TOPIC: CELLULAR RESPIRATION IN ORGANISMS
Time: 2 ½ hours
Attempt all questions in this paper

SECTION	MARKS
A	
B	
TOTAL	

SECTION A (40MARKS)

1. Why is it beneficial for cells to use ATP rather than directly using the energy stored in the bonds of carbohydrates to power cellular reactions? What re the greatest drawbacks to harnessing energy from the bonds of several different compounds?
   A. ATP is readily available in the form of a single unit that provides a consistent appropriate amount of energy. The cell would need to tailor each reaction to each energy source if it harvested energy from different compounds.
   B. ATP energy cannot activate the reactive oxygen dependent stress response whereas food molecules are responsible for activating the responses
   C. ATP is low in energy, but food molecules possess higher levels of energy that cells can use.
   D. ATP is readily available to cells, unlike compounds that have to first be phosphorylated in order to release their energy.
2. The end product of glycolysis
   A. Glucose diphosphate
   B. Lactic acid
   C. Citric acid
   D. Pyruvic acid
3. The following process does not require respiratory energy?
   A. Synthesis of cellulose
   B. Meiosis
   C. Lass of water from the stomata
   D. Mineral absorption
4. Which of the following are formed during anaerobic respiration in yeast cell?
   A. Lactic acid and ATP
   B. Lactic acid and ADP
   C. Ethanol and ATP
   D. Ethanol and ADP
5. How many kilojoules of energy are released if 1 gram of sugar burned in oxygen raises the temperature of 500g of water by 7.50C, (4.18J raise the temperature of 1 gram of water by 10C)
   A. 15.7kJ
   B. 156kJ
   C. 1.56kJ
   D. 1560kJ
6. What happens to most of the reduced NADH2 molecules metabolism?
   A. Direct use in the synthesis of starch to glucose
   B. Oxidation in mitochondria resulting in ATP formation
   C. Oxidation in Calvin cycle
   D. Combination with sulphuric acid as part of Krebs cycle
7. Which of the following will speed of phosphorylation of the Hexose sugar?
   A. Decrease of ADP concentration
   B. A decrease in the concentration of ATP
   C. An increase in the concentration of the phosphate
   D. An increase in the concentration of phosphorylated hexose
8. An athletic had just finished a race; the phrase “oxygen debt” refers to
   A. The amount of oxygen originally present in the muscle of an athlete before the race
   B. The total amount of oxygen an athlete requires to restore the breathing rate to normal
   C. The amount of oxygen taken in after the race and used for complete combustion of lactic acid
   D. The amount of oxygen after the race to convert excess lactic acid to glycogen in the liver.
9. Which of the following biological processes does not utilize respiratory energy?
   A. Loss of water from stoma
   B. Mineral salt absorption
   C. Synthesis of cellulose
   D. Meiosis
10. Which one of the following compounds act as hydrogen acceptor during anaerobic respiration in animals?
    A. NAD
    B. NADP
    C. Lactic acid
    D. Pyruvic acid
11. Which one of the following is not a method of measuring the rate of respiration in an organism?
    A. Estimating the amount of food taken in by the organism per day
    B. Measuring the heat produced by the organism in a given time
    C. Measuring the amount of CO2 produced by an organism in a given time
    D. Estimating the amount of oxygen consumed by the body in a given time
12. The substance that supplies phosphate at the beginning of glycolysis is
    A. Inorganic phosphate
    B. Adenosine triphosphate
    C. Adenosine monophosphate
    D. Nicotinamide adenine dinucleotide phosphate
13. The following are physiological conditions in living cells
    1. High concentration of ADP and Pi
    2. High concentration ATP
    3. High concentration of hydrogenase
    4. High concentration of ATPase
    Which of them will increase the rate of sugar down

A. 1 and 2
B. 2 and 3
C. 1 only
D. 4 only

14. A rat requires more energy per unit body weight than required by human because the rat
A. Has a large surface area
B. Is more active
C. Has higher body temperature
D. Has a higher metabolic rate

