Chemistry Worksheets Class 12 on Chapter 1 Solid State with Answers - Set 2

Q-1: If A, E, M, and n represent the atomic mass, equivalent mass, molecular mass and valency of an element respectively, the relation between the given quantities is:

a) A = E x n
b) A = M/E
c) A = M/n
d) M = A x n

Answer: (a.)

Explanation: Atomic mass = Equivalent mass x valency
This is because, Equivalent mass of an element = Atomic mass / valency

Q-2: The coordination number of a Gold (Au) atom in its crystal structure is____.

a) 4
b) 8
c) 12
d) 6

Answer: (c.)

Explanation: Au settles in ABC ABC type of layer pattern. Hence, Au has a cubic close packing structure. The coordination number of atoms in a cubic close packing structure is 12. Hence, the coordination number of a Gold (Au) atom in its crystal structure is 12.

Q-3: What is the atomicity of H_2SO_4?

Answer: The atomicity is the total number of atoms contained within a molecule. The H_2SO_4 molecule contains 2 atoms of hydrogen, 1 atom of sulphur and 4 atoms of oxygen. Hence, the atomicity of H_2SO_4 is 7.

Q-4: The structure having 68% packing efficiency is_____.

a) Hcp structure
b) Ccp structure
c) Fcc structure
d) Bcc structure

Answer: (d.)

Explanation: The Bcc structure has 68% packing efficiency.

Q-5: Mention two properties that occur due to the presence of F-centres inside a solid.

Answer: An F-centre is created when a vacant anionic site is occupied by an unpaired electron in the crystal lattice. The F-centre is responsible for the colour and the paramagnetic behaviour of the compound.

Q-6: Select all the correct options.
Diamond is____.

a) A covalent solid
b) A lubricant
c) Good conductor
d) sp^3 hybridised

Answer: (a, d)

Explanation: Diamond is neither a lubricant nor a good conductor. Diamond is a covalent solid that is sp^3 hybridised.

Q-7: How is the electrical conductivity of semiconductors affected with a variation in temperature?

Answer: The electrical conductivity of semiconductors increases with an increase in the temperature. This happens because as the temperature rises, more and more electrons gain the energy to jump from the valence band to the conduction band.

Q-8: What can be the value of "n" in $Be_nAl_2Si_6O_{18}$?

Answer: This can be done by adding the charges on the individual atoms. As the given molecule is neutral; hence the overall charge on the molecule is zero.
The overall charge on the molecule is equal to the sum of charges on individual atoms present.
Hence, n(charge on Be^{2+}) + 2(charge on Al^{3+}) + 6(charge on Si^{4+}) + 18(charge on O^{2-}) = 0
n(+2) + 2(+3) + 6(+4) + 18(-2) = 0
2n + 6 + 24 -36 = 0
n = 3.
So, the value of n is 3 and the complete molecular formula is $Be_3Al_2Si_6O_{18}$.

Q-9: Which of the following metals expand on freezing (solidification)?

a) Zinc
b) Aluminium
c) Copper
d) Gallium

Answer: (d.)

Explanation: Just like water, Gallium expands on freezing (or solidification). Gallium exists as a liquid at the RT. This happens because the density of liquid Gallium is higher than that in the solid state. Gallium expands by 3.1% on solidification; which is why it is not stored in glass jars.

Q-10: A haemoglobin-like structure contains one atom of Fe. The Compound has 4.6% of Fe. Calculate the approximate mass of the compound.

Answer: Mass of 1 atom of Fe = 56 g
Given: 4.6 g Fe is contained in compound = 100 g
56 g Fe is contained in compound = (100/4.6) x 56 g = 1217.4 g
Hence, the approximate molecular mass of the given compound is ~1217.4 g.

Q-11: How many moles of water are produced when 10 g hydrogen is exploded with 64 g oxygen in a steel vessel?

Answer: The reaction between hydrogen and oxygen is as:

$$H_2 + 1/2O_2 \rightarrow H_2O$$

Hence, 2 g hydrogen reacts with 16 g oxygen to form 18 g water.
∴ 10 g (5 x 2 g) hydrogen need 80 g (5 x 16 g) oxygen to react with.
As only 64 g oxygen is available, oxygen is the limiting reactant here.
So, 64 g oxygen reacts with 8 g of hydrogen to form 72 g water and 2 g hydrogen remains unreacted as excess.
18 g water = 1 mol
72 g water = (1 / 18) x 72 mol = 4 mol
Hence, 4 moles of water are produced in this reaction.

