Date:

Registration number:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
B.Sc. Biochemistry - I SEMESTER
SEMESTER EXAMINATION: October 2021
(Examination conducted in January-March 2022)

BCH121 – Inorganic and Physical Chemistry

Time- 3 hrs Max Marks-100

This question paper contains **3** printed pages and **3** parts

Part A

Answer any 15 questions out of 17 15 x 2 = 30

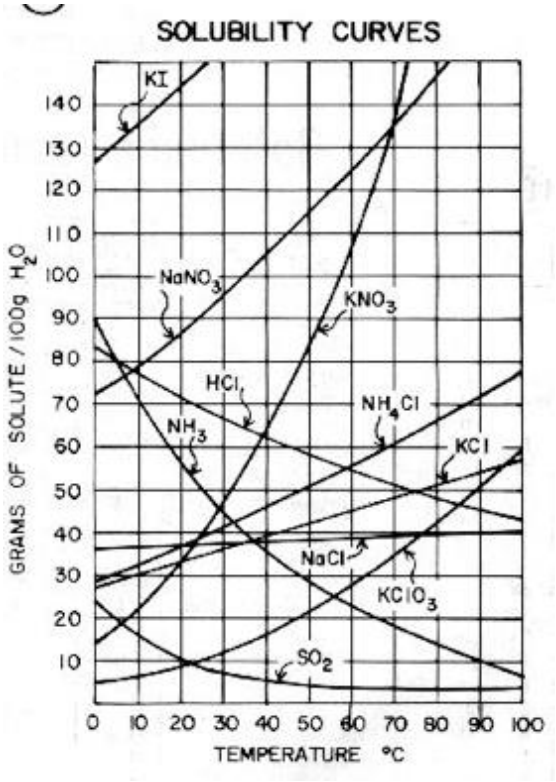
1. Draw the (a) 2s orbital (b) $3d_{x^2-y^2}$ orbital.
2. Give the electron configuration of the element having atomic number 24. How many protons and neutrons does it have?
3. State Pauli's exclusion principle?
4. Predict which molecule is more polar and explain why: LiF and LiI?
5. Mention two characteristics of ionic compounds?
6. Name two chelates occurring in biological systems?
7. Explain how a liquid "cools itself" during the process of evaporation?
8. Name the apparatus used to measure (a) viscosity (b) surface tension.
9. What are surfactants? Give an example.
10. What is Gibb's-Donnan effect?
11. Draw a neatly labelled diagram of the Berkley and Hartley pressure apparatus?
12. A solution containing 2.44 g of a solute dissolved in 75 g of water, boiled at 100.413°C. Calculate the molar mass of the solute (K_b for water = 0.52Kkgmol^{-})
13. Calculate the pH of a 0.0001M HCl solution?
14. The dissociation constants for the following acids are CH_3COOH – $1.75x10^{-5}$, C_6H_5COOH – $6.29x10^{-3}$, $CH_2ClCOOH$ – $1.38x10^{-3}$, $CHCl_2COOH$ – $5x10^{-2}$. Arrange them in order of their decreasing acid strengths.
15. Write the Henderson-Hasselbach equation? What information can one obtain from it?
16. What is an ion selective electrode (ISE)? Give an application for ISE.
17. Write the half-cell reaction and the overall cell reaction for the following cell:
    Pt,H_2 (1 atm)$|$HCl (a=1)$||Cl^-|$AgCl,Ag

Part B

Answer any 10 questions out of 12 10 x 6 = 60

18. Sketch of the electromagnetic spectrum in the increasing order of frequency and clearly label the regions. Calculate the frequency of red light of wavelength $6.5x10^2$ nm.

19. State the oxidation state of manganese in the following manganese salts (a) $KMnO_4$ (b) MnO_2 (c) K_2MnO_4 (d) $Mn(OH)_2$? Why does manganese exhibit so many stable oxidation states?
20. Using VSEPR theory with justification write the structures of (a) ICl^- (b) H_3O^+?
21. Explain the different hybridisation states of carbon as exhibited in ethane, ethene and ethyne?
22. Draw the molecular orbital diagram for the formation of molecular oxygen? Based on this determine its bond order and discuss its magnetic properties?
23. Based on the solubility curve figure given below answer the following questions:
    a) At what temperature does KNO_3 and $NaNO_3$ have the same solubility? If the temperature is raised by 5 ˚C, which of the two will become a supersaturated solution?
    b) How do the curves for HCl, NH_3 and SO_2 differ from the others, why?
    c) Which salt is least soluble at 0˚C, which is most soluble?



24. (a) How do liquids differ from solids and gases? Give two properties of a liquid.
    (b) Draw the gausian distribution for the kinetic energy possess by liquid molecule at (i) 25 ^oC and (ii)100 ^oC
25. Explain why the salt of a weak acid and a strong base is alkaline? Give the relationship between K_h, K_a and K_w for such a system?
26. Discuss with appropriate examples what is meant by common ion effect? Give a suitable application where this phenomenon can be used?
27. What is the electrochemical series? How was it established? Give two applications of this series?
28. Give a schematic diagram of a galvanic cell and an electrolytic cell. Using suitable examples distinguish between the two types of cells?

29. Explain why a solution of a weak acid and its salt behaves as a buffer? Give two examples of biological buffers?

Part C

Answer any 2 questions out of 3 2 x 5 = 10

30. Explain how $MgCl_2$ is formed via the Born-Haber cycle? Calculate the lattice energy given that IE_1=+738 kJmol^{-1}; IE_2=+1451 kJmol^{-1}; Disociation of Cl_2 = +122 kJmol^{-1}; Sublimation of Mg = +148 kJmol^{-1} EA = -349 kJmol^{-1}; ΔH_f = -643 kJmol^{-1}.
31. Determine the E°_{cell} and ΔG° for the following reaction and state if it is at equilibrium, spontaneous or a non-spontaneous reaction:
$O_{2(g)} + 4I^-_{(aq)} + 4H^+_{(aq)} \longrightarrow 2H_2O_{(l)} + 2I_{2(s)}$

$E^0_{red}(O_2/O^{2-})$ = +1.29 V; $E^0_{red}(I_2/I^-)$ = 0.535 V; F = 96485 C

32. a) 25 mL of 0.01M $AgNO_3$ is mixed with 25 mL of 0.0005 M aqueous NaCl, determine if the precipitate will be formed or not? Given $K_{sp\ (AgCl)} = 1.7 \times 10^{-10}$.
b) The quantum numbers of four electrons are given below:

Electron	n	l	m	s
E1	3	0	0	-1/2
E2	4	0	0	1/2
E3	3	2	0	1/2
E4	3	1	0	-1/2

Write the correct order of decreasing energy of these electrons and state which orbital each of the electrons is in?