Engineering Daily Exam 11 [Home Practice] EV

Syllabus: Qualitative Chemistry

Total Marks: 50 **Negative Marks:** 0.25 **Time:** 1 Hour

MCQ 50 marks

1. Using Hund's rule, which is correct when comparing the number of unpaired electrons in Fe^{2+} and Fe^{3+} ($Z = 26$)?

   (A) Fe^{2+} has 4, Fe^{3+} has 5

   (B) Both are equal (5 each)

   (C) Fe^{2+} has 6, Fe^{3+} has 5

   (D) Fe^{2+} has 5, Fe^{3+} has 4

2. Why are 3f and 2d orbitals actually impossible?

   (A) Since l ranges from 0 to $(n-1)$, neither $l = 3$ at $n = 3$ nor $l = 2$ at $n = 2$ is possible

   (B) Pauli's principle forbids them

   (C) Hund's rule is violated

   (D) They are only possible in heavy elements

3. Which pair of electron configurations correctly represents two elements that violate the Aufbau principle?

   (A) $Fe : [Ar]3d^6 4s^2$ and $Co : [Ar]3d^7 4s^2$

   (B) $Cr : [Ar]3d^5 4s^1$ and $Cu : [Ar]3d^{10} 4s^1$

   (C) $Zn : [Ar]3d^{10} 4s^2$ and $Ga : [Ar]3d^{10} 4s^2 4p^1$

   (D) $Sc : [Ar]3d^1 4s^2$ and $Ti : [Ar]3d^2 4s^2$

4. Using the $(n + l)$ rule, arrange the 3d, 4p, 5s, and 4f orbitals in increasing order of energy.

   (A) $3d < 4p < 5s < 4f$ (B) $4p < 3d < 5s < 4f$

   (C) $3d < 4p < 4f < 5s$ (D) $5s < 4p < 3d < 4f$

5. Which of the following quantum-number sets is not allowed?

   (A) $n = 2, l = 1, m = -1, s = +\frac{1}{2}$

   (B) $n = 1, l = 0, m = 0, s = -\frac{1}{2}$

   (C) $n = 4, l = 2, m = +2, s = -\frac{1}{2}$

   (D) $n = 3, l = 3, m = 0, s = +\frac{1}{2}$

6. What is the maximum number of orbitals and electrons in a g-subshell, and what is its azimuthal quantum number?

   (A) $l = 4$; 7 orbitals; 14 electrons

   (B) $l = 3$; 7 orbitals; 14 electrons

   (C) $l = 4$; 9 orbitals; 18 electrons

   (D) $l = 4$; 5 orbitals; 10 electrons

7. If the electron of He^+ is excited from $n = 3$ to $n = 4$, what is the ratio of the areas enclosed by the higher and lower orbits?

   (A) $\frac{16}{9}$ (B) $\frac{256}{81}$

   (C) $\frac{4}{3}$ (D) 16

8. Which is the correct set of quantum numbers for the three electrons of Li ($Z = 3$)?

   (A) $(1, 0, 0, +\frac{1}{2}), (2, 0, 0, +\frac{1}{2}), (2, 0, 0, -\frac{1}{2})$

   (B) $(1, 0, 0, +\frac{1}{2}), (1, 0, 0, +\frac{1}{2}), (2, 0, 0, -\frac{1}{2})$

   (C) $(1, 0, 0, +\frac{1}{2}), (1, 0, 0, -\frac{1}{2}), (2, 0, 0, +\frac{1}{2})$

   (D) $(1, 1, 0, +\frac{1}{2}), (1, 0, 0, -\frac{1}{2}), (2, 0, 0, +\frac{1}{2})$

9. In Bohr's 1st orbit, the velocity of the He^+ electron is x. What will be the velocity of the electron of Li^{2+} in the 3rd orbit?

   (A) $\frac{x}{2}$ (B) $\frac{x}{9}$ (C) $3x$ (D) $2x$

10. If $K_{ip} > K_{sp}$ is found for a solution, what is the correct conclusion about the state of the solution?

    (A) The reaction will stop completely

    (B) The solution is unsaturated

    (C) The solution is exactly saturated, no change will occur

    (D) The solution is supersaturated and a precipitate will form

11. What is the name of the technique that separates components based on differing boiling points at reduced pressure?

    (A) Chromatography (B) Crystallization

    (C) Vacuum distillation (D) Filtration

12. Which isotope is used in carbon dating to determine the age of ancient fossils?

    (A) ${}^{11}_{6}C$ (B) ${}^{12}_{6}C$ (C) ${}^{13}_{6}C$ (D) ${}^{14}_{6}C$

13. Why did Rutherford use a ZnS screen in his experiment discovering the nucleus?

    (A) To create a negative field

    (B) To change the direction of α-particles

    (C) To create a positive field

    (D) To detect the point of α-particle collision via fluorescence

14. In the complete decay chain of ${}^{238}_{92}U$ decaying to ${}^{206}_{82}Pb$, how many total α and β particles will be emitted?

