OCR
Oxford Cambridge and RSA

Thursday 6 June 2019 – Morning

A Level Biology A

H420/01 Biological processes

Time allowed: 2 hours 15 minutes

7671536543

You must have:
- the Insert (inserted)

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

H420/01

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- The Insert will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- 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. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **100**.
- 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 **36** pages.

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SECTION A

You should spend a maximum of 20 minutes on this section.

Write your answer to each question in the box provided.

Answer **all** the questions.

1 Rheumatoid arthritis is a long-term condition that causes pain, swelling and stiffness in the joints.

Which of the following, **A** to **D**, explains why stem cells are a potential source of treatment for rheumatoid arthritis?

A Stem cells can be harvested from the umbilical cords of newborn babies.

B Stem cells are cheaper than other drug-based therapies.

C Stem cells allow regeneration of a variety of tissue types.

D Stem cells can be obtained from embryos without any ethical concerns.

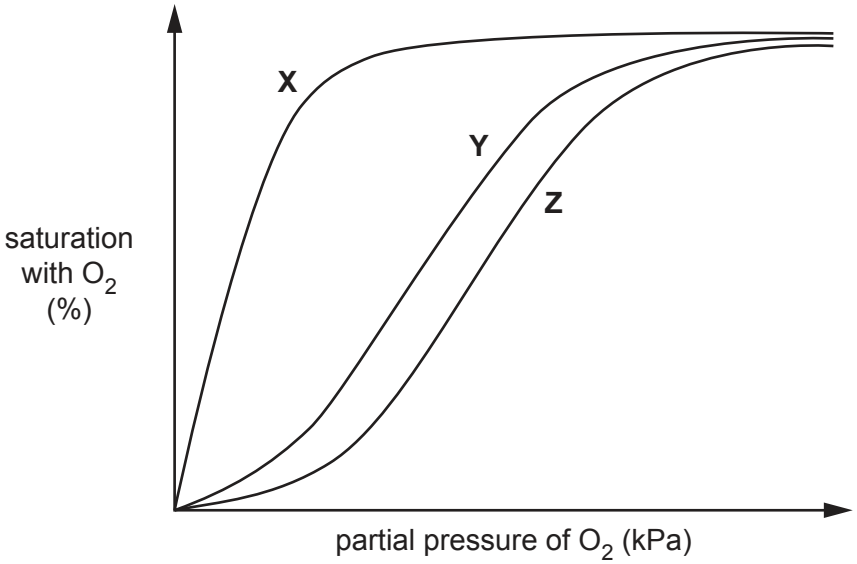
Your answer ☐ **[1]**

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2 Myoglobin is a protein found in muscle. Myoglobin has a very high affinity for oxygen at most partial pressures of oxygen.

The figure below shows dissociation curves for

- adult haemoglobin
- fetal haemoglobin
- myoglobin.



Which of the following rows, **A** to **D**, shows the correct labels for the lines on the graph?

	X	Y	Z
A	myoglobin	fetal haemoglobin	adult haemoglobin
B	fetal haemoglobin	adult haemoglobin	myoglobin
C	adult haemoglobin	fetal haemoglobin	myoglobin
D	myoglobin	adult haemoglobin	fetal haemoglobin

Your answer ☐ **[1]**

3 Which of the following, **A** to **D**, is **not** an example of cell signalling?

A The hormone insulin being removed from the blood by the glomerulus.

B The neurotransmitter acetylcholine causing depolarisation.

C The hormone prolactin binding to a cell receptor in breast tissue.

D Epithelial cells releasing cytokines in response to histamine.

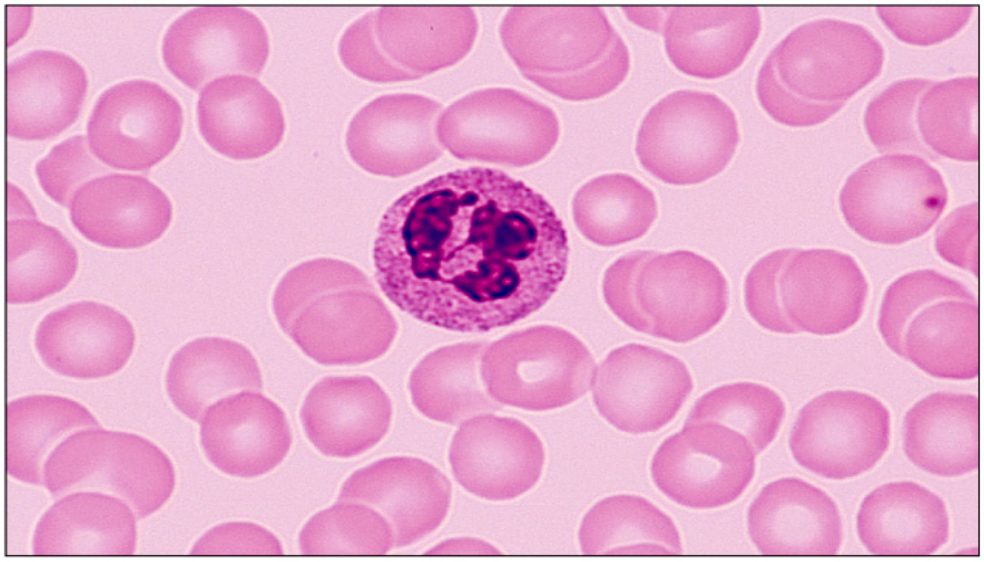
Your answer ☐ **[1]**

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The image below shows a micrograph of two different types of blood cell.

Questions **4** and **5** refer to this image.

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4 Which of the following rows, **A** to **D**, shows the correct cell names from the image above?

	P	Q
A	neutrophil	erythrocyte
B	erythrocyte	epithelial cell
C	erythrocyte	neutrophil
D	epithelial cell	erythrocyte

Your answer ☐ **[1]**

5 Both of the cell types **P** and **Q** develop from haematopoetic stem cells in the bone marrow.

Which of the following statements, **A** to **D**, correctly describes haematopoetic stem cells?

A They are neither pluripotent nor multipotent.

B They are pluripotent but not multipotent.

C They are both pluripotent and multipotent.

D They are multipotent but not pluripotent.

Your answer ☐ **[1]**

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6 Which of the following statements, **A** to **D**, correctly explains why meristems can differentiate into xylem vessels in plant stems?

A Meristems are living and unspecialised.

B Meristems are living and specialised.

C Xylem vessels are dead and specialised.

D Xylem vessels are dead and unspecialised.

Your answer ☐ **[1]**

7 The following passage outlines the process of phototropism in plants:

Auxin is synthesised in cells at the ..... of the shoot. Auxin causes the cells to ..... on one side, so the stem bends.

Scientists originally thought auxin was ..... by light but this was disproved by the fact that plants growing in the dark and plants growing in unilateral light had ..... auxin levels.

Which option, **A** to **D**, is the correct sequence of missing words?

A meristem, shorten, destroyed, different

B tip, elongate, destroyed, similar

C meristem, shorten, synthesised, raised

D tip, elongate, synthesised, similar

Your answer ☐ **[1]**

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8 A scientist tested a plant suffering from water stress. The plant was found to have high levels of abscisic acid (ABA) in its tissues.

Which of the following statements, **A** to **D**, explains this observation?

