+1

CHEMISTRY

Volume 1 & 2

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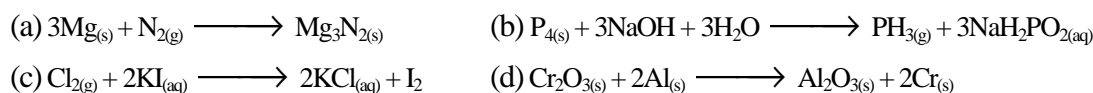**9080228421 / 9488890842**

UNIT-1: BASIC CONCEPTS OF CHEMISTRY AND CHEMICAL CALCULATIONS
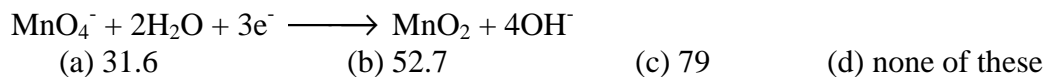
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EVALUATION

1. 40 ml of methane is completely burnt using 80 ml of oxygen at room temperature. The volume of gas left after cooling to room temperature is
    (a) 40 ml CO_2 gas   (b) 40 ml CO_2 gas and 80 ml H_2O gas
    (c) 60 ml CO_2 gas and 60 ml H_2O gas   (d) 120 ml CO_2 gas

2. An element X has the following isotopic composition $^{200}X = 90\%$, $^{199}X = 8\%$ and $^{202}X = 2\%$. The weighted average atomic mass of the element X is closest to
    (a) 201 u   (b) 202 u   (c) 199 u   (d) 200 u

3. **Assertion**   : two mole of glucose contains 12.044×10^{23} molecules of glucose.
   Reason   : Total number of entities present in one mole of any substance is equal to 6.02×10^{22}
    (a) Both assertion and reason are true and the reason is the correct explanation of assertion.
    (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
    (c) assertion is true but reason is false
    (d) both assertion and reason are false

4. Carbon forms two oxides, namely carbon monoxide and carbon dioxide. The equivalent mass of which element remains constant?
    (a) carbon   (b) oxygen
    (c) both carbon and oxygen   (d) neither carbon nor oxygen

5. The equivalent mass of a trivalent metal element is 9 g eq^{-1} the molar mass of its anhydrous oxide is
    (a) 102 g   (b) 27 g   (c) 270 g   (d) 78 g

6. The number of water molecules in a drop of water weighing 0.018 g is   *(JUN 23, MAR 24)*
    (a) 6.022×10^{26} (b) 6.022×10^{23} (c) 6.022×10^{20} (d) 9.9×10^{22}

7. 1 g of an impure sample of magnesium carbonate (containing no thermally decomposable impurities) on complete thermal decomposition gave 0.44 g of carbon dioxide gas. The percentage of impurity in the sample is
    (a) 0%   (b) 4.4%   (c) 16%   (d) 8.4%

8. When 6.3 g of sodium bicarbonate is added to 30 g of acetic acid solution, the residual solution is found to weigh 33 g. The number of moles of carbon dioxide released in the reaction is
    (a) 3   (b) 0.75   (c) 0.075   (d) 0.3

9. When 22.4 litres of $H_{2(g)}$ is mixed with 11.2 litres of $Cl_{2(g)}$, each at 273 K at 1 atm the moles of $HCl_{(g)}$, formed is equal to
    (a) 2 moles of $HCl_{(g)}$ (b) 0.5 moles of $HCl_{(g)}$
    (c) 1.5 moles of $HCl_{(g)}$ (d) 1 mole of $HCl_{(g)}$

10. Hot concentrated sulphuric acid is a moderately strong oxidising agent. Which of the following reactions does not show oxidising behaviour?
    (a) $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$ (b) $C + 2H_2SO_4 \longrightarrow CO_2 + 2SO_2 + 2H_2O$
    (c) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$ (d) None of the above

11. Choose the disproportionation reaction among the following redox reactions.

(a) $3Mg_{(s)} + N_{2(g)} \longrightarrow Mg_3N_{2(s)}$ (b) $P_{4(s)} + 3NaOH + 3H_2O \longrightarrow PH_{3(g)} + 3NaH_2PO_{2(aq)}$

(c) $Cl_{2(g)} + 2KI_{(aq)} \longrightarrow 2KCl_{(aq)} + I_2$ (d) $Cr_2O_{3(s)} + 2Al_{(s)} \longrightarrow Al_2O_{3(s)} + 2Cr_{(s)}$

12. The equivalent mass of potassium permanganate in alkaline medium is

$MnO_4^- + 2H_2O + 3e^- \longrightarrow MnO_2 + 4OH^-$

    (a) 31.6   (b) 52.7   (c) 79   (d) none of these

13. Which one of the following represents 180 g of water?   **(SEP 21)**

    (a) 5 moles of water   (b) 90 moles of water

    (c) $\dfrac{6.022 \times 10^{23}}{180}$ molecules of water   (d) 6.022×10^{24} molecules of water
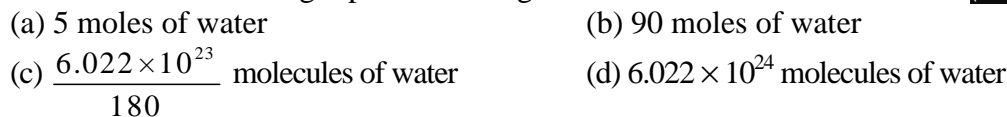
14. 7.5 g of a gas occupies a volume of 5.6 litres at 0°C and 1 atm pressure. The gas is **(SEP 21)**

