

A Level Biology B (Advancing Biology)

H422/01 Fundamentals of biology

Sample Question Paper

Date – Morning/Afternoon

Version 2.2

Time allowed: 2 hours 15 minutes

You may use:

- a scientific or graphical calculator



First name

Last name

Centre
number

Candidate
number

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.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- 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 **110**.
- 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 **44** pages.

SECTION A

You should spend a maximum of 40 minutes on this section.

Answer **all** the questions.

- 1 The medulla oblongata is a region of the brainstem. It regulates the activity of several organs within the human body.

Which of the following would result from the action of the medulla oblongata via the sympathetic nervous system?

- A sweat is produced
- B heart rate decreases
- C heart rate increases
- D ventilation rate decreases

Your answer

[1]

- 2 Fig. 2.1 below is an electron micrograph showing the ultrastructure of skeletal muscle.

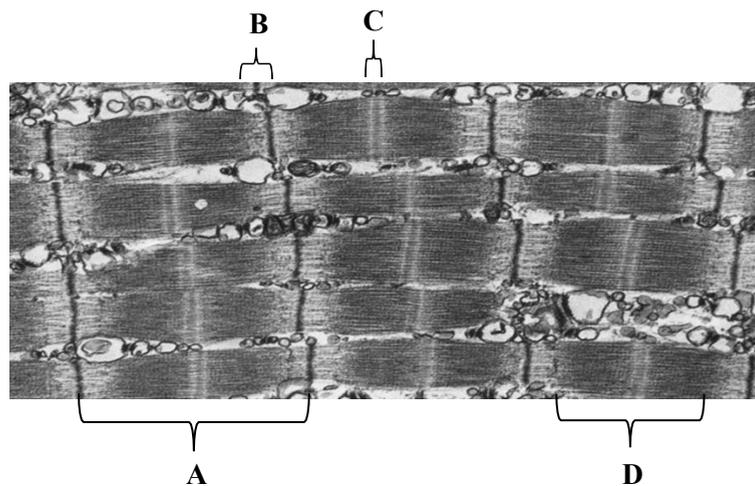


Fig. 2.1

Which of the areas labelled **A–D** represents the A-band?

Your answer

[1]

3 Organisms can be classified into taxa by analysing and comparing some of their molecules.

The molecules below are all involved in respiration.

Which would be the most appropriate molecule to study in order to classify organisms into taxa?

- A** ATP synthase
- B** Acetyl coenzyme A
- C** NAD
- D** FAD

Your answer

[1]

4 The following reactions all occur in mitochondria during aerobic respiration:

1. decarboxylation of pyruvate
2. reduction of NAD
3. substrate level phosphorylation of ATP.

Which reaction(s) take place outside the mitochondria in yeast cells?

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

Your answer

[1]

- 5 The average heart rate at rest is 72 beats per minute and the average stroke volume is 70 cm^3 .

Assuming a total blood volume of 5 dm^3 , what is the shortest time it would take for the heart to pump the total volume of blood in the body?

- A between 10 and 20 seconds
- B between 30 and 40 seconds
- C between 50 and 60 seconds
- D between 60 and 70 seconds

Your answer

[1]

- 6 Mesenchymal stromal cells (MSCs) are stem cells found in human wisdom teeth.

MSCs can differentiate into three cell types: chondrocytes, osteoblasts, and adipocytes.

To which category of stem cells do MSCs belong?

- A Pluripotent
- B Multipotent
- C Totipotent
- D Unipotent

Your answer

[1]

- 7 Some cells with damaged DNA undergo the process of apoptosis. Towards the end of the process, macrophages bind to a molecule on the cell.

What is the type of molecule to which macrophages bind?

- A Glycoprotein
- B Phospholipid
- C Glycolipid
- D Cholesterol

Your answer

[1]

8 Karyotypes, as shown below in **Fig. 8.1**, can be used to diagnose chromosome abnormalities.



Fig. 8.1

The karyotype above shows someone diagnosed with which genetic condition?

- A male with Down's syndrome
- B female with Down's syndrome
- C Turner's syndrome
- D Klinefelter's syndrome

Your answer

[1]

Fig. 9.1 shows a photomicrograph of a tissue found in the human gas exchange system. This tissue will be exposed to any pollutants present in inhaled air. Questions 9 and 10 both refer to this figure.

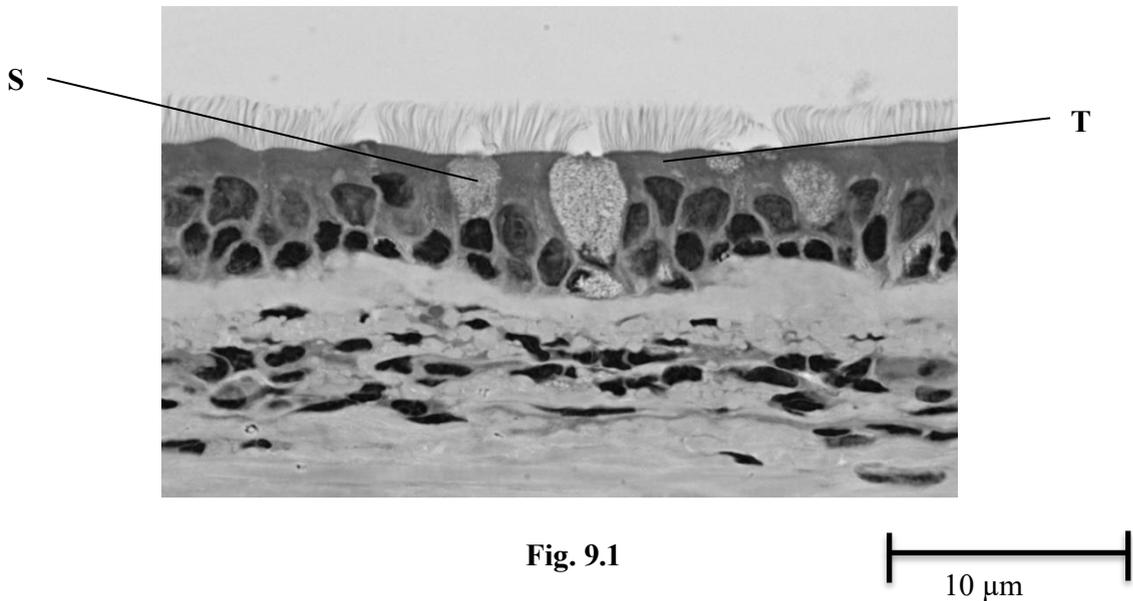
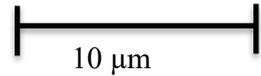


Fig. 9.1



- 9 The statements below refer to the location of cells S and T and the effect of the pollutants in tobacco smoke on these cells.

Which of the following statements are correct?

Statement 1: Cell S is a goblet cell and is stimulated by pollutants.

Statement 2: Cell T is a ciliated cell and is damaged by pollutants.

Statement 3: Cell S and T are found in the bronchi, bronchioles and alveoli.

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

Your answer

[1]

10 The statements below refer to the tissue shown in **Fig. 9.1** and the magnification.

Which of the following statements is/are true?

Statement 1: The magnification of this image is $\times 300$.

Statement 2: The tissue shown is epithelial tissue.

Statement 3: Cells S and T will be replaced from stem cells.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer

[1]

11 A pregnancy can be confirmed by detecting a substance which is only present in urine if an early embryo is developing.

Which of the following substances is present in the urine of a woman who is pregnant?

A HCG antigen

B HCG antibody

C GnRH antigen

D GnRH antibody

Your answer

[1]

12 Fig. 12.1 shows a section through a dicotyledonous plant leaf.

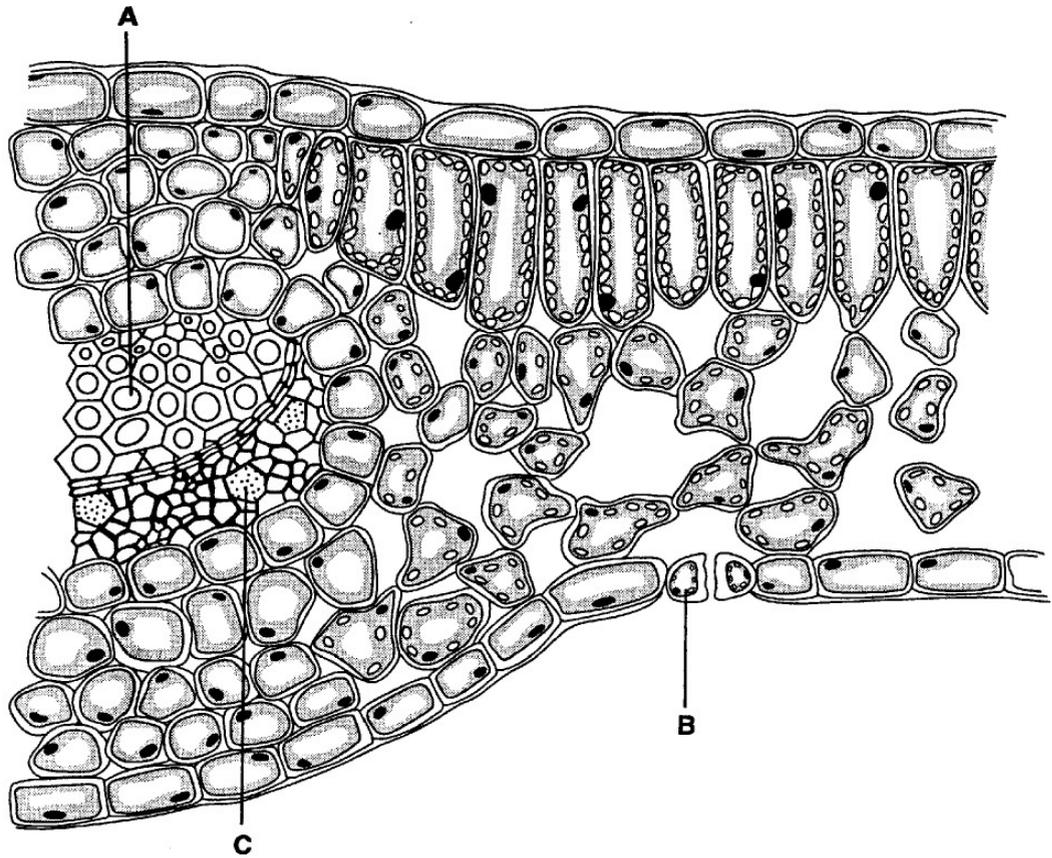


Fig. 12.1

Which of the cells labelled in Fig. 12.1 contain mitochondria?

