mole of carbon contains = 12 g = 6.022 x 10^{23} atoms (Avogadro number)

so 1 atom of carbon = 12/ g
or, 12 u = 12/6.022 x 10^{23} g
1 u = 12/6.022 x10^{23}x12 g
1 u = 1/6.022 x10^{23} g
1 u = 0.1660577 x10^{-23} g
or, 1 u = 1.660577 x10^{-24} g

4. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

Ans. Mass of the given sample compound = 0.24g

Mass of boron in the given sample compound = 0.096g

Mass of oxygen in the given sample compound = 0.144g

% composition of compound = % of boron and % of oxygen

Therefore % of boron = mass of boron x 100/mass of the sample compound
= 0.096 x 100/0.24
= 40%

Therefore % of oxygen = mass of oxygen x 100/mass of the sample compound
= 0.144 x 100/0.24
= 60%