OCR
Oxford Cambridge and RSA

Thursday 5 June 2025 – Afternoon

A Level Biology A

H420/01 Biological processes

Time allowed: 2 hours 15 minutes

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

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

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

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **32** pages.

ADVICE
- Read each question carefully before you start your answer.

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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.

1 Which option describes a function of inorganic ions?

A Ca^{2+} is pumped across the membrane of a neurone to establish the resting potential.

B Cl^- and HCO_3^- are involved in transport of oxygen in the blood.

C Plants need NO_3^- for synthesis of amino acids.

D PO_4^{3-} is a component of triglycerides.

Your answer ☐ **[1]**

2 Which option describes a conjugated protein?

A A globular protein with a prosthetic group

B A protein with an inorganic ion

C A protein with more than one polypeptide chain

D An enzyme with an inorganic ion

Your answer ☐ **[1]**

3 Which statement about the function of enzymes is **not** correct?

A Enzymes affect the structure of whole organisms.

B Enzymes build larger molecules from smaller molecules.

C Enzymes carry signals from one part of the body to another.

D Enzymes catalyse reactions that affect cellular metabolism.

Your answer ☐ **[1]**

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4 Which option describes the structure of biological molecules?

A Carbohydrates contain only C, H and O, usually with an H to O ratio of 2 : 1.

B Nucleic acids contain only C, H, O, N, P and S in variable ratios.

C Proteins contain only C, H, O and N in variable ratios.

D Triglycerides contain only C, H and O, usually with an H to O ratio of 2 : 1.

Your answer ☐ **[1]**

5 Which option describes endocrine communication?

A Endocrine glands release hormones into ducts such as the pancreatic duct.

B Hormones are all lipid soluble and bind to receptors in the cytoplasm.

C Hormones are released from exocrine glands and taken by the blood to specific target cells.

D Target cells have specific receptors for the hormones that act upon them.

Your answer ☐ **[1]**

6 Which option describes a role of the adrenal glands within the endocrine system?

A Adrenaline is produced by the adrenal cortex.

B Glucocorticoids help to regulate the balance of salt and water concentrations in the body.

C Mineralocorticoids are produced in the adrenal medulla.

D The adrenal cortex secretes steroid hormones.

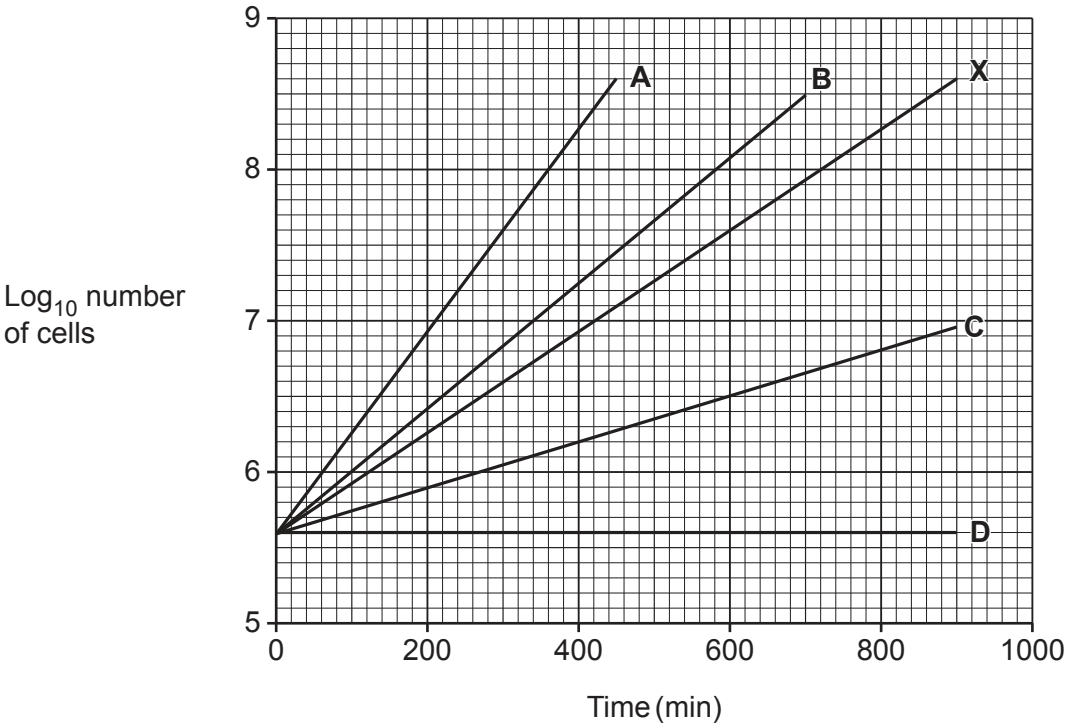
Your answer ☐ **[1]**

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A student investigates the growth of yeast cells in culture under different conditions.

In experiment one they grow yeast cells with glucose at 25 °C. The results are shown as line **X** on the graph.

In experiment two they grow yeast cells under different conditions. The results are shown as lines **A** to **D** on the graph.



Use the information to answer questions **7** and **8**.

7 In experiment one, what is the number of cells in the culture after 10 hours?

A 0.9×10^7

B 4.0×10^7

C 7.6

D 7.6×10^7

Your answer ☐ **[1]**

8 Which line, **A** to **D**, in experiment two represents a culture where the growth rate is approximately double that in experiment one?

Your answer ☐ **[1]**

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9 A scientist measures the oxygen uptake and carbon dioxide output of an athlete on an exercise bike at increasing work rates.

The results are shown in the graph.

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What are the results shown in the graph?

A There is a negative correlation between oxygen uptake and work rate.

B There is a positive correlation between carbon dioxide output and work rate up to 300 W after which the correlation becomes negative.

C There is a positive correlation between oxygen uptake and work rate.

D There is no correlation between carbon dioxide output and work rate.

Your answer ☐ **[1]**

10 Following a period of intense exercise an athlete breathes out forcefully.

Which option describes the mechanism of forceful expiration in this athlete?

A The diaphragm contracts and the internal intercostal muscles contract.

B The diaphragm relaxes and the internal intercostal muscles relax.

C The external intercostal muscles contract and the internal intercostal muscles relax.

D The external intercostal muscles relax and the internal intercostal muscles contract.

Your answer ☐ **[1]**

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11 A student completes a series of experiments to investigate the role of auxin in apical dominance.

The experimental procedures are shown in the table.

Experiment	Procedure
1	Control: apical bud left on plant.
2	Apical bud removed.
3	Apical bud removed and replaced with agar block.
4	Apical bud removed and replaced with agar block containing auxin.

What are the expected results of the investigation?

A Lateral buds will grow in all the experiments.

B Lateral buds will grow in experiments 2 and 3.

C Lateral buds will grow in experiments 2, 3 and 4.

D Lateral buds will not grow in any of the experiments.

Your answer ☐ **[1]**

12 What is the function of the link reaction in aerobic respiration?

A It converts acetate produced in glycolysis to pyruvate.

B It converts pyruvate to oxaloacetate.

C It uses coenzyme A to accept carbon from pyruvate.

D It uses reduced NAD to oxidise pyruvate.

Your answer ☐ **[1]**

13 Which statement does **not** describe the Krebs cycle?

A It combines an acetyl group with citrate to form oxaloacetate.

B It is a source of ATP produced by substrate level phosphorylation.

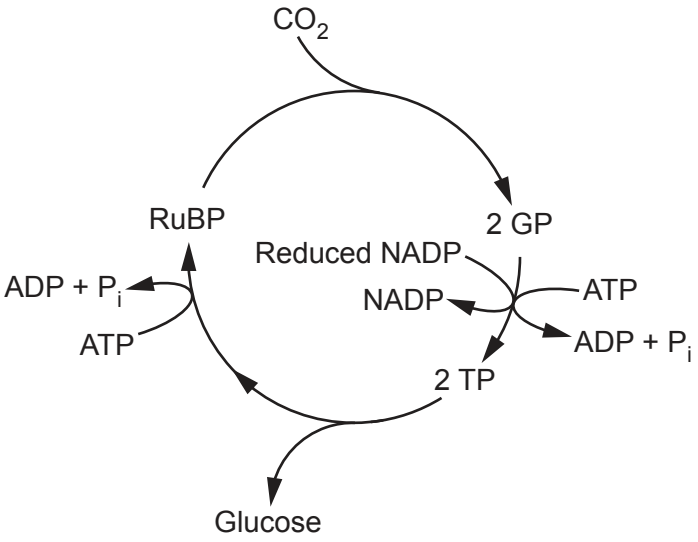
C It is a source of reduced NAD and reduced FAD that are re-oxidised in oxidative phosphorylation.

