ENTRANCE EXAM QUESTIONS

GENERAL AND INORGANIC CHEMISTRY

1. Which series contains only metals?

a) I, B, Si, K, Ca b) Br, He, Sn, As, Bi c) Hg, C, B, I, S d) Ag, Cl, He, As, Si e) Hg, Al, Bi, Cs, Be

2. The atoms of a certain chemical element have the following electron configuration: $1s^22s^22p^63s^23p^63d^{10}4s^24p^5$

This element is located in:

a) Group VII, Period IVb) Group IV, Period Vc) Group III, Period Vd) Group III, Period IV

3. Which series contains only nonmetals?

a) Ag, Cr, Ni, Co, C b) Si, O, Hg, Al, N c) P, Bi, S, Zn, Ar d) F, H, S, N, I e) Ar, Al, As, Co, Cr

4. Isotopes are atoms with:

a) the same number of neutrons

- b) the same mass number
- c) the same atomic number, but different mass numbers
- d) the same mass number, but different atomic numbers
- e) the same number of protons, but different number of electrons
- 5. What is the empirical formula of a compound containing 26.53% potassium, 35.37% chromium, and 38.10% oxygen? K = 39; Cr = 52
- a) K2Cr2O7 b) K2CrO4 c) KCrO4 d) K2CrO6 e) KCrO3
- 6. In the molecule of which substance are the atoms bonded by an ionic bond?

a) C_2H_6 b) Cl_2 c) NH_3 d) $MgCl_2$ e) PH_3

7. In the molecule of which substance are the atoms bonded by a polar covalent bond?

a) C_2H_6 b) Cl_2 c) $MgCl_2$ d) N_2 e) H_2O

8. Equal volumes of gases under the same conditions contain the same number of molecules. This statement refers to the:

a) Law of constant volume ratios

b) Proust's lawc) Avogadro's lawd) Gay-Lussac's lawe) Ostwald's law

9. How many iodine atoms are contained in the amount of iodine produced in the reaction of 224 cm³ of chlorine gas (at normal conditions) with the appropriate amount of potassium iodide?

a) 10^{-2} b) $2 \cdot 10^{-2}$ c) $1.1 \cdot 10^{23}$ d) 1.2×10^{22} e) 0.6×10^{22}

10. Calculate the percentage composition of elements in sodium sulfite (Na₂SO₃): (Na = 23, S = 32)

a) 32.4 % Na 22.5 % S 45.1 % O	b) 19.3 % Na 26.9 % S 53.8 % O	c) 36.5 % Na 25.4 % S 38.1 % O
d) 58.97 % Na 41.03 % S -	e) 38.1 % Na 36.5 % S 25.4 % O	

11. How many hydrogen atoms are there in 56 cm³ of ammonia (NH₃) at normal conditions?

a) $9x10^{21}$ b) $4.5x10^{21}$ c) $4.5x10^{20}$ d) $3x10^{21}$ e) $6x10^{21}$

- **12.** What is the relative molecular mass of a gaseous substance if 20 g of that substance occupies 5600 mL at normal conditions?
- a) 50 b) 500 c) 8 d) 80 e) 800

13. How many grams of carbon dioxide (CO₂) are obtained from 4.5 g of carbon and 16 g of oxygen?

a) 16.5 b) 20.5 c) 11 d) 19 e) 12.5

14. Which of the following nitrogen samples contains the greatest number of atoms? (N = 14)

- a) 1.2x10²³ molecules b) 0.1 mole of atoms c) 4.2 g e) 2.24 liters (at normal conditions)
- **15.** The amount of 0.3 moles of one of the following salts contains 3.6×10^{23} phosphorus atoms. Which salt is it?
- a) CaHPO₄ b) Ca₃(PO₄)₂ c) Ag₃PO₄ d) Na₂HPO₄ e) NaH₂PO₄

16. During the oxidation of 0.5 g of a metal, 280 cm³ of oxygen reacts (at normal conditions). In the oxide, the metal and oxygen are combined in a mass ratio of:

a) 10 : 4 b) 10 : 16 c) 5 : 4 d) 10 : 2 e) 5 : 16

17. Which of the following series of oxides contains only amphoteric oxides?

a) Sb ₂ O ₃ , BeO, As ₂ O ₃ , ZnO	b) CaO, CO, Al ₂ O, PbO
c) ZnO, SiO ₂ , N ₂ O, As ₂ O ₃	d) B ₂ O ₃ , BeO, As ₂ O ₃ , K ₂ O