A ABA causes fruit ripening

B ABA prevents leaf drop

C ABA causes phototropism

D ABA stimulates stomatal closing

Your answer ☐ **[1]**

9 Which of the following statements, **A** to **D**, is evidence for geotropism?

A leaves are shed from deciduous plants in the autumn

B roots grow downwards

C shoots grow towards the light

D flowers can change position throughout the day

Your answer ☐ **[1]**

10 Many trees drop their leaves in the autumn.

Which of the following plant hormones is/are thought to be involved in the control of leaf drop?

1 auxin
2 ethene
3 gibberellin

A 1, 2 and 3

B only 1 and 2

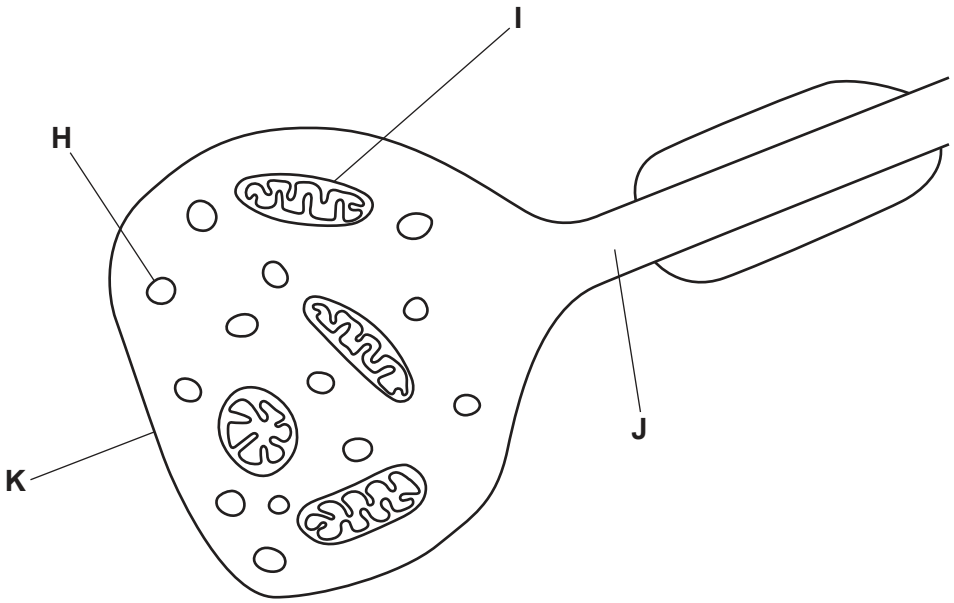
C only 2 and 3

D only 1

Your answer ☐ **[1]**

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11 The image below shows a synaptic bulb.



Which of the following rows, **A** to **D**, correctly names the parts labelled **H** to **J** in the image?

	H	I	J	K
A	vesicle containing neurotransmitter	mitochondrion	dendron	postsynaptic membrane
B	vesicle containing Ca^{2+}	mitochondrion	axon	presynaptic membrane
C	vesicle containing Ca^{2+}	myelin	dendron	postsynaptic membrane
D	vesicle containing neurotransmitter	mitochondrion	axon	presynaptic membrane

Your answer ☐ **[1]**

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12 Damage to the hypothalamus results in lower water potential of the blood.

Which of the following, **A** to **D**, explains these observations?

A ADH release increases the water potential of blood.

B Mineralocorticoids affect cells in the loop of Henle.

C Fewer water channels are inserted into the cell surface membranes of the collecting duct.

D The anterior pituitary releases hormones into the blood.

Your answer ☐ **[1]**

13 Collagen is found in tendons. Tendons attach muscles to bones.

Which of the following lists of properties, **A** to **D**, makes collagen suitable for this role?

A strong, inflexible, insoluble

B strong, flexible, soluble

C strong, inflexible, soluble

D strong, flexible, insoluble

Your answer ☐ **[1]**

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14 Cyanobacteria are photosynthetic prokaryotes.

A scientist exposed cyanobacteria to light of different colours and intensities and made the following observations:

- Most cyanobacteria are blue in colour.
- At low light intensities, glucose production in cyanobacteria is low.
- When light intensity reaches a certain level the rate of glucose production in cyanobacteria stops increasing.

Which of the following statements, **A** to **D**, correctly explains these observations?

A The pigments in cyanobacteria absorb blue light and light intensity is a limiting factor for the rate of photosynthesis.

B The pigments in cyanobacteria absorb red light and light intensity is not a limiting factor for the rate of photosynthesis.

C The pigments in cyanobacteria absorb blue light and light intensity is not a limiting factor for the rate of photosynthesis.

D The pigments in cyanobacteria absorb red light and light intensity is a limiting factor for the rate of photosynthesis.

Your answer ☐ **[1]**

15 The hormone aldosterone is produced by the adrenal cortex. Excess production of aldosterone can result in high blood pressure.

The following statements describe processes that occur as a result of aldosterone secretion:

1 Na^+/K^+ pumps in the collecting duct of the kidney move three Na^+ ions into the blood and two K^+ ions out of the blood.
2 Cl^- ions enter the blood to maintain electrochemical balance.
3 H^+ ions enter cells lining the kidney tubules.

Which of the above statements explain(s) why excess aldosterone production can result in high blood pressure?

A 1, 2 and 3

B only 1 and 2

C only 2 and 3

D only 1

Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.

16 (a) Fig. 16 shows pressure changes during the cardiac cycle.

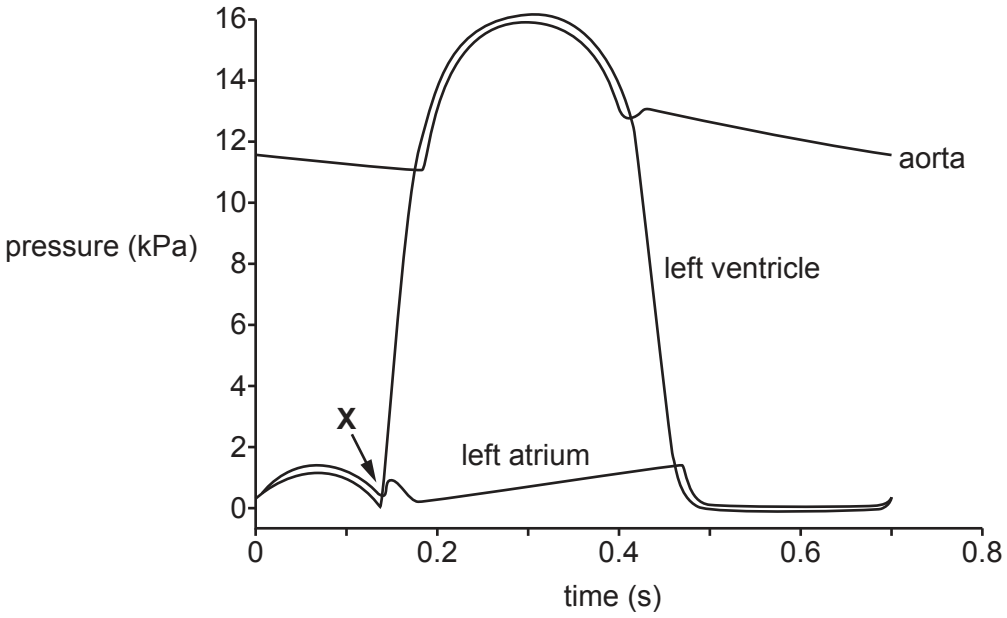


Fig. 16

(i) Using Fig. 16, compare the changes in pressure in the left ventricle with the changes in pressure in the left atrium.

