TEST CODE **02207010**

FORM TP 2005172

MAY/JUNE 2005

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 01

1 $\frac{3}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Candidates must attempt ALL questions in this paper.
2. Answers are to be written in the spaces provided in this answer booklet.
3. EACH question is worth 10 marks.
4. The use of silent non-programmable calculators is allowed.

1. (a) Define the term 'anaerobic respiration'.

[1 mark]

(b) Distinguish between the two types of fermentation.

[2 marks]

(c) After a 100 m race, runners may experience discomfort and fatigue in their muscles and may breathe deeply or pant.

(i) Name the chemical that causes the discomfort in the runners' muscles.

[1 mark]

(ii) Explain why it may be necessary for the runners to breathe deeply and pant.

[1 mark]

(d) Sparkling wines, for example champagne, are bottled while the yeast is alive and fermenting, thereby trapping the fermentation products in the bottle. Bakers yeast in bread dough causes it to rise.

Name the fermentation product that causes the bread to rise and the champagne cork to pop.

[1 mark]

(e) In cyanide poisoning, cyanide attacks the enzyme that transfers electrons from the respiratory electron transport chain to O_2.

Explain why it is not possible to survive cyanide poisoning by using anaerobic respiration alone.

_____

_____

_____

[2 marks]

(f) Respiration occurs in all living cells, but at different rates.

Explain why respiration occurs at different rates. Use ONE example to illustrate your answer.

_____

_____

_____

[2 marks]

Total 10 marks

2. Figure 1 is a simplified outline of the respiratory pathway.

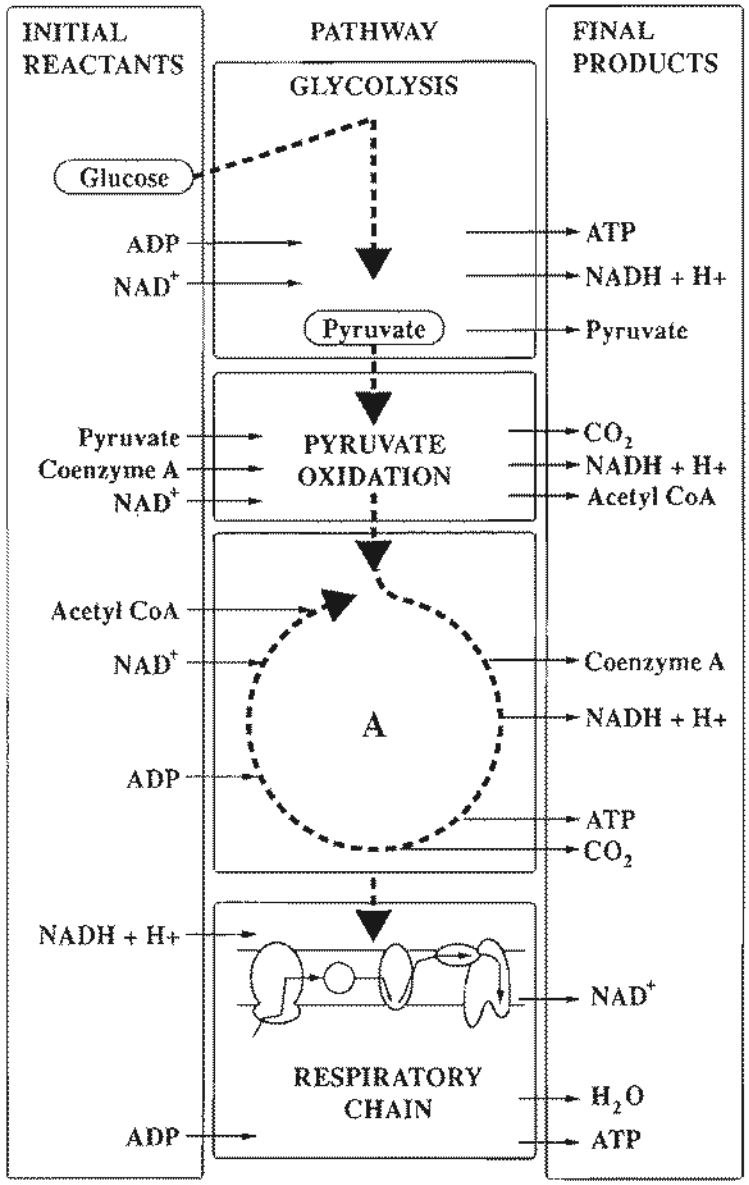

Figure 1. Outline of the respiratory pathway

(a) On Figure 1, indicate with a clear, bold arrow where O_2 will enter the pathway.

[1 mark]

(b) Name the cycle labelled A in Figure 1.

_____

[1 mark]

(c) Name the THREE pathways in Figure 1 that do not function if O_2 is NOT available.

[3 marks]

(d) Name the organelle in the cell in which the reactions shown in Figure 1 occur.

