Bihar Engineering University, Patna

B.Tech 1st Semester Exam-2022

Subject: Chemistry

Course: BTech. Time: 03 Hours

Code: 100103 Full Marks: 70

Instructions:

(i) The marks are indicated in the right-hand margin.

(i) There are NINE questions in this paper.

(iii) Attempt FIVE questions in all.

(iv) Question No. l is compulsory.

(v) Symbols used (if any) have their usual meanings.

Q. 1 Answer any seven of the following:

(a) What is the designation of the orbital having n = 4 and 1 = 3?

(b) Write the ground state electronic configuration of $N_{\overline{2}}$

(c) Which of $Cr^{+}$ or $Cu^{+}$ is expected to be coloured?

(d) Arrange molecular species N2, N+2. $N_2^-$ and $N_2^{2-}$ in increasing order of stability.

(e) Out of $Cr^{2+}$ and $Cr^{3+}$ which one is stable in aqueous solution?

(f) What is the direction of a reaction when ΔG = 0?

(g) A gas expands against vacuum. What is the work done on it?

(h) What is the condition for a reaction to be in equilibrium?

(j) Which of the following is not a nucleophile?

$H_2O$, $BE_3$, $NH_3$, $OH^-$

(i) A reaction has ΔH < 0 and ΔS < 0. At what temperature the forward reaction proceed?

Q.2 At what temperature will water boil when the applied pressure is 528 mm of Hg? (Latent heat of vaporisation of water = 545.5 cal/g)

(b) Explain dual nature of light and give one example (property/experiment) in favour of its particle nature and wave nature.

(c) The equilibrium constants for the reaction $H_2(g) + S(s) \leftrightharpoons H_2S(g)$ are 18.5 at 925K and 9.25 at 1000 K. Calculate standard enthalpy of the reaction. Also calculate $\Delta G°$ and $\Delta S°$ at 925 K.

Q.3 Which of the following two molecules has a higher bond length?

(i) O2

(ii) $O_2^+$

(iii) $O_2^-$

Explain using molecular orbital theory.

(b) Draw the MO energy level diagram for NO molecule. Using this diagram, calculate and explain bond order and magnetic behaviour of (i) NO, (ii) $NO^+$ and (iii) $NO^-$.

Q. 4 (a) Calculate the frequency (in Hz and $cm^{-1}$) of O - H bond, if the force constant and reduced mass of the atom pair are 770 N $m^{-1}$ and $1.563 \times 10^{-27}$ kg respectively.

(b) Microwave spectrum of gaseous HCI molecule exhibits a series of equally spaced lines with interspacing of 20.7 $cm^{-1}$. Calculate the inter-nuclear distance of HCI molecule.

(c) Explain geometrical isomerism and optical isomerism for transition metal complex with an example for each.

Q.5 (a) Calculate the force constant of CO molecule, if its fundamental vibrational frequency is 2140 $cm^{-1}$.(At. Mass of carbon = $1.99 \times 10^{26}$ kg and O = $2.66 \times 10^{-26}$ kg.)

(a) At what frequency shift from TMS, would a group of nuclei with $\delta = 1.00$ resonate in an NMR spectrometer operating at 500 MHz?

(c) How many 'H NMR signals are there in the following?

(i) $CH_3$ —$CH_3$

(ii) $CH_3$ —$CH_2$ —$CH_3$

(iii) $CH_3$ —$CH_2$ —CL

(iv) $CH_3$ —CHCL —$CH_3$

(v) $C_6H_5CH_3$

(vi) $C_6H_5CH_2CH_3$

Q. 6 (a) 2 mol of $NH_3$ at 300K occupy a volume of $5 \times 10^{-3}$ $m^3$. Calculate the pressure using van der Waals equation (a = 0.417 $Nm^4$ $mol^{-2}$ and b = $0.037 \times 10^{-3}$ $m^3$ $mol^{-1}$). Compare the above result with the pressure calculated using ideal gas equation.