1	similar increase **and** decrease (in pressure) , between 0 to 0.15s / to 0.15s / to point X ✓
2	steeper / faster, rise / fall , in ventricle (pressure) ✓
3	bigger , increase / decrease , in ventricle (pressure) ✓
4	*idea that* at approximately 0.15s atrial (pressure) has , (small) rise and fall / AW , but ventricular is increasing ✓
5	*idea that* from approximately 0.3s ventricular pressure decreases but atrial pressure still increasing ✓
6	from 0.5s no change in pressure(s) in both ✓
7	comparative figures with units ✓

..... **[4]**

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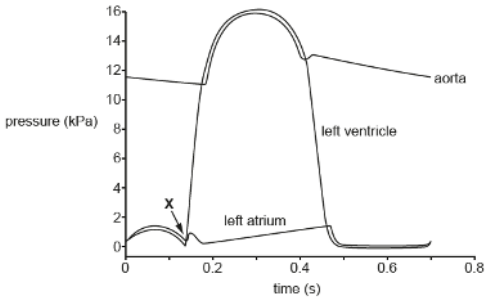
(ii) Using Fig. 16, calculate the heart rate of this individual.

Give your answer to **2** significant figures.

heart rate = .86 bpm ✓..... **Unit must be given** **[1]**

(iii) Using Fig. 16, calculate the percentage change between minimum and maximum pressure in the aorta.

Give your answer to **2** significant figures.



percentage change = ...45 (%) ✓✓ ... **[2]**

(iv) Name the valve which closes at point **X** on Fig. 16.

atrioventricular ✓..**ALLOW** bicuspid ..... **[1]**

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(b) The heart supplies oxygenated blood to the tissues.

VO_2^{max} is a measurement of the maximum volume of oxygen that an individual can use during intense exercise in a given time.

Smart watches can estimate the VO_2^{max} of an individual by measuring heart rate while exercising.

Having a higher VO_2^{max} is associated with improved aerobic fitness.

Two male students exercised for 30 min and used smart watches to record their VO_2^{max}. Table 16 shows their masses and the VO_2^{max} values they recorded.

Student	Mass (kg)	VO_2^{max} ($cm^3\,kg^{-1}\,min^{-1}$)
1	65	50.4
2	57	48.2

Table 16

Student 1 drew the following conclusion from this result:

> My VO_2^{max} is higher because my mass is greater. I have more cells than Student 2. Each cell needs oxygen to carry out respiration.

Student 2 said that this conclusion is invalid because several variables have not been controlled.

State **three** variables necessary for a valid comparison that have **not** been controlled in the above experiment.

1 ..type / vigour / intensity / AW , of exercise ✓ .....

.....

2 .age ✓ .....

.....

(environmental) temperature ✓
brand / make / type , of smart watch ✓
reference to , exercise / rest , before experiment ✓
named , health / lifestyle , condition ✓

3 .muscle mass / bone density / fitness / height / build / proportion of body fat / BMI ✓ .....

.....

[3]

(c) Brown fat is a type of tissue.

Brown fat has a higher need for oxygen because fat cells in this tissue carry out aerobic respiration at a higher rate than fat cells in other tissues.

Suggest which organelle is present in higher numbers in brown fat cells than in other fat cells.

mitochondria / mitochondrion ..... **[1]**

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17 Gibberellin causes stem elongation in plants.

Fig. 17.1 shows the effect of gibberellin on cabbage plants.



without gibberellin with gibberellin

Fig. 17.1

Gibberellin causes an increase in the distance between the leaves on the stem, which is known as the internodal length.

(a) Explain why gibberellin is classed as a plant **hormone**.

(gibberellin is) a chemical messenger ✓ .....

produced in one part of plant but has effects in another part / AW✓ .....

affects activity / AW , of target , cells / tissues ✓ .....

long-lasting / acts over long period of time ✓
wide-spread effect ✓ .....

.....

.....

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

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(b) A scientist carried out an investigation into the effect of gibberellin on cabbage plants.

The scientist applied a range of volumes of gibberellin and measured the rate of increase of internodal length over 30 days.

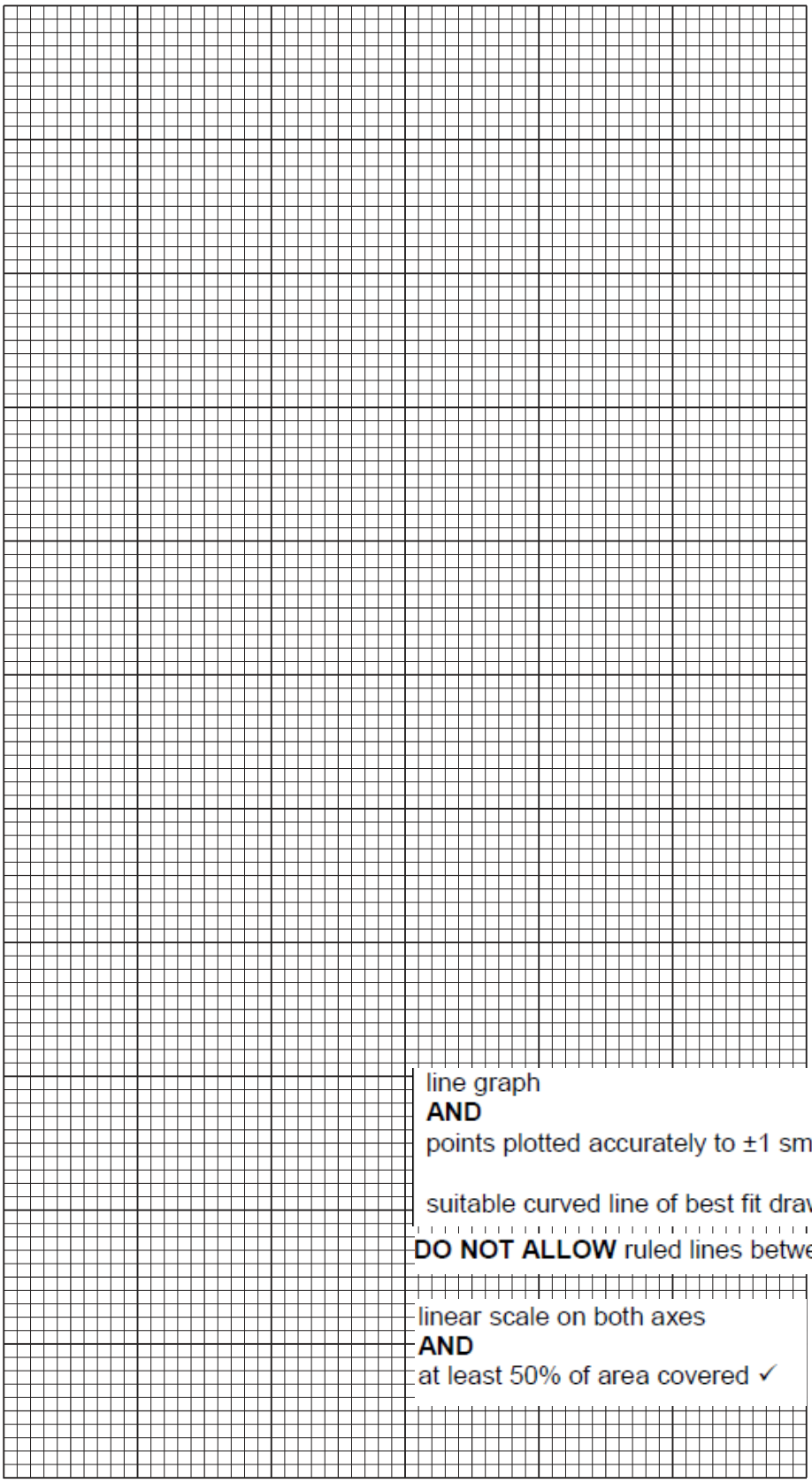
Table 17 shows the scientist's results.

