U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 23BT4PCBAB **Max Marks: 100**
Course: Biochemistry & Bioenergetics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	What are high energy compounds Draw the structure of ATP and explain the factors responsible for high energy character of ATP.	CO 1	PO 1	8
	b)	Calculate the ΔG^{10} and ΔG for the reaction at 25^0Cif pyruvate and NADH are present in 0.5M concentration and lactate and NAD^+ are present in 5M concentration. Pyruvate + NADH + H^+ →Lactate+ NAD^+ . E^{10} NAD^+/NADH= - 0.32V. E^{10} Pyruvate/lactate = - 0. 185V	CO 2	PO 1	8
	c)	For each of the metabolic transformations in (a) through (e),determine whether oxidation or reduction has occurred (a) $CH_3—OH \longrightarrow H—C(=O)—H$ Methanol Formaldehyde (b) $H—C(=O)—H \longrightarrow H—C(=O)—O^- + H^+$ Formaldehyde Formate (c) $O=C=O \longrightarrow H—C(=O)—O^- + H^+$ Carbon dioxide Formate (d) $CH_2(OH)—C(OH)(H)—C(=O)—O^- + H^+ \longrightarrow CH_2(OH)—C(OH)(H)—C(=O)—H$ Glycerate Glyceraldehyde	CO 2	PO 1	4

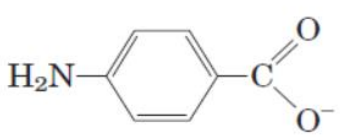
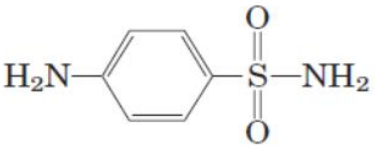
SUMMARY EXAMS 2024

			UNIT - II			
	2	a)	The citric acid cycle has eight enzymes: citrate synthase, aconitase,isocitrate dehydrogenase,α-ketoglutarate dehydrogenase,succinyl-CoA synthetase, succinate dehydrogenase, fumarase,and malate dehydrogenase. (a) Write a balanced equation for the reaction catalyzed by each enzyme. (b) For each enzyme determine which of the following describes the type of reaction(s) catalyzed: condensation (carbon–carbon bond formation); dehydration (loss of water);hydration (addition of water); decarboxylation (loss ofCO_2); oxidation-reduction; substrate-level phosphorylation; isomerization.	***CO 4***	***PO 2***	**8**
		b)	The degree of reduction of each carrier in the respiratory chain is determined by conditions in the mitochondrion. For example, when NADH and O_2 are abundant, the steady-state degree of reduction of the carriers decreases as electrons pass from the substrate to O_2. When electron transfer is blocked, the carriers before the block become more reduced and those beyond the block become more oxidized. For each of the conditions below, predict and justify the state of oxidation of ubiquinone and cytochromes *b*, c_1, *c*, and *a* &a_3. i) Abundant NADH and O_2, but cyanide added ii) Abundant NADH, but O_2 exhausted iii) Abundant NADH and O_2	***CO 3***	***PO 2***	**6**
		c)	When the antibiotic valinomycin is added to actively respiring mitochondria, several things happen: the yield of ATP decreases, the rate of O_2 consumption increases, and the pH gradient across the inner mitochondrial membrane increases. Does valinomycin act as an uncoupler or an inhibitor of oxidative phosphorylation? Justify your answers.	***CO 3***	***PO 2***	**6**
			OR			
	3	a)	Explain the mechanism of rotational catalysis of ATP synthesis with neat labelled diagrams.	***CO 3***	***PO 2***	**8**
		b)	Two of the steps in the oxidative decarboxylation of pyruvate do not involve any of the three carbons of pyruvate yet are essential to the operation of the PDH complex. i) Identify the reactions ii) Explain the mechanism of action of PDH complex	***CO 4***	***PO 2***	**8**

