CYL100-End Sem Examination

<u>Answer all questions in the answer sheet.</u>

Full marks: 70, Time: 3 hours

PART A (20 marks, -1 marks for wrong answer)

1. Which of the following amino acids has a charged side chain?

A)   Leu

B)   Ala

C)   Met

D)   Lys

E)   Trp

2. The diameter of DNA double helix has is:

A)   2 nm

B)   3.4 nm

C)   2 μm

D)   3.4 μm

E)   None of the above.

3. How enzymes enhance the reaction kinetics?

A)   By increasing the temperature.

B)   By increasing the pressure.

C)   By decreasing the activation energy.

D)   By binding to the product.

E)   By restricting inhibitors.

4. Oxidoreductase enzyme carry out following reaction:

A)   Group transfer.

B)   Hydrolysis.

C)   Condensation.

D)   Isomerization.

E)   Oxidation reduction.

5. Metal ion present in hemoglobin is-

A)   Fe.

B)   Zn.

C)   Mn.

D)   Na.

E)   Cu.

6. The Langmuir isotherm model is based on several fundamental assumptions. Which ONE of the following statements is NOT a correct assumption of the ideal Langmuir model?

A) Adsorption is monolayer (only one layer of molecules is formed on the surface)

B) All adsorption sites on the surface are energetically equivalent and identical

C) The ability of a molecule to adsorb at a given site is independent of whether neighboring sites are occupied or not

D) The adsorption process is localized (adsorbed molecules do not migrate on the surface)

E) The rate of adsorption increases exponentially with increasing surface coverage

7. An enzyme is assayed in the presence and absence of an inhibitor. The following kinetic parameters are obtained: Without inhibitor: Km = 5 mM, Vmax = 100 μmol/min, With inhibitor: Km = 15 mM, Vmax = 100 μmol/min What type of inhibition is this?

A) Competitive inhibition

B) Non-competitive inhibition

C) Uncompetitive inhibition

D) Mixed inhibition

E) Irreversible inhibition

8. The α-helix and β-sheet are classified as examples of which level of protein structure?

A) Primary structure

B) Secondary structure

C) Tertiary structure

D) Quaternary structure

E) Quinary structure

9. The following statement is not true for a peptide bond?

A) Is planar.

B) Is hydrolysable.

C) Joins two amino acids.

D) Is required for protein folding.

E) Forms spontaneously.

10. Following interactions are not responsible for tertiary structure of a protein-

A) Hydrophobic

B) Electrostatic

C) H-bonding

D) Disulfide bond

E) Peptide bond

PART B (50 marks)

1. What are five distinguishing features of living organisms compared to non-living entities?

2. Why Carbon is preferred over silicon as an element for construction of living organisms.

3. Draw all possible tripeptide sequences possible with Lys, Phe, and Trp; where aromatic amino acids are not connected via a peptide bond.

4. Use the Michaelis-Menten Equation to calculate the values of K_m and V_{max} from the table given below. Plot [S] versus V_0. Draw line parallel to the x-axis at V_{max} and extend your plotted line to show its approach to V_{max}.

   $V_0 \, vs \, [S]$

[S] mM	V_0 mmol/s
10	1.2
16.3	1.7
22.9	2.1
24.9	2.2
31.7	2.5

5. According the Michaelis-Menten equation, what is the V_0 / V_{max} ratio when [S] = 3K_m? If K_m = 3 mM, and V_0= 35 µmol/(mL·s) when [S] = 3 mM, what is the velocity, V_0, for the reaction when [S] = 18 mM?

6. What are the three key structural and functional differences between DNA and RNA?

7. Although hemoglobin subunits and myoglobin are structurally similar, hemoglobin is an oxygen transport protein and myoglobin is an oxygen storage protein. What is the reason behind this difference?

8. What are the five key differences between Physical and Chemical adsorption?

9. What is an adsorption isotherm? What are the differences between Type1 and Type2 adsorption isotherm?

10. A protein binds to a solid surface according to the Langmuir adsorption model. At 25 °C, the following equilibrium data were obtained:

Bulk solution concentration, C (µmol/L)	Surface coverage, θ
0.50	0.167
1.00	0.286
2.00	0.444
5.00	0.714
10.00	0.833

(a) Calculate the Langmuir adsorption constant K (in L/µmol).
(b) What is the maximum surface coverage (θ_max)?
(c) Calculate the concentration of free protein (in µmol/L) required to achieve 90% surface coverage ($\theta = 0.90$).

Amino Acid Structures

SMALL

Glycine (Gly, G)
MW: 75.07

Alanine (Ala, A)
MW: 89.09

NUCLEOPHILIC

Serine (Ser, S)
MW: 105.09, $pK_a \sim 16$

Threonine (Thr, T)
MW: 119.1, $pK_a \sim 16$

Cysteine (Cys, C)
MW: 121.2, $pK_a = 8.18$

HYDROPHOBIC

Valine (Val, V)
MW: 117.1

Leucine (Leu, L)
MW: 131.2

Isoleucine (Ile, I)
MW: 131.2

Methionine (Met, M)
MW: 149.2

Proline (Pro, P)
MW: 115.1

AROMATIC

Phenylalanine (Phe, F)
MW: 165.2

Tyrosine (Tyr, Y)
MW: 181.2, $pK_a = 10.46$

Tryptophan (Trp, W)
MW: 204.2

ACIDIC

Aspartic Acid (Asp, D)
MW: 133.1, $pK_a = 3.9$

Glutamic Acid (Glu, E)
MW: 147.1, $pK_a = 4.07$

AMIDE

Asparagine (Asn, N)
MW: 132.1

Glutamine (Gln, Q)
MW: 146.1

BASIC

Histidine (His, H)
MW: 155.2, $pK_a = 6.04$

Lysine (Lys, K)
MW: 146.2, $pK_a = 10.79$

Arginine (Arg, R)
MW: 174.2, $pK_a = 12.48$