    (a) NO   (b) N_2O (c) CO   (d) CO_2
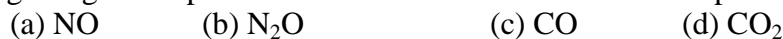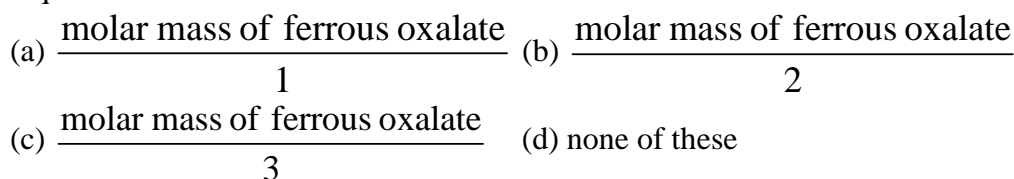
15. Total number of electrons present in 1.7 g of ammonia is   **(JUL 22)**

    (a) 6.022×10^{23} (b) $\dfrac{6.022 \times 10^{22}}{1.7}$ (c) $\dfrac{6.022 \times 10^{24}}{1.7}$ (d) $\dfrac{6.022 \times 10^{23}}{1.7}$
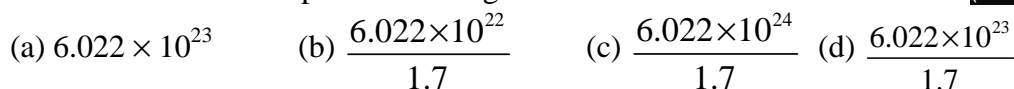
16. The correct increasing order of the oxidation state of sulphur in the anions

SO_4^{2-}, SO_3^{2-}, $S_2O_4^{2-}$, $S_2O_6^{2-}$ is

    (a) $SO_3^{2-} < SO_4^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$ (b) $SO_4^{2-} < S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$

    (c) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-} < SO_4^{2-}$ (d) $S_2O_6^{2-} < S_2O_4^{2-} < SO_4^{2-} < SO_3^{2-}$
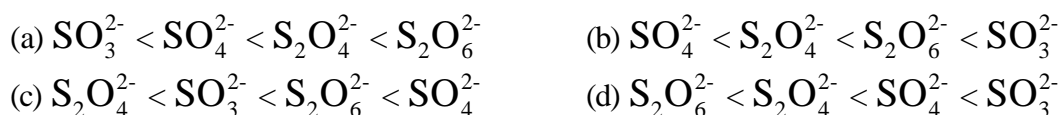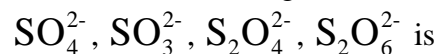
17. The equivalent mass of ferrous oxalate is

    (a) $\dfrac{\text{molar mass of ferrous oxalate}}{1}$ (b) $\dfrac{\text{molar mass of ferrous oxalate}}{2}$

    (c) $\dfrac{\text{molar mass of ferrous oxalate}}{3}$ (d) none of these

18. If Avagadro number were changed from 6.022×10^{23} to 6.022×10^{20}, this would change

    (a) the ratio of chemical species to each other in a balanced equation

    (b) the ratio of elements to each other in a compound

    (c) the definition of mass in units of grams

    (d) the mass of one mole of carbon

19. Two 22.4 litre containers A and B contains 8 g of O_2 and 8 g of SO_2 respectively at 273 K and 1 atm pressure, then

    (a) Number of molecules in A and B are same

    (b) Number of molecules in B is more than that in A

    (c) The ratio between the number of molecules in A to number of molecules in B is 2:1

    (d) Number of molecules in B is three times greater than the number of molecules in A

20. What is the mass of precipitate formed when 50 ml of 8.5% solution of $AgNO_3$ is mixed with 100 ml of 1.865% potassium chloride solution?

    (a) 3.59 g   (b) 7 g   (c) 14 g   (d) 28 g

21. The mass of a gas that occupies a volume of 612.5 ml at room temperature and pressure (25°C and 1 atm pressure) is 1.1 g. The molar mass of the gas is

    (a) 66.25 g mol^{-1} (b) 44 g mol^{-1} (c) 24.5 g mol^{-1} (d) 662.5 g mol^{-1}
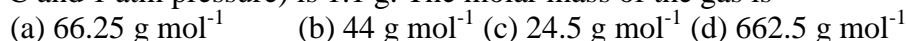
22. Which of the following contain same number of carbon atoms as in 6 g of carbon-12

    (a) 7.5 g ethane   (b) 8 g methane   (c) both (a) and (b)   (d) none of these
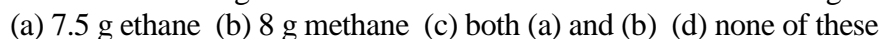
23. Which of the following compound(s) has/have percentage of carbon same as that in ethylene (C_2H_4)   **(MAR 19, SEP 21, MAR 23)**

    (a) propene   (b) ethyne   (c) benzene   (d) ethane

24. Which of the following is/are true with respect to carbon-12
   (a) relative atomic mass is 12 u
   (b) oxidation number of carbon is +4 in all its compounds
   (c) 1 mole of carbon-12 contain 6.022×10^{22} carbon atoms
   (d) all of these

