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AS Level Biology A

H020/02 Depth in biology

Monday 4 June 2018 – Afternoon

Time allowed: 1 hour 30 minutes

7001735173

You must have:
- the Insert (inserted)

You may use:
- a scientific or graphical calculator
- a ruler (cm/mm)

H020002

First name										
Last name										
Centre number						Candidate number				

INSTRUCTIONS
- The Insert will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

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Answer **all** the questions.

1 **(a)** Fig. 1.1 shows the general structure of an amino acid.

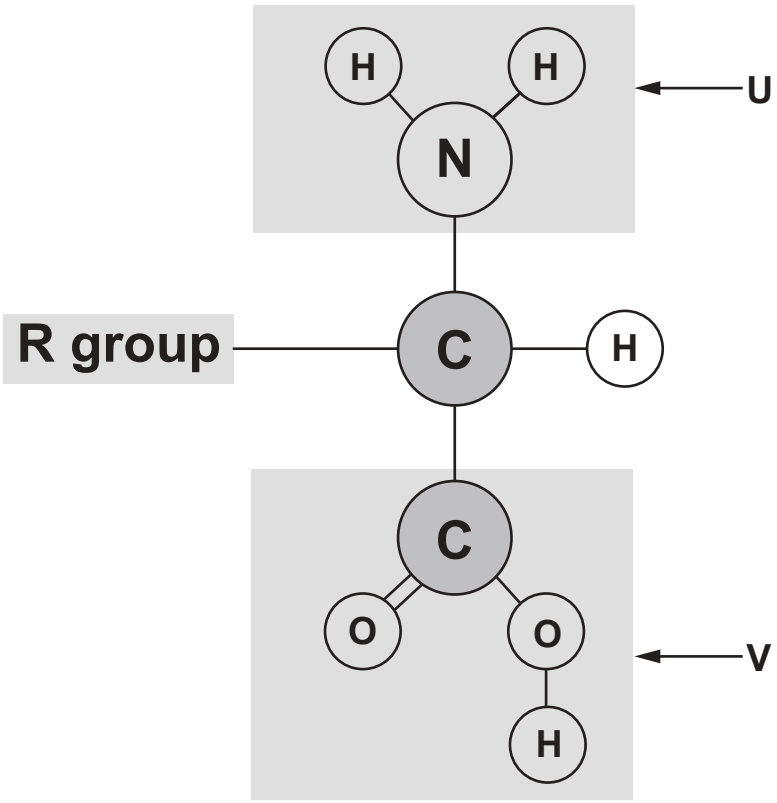


Fig. 1.1

(i) State the names of the groups labelled **U** and **V**.

U .....

V .....

[1]

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(ii) Fig. 1.2 shows a representation of a short polypeptide chain made from three amino acids.

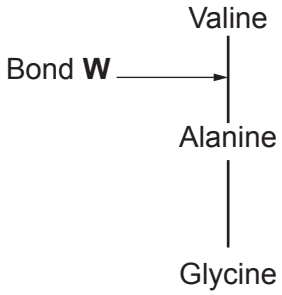


Fig. 1.2

Name bond **W and** state what type of reaction takes place to form this bond.

Name of bond **W** .....

Type of reaction .....

[1]

(b) Pepsin is a protease enzyme with a polypeptide chain containing 327 amino acids.

Titin is the largest known protein. It has a polypeptide chain containing at least 92 times more amino acids than pepsin.

(i) DNA sequences in genes code for polypeptide molecules such as pepsin and titin.

Explain why a process known as transcription is necessary for polypeptide synthesis.

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..... **[2]**

(ii) Calculate the minimum length of the DNA base sequence required to code for titin.

Show your working.

Answer ..... **[2]**

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(iii)* Titin is a fibrous protein. Pepsin is a globular protein.

Compare the properties and functions of fibrous proteins and globular proteins in the human body.

