CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

IV- Semester of B.Sc. (Biochemistry) Examination April 2019

Course code & Name BC405: Membrane Biology and Bioenergetics

Date: 1/05/2019 Day: Wednesday Time: 1: 30 PM To 2:00 PM Maximum Marks: 20

MCQ

Important Instructions:

- Tick the correct answer and it should be written in question paper itself.
- Use of non-programmable calculator is allowed.

Q I	**Choose the correct answer for the following questions.**		**20**
1.	Consider the following equation $\Delta G = \Delta H - T\Delta S$ The reaction will be spontaneous under which of the following conditions		
	(i) ΔH and ΔS are positive at temperature above ΔH / ΔS	(ii) ΔH is negative while ΔS is positive	
	(iii) ΔH is positive while ΔS is negative	(iv) Both i and ii	
2.	Which of the following is true for hydrolysis of phosphorylated compounds?		
	(i) The products are stabilized by isomerization	(ii) The bond strain in reactants due to electrostatic repulsion is relieved by charge separation.	
	(iii) The products are stabilized by resonance.	(iv) All of the above	
3.	Which of the following is true for luciferin?		
	(i) It utilizes ATP for light emission.	(ii) It requires NADH for light emission	
	(iii) It requires FMN for light emission.	(iv) None of the above	
4.	Mitochondria of the eukaryotes are believed to have originated from		
	(i) Gram-positive bacteria	(ii) Blue-green algae	
	(iii) Gram-negative bacteria	(iv) Archaea	

5.	Match the following 1. Tococepherol — a. FMN and FAD 2. Niacin — b. Coenzyme for pyruvate decarboxylase 3. Thiamine — c. NAD 4. Riboflavin — d. Anti- oxidant		
	(i) 1-d; 2-a; 3-b; 4-c	(ii) 1-b; 2-a; 3-d; 4-c	
	(iii) 1-c ; 2-a; 3-b-; 4-d	(iv) 1-d; 2-c; 3-b; 4-a	
6.	The inner membrane of the mitochondria is impervious to ions because		
	(i) It lacks porin	(ii) An outer-membrane surrounds the inner-membrane	
	(iii) There are no ions in the inter-membrane space	(iv) High proportion of phospholipid, cardiolipin	
7.	Which of the following is not a component of Complex III		
	(i) Reiske Fe-S cluster	(ii) Cytochrome c1	
	(iii) Cytochrome c	(iv) Cytochrome b	
8.	Ubiquinone can be reduced by		
	(i) Heme a_3	(ii) Malate dehydrogenase	
	(iii) Glycerol-3- phosphate dehydrogenase	(iv) Cytochrome C	
9.	Which of the following is true for reactive oxygen species?		
	(i) It can be generated by reduction of molecular oxygen.	(ii) It can be inactivated by superoxide dismutase	
	(iii) It can be generated by reduction by semi-ubiquinone produced by complex I	(iv) All of the above	
10.	Which of the following is true for 2, 4-dinitrophenol?		
	(i) It is an ionophore.	(ii) It inhibits the F_0 complex.	
	(iii) It is passes through the inner membrane and ionizes in the matrix to dissipate the ionic gradient.	(iv) It binds to the Fe- clusters of the electron transport chain.	
11.	During ATP synthesis the c subunit of the F_0 complex rotates by		
	(i) 180^0	(ii) 60^0	
	(iii) 120^0	(iv) 360^0	
12.	Arrange the following in increasing order of oxidation state of carbon molecule CO_2 , CH_4, CH_3CHO, CH_3COOH, CH_3OH		
	(i) $CO_2<CH_4<CH_3CHO<CH_3COOH<CH_3OH$	(ii) $CH_4<CH_3OH<CH_3CHO<CH_3COOH<CO_2$	
	(iii) $CH_4<CH_3CHO<CH_3COOH<CH_3OH<CO_2$	(iv) $CH_4<CH_3OH<CH_3COOH<CH_3CHO<CO_2$	
13.	Emerson's enhancement effect and Red drop have been instrumental in the discovery of		
	(i) Oxidative phosphorylation	(ii) Photophosphorylation & noncyclic electron transport	
	(iii) Two photosystems operating simultaneously	(iv) Photophosphorylation and cyclic electron transport	

14.	Cyclic phosphorylation results in the formation of		
	(i) ATP	(ii) NADPH	
	(iii) ATP and NADPH	(iv) ATP, NADPH and Oxygen	
15.	O_2 released during photosynthesis comes from		
	(i) CO_2	(ii) H_2O	
	(iii) $C_6H_{12}O_6$	(iv) Chlorophyll	
16.	What is the location of photosynthetic pigment in an oxygenic photosynthetic organism?		
	(i) Plasma membranes	(ii) Chromatophores	
	(iii) Thylakoid membranes	(iv) Chlorosome	
17.	Pathway that produces oxygen during photosynthesis is		
	(i) Electron transport pathway	(ii) Noncyclic electron pathway	
	(iii) Light independent reactions	(iv) Cyclic electron pathway	
18.	Which of the following statements about thylakoids is false?		
	(i) They contain chlorophyll pigments	(ii) They contain the photosystems	
	(iii) They contain electron transport machinery	(iv) They contain Calvin cycle enzymes	
19.	The oxygen evolving complex contains which of the following elements for photosynthetic oxygen release from H_2O?		
	(i) Manganese	(ii) Sulphur	
	(iii) Iron	(iv) Chlorine	
20.	The simplest light driven proton pump present in *Halobacteria is*		
	(i) Cytochrome b_6f	(ii) Bacteriorhodopsin	
	(iii) ATPase	(iv) All of the above	