25. Which of the following is used as a standard for atomic mass?
   (a) $_6C^{12}$ (b) $_7C^{12}$ (c) $_6C^{13}$ (d) $_6C^{14}$

ADDITIONAL QUESTIONS

26. Which has maximum number of molecules?
   (a) 7 g N_2 (b) 2 g H_2 (c) 18 g NO_2 (d) 16 g O_2

27. The number of atoms in 0.1 mole of a triatomic gas is:
   (a) 1.8×10^{22} (b) 6.02×10^{23} (c) 1.806×10^{23} (d) 3.6×10^{23}

28. 6.02×10^{20} molecules of urea are present in 100 ml of its solution. The concentration of solution is:
   (a) 0.01 M   (b) 0.001 M (c) 0.1 M   (d) 0.02 M

29. The Number of water molecules is maximum in:
   (a) 1.8 g H_2O (b) 18 g H_2O
   (c) 18 moles of water   (d) 18 molecule of water

30. The oxidation number of Carbon in CH_2F_2 is ......   *(JUNE 19)*
   (a) +4   (b) – 4   (c) 0   (d) +2

31. The relative molecular mass of ethanol is   *(SEP 20)*
   (a) 0.46g   (b) 4.6g   (c) 460 g   (d) 46g

UNIT-2: QUANTUM MECHANICAL MODEL OF ATOM

Choose the Best Answer

EVALUATION

1. Electronic configuration of species M^{2+} is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$ and its atomic weight is 56. The number of neutrons in the nucleus of species M is
    (a) 26   (b) 22   (c) 30   (d) 24

2. The energy of light of wavelength 45 nm is
    (a) 6.67×10^{15} J (b) 6.67×10^{11} J (c) 4.42×10^{-18} J (d) 4.42×10^{-15} J

3. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths i.e. λ_1 and λ_2 will be

    (a) $\dfrac{\lambda_1}{\lambda_2} = 1$ (b) $\lambda_1 = 2\lambda_2$ (c) $\lambda_1 = \sqrt{25 \times 50}\lambda_2$ (d) $2\lambda_1 = \lambda_2$

4. Splitting of spectral lines in an electric field is called   *(MAR 19,22)*
    (a) Zeeman effect   (b) Shielding effect
    (c) Compton effect   (d) Stark effect

5. Based on equation E = -2.178 $\times 10^{-18}$ J $\left(\dfrac{z^2}{n^2}\right)$, certain conclusions are written. Which of them is

    not correct?   *(NEET)*
    (a) Equation can be used to calculate the change in energy when the electron changes orbit
    (b) For n = 1, the electron has a more negative energy than it does for n = 6, which means that the electron is more loosely bound in the smallest allowed orbit
    (c) The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus
    (d) Larger the values of n, the larger is the orbit radius

6. According to the Bohr Theory, which of the following transitions in the hydrogen atom will give rise to the least energetic photon?
    (a) n = 6 to n = 1   (b) n = 5 to n = 4
    (c) n = 5 to n = 3   (d) n = 6 to n = 5

7. **Assertion**   : The spectrum of He^+ is expected to be similar to that of hydrogen.
    Reason   : He^+ is also one electron system.
    (a) If both assertion and reason are true and reason is the correct explanation of assertion
    (b) If both assertion and reason are true but reason is not the correct explanation of assertion
    (c) If assertion is true but reason is false
    (d) If both assertion and reason are false

8. Which of the following pairs of d-orbitals will have electron density along the axes?
                                                                        (NEET Phase-II)

    (a) d_{z^2}, d_{xz} (b) d_{xz}, d_{yz} (c) $d_{z^2}, d_{x^2-y^2}$ (d) $d_{xy}, d_{x^2-y^2}$

9. Two electrons occupying the same orbital are distinguished by   *JUN 23)*
    (a) azimuthal quantum number   (b) spin quantum number
    (c) magnetic quantum number   (d) orbital quantum number

10. The electronic configuration of Eu (Atomic No. 63) Gd (Atomic No. 64) and Tb (Atomic No. 65) are   (**NEET Phase II**)
    (a) [Xe] $4f^6$ $5d^1$ $6s^2$, [Xe] $4f^7$ $5d^1$ $6s^2$ and [Xe] $4f^8$ $5d^1$ $6s^2$
    (b) [Xe] $4f^7$, $6s^2$, [Xe] $4f^7$ $5d^1$ $6s^2$ and [Xe] $4f^9$ $6s^2$
    (c) [Xe] $4f^7$, $6s^2$, [Xe] $4f^8$ $6s^2$ and [Xe] $4f^8$ $5d^1$ $6s^2$
    (d) [Xe] $4f^6$ $5d^1$ $6s^2$, [Xe] $4f^7$ $5d^1$ $6s^2$ and [Xe] $4f^9$ $6s^2$

11. The maximum number of electrons in a sub shell is given by the expression   (**MAR 24**)
    (a) $2n^2$ (b) $2l + 1$ (c) $4l + 2$ (d) none of these

12. For d-electron, the orbital angular momentum is
    (a) $\dfrac{\sqrt{2}h}{2\pi}$ (b) $\dfrac{\sqrt{2}h}{2\pi}$ (c) $\dfrac{\sqrt{2 \times 4}h}{2\pi}$ (d) $\dfrac{\sqrt{6}h}{2\pi}$