[1 mark]

(e) ATP synthase is a specific channel protein that synthesises ATP. Name the specific molecule or ion that must flow through the channel of this protein for ATP to be synthesized.

[1 mark]

(f) Define the term 'metabolism of a cell'.

[1 mark]

(g) Explain why metabolic pathways need to be linked or coupled together in the cell.

[2 marks]

Total 10 marks

3. Figure 2 below is a diagram of the nitrogen cycle.

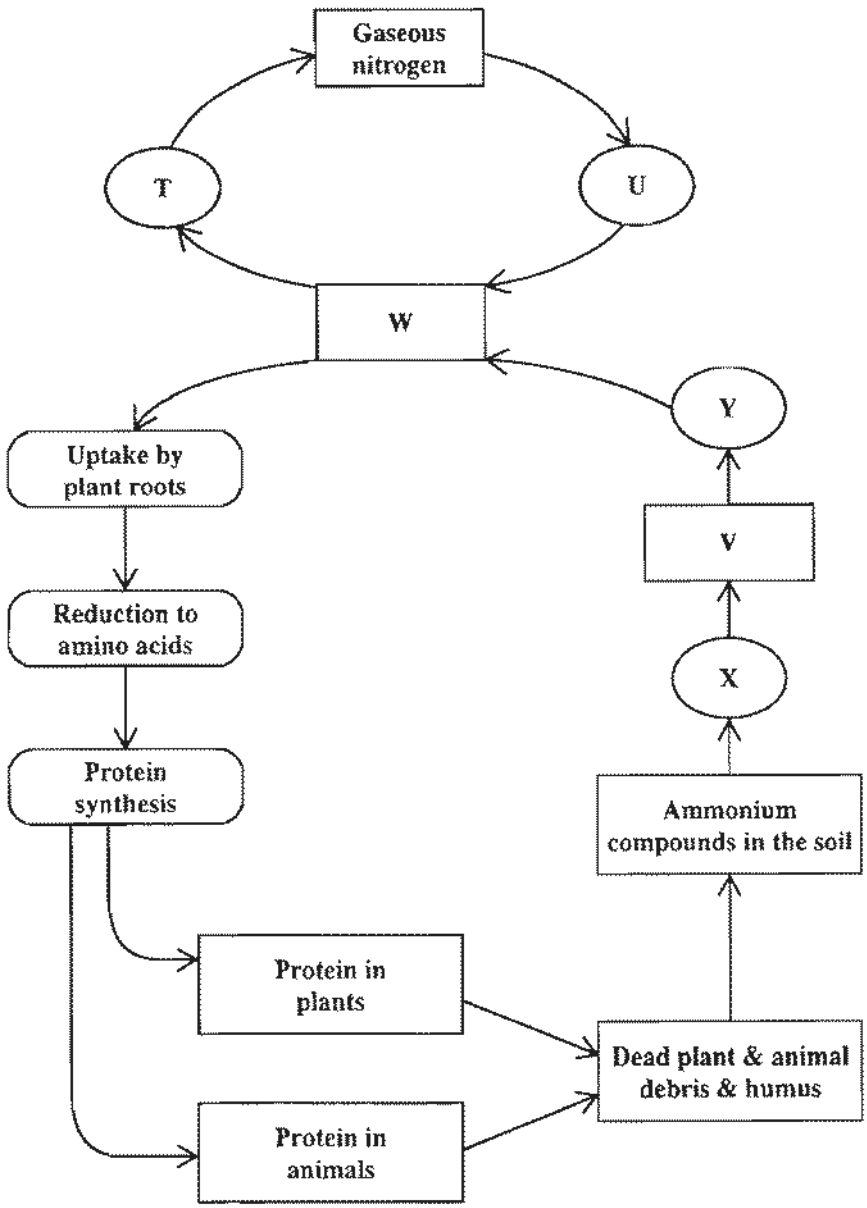

Figure 2. The nitrogen cycle

Use Figure 2 to answer questions (a) to (e).

(a) State the names of the **bacteria** acting at X and Y.

(i) X: _____

(ii) Y: _____

[1 mark]

GO ON TO THE NEXT PAGE

(b) Give the names of the ions labelled V and W.

(i) V: _____

[1 mark]

(ii) W: _____

[1 mark]

(c) Identify the bacteria operative at T and U.

(i) T: _____

[1 mark]

(ii) U: _____

[1 mark]

(d) State ONE other process by which gaseous nitrogen is converted to nitrates.

_____

[1 mark]

(e) Minerals are absorbed by primary producers, and passed up the trophic levels of the food chains. They are eventually returned to the soil in approximately the same concentration, due to the action of decomposers.

Does energy circulate through the trophic levels in the same way? Give reasons to support your answer.

_____

_____

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_____

[4 marks]

Total 10 marks

4. Figure 3 is a scanning electron micrograph showing the anatomical basis for kidney function.

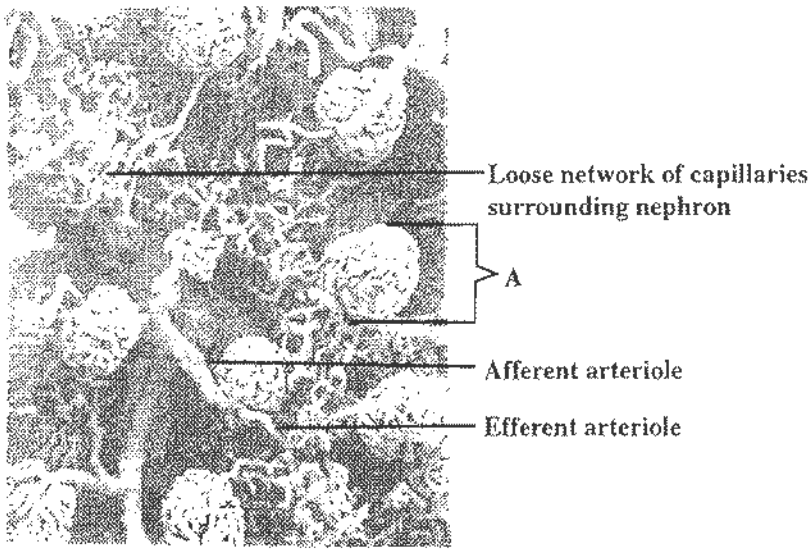


Figure 3. Scanning electron micrograph of part of a kidney

Life: The Science of Biology, 6th Edition.
W. K. Purves et al. Sinauer Associates, Inc.

(a) (i) Name the structure labelled A in Figure 3.

_____

[1 mark]

(ii) Briefly describe how A functions.

_____

_____

_____

[1 mark]

(b) The graph in Figure 4 shows how the glomerular filtration rate is affected by changes in arterial pressure.

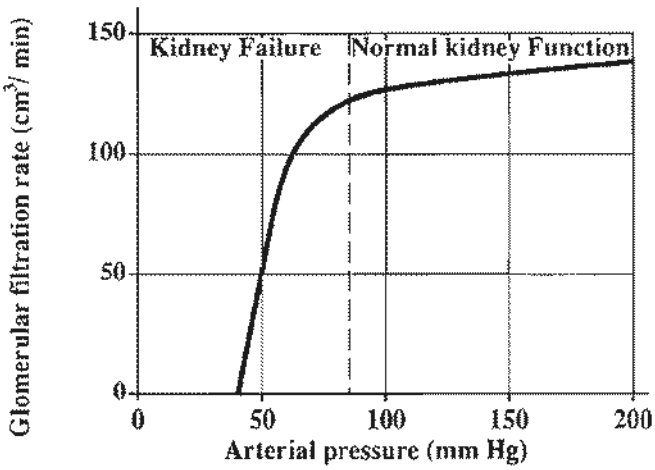


Figure 4. How glomerular filtration rate is affected by arterial pressure.

Life: Science of Biology, 6th Edition.
W. K. Purves et al. Sinauer Associates, Inc.

(i) Using the graph in Figure 4, determine the range of arterial pressure over which a kidney functions NORMALLY.

_____

[1 mark]

(ii) From the graph in Figure 4, estimate the maximum glomerular filtration rate.

_____

[1 mark]

(iii) With reference to the graph in Figure 4, give ONE reason for kidney failure.

_____

_____

[1 mark]

(c) Inulin is a carbohydrate molecule that is filtered in the glomerulus but is NOT secreted NOR re-absorbed by the renal tubules. One single dose of inulin was injected into an animal's blood stream and the rate of urine production of the animal was found to be 1 cm^3 per minute.

(i) State the function of the renal tubules.

_____

_____

[1 mark]

(ii) Suggest, giving ONE reason, whether inulin would be

a) excreted in the animal's urine

_____

_____

[1 mark]

b) maintained in the animal's blood over a prolonged period.

_____

_____

[1 mark]

(iii) Suggest how the glomerular filtration rate can be determined using inulin.

_____

_____

_____

_____

[2 marks]

Total 10 marks

5. (a) During the resting potential, there is a potential difference of approximately 70 mV between the inside and the outside of the axon membrane, with the inside being negative in relation to the outside.

Explain the role of membrane pumps and diffusion gradients in creating this potential difference. Refer to both anions and cations in your answer.

[4 marks]

(b) Figure 5 below shows activity along an axon.

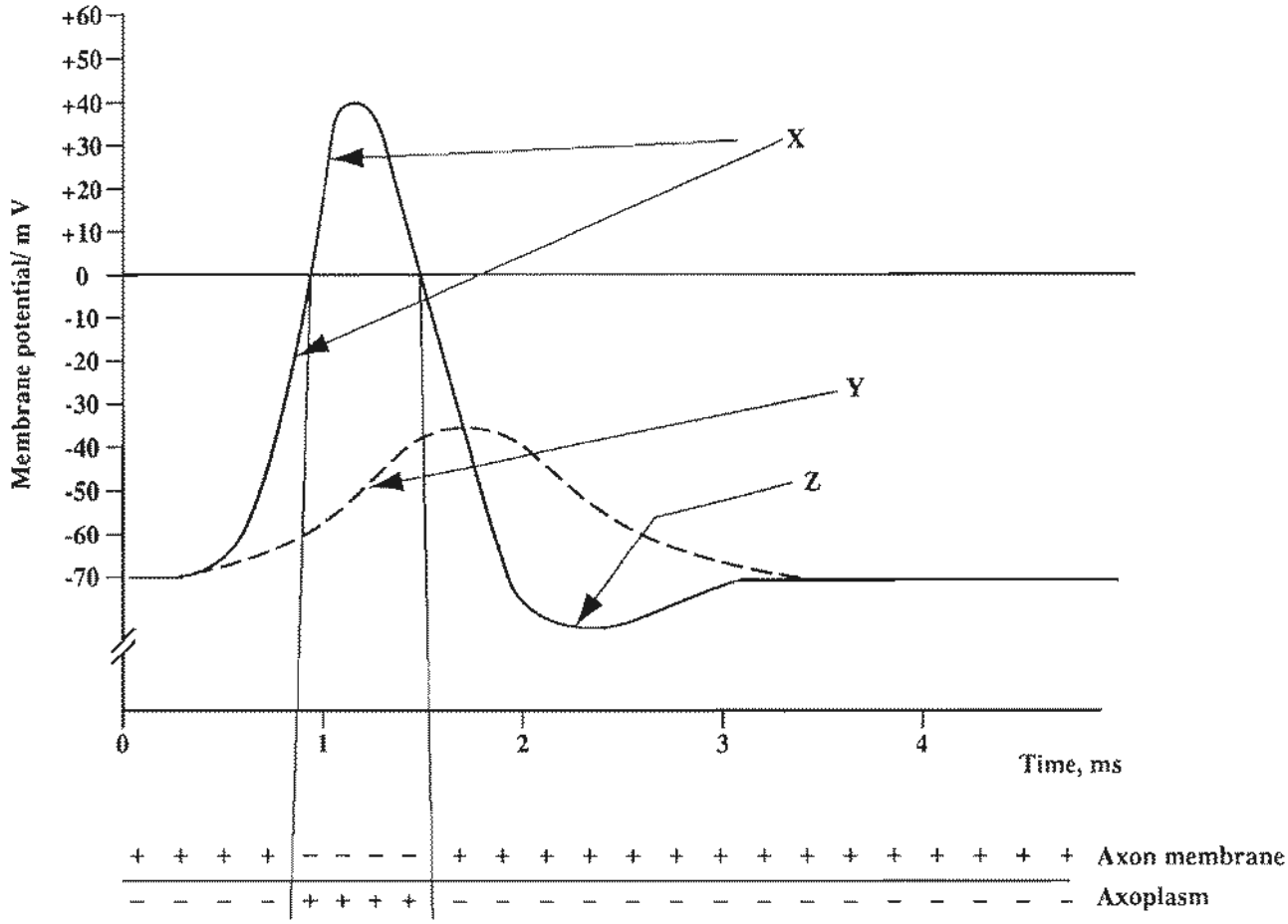


Figure 5. Activity along an axon

Study Figure 5 and answer questions (b) (i), (ii) and (iii).

(i) Describe the event occurring at X **and** suggest how this event is affected by lack of oxygen.

[2 marks]

(ii) Describe the activity occurring at X.

_____

_____

[1 mark]

(iii) Suggest what causes the reading of –90 mV at Z.

_____

_____

_____

[1 mark]

(c) Suggest the benefit of saltatory conduction in myelinated nerve fibres.

_____

_____

_____

_____

[2 marks]

Total 10 marks

6. (a) Figure 6 below depicts pancreatic cells in the ilets of Langerhans.

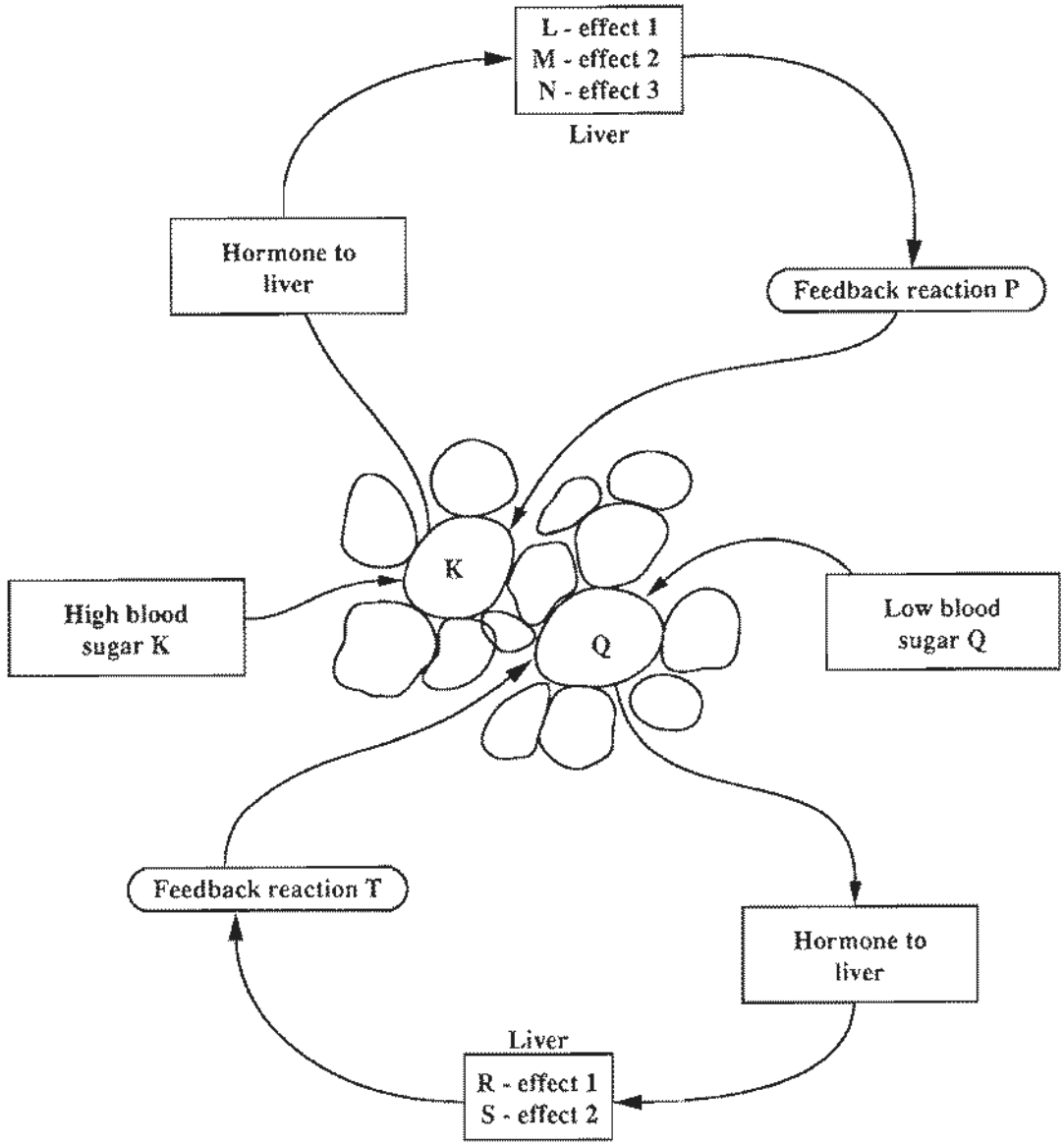


Figure 6. Feedback processes in pancreatic cells

Study Figure 6 and answer questions (i) to (iv) in question (a).

(i) Identify cells K and Q.

Cell K: _____

Cell Q: _____

[1 mark]

(ii) State the effects identified by L, M and N.

Effect at L: _____

_____

Effect at M: _____

_____

Effect at N: _____

_____

[2 marks]

(iii) State the effects at R and S.

Effect at R: _____

_____

Effect at S: _____

_____

[1 mark]

(iv) Give the approximate adjusted concentration of glucose in the blood at P and T.

Concentration at P: _____

Concentration at T: _____

[1 mark]

(b) When bunches of bananas are harvested, all the fruits are generally at the same stage of ripeness. It is much more expensive to harvest mangoes, as the fruits on a tree are at slightly different stages of ripening. How can the growers and shippers overcome this problem?

_____

_____

_____

_____

_____

_____

_____

[2 marks]

(c) Complete Table 1 by describing THREE differences between co-ordination effected by the endocrine system and the nervous system.

TABLE 1

DIFFERENCES BETWEEN ENDOCRINE AND NERVOUS SYSTEMS

Endocrine System	Nervous System
1.	1.
2.	2.
3.	3.

[3 marks]

Total 10 marks

7. (a) Figure 7 shows an immunoglobulin molecule.

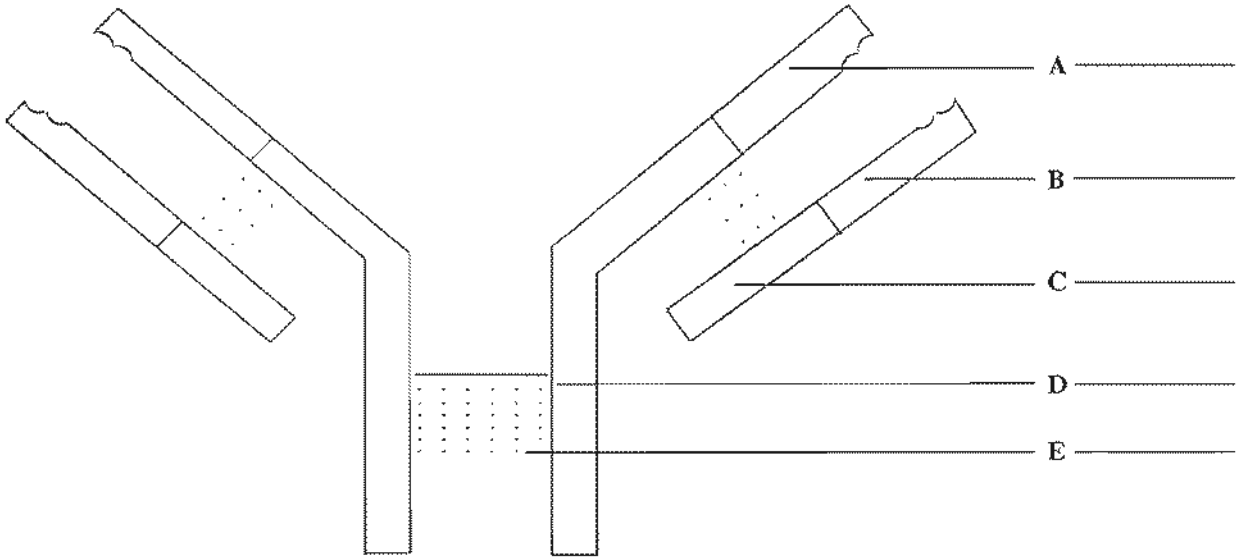


Figure 7. An immunoglobulin molecule

(i) Examine the immunoglobulin molecule in Figure 7 and complete the labels A to E. **[3 marks]**

(ii) CIRCLE the antigen binding site on the immunoglobulin molecule in Figure 7. **[1 mark]**

(b) The major histocompatibility complex (MHC) encodes proteins that present antigens to the immune system's T cell receptors. In human organ-transplant surgery, MHC molecules are important because the proteins produced by the MHC are specific to each individual. They act as antigens if transplanted into another individual.

Explain why **twins** can accept organs from each other and **parents** can accept organs from their **children**.

_____

_____

_____

_____

_____

_____

[3 marks]

GO ON TO THE NEXT PAGE

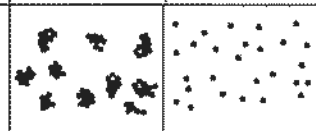
(c) The method used in laboratories to determine blood groups involves the mixing of blood of unknown type with anti-A or anti-B antibodies.

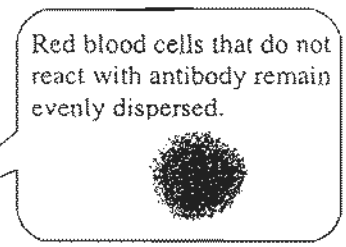
Table 2 below shows ABO blood reactions when anti-A and anti-B antibodies are mixed with blood of different blood groups. Red blood cells that react with antibodies clump together and the blood appears speckled. Red blood cells that do not react with antibodies remain evenly distributed.

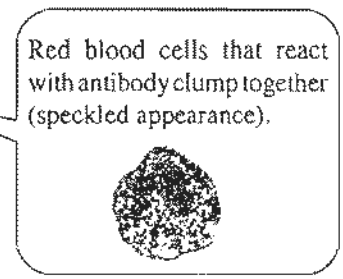
(i) Study and complete Table 2 by writing 'CLUMPED' or 'EVENLY DISPERSED' in the boxes a) to d).

TABLE 2

ABO BLOOD REACTIONS

Blood type of cells	**Genotype**	**Antibodies made by body**	**Reaction to added antibodies**	
			Anti-A	**Anti-B**
A	I^AI^A or I^AI^O	Anti-B		
B	I^BI^B or I^BI^O	Anti-A		
AB	I^AI^B	Neither anti-A nor anti-B	a)	b)
O	I^OI^O	Both anti-A and anti-B	c)	d)





Life: The Science of Biology, 6th Edition.
W. Purves et al. Sinauer Associates, Inc.

[2 marks]

(ii) State the blood type of a person who is a **universal donor** (can give blood to individuals of all ABO blood types) AND a person who is a **universal recipient** (can receive blood from individuals of all ABO blood types).