18. The anhydride of hypochlorous acid is:

a) ClO b) Cl_2O_5 c) Cl_2O d) Cl_2O_3 e) Cl_2O_7

19. One of the following oxides reacts with water to produce a dibasic acid:

a) CaO b) N_2O_5 c) SO_2 d) Cl_2O e) Mn_2O_7

20. In which of the following series are all compounds dissociated in aqueous solution?

a) HCN, CaCl ₂ , HCl, NaHS	b) CH ₄ , CaCl ₂ , Na ₂ SO ₄ , NaOH
c) H ₂ SO ₄ , AgNO ₃ , LiOH, CCl ₄	d) CO, AgNO ₃ , KOH, HNO ₃

21. In which of the following compounds does chlorine have an oxidation number of +5?

a) PCI_3 b) CI_2O_3 c) $KCIO_2$ d) $NaCIO_4$ e) $Ca(CIO_3)_2$

22. Which of the following equations represents a redox reaction?

a) $2NH_3 + H_2CO_3 = (NH_4)_2CO_3$ b) $Mn_2O_7 + 2KOH = 2KMnO_4 + H_2O$ c) $SO_3 + H_2O = H_2SO_4$ d) $Fe_2O_3 + 3H_2SO_4 = Fe_2(SO_4)_3 + 3H_2O$ e) $2KCIO_3 = 2KCI + 3O_2$

- **23.** When calcium carbonate is heated, a reaction occurs as shown by the following equation: $CaCO_3 \rightarrow CaO + CO_2$. This reaction involves:
- a) Oxidation of carbon b) Oxidation of calcium c) No redox reaction occurred d) Oxidation of both calcium and carbon e) Reduction of carbon
- **24.** In the reaction of 0.4 moles of iron(III) chloride with hydrogen sulfide, the amount of sulfur produced is:

a) 0.4 moles of sulfur b) 0.8 moles of sulfur c) 0.2 moles of sulfur d) 2 moles of sulfur e) 0.04 moles of sulfur

25. In the reaction of potassium permanganate, hydrogen sulfide, and sulfuric acid, the products are manganese(II) sulfate, potassium sulfate, sulfur, and water. How many moles of manganese(II) sulfate will be produced if 2240 cm³ of hydrogen sulfide reacts (at normal conditions)?

a) 0.1 b) 0.2 c) 0.04 d) 0.004 e) 0.4

- **26.** How many milliliters of the oxidizing agent (at normal conditions) are needed in the reaction of hydrogen sulfide and sulfur dioxide to produce 4.8 g of sulfur? (S = 32)
- a) 22400 b) 2.24 c) 1120 d) 112 e) 1.12
 27. In laboratory conditions, chlorine is obtained by the reaction of hydrochloric acid with manganese(IV) oxide. How many cm³ of chlorine gas (at normal conditions) will be released when 2.61 g of manganese(IV) oxide reacts with hydrochloric acid? (Mn = 55)
- a) 1344 b) 1120 c) 672 d) 896 e) 560
- **28.** How many liters of KOH solution with a concentration of 0.05 mol/dm³ can be obtained from 200 cm³ of a solution containing 28 g/dm³ of KOH? (K = 39)
- a) 0.2 b) 0.5 c) 1 d) 2 e) 2.5
- **29.** How many moles of sodium sulfate are there in 1 dm³ of solution obtained by mixing 200 cm³ of a 2 mol/dm³ solution and 300 cm³ of a 1 mol/dm³ solution?
- a) 1.4 b) 0.7 c) 1.5 d) 0.75 e) 3
- **30.** How many cm³ of concentrated HCl (36 wt.%; $\rho = 1.2 \text{ g/cm}^3$) should be measured out to prepare 400 cm³ of solution with a concentration of 0.15 mol/dm³? (Cl = 35.5)
- a) 2.19 b) 5.06 c) 6.08 d) 21.9 e) 50.6
- 31. How many cm³ of water need to be evaporated from 0.400 dm³ of a solution containing 5 g/dm³ NaOH to obtain a solution with a concentration of 0.5 mol/dm³? (Na = 23)
- a) 100 b) 300 c) 200 d) 400 e) 50
- 32. How many grams of potassium nitrate are dissolved in 0.5 dm³ of solution, if 1 dm³ contains 0.4 mol? (K = 39, N = 14)
- a) 20.2 b) 40.4 c) 10.1 d) 2.02 e) 4.04
- **33.** The most acidic solution is the one that has:

a) $[H^+] = 10^{-8}$ b) $6x10^{13}$ OH⁻ ions/dm³ c) pH = 6 d) $6x10^{13}$ H⁺ ions/dm³ e) pOH = 5