Volume of gibberellin applied ($x10^{-3}$ cm^3 kg^{-1} day^{-1})	**Rate of increase of internodal length (mm day^{-1})**
0.0	1
0.2	1
0.4	2
0.6	4
0.9	22
1.2	47
1.4	48
1.8	49
1.9	50
2.0	50

Table 17

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(i) Plot the results from Table 17 as a suitable graph.



line graph
AND
points plotted accurately to ±1 small square ✓

suitable curved line of best fit drawn ✓

DO NOT ALLOW ruled lines between points

linear scale on both axes
AND
at least 50% of area covered ✓

[4]

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(ii) Gibberellin causes an increase in internodal length.

State one **other** role of gibberellin in plants.

seed germination
flowering in long-day plants
cellular , transcription / translation
prevents leaf abscission
aids stomatal opening
promotes fruit development
promotes , activity of amylase / hydrolysis of starch ✓

(c) A student carried out chemical tests on cabbage leaves to investigate which molecules were present.

The student's method was as follows:

- Add 50 cm^3 of distilled water to 2 large cabbage leaves and blend into a smooth liquid using a food mixer.
- Place 1 cm^3 of the blended cabbage leaf liquid into 5 test tubes:
  - Tube **1**: Add 5 drops of biuret reagent and mix.
  - Tube **2**: Add 2 cm^3 of Benedict's solution, mix, then place tube into a water bath for 5 min. Remove and cool.
  - Tube **3**: Add 2 drops of iodine solution and mix.
  - Tube **4**: Add 2 cm^3 of ethanol and mix. Then add 2 cm^3 of distilled water and mix.
  - Tube **5**: Insert a glucose test strip into the liquid then compare the colour to the colour chart provided (see Fig. 17.2 **on the Insert**).

(i) Name a **type** of food molecule that the student will **not** be able to detect using these chemical tests.

non-reducing , sugars / disaccharides ✓ ..... **[1]**

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(ii) The table below is a summary of some of the student's findings.

Complete the table by writing in the missing observations and conclusions.

Tube	Observation	Conclusion
1	(pale) purple / lilac / violet / mauve	Protein present
2	Yellow colour	reducing sugar (present) .....
3	Pale brown colour	no / very little , starch (present).....
4	(turns) white / cloudy / milky OR • (forms white) suspension / emulsion	Fat present
5	pink	Glucose concentration small (15 mg dm^{-3})

1 mark per correct column **[2]**

(iii) The student then used a colorimeter to measure the absorbance of the contents of Tube **2**.

Explain how the use of a colorimeter could improve the student's conclusion.

(result using colorimeter will be) quantitative ..... **OR** not subjective / less affected by human error / no bias ✓ .....

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

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18 Mammals and fish both need circulatory systems to transport oxygen to respiring tissues. They have different circulatory systems because they have different oxygen requirements.

(a)* Compare and contrast the circulatory systems of mammals and fish.

As this is a comparison BOTH fish and mammals must be mentioned

Similarities

- Both are closed systems / blood in blood vessels
- Both have a heart
- Both carry oxygen using haemoglobin
- Both have arteries / veins / capillaries

Differences:

Fish	Mammal
Single circulation / blood though heart once	Double circulation / blood through heart twice Pulmonary and systemic circulations
One atrium and 1 ventricle / 2 chambers (in heart) / no septum in heart	Two atria and 2 ventricles / 4 chambers (in heart) / heart has a septum
Blood passes through 2 sets of capillaries (before returning to heart)	Blood passes through 1 set of capillaries (before returning to heart)
Blood pressure is lower (to organs)	Blood maintained at higher pressure
	2 circulations with different pressures / can have high pressure in systemic circulation
Less efficient at transporting / supplying oxygen to tissues	More efficient at transporting / supplying oxygen to tissues
(Fulfils needs) as fish are 'cold blooded' / have a low oxygen demand / low metabolic rate	(Fulfils needs) as mammals need to maintain a constant body temperature / have a high oxygen demand / high metabolic rate

Level 3 (5–6 marks)

Full and detailed comparison of the circulatory systems of a fish and mammal.

There is a well-developed comparison including a range of features. The information presented is relevant and clearly explained.

Level 2 (3–4 marks)

Detailed comparison of the circulatory systems of a fish and mammal.

There is a reasonable attempt at comparison including a small range of features. The information presented is mostly relevant and clearly explained.

[6]

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(b) Acetylcholine (ACh) is a neurotransmitter in mammals. Studies have suggested that it also functions as a hormone in some invertebrate species, such as squid.

When ACh comes into contact with specialised cells in squid skin, it causes them to change colour. These colour changes allow the squid to communicate and to camouflage itself.

ACh is made by cells in the centre of the squid's body.

Explain how it is possible for ACh to have an effect on cells in the skin of the squid.

secreted into / travels in , blood ✓
binds to receptors on (skin) cell (surface) ✓

ALLOW transport medium / AW for blood
ALLOW specific binding sites for receptors

detail of response inside cell(s) ✓

e.g. activates G protein
e.g. causes formation of a secondary messenger
e.g. enzyme / phosphorylation , cascade

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

(c) Squid blood contains a blue oxygen-carrying protein called haemocyanin.

High partial pressures of carbon dioxide reduce the affinity for oxygen of haemocyanin.

Suggest a mechanism by which carbon dioxide could reduce the affinity for oxygen of haemocyanin.

carbon dioxide / CO_2 , forms , carbonic acid / H_2CO_3
OR
carbonic acid / H_2CO_3 , dissociates into H^+ (and HCO_3^-) ✓

haemocyanin , acts as a buffer / associates with (excess) H^+ ✓

H^+ / low pH , causes change in (tertiary) structure of haemocyanin ✓

ALLOW hydrogen ions / H ions throughout for H^+
IGNORE cannot bind to oxygen / reduced affinity for oxygen
IGNORE Bohr effect

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

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19 Resistance training with weights can increase muscle mass in the body. It can also lead to vascularisation, where blood vessels become more visible through the skin. Fig. 19.1 shows vascularisation.



Fig. 19.1

Vascularisation occurs in bodybuilders because blood vessels are pushed to the surface by increased muscle mass. They can also become more visible due to reduced body fat and dehydration.

(a) Explain why the visible blood vessels are likely to be veins.

have , thin wall / valves , so will , distend / bulge ✓ .....

large lumen / wide , as contains , large volume of / slow-moving , blood ✓ .....

found closer to the , surface / skin , than arteries ✓ .....

.....

.....

.....

.....

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

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(b) Some bodybuilders use anabolic steroids to increase their muscle mass.

Suggest why anabolic steroids are effective when applied to the surface of the skin.

(skin has) large surface area for absorption ✓
(skin has) many / network of , capillaries ✓

(steroids are) lipid-soluble / non-polar ✓
(so) can cross phospholipid bilayer ✓

muscles are close to the skin (surface) so
short diffusion , pathway / distance ✓

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

Question 19(c) begins on page 22

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(c) Illegal use of steroids is widespread in professional sport.

The International Olympic Committee (IOC) tests the urine of athletes to help prevent steroid abuse.

Fig. 19.2 is a graph showing tests carried out by the IOC between 1986 and 1994.

- The bars represent the number of urine samples tested.
- The line shows the percentage of samples testing positive for the steroid testosterone.

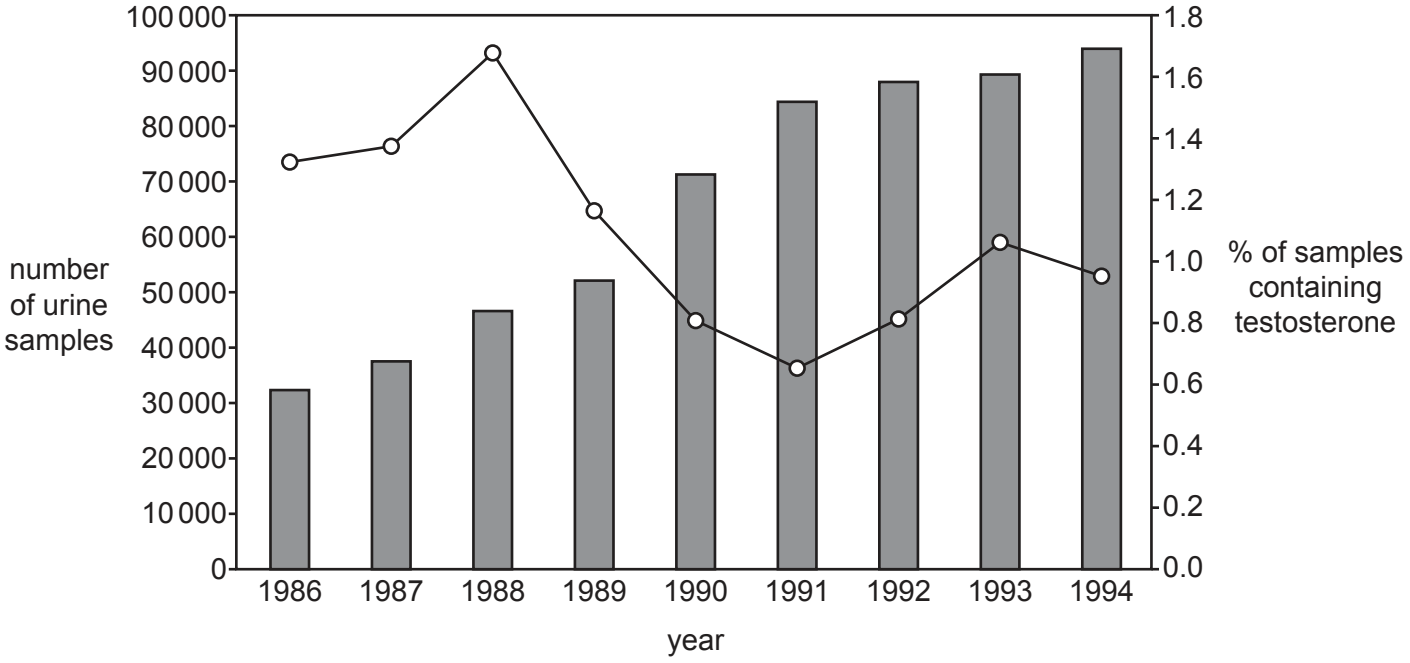


Fig. 19.2

(i) Calculate the change in the **number** of samples testing positive for testosterone between 1988 and 1991.

number of samples = ... **[3]**

(any number in range) 180 to 279 ✓✓✓

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(ii)* Based on the findings in Fig. 19.2, the head of the IOC stated that:

"The IOC is succeeding in reducing the level of steroid abuse in professional sport."

Evaluate this statement using the data in Fig. 19.2.

Indicative scientific points may include...

Evidence in support of the statement:

- General trend : reduction in % samples with testosterone from start to end of test
- From 1988 to 1991, % samples with testosterone decreased as test numbers increased
- Increase in number of tests carried out over time
- More testing shows , more awareness / scrutiny / acts as deterrent

Evidence against the statement:

- From 1986 to 1988 there was an increase in % tests with testosterone / number of positive tests
- Correlation does not show causation
- More tests but more athletes competing
- After 1991 / in 1992 and 1993 there was an increase in % tests with testosterone / number of positive tests
- Fewer samples with testosterone is not the same as less incidence of abuse
- No clear pattern / trend in positive samples
- From 1986 to 1994 the number of positive tests increases

Issues of validity with data:

- Only a limited / short time was studied or only valid for the time studied
- Other steroids used and not detected
- Other drugs mask testosterone levels
- Testosterone levels may vary naturally in the population (AW)
- No details provided for the method used / modern technology may have improved the sensitivity of the test over time
- No detail of a control group
- Security of testing / cheating / corruption / bribery
- Not turning up for testing / times of testing
- Reference to significance of data
- No statistical tests / SD bars / range bars
- Could be same sport being tested or different sports
- Could be same athletes repeatedly tested or different athletes

[6]

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20 Rubredoxin is a protein found in bacteria. It contains around 50 amino acids. One iron ion is bound by the sulphur atoms of four cysteine amino acids.

The structure of rubredoxin is shown in Fig. 20.1.

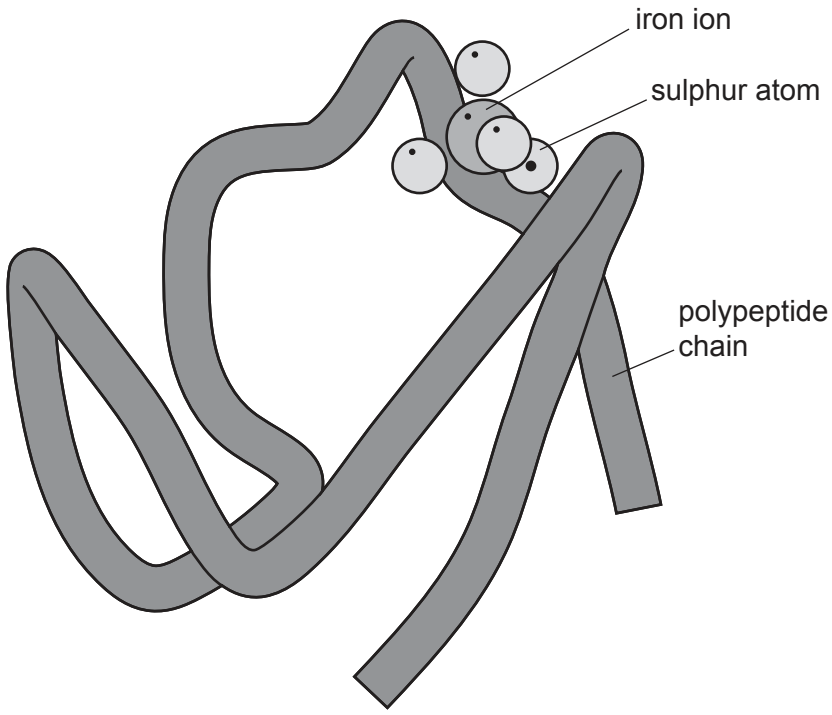


Fig. 20.1

(a) (i) Rubredoxin is known as a **conjugated protein**.

