



CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

2 hours

In addition to the 2 hours, candidates are allowed a reading time of 15 minutes. Candidates may begin writing during this 15-minute period.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This paper consists of NINE questions.
2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section and should spend no more than 30 minutes on this section. Answers to this section MUST be written in this question paper answer booklet.
3. Section B consists of SIX questions. Candidates must attempt THREE questions in this section, ONE question from EACH module. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

1. Figure 1 shows Stage 1 of the Calvin Cycle.

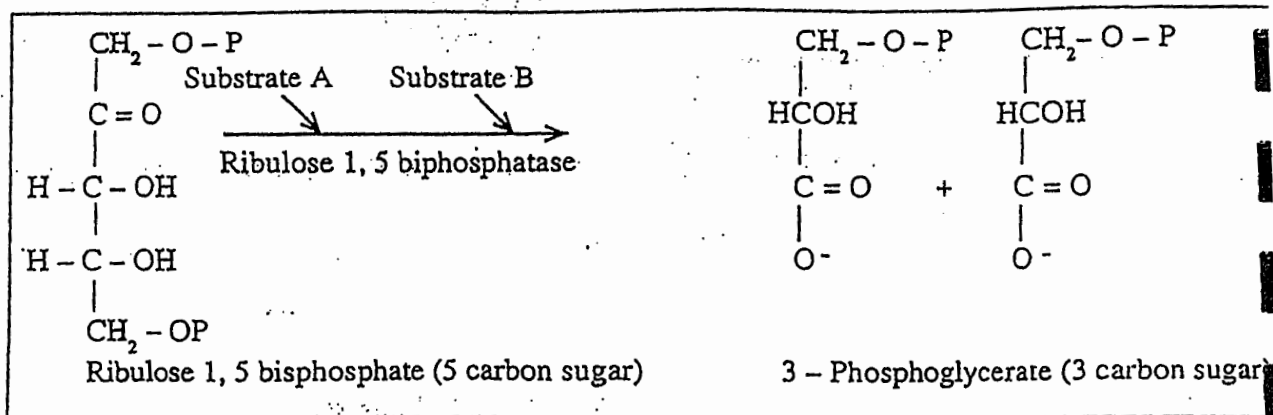


Figure 1. Stage 1 of the Calvin Cycle

(a) (i) Name the substrate A, in Figure 1, that is fixed during Stage 1 of the Calvin cycle.

[1 mark]

(ii) Name the substrate B, in Figure 1, that must be present for the enzyme Ribulose 1, 5 biphosphate carboxylase to complete the reaction.

[1 mark]

Figure 2 shows Stage 2 of the Calvin Cycle.

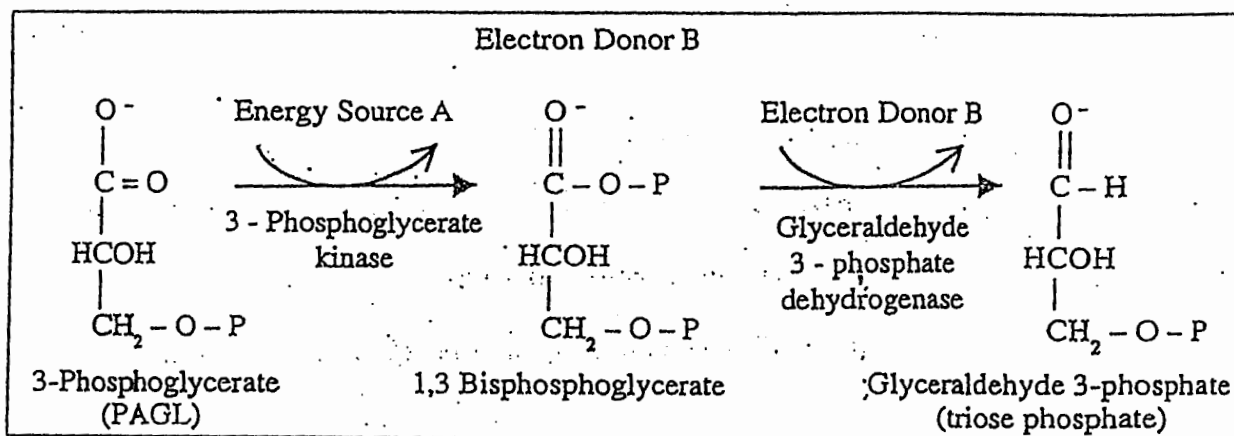


Figure 2. Conversion of phosphoglyceric acid to triose phosphate

(b) (i) Name the energy source A in Figure 2.

[1 mark]

(ii) Name the electron donor B in Figure 2.

[1 mark]

- (c) Six molecules of glyceraldehyde 3-phosphate (triose phosphate) are produced at the end of Stage 2 of the Calvin Cycle. Outline what happens to these molecules in the final stages of the cycle.

[2 marks]

- (d) The structure shown in Figure 3 is a pictomicrograph of an organelle commonly found in plant cells.

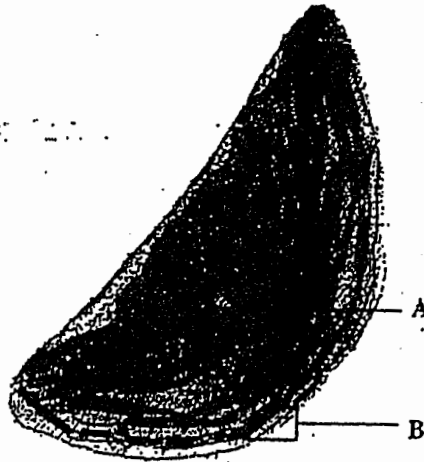


Figure 3

*Biology, Life on Earth, T. Audesirk and G. Audesirk
Prentice Hall, 1999.*

- (i) Name the structure labelled B in Figure 3.

[1 mark]

- (ii) Briefly outline the process that occurs in B and indicate how it is linked to the process occurring at A in Figure 3 above.

[3 marks]

Total 10 marks

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2. Figure 4 is a pyramid of energy flow for a river ecosystem in the tropics. The numerical values at each level represent energy flow in $\text{kJ m}^{-2} \text{yr}^{-1}$.

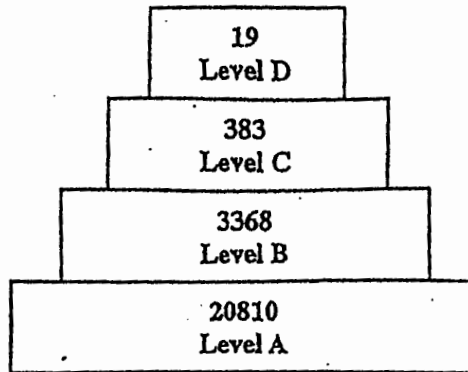


Figure 4. Pyramid of energy

- (a) (i) Which level in Figure 4 represents the primary consumers?

[1 mark]

- (ii) Give ONE reason for your answer in (a) (i).

[1 mark]

- (b) Using the information in Figure 4, calculate the percentage of energy that is transferred from the producers to the tertiary consumers.

[1 mark]

- (c) Explain why a relatively small portion of energy in an ecosystem is transferred at each trophic level.

[2 marks]

The graphs in Figure 5 show the numbers of four species of whale, killed for consumption each year from 1950 to 1985.