- A A, B and C
- B A and C
- C B and C
- D B only

Your answer

[1]

- 13** In organic matter, macromolecules containing nitrogen are broken down by decomposers. The decomposers are also respiring aerobically.

Which of the following will be released?

- 1:** carbon dioxide
 - 2:** ammonium ions
 - 3:** nitrate ions
-
- A** 1, 2 and 3
 - B** Only 1 and 2
 - C** Only 2 and 3
 - D** Only 1

Your answer

[1]

- 14** The light independent reaction of photosynthesis needs products from the light dependent reaction.

What are the correct products of the light dependent reaction which are needed for the light independent reaction?

- A** reduced NAD, ADP
- B** reduced NADP, ATP, carbon dioxide
- C** reduced NADP, ATP
- D** reduced NAD, ADP, oxygen

Your answer

[1]

- 15 A student carried out an investigation into the effect of light intensity on photosynthesis.

Several groups of spinach leaf discs were placed in test tubes of water. The discs all sank to the bottoms of the tubes. Each tube was placed at a measured distance from a lamp, as shown below in Fig. 15.1.



Fig. 15.1

As photosynthesis occurs, the build-up of oxygen gas in the leaf discs causes them to rise from the bottom of the tube upwards.

Table 15.1 shows the results:

Tube number	Distance from lamp (mm)	Time taken for five discs to float (s)
1	50	125
2	100	210
3	150	360
4	200	600
5	250	None floated in the time available

Table 15.1

Which of the following statements is/are true?

Statement 1: The compensation point occurs between 200 and 250 mm.

Statement 2: A variable which is controlled is the distance of the tube from the light source.

Statement 3: The time taken for the discs to rise is directly proportional to the distance from the lamp.

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

Your answer

[1]

- 16** It is very important that meat products are stored at the correct temperature.

A student was investigating the growth of a bacterial culture at 20°C in a liquid containing meat extract. The following results were obtained:

Time (hrs)	<i>E. coli</i> (\log_{10} of numbers per cm^3)
0	2.0
4	2.0
8	3.0
12	4.0
16	5.0
20	5.5
24	6.0

Table 16.1

Which of the following conclusions is correct?

- A** The number of bacteria doubles between 4 hours and 12 hours.
B There is a 25% increase in the number of bacteria between 12 and 16 hours.
C There are 550 000 bacteria per cm^3 after 20 hours.
D There are a million bacteria per cm^3 after 24 hours.

Your answer

[1]

Sections of muscle tissue can be prepared and studied under a microscope.

A magnified section of muscle tissue is shown below in **Fig. 17.1**. Questions 17 and 18 both refer to this figure.

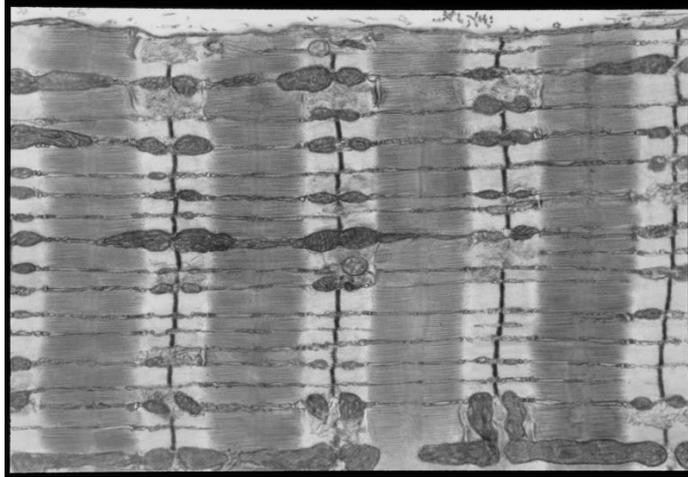


Fig. 17.1

Magnification = $\times 16800$

17 What is the approximate length of a sarcomere?

- A** 1.5×10^{-5} m
- B** 1.5×10^{-6} m
- C** 1.25×10^{-5} m
- D** 1.25×10^{-6} m

Your answer

[1]

18 Students prepared a section of muscle tissue and added drops of ATP solution to the tissue.

The students observed changes in the muscle tissue.

What would happen to the length of the sarcomere?

- A** no change
- B** shortens
- C** lengthens
- D** disappears

Your answer

[1]

19 A researcher carried out an investigation into patterns of inheritance using mice as a model organism and observed the coat colour of the mice.

- Coat colour is controlled by two alleles which are not sex linked.
- The allele for yellow coat colour (A) is dominant to the allele for normal (agouti) coat colour (a).

Heterozygous yellow mice were crossed with each other repeatedly and the offspring obtained are shown in **Table 19.1**.

Colour of coat	Number of offspring
yellow	1063
normal (agouti)	535

Table 19.1

Which of the following statements describes the correct way to analyse these results?

- A** Use a student's t-test with an expected ratio of 2 : 1 yellow to normal mice.
- B** Use a χ^2 test with an expected ratio of 2 : 1 yellow to normal mice.
- C** Use a student's t-test with an expected ratio of 3 : 1 yellow to normal mice.
- D** Use a χ^2 test with an expected ratio of 3 : 1 yellow to normal mice.

Your answer

[1]

20 Some of the stages in the genetic engineering of the bacteria *E. coli* to produce human growth hormones, HGH, are listed below.

1. A plasmid is cut with **enzyme 1** so the gene for HGH can be inserted.
2. A DNA copy of the messenger RNA for HGH is made using **enzyme 2**.
3. Many copies of the gene for HGH are made using PCR and **enzyme 3**.
4. The gene and plasmid are attached to each other using **enzyme 4**.

Select the row from **Table 20.1** to correctly identify enzymes **1, 2, 3** and **4**.

Answer	Enzyme 1	Enzyme 2	Enzyme 3	Enzyme 4
A	DNA Ligase	DNA Polymerase	Reverse Transcriptase	Restriction Enzyme
B	Reverse Transcriptase	Restriction Enzyme	DNA Polymerase	DNA Ligase
C	Restriction Enzyme	Reverse Transcriptase	DNA Polymerase	DNA Ligase
D	DNA Ligase	Reverse Transcriptase	Restriction Enzyme	DNA Polymerase

Table 20.1

Your answer

[1]

21 Neurotransmitters such as gamma-aminobutyric acid (GABA) are found at synapses within the human brain and are known as inhibitory neurotransmitters.

GABA binds to receptors in the post-synaptic membrane and causes potassium ion channels to open. This prevents an action potential in the post-synaptic neurone.

An action potential is prevented because potassium ions diffuse:

- A** out of the post-synaptic neurone causing depolarisation
- B** out of the post-synaptic neurone causing hyperpolarisation
- C** into the post-synaptic neurone causing depolarisation
- D** into the post-synaptic neurone causing hyperpolarisation

Your answer

- 22 **Fig. 22.1** is a simplified diagram of cells in a dicotyledonous root.

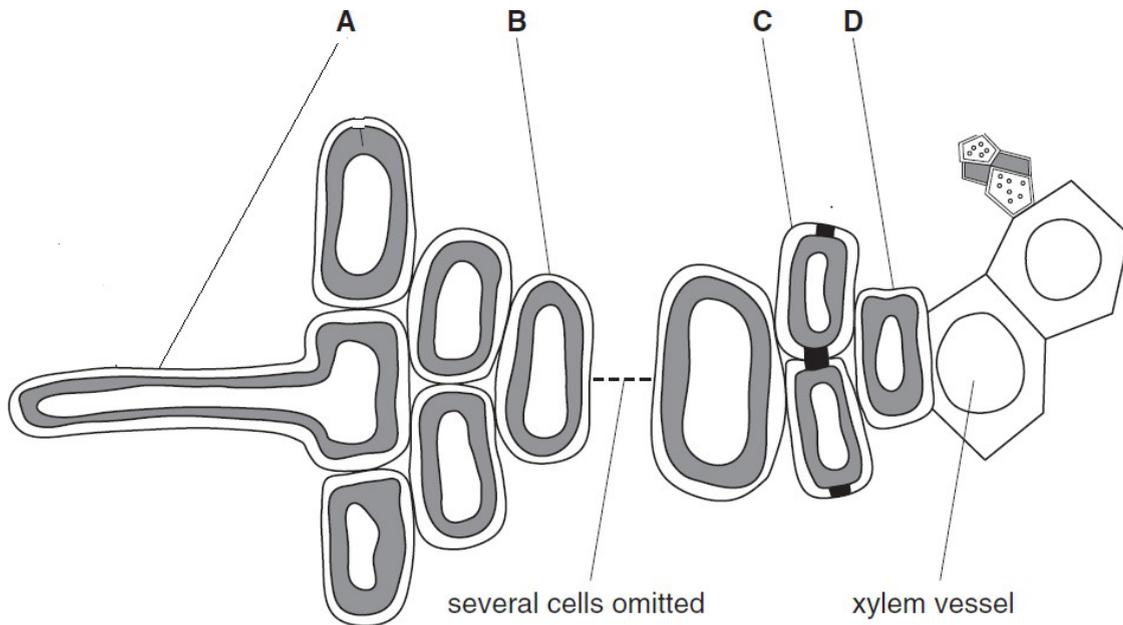


Fig. 22.1

Which of the following is a cell in the endodermis?

