

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

First Semester 2016-17

Comprehensive Exam - Biological Chemistry (BIO F211)

Closed Book Part

Date: 01/12/2016

Max Duration: 90 min

Max Marks: 40 (20%)

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- 1.** If a molecule of glucose produces two molecules of ATP by substrate level phosphorylation of ADP in glycolysis and the resulting two molecules of pyruvate can each yield 15 molecules of ATP when oxygen is available, how many glucose molecules will be necessary to produce 160 molecules of ATP by yeast grown under (a) aerobic and (b) anaerobic conditions? Clearly give the calculations/justification wherever necessary. [4]
- 2.** Mitochondria in the brown adipose tissue have a P/O ratio of less than 1 for ATP synthesis arising from oxidation of NADH. Justify briefly. Also mention the physiological significance of such tissue in animals. [4]
- 3.** Define 'turnover number' for an enzyme. At what substrate concentration would an enzyme with a k_{cat} of 30.0 s^{-1} and a K_m of 0.0050M operate at one-quarter of its maximum rate? Justify/show calculations. [4]
- 4.** Triacylglycerols, with their hydrocarbon-like fatty acids, have the highest energy content of the major nutrients. [6]
(a) If 15% of the body mass of a 70.0 kg adult consists of triacylglycerols, what is the total available fuel reserve, in kilojoules, in the form of triacylglycerols? Given that the energy value of stored triacylglycerol is 38 kJ/g.
(b) If the basal energy requirement is approximately 8,400 kJ/day, how long could this person (under starvation conditions) survive if the oxidation of fatty acids stored as triacylglycerols were the only source of energy?
(c) What would be the weight loss in Kg per day under such starvation conditions?
- 5.** Glycogen phosphorylase catalyzes the removal of glucose from glycogen. The ΔG° for this reaction is 3.1 kJ/mol. (a) Calculate the ratio of $[\text{P}_i]$ to [glucose 1-phosphate] when the reaction is at equilibrium (taking temperature as 25°C). (Hint: The removal of glucose units from glycogen does not change the glycogen concentration.) (b) The measured ratio $[\text{P}_i]/[\text{glucose 1-phosphate}]$ in myocytes (muscle cells) under physiological conditions is more than 100:1. What does this indicate about the direction of metabolite flow through the glycogen phosphorylase reaction in muscle? [6]
- 6.** Write short notes on: [4x2M=8]
(a) Stability of DNA in comparison to RNA
(b) Glutathione
(c) Beta oxidation of fatty acids
(d) Disaccharides
- 7.** Depict schematically (with labels) the following metabolic pathways: [4x2M=8]
(a) Glyoxylate cycle
(b) Urea cycle
(c) Pentose phosphate pathway
(d) Calvin cycle

-----ALL THE BEST-----