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(iv) Another protease enzyme is HIV1 protease, which is essential for the life cycle of the human immunodeficiency virus (HIV). Inhibition of this protease prevents HIV from maturing.

In 1995, saquinavir was the first HIV1 protease inhibitor drug to be approved by the US Food and Drug Administration (FDA).

The data in Fig. 1.3 show the number of acquired immune deficiency syndrome (AIDS) diagnoses and deaths between 1981 and 2007 in the US.

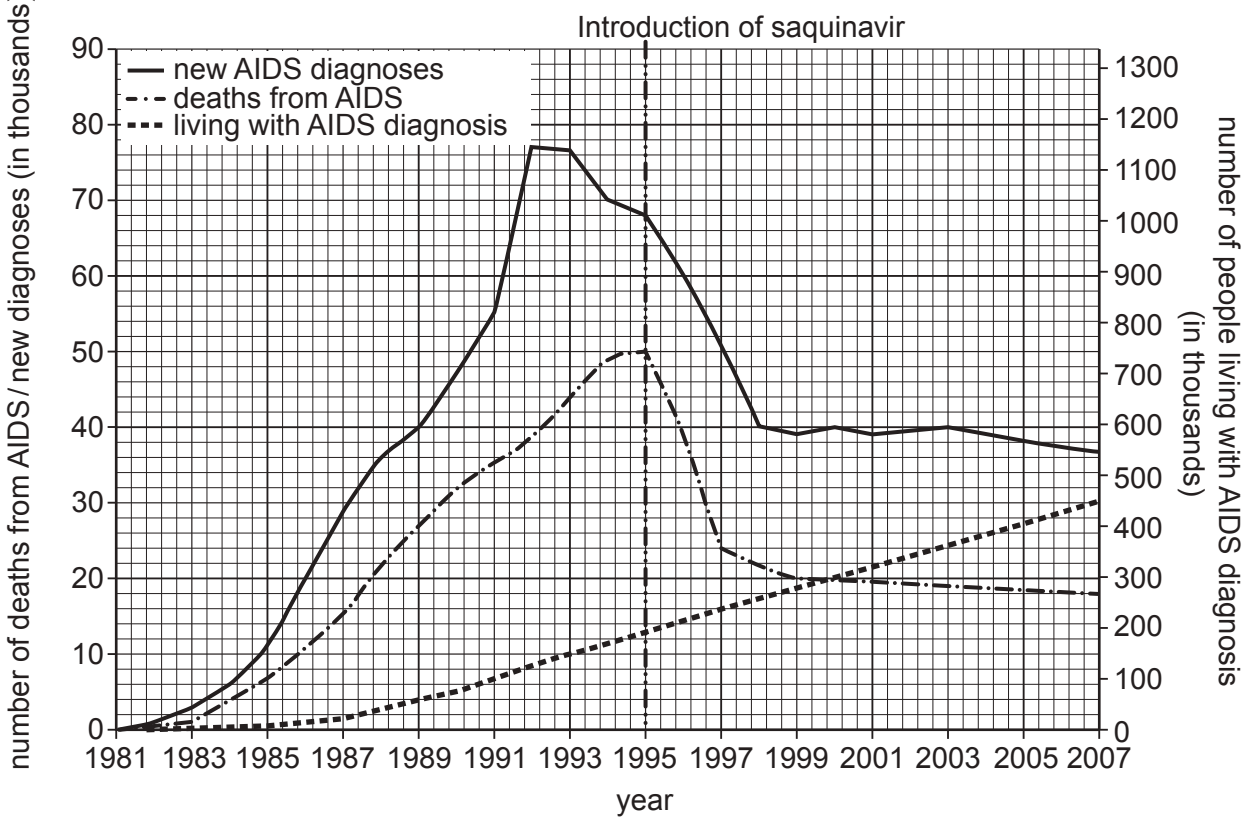


Fig. 1.3

Calculate the rate of decrease in deaths from AIDS between 1995 and 1998.

Give your answer to **two significant figures**.

