PU/AT/UG/2013

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Booklet Series: A

Subject: Chemistry **F.M.: 100** **Time: 2 Hours**

All questions are of equal value. **For each wrong answer, 0.5 mark will be deducted.** Use of calculator is not permitted

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1. The solubility product of $PbSO_4$ in water at 298 K is 1.06 x 10^{-8}. Which of the following is true regarding its solubility (s) in x (M) solution of H_2SO_4 (assume s to be negligibly small compared to x): **(A)** s = 1.06 x 10^{-8} / x (M), **(B)** s = 1.06 x 10^{-8} x (M), **(C)** $s = x$ (M), **(D)** None.

2. For a reaction in which A and B form C, the following data were obtained

[A](mol.L^{-1})	[B](mol.L^{-1})	Formation of C (mol.L^{-1}.s^{-1})
0.03	0.03	1.8 x 10^{-5}
0.06	0.06	7.2 x 10^{-5}
0.06	0.09	16.2 x 10^{-5}

The rate of reaction is: **(A)** Rate = k [A][B], **(B)** Rate = k $[A]^2$, **(C)** Rate = k $[B]^2$, **(D)** None.

3. The standard potential for the electrode reaction $Cu^{2+}_{(aq)}$ + 2e = Cu at 298 K is + 0.336 V (hydrogen scale). The single electrode potential for this couple containing 0.01 mol L^{-1} of $Cu^{2+}_{(aq)}$ would be: **(A)** +0.277 V **(B)** -0.277 V **(C)** +0.337 V **(D)** None.

4. K_c for the reaction $SO_2 + 0.5O_2 = SO_3$ at 873 K is 61.7 (with concentrations in M). The relationship between K_p and K_c for this reaction is: **(A)** $K_p = K_c$, **(B)** $K_p > K_c$, **(C)** $K_p < K_c$, **(D)** None.

5. An insulated compartment has two chambers separated by a valve. One chamber contains an ideal gas whereas the other is evacuated. When the valve is opened, the temperature of the gas: **(A)** increases, **(B)** decreases, **(C)** remains constant, **(D)** either increases or remains constant.

6. For the reaction 2A + B $\longrightarrow$ Products, when the concentration of B alone was doubled, $t_{1/2}$ did not change, and when the concentrations of both A and B are doubled, the rate increases by a factor of 4. The unit of rate constant is: **(A)** s^{-1}, **(B)** L.mol^{-1}.s^{-1}, **(C)** mol.L^{-1}.s^{-1}, **(D)** L^2.mol^{-2}.s^{-1}.

7. A 0.2 N solution of sugar is isotonic with a solution of common salt. Both solutions have the same volume and temperature. The concentration of common salt solution is: **(A)** 0.1 M, **(B)** 0.2 M, **(C)** 0.3 M, **(D)** 0.4 M.

8. The most effective electrolyte in causing the flocculation of a negatively charged arseneous sulfide is: **(A)** $CaCl_2$, **(B)** $MgCl_2$, **(C)** $K_3[Fe(CN)_6]$, **(D)** $AlCl_3$.

9. The highest equivalent conductance is observed in the aqueous solution of : **(A)** 0.050 M NaCl, **(B)** 0.020 M NaCl, **(C)** 0.010 M NaCl, **(D)** 0.005 M NaCl.

10. A box of 1 L capacity is divided into two equal compartments by a thin partition. The compartments are filled with 6 g of H_2 and 16 g of CH_4. The pressure in each compartment is recorded as P atm. at 300 K. Upon removal of the partition, the total pressure would be: **(A)** P atm., **(B)** 2P atm., **(C)** P/2 atm., **(D)** P/4 atm.

11. In a solvent phenol dimerizes to the extent of 60%. It's molar mass (in g.mol^{-1}), observed from cryoscopic experiment should be: **(A)** > 94, **(B)** < 94, **(C)** 94, **(D)** unpredictable.

12. Aluminium oxide may be electrolyzed at 1273 K to give Al metal (at. wt. = 27). The cathode reaction is $Al^{3+} + 3e^- \longrightarrow Al$. Preparation of 5.12 kg of Al metal by this method would require: **(A)** 5.49 x 10^2 C, **(B)** 5.49 x 10^4 C, **(C)** 1.83 x 10^7 C, **(D)** 5.49 x 10^7 C.

