

SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR-388120.
M.Sc. (I Sem) Industrial Biotechnology
PS01C IBT03 – Chemical Engineering and Thermodynamics of Biological System
6 Dec 2012, Thursday, 10.30 a.m. to 1.30 p.m.

Total Marks: 70

- Q1** Choose the most appropriate answer (1x8)
- (i) A positive value of ΔG means
- A. Products of the reaction contain more free energy
 - B. Reactants of the reaction contain more free energy
 - C. Products and reactants both have equal energy
 - D. None
- (ii) NAD^+ accepts
- A. Accepts 2 electrons and 2 hydrogen ions
 - B. Accepts 2 electrons and 1 hydrogen ion
 - C. Accepts 1 electron and 1 hydrogen ion
 - D. Transfers electrons in reductive biosynthesis
- (iii) Which one describe the relationship between $\Delta G'^{\circ}$ and rate of a reaction
- A. $\Delta G'^{\circ}$ is linearly proportional to the rate
 - B. $\Delta G'^{\circ}$ is inversely proportional to the rate
 - C. If $\Delta G'^{\circ}$ is positive, the reaction is spontaneous
 - D. $\Delta G'^{\circ}$ provides no information about the rate.
- (iv) The proton – motive force generated by the electron transfer chain
- A. Includes a pH –gradient component
 - B. Includes an electrical –potential gradient component
 - C. Is used to synthesize ATP and for active transport processes
 - D. Has all the above characteristics.
- (v) Starch suspension is example of
- A. Bingham plastic fluid
 - B. Pseudo plastic fluid
 - C. Dilatant fluid
 - D. Rheoplectic
- (vi) Physical significance of Reynolds is
- A. Viscous force / Interfacial force
 - B. Interfacial force / Viscous force
 - C. Rate of change of momentum
 - D. Mass / Kinematic viscosity.

(vii) In power law, value of n for Bingham plastic fluid is:

- A. $n > 1$
- B. $n < 1$
- C. $n = 1$
- D. $n = 0$

(viii) Mechanical energy loss associated with boundary layer formation is known as:

- A. Drag resistance
- B. Form friction
- C. Skin friction
- D. Viscous loss

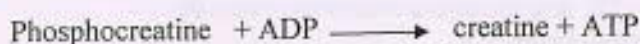
QII Write short notes on any Seven

7 X 2 = 14

- A. Laws of thermodynamics
- B. Biological clocks
- C. System and surroundings
- D. Extensive and intensive properties of system
- E. Catabolic and anabolic reaction
- F. Homolytic and heterolytic cleavage
- G. Why flow of electron is unidirectional in electron transport chain ?
- H. Why cell can not use heat directly as an energy source ?
- I. Why conversion of ATP to ADP is an irreversible reaction ?

QIII A. How do ΔG , $\Delta G'$, $\Delta G'^{\circ}$ and ΔG_p differ ? How cell can drive a thermodynamically unfavourable reaction in forward direction ? [06]

QIII B. Calculate the physiological ΔG for the reaction [06]



At 25 °C, as it occurs in the cytosol of neurons, with phosphocreatine at 4.7 mM, creatine at 1.0 mM, ADP at 0.73 mM and ATP at 2.6 mM, using following $\Delta G'^{\circ}$ values



OR

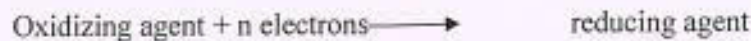
Q III B. A total of 30.5 kJ/mol of free energy is needed to synthesize ATP from ADP and Pi, when the reactants and products are at 1M concentration (Standard state). Calculate the free energy required to synthesize ATP in the human hepatocyte when the physiological concentration of ATP, ADP and Pi are 3.5, 1.5 and 5.0 mM respectively. [06]

QIVA. Explain how electron transfer reactions in mitochondria leads to synthesis of ATP? [6]

QIVB. With suitable example briefly explain various types of chemical reaction occurring in biological system. [06]

OR

QIVB The standard reduction potential E° , of any redox pair is defined for the half-cell reaction



The E° values for the NAD^+/NADH and pyruvate /lactate conjugate redox pairs are -0.32 V and -0.19 V respectively.



i) Which conjugate pair has the greater tendency to lose electrons?

ii) Which is stronger oxidizing agent?

iii) What is standard free energy change ΔG° and equilibrium constant K'_{eq} for the conversion of Pyruvate to lactate.

QVA. Classify fluid mechanics. Mention an industrial application of continuous gravity decanter and derive an expression of height of heavy liquid discharge leg required by using concept of hydrostatic equilibrium. [06]

QVB. Velocity profile of a fluid over the plate is parabolic with the vertex 20 cm from the plate surface where the fluid velocity is 120 m/s. Calculate velocity gradient and shear stress at a distance 0, 10 and 20 cm from the plate surface. Viscosity of fluid is 8.5 poise. [06]

OR

QVB. Show that average velocity is a one half of maximum velocity for laminar flow of incompressible Newtonian fluid through circular pipe. [06]

QVIA. Define friction factor and discuss the friction factor chart with necessary diagram. Show that $f = \frac{16}{N_{Re}}$ for laminar flow of incompressible Newtonian fluid through circular pipe. [06]

QVIB. Discuss importance of momentum correction factor and show that momentum correction factor is $4/3$ for laminar flow of incompressible Newtonian fluid through circular pipe. [06]

OR

QVIB. Discuss shear stress distribution for fully developed steady flow of incompressible fluid through horizontal circular tube. [06]