- A** A
B B
C C
D D

Your answer

[1]

- 23 In **Fig. 22.1**, which of the following statements is **incorrect** about the movement of water across the root?

- A** Water moves from cell **A** to cell **B** by the apoplast pathway
B Water moves from cell **A** to cell **B** by the symplast pathway
C Water moves from cell **B** to cell **D** by the apoplast pathway
D Water moves from cell **B** to cell **D** by the symplast pathway

Your answer

[1]

24 Fig. 24.1 shows the structure of an ATP molecule.

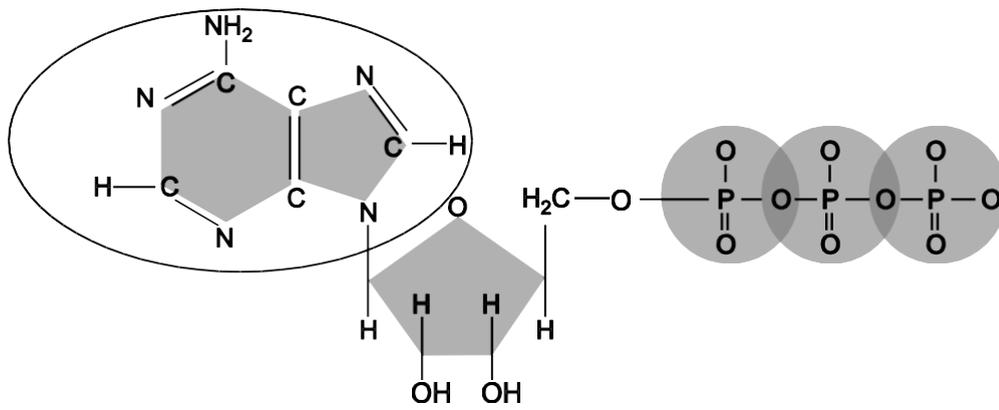


Fig. 24.1

Which part of the ATP molecule is circled?

- A adenine
- B adenosine
- C ribose
- D deoxyribose

Your answer

[1]

- 25 The image below in **Fig. 25.1** shows a section of pancreatic tissue as seen under a microscope.

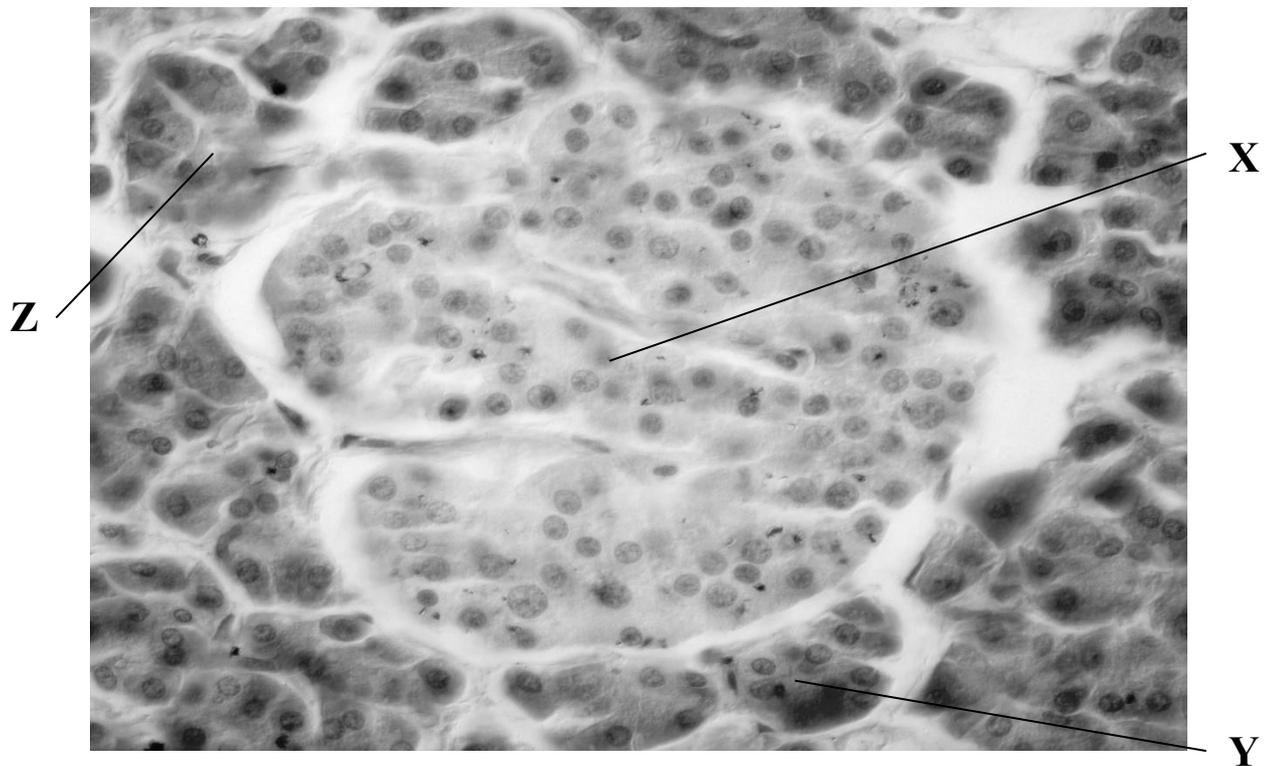


Fig. 25.1

A student identifies **X** as endocrine cells, **Y** as alpha cells and **Z** as Islets of Langerhans.

Is the student correct?

- A** **X**, **Y** and **Z** are correct
- B** only **X** and **Y** are correct
- C** only **Y** and **Z** are correct
- D** only **X** is correct

Your answer

[1]

- 26 The brain tissue of a person who has Alzheimer's disease is shown to contain neurofibrillary tangles. These are shown in the micrograph in **Fig. 26.1**.

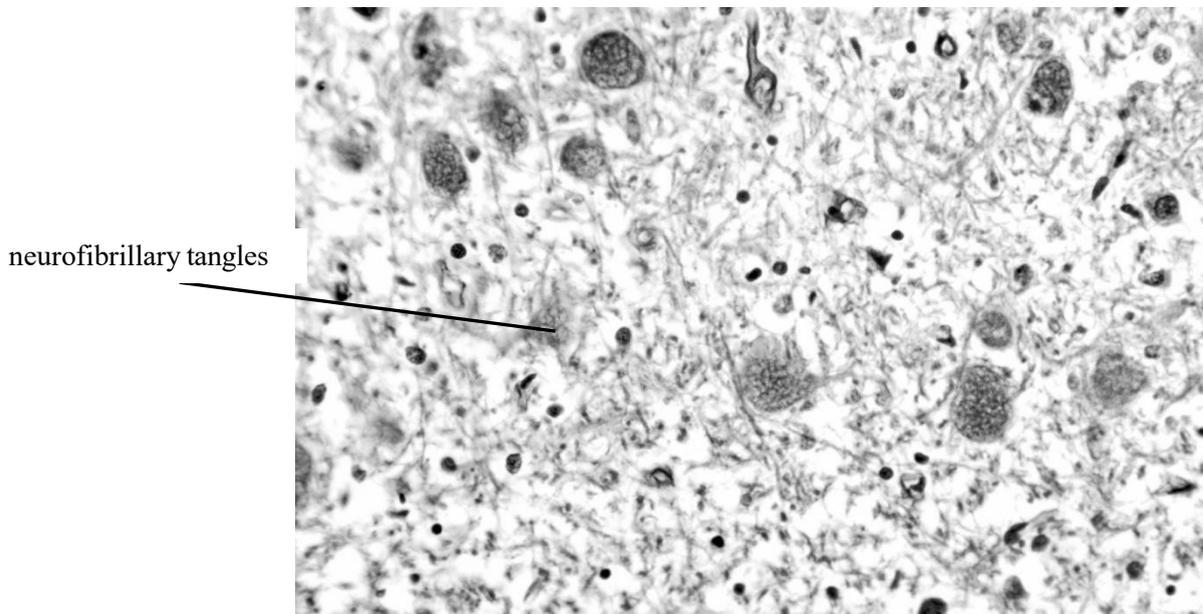


Fig. 26.1

Which of the following statements are true?

Statement 1: Neurofibrillary tangles contain β -amyloid protein.

Statement 2: Neurofibrillary tangles contain Tau protein.

Statement 3: Neurofibrillary tangles are caused by an accumulation of twisted protein fragments inside the neurones.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer

[1]

- 27 As people age, damage to the peripheral nerves associated with the eye may result in poor vision due to specific eye conditions, such as age-related macular degeneration (AMD).

Which of the following could lead to the development of AMD?

- A a poor diet lacking in vitamins
- B increased pressure in the eye
- C hardening of the arteries that supply oxygen
- D damage to the optic nerve

Your answer

[1]

- 28 Cellular respiration occurs in different regions of a cell.

In which region is FADH_2 produced?