(b) Write short notes on the following:

(i) Magnetic resonance imaging

(ii) Fingerprint region in infrared spectroscopy

(iii) Different types of electronic excitations

Q. 7 (a) Write the principle for lime soda process for softening of hard water.

(b) Calculate the amount of lime and soda required for the softening of a million litres of hard water containing $CaCo_3$ = 25 ppm, $MgCO_3$ = 144 ppm, $CaCl_2$ = 111 ppm, $MgCl_2$ = 95 ppm,$Na_2SO_4$ = 15 ppm, $Fe_2O_3$ = 25 ppm.

(c) The hardness of 50000 litres of water sample was removed by passing it through a zeolite softener. The softener then required 200 L of NaCl solution, containing 125g/L of NaCl for regeneration. Calculate the hardness of the sample of water.

Q.8 (a) Write notes on the following:

(i) Optical isomerism of lactic acid

(ii) Optical isomerism of tartaric acid

(b) Differentiate between the following:

(i) Enantiomers and diastereomers

(ii) Racemic mixture and meso-compounds

Q.1 Choose the correct answer of the following: (any )

(a) What does the following declaration mean? Int *ptr [5]

(i) ptr is an array of pointers to 5 integers

(ii) ptr is an array of 5 integers

(iii) ptr is a pointer to an array of 5 integers

(iv) ptr is a pointer to array

(b) The function malloc() is declared in which header file.

(i) stdio.h

(ii) stdlib.h

(iii) conio.h

(iv) iostream.h

(c) #include<stdio.h>

{

char ch = ‘Z’

printf (“% d\n”,ch);

return 0;

}

(i) 65 (ii) 90 (iii) 97 (iv)122

(d) How is an array initialized in C language?

(i) int a [3] = {1,2,3};

(ii) int a = {1,2,3};

(iii) int a[ ] = new int [3];

(iv) int a(3) = [1,2,3];

(e) What is the return type of the fopen() function in C?

(i) Pointer to a FILE object.

(ii) Pointer to an integer.

(iii) An integer.

(iv) None of the above

(f) What will be the output of the following C Code?

#include<stdio.h>

Int main()

{

Int x = 4, y, z;

Y = --x;

Z = x --;

printf(“%d%d%d”, x,y,z);

(i) 3 2 3

(ii) 2 2 3

(h) #include<stdio.h>

Int main ( )

{

float a = 5, b = 2;

int c,d;

c = a/b;

d = c/2;

printf(“%”, d)’

retrun 0;

}

(i) 1 (ii) 0 (iii) 1.5 (iv) 1.25

(j) In C, if you pass an array as an argument to a function, what actually gets passed?

(i) First element of the array

(ii)Value of elements of the array

(iii) Base address of the array

(iv) Address of the last element of array

(i) How is the $3^{nd}$ element in an array accessed based on pointer notation

(i) *a+3

(ii) *(a+3)

(iii) *(*a+3)

(iv) &(a+3)

Q.2 (a) Explain entry controlled loop and exit controlled loop with flow charts and examples.

(b) Write a C program to reverse a given multi-digit number.

Q.3 (a) Explain break and continue keywords with suitable examples in context of managing loops.

(b) What is storage classes in C. Write features (storage, default value, scope, life) of variables defined under each storage class.

Q.4 (a) Write a C function for Bubble sort. Analyse the time complexity of Bubble sort for each standard cases.

(b) Differentiate between formal argument and actual argument with an example.

Q.5 (a) What is recursion? Write a recursive C program to generate n" term of the Fibonacci series.

(b) How string is declared and initialized? Explain any four predefined string manipulation functions with examples. https://www.akubihar.com

Q. 6 (a) write a C program to find result matrix after multiplying two given matrices using 2-D arrays.

(b) Write a program to copy contents of one file to another. While doing so replace all lowercase characters to their equivalent uppercase characters.

Q.7 (a) Write the difference between structure and union. Compare them with the help of an example.

(b) Write a program to copy the contents of one array into another in reverse order.

Q.8 (a) Differentiate between call-by-value and call-by-reference with suitable examples.

(b) Discuss conditional operator? Write a C program to find largest of three numbers using conditional operator?

Q.9 (a) Write a C program that converts a string like “12” to an integer 124.

(b) Write a C program using the nesting of loops to print the following pattern: