BOTANY - II

RESPIRATION IN PLANTS

VSA

1)Different substrates get oxidised during respiration. How does respiratory quotient (RQ) indicate which type of substrate i.e., carbohydrate, fat or protein is getting oxidised ?

RQ = A/B

What do A and B stand for ?

What type of substrates have RQ of 1, < 1, > 1 ?

Ans.

$$\text{Respiratory Quotient (R.Q)} = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ consumed}}$$

Here, A stands for volume of CO_2 evolved

Here B stands for volume of O2 consumed

If RQ value is 1 the Respiratory substrates are carbohydrates

If RQ values is < 1 the Respiratory substrates are Protein's & fats

Mode 02

If RQ values is > 1 the Respiratory substrates are Organic acids. – 2, 3, 4

RQ

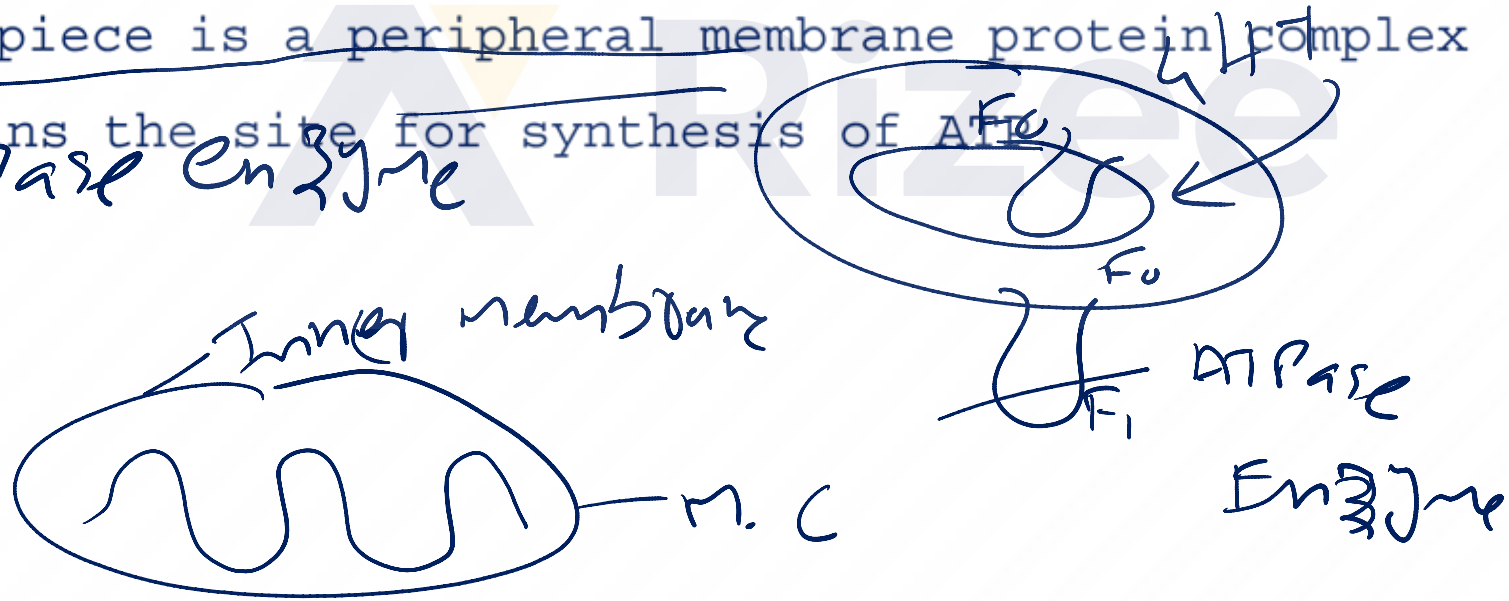
$\frac{6CO_2}{6O_2} = 1$

$\frac{6CO_2}{12O_2}$ 0.7 . 0.5 Fats

2) What is the specific role of F_0-F_1 particles in respiration ?

Ans.

- F_0 is an integral membrane protein complex that forms the channel through with protons cross the inner membrane.
- The F_1 headpiece is a peripheral membrane protein complex and contains the site for synthesis of ATP.



3) When does anaerobic respiration occur in man and yeast ?

Ans.

Anaerobic respiration occurs in the absence of oxygen.

Man : when oxygen is inadequate for cellular respiration, anaerobic respiration occurs which leads to muscle fatigue; (Pyruvic acid reduced to lactic acid)

Yeast : Incomplete oxidation of glucose occurs under anaerobic conditions, which leads to formation of alcohol. (Fermentation)

4) What is the common pathway for aerobic and anaerobic respirations? Where does it take place ?

- Glycolysis
- Cytosol of the cell

aerobic

O_2 ✓

Glycolysis

↓

T.C.A cycle

M.C

anaerobic

O_2 ×

Glycolysis

↓

Fermentation

5) What cellular organic substances are never used as respiratory substrates?

Ans.

Pure proteins or fats are never used as respiratory substrates

carbohydrates

SAG/4M

6) Why is the respiratory pathway referred to as an amphibolic pathway? Explain?

- **Amphibolic pathway** is the one which is used for both breakdown (catabolism) and build-up (anabolism) reactions.
- **Respiratory pathway** is mainly a catabolic process which serves to by provide energy.
- The pathway produces a number of intermediates.
- Many of them are raw materials for building up both primary and secondary metabolites.

- Acetyl CoA is helpful not only in kerbs' cycle but it also raw material for synthesis of fatty acids, steroids, terpenes, aromatic compounds and carotenoids
- Fatty acids would be broken down to acetyl CoA before entering the respiratory pathway when it is used as a substrate. But when the organism needs to synthesize fatty acids, acetyl CoA would be withdrawn form the reparatory pathway for it.
- Hence, the respiratory pathway comes into the picture both during breakdown and synthesis of fatty acids.
- Breaking down processes within the living organism is catabolism, and synthesis is anabolism.

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- Because the respiratory pathway is involved in both anabolism and catabolism, it would hence be better to consider the respiratory pathway as an amphibolic pathway rather than as a catabolic one.

7) Write about two ATP yielding reactions of glycolysis. — anaerobic cytosol

Ans.

- 1,3 dPGA (disphosphoglyceric acid) looses phosphate group in the presence of phosphoglycerokinase to form 3-phosphoglyceric acid. ADP accepts phosphate group and gets converted to ATP.

$$\textbf{1,3 dPGA + ADP} \xrightarrow{\textbf{phosphoglycerokinase}} \textbf{3 - PGA + ATP}$$

(1) ATP

- Phosphoenol pyruvic acid undergoes dephosphorylatio in the presence of pyruvic kinase results in the formation of pyruvic acid. ADP accepts phosphate group and gets converted to ATP

$$\textbf{PEP + ADP} \xrightarrow{\text{pyruvic } \textit{kinase}} \textbf{Pyruvic acid + ATP}$$

2 ATP

8) The net gain of ATP for the complete aerobic oxidation of glucose is 36. Explain.

Ans.

1) Glycolysis :

1. ATP produced by substrate by substrate level phosphorylation

Bisphosphoglyceric acid to Phosphoglyceric acid**: 2 x 1 = 2 ATP**

Phosphoenol pyruvic acid to pyruvic acid**: 2 x 1 = 2** ATP

ATP consumed : for the phosphorylation of glucose and fructose-6 phosphate**: -2 ATP**

Net gain of ATP**: +2 ATP**

2. ATP from NADH general in glycolysis :

G-3-P to BPGA (2NADH, each worth 2ATP) : **2x2 = 4** ATP

Total ATP gain from glycolysis in the presence of O_2 : **(a)$_{6ATP}$**

1 NADH = 2 ATP (old)

newbooks 1 NADH 3 ATP

1 = 3 x 2 = 6 NADH

4+2 = 6 ATP

new 6+2 = 8 ATP

2) Oxidative decarboxylation of pyruvic acid Link Reaction

Pyruvic acid to acetyl COA

(2 NADH, each worth 3 ATP) 1 NADH = 3 ATP : (b) **2x3 = 6 ATP**

3) Krebs cycle TCA Cycle

1.ATP produced in substrate level phosphorylation : succinyl CoA to succinic acid **: 2 x 1 = 2 ATP**