13. What is the maximum numbers of electrons that can be associated with the following set of quantum numbers? n = 3, l = 1 and m = -1.
    (a) 4   (b) 6   (c) 2   (d) = 10

14. **Assertion :** Number of radial and angular nodes for 3p orbital are 1, 1 respectively.
    Reason : Number of radial and angular nodes depends only on principal quantum number.
    (a) both assertion and reason are true and reason is the correct explanation of assertion
    (b) both assertion and reason are true but reason is not the correct explanation of assertion
    (c) Assertion is true but reason is false
    (d) both assertion and reason are false

15. The total number of orbitals associated with the principal quantum number n = 3 is
    (**JUL 22, MAR 23**)
    (a) 9   (b) 8   (c) 5   (d) 7

16. If n = 6, the correct sequence for filling of electrons will be,
    (a) ns → (n – 2) f → (n – 1) d → np (b) ns → (n – 1) d → (n – 2) f → np
    (c) ns → (n – 2) f → np → (n – 1) d (d) none of these are correct

17. Consider the following sets of quantum numbers:

	n	l	m	s
i)	3	0	0	$+\dfrac{1}{2}$
ii)	2	2	1	$-\dfrac{1}{2}$
iii)	4	3	-2	$+\dfrac{1}{2}$
iv)	1	0	-1	$+\dfrac{1}{2}$
v)	3	4	3	$-\dfrac{1}{2}$

18. Which of the following sets of quantum number is not possible?
    (a) (i), (ii), (iii) and (iv)   (b) (ii), (iv) and (v)
    (c) (i) and (iii)   (d) (ii), (iii) and (iv)

19. How many electrons in an atom with atomic number 105 can have (n + l) = 8?
    (a) 30   (b) 17   (c) 15   (d) unpredictable

20. Electron density in the yz plane of $3d_{x^2-y^2}$ orbital is
    (a) zero   (b) 0.50   (c) 0.75   (d) 0.90

21. If uncertainty in position and momentum are equal, then minimum uncertainty in velocity is

(a) $\dfrac{1}{m}\sqrt{\dfrac{h}{\pi}}$ (b) $\sqrt{\dfrac{h}{\pi}}$ (c) $\dfrac{1}{2m}\sqrt{\dfrac{h}{\pi}}$ (d) $\dfrac{h}{4\pi}$

22. A macroscopic particle of mass 100 g and moving at a velocity of 100 cm s^{-1} will have a de Broglie wavelength of

(a) 6.6×10^{-29} cm (b) 6.6×10^{-30} cm (c) 6.6×10^{-31} cm (d) 6.6×10^{-32} cm

23. The ratio of de Broglie wavelengths of a deuterium atom to that of an α-particle, when the velocity of the former is five times greater than that of later, is

(a) 4   (b) 0.2   (c) 2.5   (d) 0.4

24. The energy of an electron in the 3rd orbit of hydrogen atom is –E. The energy of an electron in the first orbit will be   *(JUNE 19)*

(a) -3E   (b) $\dfrac{-E}{3}$ (c) $\dfrac{-E}{9}$ (d) -9E

25. Time independent Schrodinger wave equation is

(a) $\hat{H}\psi = E\psi$ (b) $\nabla^2\psi + \dfrac{8\pi^2 m}{h^2}(E + V)\psi = 0$

(c) $\dfrac{\partial^2\psi}{\partial x^2} + \dfrac{\partial^2\psi}{\partial y^2} + \dfrac{\partial^2\psi}{\partial z^2} + \dfrac{2m}{h^2}(E - V)\psi = 0$ (d) all of these

26. Which of the following does not represent the mathematical expression for the Heisenberg uncertainty principle?

(a) $\Delta x \cdot \Delta p \geq \dfrac{h}{4\pi}$ (b) $\Delta x \cdot \Delta v \geq \dfrac{h}{4\pi m}$

(c) $\Delta E \cdot \Delta t \geq \dfrac{h}{4\pi}$ (d) $\Delta E \cdot \Delta x \geq \dfrac{h}{4\pi}$

ADDITIONAL QUESTIONS

26. The orientation of an atomic orbital is governed by

(a) Magnetic quantum number (b) Principal quantum number
(c) Azimuthal quantum number   (d) Spin quantum number

27. Which of the following is not permissible arrangement of electrons in an atom?

(a) n = 5, ℓ = 3, m = 0 , s = +1/2   (b) n = 3, ℓ = 2, m = -2 , s = -1/2
(c) n = 3, ℓ = 2, m = -3, s = -1/2   (d) n = 4, ℓ = 0, m = 0, s = -1/2

28. The orbital angular momentum of a p-electron is given as

(a) $\sqrt{3}\dfrac{h}{2\pi}$ (b) $\dfrac{\sqrt{3}}{2}\dfrac{h}{\pi}$ (c) $\sqrt{6}\sqrt{\dfrac{h}{2\pi}}$ (d) $\dfrac{h}{2\pi}$