Show your working.

Answer ..... Units ..... **[2]**

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(v) A student looking at the data in Fig. 1.3 made the following conclusion:

> "The decrease in deaths from AIDS after 1995 is because of the use of saquinavir by HIV patients."

Suggest why this conclusion may be invalid based on the data in Fig. 1.3.

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(c) A group of students wanted to use thin layer chromatography to identify four amino acids.

To produce the chromatogram, the students:

- drew a pencil line 1 cm from the bottom of the chromatography plate and put solvent into the beaker to a height of approximately 0.9 cm
- held the chromatography plate firmly in the middle with their hands and lowered it into the beaker
- left the apparatus to stand as shown in Fig. 1.4.

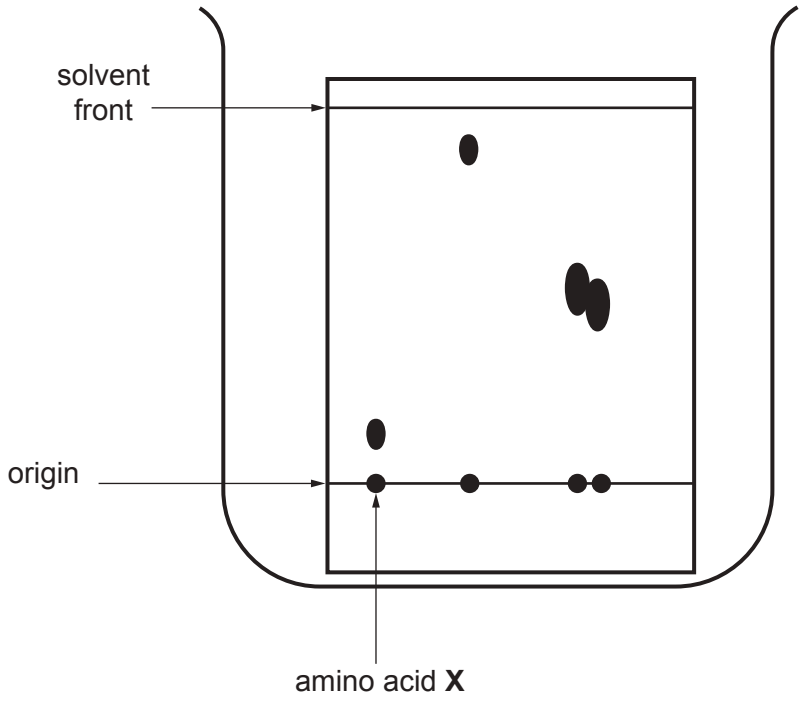


Fig. 1.4

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(i) Describe **four** ways you would refine the method used by the students. For each change you suggest, give a reason why this would improve the results of the experiment.

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(ii) Table 1 shows the R_f values of some amino acids.

Name of amino acid	R_f value
Alanine	0.31
Cysteine	0.40
Glutamine	0.13
Phenylalanine	0.59

Table 1

Using the information in Table 1 and Fig. 1.4, identify amino acid **X** by calculating its R_f value.

Show your working.

R_f value of amino acid **X** .....

Name of amino acid **X** .....

[2]

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2 **(a)** A patient was admitted to a hospital ward suffering from a heart rhythm abnormality.

Fig. 2.1(a) shows an ECG trace of the patient upon arrival at the hospital.

Fig. 2.1(b) shows an ECG trace of the patient when their heart rhythm had settled down to that of a normally functioning heart.

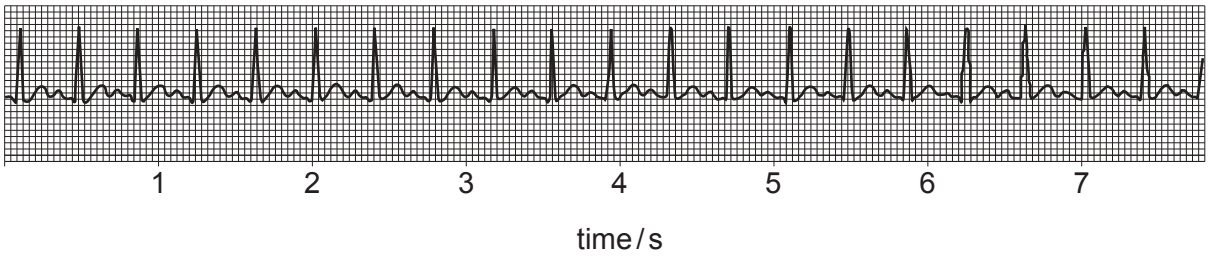


Fig. 2.1(a)

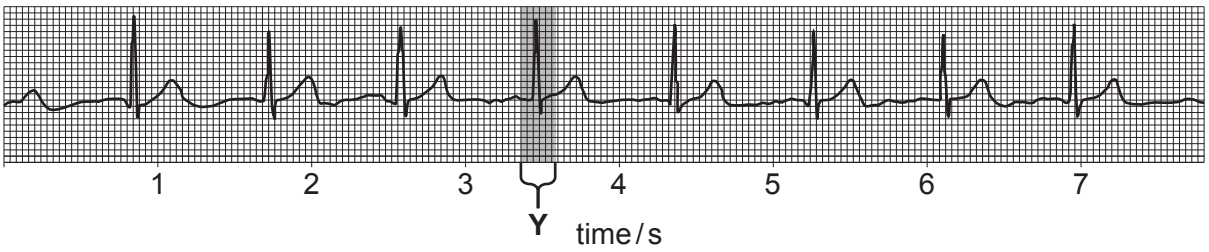


Fig. 2.1(b)

(i) Using the traces shown in Fig. 2.1, name the heart rhythm abnormality that the patient is suffering from.

..... **[1]**

(ii) The equation for working out cardiac output is:

cardiac output = stroke volume × heart rate

Stroke volume is the volume of blood pumped per heart beat.

The stroke volume of the patient is 80 cm^3.

Calculate the cardiac output of the patient using **Fig. 2.1(b)**. Give your answer in standard form.

Answer ..... Units ..... **[3]**

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(iii) Explain how the heart is controlling the electrical activity at **Y** on Fig. 2.1(b).

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(b) Fig. 2.2, **on the insert**, shows photographs of sheep's hearts that were considered for use in a school dissection.

(i) Looking at the two hearts in Fig. 2.2, a student decided that **Heart 2** was a better choice for the dissection because it had more structures present.

What evidence from the two hearts in Fig. 2.2 supports the student's decision?

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..... **[1]**

(ii) Name the structure labelled **Z** on Fig. 2.2.

..... **[1]**

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(c)* Fig. 2.3 shows the heart at different stages of the cardiac cycle.