    (A) 8 α, 6 β (B) 6 α, 8 β

    (C) 8 α, 8 β (D) 10 α, 4 β

15. Adding $BaCl_2$ to an unknown salt solution gives a white precipitate insoluble in HCl(aq). The flame test shows no characteristic colour. What is the likely salt?

    (A) $MgSO_4$ (B) Na_2SO_4

    (C) $CaSO_4$ (D) K_2SO_4

16. A radioactive sample decays to $\frac{1}{64}$ of its initial activity in 90 minutes. What is its half-life?

(A) 10 minutes (B) 12 minutes

(C) 15 minutes (D) 18 minutes

17. If the solubility product of Cr_2S_3 is $K_{sp} = 1.08 \times 10^{-5}$, what is its approximate molar solubility?

(A) 1.08×10^{-1} M (B) 3.98×10^{-2} M

(C) 2.0×10^{-3} M (D) 5.4×10^{-6} M

18. How many grams of salt will crystallize when 250 g of saturated solution is cooled from 60°C to 20°C? (solubility at 60°C and 20°C is 45 and 20 respectively)

(A) 25.0 g (B) 43.1 g (C) 62.5 g (D) 77.6 g

19. Both Zn^{2+} and Al^{3+} give a white precipitate with NaOH that dissolves in excess NaOH. Which reagent should be used to distinguish between these two ions?

(A) Diluting with water (B) Adding more NaOH

(C) Adding HCl (D) Adding NH_4OH

20. What colour compound is formed when $K_3[Fe(CN)_6]$ (potassium ferricyanide) reacts with the Fe^{2+} ion?

(A) Turnbull's blue (deep blue)

(B) Prussian blue

(C) Chocolate brown

(D) White

21. In the precipitation of Group-3 cations, why is NH_4Cl added before NH_4OH?

(A) To suppress the OH^- concentration via the common ion effect

(B) To increase the OH^- concentration

(C) To act as a catalyst

(D) To dissolve the Group-2 precipitate

22. If an electron in a hydrogen atom falls from n = 4 to n = 2, what is the wavelength of the emitted light?

(A) 434.2 nm (B) 486.3 nm

(C) 656.3 nm (D) 121.6 nm

23. What is the wavelength of the 2nd line of the Lyman series ($n = 3 \rightarrow n = 1$) of the hydrogen spectrum?

(A) 121.6 nm (B) 91.2 nm

(C) 102.6 nm (D) 97.3 nm

24. Evaporating 0.025 kg of an unsaturated solution in 100 g of water yielded 5 g of solute. If the solute's solubility is 40, how many grams of solute must be added to saturate 0.1 kg of the unsaturated solution at that temperature?

(A) 8 g (B) 20 g (C) 15 g (D) 12 g

25. If an electron in a Be^{2+} ion falls from n = 3 to n = 1, what is the approximate wavelength of the emitted radiation, and which region does it fall in?

(A) 6.41 nm, X-ray/UV border region

(B) 121.6 nm, UV

(C) 65.4 nm, UV

(D) 486 nm, visible

26. How much energy will be absorbed to excite an electron in a hydrogen atom from n = 1 to n = 4?

(A) 12.09 eV (B) 13.6 eV

(C) 12.75 eV (D) 0.85 eV

27. According to the Bohr model, the velocity of the electron in the 4th orbit of a hydrogen atom is what fraction of the velocity in the 1st orbit?

(A) $\frac{1}{2}$ (B) 4 (C) $\frac{1}{16}$ (D) $\frac{1}{4}$

28. What is the de Broglie wavelength of a neutron moving at 500 ms^{-1}? ($m_n = 1.675 \times 10^{-27}$ kg)

(A) 7.91×10^{-10} m (B) 7.91×10^{-13} m

(C) 1.26×10^{9} m (D) 3.35×10^{-24} m

29. If K_{sp} of AgI is 8.5×10^{-17}, what is its molar solubility?

(A) 8.5×10^{-17} M (B) 9.22×10^{-9} M

(C) 2.92×10^{-6} M (D) 4.25×10^{-17} M

30. If equal volumes of 0.05 M $Pb(NO_3)_2$ and 0.05 M NaCl are mixed, will $PbCl_2$ ($K_{sp} = 1.7 \times 10^{-5}$) precipitate?

(A) The solution will remain exactly saturated

(B) Yes, precipitation will occur

(C) No, precipitation will not occur

(D) Insufficient information

31. If the solubility of $Mg_3(PO_4)_2$ is S, which is the expression for its K_{sp}?

(A) $K_{sp} = 27S^5$ (B) $K_{sp} = S^5$

(C) $K_{sp} = 6S^5$ (D) $K_{sp} = 108S^5$

32. The electron of a He^+ ion is in the M shell, orbiting the nucleus. Find the energy absorbed, in eV/mol, if it transitions to the fourth energy level.