15. Red blood cells(RBCs) do not perform aerobic respiration, but they do perform glycolysis. Why do all cells need an energy source and what would happen if glycolysis were blocked in a red blood cell?
A. Cells require energy to perform certain basic functions. Blocking glycolysis in RBCs causes imbalance in the membrane potential leading to cell death.
B. Cells need energy to perform cell division. Blocking glycolysis in RBCs interrupts the process of mitosis leading to nondisjunction.
C. Cells maintain the influx and efflux of organic substances using energy. Blocking glycolysis stops the binding of carbon dioxide to the RBCs, causing cell death
D. Cells require energy to recognize attacking pathogens. Blocked glycolysis inhibits the process of recognition, causing invasion of the RBCs by a pathogen

16. The life process which releases most energy is
A. The light reaction of photosynthesis
B. Fermentation of glucose
C. Aerobic cellular respiration of glucose
D. The oxidation of lactic in mammalian of muscle cells

17. At what stage of citric acid cycle does subtract level phosphorylation occur?
A. Isocitrate in to ∝-ketoglutarate
B. Succinyl-CoA in to succinate
C. Fumarate in to malate
D. Malate in to oxaloacetate

18. Which biological process takes place in the mitochondrion?
A. Glycolysis
B. Formation of lactic acid
C. Tricarboxylic cycle
D. Alcoholic fermentation

19. Which of the following conversion takes place in human under conditions of starvation?
A. Fatty acids to carbohydrate
B. Proteins to carbohydrates
C. Glucose to lipids
D. Lipids to lipoproteins

20. During which one of the following is the respiratory quotient most likely to be high
A. In plants during bright light
B. In animals during laying down of fats
C. During egg laying in birds
D. During lactic acid formation

21. What impact, if any, do high levels of ADP have on glycolysis?
A. they increase the activity of enzymes involved with glycolysis
B. The high levels decrease the activity of enzymes involved with glycolysis
C. They have no effect on the activity of any enzymes involved with glycolysis
D. The high levels slow down all pathways involved with glycolysis

22. During strenuous activity, the pyruvic acid in the muscle may accept hydrogen from reduced NAD to become
A. Acetyl CoA
B. Lactic acid
C. Ethanol
D. Citric acid

23. The equation for complete oxidation of a substance is $2C_{18}H_{34}O_2 + 51O_2 \longrightarrow 36CO_2 + 34H_2O$
The respiratory quotient for oxidation is
A. 0.70
B. 1.4
C. 0.9
D. 1.0

24. Which of the following is liberated during both aerobic and anaerobic respiration?
A. Carbon dioxide and energy
B. Ethanol and water
C. Water and carbon dioxide
D. Carbon dioxide and ethanol

25. In endergonic reaction, the products of the reaction contain
A. More energy than the reactants and energy is released
B. Less energy than the reactants and energy is absorbed
C. More energy than the reactants and energy is supplied
D. Less energy than the reactants and energy is released

26. What do the electrons added to NAD do in aerobic respiration? They.
A. become part of a fermentation pathway
B. go to another pathway for ATP production
C. energize the acetyl group in the citric acid cycle
D. are converted to NADP

27. Which one of the following is unlikely to be found in the body of obligate anaerobes?
A. Glycolytic enzymes
B. ATP
C. Mitochondria
D. Acetaldehyde

28. Nearly all organisms on Earth carry out some form of glycolysis. How does his fact support or not support the assertion that glycolysis is one of the oldest metabolic pathways?
A. To be present in so many different organisms, glycolysis was probably present in a common ancestor rather than evolving many separate times
B. Glycolysis is present in nearly all organisms because it is an advanced and recently evolved pathway that has been widely used as it is so beneficial
C. Glycolysis is absent in a few higher organisms. This contradicts the fact that it is one of the oldest metabolic pathways.
D. Glycolysis is present in some organisms and absent in others.