29. How many electrons can fit in the orbital for which n = 3 and l = 1?

(a) 2   (b) 6   (c) 10   (d) 14

30. The maximum number of electrons that can be accommodated in L orbit is.   *(SEP 20)*

(a) 8   (b) 2   (c) 4   (d) 6

1. Basic Concepts of Chemistry and Chemical Calculations

1. What do you understand by the term mole? (June-19, June-23) (Gem guide Q.No: 27)

Answer Key	Marks
Correct Explanation	3

2. Define Equivalent Mass(or) Define Gram equivalent mass? (May-22,May-24)

Gem guide Q.No: 28

Answer Key	Marks
Correct definition (or) Gram Equivalent mass= $\dfrac{mass\ (gmol^{-1})}{Equivalent\ Factor}$	2

3. Distinguish between oxidation and reduction? (Sep-21, Mar-23) Gem guide Q.No: 30

Answer Key	Marks
Any three points	3

4. What is the empirical formula of the following? (Sep-21) Gem guide Q.No: 38

   i) Fructose($C_6H_{12}O_6$) Found in honey

   ii) Caffeine ($C_8H_{10}N_4O_2$) a substance found in tea and coffee.

Compound	Molecular Formula	Empirical Formula	Marks
Fructose	$C_6H_{12}O_6$	CH_2O	1
Caffenine	$C_8H_{10}N_4O_2$	$C_4H_5N_2O$	1

5. Calculate the empirical and molecular formula of a compound containing 76.6% carbon, 6.38% hydrogen and rest oxygen. It's vapour density is 47. (Sep 20, Jul 22)

Gem guide Q.No: 42

Answer Key	Marks
Tabular column with simple ratio	2
Empirical Formula = C_6H_6O	1
n=1	1
Molecular Formula = C_6H_6O	1

6. A Compound on analysis gave Na=14.31%, S=9.97%, H=6.22%, H=6.22% and O=69.5%. Calculate the molecular formula of the compound if all the hydrogen in the compound is present in combination with oxygen as water of crystallization. (molecular mass of the compound is 322) (Mar-23) Gem guide Q.No: 43

Answer Key	Mark
Tabular column with simple ratio	2
Empirical formula = $Na_2SH_{20}O_{14}$	1
n = 1	1
Molecular Formula = $Na_2SO_4.10H_2O$	1

7. Balance the following equations by oxidation number method.

(Mar 23) Gem guide Q.No: 45

a) $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO_2 + H_2O$

Answer Key	Mark

$\overset{0}{Cu}+H\overset{+5}{N}O \rightarrow \overset{+2}{Cu}(NO_3)_2 + \overset{+4}{N}O_2 + H_2O$
    ↑   ↓
   2e   1e
 $\mathbf{Cu+2HNO_3 \longrightarrow Cu(NO_3)_2 + NO_2 + H_2O}$
 $Cu+2HNO_3 + \mathbf{2HNO_3} \longrightarrow Cu(NO_3)_2 + 2NO_2 + \mathbf{2H_2O}$
 $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$
	½
	 1

(b) $KMnO_4 + Na_2SO_3 \rightarrow MnO_2 + Na_2SO_4 + KOH$

Answer Key	Mark
$\overset{+7}{K M nO_4} + Na_2 \overset{+4}{S} O_3 \longrightarrow \overset{+4}{Mn} O_2 + Na_2 \overset{+6}{S} O_4 + KOH$ $\uparrow \qquad\qquad \downarrow$ $3e^- \qquad 2e^-$ **2KMnO₄ + 3Na₂SO₃** → MnO₂ + Na₂SO₄ + KOH 2KMnO₄ + 3Na₂SO₃ → 2MnO₂ + 3Na₂SO₄ + **KOH** 2KMnO₄ + 3Na₂SO₃ + **H₂O** → 2MnO₂ + 3Na₂SO₄ + **2KOH**	½ 1

8. Calculate the equivalent mass of H₂SO₄ ? (Mar-19)   **Gem guide Q.No: 62**

Answer Key	Mark
$E= \dfrac{Molar\,mass\ of\ the\ acid}{Basicity\ of\ the\ acid}$ Gram equivalent mass of H₂SO₄ = $\dfrac{98}{2}$ Gram equivalent mass of H₂SO₄ = 49 g eq⁻¹	1 1 1

9. Define Basicity. Find the basicity of ortho-phosphoric acid. (Sep-20) Gem guide Q.No: 55

Answer Key	Marks
Correct Definition	1
Basicity = 3 equ mol⁻¹	1

10. What is meant by limiting agent? (July-22)   **Gem guide Q.No: 58**

Answer Key	Marks
Correct definition	2

11. Calculate oxidation number of oxygen in H₂O₂. (Mar-19)   **Gem guide Q.No: 63**

Answer Key	Marks
H₂O₂, 2(+1)+2x=0, x= -1	1 + 1

12 Calculate the oxidation number of underlined elements. (May-22) Gem guide Q.No: 66
a) C̲O₂ b)H₂ S̲O4

Answer Key	Marks
i)C+2(-2) = 0 C=+4	1 ½
ii) 2(+1)+S+4(-2)=0 S=+6	1 ½

13. A Compound having the empirical formula C₆H₆O has the vapour density 47. Find its Molecular Formula. (Mar-19)   **Gem guide Q.No: 68**

Answer Key	Marks
Mass of empirical formula= 6(12)+6(1) + 16 = 94	½
Molar mass =2×Vapour density=2×47=94	½
$n = \dfrac{molecular\ mass}{Calculated\ empirical\ formula\ mass}$	½
= 94/94 = 1	½
Molecular formula = n× empirical formula	½
Molecular formula = 1×(C₆H₆O) = C₆H₆O	½