(A) 2.65 eV/mol (B) 1.6×10^{24} eV/mol

(C) 6.54×10^{27} eV/mol (D) 1.6×10^{-24} eV/mol

33. At what angle are the P_x, P_y, P_z orbitals oriented with respect to each other?

(A) 0 (B) $\frac{\pi}{2}$ (i.e. 90°)

(C) π (D) 2π

34. How many times greater is the energy of the 4th Bohr orbit compared to the 3rd Bohr orbit of a hydrogen atom?

(A) $\frac{4}{3}$ (B) $\frac{16}{9}$ (C) $\frac{9}{16}$ (D) $\frac{3}{4}$

35. If an electron in a hydrogen atom moves from the 3rd orbit to the 5th orbit, by how much will the orbital radius increase? (express as a multiple of r_3)

Ⓐ It will remain unchanged

Ⓑ It will increase by $\frac{25}{9}r_3$

Ⓒ It will increase by $2r_3$

Ⓓ It will increase by $\frac{16}{9}r_3$

36. How many angular (axial) nodes are there in a 3p orbital?

Ⓐ 0 Ⓑ 2 Ⓒ 1 Ⓓ 4

37. If an element has an outer-shell electron configuration of the form $4d^5 4s^2$ (considering a 4d/5s block element like molybdenum), what is its approximate atomic number?

Ⓐ 44 Ⓑ 43 Ⓒ 41 Ⓓ 42

38. What is the total number of electrons in the HSO_4^- ion?

Ⓐ 48 Ⓑ 49 Ⓒ 50 Ⓓ 51

39. If an ion has 18 electrons, 22 neutrons, and a charge of −1, what is its mass number?

Ⓐ 41 Ⓑ 40 Ⓒ 39 Ⓓ 38

40. Which of the following cannot be accelerated by an electromagnetic field?

Ⓐ β-particle Ⓑ Proton

Ⓒ α-particle Ⓓ Neutron

41. In the following reaction, what is Y ? $^{24}_{12}Mg \xrightarrow{-\beta} X \xrightarrow{-\alpha} Y$

Ⓐ $^{27}_{13}Al$ Ⓑ $^{20}_{11}Na$

Ⓒ $^{23}_{11}Na$ Ⓓ $^{24}_{13}Al$

42. What is the total mass, in kilograms, of 1 mole of neutrons? (mass of one neutron = 1.6749×10^{-27} kg)

Ⓐ 1.008×10^{-3} kg Ⓑ 1.008×10^{-2} kg

Ⓒ 1.675×10^{-27} kg Ⓓ 6.022×10^{-23} kg

43. What is the orbital angular momentum of an electron in a 3d orbital?

Ⓐ $\sqrt{6}\hbar$ Ⓑ $\sqrt{2}\hbar$ Ⓒ $\sqrt{12}\hbar$ Ⓓ $2\hbar$

44. What is the characteristic colour of the precipitate formed when NaOH is added to an Fe^{2+} salt solution?

Ⓐ Reddish brown Ⓑ Dirty green

Ⓒ White Ⓓ Yellow

45. What molecular motion does IR spectroscopy fundamentally rely on?

Ⓐ Electronic transitions

Ⓑ Bond vibration and rotational transitions

Ⓒ Nuclear spin change

Ⓓ Inner-shell electron ejection

46. K_{sp} of $Al(OH)_3$ is 2×10^{-32}. If 12% of $Al(OH)_3$ dissociates in a saturated aqueous solution, what is the pH of the solution?

Ⓐ 7.063 Ⓑ 6.981 Ⓒ 5.363 Ⓓ 8.923

47. Which region of electromagnetic radiation is blocked by the ozone layer?

Ⓐ Infrared (IR) Ⓑ X-ray

Ⓒ γ-ray Ⓓ Ultraviolet (UV)

48. According to Pauli's exclusion principle, what cannot be the same for two electrons in an atom?

Ⓐ The same energy level

Ⓑ All four quantum numbers being identical

Ⓒ The same spin direction

Ⓓ The same principal quantum number

49. According to the Aufbau principle, in what order do electrons fill orbitals?

Ⓐ In order of decreasing energy

Ⓑ In order of increasing energy

Ⓒ Randomly at any energy level

Ⓓ In order of increasing atomic mass

50. Which is the correct order of energy for electromagnetic radiations?

Ⓐ Visible light > γ-ray > X-ray

Ⓑ Radio wave > Visible light > X-ray > γ-ray

Ⓒ γ-ray > X-ray > Visible light > Radio wave

Ⓓ All radiations have equal energy