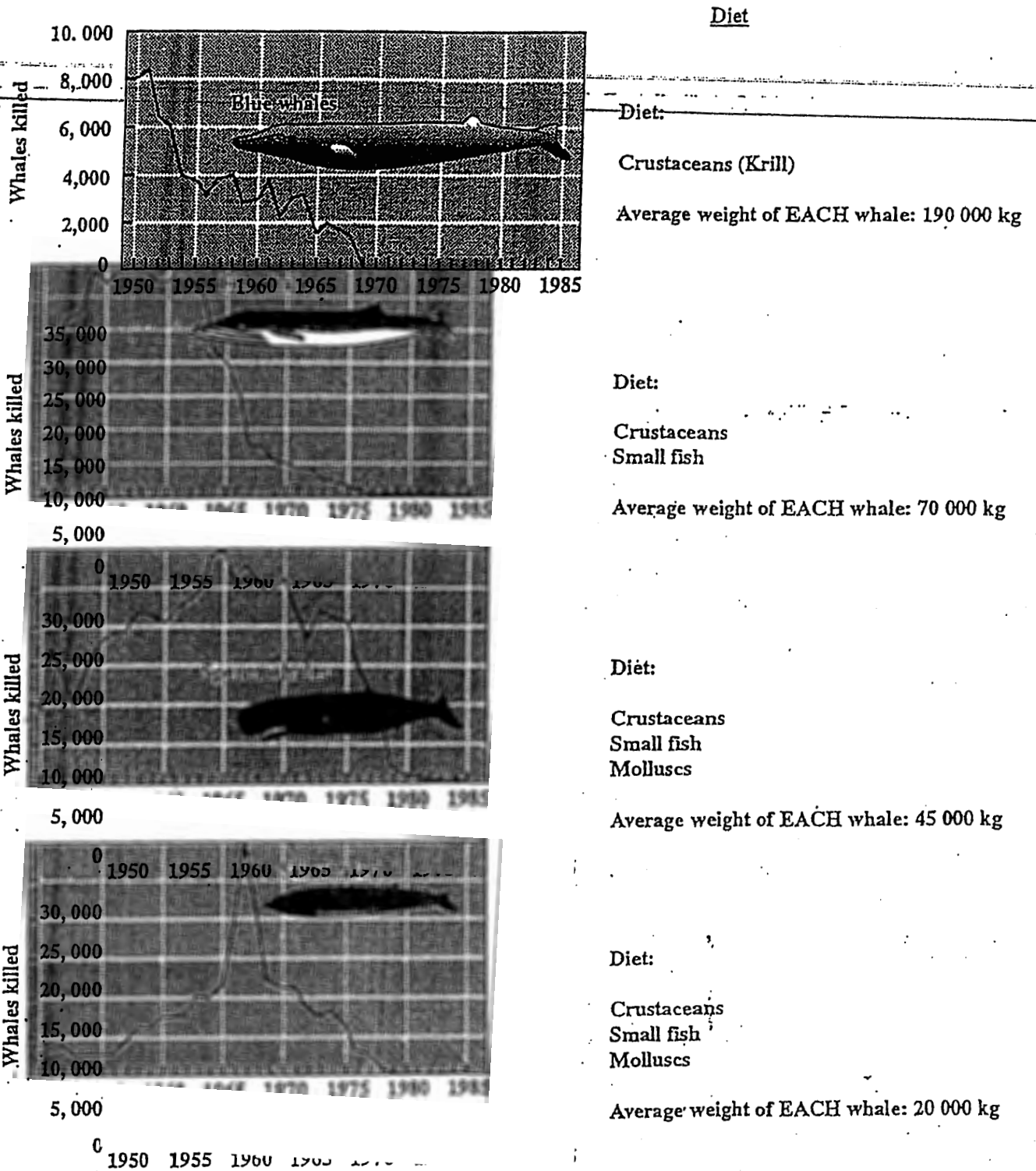


Figure 5

Life, The Science of Biology, W. Purves, D. Sadava, G. Orians, H. Craig-Heller. W.H. Freeman and Company. 2001.

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- (d) From Figure 5, determine the species of whale that had the greatest numbers of its population killed between 1950 to 1985.

[1 mark]

- (e) Calculate the biomass of whales killed in 1965. Show your working.

[3 marks]

- (f) Suggest, giving your reason, which trophic level the whales in Figure 5 occupy.

[1 mark]

Total 10 marks

3. Figure 6 represents the reactions in an electron transport chain. C I to C IV are the carriers in the chain and the numbers represent chemicals or actions in the sequence.

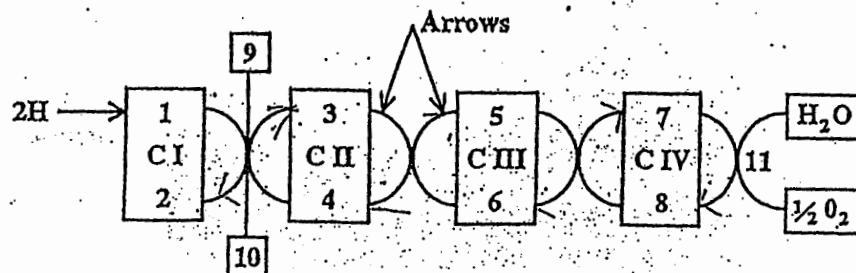


Figure 6. An electron transport chain

- (a) (i) What substance is represented by 10 in Figure 6?

ATP

[1 mark]

- (ii) Add arrow heads to all arrows to show the direction of flow of the reactions in Figure 6.

[1 mark]

- (iii) Based on your answer to (a) (ii) write the numbers between 1 and 8 which represent the reduced state of the carriers.

1, 3, 5, 7

[1 mark]

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4. The diagrams in Figure 7 show the movement of materials through membranes.

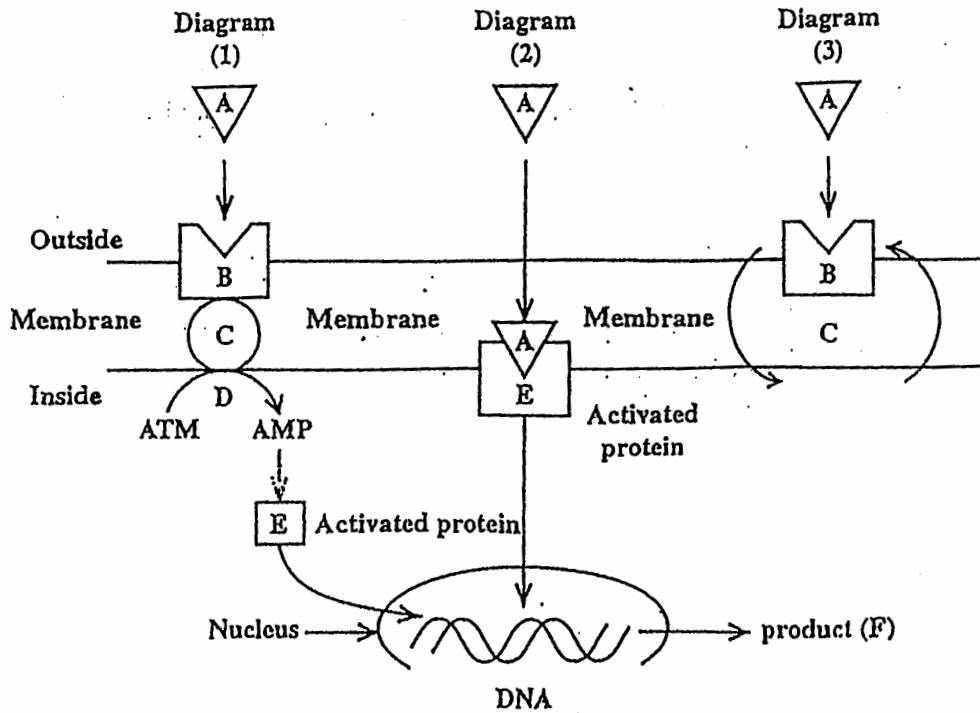


Figure 7. Movement through membranes

(a) Figure 7, at Diagrams (1) and (2), shows the entry of two different categories of hormones through a cell membrane and their mode of action inside the cell. Give ONE example of EACH type of hormone.

(i) Diagram (1) _____ [1 mark]

(ii) Diagram (2) _____ [1 mark]

(b) What effect(s) could the activated protein of either Diagram (1) or Diagram (2), in Figure 7, have on the nuclear DNA?

[2 marks]

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(c) The membrane in Diagram (3) of Figure 7 is the post-synaptic membrane of a synapse.

(i) Name the molecule at A in Diagram (3).

[1 mark]

(ii) Identify the type of molecule at B in Diagram (3).

[1 mark]

(iii) Draw on your knowledge of the operation of the synapse to suggest what happens at the arrows labelled C.

[2 marks]

(d) What causes the termination of the stimulus by A in Diagram (3) of Figure 7 when the nervous impulse ceases?

[1 mark]

(e) In Figure 7 at Diagrams (1) and (2), a final product (F) is produced. What effect could Product (F) have on A?

[1 mark]

Total 10 marks

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5. Figure 8 below is a diagram of one of the types of artificial hearts which can be implanted into the chest. The pump is activated by a battery pack, worn on a belt.

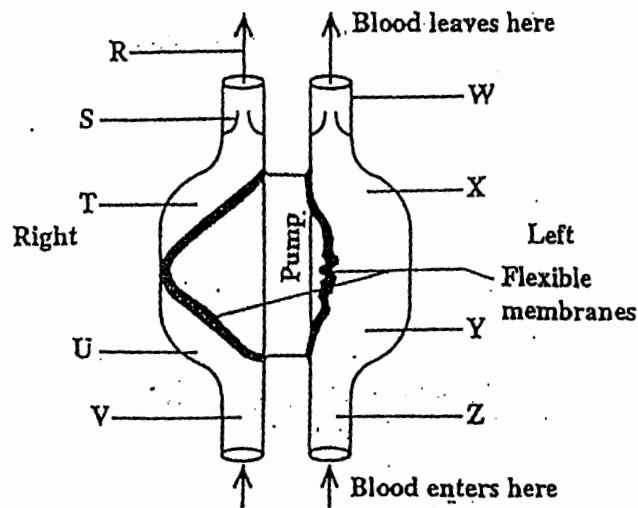


Figure 8. Artificial heart

The heart is operated when flexible membranes are inflated or deflated by a pump. The membrane inflates at the left, then right, then left in an alternating sequence. Blood enters at the base and leaves at the top.

- (a) What do the following letters represent?

S _____	W _____
T _____	X _____
V _____	Y _____

[3 marks]

- (b) You are a surgeon connecting the artificial heart to the patient's major blood vessels in the chest. To which of the four tubes would you attach the pulmonary vein. Write the letter.

_____ [1 mark]

- (c) Explain how blood is

- (i) pushed out of the artificial heart at R

[1 mark]

(ii) drawn into the artificial heart via Z.

[2 marks]

(d) In the human heart, the walls of the right ventricle are 3 times thinner than those of the left ventricle. Give TWO reasons why this is so.

(1)

[1 mark]

(2)

[1 mark]

(e) Suggest how the design of the artificial heart could be modified to achieve the same effect as in (d) above.

[1 mark]

Total 10 marks

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6. Figure 9.1 shows the interstitial concentrations of urea, sodium and protein at different depths of the mammalian kidney.

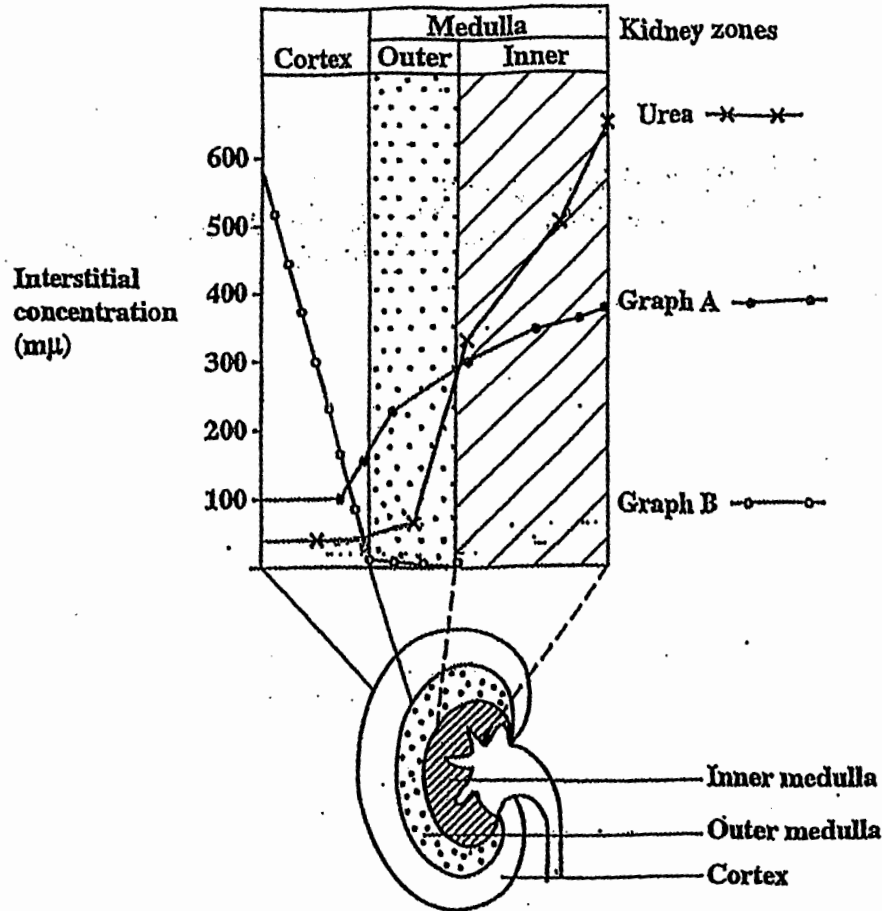


Figure 9.1. Interstitial concentrations of urea, sodium and protein

(a) With reference to Figure 9.1 and based on your knowledge of the functioning of the nephron, deduce which graph lines, A or B, represent sodium and protein. Explain your answers.

(i) Graph line A represents _____

[3 marks]

(ii) Graph line B represents _____

[3 marks]

(b) The graph in Figure 9.2 shows the result of an experiment investigating water absorption rate in portions of the collecting duct of the mammalian kidney. (ADH- Antidiuretic Hormone)