Use Fig. 20.1 to explain what is meant by the term conjugated protein.

contains non-protein groups ✓ .....

has prosthetic group ✓ .....
(prosthetic group) is , iron / Fe , ion ✓

.....

(prosthetic group) is attached by , covalent bonds / ionic interactions / hydrogen bonds ✓ .....

.....

.....

.....

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

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(ii) Using the information provided about rubredoxin, state **two** similarities between the structures of rubredoxin and haemoglobin.

similarity 1 ..... proteins / contain polypeptide chain(s) ✓ .....

..... contain , cysteine / sulphur (atoms) ✓ .....

similarity 2 ..... have prosthetic group(s) / are conjugated (proteins) ✓ .....

contain iron ions ✓

.....

[2]

(iii) Rubredoxin and haemoglobin have different secondary and tertiary structures.

Using the information provided about rubredoxin, state **two other** differences between the structures of rubredoxin and haemoglobin.

difference 1 ..... haemoglobin , is a larger molecule / has greater molecular mass / has more amino acids ✓ .....

..... haemoglobin has , quaternary structure / more than one polypeptide chain ✓ .....

difference 2 ..... haemoglobin has , more than one / four , prosthetic groups / iron ions ✓ .....

[2]

haemoglobin contains haem (groups) ✓

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(b) Ferritin is a protein that is used to regulate iron levels within plant tissues.

It is a large spherical structure which can hold many iron (Fe^{3+}) ions at its centre.

Iron can be toxic to plant tissues. Ferritin prevents the build-up of iron.

Fig. 20.2 shows the internal structure of ferritin.

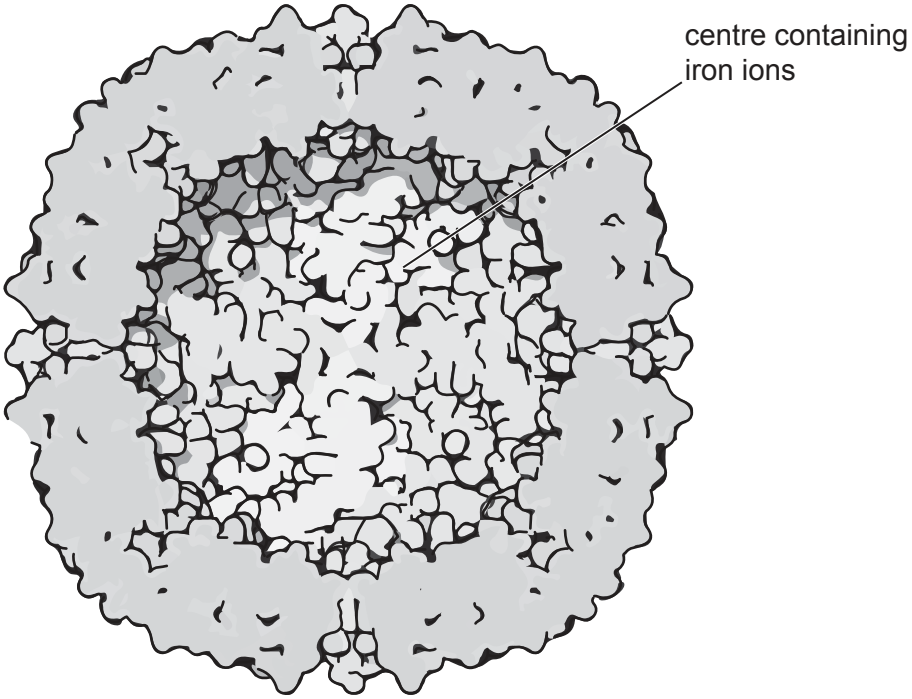


Fig. 20.2

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(i) Ferritin molecules can hold 4500 Fe^{3+} ions in the inner sphere.

It is thought that the Fe^{3+} ions are unable to occupy the total available volume of the inner sphere because other molecules are present in the inner sphere.

The volume of the inner sphere of the ferritin molecule is 268 nm^3.

The volume of an Fe^{3+} ion is 9.04×10^{-4} nm^3.

Calculate the volume of the inner sphere **not** occupied by Fe^{3+} ions.

264 / 263.932 / 263.93 / 263.9 (nm^3) ✓✓✓

volume = ... nm^3 **[3]**

(ii) Explain how hydrophilic and hydrophobic interactions contribute to the spherical shape of ferritin.

hydrophobic regions / R groups , on inside (of molecule / protein) .....

AND .....

hydrophilic regions / R groups , on outside (of molecule / protein) ✓ ..... **[1]**

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21 Fig. 21.1 shows a transverse section of a human adrenal gland.

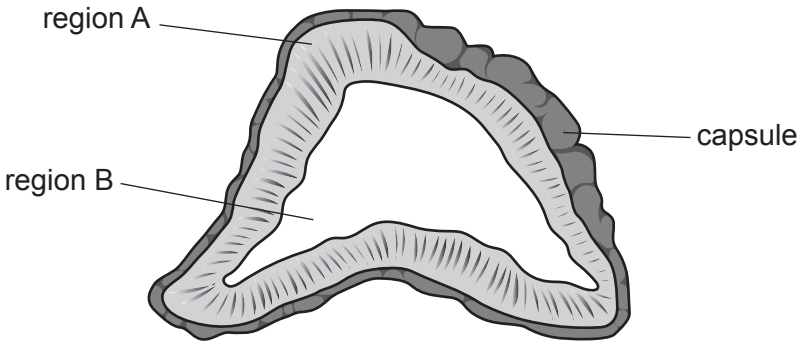


Fig. 21.1

(a) (i) The table below describes the functions of some hormones produced by different regions of the adrenal gland.

Complete the table using Fig. 21.1 and your own knowledge.

Hormone produced	Functions of hormone
adrenaline	increases heart rate increases blood glucose concentration increases blood flow to muscles increases glycogenolysis causes pupils to dilate decreases blood flow to gut increases blood pressure dilation of bronchioles increases air flow to alveoli increases breathing rate ....
noradrenaline	• increases heart rate • increases blood pressure • widens pupils
androgens	regulation of sexual characteristics and cell growth
glucocorticoids / cortisol / corticosterone	regulation of metabolism

[2]

(ii) Using Fig. 21.1, identify the letter and name of the region of the adrenal gland that secretes adrenaline.

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

B
AND
(adrenal) medulla ✓

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(b) Phaeochromocytoma is a rare tumour of adrenal gland tissue. It causes increased hormone release from the adrenal glands.

Fig 21.2 shows three ECG traces showing the heart rhythms of three different patients.

- Patient **X** has a normal heart rhythm.
- Patient **Y** has phaeochromocytoma.
- Patient **Z** has bradycardia.