Universal donor _____ Universal recipient _____

[1 mark]

Total 10 marks

8. (a) Using ONE named example of EACH type of drug, distinguish between a socially-accepted drug and an illicit drug.

_____

_____

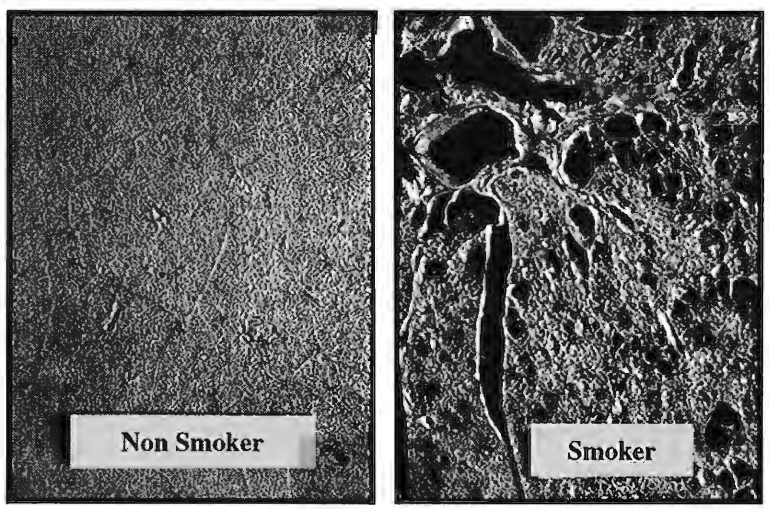
_____

_____

_____

[2 marks]

(b) Figure 8 below shows a part of the lungs of a non-smoker in photograph (a) and part of the lungs of a smoker in photograph (b).



(a) (b)

Figure 8. Lungs of a non smoker and a smoker

Biology of Life on Earth.
J. Audesirk, G. Audesirk, Prentice Hall

Explain what causes the lung of the cigarette smoker to appear as in photograph (b), Figure 8.

_____

_____

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

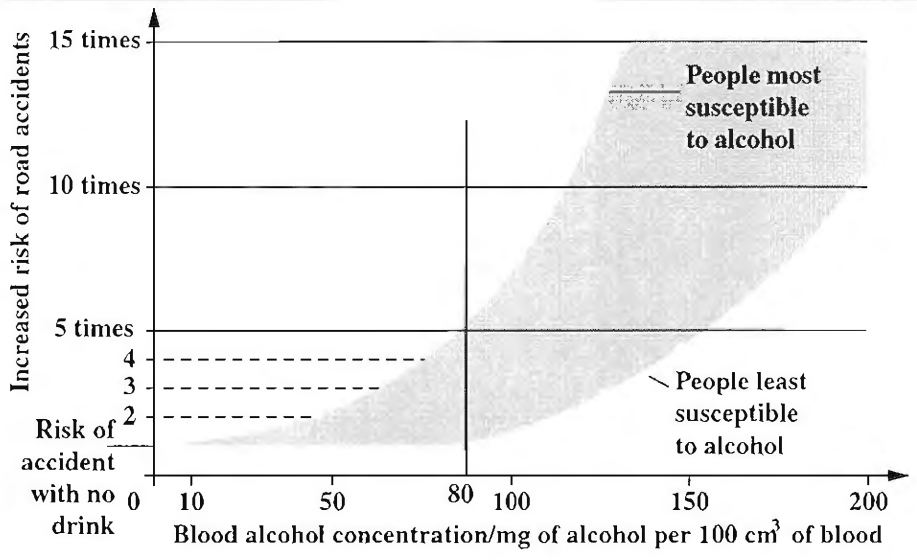
(c) Describe ONE symptom experienced by the cigarette smoker whose lungs are shown in (b).

_____

_____

[1 mark]

(d) The graph in Figure 9 below shows how the risk of road accidents increases as the blood alcohol concentration increases.



Human Health and Disease.
A. Fullick. Heinemann Educational Publishers.

Figure 9. How the risk of road accidents varies with blood alcohol concentration.

Examine the graph in Figure 9. With regard to road accident risk, describe the MAIN trend that is illustrated by the graph.

_____

_____

_____

_____

[2 marks]

(e) In developed countries, there are legal sanctions against driving with blood alcohol levels over a set limit. In Britain the limit is 80 mg per 100 cm^3 of blood. The police can stop drivers and ask them to take a Breathalyser test which involves breathing into a device that analyses the breath and estimates the content of alcohol in the blood. The graph in Figure 9 on page 20 shows how the risk of road accidents increases as the blood alcohol concentration increases.

Using the graph as well as your knowledge of the physical symptoms caused by different levels of alcohol in the blood, suggest, giving your reasons, where the legal alcohol limit should be set for your territory.

[3 marks]

Total 10 marks

9. (a) (i) A plasmid has taken up some genes, including the human insulin gene.