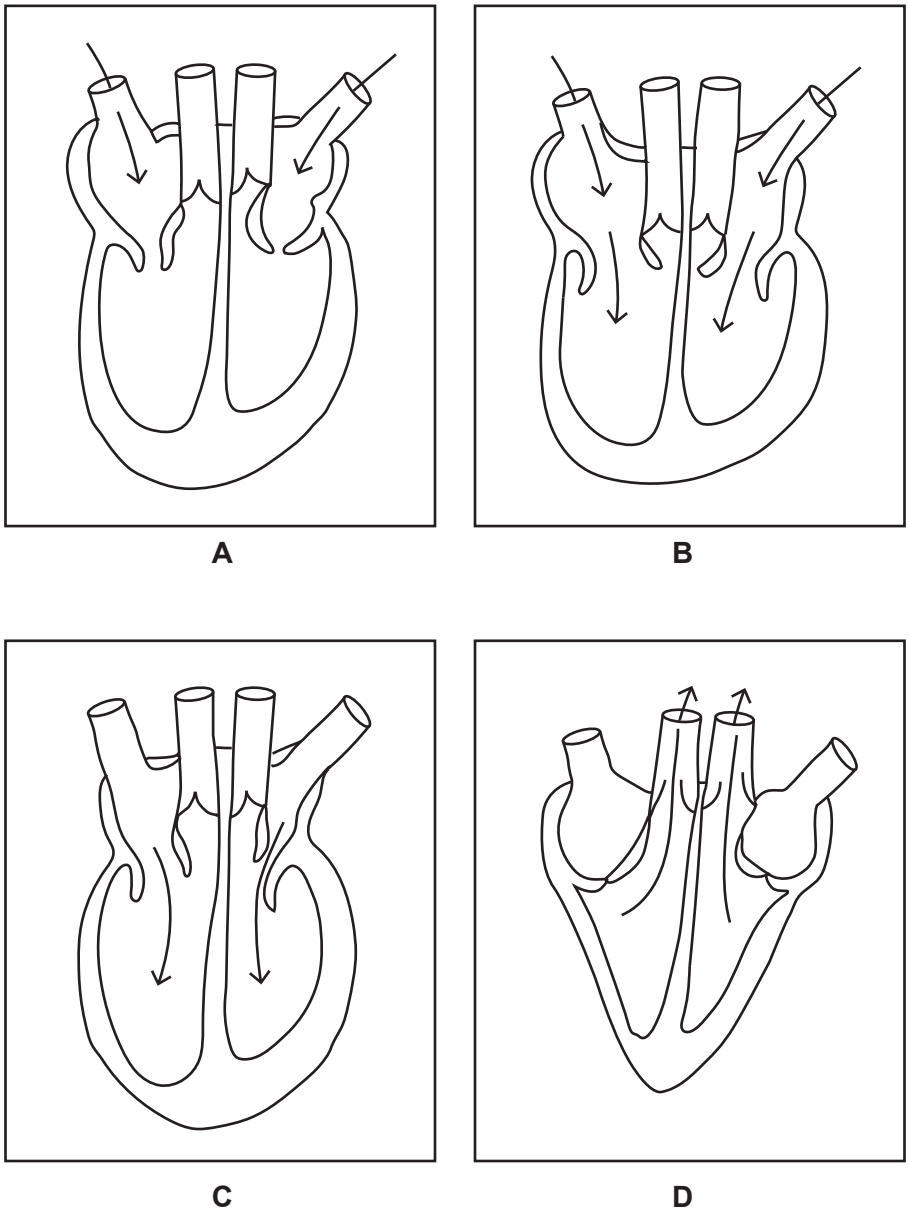


Fig. 2.3

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Box A shows atrial diastole. Blood is entering the atria, which are relaxed.

Outline the remaining stages of the cardiac cycle, with reference to boxes B, C and D in Fig. 2.3.

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3 **(a)** A cytoskeleton is present in all eukaryotic cells. One of its functions is to control the movement of organelles.

State how the cytoskeleton moves organelles around the cell.

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..... **[1]**

(b) Epithelial cells in the airways of mammals play an essential role in defences against pathogens.

Explain the function of epithelial cells in the airways of mammals in the defence against pathogens **and** suggest the importance of the cytoskeleton in carrying out this function.

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(c) (i) Phagocytes defend the body by engulfing and destroying pathogens in a process called phagocytosis.

A student produced a summary of the stages of phagocytosis, which is shown in Fig. 3.1.

The student made two errors in their summary. Describe what **two** corrections the student should make.