Z **THEN** X ✓

Y ✓

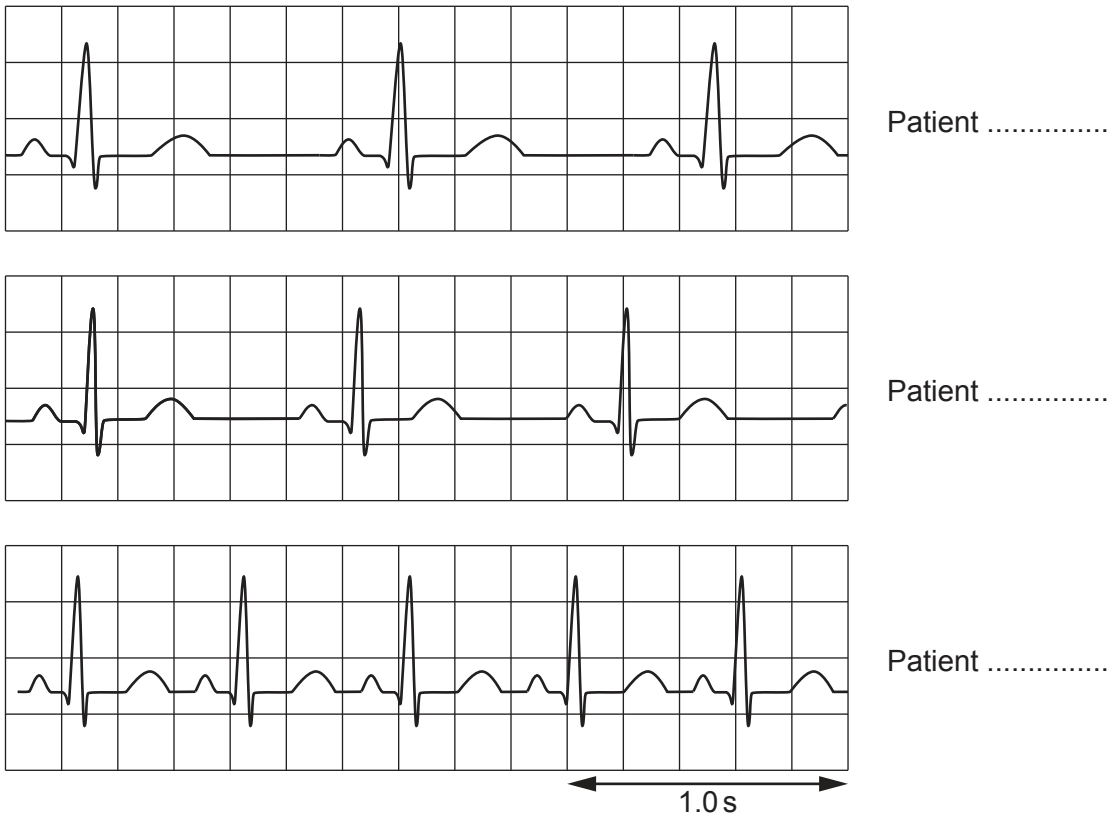
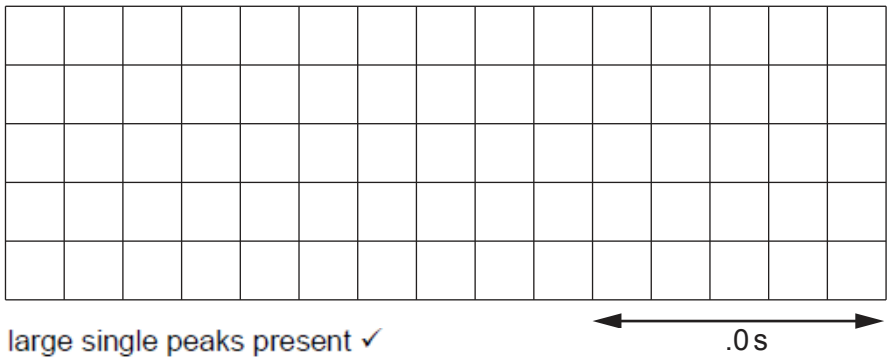


Fig. 21.2

(i) Identify patients **X**, **Y** and **Z** by labelling the traces in Fig. 21.2. **[2]**

(ii) Sketch a trace for a patient who has entered atrial fibrillation.



large single peaks present ✓
small wavy line between peaks with
at least three waves between any two peaks ✓

[2]

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(iii) Suggest why reduced heart rate is sometimes seen in people who are very aerobically fit.

.....

.....

.....

increased stroke volume / AW ✓
increased volume of ventricle (chamber) ✓ .....

increased , thickness / strength , of heart <u>muscle</u> ✓ ..... **[2]**

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22 Plants are capable of synthesising a variety of molecules from the products of the light-independent stage of photosynthesis.

Fig 22.1 summarises these processes.

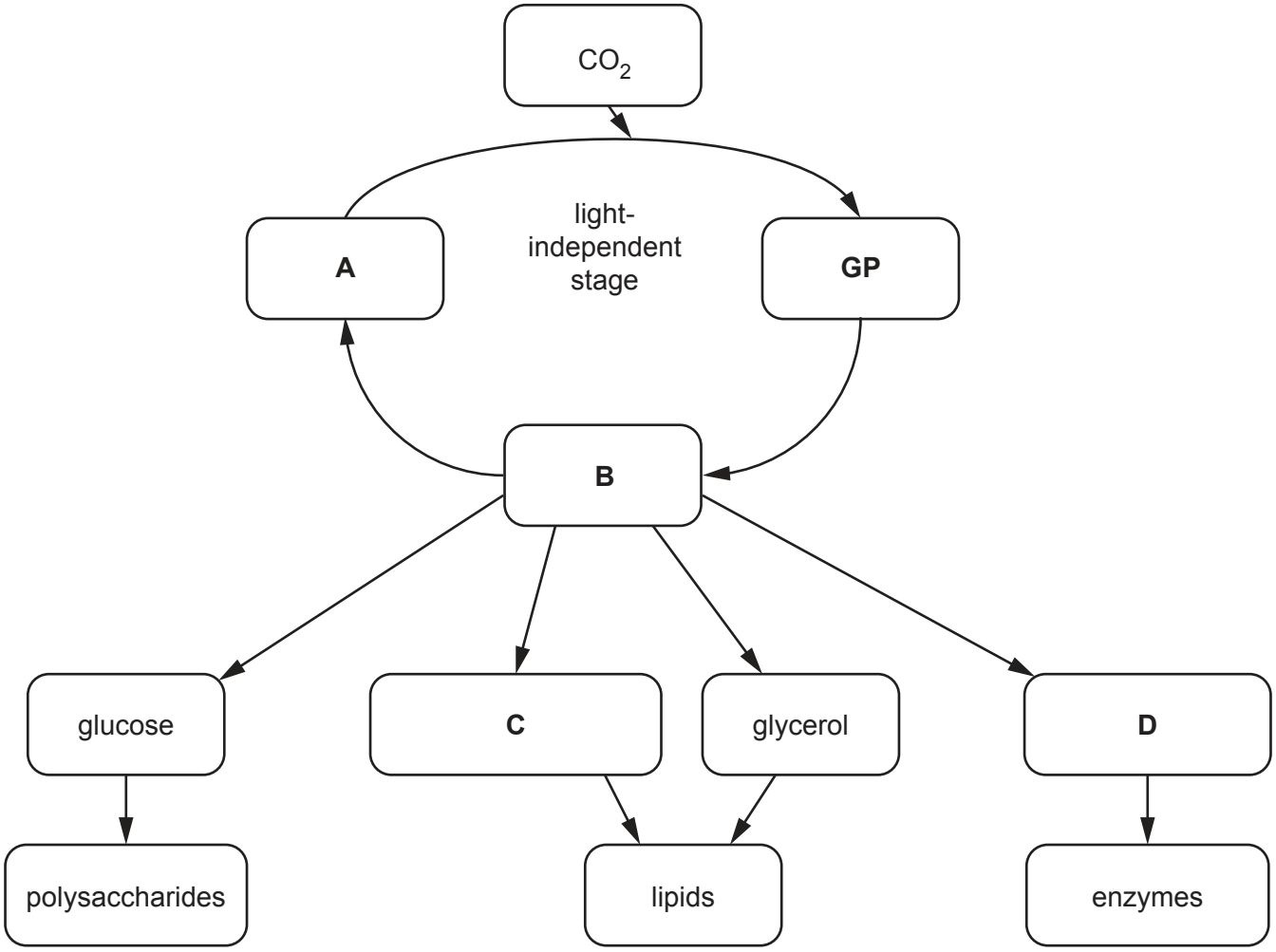


Fig. 22.1

(a) Identify the molecules represented by the letters **A**, **B**, **C** and **D** in Fig. 22.1