14. An organic compound present in the vinegar has 40% carbon, 6.6% hydrogen and 53.4% oxygen. Find its Empirical formula. (Mar-24)   **Gem guide Q.No: 72**

Answer Key	Marks
Tabular column with simple ratio for three elements	2
Empirical formula = CH₂O	1

2. Quantum Mechanical Model of Atom

1. Calculate the total number of angular nodes and radial nodes present in 3d and 4f Orbitals. (Sep-20) (Gem Guide Q.No – 4)

Answer Key	Marks
3d $\Rightarrow$ Radial node=0, Angular node=2	1
4f $\Rightarrow$ Radial node=0, Angular node=3	1

2. How many orbitals are possible for n=4? (May-22)   (Gem Guide Q.No -27)

Answer Key	Marks
Possible orbitals-16	2

3. State and explain Pauli's exclusion principle. (Mar-19, Mar-23) (Gem Guide Q.No – 31)

Answer Key	Marks
No two electrons in an atom can have the same set of values of all four quantum numbers	3

4. Define orbital. What are the n and *l* values for $3p_x$ and $4d_{x^2-y^2}$ electrons?

(June-19, June-23, Mar-24) (Gem Guide Q.No– 32)

Answer Key	Mark
Correct definition	1
$3p_x \Rightarrow$ n=3, l=1	1
$4d_{x^2-y^2} \Rightarrow$ n=4, l=2	1

5. Give the electronic configuration of Mn^{2+} and Cr^{3+} (Aug-22) (Gem Guide Q.No: 39)

Answer Key	Mark
Mn^{2+} - $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^0$	1
Cr^{3+}- $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^0$	1

6. Describe the Aufbau principle. (Sep-21)   (Gem Guide Q.No: 40)

Answer Key	Marks
Correct Explanation	2
Figure Only	1

7. State Heisenberg's uncertainity principle. (Sep-20, Aug-22, Mar-23)

(Gem Guide Q.No: 52)

Answer Key	Marks
Correct Definition (or)	3
$\Delta x. \Delta p \geq h/4\pi$	2
Δx – uncertainty in determining the position	½
Δp – uncertainty in determining the momentum	½

8. Define exchange energy. (Sep-21)   (Gem Guide Q.No: 57)

Answer Key	Marks
Correct Explanation	2

9. Calculate the orbital angular momentum for d and f orbital.(June-19)

(Gem Guide Q.No: 59)

Answer Key	Marks
Angular momentum of electron in $d = \dfrac{\sqrt{6}h}{2\pi}$	1
Angular momentum of electron in $f = \dfrac{\sqrt{12}h}{2\pi}$	1

10. In degenerate orbitals, why do the completely filled and half filled configuration are more stable than the partially filled configuration? (Sep-20)   (Gem Guide Q.No: 60)
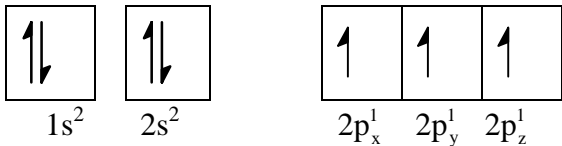
Answer Key	Marks
Correct Explanation	2

11. Calculate the maximum number of electron that can be accommodated in L shell.
(May-22) (Gem Guide Q.No: 61)

Answer Key	Mark
The maximum number of electrons = $2n^2$	1
The maximum number of electrons = 8	1

12. Write the electronic configuration and orbital diagram for nitrogen.(May-22)
(Gem Guide Q.No: 62)

Answer Key	Marks
Electronic configuration for nitrogen = $1s^2 2s^2 2p^3$ Orbital diagram for nitrogen $\boxed{\uparrow\downarrow}$ $\boxed{\uparrow\downarrow}$　　$\boxed{\uparrow}$ $\boxed{\uparrow}$ $\boxed{\uparrow}$ 　$1s^2$　$2s^2$　　　$2p_x^1$ $2p_y^1$ $2p_z^1$	1 2

13. Derive the de-Brogile equation. (Mar-19) (Gem Guide Q.No: 66)

Answer Key	Marks
$E = h\nu$	½
$E = mc^2$	½
$h\nu = mc^2$	½
$\nu = \dfrac{c}{\lambda}$	½
$\lambda = \dfrac{h}{mv}$	1

14. Write a short note on Quantum numbers.
(Sep-21, Mar-23, Jun-23) (Gem Guide Q.No: 68)

Answer Key	Marks
Principal Quantum Number – Explanation	2
Azimuthal Quantum Number – Explanation	1
Magnetic Quantum Number – Explanation	1
Spin Quantum Number – Explanation	1
(or) Heading only	1

3. PERIODIC CLASSIFICATION OF ELEMENTS

1. State: Modern Periodic law. (Mar-23) (Gem Guide Q. No –24)

Key Answer	Mark
Correct statement	2

2. Define: Electro negativity. (Sep-21, Mar-24) (Gem Guide Q. No – 29)

Key Answer	Mark
Correct definition	2

3. How would you explain the fact that the second ionization potential is always higher than first ionization potential? (June-23) (Gem Guide Q. No – 30)