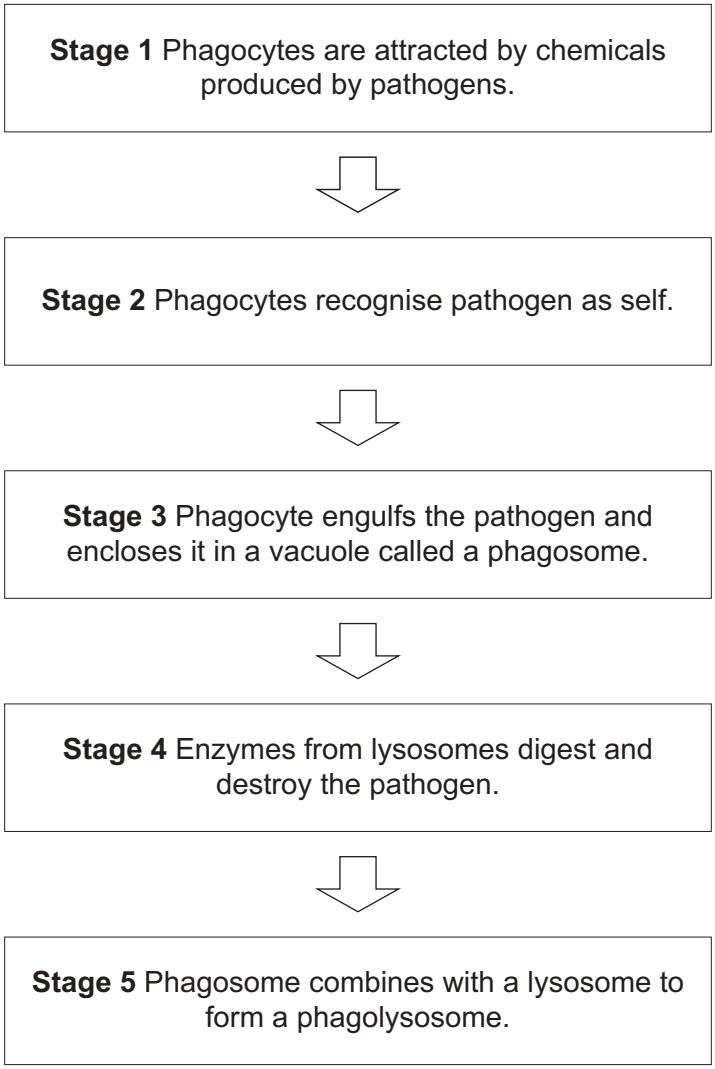


Fig. 3.1

Correction 1 .....

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Correction 2 .....

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[2]

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(ii) Antibodies are defensive proteins carried in the bloodstream. Fig. 3.2 shows the simplified, incomplete structure of an antibody.

Complete Fig. 3.2 by **drawing and labelling** the missing part(s) of the antibody.

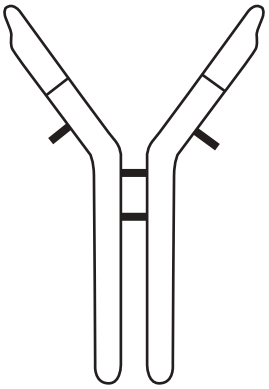


Fig. 3.2

[Answer on Fig. 3.2] **[1]**

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4 (a) (i) Ions have a number of important roles in living organisms.

Complete the table below by identifying the ion that plays each of the roles. Choose from the following list.

NH_4^+ Cl^- H^+ OH^- PO_4^{3-} Ca^{2+}

Important role	Ion
Production of nitrate ions by bacteria	NH_4^+
Loading of phloem	
DNA structure	
Cofactor for amylase	

[2]

(ii) Dissolved ions diffuse between blood plasma and tissue fluid.

Pressure differences at the arterial and venous ends of capillaries are responsible for the formation of tissue fluid. The following measurements were made in one capillary:

- Net hydrostatic pressure at the arterial end was 4.6 KPa
- Net oncotic pressure was −3.0 KPa
- Net hydrostatic pressure at the venous end was 2.3 KPa.

Use this information to explain the movement of fluid in and out of a capillary.

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(b) Copper (II) ions act as irreversible non-competitive inhibitors of the enzyme catalase.

(i) Describe how a non-competitive inhibitor works to inhibit the activity of an enzyme.