- A Cytoplasm
- B Outer mitochondrial membrane
- C Inner mitochondrial membrane
- D Mitochondrial matrix

Your answer

[1]

29 Fig. 29.1 is a diagram of a section through the flower of the bean plant, *Vicia fabia*.

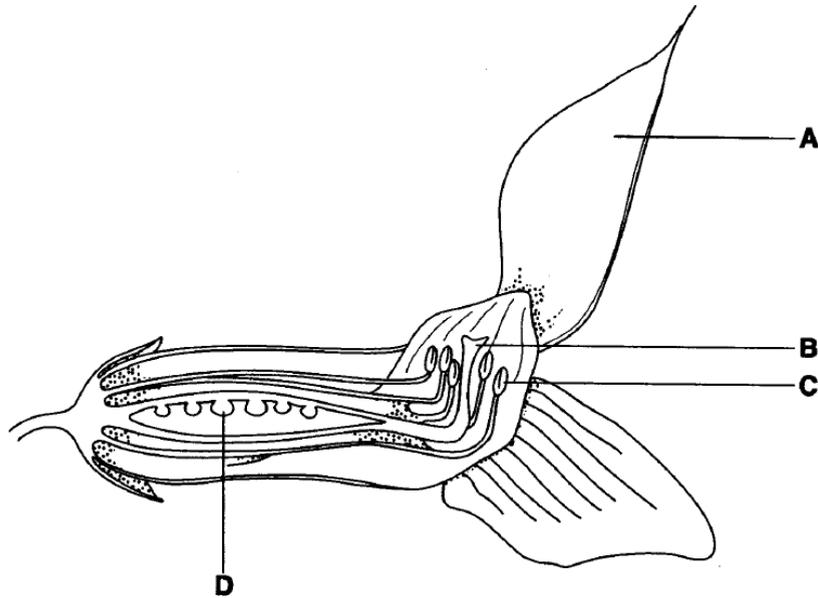


Fig. 29.1

Which of the letters on the diagram indicate sites where meiosis occurs?

- A A and B
- B B and C
- C B and D
- D C and D

Your answer

[1]

30 Which of the following is likely to be correct about the flowers of *Vicia fabia*?

- A The flowers have a nectary and are wind pollinated
- B The flowers have a nectary and are insect pollinated
- C The flowers are scented and are wind pollinated
- D The flowers are unscented and are insect pollinated

Your answer

[1]

SECTION B

Answer **all** the questions.

31 (a) Penicillin and other antibiotics are widely used to treat bacterial infections. The bacteria are sometimes analysed using stains such as the Gram stain before an antibiotic is prescribed.

(i) Explain why a counter stain such as Safranin is necessary to identify the presence of Gram negative organisms such as *E.coli*.

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

(ii) Some bacteria such as the pathogens *Haemophilus* and *Legionella* are also gram negative. Unlike other Gram negative bacteria, these pathogens do **not** stain with Safranin.

Instead, medical laboratories use Fuchsin as a counter stain.

Why is the use of Safranin justified as a choice of counter stain in a school laboratory?

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

(b) Penicillin is **not** effective against Gram negative bacteria and has no effect on plant and animal cells.

(i) Explain why penicillin has no effect on Gram negative bacteria.

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

(ii) Explain why penicillin has **no** effect on plant or animal cells.

.....

.....

..... [1]

32 The control of growth in plants is achieved by plant hormones. Plant hormones can be produced in the locations where they have their effects or they can be transported from the regions where they are synthesised to the regions where they have their effects.

(a) Suggest how the plant hormone gibberellic acid (gibberellin) is transported in plants.

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

An experiment was carried out into the role of plant hormones in germination. The experiment was carried out on winter barley seeds.

Four sterile starch agar plates were prepared containing the following solutions:

- Plate 1 – distilled water
- Plate 2 – gibberellic acid (GA) solution
- Plate 3 – abscisic acid (ABA) solution
- Plate 4 – GA and ABA solution

Winter barley grains were soaked for 24 hours and then cut in half as shown in Fig. 32.1.

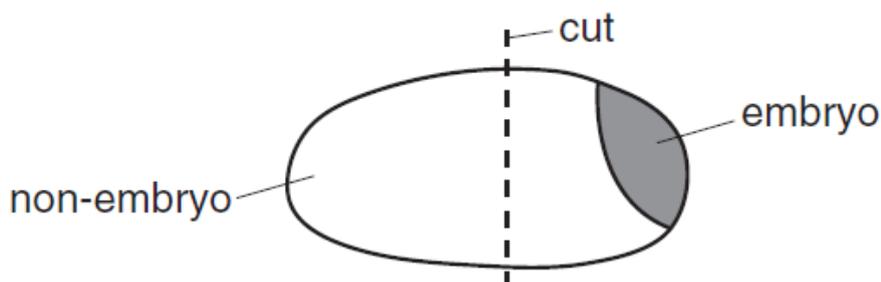


Fig. 32.1

Four non-embryo halves were placed cut side down onto each of the agar plates.

The plates were incubated at 20°C.

After incubation, iodine solution was added to each plate. The appearance of a plate after adding iodine solution is shown in Fig. 32.2.

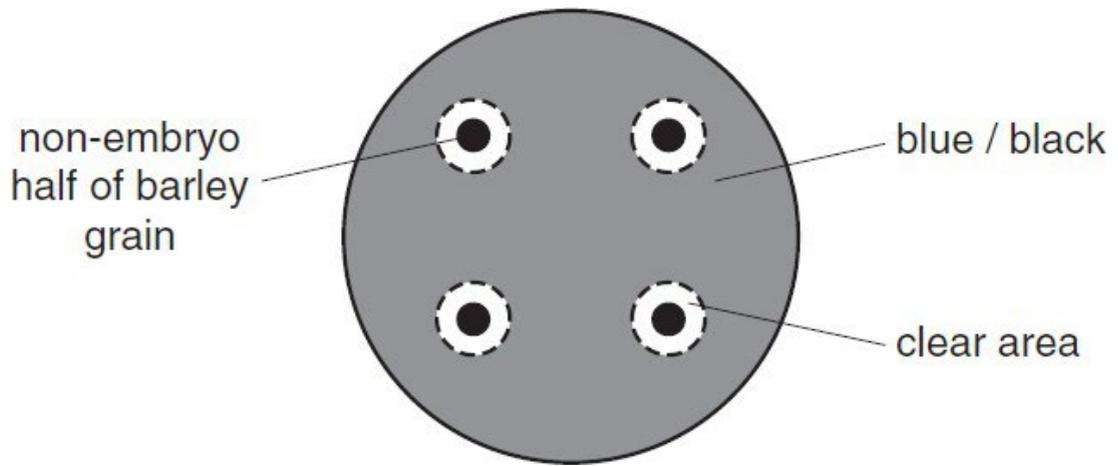


Fig. 32.2

The maximum diameter of the clear area surrounding each halved seed was recorded.

The results are shown in **Table 32.1**.

Agar plate		Maximum diameter of the clear area surrounding halved seed (cm)					
		Halved seed 1	Halved seed 2	Halved seed 3	Halved seed 4	Mean	Standard deviation
1	Distilled water	1.5	2.4	1.5	1.4	1.7	0.47
2	GA	2.0	1.3	2.5	2.2	2.0	
3	ABA	0.9	0.8	1.5	1.3	1.1	0.32
4	GA and ABA	1.2	1.2	1.0	1.2	1.2	0.10

Table 32.1

- (b) Using the information in **Table 32.1**, calculate the standard deviation (s) for the data from plate 2 (GA).

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

standard deviation = [2]

(d) The seeds used in the experiment were a variety of winter barley.

Suggest one treatment that would need to be carried out on the germinated seedlings in order to ensure a grain harvest from the matured plants.

Explain your suggestion.

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.....

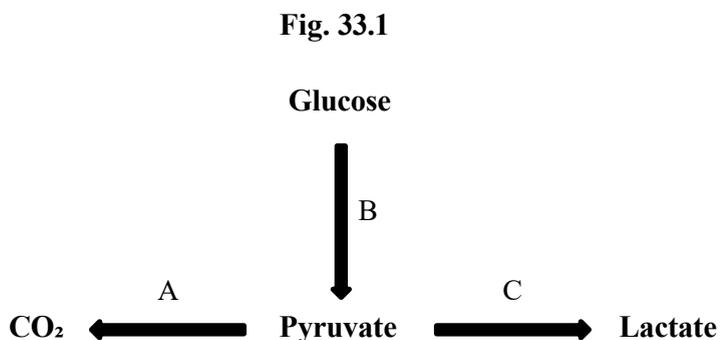
.....

.....

..... [2]

33 Cells need to maintain a supply of ATP in order to function properly. A number of metabolic pathways in the cell are linked to the formation of ATP.

(a) Fig. 33.1 shows three metabolic pathways, A, B and C.



(i) Suggest which metabolic pathway(s) is represented by pathway A and state precisely where A might occur in a eukaryotic cell.

.....
 [2]

(ii) In which of the three pathways and by what mechanism does the formation of ATP from ADP occur?

Pathway(s)
Mechanism [2]

(b) (i) The enzyme lactate dehydrogenase (LDH) catalyses pathway C. When the blood supply to any tissue is limited, LDH concentrations increase in cells.

Explain why LDH concentrations in cells increase when the blood supply to tissues is limited.

.....

 [2]

- (ii) A heart attack occurs when blood vessels supplying the cardiac muscle become narrowed or blocked. This can lead to the death of cardiac muscle cells.

One indicator that a heart attack has occurred is a rise in concentrations of LDH in **blood plasma**.

Suggest why the death of cardiac muscle cells results in a rise in LDH concentrations in blood plasma.

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

- (c) Plasma LDH concentrations were used to diagnose and monitor heart attacks.

The concentration of other molecules within the plasma is now more commonly used. One of these molecules is cardiac troponin (troponin T).

- (i) Describe the role of troponin T in cardiac muscle **cells** during diastole.

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

- (ii) Table 33.1 shows the results from an investigation comparing troponin T plasma concentrations in three different groups.

Group	Number of subjects	Concentration of plasma troponin T ($\mu\text{g dm}^{-3}$)	
		Median	Interquartile range
Normal subjects	100	0.20	0.16-0.30
Subjects where a heart attack was confirmed using an ECG	72	15.30	9.60-22.70
Subjects with other injuries but no heart attack occurred as confirmed using an ECG	13	0.29	0.23-0.43

Evaluate the evidence that the use of troponin T concentration in plasma is a useful diagnostic test to confirm a heart attack.

You should use information from **Table 33.1** to support your argument.

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.....

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.....

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.....

[3]

34 Photosynthesis is key to crop production.

The light dependent reactions of photosynthesis depend on pigments such as chlorophyll. The molecular structure of chlorophyll is shown in Fig. 34.1.

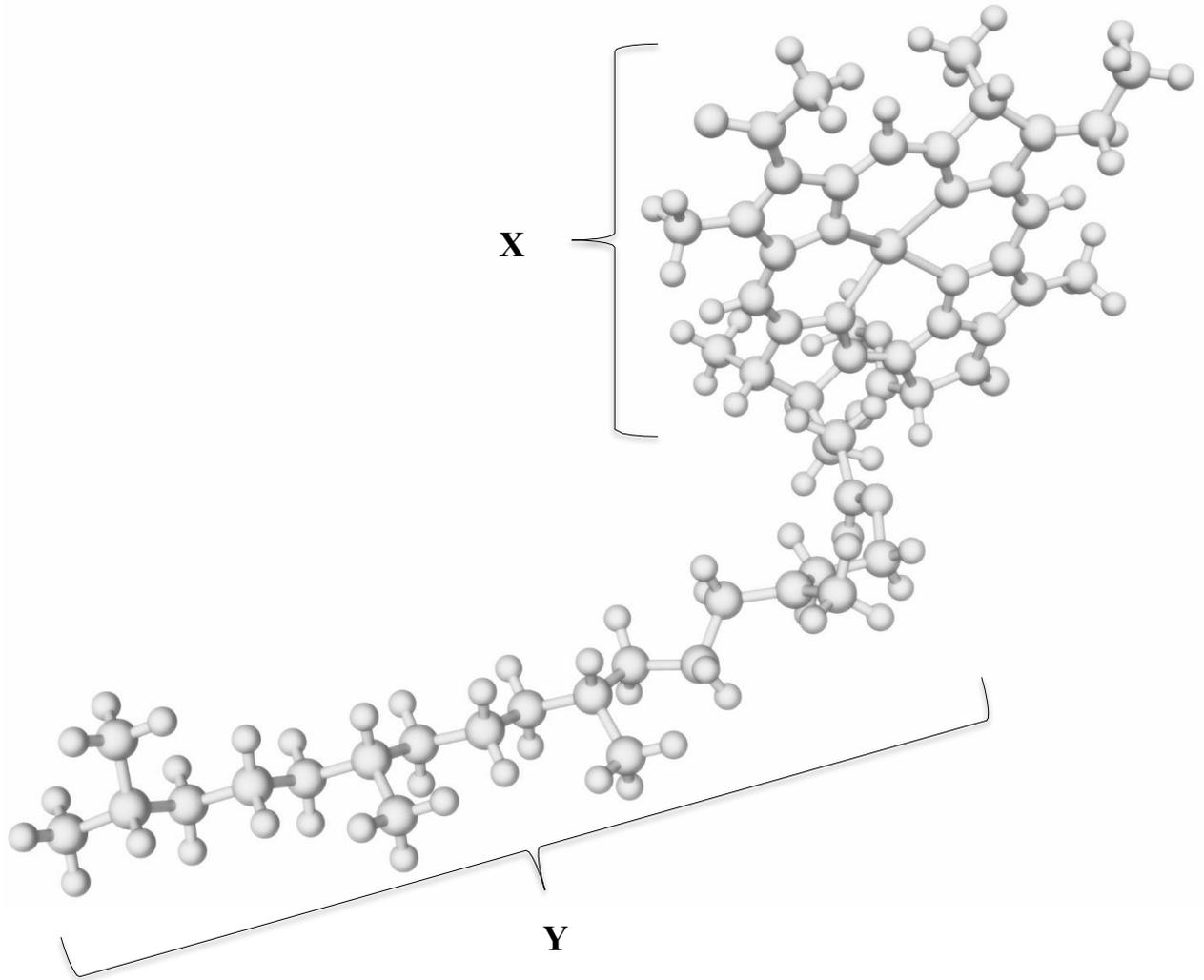


Fig. 34.1

- (a) Light energy is absorbed in the 'head' of the molecule labelled X. The part labelled Y is a long, hydrocarbon chain.

State the location of chlorophyll molecules in chloroplasts **and** suggest the arrangement of parts X and Y of the molecules.

.....

.....

.....

.....

[3]

(b) There are several different photosynthetic pigments present in the leaves of plants. These pigments can be separated out using chromatography. The technique is outlined below:

- pigments are extracted from plant leaves
- leaf extract is loaded onto a strip of chromatography paper
- the strip is placed in a container so that the end of the strip is touching a solvent
- the solvent moves through the paper, separating out the pigments due to differences in their solubility in the solvent.

(i) Outline **one** precaution you would take in order to obtain good separation of photosynthetic pigments.

.....

..... [1]

(ii) In order to identify the pigments that are present in leaves, R_f values can be calculated.

The R_f value compares the distance moved by the solvent with the distance moved by the pigment.

Table 34.1 shows the results of a chromatography experiment on pigments extracted from rye grass.

Pigment	Distance travelled by the pigment (mm)	Distance travelled by the solvent (mm)	R_f value
Chlorophyll A			0.85
Chlorophyll B			0.58
Xanthophyll	100	107	0.93

Table 34.1

Calculate the distances moved by Chlorophyll A and Chlorophyll B.

distance for Chlorophyll A distance for Chlorophyll B

[2]

(iii) Use the results in **Table 34.1**, to show what can be concluded about the relative solubility of the three pigments.

.....

.....

..... [2]

(c) Ruminants such as cows are used extensively in food production.

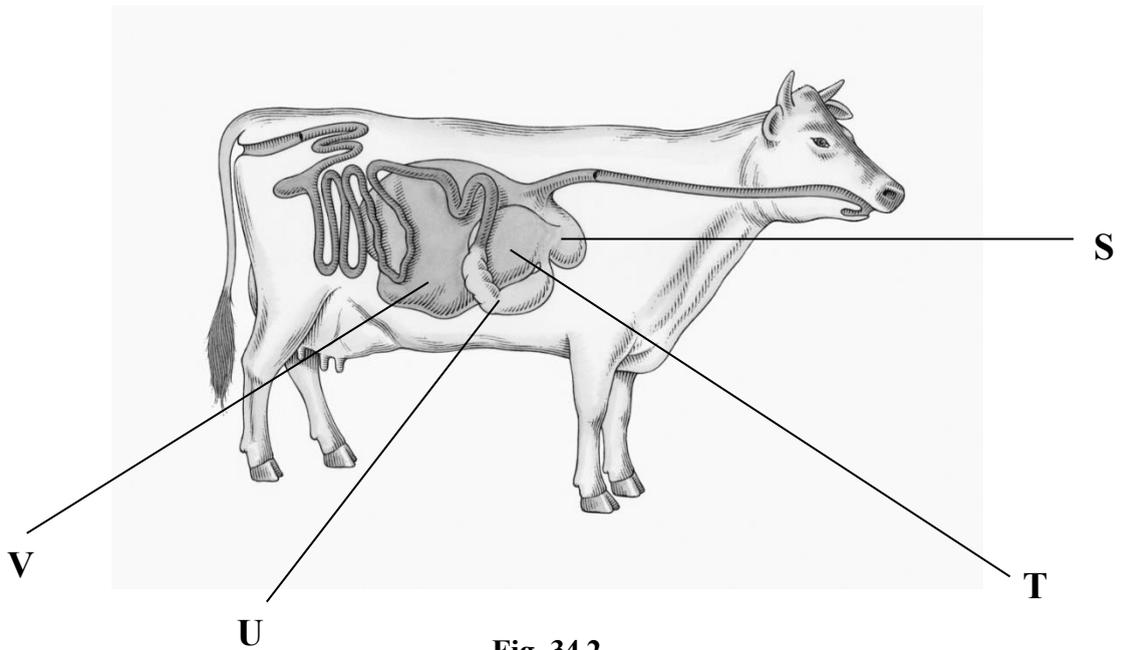


Fig. 34.2

(i) Complete the following table about the parts of the cow's digestive system labelled in **Fig. 34.2**.

Description	Name	Letter
Secretes hydrochloric acid and protease enzymes.		
Allows the cow to regurgitate material back up to the mouth for further chewing.		

[2]

(ii) Both cows and humans need a range of amino acids to make their own proteins.

- Amino acids which have to be present in the diet are called essential amino acids.
- Unlike humans, essential amino acids do **not** need to be present in the diet of cows.

Explain how cows obtain their essential amino acids.

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

(iii) Amino acids which have been absorbed but which are **not** required for protein synthesis cannot be stored.

State what happens in liver cells to the amino acids which are not required for protein synthesis.

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

- (b) Ageing is known to affect the male urinogenital system in a number of ways.

Fig. 35.1 is a diagram of the male urinogenital system.

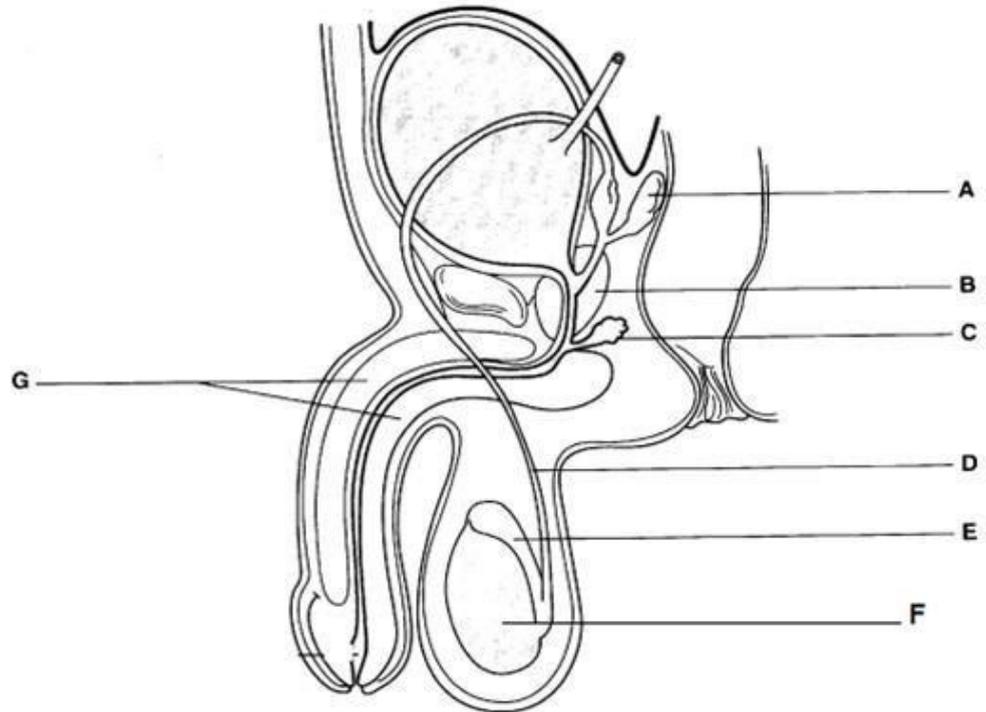


Fig. 35.1

Complete **Table 35.1** below so that the correct letter from **Fig. 35.1** is against each of the following statements:

Statement	Letter
If this is enlarged it can lead to difficulty in starting to urinate or emptying a full bladder.	
Changes in this structure mean sperm can fail to become motile.	
Changes in this structure can lead to more chromosome abnormalities in sperm.	
Changes in tissues here can lead to erectile dysfunction.	

Table 35.1

[4]

(c) Cyclic **AMP** acts as an intracellular messenger molecule in many cells.

The sequence of cellular events which happens in a normal erection is described below:

- stimulation of tissue causes the release of a cell signalling molecule (nitrogen monoxide) from nerve endings
- nitrogen monoxide diffuses into neighbouring cells and causes the production of an intracellular messenger molecule, cyclic **GMP**
- cyclic GMP causes smooth muscle in cells in blood vessel walls to relax
- cyclic GMP is then broken down by an enzyme **PDE-5**.

(i) Comment on the properties of nitrogen monoxide as a cell signalling molecule.

.....

.....

.....

..... [2]

(ii) The chemical sildenafil citrate (Viagra®) binds to the active site of the enzyme **PDE-5**.

Suggest how the action of Viagra® makes it an effective treatment for erectile dysfunction.

.....

.....

.....

.....

.....

..... [3]

(b) One mechanism for controlling gene expression in cells uses small, double stranded pieces of RNA known as siRNA.

1. siRNA molecules are introduced into the cell.
2. The siRNA molecules are combined with a protein complex called the RNA induced silencing complex (**RISC**) and one of the siRNA strands is destroyed.
3. The other strand remains bound to RISC and acts as a guide. RISC is now said to be activated.
4. This strand binds to complementary sequences on messenger RNA molecules in the cytoplasm causing them to be destroyed.

Fig. 36.1 shows the sequence of events for this mechanism.

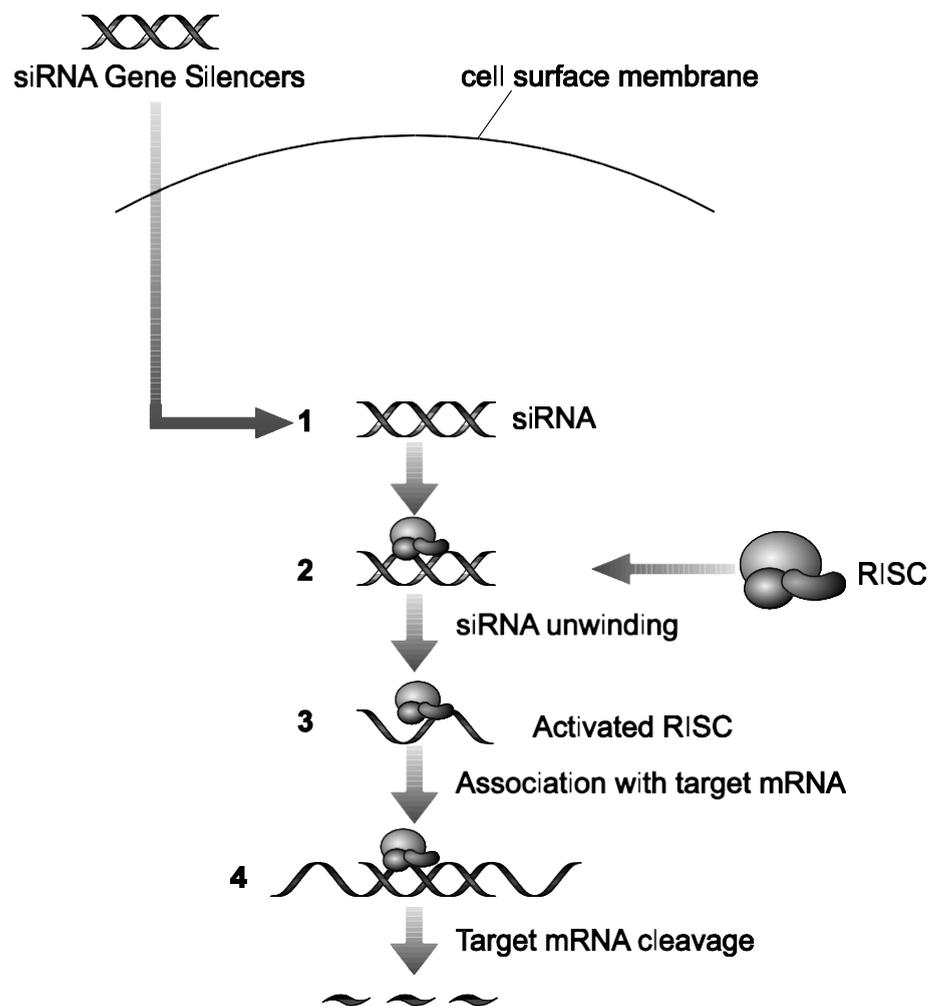


Fig. 36.1

- (i) An RNA strand on an activated **RISC** has the following sequence.

ACGGGAAGGGCCCGAGCACGGA

.....

On the line above, write out the sequence that activated **RISC** would bind to on the mRNA molecule.

[1]

- (ii) What type of reaction is carried out by activated **RISC** on the bonds in the mRNA molecule?

.....

[1]

- (iii) Clinical trialling is being carried out on the use of siRNA as an anti-viral therapy for the treatment of Hepatitis C infections.

Suggest how siRNA could prevent the spread of a virus within a person infected by the Hepatitis C virus.

.....

.....

.....

.....

[3]

37 During the cardiac cycle, the pressure inside the heart varies. Fig. 37.1 shows the pressure changes on the right and left sides of the heart during one cardiac cycle.

