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Your Roll No

5808

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B.Sc. (Hons.)/III

BIOCHEMISTRY—Paper XIII

(Membrane Biochemistry and Bioenergetics)

(Admissions of 2000 and onwards)

Time 3 Hours

Maximum Marks 60

*(Write your Roll No on the top immediately
on receipt of this question paper)*

*Attempt Five questions in all, including
Q No 1 which is compulsory*

- 1 (a) Comment on the following 12
- (i) Each cytochrome present in the electron transport chain has a different reduction potential
 - (ii) Non-ionic detergents are preferred over ionic detergents to solubilize membrane proteins
 - (iii) Photosynthetic organisms contain several types of pigment molecules
 - (iv) A 0.25M sucrose solution would not be isotonic for a mammalian cell if the cell had sucrose carrier protein in its plasma membrane

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- (v) A reaction with a positive ΔE_0^1 can proceed in the forward direction
- (vi) Nerve impulses travel much faster through electrical synapses than chemical synapses
- (b) Name the following 4
- (i) The disorder of endocrine glands that is a result of an anionic transporter defect
- (ii) A major regulatory catabolite that represses glucose transport in bacterial systems
- (iii) A protein mobile electron carrier of the electron transport chain
- (iv) A photosynthetic bacterium
- (v) An inhibitor of photophosphorylation used as herbicide
- (vi) Calmodulin dependent active transporter of Ca^{2+}
- (vii) Photon dependent ion transporter in prokaryotes
- (viii) The protein present in flask shaped invaginations in the plasma membrane
- 2 (a) For each of the conditions below predict the state of oxidation of ubiquinone and cytochromes b, c_1 , c and $a + a_3$ 8
- (i) Abundant NADH and oxygen, but antimycin A added

- (ii) Abundant NADH and oxygen, but cyanide is added
 - (iii) Abundant NADH but oxygen exhausted
 - (iv) Abundant oxygen but NADH exhausted
- (b) State True or False and justify your answer 3
- (i) A living organism exists in a state of equilibrium with its surroundings
 - (ii) ATP has a higher standard free energy of hydrolysis than phosphoenolpyruvate
 - (iii) The mitochondrial membrane potential is negative on the matrix side and positive on the cytosolic side
- 3 (a) Give the full form of the following and briefly explain 6
- (i) FRET
 - (ii) CURL
 - (iii) NMDA
 - (iv) FRAP
 - (v) GEM
 - (vi) PTS
- (b) You are studying the uptake of L-Leucine by epithelial cells of the mouse intestine. Measurements of the rate of uptake of L-Leucine and several of its analogs, with and without sodium ions in the

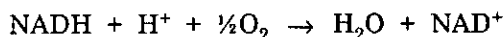
assay buffer, yield the results given in the table
 What can you conclude about the properties and
 mechanism of the Leucine transporter ? Would you
 expect L-Leucine uptake to be inhibited by ouabain

<i>Substrate</i>	<i>Uptake in the presence of Na</i>		<i>Uptake in the absence of Na</i>	
	V_{\max}	K_t (mM)	V_{\max}	K_t (mM)
L-Leucine	420	0.24	23	0.24
D-Leucine	310	4.7	5	4.7
L-Valine	225	0.31	19	0.31

Would V_{\max} and/or K_t change if you added a Na^{+1} ionophore to the assay solution containing Na^{+1} ?

Explain 5

- 4 (a) Electron transfer in the mitochondrial respiratory chain may be represented by the net reaction equation

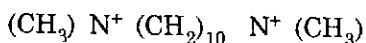


- (i) Calculate ΔE_0^1 for the net reaction of mitochondrial electron transfer
- (ii) Calculate ΔG_0^1 for this reaction
- (iii) How many ATP molecules can theoretically be generated by this reaction if the free energy ATP synthesis under cellular conditions is 52 kJ/mol

$$\Delta E_0^1 \text{ for NAD/NADH} = -0.320 \text{ V}$$

$$\Delta E_0^1 \text{ for O}_2/\text{H}_2\text{O} = +0.820 \text{ V}$$

- (b) When chloroplasts are illuminated with 700 nm light cytochrome f, plastocyanin and plastoquinone are oxidized. When chloroplasts are illuminated with 680 nm light these electron carriers are reduced. Explain 5
- 5 (a) Give the structure and flow of electrons in a bacterial photosynthetic reaction centre 4
- (b) ATP synthase can form ATP even in the absence of a proton gradient when it is mixed with ADP and P_i . Comment 4
- (c) Explain photocycle of *Halobacterium halobium* 3
- 6 (a) Membrane vesicles of *E. coli* that possess the lactose permease are preloaded with KCl and are suspended in equal concentration of NaCl. It is observed that these vesicles actively though transiently, accumulate lactose if valinomycin is added to the vesicles suspension. No such active uptake is observed if KCl replaces NaCl in the suspending medium. Explain 4
- (b) We are unable to detect color in dim light. Comment 4
- (c) Decomethonium ion which has the following structure is used as a muscle relaxant and also increases the heart rate



Propose its mode of action. Why is the action on the skeletal muscle and cardiac muscle different?

- 7 (a) What would happen if 4
- (i) Phosphatidylcholine 1-0-steroyl, 2-0-arachidonyl is mixed in a hydrophilic solvent
 - (ii) A mixture of equimolar phosphatidylcholine 1, 2-0-oleoyl and phosphatidyl ethanolamine 1,2-0-linoyl are mixed in a solvent of hexane water 1 : 1 and hexane is slowly evaporated
 - (iii) The solutions are placed at 10°C
 - (iv) Cholesterol is also added in (ii) and the temperature is maintained at 5°C
- (b) Describe briefly two key experiments that established the role of the proton motive force in ATP synthesis 4
- (c) At pH 7, Tryptophan crosses a lipid bilayer at about one-thousandth the rate of the closely related substance indole. Suggest an explanation for this observation 3
- 8 (a) What is membrane fusion? Differentiate the membrane fusion events triggered by influenza virus and neurotransmitter release 4
- (b) Describe the subunit structure of mitochondrial ATP Synthase 4
- (c) Membrane biogenesis occurs in organelles. Explain 3