Q-12: The density of CsCl that crystallises in the cubic structure is 3.99 g cm^{-3}. Calculate the distance between the Cs^+ ions and the Cl^- ions.

Answer: CsCl has a BCC structure. So, it has 1 formula unit in its unit cell. Hence, the value of Z is 1 for CsCl with Cubic structure. Hence, density for the ionic compound CsCl can be calculated from the formula:

$$\rho = \frac{Z \times M}{a^3 \times N_0}$$

Where ϱ = density of the crystal (kg m^{-3})
Z = number of formula units present within the unit cell

M = Formula mass of the ionic compound (kg mol^{-1})
a = edge length of the unit cell (m)
N_0 = Avogadro's number

$$a^3 = \frac{Z \times M}{\rho \times N_0}$$

Formula mass of CsCl = 133 g mol^{-1}(mass of Cs) + 35.5 g mol^{-1}(mass of Cl) = 168.5 g mol^{-1}

$$a^3 = \frac{1 \times 168.5\ g\ mol^{-1}}{3.99\ g\ cm^{-3} \times 6.022 \times 10^{23}\ mol^{-1}} = 70.15 \times 10^{-24}\ cm^3$$

Hence, a = $\sqrt[3]{}$70.15 x 10^{-24} cm^3
As 1 pm = 10^{-10} cm
a = $\sqrt[3]{}$70.15 x 10^2 pm = 4.124 x 10^2 pm = 412.4 pm
Now, interionic distance = ($\sqrt{3}$/2)a = (1.732 / 2) x 412.4 pm = 357 pm
Hence, the distance between the Cs^+ ions and the Cl^- ions is 357 pm.

Q-13: The Br^- ion having an ionic radius 195 pm forms a close packed structure. What will be the radius of the cation that just fits into the tetrahedral void?

Answer: The radius of the cation that just fits into the tetrahedral hole must be equal to the radius of the tetrahedral hole.
Radius of the tetrahedral hole = 0.225 x r_{Br^-} = 0.225 x 195 = 43.875 pm
Hence, the radius of the cation that just fits into the tetrahedral hole is 43.875 pm.

Q-14: Why do most of the elements have fractional atomic mass?

Answer: This is due to the fact that the atomic masses are determined by the comparison with the mass of an atom of C-12. The atomic masses of atoms of different elements are the relative masses of the atoms as compared with the mass of an atom carbon 12 taken as 12 g. Hence, atomic masses of most elements are fractional.

Q-15: Which one among the following has the least number of molecules?

a) 0.1 mole of O_2
b) 8 g O_2
c) 11.2 L O_2 at NTP
d) 2.24 x 10^4 mL O_2

Answer: (a.)

Explanation: From (a), 1 mole O_2 contains avogadro's number (N_A) of molecules.
So 0.1 mole contains 0.1 x N_A molecules.
From (b), 32 g O_2 contains moles = 1 mol
8 g O_2 contains moles = 8/32 = 0.25 mol = 0.25 x N_A molecules

From (c), 22.4 L O_2 contains moles = 1 mol
11.2 L O_2 contains moles = 0.5 mol = 0.5 x N_A molecules
From (d), 2.24 x 10^4 mL = 22.4 x 10^3 mL = 22.4 L
22.4 L O_2 contains moles = 1 mol = N_A molecules
Hence, (a) contains the least number of molecules of O_2.

Q-16: Three different isotopes of Neon with the mass number 20, 21 and 22 have fractional abundances 0.9051, 0.0027 and 0.0922 respectively.What is the average atomic mass of Neon?

Answer: The fractional abundance of an isotope is the fraction of total number of atoms of that isotope that occurs naturally in the element in its pure state. The average atomic mass can be calculated by taking out the sum of the product of fractional abundances along with the mass numbers of the given isotopes.

$$\bar{A} = \sum f_i A_i = f_1A_1 + f_2A_2 + f_3A_3 + ...$$

Where $\bar{A}$ is the average atomic mass
f_i = fractional abundances of the respective isotopes
A_i = mass numbers of the corresponding isotopes
Here, f_1 = 20, A_1 = 0.9051
f_2 = 21, A_2 = 0.0027
f_3 = 22, A_3 = 0.0922
Hence, $\bar{A}$ = (20 x 0.9051) + (21 x 0.0027) + (22 x 0.0922)
$\bar{A}$ = 20.179 u
So, the average atomic mass of Neon is 20.179 u.