The mentioned fact may or may not support this assertion

29. Anaerobes thrive better than aerobic organism in water experiencing thermal pollution because
    A. High temperatures kill aerobic organisms
    B. Anaerobes possess enzymes that work best at high temperatures
    C. High temperatures reduce solubility of oxygen
    D. High temperatures encourage multiplication of aerobes predators.
30. A major difference between respiration and burning is that
    A. no heat is produced during respiration
    B. burning is a faster process
    C. burning is a chemical process
    D. chemical energy is stored in respiration
31. What is removed from pyruvate during its conversion in to an acetyl group
    A. oxygen
    B. ATP
    C. B vitamin
    D. carbon dioxide
32. The compound which acts as oxidizing agent during anaerobic respiration in plants
    A. NAD and pyruvate
    B. Ethanal and NAD
    C. NAD and FAD
    D. NADP and pyruvic acid
33. Which of the following increases the rate photophosphorylation of hexose sugar during the normal respiration process?
    A. An increase in ADP concentration
    B. An increase in ATP concentration
    C. An increase in concentration of hexose sugar
    D. A decrease in concentration of phosphorylated sugar
34. Which one of the following activities in living organisms can result in a respiratory quotient of less than 1.0?
    A. When carbohydrates are respired
    B. During extensive laying, down of fat in livestock
    C. At compensation point, during photosynthesis
    D. When the rate of exhalation equals that of inhalation.
35. A rat requires more energy per unit body weight than that required by a human because a rat
    A. Has a larger surface area
    B. Is more active
    C. Has higher body temperature
    D. Has a higher metabolic rate
36. Lipids are better energy sources than carbohydrates is that
    A. Are insoluble
    B. Do not form hydrogen bonds with water
    C. Are more compact
    D. Have a higher proportion of hydrogen
37. Which one of the following changes occur in mammalian body at the onset of an exercise?
    A. Increase in the pH of blood
    B. Decrease in the rate of contraction of the diaphragm muscles
    C. Increase in the rate of tissue respiration
    D. Decrease in the amounts of water vapor in the breath
38. How many ATP molecules are used and produced per molecule of glucose during glycolysis?
    A. the first half of glycolysis uses 2 ATPs, and the second half of glycolysis produces 4 ATPs
    B. The first half of glycolysis produces 2 AATPs, and the second half of glycolysis uses 4 ATPs
    C. The first half of glycolysis uses 4 ATPs, and the second half of glycolysis produces 2 ATPs
    D. The first half of glycolysis produces 4 ATPs, and the second half of glycolysis
39. Which one of the following best describes basal metabolic rate?
    A. Average amount of energy produced by the body
    B. Average amount of energy produced when at rest
    C. Amount of energy produced by an average body
    D. Amount of energy produced when all voluntary movement have ceased.
40. GLUTs are integral membrane proteins that assist in the facilitated diffusion of glucose in to and out of cells. What reaction in glycolysis prevents glucose from being transported back out of the cell?
    A. Hexokinase dephosphorylates glucose using ATP creating a glucose molecule that can't cross the hydrophilic portion of plasma membrane
    B. Hexokinase phosphorylates glucose using ADP, creating a glucose molecule that can't cross the hydrophobic portion of the plasma membrane
    C. Hexokinase dephosphorylates glucose using ADP, creating a glucose molecule that can't cross the hydrophilic portion of the plasma membrane
    D. High rate of respiration

SECTION B (60MARKS)

41. (a) Outline the chemical changes which the following substances undergo when they are used as energy sources. Indicate where the products of each substances links up with carbohydrate respiration.

(i) Protein (4marks)

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(ii) Lipids (2marks)

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(b) Describe what happens to pyruvate before entering the mitochondria. (2marks)

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(c) Mention two roles of the Krebs cycle in cells. (2marks)

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42. (a) The following results were obtained from two experiments using different kinds of germinating seeds.

	Volume of oxygen consumed (cm^3)	Volume of carbon dioxide produced (cm^3)
Germinating seeds A	9.6	10.4
Germinating seeds B	9.1	6.3

(i) Calculate the respiratory quotient and suggest the type of substrate being respired for. (3marks)

Germinating seeds A

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Germinating seeds B

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(b) (i) For each of the following respiratory quotient values in a green plant, state the types of respiratory substrate being used and the conditions in which the process occurs. (3marks)

Respiratory quotient	Respiratory substrate	Condition in which process occurs
1.0		
0.7		
0.5		

(ii) Why are high respiratory quotient values are obtained from tissues involved with conversion of carbohydrates to fat? (1mark)

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(c) State three clinical applications of respiratory quotients in humans. (3marks)

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43. Mitochondria are organelles that are thought to have entered in to a mutualistic existence with cells many millions of years ago. They are surrounded by a double membrane system and the inner membrane is folded in to structures called cristae and the space inside is called matrix. Mitochondria possess proteins called cytochromes. They also contain small circles of DNA which code for a few of the mitochondrial proteins. Mitochondria have the biochemical machinery needed for carrying out some protein synthesis. Liver cells have between 1000 and 2000 mitochondria which can have between 20% of the cell volume.