13. NH_4HS (s) dissociates to NH_3 (g) and H_2S (g). At a particular temperature, the total pressure of the gas mixture at the equilibrium of dissociation reaction is P. The equilibrium constant of the dissociation reaction is: **(A)** $K_p = P^2$, **(B)** $K_p = P^2/4$, **(C)** $K_p = P^{1/2}$, **(D)** $K_P = P^{3/2}$.

14. The dissociation equilibrium of AB_2 (g) is: $2AB_2 (g) \rightleftharpoons 2AB (g) + B_2 (g)$. The degree of dissociation of AB_2 (g) is x and x << 1. The relation among x, the equilibrium constant (K_p) and the total pressure (P) is: **(A)** $x = (2K_p/P)^{1/2}$, **(B)** $x = K_p/P$, **(C)** $x = 2K_p/P$, **(D)** $x = (2K_p/P)^{1/3}$.

15. The enthalpies of formation of Al_2O_3 (s) and Fe_2O_3 (s) are -1670 kJ.mol^{-1} and -834 kJ.mol^{-1} respectively. The ΔH of the reaction : Fe_2O_3 (s) + 2Al (s) $\longrightarrow$ Al_2O_3 (s) + 2Fe (s) is: **(A)** 836 kJ.mol^{-1}, **(B)** 2504 kJ.mol^{-1}, **(C)** -2504 kJ.mol^{-1} , **(D)** -836 kJ.mol^{-1}.

16. Which of the following results in a decrease in entropy? **(A)** crystallization of sucrose from solution **(B)** rusting of iron **(C)** conversion of ice into water **(D)** vaporisation of camphor.

17. For a spontaneous process at all temperatures, which of the following is correct? **(A)** Both ΔH and ΔS are positive, **(B)** ΔH is negative and ΔS is positive, **(C)** ΔH is positive and ΔS is negative, **(D)** Both ΔH and ΔS are negative.

18. An ideal gas expands reversibly and isothermally from 5 L to 10 L. The internal energy change is: **(A)** 2 ln2, **(B)** -2 ln2, **(C)** 5, **(D)** 0

19. The half cell reactions for rusting of iron are: $Fe^{2+} + 2e \rightarrow Fe_{(s)}$, E^0 = - 0.44 V and $2H^+ + 0.5\ O_2 + 2e \rightarrow H_2O$, E^0 = + 1.23 V. ΔG^0 (kJ/mole) value of the reaction is **(A)** -76 **(B)** -322 **(C)** -122 **(D)** -176

20. Which of the following contains maximum number of lone pairs on the central atom? **(A)** ClO_3^- **(B)** XeF_4 **(C)** SF_4 **(D)** I_3^-

21. {X} + H_2SO_4 → {Y}, (a colourless gas with irritating smell); {Y} + $K_2Cr_2O_7$ + H_2SO_4 → Green solution. The species {X} and {Y} are: **(A)** Cl^-, Cl_2 **(B)** SO_3^{2-}, SO_2 **(C)** S^{2-}, H_2S (D) CO_3^{2-}, CO_2

22. Which of the following pair of cations can be separated by NaOH solution? **(A)** Pb^{2+}, Al^{3+} **(B)** Sn^{2+}, Pb^{2+} **(C)** Cu^{2+}, Zn^{2+} **(D)** Zn^{2+}, Pb^{2+}.

23. Which type of isomerism is shown by $[Co(NH_3)_4Br_2]Cl$?
(A) Geometerical and ionization **(B)** Optical and ionization **(C)** Geometrical and optical **(D)** Geometrical only.

24. X mL of 0.05 M solution of a salt mixture comprising of Na_2CO_3. $NaHCO_3$ is titrated against 0.05 M HCl. When phenolphthalein is used as indicator A mL of HCl is required and B mL of said acid is required separately when methyl orange is the indicator. Ratio of B/A is: **(A)** 3 **(B)** 1/3 **(C)** 5 **(D)** 2.

25. Which of (I) CN^- (II) N_2 (III) C_2 have same bond order? **(A)** I, III **(B)** II, III **(C)** I, III **(D)** I, II.

26. Which of the following has the maximum number of unpaired electrons? **(A)** Mg^{2+} **(B)** Ti^{3+} **(C)** V^{3+} **(D)** Fe^{3+}.

