

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2023, Set 1

Course: Biochemistry and Metabolic Engineering

Semester: 3rd Program: B.Tech (Biotechnology)

Duration: 3 Hours

Course Code: HSBT 2001

Max. Marks: 100

Instructions: Read all questions carefully.

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q			
1	MATLAB is a programming language developed by _____ A) Apple B) Math Pro C) Math Lab Sublime D) MathWork	1.5	CO 1
2	MATLAB started out as a _____ where linear algebra programming was simple A) Matrix Programming Language B) Super Programming Language C) Nested Programming Language D) Structured Programming Language	1.5	CO 1
3	Metabolic flux is regulated by A) Enzymes B) Sugars C) Phospholipids D) Sterols	1.5	CO 1
4	Metabolic flux analysis (MFA) is a technique used to: A) Study the rate of photosynthesis in plants B) Measure the flow of carbon through metabolic pathways C) Analyze the electrical activity of neurons D) Determine the genome of an organism	1.5	CO 1
5	Which of the following factors can influence metabolic flux in a biological system? A) Enzyme concentration B) Temperature C) pH D) All of the above	1.5	CO 1
6	Which of the following best describes the Michaelis-Menten constant (K_m)? A) The maximum velocity of an enzyme-catalyzed reaction B) The concentration of substrate at which the reaction rate is half of V_{max} C) The rate constant for enzyme-substrate binding	1.5	CO 1

	D) The total enzyme concentration in a reaction		
7	Non-competitive inhibition of an enzyme involves: A) Direct competition between two substrates for the enzyme's active site B) Binding of the inhibitor to the enzyme's active site C) Binding of the inhibitor to a site other than the active site D) Enhancing the enzyme's catalytic activity	1.5	CO 1
8	Which technique is commonly used for incorporating C13 labels into molecules for metabolic studies? A) NMR spectroscopy B) Mass spectrometry C) Radioactive decay D) Isotopic dilution	1.5	CO 1
9	What is the significance of the "C13" isotope? A) It indicates the number of carbon atoms in a molecule. B) It signifies a radioactive isotope used in labeling experiments. C) It represents a stable, non-radioactive isotope of carbon. D) It is used to label nitrogen atoms in molecules.	1.5	CO 1
10	What is the primary function of metabolism in living organisms? A) To store energy B) To maintain body temperature C) To build and break down molecules for energy and growth D) To regulate the circulatory system	1.5	CO 1
11	Which of the following is a key regulatory sequence in eukaryotic gene expression that binds transcription factors to initiate transcription? A) Promoter B) Exon C) Intron D) Terminator	1.5	CO 1
12	What are the three types of passive transport? A) Simple diffusion facilitated diffusion and pumps B) Exocytosis, endocytosis, pumps C) Exocytosis, endocytosis, osmosis D) Simple diffusion, facilitated diffusion, and osmosis	1.5	CO 1
13	In a balanced chemical equation, which of the following is conserved? A) Mass and energy B) Charge and energy C) Mass and charge D) Volume and energy	1.5	CO 1
14	What is the primary purpose of Gas Chromatography (GC) in GC-MS? A) To ionize the sample B) To separate compounds in a mixture C) To detect and quantify ions D) To provide mass-to-charge ratio information	1.5	CO 1
15	In NMR spectroscopy, what does the "N" in NMR stand for? A) Nuclear B) Nonmetallic C) Nanometer D) Neutral	1.5	CO 1
16	Which of the following is NOT a characteristic of enzymes?	1.5	CO 1

	<p>A) They are catalysts. B) They alter the equilibrium of a reaction. C) They are specific to certain substrates. D) They are usually proteins.</p>		
17	<p>The Jacob-Monod Model primarily explains the regulation of gene expression in which type of organisms? A) Prokaryotes B) Eukaryotes C) Both prokaryotes and eukaryotes D) Archaea</p>	1.5	CO 1
18	<p>How many ATP molecules are consumed during the energy investment phase of glycolysis? A) 0 ATP B) 1 ATP C) 2 ATP D) 4 ATP</p>	1.5	CO 1
19	<p>During glycolysis, which enzyme is responsible for the conversion of 1,3-bisphosphoglycerate to 3-phosphoglycerate? A) Hexokinase B) Phosphofructokinase C) Glyceraldehyde-3-phosphate dehydrogenase D) Phosphoglycerate kinase</p>	1.5	CO 1
20	<p>Where does the Krebs Cycle (Citric Acid Cycle) take place within a eukaryotic cell? A) Mitochondrial matrix B) Cytoplasm C) Nucleus D) Endoplasmic reticulum</p>	1.5	CO 1

Section B (4Qx5M=20 Marks)			
1	Illustrate the regulation of gene expression in eukaryotes.	5	CO 2
2	Define the mechanism of metabolite transport through cell membranes.	5	CO 3
3	Explain the GC-MS based methods for flux determination using C13 labelling.	5	CO 2
4	Discuss the function and application of feedback inhibition.	5	CO 3
Section C (2Qx15M=30 Marks)			
1	If you are a bioprocess engineer working for a company that specializes in the production of enzymes used in the biotechnology industry. Your task is to optimize the production of industrially relevant enzymes. (a) Highlight the importance of enzyme kinetics. (5) (b) Write the importance of enzymes in Biotechnology Industry. (5) (c) Investigate the inhibitory effects of the inhibitors on enzyme production. (5)	15	CO 3
2	A metabolic engineer is working for a pharmaceutical company specializing in antibiotic production. His task is to optimize the metabolic flux in a microbial strain to enhance the production of a critical antibiotic. (a) Explain the role of metabolic flux in antibiotic biosynthesis. (5) (b) Discuss the importance of tracer studies, isotope labeling. (5) (c) and flux balance analysis to quantify intracellular fluxes. (5)	15	CO 3
Section D (2Qx10M=20 Marks)			
1	Describe the genetic engineering strategies and tools you plan to use to optimize the expression of this enzyme in a microbial host.	10	CO 3
2	Point out the key steps and enzymes involved in glycolysis, and discuss the overall purpose of this pathway in cellular energy metabolism.	10	CO 2