Outline THREE steps in the method for producing human insulin commercially through transgenic bacteria.

[3 marks]

(ii) Suggest ONE method which could be used to introduce new genes into eukaryotic cells.

[1 mark]

Restriction endonucleotidases are enzymes found in bacteria which recognise and cut DNA. The enzymes bind to the DNA at target sites and cut it at specific base sequences, as shown in Table 3 below.

TABLE 3

TARGET SITES OF RESTRICTION ENDONUCLEOTIDASES

Enzyme	Target site on DNA.
Hind II	G C A A ▼ A G C T T G G A C G T T T C G A ▲ A C C T
ECORI	G C A A ▼ A A T T T G G A C G T T T T A A ▲ A C C T

Figure 10 below shows sections of cut DNA, revealing "sticky ends".

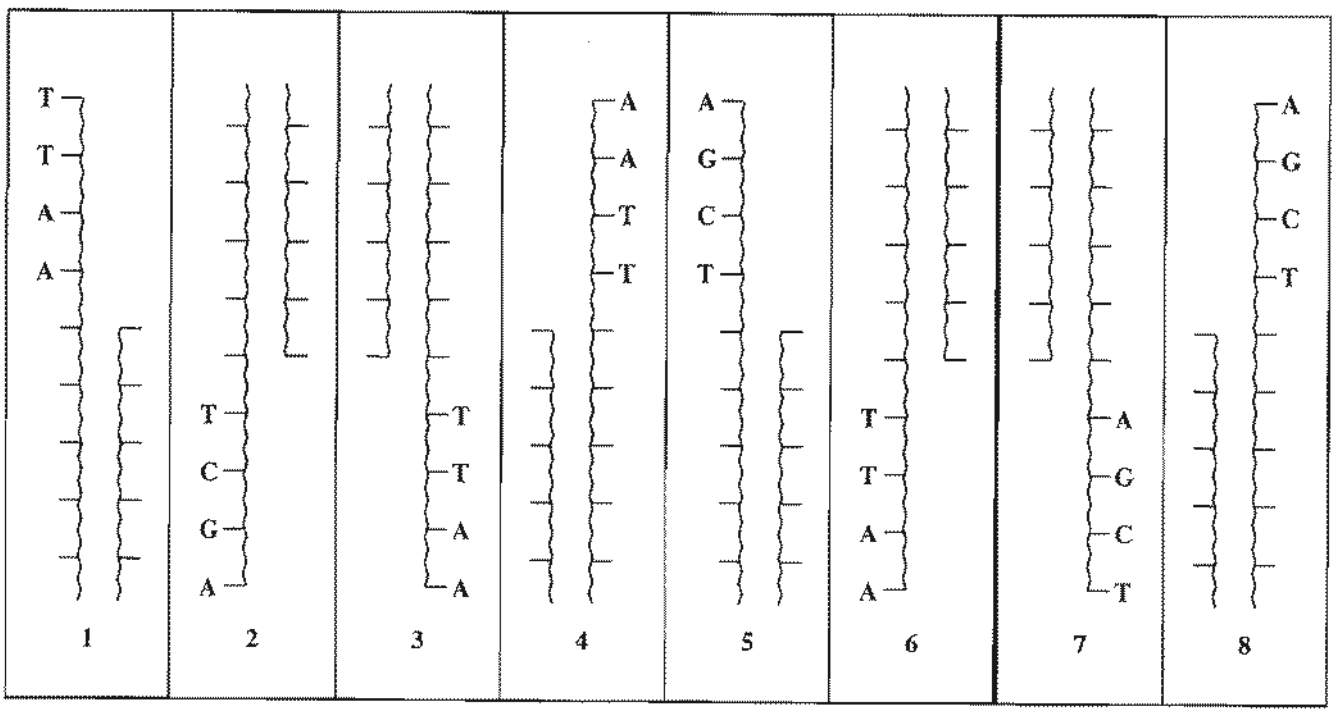


Figure 10. Sections of cut DNA revealing sticky ends

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(b) Use the numbers provided to identify the DNA whose "sticky ends" are complementary to each other, which would enable them to rejoin accurately.

(i) Number _____ and Number _____ (by Hind II)

(ii) Number _____ and Number _____ (by ECORI)

[2 marks]

(c) (i) Name the enzyme which seals the "sticky ends" together in complementary bonds.

_____

[1 mark]

(ii) State ONE function of this type of enzyme during meiosis I in eukaryotes.

_____

[1 mark]

(d) Genetic engineering has been used to integrate insecticide genes into the genome of crop plants, such as maize (corn). Each cell of the genetrically altered plant can produce the toxin which, when eaten, kills insects. Maize is a wind pollinated plant.

State TWO effects that this example of genetic engineering could have on the ecological balance of the environment.

_____

_____

_____

_____

_____

_____

[2 marks]

Total 10 marks

END OF TEST