27. A wavelength associated with a golf ball weighing 200 g moving at a speed of 5 m/h isof the order: **(A)** 10^{-10} m **(B)** 10^{-20} m **(C)** 10^{-30} m **(D)** 10^{-40} m.

28. 0.023 g of sodium metal is reacted with 100 mL distilled water. The pH of the resulting solution is:
(A) 10 **(B)** 11 **(C)** 12 **(D)** 13.

29. Ratio of the fourth to second Bohr's orbit of hydrogen is: **(A)** 2 **(B)** 4 **(C)** 6 **(D)** 0.5.

30. The volume of water (V_2) which must be added to V_1 mL of a concentrated solution of molarity M_1 to prepare a dilute solution of molarity M_2 is: **(A)** V_1M_1/M_2 **(B)** $[V_1 (M_1 + M_2)]/M_2$ **(C)** $[V_1 (M_1 – M_2]/M_2$ **(D)** $[V_1(M_1-M_2)]/M_1$.

31. $^{238}U_{92}$ disintegrates to give an end product $^{206}Pb_{82}$. The total number of particles emitted are
(A) 6α and 8β **(B)** 6α and 6β **(C)** 4α and 10β **(D)** 8α and 6β.

32. A radioactive element lost 50% activity in 3 days 20 hours. The decay constant of the element is:
(A) $7.532 \times 10^{-3}\ h^{-1}$ **(B)** $7.532 \times 10^{-2}\ h^{-1}$ **(C)** $7.532 \times 10^{-4}\ h^{-1}$ **(D)** $7.532 \times 10^{-1}\ h^{-1}$.

33. Four elements P, Q, R and S have atomic number 10, 19, 25 and 31, respectively. Indicate which of these are an alkali metal and a transition metal: **(A)** P, Q **(B)** Q, R**, (C)** R, S **(D)** P, S.

34. When I^- is oxidized with MnO_4^- in alkaline medium I^- is converted to: **(A)** IO_3^- **(B)** I_2 **(C)** IO_4^- **(D)** IO^-.

35. The decreasing order of the first ionization energy of the following elements is
(A) He > H > Be > B **(B)** Be > B > H > He **(C)** H > He > Be > B **(D)** B > Be > He > H.

36. The maximum number of carbon atoms and hydrogen atoms that could be coplanar in $Ph(CH_3)C{=}CH_2$ is respectively:
(A) 8, 9 **(B)** 9, 8 **(C)** 8, 10 **(D)** 9, 10.

37. The structure of ethyl cyanoacetate is:
(A) $CH_3CH_2OCOCH_2CN$ **(B)** $CH_3CH_2COOCH_2CN$ **(C)** $CH_3COOCH_2CH_2CN$ **(D)** CH_3COOCH_2CN.

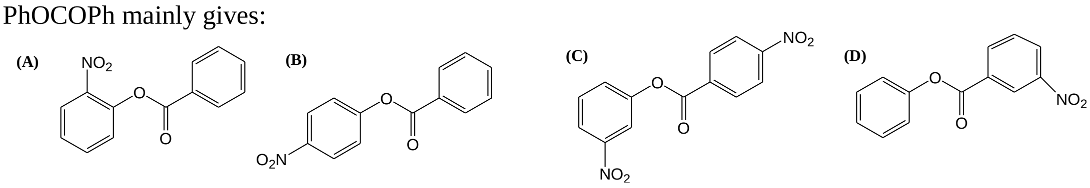
38. The number of optically active and optically inactive stereoisomers of 4-bromopent-2-ene is respectively:
(A) 2, 2 **(B)** 4, 2 **(C)** 4, 0 **(D)** 2, 0

39. The compounds that could be used in aldol condensation and Cannizzaro reaction respectively are:
(A) CH_3COCH_3, PhCHO **(B)** PhCHO, CH_3COCH_3 **(C)** CH_3CHO, $(CH_3)_3CHO$ **(D)** CH_3CHO, HCHO

40. An organic compound ($C_4H_{10}O_2$) on hydrolysis in aqueous acid produces two products. These are:
(A) CH_3COOH, CH_3CH_2OH **(B)** CH_3COOH, CH_3OH **(C)** CH_3CH_2COOH, CH_3OH **(D)** CH_3CHO, CH_3OH.

41. Number of possible isomeric monobromoxylenes are: **(A)** 2 **(B)** 4 **(C)** 6 **(D)** 8.

42. Nitration of PhOCOPh mainly gives:



43.