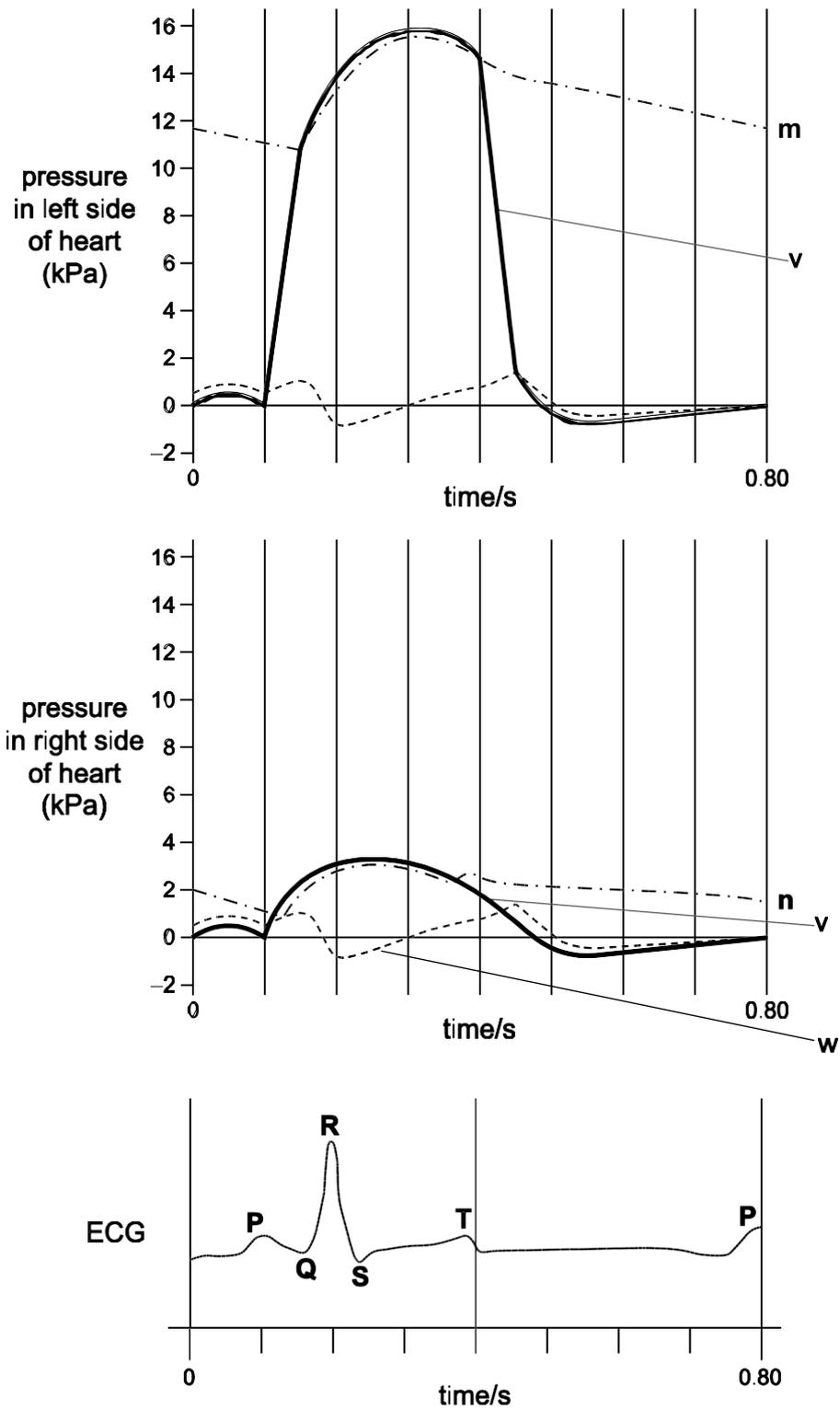


Fig. 37.1

(a) Identify the vessels represented by the labels **m** and **n** in Fig. 37.1.

m

n..... [2]

(b) The lines labelled **w** and **v** in **Fig. 7.1** show the pressure changes in the ventricles and atria during one cardiac cycle.

(i) The line labelled **w** shows the pressure changes in the right atrium.

What can be concluded about the structure of the right atrium?

You should use data to support your conclusion.

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

(ii) The lines labelled **v** show the pressure changes in the left and right ventricles.

Express the **maximum** pressures in the left and right ventricles as a simple ratio.

ratio1 [1]

(iii) Assuming the thickness of the left ventricle wall is 8 mm, use the ratio calculated in part (ii) to estimate the thickness of the right ventricle wall.

Give your answer to one decimal place.

right ventricle wall thickness [2]

(c) In addition to changes in pressure, **Fig. 37.1** also shows an ECG trace.

The part of the trace labelled T represents the repolarisation of the ventricles. Until this has happened, it is not possible for another heartbeat to occur.

(i) As the heart rate increases, what happens to the time between the T wave and the P wave which signals the start of the next heartbeat?

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

(ii) It can be dangerous in some circumstances to exercise at a level where the heart rate approaches its maximum possible.

Using the information in **Fig. 37.1**, calculate the maximum heart rate possible for the person from whom this trace was obtained.

Maximum heart rate [2]

END OF QUESTION PAPER

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Page 5, Fig. 8.1: Johannes Nielson, 2007.

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Oxford Cambridge and RSA

...day June 20XX – Morning/Afternoon

A Level Biology B (Advancing Biology)

H422/01 Fundamentals of biology

SAMPLE MARK SCHEME

Duration: 2 hours 15 minutes

MAXIMUM MARK 110

MARKING INSTRUCTIONS**PREPARATION FOR MARKING****SCORIS**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to scoris and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
- a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
- if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
- If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

- Read through the whole answer from start to finish.
- Decide the level that **best fits** the answer – match the quality of the answer to the closest level descriptor.
- To select a mark within the level, consider the following:
 - Higher mark:** A good match to main point, including communication statement (in italics), award the higher mark in the level
 - Lower mark:** Some aspects of level matches but key omissions in main point or communication statement (in italics), award lower mark in the level.

Level of response questions on this paper are **32(c) and 36(a)**.

11. Annotations

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

SECTION A

Question	Answer	Marks	Guidance
1	C	1	
2	D	1	
3	A	1	
4	A	1	
5	C	1	
6	B	1	
7	B	1	
8	C	1	
9	B	1	
10	C	1	
11	A	1	
12	C	1	
13	B	1	
14	C	1	
15	D	1	
16	D	1	
17	D	1	
18	B	1	
19	D	1	
20	C	1	
21	B	1	
22	C	1	
23	C	1	
24	A	1	
25	D	1	
26	C	1	
27	C	1	
28	D	1	
29	D	1	
30	B	1	
	Total	30	

SECTION B

Question			Answer	Marks	Guidance
31	(a)	(i)	<p>Any 2 from: <i>idea that</i> Gram stain is removed by, ethanol / AW, rinses ✓ (due to) <u>peptidoglycan</u> (layer) being thin ✓ <i>idea that</i> bacteria would not be visible without the counter stain ✓</p>	2	<p>ALLOW alcohol / ethyl alcohol / acetone / solvent instead of ethanol</p> <p>IGNORE reference to the outer membrane</p> <p>A statement such as 'the Gram stain is washed out of the peptidoglycan within the alcohol wall because the layer is thin' = 2 marks</p>
		(ii)	<p>justification on cost grounds / justification on stain safety grounds ✓ <i>idea that</i> (these) pathogens would not be handled in a school lab / only allowed to handle non-pathogenic bacteria in school ✓</p>	2	e.g. 'it is cheaper than other counter stains', 'it is less toxic than other counter stains'
	(b)	(i)	<p>Any 2 from: (Gram negative bacteria have) outer, membrane / lipopolysaccharide layer ✓ <i>idea that</i> this is impermeable to penicillin ✓ <i>idea that</i> penicillin cannot reach, murein / peptidoglycan layer ✓</p>	2	
		(ii)	<p>animal cells do not have a cell wall AND cell wall in plants is, cellulose / not peptidoglycan ✓</p>	1	Both needed for one mark
			Total	7	

Question		Answer	Marks	Guidance
32	(a)	<p>Any 1 from: by apoplast and symplast pathways ✓ in xylem / phloem ✓ by, diffusion / active transport ✓</p>	1	ALLOW by mass flow / translocation
	(b)	0.51 ✓ ✓	2	ALLOW unrounded answer for 1 mark (0.509902 etc.)
	(c)*	<p>Level 3 (5–6 marks) A detailed conclusion of both hormones in germination including detailed and relevant comments on the experimental design and the strength of evidence as shown by the data. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) A conclusion on the roles of both hormones in germination including some relevant information on the experimental design using evidence from the data. <i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) A limited conclusion on the role of at least one hormone with some comment on either the experimental design or using supporting data. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks No response or no response worthy of credit.</p>	6	<p>Examples of relevant material:</p> <ul style="list-style-type: none"> • GA promotes germination • GA produced by embryo & acts on aleurone layer • Aleurone layer present in the seed half without embryo • Enzyme is amylase which breaks down the starch in the endosperm • Enzyme diffuses into the agar plate • GA has largest clear zones • ABA inhibits germination • ABA zones smaller than control plates • Smaller GA zone in the presence of ABA • Sample size is limited • Ref to overlap of data or closeness of means between GA and control reducing confidence in conclusion • Ref to anomalous results • Ref to improvements in design such as more repeats • Ref to use of a named statistical test to test strength of the conclusion (if more repeats are carried out) • Comment on ABA preventing germination at the wrong time of year.

Question		Answer	Marks	Guidance
	(d)	<p><i>Treatment</i> vernalisation / described ✓ OR period of short day length / AW ✓</p> <p><i>explanation</i> <i>idea that</i> no flowering will occur in winter cereals without, vernalisation / a short day length ✓ OR seeds are from pollination and fertilisation in (barley) flowers ✓</p>	2	ALLOW exposure to a period of cold or low temperatures
		Total	11	

Question			Answer	Marks	Guidance
33	(a)	(i)	<i>Pathway:</i> Krebs cycle / link reaction ✓ <i>Location:</i> matrix, of mitochondria ✓	2	DO NOT ALLOW 'matrix' unqualified
		(ii)	Pathways A and B ✓ substrate level phosphorylation ✓	2	
	(b)	(i)	(limited blood supply) reduced oxygen available ✓ ref to, increased / more, anaerobic respiration ✓	2	IGNORE reference to glucose DO NOT ALLOW anaerobic respiration alone - need the idea of more anaerobic respiration
		(ii)	<i>idea that</i> (muscle) cell surface / plasma, membrane is, damaged / AW ✓ <i>idea that</i> LDH, diffuses, out of cytoplasm / into blood plasma ✓	2	
	(c)	(i)	troponin, binds to / AW, tropomyosin ✓ myosin binding site is blocked (by tropomyosin) / <i>idea that</i> myosin is prevented from binding to actin ✓	2	

Question		Answer	Marks	Guidance
	(ii)	<p>comparison of median values in support of a statement / comparison of interquartile range values in support of a statement ✓</p> <p><i>plus any two from the following marks up to a maximum of 3</i></p> <p><i>idea that</i> (very) high concentrations are only seen where a heart attack is confirmed / heart attack subject have significantly higher median values than other groups ✓</p> <p><i>idea that</i> bottom of interquartile range for confirmed heart attacks is significantly higher than other groups / top of interquartile range of other groups is significantly below bottom of range for group with heart attack ✓</p> <p><i>idea that</i> unlikely to get 'false positives' or 'false negatives' ✓</p> <p><i>idea that</i> sample sizes are very different in the three groups and could affect the validity of the data ✓</p>	3	<p>DO NOT ALLOW a simple description of the concentrations for each group - look for a clear statement that the high levels are specific to a heart attack or that they are significantly higher for this group.</p>
		Total	13	