34. The most basic solution is the one that has:

a) $[H^+] = 10^{-8}$ b) $6x10^{13}$ OH⁻ ions /dm³ c) pH = 6 d) $6x10^{13}$ H⁺ ions /dm³ e) pOH = 5

- **35.** How many hydrogen ions are there in 100 cm³ of a solution with pH = 2?
- a) 2 b) 10^{-2} c) 10^{-3} d) $6x10^{21}$ e) $6x10^{20}$

36. What is the pH of a solution that contains 1.5×10^{20} hydroxide ions in 250 cm ³ ?							
a) 3	b) 10	c) 11	d) 4	Ļ	e) 6		
37. If the pH o	of a solution	changes f	rom 2 to 4, th	e concent	ration of H	⁺ ions:	
a) decreases 100 times b) increases by 2 c) decreases by 2 d) doubles e) increases 100 times							
38. How man acid solut	y milligrams ion with pH	s of potass = 2 (comp	ium hydroxid lete dissociatio	e are nee on)? (K = 3	ded to neu 39)	utralize 50 cm ³	of hydrochloric
a) 14	b) 56	c) 28	d) 42	e) 7	7		
39. Among th	e following	compound	s, the strong	base is:			
a) Fe(OH) ₂	b) Cu(O	H)2	c) Al(OH)₃	d) Ca((OH)₂	e) NH₄OH	
40. Among th	e following	compound	ls, the weak e	lectrolyte	is:		
a) Nal	b) Zn(O	H) ₂	c) HBr	d) NH₄	ŀCI	e) HNO₃	
41. An acidic	salt is:						
a) NH ₄ NO ₃	b) NaH ₂	PO ₄	c) K ₂ S	d) CH₃C(OONa	e) MgOHCl	
42. An acid and a base are mixed in an equimolar ratio. Which of the following solutions reacts neutrally?							
a) $H_2SO_4 + Na$	OH b) H	₃ PO ₄ + NaC	0H c) H₂S	S + KOH	d) CH₃CO	ОН + КОН	e) HCl + KOH
43. In which of the following electrolyte solutions is the concentration of OH ⁻ ions higher than in water?							
a) NaCl	b) Ca(NO	3)2	c) NH ₄ Cl	d) N	laHSO₄	e) Na ₂ S	
44. Which salt does not hydrolyze in aqueous solution?							
a) NH ₄ NO ₃	b) ZnSO	4	c) AICl ₃	d) CH	₃COONa	e) CaCl ₂	
45. Which of the following factors can change the equilibrium constant of a chemical reaction?							
a) Change of catalystb) Change in reactant concentrationc) Change in product concentration							

- d) Change in temperature
- e) Change in both reactant and product concentrations

46. In the following equilibrium system:

 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92 \text{ kJ/mol}$

The concentration of ammonia will increase:

a) with increased pressure and increased temperature

b) with decreased pressure and decreased temperature

c) with increased pressure and decreased temperature

d) with decreased pressure and increased temperature

e) with decreased pressure and the addition of a catalyst

47. Tetraamminecopper(II) sulfate dissociates to form the following ions:

a) Cu²⁺, NH₄⁺, SO₄²⁻ b) [Cu(NH₃)₄]²⁺, SO₄²⁻ c) Cu²⁺, NH₃⁺, SO₄²⁻ d) [Cu(NH₃)₄]²⁺, (NH₃)₂SO₄²⁻ e) [CuNH₃]³⁺, SO₄²⁻

48. Which of the following solution mixtures has buffer properties?

a) HCl + Na₂SO₄ b) NH₃ + NH₄Cl c) H₃PO₄ + Na₂SO₄ d) H₂S + Na₂HPO₄ e) HCl + NH₄Cl

49. Catalysts are substances that:

a) increase the kinetic energy of molecules

b) reduce the amount of heat released in a reaction

c) increase the number of collisions between molecules

d) lower the activation energy of the reaction

e) increase the activation energy of the reaction

50. How does the rate of the chemical reaction

 $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

change if the volume of the reaction vessel is reduced 4 times?

a) Increases 64 times	b) Decreases 64 times	c) Does not change
d) Increases 128 times	e) Increases 16 times	

ANSWERS:

1) -	21) -	44) 6
1) e	21) e	41) D
2) a	22) e	42) e
3) d	23) c	43) e
4) c	24) c	44) e
5) a	25) c	45) d
6) d	26) c	46) c
7) e	27) с	47) b
8) c	28) d	48) b
9) d	29) a	49) d
10) c	30) b	50) a
11) b	31) b	
12) d	32) a	
13) a	33) b	
14) a	34) d	
15) b	35) e	
16) c	36) c	
17) a	37) a	
18) c	38) c	
19) c	39) d	
20) a	40) b	