2. ATP from NADH : Isocitric acid to Oxalosuccinic acid 6 NADH

: 2 x 3 = 6 ATP 6 x 3 = 18 - NADH

alpha Ketoglutaric acid to succinyl CoA **: 2 x 3 = 6 ATP**

Malic acid to Oxaloacetic acid **: 2 x 3 = 6 ATP**

3.ATP from FADH2 : Succinic acid to fumaric acid

: 2 x 2 = 4 ATP

2 FADH
1 FADH = 2 ATP

Total ATP value of Krebs cycle : (c) 24ATP

Net gain of ATP in aerobic respiration per mole glucose

(a + b + c) : 36 ATP

18 NADH
4 FADH
2 ATP
24 TCA

K.C 2R Glyc
24 + 6 + 6 = 36 ATP

24 + 6 + 8 = 38 ATP / Net Gain

2 Marks

9) Give an account of Glycolysis. Where does it occur? What are the end products? Trace the fate of these products in both aerobic and anaerobic respiration.

cytosol

1 Glucose → 2 PA

Ans.

Breakdown of 1 molecule of glucose into 2 molecules of pyruvic acid is called **glycolysis.** It was given by Gustavo embed, Otto Mayerhof and J.Parnas so called EMP pathway. Glycolysis

Glycolysis occur in cytosol. Pyruvic acid, 2ATP, 2NADH+H are the end products in Glycolysis. Pyruvic acid, 2NADH+H are completely oxidized through TCA cycle, ETS pathway and produce 36 ATP molecules.

1 M

In Anaerobic respiration, pyruvic acid is partially oxidized results in the formation of Ethyol alcohol and CO_2. The path of glycolysis is as follows:9 steps /10 steps

Reactions of Glycolysis:

1) Phosphorylation: - use ATP

$$\text{Glucose} + \text{ATP} \xrightarrow{\text{Hexokitonase}} \text{Glucose-6-phosphate} + \text{ADP}$$

2) Isomerisation:

$$\text{Glucose-6-phosphate} \xrightarrow{\text{Phosphohexose isomerase}} \text{Fructose -6-phosphate}$$