Question		Answer	Marks	Guidance									
34	(a)	(chlorophyll molecules) in thylakoid membrane ✓ Y / hydrocarbon chain, in the (phospholipid) bilayer of thylakoid membranes ✓ X / head, at the surface of the thylakoid membrane ✓	3	Thylakoid membrane must be stated in at least one of the mark points but can be implied in the second ALLOW a description e.g. in the phosphate head region									
	(b)	(i) Any 1 from: <i>idea that</i> spot of extract needs to be (very) concentrated / AW ✓ allow one spot to dry before adding another ✓ sufficient length of chromatography paper ✓ AVP ✓	1	ALLOW a description e.g. 'put several spots of extract' ALLOW answers which refer to different apparatus as this may have been Centre dependent ALLOW values inserted into table									
		(ii) Chlorophyll B = 62 mm ✓ Chlorophyll A = 91 mm ✓	2	0.58 x 107 = 62.06 mm 0.85 x 107 = 90.95 mm Max 1 if units are not given OR figures not given as whole numbers									
		(iii) <i>idea that</i> Chlorophyll A is less soluble than xanthophyll but more soluble than chlorophyll B / AW ✓ Rf data quote in support ✓	2	ALLOW answers where comparative statements are made about the three pigments DO NOT ALLOW if units are given for the Rf value as this is a ratio									
	(c)	(i) <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Description</th> <th>Name</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td style="background-color: #cccccc;"></td> <td>Abomasum</td> <td>U</td> </tr> <tr> <td style="background-color: #cccccc;"></td> <td>Reticulum</td> <td>S</td> </tr> </tbody> </table>	Description	Name	Letter		Abomasum	U		Reticulum	S	2	One mark for each correct row ALLOW rumen and V
Description	Name	Letter											
	Abomasum	U											
	Reticulum	S											

Question			Answer	Marks	Guidance
	(c)	(ii)	<i>idea that</i> microbes in rumen are a protein source ✓ (microbial protein) hydrolysed into amino acids by protease enzymes ✓	2	
		(iii)	(amino acids are) deaminated / AW ✓	1	
			Total	13	

Question			Answer	Marks	Guidance												
35	(a)	(i)	<p><i>conclusion</i> a higher BMI increases sperm concentration and quality ✓</p> <p><i>data in support</i> concentrations correctly calculated ✓</p> <p>correct unit given ✓</p> <p>data used with units to support statement on quality ✓</p>	4	<p>ALLOW comments referring to a small difference</p> <p>BMI 20 - 25 $342 \div 2.6 = 131.5$ AND BMI >25 $413.1 \div 3 = 137.7$</p> <p>10^6 cm^{-3} OR $10^6 / \text{cm}^3$</p> <table border="1"> <thead> <tr> <th>Group</th> <th>BMI</th> <th>Total progressively motile sperm (10^6)</th> <th>Concentration 10^6 cm^{-3}</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>20-25</td> <td>74.2</td> <td>131.5</td> </tr> <tr> <td>B</td> <td>>25</td> <td>110.4</td> <td>137.7</td> </tr> </tbody> </table>	Group	BMI	Total progressively motile sperm (10^6)	Concentration 10^6 cm^{-3}	A	20-25	74.2	131.5	B	>25	110.4	137.7
Group	BMI	Total progressively motile sperm (10^6)	Concentration 10^6 cm^{-3}														
A	20-25	74.2	131.5														
B	>25	110.4	137.7														
		(ii)	<p>Any 2 from: <i>Idea that</i> BMI >25 needs to be subdivided ✓ age in both groups should be same ✓ larger sample size ✓ carry out study over more generations of men / time span of study ✓</p> <p>named factor should be controlled ✓✓</p>	2	<p>e.g. smoking, fitness level, exposure to STDs or traumatic damage</p>												

Question		Answer	Marks	Guidance										
	(b)	<table border="1"> <thead> <tr> <th>Statement</th> <th>Letter(s)</th> </tr> </thead> <tbody> <tr> <td><i>If this is enlarged it can lead to difficulty in starting to urinate or emptying a full bladder.</i></td> <td>B ✓</td> </tr> <tr> <td><i>Changes in this structure mean sperm can fail to become motile.</i></td> <td>E ✓</td> </tr> <tr> <td><i>Changes in this structure can lead to chromosome abnormalities in sperm.</i></td> <td>F ✓</td> </tr> <tr> <td><i>Changes in tissues here can lead to erectile dysfunction.</i></td> <td>G ✓</td> </tr> </tbody> </table>	Statement	Letter(s)	<i>If this is enlarged it can lead to difficulty in starting to urinate or emptying a full bladder.</i>	B ✓	<i>Changes in this structure mean sperm can fail to become motile.</i>	E ✓	<i>Changes in this structure can lead to chromosome abnormalities in sperm.</i>	F ✓	<i>Changes in tissues here can lead to erectile dysfunction.</i>	G ✓	4	
Statement	Letter(s)													
<i>If this is enlarged it can lead to difficulty in starting to urinate or emptying a full bladder.</i>	B ✓													
<i>Changes in this structure mean sperm can fail to become motile.</i>	E ✓													
<i>Changes in this structure can lead to chromosome abnormalities in sperm.</i>	F ✓													
<i>Changes in tissues here can lead to erectile dysfunction.</i>	G ✓													
	(c)	(i) Any 2 from: <i>idea that</i> nitrogen monoxide must be, lipid soluble / hydrophobic ✓ (explanation) it diffuses / AW, through the cell surface membrane ✓ binds to, receptor / AW, inside the cell ✓ <i>idea that</i> second messenger is cyclic GMP rather than cyclic AMP ✓	2											
		(ii) Any 3 from: Viagra acts as a competitive inhibitor (of PDE-5) ✓ <i>idea that</i> cyclic GMP, is not broken down / lasts longer (in cells) ✓ <i>idea that</i> blood vessels dilate, more / for longer ✓ <i>idea that</i> erection maintained for longer ✓	3	ALLOW 'Viagra forms an enzyme inhibitor complex' OR description 'prevents the formation of ESC'										
		Total	15											

Question		Answer	Marks	Guidance										
36	(a)*	<p>Level 3 (5–6 marks) A detailed description, including at least one statement from each section in the correct sequence (from 1, 2 and then 3), showing knowledge and understanding of the production of mRNA is given and all steps are in the correct order.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Description includes at least two correct statements in the correct sequence but there is some repetition or irrelevant information (e.g. about translation).</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) One correct statement is made which include points from any of the sections shown in the guidance.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks No response or no response worthy of credit.</p>	6	<p>Sections indicate possible scientific points and the expected sequence of the answer.</p> <p>Section 1</p> <ul style="list-style-type: none"> RNA polymerase binds to the DNA reference to the promoter region (for binding) reference to transcription factors <p>OR DNA unwinding (by DNA helicase)</p> <p>Section 2</p> <ul style="list-style-type: none"> reference to RNA, nucleotides / bases, pairing with bases on, template strand reference to complementary base pairing / numbers of hydrogen bonds forming correct reference to base pairings <table style="margin-left: 40px;"> <tr> <td>DNA</td> <td>RNA</td> </tr> <tr> <td>A</td> <td>U</td> </tr> <tr> <td>T</td> <td>A</td> </tr> <tr> <td>C</td> <td>G</td> </tr> <tr> <td>G</td> <td>C</td> </tr> </table> <ul style="list-style-type: none"> reference to RNA polymerase, catalysing / AW, formation of, phosphodiester bonds / AW <p>Section 3</p> <ul style="list-style-type: none"> reference to termination / stop sequence reference to DNA rewinding / RNA polymerase leaving the DNA strand reference to removal of introns from primary RNA / formation of, mature / messenger RNA 	DNA	RNA	A	U	T	A	C	G	G	C
DNA	RNA													
A	U													
T	A													
C	G													
G	C													

Question		Answer	Marks	Guidance	
	(b)	(i)	ACGGGAAGGGCCCGAGCACGGA UGCCCUUCCCGGGCUCGUGCCU ✓	1	
		(ii)	hydrolysis ✓	1	IGNORE 'cleavage'
		(iii)	Any 3 from: (activated) RISC, cleaves / AW, viral mRNA ✓ no viral proteins made ✓ no, viral particles / AW, assembled ✓ <i>idea that</i> no new cells are infected ✓	3	IGNORE 'virus cannot spread' as this is given in the question
			Total	11	

Question		Answer	Marks	Guidance
37	(a)	m - aorta ✓ n - pulmonary artery ✓	2	
	(b)	(i) wall must be thinner than right ventricle wall ✓ figures in support ✓	2	ALLOW manipulated figures e.g. right ventricle pressure is 6 x higher, ratio is 3 : 0.5 or 6 : 1
		(ii) ratio = 5 : 1 ✓	1	ALLOW 5.3 : 1
		(iii) 1.5 mm ✓✓	2	Award 1 mark if units are incorrect or omitted. If an alternative answer is given with units and to one decimal place, ALLOW 2 marks for 1 divided by ratio obtained from (ii) multiplied by 8 as error carried forward
	(c)	(i) Time between them gets less / AW ✓	1	
		(ii) Any 2 from: Minimum time for 1 beat = 0.3 seconds (distance from first P to T wave) ✓ 60 ÷ 0.3 ✓ Answer = 200 bpm / beats per minute ✓	2	
			Total	10

Summary of updates

Date	Version	Change
January 2019	2.0	Minor accessibility changes to the paper: i) Additional answer lines linked to Level of Response questions ii) One addition to the rubric clarifying the general rule that working should be shown for any calculation questions.
October 2020	2.1	Updated copyright acknowledgements.
March 2024	2.2	Question 33: Metabolic pathways changed in Figure 33.1 so that the question and mark scheme are correct.