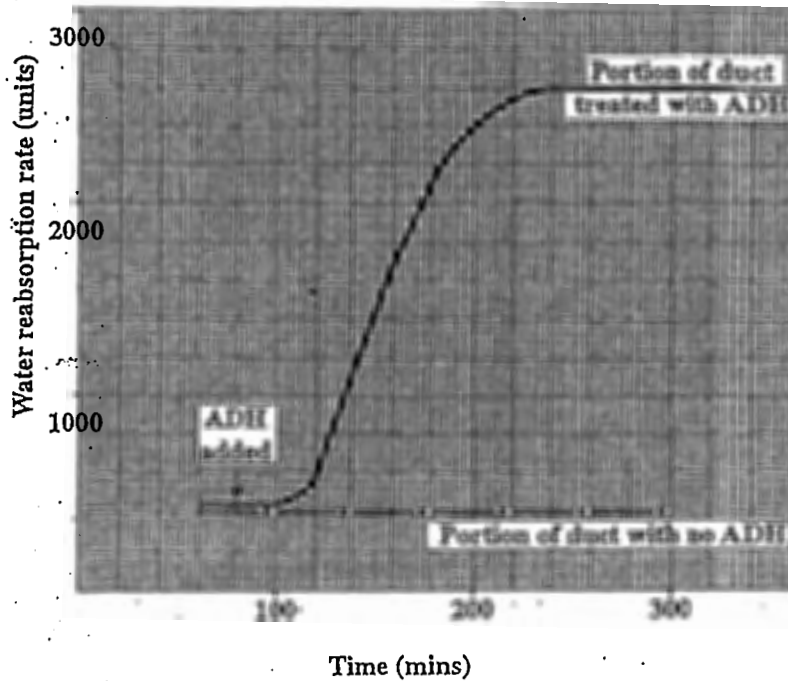


Figure 9.2. Graph of water reabsorption in nephron

From the graph in Figure 9.2, determine the difference in water reabsorption rate between the TWO portions of the collecting duct at 250 minutes. Show your working.

[1 mark]

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(c) Under what conditions is antidiuretic hormone (ADH) released in the body?

[1 mark]

(d) If ADH were inactivated, and a large volume of urine was continually produced, suggest what effect this would have on the body.

[1 mark]

(e) Name ONE medical condition for which the production of a large volume of dilute urine is a symptom.

[1 mark]

Total 10 marks

Figure 10 shows the prevalence of diabetes in developing countries compared with developed countries.

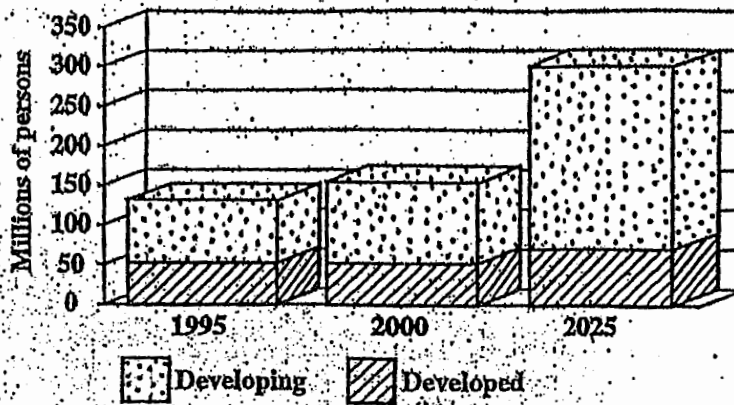


Figure 10

Source: *Global Burden of Diabetes, 1995 - 2025, Prevalence, numerical statistics estimates - Hilary King, Ronald E. Aubert, William H. Herman; Diabetes Care, Vol. 21 No. 9 September 1998*

(a) With reference to Figure 10, explain why the prevalence of diabetes is rising in developing countries as compared with developed countries.

[1 mark]

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(b) Distinguish between the TWO types of diabetes mellitus.

[2 marks]

(c) Your friend, who is overweight, and smokes, has just been diagnosed with diabetes. State the actions your friend will be required to take to manage and control this disease.

[3 marks]

(d) Discuss why diabetics lose weight, eat more and produce more urine than non-diabetics.

[3 marks]

(e) Name the hormone that is antagonistic to insulin and describe its action on the body.

[1 mark]

Total 10 marks

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8. (a) Distinguish between vaccination and passive immunity.

(i) Vaccination _____

(ii) Passive immunity _____

[2 marks]

A rabbit receives an injection of staphylococcus toxin on day one and day 60 of an investigation. The blood serum is then tested for the presence of the bacterial antibody. Figure 11 below shows the immunological response.