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..... **[2]**

(ii) Catalase is found in all living things that are exposed to oxygen. It protects cells from oxidative damage by breaking down hydrogen peroxide to water and oxygen.

Catalase is a useful biomarker of oxidative stress in fish exposed to water contaminated with copper ions.

A group of students carried out an experiment to explore the effects of copper sulfate on the action of catalase. They measured the activity of catalase exposed to different concentrations of copper sulfate.

The results of their experiment are shown in Table 4.

Concentration of copper sulfate (moles dm^{-3})	**Volume of oxygen gas produced (cm^3)**
0.00	14.50
0.05	10.50
0.10	7.55
0.15	5.80
0.20	4.20

Table 4

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In the space provided below, **sketch** a graph of the results in Table 4.

[2]

(iii) What can the students conclude from their results?

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..... **[2]**

(iv) Three rivers in the Himalayan foothills were polluted with copper, which affected the aquatic wildlife. Scientists were provided with one dead Indian Barb fish, *Esomus danricus*, from each of the rivers.

Scientists were unable to take a direct measurement of the copper ion concentration in the fish.

Using the information provided in 4(b)(ii), suggest how the scientists could use the fish tissue to compare the copper ion pollution in the three rivers.

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..... **[3]**

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5 **(a)** Elephants are protected by the treaty known as the Convention on International Trade in Endangered Species (CITES).

(i) Give **one** aim of CITES.

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..... **[1]**

(ii) Between 1913 and 2013 the approximate worldwide population of living elephants dropped from 10 000 000 to 500 000.

Calculate how many orders of magnitude smaller the elephant population is likely to be in 2213 compared to 1913.

Assume that the elephant population continues to decline at the same rate each 100 years.

Show your working.

Answer ..... **[2]**

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(b) Fig. 5 shows the approximate percentages of elephants that were killed illegally in three different regions of Africa.