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Date: 1/05/2019 Day: Wednesday Time: 2:00 PM To 4:30 PM Maximum Marks: 50

Instructions:

1. **Section I and II must be attempted in SEPERATE ANSWER SHEET.**
2. Make suitable assumptions and draw neat figures wherever required.
3. Use of non-programmable calculator is allowed.
4. Show necessary calculations.

SECTION -I		**20**
Q - II Answer the following questions as directed		**12**
Q- II (A)	**Describe briefly (any three)** a) Structure of mitochondria b) Proton motive force c) Thermogenesis d) Uncouplers	**6**
Q- II (B)	a) Describe reactive oxygen species (ROS) generation in mitochondria and strategies to combat ROS. OR b) Describe experiments that support the chemiosmotic theory of ATP synthesis.	**3**
Q-II (C)	a) The inner membrane of mitochondria is impervious to charged molecules. Describe the transport of ATP, ADP and Pi in mitcochondria. OR b) What are the constituents of complex III? Explain the Q-cycle	**3**
Q-III Answer the following questions as directed		**8**
Q- III (A)	Answer (Any one) a) Describe the structure of F_0-F_1 complex? Explain the rotational catalysis of ATP synthesis. b) Explain the regulation of oxidative phosphorylation.	**5**
Q-III (B)	(i) Consider the following reaction used for the determination of $\Delta G^{0'}$ Glucose-6- phosphate + H_2O → Glucose +P_i K'_{eq} = 270……(1) ATP+ glucose → ADP + glucose-6- phosphate K'_{eq} = 890……(2) Using this information, Calculate the standard free energy of hydrolysis of ATP at 25^0C. Given R=8.314kJ/mol. OR (ii) The phosphorylation of glucose in the cell is coupled to the hydrolysis of ATP; that is, part of the free energy of ATP hydrolysis is used to phosphorylate glucose. (1) Glucose + P_i ⟶ glucose 6-phosphate + H_2O $\Delta G'° = 13.8$ kJ/mol (2) ATP + H_2O ⟶ ADP + P_i $\Delta G'° = -30.5$ kJ/mol *Sum:* Glucose + ATP ⟶ glucose 6-phosphate + ADP	**3**

	Calculate K'_{eq} for the overall reaction. For the ATP-dependent phosphorylation of glucose, what concentration of glucose is needed to achieve a 250μM intracellular concentration of glucose 6-phosphate when the concentrations of ATP and ADP are 3.38 mM and 1.32 mM, respectively?	

	SECTION -II	**30**
Q-IV Answer the following questions as directed		**15**
Q- IV (A)	a) Electron transfer in the mitochondrial respiratory chain may be represented by the net reaction equation $NADH + H^+ + \frac{1}{2}O_2 \rightleftharpoons H_2O + NAD^+$ i) Calculate the value of $\Delta E^{0\prime}$ for the net reaction of mitochondrial electron transfer. Given that $\frac{1}{2} O_2 + 2H^+ + 2e^- \rightarrow H_2O$ $E^{0\prime} = +0.816V$ $NAD^+ \; H^+ + 2e^- \rightarrow NADH$ $E^{0\prime} = -0.320V$ ii) Calculate $\Delta G^{0\prime}$ for this reaction. iii) How many ATP molecules can theoretically be generated by this reaction if the free energy of ATP synthesis under cellular conditions is 52kJ/mol? OR b) Describe an experiment to illustrate that proton gradient is necessary for ATP synthesis.	**5**
Q- IV (B)	**Answer any two** a) What is photosynthetic unit? Describe structure and function of various photosynthetic pigments b) What is cyclic and noncyclic photophosphorylation? Explain electron flow of noncyclic photophosphorylation in detail. c) Write a short note on evolution of oxygenic photosynthesis. Describe anoxygenic photosynthesis in Green and Purple Sulphur bacteria	**10**
Q-V Answer the following questions as directed		**15**
Q-V(A)	Describe the following (Any three) a) Hill reaction b) Water splitting complex c) Bacteriorhodopsin d) Structure of chloroplast	**9**
Q-V (B)	**Answer briefly (any two)** a) Chemical basis of large free energy change associated with ATP hydrolysis. b) Oxidation –reduction reaction in biological systems. c) Different electron carriers of the electron transport chain d) Suggest the methods employed to determine the sequence of the electron carrier in electron transport chain	**6**