(a) Use information in the passage to answer the following:

(i) Outline two pieces of evidence suggesting that mitochondria originally existed outside eukaryotic cells as free living organisms. (1mark)

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(ii) Suggest why mitochondria can no longer exist as free living organisms. (½marks)

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(iii) Suggest why liver cells have so many mitochondria. (½marks)

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(iv) Explain the significance of the folding of the inner mitochondrial membrane. (1mark)

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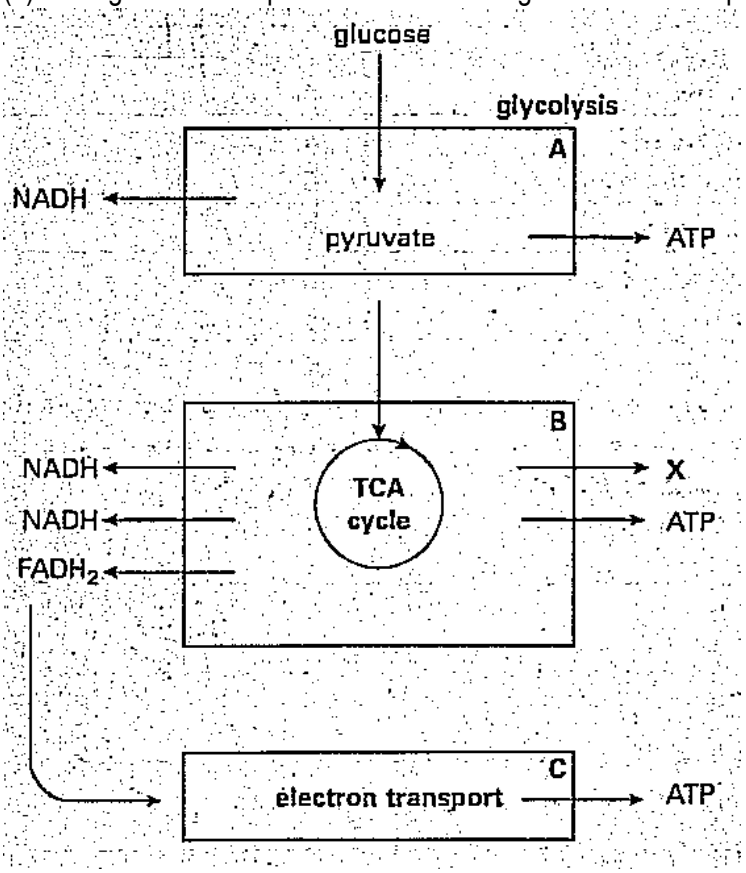
(b) The figure below represents the main stages of aerobic respiration.



(i) State precisely where the reactions in boxes B and C occur in the cell. (1mark)

B……

C……

(ii) What substance is X. (1mark)

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(iii) A total of 38 molecules of ATP is formed during the complete breakdown of one molecule of glucose. State how many molecules are formed at each stages A, B and C. (2marks)

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(iv) If glucose is burned, the energy transferred as heat and light is 2881 KJ mol^{-1}. In the reactions described above, so of the energy is retained in form of ATP. The energy trapped in ATP is 50 $KJmol^{-1}$. Calculate the percentage of the energy made available from the breakdown of one molecule of glucose which is retained for biological reactions in the cell. Show your working. (3marks)

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44. The diagram below shows some of the stages in anaerobic respiration in a muscle

Hexose

Stage A ↓

Hexose bisphosphate

Stage B ↓

Glycerate 3-phosphate

Stage C ↓

Pyruvate

Stage D ↓

Lactic acid

(a) Name the process shown by stages A and C. (1mark)

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(ii) State where in a cell this process occurs. (1mark)

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(iii) Give two uses of ATP in cells. (2marks)

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(iv) At which of the stages shown in the diagram is ATP used. (1mark)

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(b) NADH + H^+ is a reduced coenzyme which is involved in anaerobic respiration. At which of the stages shown is NADH + H^+ oxidized. (1mark)

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(c) What might induce anaerobic respiration in.

