Total number of printed pages = 11

19/2nd Sem/UCH 201

2022

ENGINEERING CHEMISTRY

Full Marks – 100

Time – Three hours

The figures in the margin indicate full marks for the questions.

Question No. 1 is mandatory.

Answer any *four* questions from the rest.

1. Choose the correct answer : 1×20=20

(a) Infrared spectroscopy is associated with

(i) Proton transition

(ii) Electronic transition

(iii) Molecular vibrations

(iv) Electron bombardment

[Turn over

(b) Alcoholic group is the example of

(i) Chromophore

(ii) Auxochrome

(iii) Relative abundance

(iv) None of the above

(c) Which of the following is not an important property of an ideal fuel ?

(i) High viscosity

(ii) High calorific value

(iii) Low cost

(iv) Moderate ignition temperature

(d) Choose the chemical species that can be used a nuclear fuel

(i) ^{233}U (ii) ^{234}U

(iii) ^{235}U (iv) ^{236}U

(e) Highest rank of coal is

(i) Peat (ii) Lignite

(iii) Anthracite (iv) Graphite

(f) The unit of 2nd order reaction is

(i) mol/dm^3 (ii) $mol^{-1}dm^3s^{-1}$

(iii) S^{-1} (iv) None of these

(g) Formaldehyde is the monomer of

(i) Buna-n-rubber (ii) Neoprene

(iii) Bakelite (iv) None of these

(h) Inversion of cane sugar is an example of

(i) Pseudo-first order reaction

(ii) First order reaction

(iii) Bimolecular reaction

(iv) None of the above

(i) Thiamine is present in

(i) RNA

(ii) DNA

(iii) In both RNA and DNA

(iv) None of the above

(j) The monomer unit of natural rubber is

(i) isoprene

(ii) 1,3-butadiene

(iii) styrene

(iv) None of the above

(k) Find the correct inductive effect series

(i) $-CN > -SO_3H > -CHO > -CO$

(ii) $-SO_3H > -CN > -CHO > -CO$

(iii) $-CN > -SO_3H > -CO > -CHO$

(iv) $-CN > -CO > -CHO > -SO_3H$

(l) The example of Lewis acid is

(i) NH_3 (ii) $AlCl_3$

(iii) $^-OCH_3$ (iv) HCl

(m) An alkene compound propene-1 could be converted to 1-bromopropane in the presence of HBr through free radical reaction mechanism, the name of the reaction is

(i) Markovnikoff rule

(ii) Anti-Markovnikoff rule

(iii) E2 reaction

(iv) Saytzeff rule

(n) In S_{N^2} and E^2 reaction, there is no rate determining step. It is due to

(i) Slow reaction

(ii) Fast reaction

(iii) Formation of carbocation

(iv) Formation of carbanion

(o) In Chichibabin reaction, the mechanism is

(i) an addition-elimination

(ii) elimination

(iii) S_{N^2}

(iv) addition

(p) Standard electrode potential of hydrogen electrode is

(i) 100V (ii) 10V

(iii) 1V (iv) 0V

(q) Increasing metal ion concentration electrode potential

(i) increases

(ii) decreases

(iii) remains unchanged

(iv) depends on other factors

(r) Which of the following statement is correct ?

(i) In the cell expression oxidation electrode written in left and reduction electrode in right.

(ii) In the cell expression oxidation electrode written in right and reduction electrode in left.

(iii) In the cell expression oxidation and reduction electrode can be written randomly.

(iv) There is no rule on writing the cell expression.

(s) For isothermal process

(i) $\Delta U = 0$ (ii) $\Delta H = 0$

(iii) $\Delta Q = 0$ (iv) $\Delta S = 0$

(t) When a system undergoes change at constant volume, it is known as

(i) Isothermal process

(ii) Sobaric process

(iii) Isochoric process

(iv) Adiabatic process.