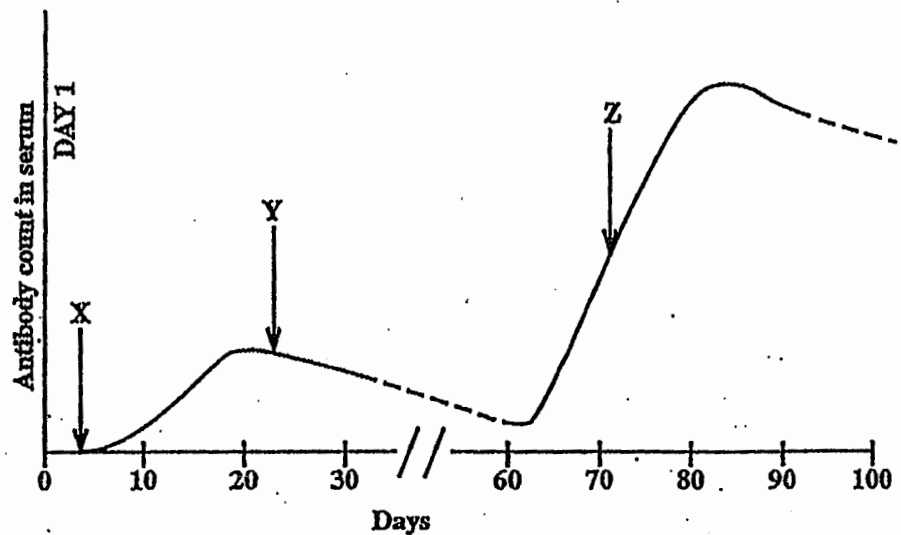


Figure 11

(b) (i) Outline the activities of the cells of the immune system in the immune response during the period marked X on the graph in Figure 11.

[3 marks]

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(ii) At Y the infection is coming under control. How is the immune reaction decreased?

[1 mark]

(iii) Give THREE reasons for the response at Z in Figure 11.

[3 marks]

(c) Give ONE difference in the mode of pathogen control between phagocytes and killer T-cells.

[1 mark]

Total 10 marks

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9. It is essential to good health to have an adequate supply of nutrients in the diet. Table 1 below shows the recommended daily intake of protein, vitamin A and the minerals magnesium and iron. Table 2 shows the amount of these nutrients in milk and Unimix, an emergency powdered food mix used by relief workers in famine-stricken zones.

TABLE 1. RECOMMENDED DAILY INTAKES

Age groups	Recommended intake			
	Protein (g)	Vitamin A (µg)	Ca (mg)	Iron (mg)
4 - 7 yr Boys & Girls	45	300	500	8
12 - 15 Girls	58	725	760	15
12 - 15 Boys	70	725	760	14
15 - 18 Girls	58	725	600	16
15 - 18 Boys	75	725	600	15

TABLE 2. NUTRIENTS IN MILK AND UNIMIX PER 100 G

Food type	Cow's milk per 100 g	Unimix per 100 g
Protein	3.3 g	6.82 g
Vitamin A	150 µg	231 µg
Calcium	0.12 mg	92.4 mg
Iron	0.03 mg	3.82 mg

Dosage of Unimix = 350 g per day.

- (a) With reference to Table 1, comment on the relationship between age and gender and recommended food intake.

[2 marks]

- (b) (i) With reference to Tables 1 and 2, how much protein would a starving child of 7 years get on a daily basis from Unimix in comparison with the recommended allowance?

[1 mark]

- (ii) Why is the amount of protein from Unimix, given in (b) (i), adequate?

[2 marks]

- (c) (i) Calculate the difference between the recommended amount of Vitamin A for teenagers and the amount available from a day's supply of Unimix.

[1 mark]

- (ii) Lowered resistance may result from Vitamin A deficiency. Name ONE other debilitating condition which results from this deficiency.

[1 mark]

- (d) Milk is an excellent food for infants, but is inadequate as the sole resource beyond 12 months. From the data given in Table 1 and Table 2 comment on the limitations of a milk diet.

[1 mark]

GO ON TO THE NEXT PAGE

- (e) Prolonged deprivation of dietary protein leads to protein energy malnutrition (P.E.M). State TWO characteristics of P.E.M.

1 _____

2 _____

[2 marks]

Total 10 marks

END OF TEST

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