Key Answer	Mark
Correct explanation	3

4. Give the general electronic configuration of lanthanides and actinides? (June-19, Mar24) (Gem Guide Q. No – 36)

Key Answer	Mark
Lanthanides: $4f^{1-14}5d^{0-1}6s^2$ Actinides: $5f^{0-14}6d^{0-2}7s^2$	2

5. Explain the diagonal relationship. (Mar-19, Sep-21, Mar-23) (Gem Guide Q. No – 41)

Key Answer	Mark
Correct definition	2
Suitable example (any one pair)	1

6. Explain the periodic trend of ionization potential. (Mar-24) (Gem Guide Q. No – 40)

Key Answer	Mark
IE decreases down a group (or top to bottom)	1 ½
IE increases along a period (or left to right)	1 ½

7. Explain the Pauling Method for the determination of ionic radius (Sep-20, May-22) (Gem Guide Q. No – 39)

Key Answer	Mark
$d = r_{C^+} + r_{A^-}$ … (1) r_{C^+} = radius of the cation r_{A^-} = radius of the anion	1
$$r_{C^+} \alpha \frac{1}{(Z_{eff})_{C^+}} \quad … (2)$$	1
$$r_{A^-} \alpha \frac{1}{(Z_{eff})_{A^-}} \quad … (3)$$	1
Z_{eff} = effective nuclear charge ($Z_{eff} = Z – S$)	½
$$\frac{(2)}{(3)} \Rightarrow \quad \frac{r_{C^+}}{r_{A^-}} = \frac{(Z_{eff})_{A^-}}{(Z_{eff})_{C^+}} \quad … (4)$$ Using equation (1) and (4), r_{C^+} and r_{A^-} can be determined.	1 ½

8. Explain the following, give appropriate reasons. (June -19) (Gem Guide Q. No – 44)

i) Ionisation potential of N is greater than that of O.

Key Answer	Mark
$N = 1s^2 2s^2 2p^3$ $O = 1s^2 2s^2 2p^4$	1
Correct Explanation	1

ii) Electron affinity of Be and N have zero. Give reason (Sep-20)

Answer Key	Marks
$Be = 1s^2 2s^2$ $N = 1s^2 2s^2 2p^3$	1
Correct Explanation	1

9. State the trends in the variation of electro negativity in group and periods.

(Sep-21, Aug-22) (Gem Guide Q. No – 47)

Key Answer	Marks
The electro negativity increases across a period from left to right	1
The electro negativity decreases down a group	1

10. State: Law of triads (or) State and explain Dobereiner's "Triad".

(Mar 19) (Gem Guide Q. No – 48)

Key Answer	Mark
Correct definition	2
Example	1

11. Define – atomic radius (Sep-21) (Gem Guide Q. No – 52)

Key Answer	Mark
Correct definition	2

12. Define Metallic radius (Sep-21) (Gem Guide Q. No – 54)

Answer Key	Mark
Correct definition	2

13. Define: Ionic radius (Sep-21) (Gem Guide Q. No – 57)

Key Answer	Mark
Correct definition	3

14. Define: Electron Gain enthalpy/Electron affinity. (Mar-22) (Gem Guide Q. No – 59)

Key Answer	Mark
Correct definition	3

15. Compare the ionisation energy of Beryllium and Boron? (Sep-22)

(Gem Guide Q. No – 64)

Key Answer	Mark
$Be = 1s^2 2s^2$ $B = 1s^2 2s^2 2p^1$	1
ionisation energy of Beryllium is greater than Boron Reason : Fully filled 2S orbital in Beryllium	1 1

16. What are inner transition elements? (or) What are f-block elements? (Aug-22)

(Gem Guide Q. No – 62)

Key Answer	Mark
Correct explanation	2
1. Lanthanide 2. Actinide	1

17. Define valency. How is it determined? (Mar-19) (Gem Guide Q. No – 63)

Key Answer	Mark
It is equal to the total number of electrons in the valence shell	2

18. Calculate the effective nuclear charge on 4s electron and 3d electron in Scandium.

(Jul -23) (Gem Guide Q. No – 65)

Key Answer	Mark
Calculation of effective nuclear charge on 4s electron $Z_{eff} = Z – S = 21-18=3$	1
Calculation of effective nuclear charge on 3d electron $Z_{eff} = Z – S = 21-18=3$	1

4. HYDROGEN

1. Discuss the three types of covalent hydrides. (or) What are covalent hydrides? (May-22)

(Gem Guide Q. No – 23)

Answer key	Mark
(i) Electron precise – CH_4 (ii) Electron-deficient – B_2H_6 (iii) Electron-rich hydrides – NH_3	2

2. What is water-gas shift reaction? (June-23)   (Gem Guide Q. No – 30)

Answer key	Mark
$CO + H_2O \xrightarrow[400°]{Fe/Cu} CO_2 + H_2$	2

3. What are isotopes? Write the names of isotopes of hydrogen. (Mar-23)

(Gem Guide Q. No – 32)

Answer key	Mark
Correct definition	1 ½
Protium – $_1H^1$, Deuterium – $_1H^2$, Tritium – $_1H^3$	½+½+½

4. Give the uses of heavy water. (June-23)   (Gem Guide Q. No – 33)

Answer key	Mark
Any three uses	3

5. Explain the exchange reactions of deuterium. (Sep-20)   (Gem Guide Q. No – 34)

Answer key	Mark
Any one correct equation	2

6. How do you convert para hydrogen into ortho hydrogen? (Mar-23)

(Gem Guide Q. No – 35)