2. (a) Define strong and weak electrolytes with examples. 2

(b) Write short note on any *one* : 4

(i) Standard hydrogen electrode

(ii) calomel electrode.

(c) The standard reduction potential of $Zn^{2}+/Zn$ electrode is $-0.76V$ and standard reduction potential of $Cu^{2}+/Cu$ electrode is $+0.34V$. What is the standard potential of the cell $Zn / Zn^{2+} \parallel Cu^{2+} / Cu$? 3

(d) What is the emf of the following cell ? Zn / Zn^{2+} (0.1M) $\parallel Ni^{2+}$ (10M)/ Ni. [Given: Standard reduction potential of Zn and Ni electrodes are $-0.76V$ and $-0.25V$ respectively] 5

(e) What are Carbon nanotubes ? Describe their properties and applications. 2+4=6

3. (a) What is internal energy and enthalpy of a system ? For a particular system write down the mathematical relation between internal energy and enthalpy. 3

(b) Prove that for isothermal reversible process work done (W) = $nRT\ln V_2/V_1$ 4

(c) Calculate the maximum work done when pressure on 10g of hydrogen is reduced from 20 atm to 1atm at a constant temperature of 273K. The gas behaves ideally. CalculateΔU and Δ Q. 5

(d) The activation energy of a non-catalyzed reaction at 37°C is 83.68 $kJmol^{-1}$ and the activation energy of the same reaction catalyzed by an enzyme is 25.10 $kJmol^{-1}$. Calculate the ratio of the rate constants of the enzyme catalyzed and non-catalyzed reactions. 4

(e) Distinguish between thermoplastics and thermosetting plastics. Give examples. 4

4. (a) For a second order reaction show that :

$t_{1/2} \alpha (1/k)$, where $t_{1/2}$ is the half-life period and k is the 2nd order rate constant. 5

(b) Draw the energy profile diagram for catalyzed, non-catalyzed reaction. Define activation energy. 5

(c) Distinguish between RNA and DNA. 5

(d) Write short notes on : 2.5+2.5=5

(i) Natural Rubber

(ii) Nylon 6,6.

5. (a) Arrange $n \rightarrow \sigma^*$, $n \rightarrow \pi^*$, $\sigma \rightarrow \sigma^*$ and $\pi \rightarrow \pi^*$ transitions in decreasing order of energy. 2

(b) What are the various chemical shifts associated with UV-visible spectroscopy. 4

(c) Describe the instrumentation of a mass spectrometer with a diagram. 3

(d) Explain the ^1H NMR spectra of methanol and ethanol. 4

(e) What is crystal field splitting energy ? Compare the magnetic properties of $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$ on the basis crystal field splitting energy. 1+6=7

6. (a) Explain the stoichiometric combustion of propane with proper chemical equation. 4

(b) Answer any *three* from the following questions : 2×3=6

(i) What are high and low temperature carbonization processes ?

(ii) Define the proximate and ultimate analysis of coal.

(iii) Write note on Octane and Cetane number.

(iv) Write note on Aviation fuel.

(c) Give reaction mechanism for formation of o-aminotoluene from o and m-aminotoluene. 2+2=4

(d) Give a conversation with mechanism from haloalkane to alkene. 2

(e) Write the decomposition products of ketene and diazomethane ? 2+2=4

7. (a) Give synthetic method for drug molecule such as Ibuprofen. 4

(b) What is Beckmann reaction ? Give reaction mechanism from cyclohexanone to ε-capro-lactum. 1+3=4

(c) Give reaction mechanism for formation of triene compound from tertiary amine. 4

(d) Give examples of each electrophilic and nucleophilic addition reactions. 2+2=4

(e) Write the following conversion with mechanism any *one* : 4×1=4

(i) α-Chlorocyclohexanone to cyclopentanoic acid

(ii) Acetaldehyde to crotonaldehyde

(iii) 2-Bromobutane to butene-1 and butene 2.