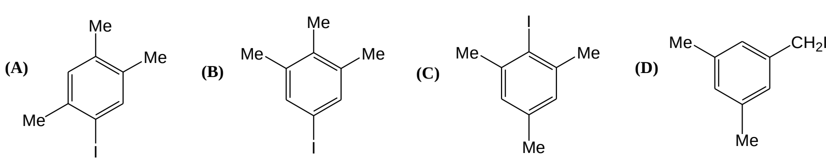
$$\overset{*}{C}H_3CH_2Br\ (^*C = {}^{14}C) \xrightarrow[\text{ii) } CH_3CH_2CHO \quad \text{iii) } H_2O]{\text{i) Mg, dry ether}} A \xrightarrow[\text{heat}]{\text{Conc. } H_2SO_4} B \xrightarrow[\text{ii) Zn-dust, } H_2O]{\text{i) } O_3} \text{Products}$$

Final products are:

(A) $\overset{*}{C}H_3CHO$, CH_3CH_2CHO **(B)** $CH_3\overset{*}{C}HO$, CH_3CHO, $CH_3CH_2\overset{*}{C}HO$, CH_3CH_2CHO

(C) $CH_3\overset{*}{C}HO$, CH_3CHO, $CH_3\overset{*}{C}H_2CHO$, CH_3CH_2CHO **(D)** $\overset{*}{C}H_3CHO$, $CH_3\overset{*}{C}HO$, $\overset{*}{C}H_3CH_2CHO$, $CH_3\overset{*}{C}H_2CHO$,

44. CH_3COCH_3 when sequentially treated with (i) Conc. H_2SO_4, heat (ii) Conc. HNO_3 & Conc. H_2SO_4, 0 °C (iii) Sn, HCl, (iv) $NaNO_2$, dil HCl, 0 °C (v) KI, heat, formed "X". Compound "X" is:



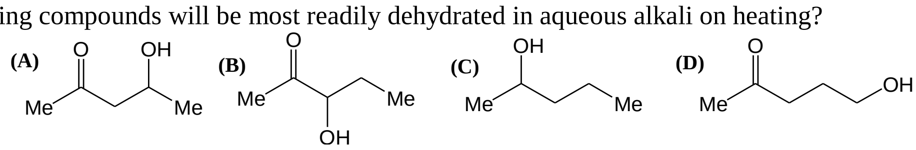
45.

$$\text{Toluene} \xrightarrow{\text{i) } Br_2\text{, Fe (ii) } 2Cl_2\text{, light, heat (iii) 50\% KOH, heat}} X + Y;$$

X & Y in thereaction are:

46. Correct order of basicity of the compounds (1) $CH_3\text{-}C(NH_2){=}NH$; (2) $CH_3CH_2NH_2$; (3) $(CH3)_2NH$; (4) CH_3CONH_2 are:
(A) 2 > 1 > 3 > 4 **(B)** 1 > 3 > 2 > 4 **(C)** 1 > 2 > 3 > 4 **(D)** 3> 1 > 2 > 4.

47. Which of the following compounds will be most readily dehydrated in aqueous alkali on heating?



48.

$$Ph_3CCOCH_3 \xrightarrow{\text{(i) NaOH, } Cl_2 \quad \text{(ii) } H^+ \quad \text{(iii) } NH_3\text{, heat} \quad \text{(iv) KOH, } Br_2} \mathbf{X}$$

"X" is: **(A)** Ph_3CNH_2 **(B)** $Ph_3CCH_2NH_2$ **(C)** $Ph_3C(NH_2)CH_3$ **(D)** CH_3NH_2

49."X" and "Y" in the reaction **X** (excess) + **Y** + aqueous $Ca(OH)_2$ + Heat → $C(CH_2OH)_4$ are:
(A) HCHO (X) & HCO_2H (Y) **(B)** HCHO (X) & CH_3CHO (Y) **(C)** HCHO (X) & CH_3CO_2H (Y) **(D)** None of these

50. Identify "X" and "Y" in the following reaction are: **(A)** Ethyl butyrare (X), n-butanol(Y) **(B)** Methyl butyrate (X), n-butanol(Y) **(C)** Methyl ethanoate (X), n-pentanol (Y) **(D)** Pentanoic acid (X), n-pentanol (Y)