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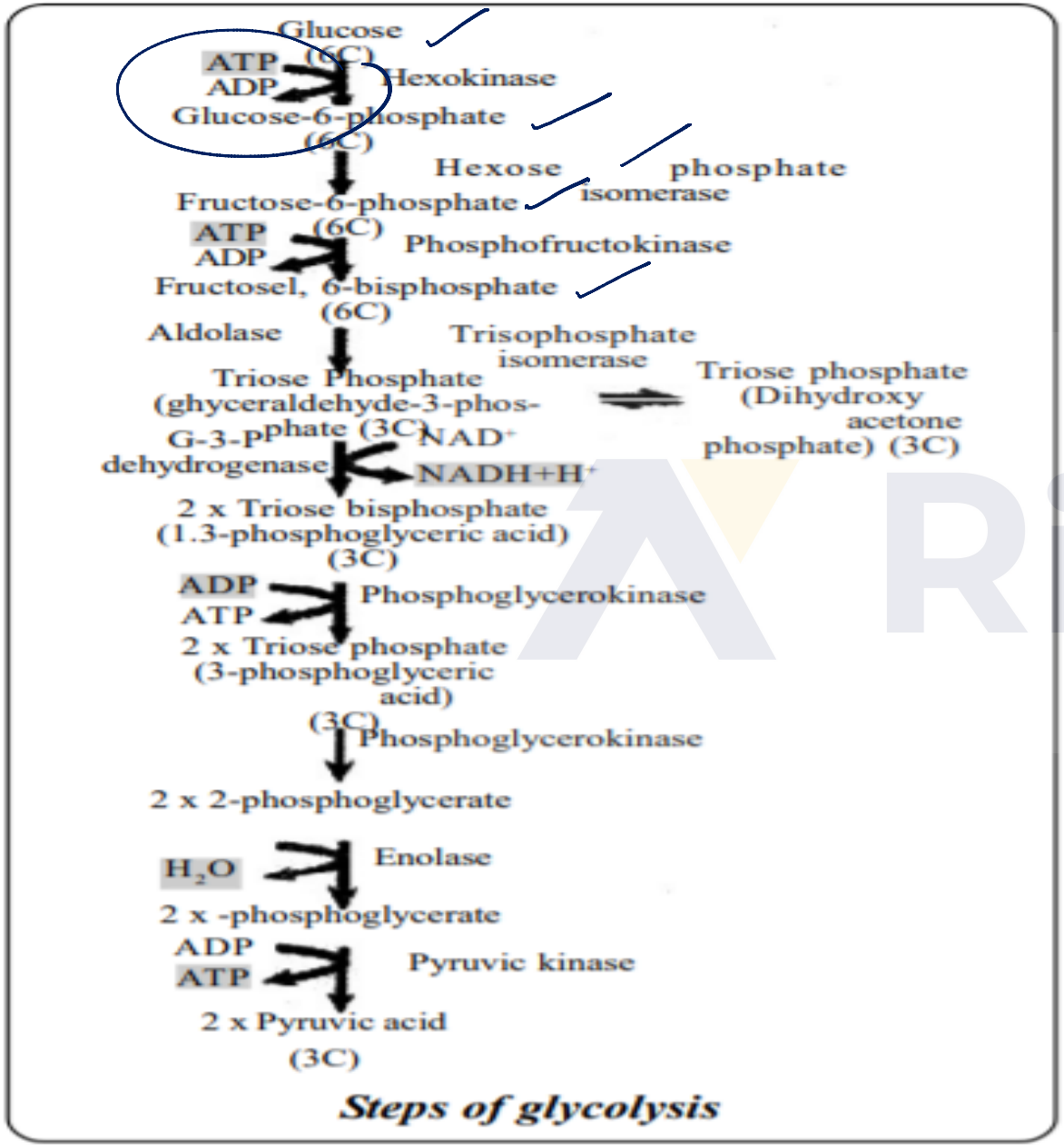

Steps of glycolysis

Marks
(3)

ATP → ADP } PhosPho Relation
ADP → ATP } DeP.R

3) Phosphorylation:

$$\text{Fructose -6-phosphate} + \text{ATP} \xrightarrow{\text{phosphofru tokinase}} \text{Fructose 1,6 bis phosphate} + \text{ADP}$$

4) Cleavage:

$$\text{Fructose 1,6 bis phosphate} \xrightarrow{\text{Aldolase}} \text{DHAP} + \text{Glyeroldyhyde 3 - phosphate}$$

5) Isomerisation:

$$\text{DHAP} \xrightarrow{\text{Triosephosphateisomerase}} \text{Glyeroldyhyde 3 - phosphate}$$

6) Oxidation:

Glyeroldyhyde 3 - phosphate +NAD +Pi $\xrightarrow{\text{G–3 pDehydrogenase}}$ 1,3 bis PGA +NADH

7) Dephosphorylation:

1,3 bis PGA + AD P $\xrightarrow{\text{Phosphoglycerokinase}}$ 3- Phosphoglyceric acid (3-PGA) +ATP

8)Intramolecular shift:

3- Phosphologyceric acid (3-PGA) $\xrightarrow{\text{Phosphoglyceromutase}}$ 2 PGA (2-Phosphoglyceric acid)

9) Dehydration: $H_2O\uparrow$

2- Phosphoglyceric acid Pi $\xrightarrow{\text{Enolase}}$ phoshoenolpyruvic acid (PEP) +H2O

10) Dephosphorylation:

Phosphoenolpyruvic acid +ADP $\xrightarrow{\text{Pyruvickinase}}$ Pyruvic acid + ATP

Net Gain ATP = 2 ATP

2 ADP

THANK YOU