A .....**A** RuBP / ribulose bisphosphate ✓ .....
B triose phosphate / TP ✓

B .....**C** fatty acid(s) ✓ .....
D amino acid(s) ✓

C .....

D .....

[4]

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(b) A scientist investigated the rate of photosynthesis in lesser pondweed, *Potamogeton pusillus*.

The method used is outlined below:

- Add 200 cm^3 of distilled water to a 300 cm^3 glass beaker.
- Dissolve 5 g of $NaHCO_3$ in the water to provide an excess of CO_2.
- Place the beaker in a water bath at 10 °C and leave for 10 min to equilibrate.
- Insert an oxygen sensor into the water in the beaker and measure the baseline O_2 concentration.
- Place 100 g of *P. pusillus* into the beaker.
- Remove all other light sources from the room and place an LED light source 20 cm above the top of the beaker.
- Use a light intensity meter to ensure the light intensity above the beaker is 5000 lux.
- Measure the concentration of oxygen dissolved in the water using a data logger every 10 min for 200 min.
- Carry out four more repeats at 10 °C.
- Repeat all the above steps in water baths at 15 °C, 20 °C, 25 °C and 30 °C.

(i) Identify the following variables from the scientist's method:

independent variable

temperature ✓ .....

dependent variable

concentration of oxygen ✓ .....

one control variable ..... species / type of pondweed **OR** mass of pondweed **OR** light intensity / distance of light source from beaker .. time in water bath / equilibration time / time intervals **OR** volume of (distilled) water **OR** mass of $NaHCO_3$ ✓ ..

[3]

(ii) Identify **one** variable that was **not** controlled in the scientist's method.

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

pH ✓
concentration of CO_2 ✓

age of pondweed ✓
size / surface area / number , of leaves ✓

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(c) Fig. 22.2 is a graph of the scientist's results.

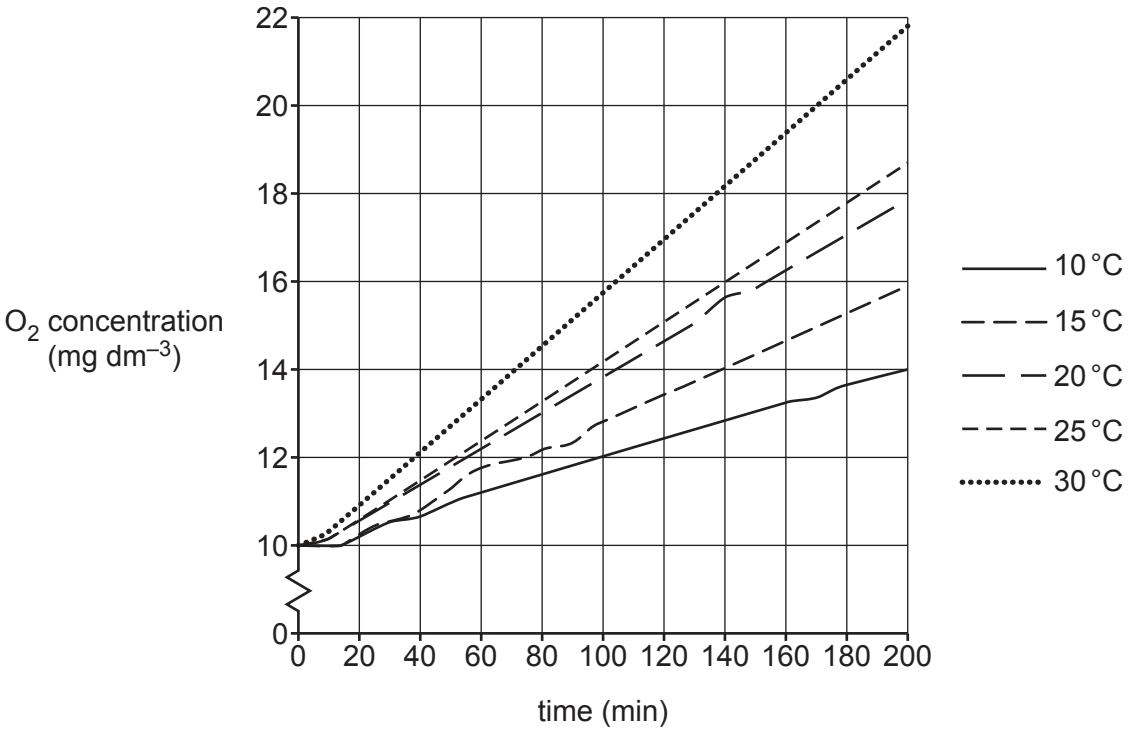


Fig. 22.2

Describe **and** explain what these results show about photosynthesis in *P. pusillus*.

increasing temperature increases , O_2 concentration / rate of photosynthesis ✓

at each temperature rate of , oxygen production / photosynthesis , is constant ✓

explanations

oxygen is a product of , photosynthesis / photolysis / light-dependent reactions ✓

temperature acts as a limiting factor ✓

no other (named) factor was limiting ✓

increasing temperature increases , kinetic energy of molecules / rate of enzyme reactions ✓

[3]

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(d) The light-independent stage of photosynthesis used to be referred to as the 'dark reaction'.

(i) Explain why this is both an accurate **and** an inaccurate way to describe the light-independent stage.

accurate because:
does not require , photons / light energy ✓

inaccurate because:
needs , ATP / reduced NADP , produced in light-dependent stage ✓

.....

.....

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

(ii) Name the enzyme responsible for fixing CO_2 in the light-independent stage.

ribulose bisphosphate carboxylase / RuBisCO ✓ ..... **[1]**

(e) The scientist then investigated the effect of auxin on *P. pusillus* stems.

The growing tips of stems were removed and the stems were placed in solutions containing different concentrations of auxin.

The scientist analysed the results and determined the following relationship:

The higher the concentration of auxin in the solution, the fewer side shoots grew on the *P. pusillus* stems.

(i) Explain why this relationship occurs in *P. pusillus* stems.

(auxin causes) apical dominance ✓ .....

.....

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

(ii) Give **two** examples of the commercial uses of auxin.

1 rooting , powder / solutions ✓
micropropagation / tissue culture ✓ .....

2 weed killers / herbicides ✓
production of seedless fruit ✓
preventing abscission ✓
promotes fruit ripening ✓ .....

[2]

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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