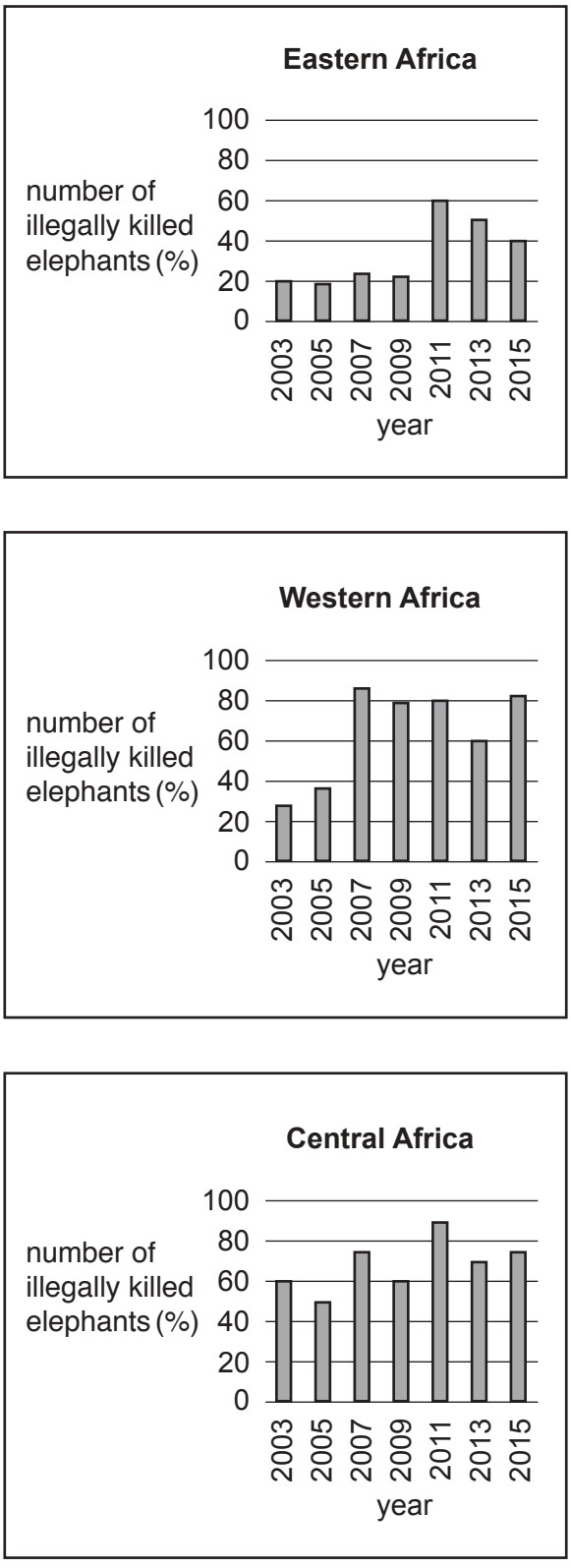


Fig. 5

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21

John Scanlon, the Secretary-General of CITES in 2015, made the following statement:

> "African elephant populations continue to face an immediate threat to their survival from unacceptably high-levels of poaching for their ivory, especially in Central and West Africa where high levels of poaching are still evident. There are some encouraging signs, including in certain parts of Eastern Africa... showing us all what is possible through a sustained and collective effort..."

Give two pieces of evidence to show how the data in Fig. 5 support the statement made by John Scanlon.

Evidence 1 .....

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Evidence 2 .....

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[2]

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6 **(a)** A group of students were studying a local field, Upper End Meadow. The students sampled plants from this field.

The students' results are given in Table 6.

Species	*n*
Meadow buttercup	6
Common daisy	7
Red clover	3
Ribwort plantain	8

Table 6

(i) Calculate the Simpson's Index of Diversity for Upper End Meadow.

Use the information in Table 6 and the formula:

$$D = 1 - \left(\sum\left(\frac{n}{N}\right)^2\right)$$

n = number of organisms of this species
N = total number of organisms

Show your working. Give your answer to **two significant figures**.

Answer ..... **[3]**

(ii) Name a piece of equipment that you could use for the random sampling of the plants shown in Table 6.

..... **[1]**

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(b) The group of students attempted to extract and purify DNA from a plant in Upper End Meadow.

The students used the following steps:

1. Mix the plant sample with detergent.
2. Add salt.
3. Add protease enzyme.
4. Spool the DNA precipitate onto a glass rod.

Suggest whether this method would successfully extract and purify DNA. Justify your conclusion.

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..... **[3]**

(c) The students found 50 animals in a soil sample collected from Upper End Meadow and identified them as follows:

- 2 click beetles
- 24 leatherjackets
- 23 meadow ants
- 1 wireworm

What can you conclude about the species evenness shown in the soil sample? Justify your answer.

Conclusion .....

Justification .....

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[1]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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Insert

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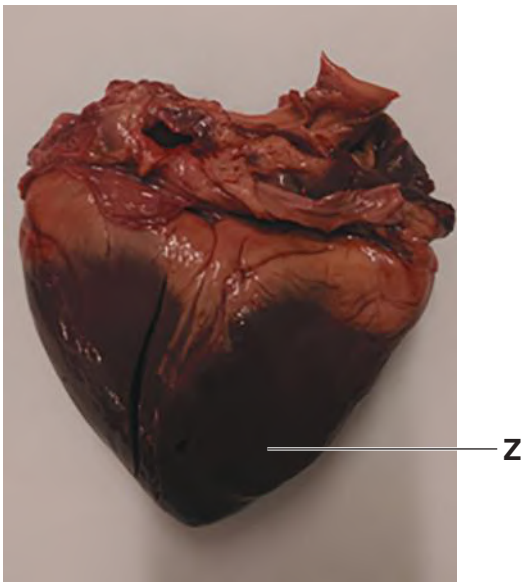
INFORMATION

- This Insert contains Fig. 2.2.
- This document consists of **2** pages.

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Heart 1 **Heart 2**

Fig. 2.2

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