

B.Sc. 3rd Semester (Honours) Examination, 2022 (CBCS)

Subject : Chemistry

Course : SEC-1

Time: 2 Hours

Full Marks: 40

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Candidates are instructed to attempt either Section-A or Section-B.

Section-A

(Basic Analytical Chemistry)

1. Answer *any five* questions: 2×5=10
- (a) Why sampling is needed prior to chemical analysis?
 - (b) What do you mean by Nutritional value of food?
 - (c) Define food adulterants? Name one food adulterant which is used in coffee powder.
 - (d) “High precision of the data does not warrant high accuracy of the result”— Explain.
 - (e) Among the following readings which one is more significant and why?
2.0 cm, 2.00 cm, 2.000 cm.
 - (f) Name one stationary phase and one mobile phase in column chromatography.
 - (g) What is the role of boric acid in cosmetics?
 - (h) Give examples of two ionic salts which are used as food preservatives.
2. Answer *any two* questions: 5×2=10
- (a) What are the sources of error in analytical measurement? What are the fundamental requirements to become a good exchanger? 3+2
 - (b) Why EDTA is used as a chelator in complexometric titration? What is the significance of soil analysis? 2.5+2.5
 - (c) What do you mean by R_f in Thin layer chromatography? 22.22 g of cation exchanger in the H^+ form can absorb Ca^{2+} ion fully from 1.0 L of 0.1(N) $CaCl_2$ solution. Calculate the exchange capacity of the cation exchanger. 2+3

- (d) Give the differences between deodorants and antiperspirants. Arrange the order of the exchange capacity by a strongly acidic cation exchanger of the following ions in aqueous medium under optimum condition Li^+ , Cs^+ , K^+ , Rb^+ , Na^+ . 3+2
- 10×2=20
3. Answer any two questions:
- (a) Which compound will have higher R_f value on TLC plate: Ethyl acetate or acetone? Explain. Write maximum possible R_f value in TLC. Write two differences between thin layer chromatography and paper chromatography. Define Eluent, Effluent and Eluate. 1+2+1+3+(1+1+1)
- (b) What do you mean by significant figure? Compute the following results with proper significant figures:
- (i) $\text{Log}(9.45 \times 10^5)$
- (ii) $3.5 + 0.020 + 6.32$
- What are the minor constituents in cosmetics? What are the probable harmful side effects of the aluminium compound present in antiperspirant? Give two examples of antiperspirant. 1+4+1+2+2
- (c) What are the different types of contaminants in drinking water? What are the different methods for water purification? What is the full form of pH? Define ion exchange capacity and mention its unit. Mention two methods of determining soil pH? 3+2+1+1+2+1
- (d) Why is standard deviation used for analyzing data? What are the different steps for proper processing of food? What is deionisation process of water? Write its advantage and disadvantage of this process. Give an example of each metal ion indicator and adsorption indicator. How can you separate Zn^{2+} and Mg^{2+} by an anion exchanger? 2+2+2+2+2

Section-B

(IT Skill in Chemistry)

1. Answer any five questions: 2×5=10
- (a) How will you calculate mean and standard deviation of a set of data using Excel's in built function?
- (b) Show a plot of the function $y = e^{-bx^2}$ in $(-\infty, \infty)$.
- (c) Find the equation of the tangent at the point (1, 2) of the curve $y^2 = 4x$.
- (d) For what order of polynomials does the trapezoid rule furnish an exact value of the integral? Give one example.
- (e) Convert $(1011.11)_2$ into decimal.
- (f) If $f(x) = \frac{4^x}{4^{x+2}}$, show that $f(x) + f(1-x) = 1$.
- (g) Viscosity coefficient bears a relation with radius as $\eta = Ar^4$. What will be the % error in η if there is a 2% error in the determination of r .
- (h) Define (i) absolute error (ii) % relative error.

2. Answer *any two* questions from the following: 5×2=10

- (a) Write a program to compute the change in pressure for small change in volume of a van der Waals gas.
- (b) Use least square method to calculate the slope and intercept of the straight line from the following data.

| | | | | | | |
|---|-----|-----|-----|-----|---|---|
| x | 1 | 2 | 3 | 4 | 6 | 8 |
| y | 2.5 | 3.1 | 3.5 | 4.2 | 5 | 6 |

- (c) How will you determine the area under the curve in Normal or Gaussian distribution? What excel function will you use to determine the area under the curve? Write down the syntax of the function and explain the corresponding arguments. What excel function will you use to determine the area under the standard normal curve?
- (d) Use trapezoidal rule to calculate the integral $\int_1^5 (x^2 + x) dx$ (taking $n = 5$).

3. Answer *any two* questions from the following: 10×2=20

- (a) (i) Calculate the % relative error and the variance for the following data:
30, 20, 15, 25, 12, 18
- (ii) Write a program to read the half life period of a radioactive element and determine the time at which 75% of element disintegrate. 5+5
- (b) (i) Write a BASIC program for computing product of two 3×3 matrices.
- (ii) What do you mean by a point of inflexion on the curve $f(x)$? Demonstrate using van der Waals equation of state. Which type of error systematic or random is associated with Gaussian distribution? 6+(1+2+1)
- (c) (i) Find the root of the equation $f(x) = x^2 - 3x + 2$ in the vicinity of $x = 0$ using Newton-Raphson iterative method (use 5 iterations only).
- (ii) Sketch the curve $y = x^2 + 2x - 3$ with proper Labelling using dataset.
- (iii) What are the advantages and disadvantages of using Trendline in Excel? 4+4+2
- (d) (i) Given $f(x) = 2.e^{3x}$. Find $f'(x)$ at $x = 2$ using the method of forward divided difference (FDD) taking $\Delta x = 0.01$. Compare the result with the exact value.
- (ii) Consider the titration of a weak monoprotic acid HA against a strong base MOH and deduce the relation

$$\frac{V_b}{V_a} = \frac{C_a \left(\frac{[A^-]}{[HA] + [A^-]} \right) - ([H^+] - [OH^-])}{C_b + \left([H^+] - \frac{K_w}{[H^+]} \right)}$$

where C_a is the conc. of acid HA , C_b is the conc. of base MOH , V_a and V_b be the volume of the acid and base respectively.

What information will be required by Microsoft Excel in order to generate values of

$\left(\frac{V_b}{V_a} \right)$ for different hydrogen ion concentrations? 5+5