

**AS Level Biology B (Advancing Biology)**  
**H022/01 Foundations of biology**  
Sample Question Paper

**Date – Morning/Afternoon**

Time allowed: 1 hour 30 minutes



**You may use:**

- a scientific calculator



<b>First name</b>					
<b>Last name</b>					
<b>Centre number</b>					
<b>Candidate number</b>					

**INSTRUCTIONS**

- 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.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

**INFORMATION**

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [ ].
- This document consists of **28** pages.

**SECTION A**

**You should spend a maximum of 25 minutes on this section.**

Answer **all** the questions.

- 1** Erythrocytes contain few organelles. They do **not** have mitochondria or Golgi apparatus.

Which process can be carried out by an erythrocyte?

- A** cell division
- B** aerobic respiration
- C** anaerobic respiration
- D** protein synthesis

Your answer

**[1]**

- 2** During protein synthesis mRNA is produced by the process of 'transcription'.

Where is mRNA produced?

- A** nucleus
- B** nucleolus
- C** ribosome
- D** rough endoplasmic reticulum

Your answer

**[1]**

- 3 Samples of normal plasma and normal urine were analysed in a laboratory. One test is described below:

**STEP 1:** add 2 cm<sup>3</sup> of the test sample to a test tube containing solution **M** and mix.

**STEP 2:** place the test tube in a water bath at 90 °C.

**OBSERVATION:** the final colour was red.

Which is correct?

- A **M** is Biuret solution and the sample is plasma.
- B **M** is Biuret solution and the sample is urine.
- C **M** is Benedict's solution and the sample is plasma.
- D **M** is Benedict's solution and the sample is urine.

Your answer

[1]

- 4 Carcinogen **W** can cause changes in tumour suppressor genes, **X**. This can lead to uncontrolled cell division and the formation of a tumour which may spread to other parts of the body forming **Y**.

Which of the following responses correctly identifies **W**, **X**, and **Y**?

	<b>W</b>	<b>X</b>	<b>Y</b>
<b>A</b>	Nicotine	Ras	mutations
<b>B</b>	Asbestos	P53	metastases
<b>C</b>	Tar	Ras	metastases
<b>D</b>	Benzopyrene	P53	mutations

Your answer

[1]

- 5 DNA barcodes are genetic sequences that allow organisms to be identified. The DNA sequence of cytochrome c oxidase I is a common DNA barcode.

Which property of cytochrome c oxidase I makes it suitable for use as a DNA barcode?

- A location on mitochondrial DNA
- B slow mutation rate
- C short DNA sequence
- D long DNA sequence

Your answer

[1]

- 6 The passage below outlines one method that can be used to prepare and view onion cells under a microscope. Two terms are missing.

*Add a few drops of water to a microscope slide. Use forceps to remove the ..... layer of cells from the onion tissue. Place the layer on the microscope slide and use a pipette to add a stain. Place a cover slip over the stained layer. Place the slide on the microscope stage. Adjust the magnification by rotating the microscope nosepiece to select a suitable ..... lens.*

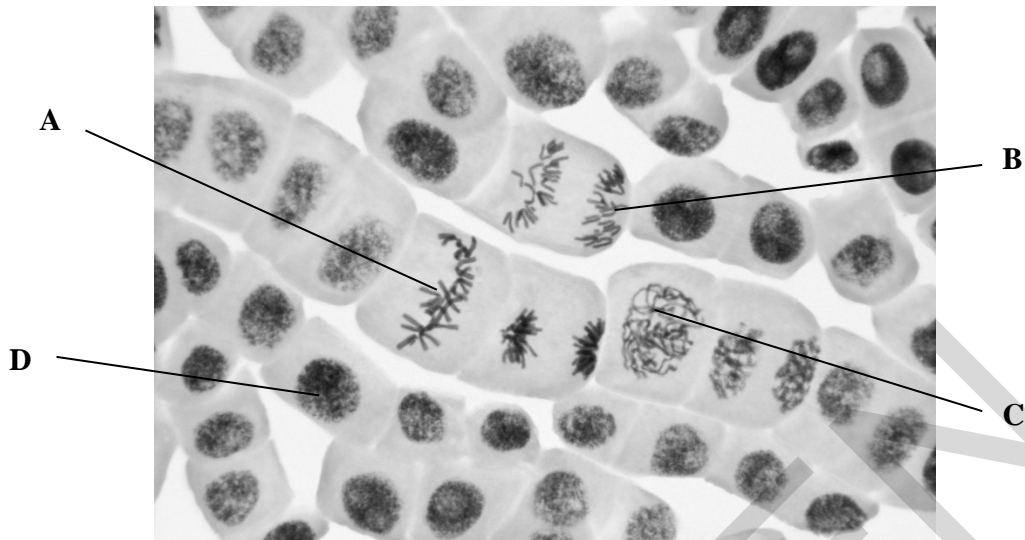
Which are the missing terms?

- A epidermal and eyepiece
- B epidermal and objective
- C endodermal and eyepiece
- D endodermal and objective

Your answer

[1]

7 **Fig. 7.1** below shows onion cells at various stages of mitosis.



**Fig. 7.1**

Which cell shows the stage when the chromosomes attach to the spindle fibres?

Your answer

[1]

8 Which of the following events would **not** happen during mitosis in onion cells?

- A two nuclear envelopes will form
- B a cell plate will form
- C centrioles will move to opposite poles of the cell
- D the nuclear envelope will break down

Your answer

[1]

- 9 The genetic diversity of four species was studied by analysing a number of genes. Data from the studies are shown in **Table 9.1** below.

Species	Common name	Genome size (picograms)	Number of gene loci studied	Number of monomorphic gene loci	Number of polymorphic gene loci
A	Humans	3.50	71	51	20
B	House sparrow	1.57	15	10	5
C	American toad	6.35	14	10	4
D	Atlantic horseshoe crab	2.80	25	19	6

**Table 9.1**

Which species has the greatest genetic diversity?

Your answer

[1]

- 10 After a cut, the body responds by forming a blood clot. Platelets release thromboplastin and an enzyme-controlled reaction begins.

Why does this cause the rate of blood clotting to increase?

- A there is less enzyme inhibition
- B there are more active sites available
- C there are more substrates to collide with the active site
- D there is an increase in kinetic energy

Your answer

[1]

11 Which protein in the blood clotting process is indicated by line X in Fig. 11.1 below?

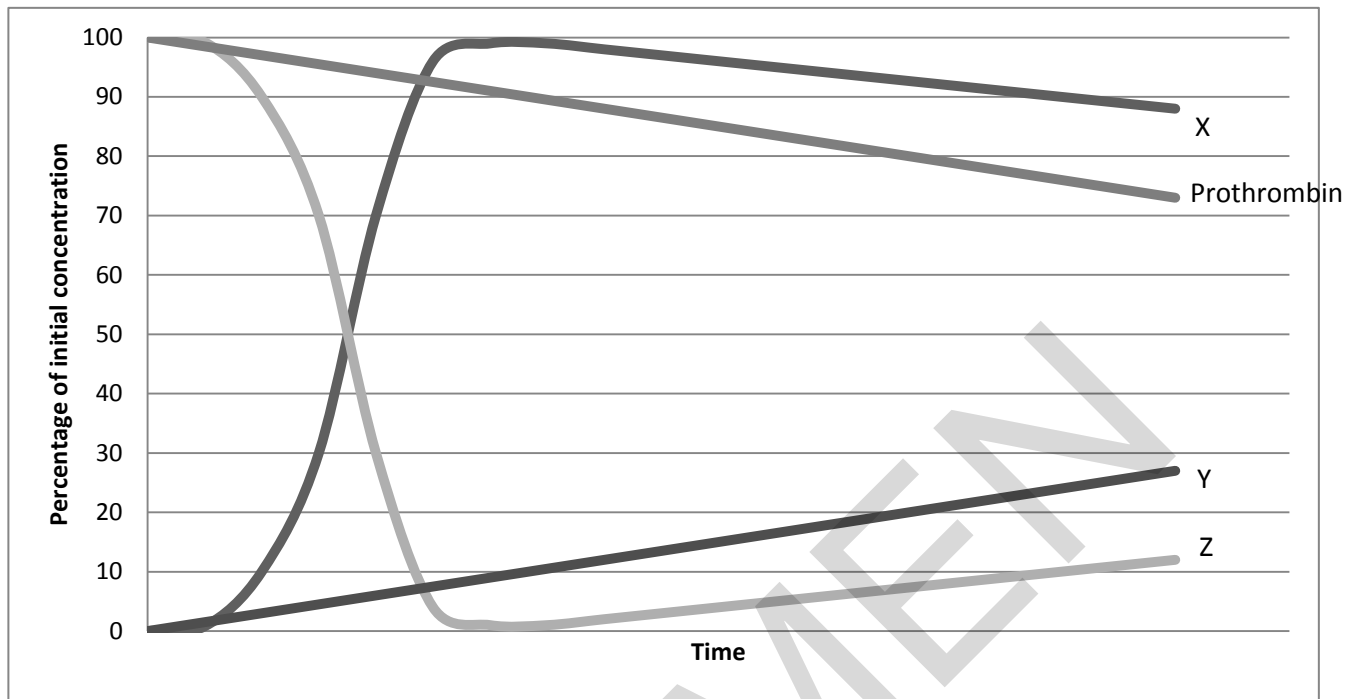


Fig. 11.1

- A Thromboplastin
- B Thrombin
- C Fibrin
- D Fibrinogen

Your answer

[1]

12 A group of students were comparing electron micrographs of three different types of cell:

X a macrophage

Y a palisade mesophyll cell

Z the bacterium *Escherichia coli*

They recorded their observations in a table.

Which row, in **Table 12.1** below, shows the correct observations?

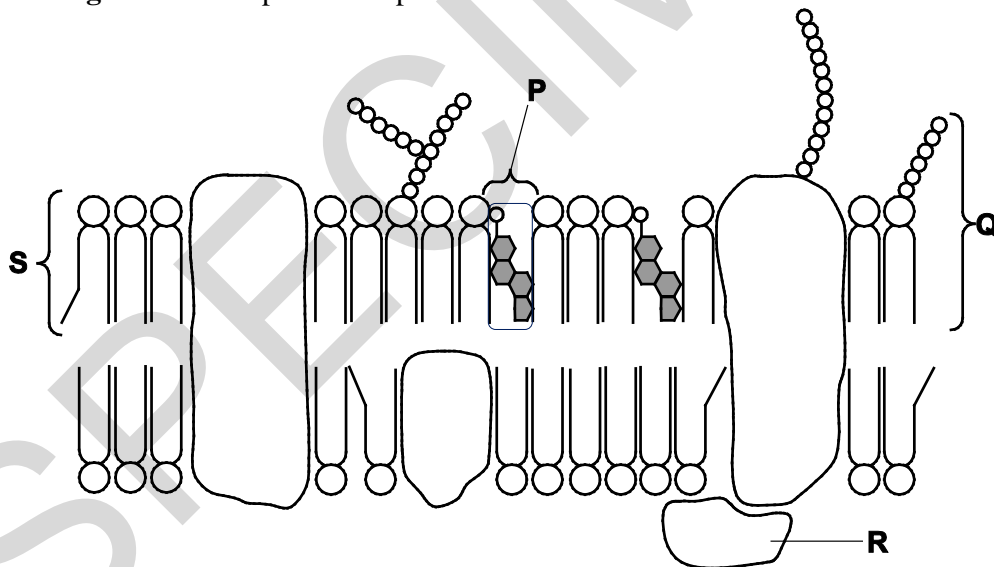
	Has a cellulose cell wall	Has a Golgi apparatus	Has a plasma membrane	Has ribosomes
<b>A</b>	Y and Z	X, Y and Z	X, Y and Z	X, Y and Z
<b>B</b>	Y and Z	X and Y	X and Y	X, Y and Z
<b>C</b>	Y	X	X, Y and Z	X and Y
<b>D</b>	Y	X and Y	X, Y and Z	X, Y and Z

**Table 12.1**

Your answer

[1]

13 The diagram in **Fig. 13.1** shows part of the plasma membrane.



**Fig. 13.1**

Which components affect the fluidity of the plasma membrane?

**A** P, Q, R and S

**B** P and S

**C** P

**D** P, Q and S

Your answer

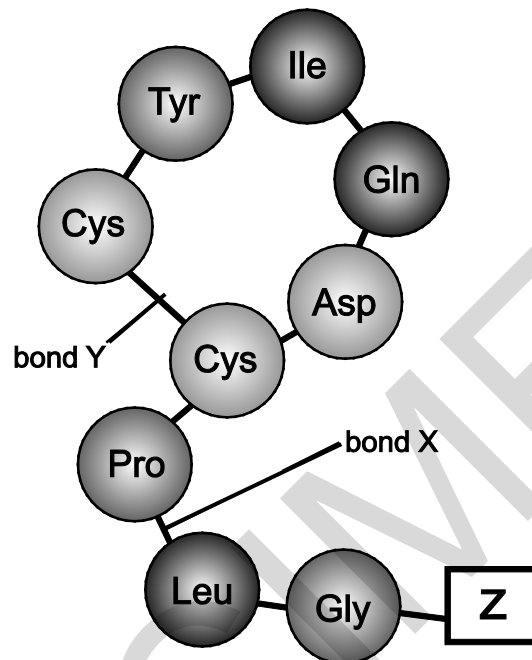
[1]



14 Some proteins act as hormones.

Oxytocin is a hormone which is released during labour.

**Fig. 14.1** is a diagram of a molecule of oxytocin. Each circle represents an amino acid. The two molecules of the amino acid cysteine (Cys) are joined by their R groups so part of the molecule is circular.



**Fig. 14.1**

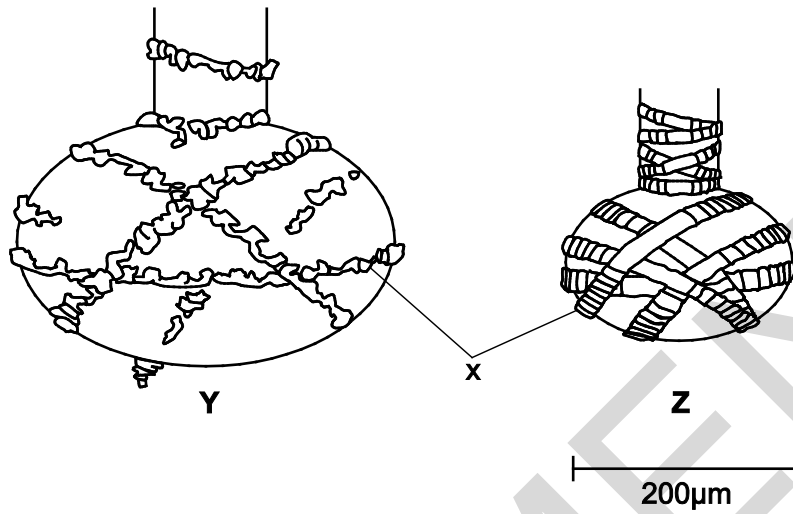
Which row best describes the structure of oxytocin?

Row	Bond X	Bond Y	Group Z
A	peptide	disulfide	amine
B	hydrogen	peptide	amine
C	peptide	disulfide	phosphate
D	disulfide	hydrogen	phosphate

Your answer

[1]

- 15 **Fig. 15.1** shows simplified models of two alveoli after exhalation is complete. One shows an alveolus from a non-smoker and the other shows the alveolus from a smoker. **X** is a tissue found in the lungs. Questions 15 and 16 both refer to this figure.



**Fig. 15.1**

Which of the following statements is correct:

- A **Y** is from a non-smoker and **X** labels cartilage rings.
- B **Z** is from a non-smoker and **X** labels cartilage rings.
- C **Y** is from a non-smoker and **X** labels elastic fibres.
- D **Z** is from a non-smoker and **X** labels elastic fibres.

Your answer

[1]

- 16 In **Fig. 15.1**, the two alveoli are shown as simple spheres.

Using  $\pi = 3.142$ , what is the approximate surface area for alveolus **Z**?

- A  $5.0 \times 10^5 \mu\text{m}^2$
- B  $1.3 \times 10^5 \mu\text{m}^2$
- C  $3.1 \times 10^4 \mu\text{m}^2$
- D  $4.2 \times 10^6 \mu\text{m}^2$

Your answer

[1]

17 Glycogen is a complex carbohydrate found in the liver of mammals.

Which of the statements is/are true?

**Statement 1:** glycogen contains 1,4-glycosidic bonds between alpha glucose molecules.

**Statement 2:** glycogen contains 1,6-glycosidic bonds between alpha glucose molecules.

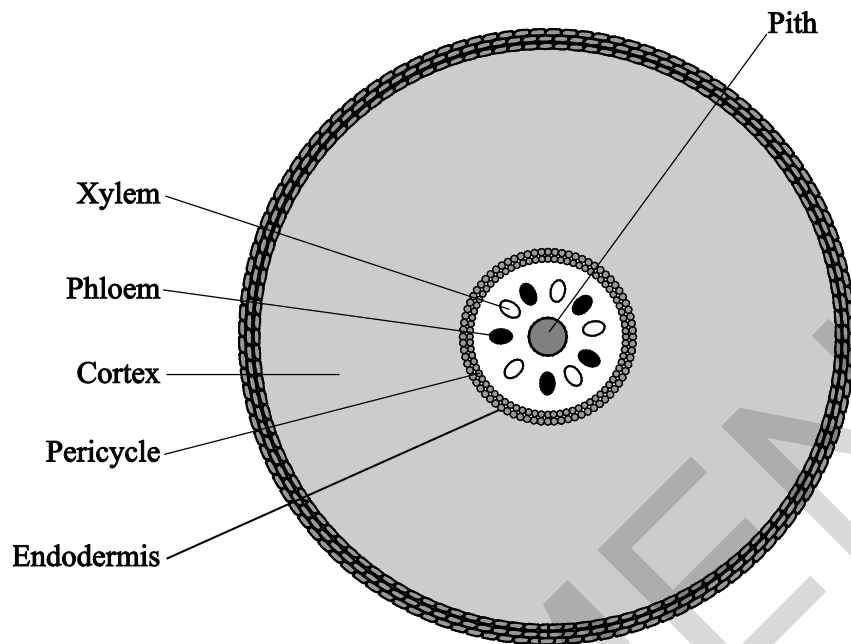
**Statement 3:** branches occur within the glycogen molecule by the formation of 1-6 glycosidic bonds.

- A 1, 2 and 3
- B Only 1 and 2
- C Only 2 and 3
- D Only 1

Your answer

[1]

18 Fig. 18.1 shows a simplified drawing of a section through a plant organ.



**Fig. 18.1**

Which organ is illustrated by **Fig. 18.1**?

- A** a section through the stem of a wheat plant
- B** a section through the stem of a cabbage plant
- C** a section through the root of a wheat plant
- D** a section through the root of a cabbage plant

Your answer

**[1]**

19 Arteries contain elastic fibres.

Which of the following statements is/are true about the primary function of elastic fibres in artery walls?

**Statement 1:** contract to maintain high blood pressure.

**Statement 2:** recoil to maintain high blood pressure.

**Statement 3:** keep the blood moving away from the heart.

**A** 1, 2 and 3

**B** Only 1 and 2

**C** Only 2 and 3

**D** Only 1

Your answer

[1]

20 Amniocentesis and chorionic villus sampling are two techniques that can be used to detect chromosomal mutations in a fetus.

Which of the following statements is/are true?