Answer key	Mark
Any three methods	3

7. Mention the uses of deuterium. (Sep-20)   (Gem Guide Q. No – 36)

Answer key	Mark
Any three Uses	3

8. Complete the following reactions. (i) $Na_2O_2 + - - - - \rightarrow Na_2SO_4 + H_2O_2$ (Mar-19)

(Gem Guide Q. No – 45)

Answer key	Mark
$Na_2O_2 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O_2$	2

9. Write the laboratory method of preparation of hydrogen (Sep-20)

(Gem Guide Q. No – 47)

Answer key	Mark
$Zn + 2HCl \rightarrow ZnCl_2 + H_2\uparrow$	**2**

10. Why H_2O_2 is stored in plastic bottles? Give reason. (or) Why hydrogen peroxide is stored in plastic containers, not in glass container? (JUNE-19) (Gem Guide Q. No – 59)

Answer key	Mark
It dissolves alkali metals in glass	3

11. How is tritium prepared? (Mar-19, June-23)   (Gem Guide Q. No – 60)

Answer key	Mark
$_3^6Li + _0^1n \rightarrow _2^4He + _1^3T$	2

12. What are syngas? How is prepared? (June -19)　　　**(Gem Guide Q. No – 61)**

Answer Key	Mark
$C + H_2O \xrightarrow{1000°} \underbrace{CO + H_2}_{water\ gas/syngas}$	2

1**3. Give an example for ionic hydride and covalent hydride.**

(June-22) (Gem Guide Q. No – 62)

Answer key	Mark
Any one example for ionic hydride	1
Any one example for covalent hydride	1

14. What are Metallic hydrides (or) interstitial hydrides? Give the Example. (Mar-24)

(Gem Guide Q. No – 65)

Answer key	Mark
Correct definition	2
Any one example	1

15. Give the uses of hydrogen (Mar-24)　　　**(Gem Guide Q. No – 66)**

Answer key	Mark
Any three uses	3

5. ALKALI AND ALKALINE EARTH METALS

1. Discuss briefly the similarities between beryllium and aluminium.
(June-19, Sep-21, June-23, Mar-24) (Gem Guide Q. No –30)

Answer Key	Marks
Any five similarities	5

2. Mention the uses of plaster of Paris (Mar-23) (Gem Guide Q. No –33)

Answer Key	Marks
Any two uses	2

3. Write balanced chemical equation for the following processes
 Heating calcium carbonate (Mar-24)   (Gem Guide Q. No –36)

Answer Key	Marks
$CaCO_3 \xrightarrow{\ \Delta\ } CaO + CO_2$	2

4. Discuss briefly the similarities between beryllium and aluminium.
(Jun-19, Sep-21, Jun-23, Mar-24) (Gem Guide Q. No –38)

Answer Key	Marks
Any five similarities	5

5. Among the alkaline earth metals BeO and MgO is insoluble in water but other oxides are soluble. Why? (Mar-2019) (Gem Guide Q. No –44)

Answer Key	Marks
BeO is covalent due to the small size of Be^{2+} ion,	1
while other oxides are ionic in nature.	1

6. Why blue colour appears during the dissolution of alkali metals in liquid ammonia?
(June-19) (Gem Guide Q. No –57)

Answer Key	Marks
The blue colour of the solution is due to the ammoniated electron which absorbs energy in the visible region of light and thus imparts blue colour to the solution.	2

7. Among the alkali metal halides, which is covalent? Explain with reason.
(June-19)(Gem Guide Q. No –56)

Answer Key	Marks
Lithium halides shows covalent character, as it is the smallest cation that exerts high polarising power on the halides.	2

8. Explain why Ca(OH)₂ is used in white washing. (Mar-2019) (Gem Guide Q. No –59)

Answer Key	Marks
due to its disinfectant nature	3

9. How is Bleaching powder prepared? (sep-20) (Gem Guide Q. No –60)

Answer Key	Marks
Milk of lime reacts with chlorine gives bleaching powder. $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$	2

10. Discuss distinctive behavior of beryllium (or) Mention any two anomalous properties of second period elements. (or) What are the reasons for anomalous properties of Beryllium? (May-22) (Gem Guide Q. No –61)

Answer Key	Marks
Any two reasons for anomalous behaviors of beryllium	2x1=2

11. What are the uses of magnesium? (Sep-20) (Gem Guide Q. No –63)

Answer Key	Marks
Any three uses	3

12. Mention the uses of calcium (Mar-23) (Gem Guide Q. No –64)

Answer Key	Marks
Any three uses	2

13. Write the chemical name of baking soda. Give the uses sodium bicarbonate
                                    (June-23) (Gem Guide Q. No –70)

Answer Key	Marks
Chemical Name: Sodium bi carbonate	1
Any two uses	2

14. Compare the properties of Beryllium with other elements of group 2. (or) Give the properties of Beryllium that are different from other elements of the group.
                                    (May-22)(Gem Guide Q. No –71)

Answer Key	Marks
Any three properties of Beryllium that are different from other elements	3

15. Discuss the similarities between lithium and magnesium.
                                    (June-22) (Gem Guide Q. No –73)

Answer Key	Marks
Any five similarities	5

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