Q-17: In a closed vessel containing 2 g of oxygen, 1 g of magnesium was burnt. Pick a correct fact for the same.

a) The mixture obtained weighs 5 g.
b) 0.25 g Mg is left unburnt.
c) 1.5 g Oxygen is left unused.
d) 1.67 g of MgO is formed

Answer: (d.)

Explanation: The balanced chemical equation for the reaction between Mg and O is:

$$2Mg + O_2 \rightarrow 2MgO$$

This means that (2 x 24 g) Mg reacts with (2 x 16 g) O_2 i.e. 48 g Mg reacts with 32 g O_2.
1 g Mg will react with oxygen = (32 / 48) x 1g = 0.67 g oxygen
Thus, whole of the Mg is used and the amount of O_2 left unused = 2 g - 0.67 g = 1.33 g
As per the law of conservation of mass, the mixture obtained at the end must be the sum of the initial masses of Mg and O_2. Hence, the mixture should weigh 3 g at the end.
Now, mass of MgO formed from balanced equation = 2 x 40 g = 80 g

This implies that 48 g Mg produces MgO = 80 g
1 g Mg produces MgO = (80/48) x 1 g = 1.67 g
Hence, option (d) is correct.

Q-18: The radius of the anion in a solid A^+B^- having the NaCl type close packed structure is 241.5 pm. What can be the ideal radius of the cation? Can a cation with radius 50 pm fit into the tetrahedral hole of this structure?

Answer: (i) As A^+B^- has a close packed structure, the A^+ ions lie in the octahedral voids. For a close packed structure, the cations must touch the neighbouring anions. Hence, the ideal radius of the cations must be equal to the radius of the octahedral void.
Radius of the Octahedral void = r_{A+} = 0.414 x r_{B-} = 0.414 x 241.5 pm = 99.981 pm = 100 pm
Hence, the ideal radius of the cations must be equal to 100 pm.

(ii) Now, radius of the tetrahedral site = 0.225 x r_{B-} = 0.225 x 241.5 pm = 54.3 pm
Now, as the given radius of cation = 50 pm
The given radius of the cation is smaller than the radius of the tetrahedral void. Hence, the cation with the radius of 50 pm can fit into the tetrahedral hole.

Q-19: Balance the chemical equation given below:

$$Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO + H_2O$$

Answer: In order to get a balanced chemical equation, the number of atoms of each element should be made equal on both sides (reactants and products).
This equation cannot be balanced by the hit and trial method because elements like oxygen are repeated many times. Hence, this equation will be balanced by the partial equation method.
The given reaction proceeds in two steps (each step called the partial equation):
(i) Copper replaces hydrogen from HNO_3

$$Cu + HNO_3 \rightarrow Cu(NO_3)_2 + H$$

This equation is balanced by the hit and trial method as: Cu is balanced, 2 N-atoms are on the product side and only 1 at reactant side. So, HNO_3 is doubled. Oxygen also gets balanced along with N-atoms. There are 2 hydrogen atoms in reactants, so, the H-atom in products is doubled.

$$Cu + 2HNO_3 \rightarrow Cu(NO_3)_2 + 2H$$

(ii) HNO_3 gains an H-atom released in (i) and form NO and water:

$$HNO_3 + H \rightarrow NO + H_2O$$

The balanced chemical equation of this partial equation will be:

$$HNO_3 + 3H \rightarrow NO + 2H_2O$$

Now equation (i) and (ii) are added such that the intermediate reactants and products (i.e. H) are cancelled.

$$Cu + 2HNO_3 \rightarrow Cu(NO_3)_2 + 2H] \times 3$$
$$+ \quad HNO_3 + 3H \rightarrow NO + 2H_2O] \times 2$$

The resultant balanced equation is:

$$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$$

Q-20: How is quartz different from glass? How can quartz be converted into glass?

Answer: The constituent particles in quartz are the SiO_4 tetrahedra units. These constituent particles are arranged in a short range as well as long range order. While in glass, the same constituent particles (SiO_4 tetrahedra) possess only the short range order.
Quartz can be converted into glass by melting followed by rapid cooling.