**Statement 1:** amniocentesis can be performed earlier in pregnancy than chorionic villus sampling.

**Statement 2:** amniocentesis carries a lower risk of miscarriage than chorionic villus sampling.

**Statement 3:** amniocentesis carries a lower risk of fetal deformities than chorionic villus sampling.

**A** 1, 2 and 3

**B** Only 1 and 2

**C** Only 2 and 3

**D** Only 1

Your answer

[1]

**SECTION B**

Answer **all** the questions.

**21** Xylem and phloem are tissues involved in bulk transport in vascular plants.

The structure of the two tissues is different because the mechanism of transport in the two tissues is different.

**(a)** On **Fig. 21.1**, draw and label the position of xylem and phloem tissues in the stem of a dicotyledonous (broad-leaved) vascular plant. Use the letter **X** to indicate the position of the xylem tissue and **P** to indicate the position of the phloem tissue.



**Fig. 21.1**

[2]

**(b)** How do the following differ in xylem and phloem tissue?

**(i)** The type of cells present.

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

**(ii)** The composition of the cell walls in the cells present.

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

(c) Plants which are adapted to living in water are known as hydrophytes.

Two adaptations found in hydrophytes are the absence of a waxy cuticle on leaves and the absence of xylem tissue throughout the plant.

Suggest the advantage to plants living in water of:

*The absence of a waxy cuticle* .....

.....

.....

*The absence of xylem tissue* .....

.....

.....

[2]

SPECIMEN

- 22 (a) A haemocytometer can be used to count the number of erythrocytes in a blood sample.

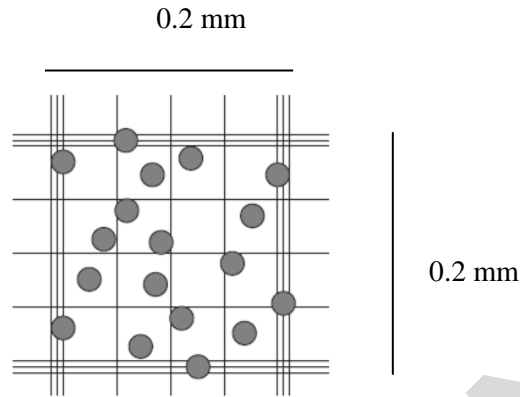


Fig. 22.1

Fig. 22.1 shows erythrocytes on a haemocytometer produced with a dilution of 1 in 200.

The volume of the haemocytometer chamber shown is  $0.1 \text{ mm} \times 0.2 \text{ mm} \times 0.2 \text{ mm} = 0.004 \text{ mm}^3$ .

Calculate the number of erythrocytes in  $1 \text{ cm}^3$  of blood.

Show your working.

number of erythrocytes ..... [3]

- (b) Water is the main component of blood plasma.

State **two** properties of water in blood plasma and explain their significance.

*Property* .....

*Significance* .....

.....

*Property* .....

*Significance* .....

.....

[4]



- 23 Different models can be used to investigate factors that affect the rate of diffusion of molecules into and out of cells.

Beetroot cells are a useful model for investigating the effect on diffusion rates of changes to plasma membranes. These cells contain the pigment betalain and the diffusion of betalain out of the cells can be measured using a colorimeter.

Fig. 23.1 is a simplified diagram of an intact beetroot cell.

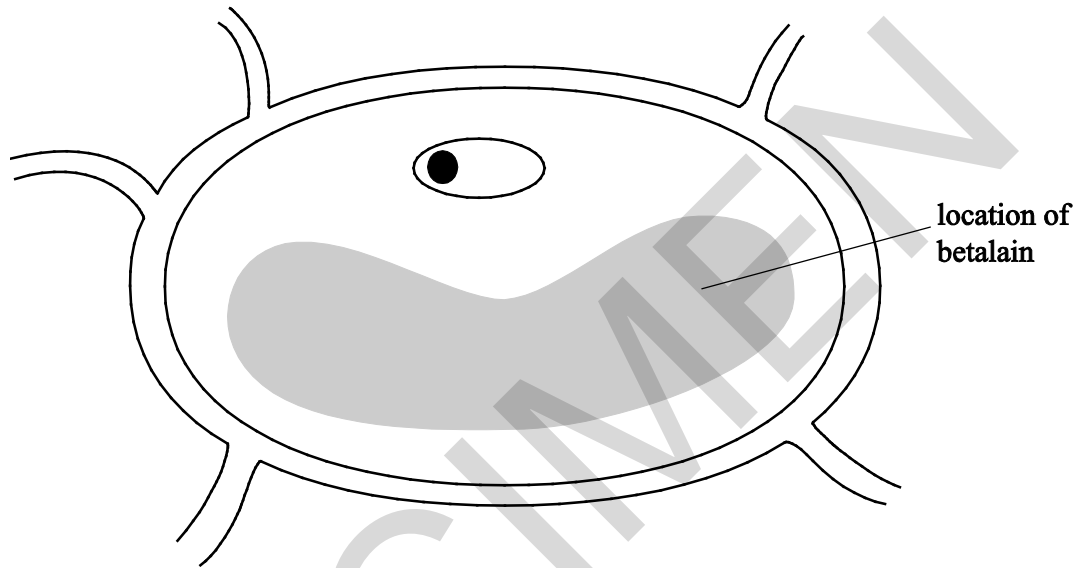


Fig. 23.1

- (a) Describe the diffusion of betalain out of a beetroot cell under normal conditions.

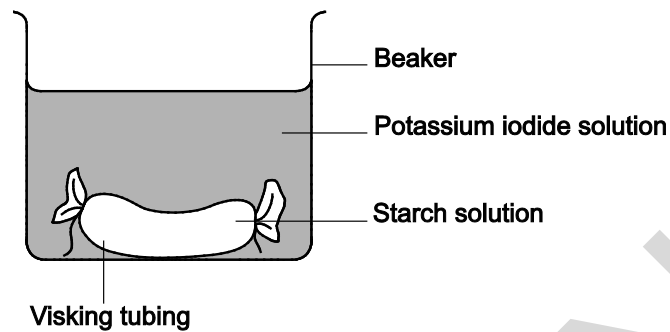
.....

.....

.....

..... [3]

- (b) Alternatively, a model cell can be made using visking tubing. A group of students investigated the effect of temperature on the rate of diffusion using visking tubing as a model cell as shown in **Fig. 23.2**.



**Fig. 23.2**

This is the method they used:

- take a piece of visking tubing approximately 6 cm in length
- tie a knot in one end of the tubing
- half fill the tubing with starch solution
- tie a knot in the other end
- blot dry the outside of the tubing
- place the 'model cell' into a potassium iodide solution at 20 C
- time how long it takes for potassium iodide to diffuse into the model cell and turn it blue-black in colour
- complete the procedure a total of three times and calculate a mean
- repeat the experiment at temperatures of 25 C, 30 C, 35 C and 40 C.

Table 23.1 shows their results.

Temperature (°C)	Time taken to turn blue-black in colour (s)				Standard deviation
	Repeat 1	Repeat 2	Repeat 3	Mean	
20	545	522	498	521.7	23.50
25	477	451	446	458.0	16.64
30	421	427	448	432.0	14.18
35	378	361	358	365.7	10.79
40	321	311	330	320.7	

Table 23.1

Complete the flowchart below to calculate the standard deviation at 40 °C and comment on the precision of results over the temperature range tested.

Time taken (s)
<b>X</b>
321
311
330
962
Total of X =
Total of X <sup>2</sup> =
(Total of X <sup>2</sup> )/3 =
925 444
308 481.3

<b>X<sup>2</sup></b>
103 041
96 721
108 900
Total of X <sup>2</sup> =

Total of X<sup>2</sup> =

--

-

308 481.3
-----------

=

--

÷
2
=

√



=

.....

.....

.....

.....

(c) State **two** limitations to the experiment and explain how each could be improved.

*Limitation* .....

*Improvement* .....

.....

*Limitation* .....

*Improvement* .....

.....

[4]

(d) Mammals require iodine for the function of the thyroid gland. The iodine is transported as an iodide ion.

Suggest how iodide ions might enter the cells of the thyroid gland.

.....

.....

.....

[1]

SPECIMEN

24 (a) The circulatory system of mammals can be described as a mass transport system.

State **two** reasons why mammals need a mass transport system.

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

(b) Fig. 24.1 shows a vertical section through a mammalian heart.

