Section B Self-Test Answers

Question 1

What is the difference between catabolism and anabolism in cells?

Answer

Anabolism is the chemical process where external nutrients are taken into a cell to produce cell components for growth. Energy is consumed to build these components In contracts catabolism is the break down of a chemical energy source (or food) to release energy for use by the cell.

Question 2

What is activation energy and what is the effect of enzymes on chemical reactions in living organisms?

Answer

Activation energy is as the amount of energy required to bring all the molecules in a chemical reaction to a reactive state. This means once the activation energy level is reached the reaction will proceed spontaneously. Enzymes act as catalysts, reducing the level of activation energy required thus speeding up the rate at which reactions occur. Enzymes are highly specific in the reactions they catalyse, that is, each enzyme catalyses only a single type of chemical reaction..

Question 3

Define the following terms: reduction potential; redox coupled reactions and electron carriers

Answer

Redox potential is the ability of a substance to give up or accept electrons. This potential is measured electrically in reference to a standard substance, H_2. A compound with a negative reduction potential is more likely to donate electrons, i.e. become oxidised. A compound with a positive reduction potential is more likely to accept electrons, i.e. become reduced.

Redox coupled reactions or (O-R) are the reactions that actually release energy. The amount of energy in an O-R reaction depends on both the nature of the electron donor and acceptor: the greater the difference between reduction potentials of the two half reactions, the more energy their will be released upon their coupling.

Electron carriers are intermediary substances in the electron transport chain of catabolic reactions. For example they carry the electron released by a donor compound e.g. glucose which is cascaded down a number of intermediate electron accepting compounds to a point when the reaction ends with a terminal electron acceptor.

Question 4

Calculate the energy yield from the electron transfer of NAD to oxygen using the equations and supporting information below.

$$NAD^+ + 2H^+ + 2e \rightarrow NADH + H^+$$

$$\tfrac{1}{2} O_2 + 2e \rightarrow O_2^{2-}$$

Nernst Equation $\Delta G = -nF\Delta E$
Where F is the Faraday constant and is 23,000 calories/volt

Data sheet oxidation reduction potentials

Redox pairs	E in volts
CO_2/acetate	- 0.432
H^+/H_2	- 0.420
$NAD^+/NADH_2$	- 0.320
FAD/FADH	- 0.280
S/HS^-	- 0.220
SO_3/S	- 0.110
Fumerate/Succinate	+ 0.030
NO_3/NO_2	+ 0.430
Fe^{3+}/Fe^{2+}	+ 0.770
O_2/H_2O	+ 0.820

Answer

From the table the oxidation reduction potential of NAD^+/NADH is -0.32 volts O_2/H_2O is +0.820.

To measure the energy yield use the equation
delta G = -nFE This is also the Nernst Equation
n= number of electrons (2 here)
F= Faraday constant (9.64*10 power4 Joules/ volt equivalent or 23 000 calories)
E+ difference in redox potential -0.32 through to +0.82 = 1.14

insert these as

G= -2 * 9.64*10 power 4 * 1.14
Answer is G= -220 KJ

Question 5

What is adenosine triphosphate and why is it important in cells?

Answer

ATP is a high energy compound which is the major source of energy for cellular reactions. ATP is important as it is able to store and transport energy within cells.