(i) Parenchyma cells in a plant root (1mark)

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(ii) Mammalian skeletal muscle fibres. (1mark)

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(d) Account for the net ATP yield in glycolysis. (2marks)

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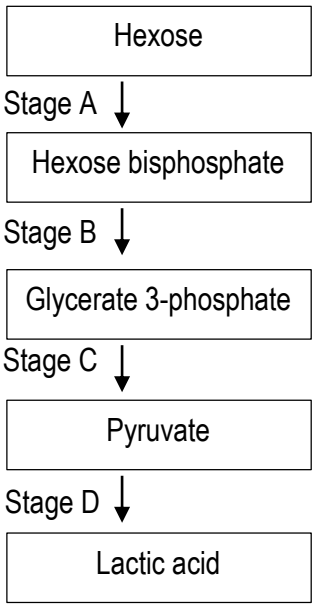
The diagram below shows some of the stages in anaerobic respiration in a muscle



(a) Name the process shown by stages A and C. (1mark)

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(ii) State where in a cell this process occurs. (1mark)

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(iii) Give two uses of ATP in cells. (2marks)

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(iv) At which of the stages shown in the diagram is ATP used. (1mark)

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(b) NADH + H^+ is a reduced coenzyme which is involved in anaerobic respiration. At which of the stages shown is NADH + H^+ oxidized. (1mark)

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(c) What might induce anaerobic respiration in.

(i) Parenchyma cells in a plant root (1mark)

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(ii) Mammalian skeletal muscle fibres. (1mark)

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(d) Account for the net ATP yield in glycolysis. (2marks)

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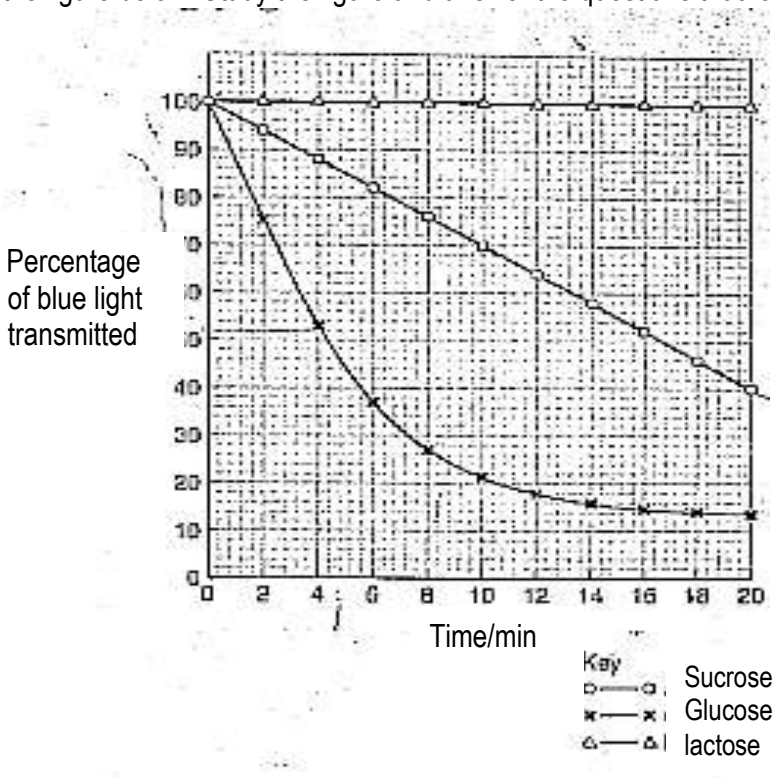
45. An experiment was carried out to investigate the rate of respiration of yeast calls mixed with three different carbohydrates (glucose, sucrose and lactose), using methylene blue as an indicator (methylene blue is blue in alkaline condition and colorless in acidic condition). 1cm^3 of 0.1M methylene blue was added to a mixture of 5cm^3 of a suspension of yeast in 10cm^3 of 0.5% glucose solution in boiling tube. The boiling tube was placed in a water bath at 30^{0}C for 20 minutes. The rate of respiration was measured as a percentage of the intensity of the blue color at the beginning of the experiment, at interval of 2minutes. The experiment was repeated using 5% sucrose and lactose. The results are shown in the figure below. Study the figure and answer the questions that follow.