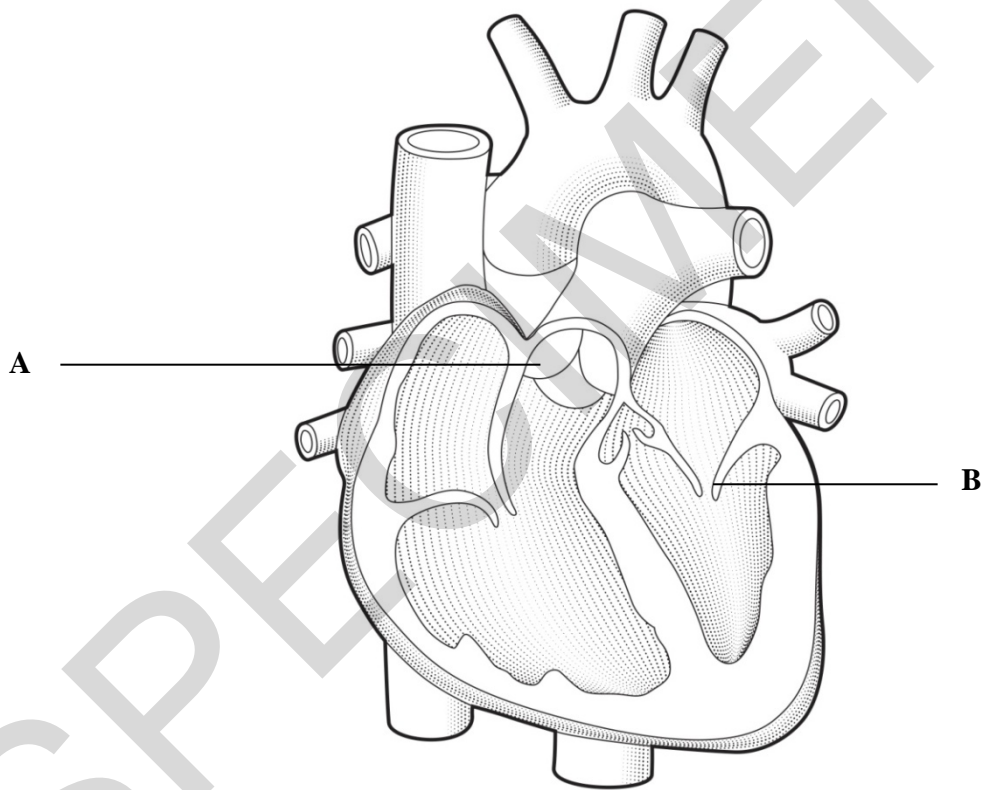


Fig. 24.1

State the roles of structure **A** and structure **B** during the cardiac cycle.

**A** .....  
.....  
**B** .....  
..... [2]

- (c) A sphygmomanometer and stethoscope can be used to measure blood pressure. The cuff of the sphygmomanometer is put around the arm and inflated to around 200 mmHg. The stethoscope is placed over the artery and the pressure in the cuff is slowly released.

Describe the role of the stethoscope in taking blood pressure readings.

.....

.....

.....

..... [2]

- (d) An epidemiological study was carried out on 614 individuals on the effects of hypotension and hypertension on the cardiovascular system.

The results are shown below in Fig. 24.2.

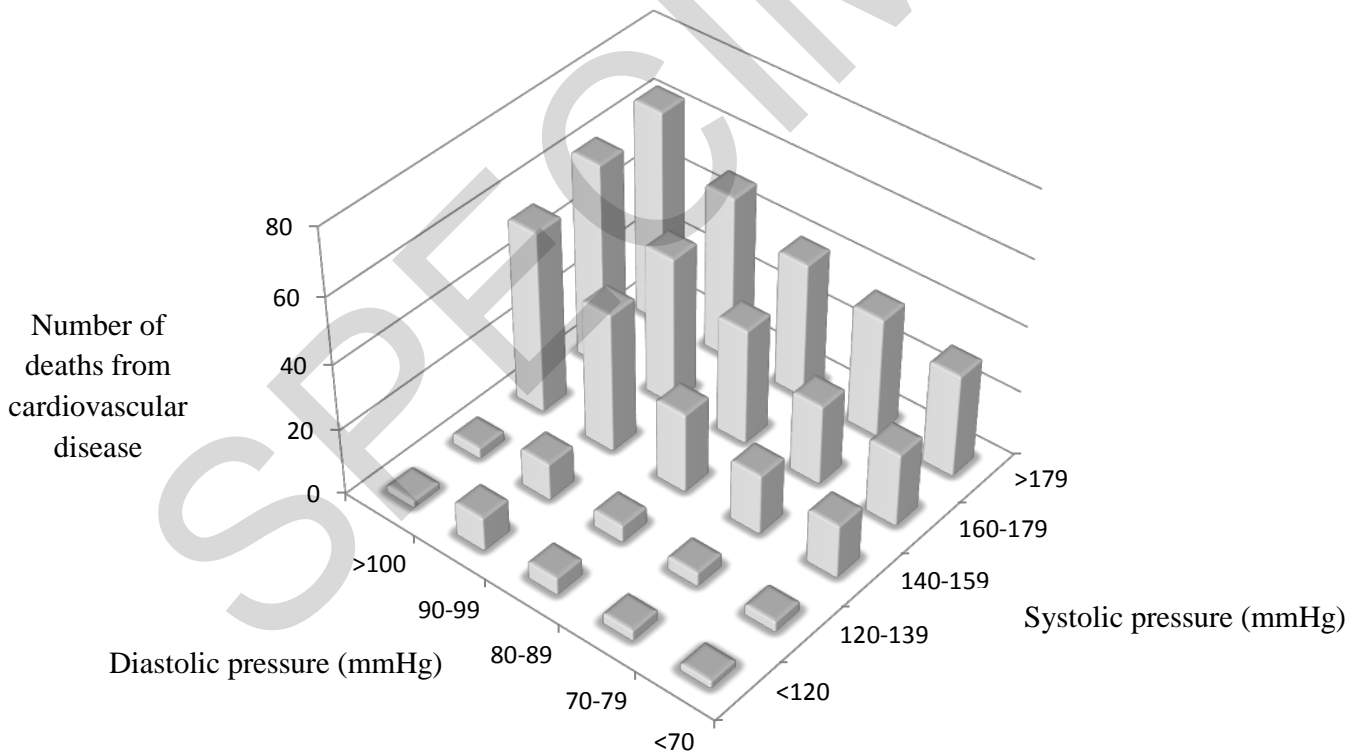


Fig. 24.2

Using the information in **Fig. 24.2**, what can you conclude about the impact of blood pressure on the number of deaths from cardiovascular disease?