SUPPLEMENTARY EXAMS 2024

		c)	^{14}C-labeled glyceraldehyde3-phosphate was added to a yeast extract. After a short time, fructose 1,6-bisphosphate labeled with ^{14}C at C-3 and C-4 was isolated. i) What was the location of the ^{14}C label in the starting glyceraldehyde 3-phosphate? ii) Where did the second ^{14}C label in fructose 1,6-bisphosphate come from? Explain.	***CO 4***	***PO 2***	**4**
			UNIT - III			
	4	a)	If a maize (corn) plant is illuminated in the presence of $^{14}CO_2$, after about 1 second, more than 90% of all the radioactivity incorporated in the leaves is found at C-4 of malate, aspartate and oxaloacetate. Only after 60 seconds does 14C appear at C-1 of 3-phosphoglycerate. Explain showing the steps involved.	***CO 4***	***PO 2***	**8**
		b)	Photorespiration is an expense paid by C3 plants during Photosynthesis .Justify	***CO 4***	***PO 2***	**8**
		c)	With a neat labelled diagram , explain the structure of a chloroplast	***CO 1***	-	**4**
			UNIT - IV			
	5	a)	Write the sequence of steps and the net reaction for the biosynthesis of phosphatidic acid from glucose and glycerol.	***CO 4***	***PO 2***	**8**
		b)	What changes in metabolic pattern would result from a mutation in the muscle carnitine acyltransferase I in which the mutant protein has lost its affinity for malonyl-CoA but not its catalytic activity?	***CO 5***	***PO 2***	**4**
		c)	When the acetyl CoA produced during β oxidation in the liver exceeds the capacity of the TCA cycle, the excess acetyl CoA forms ketone bodies. This occurs in severe uncontrolled diabetes as the tissues oxidize large amounts of fatty acids. What are ketone bodies? Explain the mechanism of formation	***CO 5***	***PO 2***	**8**
			OR			
	6	a)	Elucidate the pathway for synthesis of cholesterol.	***CO 4***	***PO 2***	**8**
		b)	Free palmitate is activated to its coenzyme A derivative (palmitoyl-CoA) in the cytosol before it can be oxidized in the mitochondrion. If palmitate and [14C]coenzyme A are added to a liver homogenate, palmitoyl-CoA isolated from the cytosolic fraction is radioactive, but that isolated from the mitochondrial fraction is not. Explain.	***CO 4***	***PO 2***	**4**
		c)	In the initial stages of fatty acid synthesis, in the condensation reaction catalyzed by ketoacyl-ACP synthase, a four-carbon unit is synthesized by the combination of a two-carbon unit and a three-carbon unit, with the release of CO2. (i) Identify the two-carbon unit , a three-carbon unit and four-carbon unit (ii) Give the reaction catalyzed by ketoacyl-ACP synthase (iii) What is the thermodynamic advantage of this process over one that simply combines two two-carbon units?	***CO 4***	***PO 2***	**8**

SUPPLEMENTARY EXAMS 2024

			UNIT - V			
	7	a)	Why are Carbamoyl phosphate and aspartate required for the synthesis of urea? List the sequence of reactions involved in the synthesis of urea.	***CO 4***	***PO 2***	**7**
		b)	PRPP is essential for recycling of nucleotides by salvage pathway .Justify	***CO 5***	***PO 2***	**4**
		c)	Name and draw the structure of the α keto acid resulting when each of the following amino acids undergoes transamination with α-ketoglutarate: (a) aspartate, (b) alanine	***CO 1***	-	**4**
		d)	Some bacteria require p-aminobenzoate which is an important component of formyl tetrahydrofolate in the culture medium for normal growth.Their growth is severely inhibited by the addition of sulfanilamide, one of the earliest sulfa drugs.Moreover, in the presence of this drug, 5-aminoimidazole-4-carboxamideribonucleotide (AICAR) accumulates in the culture medium. These effects are reversed by addition of excess p-aminobenzoate. i. Identify the nucleotide pathway involved ii. Show the structure of the nucleotide marking the origin of its atoms. iii. Addition of what atom is being inhibited in the above situation ? iv. Why does AICAR accumulate in the presence of sulfanilamide? v. identify the enzyme and the reaction involved leading to accumulation of AICAR  *p*-Aminobenzoate  Sulfanilamide	***CO 5***	***PO 2***	**5**

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SUPPLEMENTARY EXAMS 2024