(a) What causes the methyl blue to lose its colour during this experiment? (1mark)

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(b) Calculate the average rate of respiration of yeast in glucose solution during the first four minutes in terms percentage intensity of blue color. (2marks)

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(c) Explain the changes for

(i) Lactose (2marks)

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(ii) Glucose (3marks)

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(d) (i) State one main difference in the percentage of intensity of blue light between glucose and sucrose. (1mark)

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(ii) Explain why the boiling tubes were kept covered during the experiment. (1mark)

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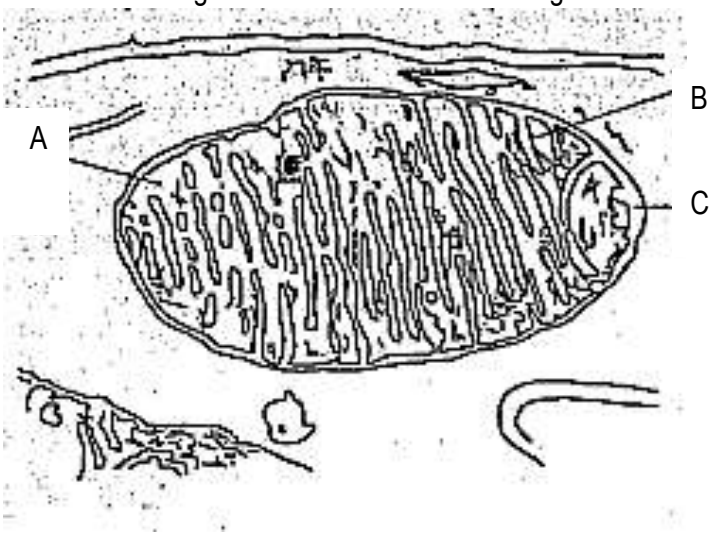
46. (a) The diagram below shows a section through mitochondrion as seen using an electron microscope.



(i) Name the parts labeled A, B and C. (I½marks)

A.....

B.....

C.....

(ii) On the diagram, by means of an arrow, show the location of the electron transport system. (½mark)

(iii) The magnification of this diagram is x34000. Calculate the actual length of the mitochondrion, giving your answer in suitable units. Show your working. (2marks)

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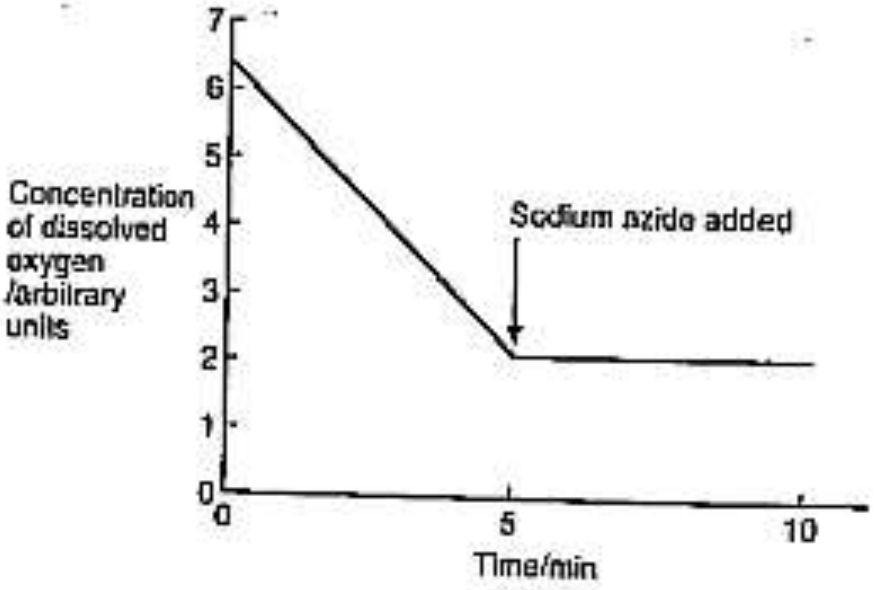
(b) An experiment was carried out in which a suspension of active mitochondria was incubated in a buffer solution containing succinate, an intermediate of the Krebs cycle. The concentration of dissolved oxygen was measured every minute for five minutes. A solution containing sodium azide was then added to this preparation and the concentration of dissolved oxygen was measured for a further five minutes.



(i) Explain the change in the concertation of dissolved oxygen during the first five minutes. (3marks)

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(ii) Suggest what effect the addition of sodium azide will have on the rate of production ATP and give an explanation for your answer. (3marks)

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