.....

.....

.....

.....

.....

.....

.....

[3]

SPECIMEN

- 25 (a) In 1958 Matthew Meselson and Franklin Stahl conducted an experiment that supported the theory that DNA replication occurred due to semi-conservative replication.

Fig. 25.1 shows semi-conservative replication of part of a DNA molecule.



Fig. 25.1

Explain what is meant by the term *semi-conservative replication*.

.....

.....

.....

.....

..... [2]

- (b) The genome of the plant *Arabidopsis thaliana*, the mouse-ear cress, was the first plant genome to be sequenced. Its genome was found to be relatively small and contains 5 chromosomes and 135 million base pairs.

Calculate the number of adenine **nucleotides** present in this genome if 20% of the nucleotides are guanine.

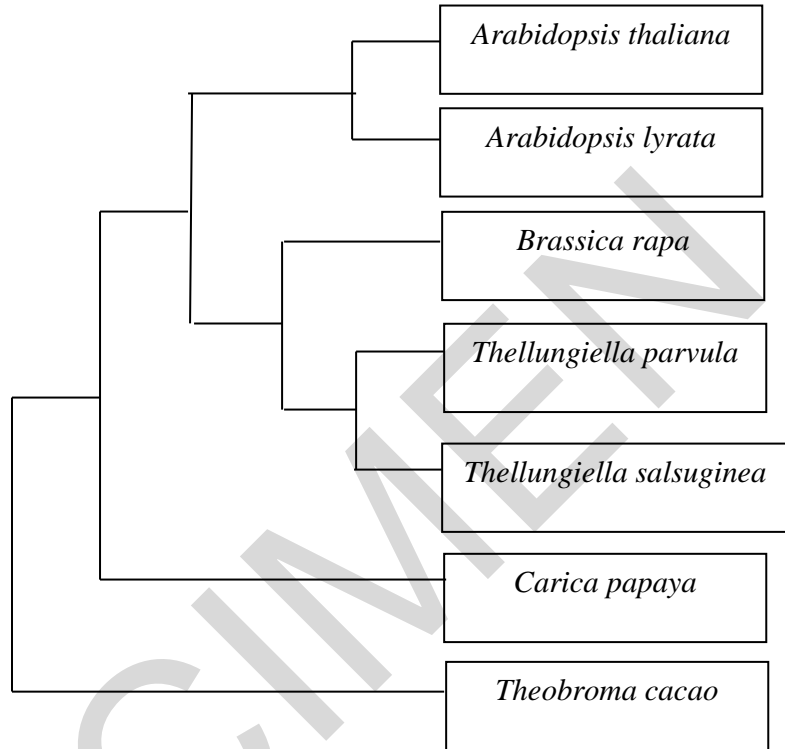
Show your working.

number of adenine nucleotides ..... [2]



(c) DNA sequencing is a technique that may be used to show the evolutionary relationships of organisms.

**Fig. 25.2** shows some of the evolutionary relationships of *Arabidopsis thaliana* in the form of a phylogenetic tree.



**Fig. 25.2**

- (i) Which species is most closely related to *Arabidopsis thaliana*?  
 ..... [1]
- (ii) Which species is most distantly related to *Arabidopsis thaliana*?  
 ..... [1]
- (iii) How many genera are there in this phylogenetic tree?  
 ..... [1]

26 (a) In 2012, 8.6 million people fell ill with tuberculosis (TB) and 1.3 million died from TB.

(i) Describe how the Mantoux test is carried out to diagnose TB.

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

(ii) Antibodies are produced in response to the TB pathogen. Fig. 26.1 shows an antibody.

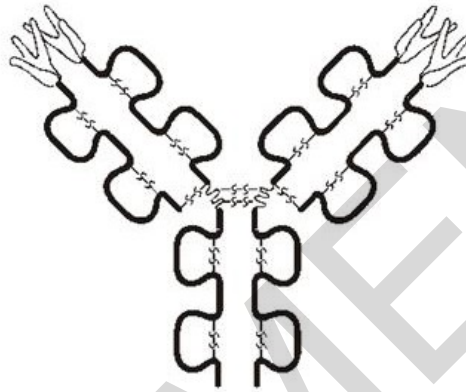


Fig. 26.1

Suggest how the structure of the antibody allows it to carry out its role as an:

*agglutinin*.....  
.....

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

(b) Scientists are conducting trials on a monoclonal antibody to treat cervical cancer by immunotherapy.

(i) Suggest how cancerous cells are targeted and destroyed by immunotherapy.

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

- (ii) Most cases of cervical cancer are caused by infection with Human Papilloma Virus (HPV) which is a sexually transmitted virus.

A vaccine to protect against HPV is now routinely offered to girls between the ages of 11 and 13.

For many people the vaccination is considered unethical.

Suggest **two** reasons why this vaccination programme may be considered unethical.

1.....  
.....  
2.....  
.....

[2]

**END OF QUESTION PAPER**

SPECIMEN