D It releases coenzyme A for reuse in the link reaction.

Your answer ☐ **[1]**

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The diagram shows the process of carbon dioxide fixation in the light independent stage of photosynthesis (Calvin cycle).



Use the diagram to answer questions **14** and **15**.

14 Which of the statements about the effect of reducing light intensity is/are correct?

1 The amount of glucose produced will be reduced.
2 The concentration of GP will increase.
3 More ATP and reduced NADP will be available from the light dependent reaction.

A 1, 2 and 3 are correct

B Only 1 and 2 are correct

C Only 2 and 3 are correct

D Only 1 is correct

Your answer ☐ **[1]**

15 Which of the statements about the effect of reducing carbon dioxide concentration is/are correct?

1 The amount of glucose produced will be increased.
2 The concentration of RuBP will increase.
3 The concentrations of GP and TP will both decrease.

A 1, 2 and 3 are correct

B Only 1 and 2 are correct

C Only 2 and 3 are correct

D Only 1 is correct

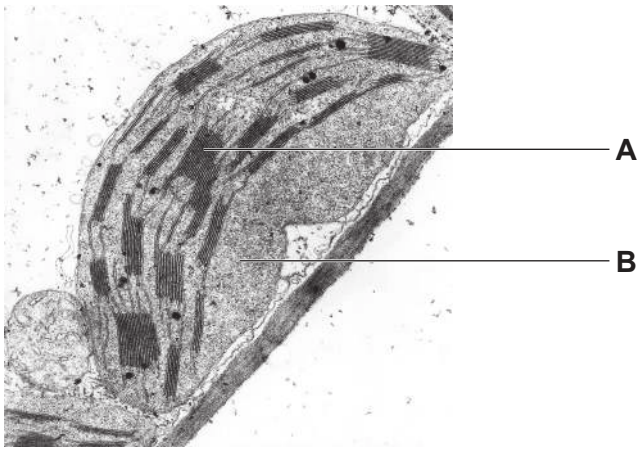
Your answer ☐ **[1]**

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Section B

16

(a) This is a transmission electron micrograph of a chloroplast.



(i) Identify the components labelled **A** and **B and** describe how they are adapted for their function.

Component **A** .....

Adaptation .....

.....

.....

Component **B** .....

Adaptation .....

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[4]

(ii) Identify **one** similarity and **one** difference between the structures of chloroplasts and the structures of mitochondria.

Similarity .....

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Difference .....

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[2]

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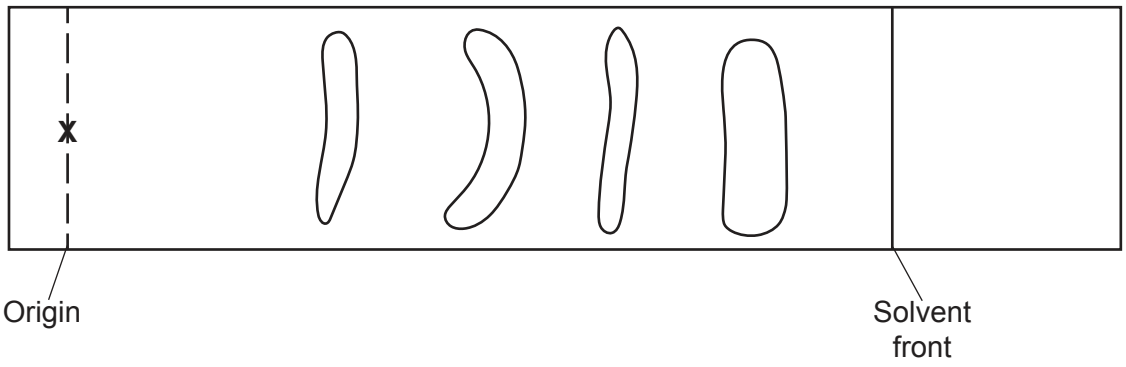
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(b) A student used thin layer chromatography (TLC) to separate the photosynthetic pigments in a chloroplast extract.

This is the result of the TLC.



(i) Calculate the R_f for the most soluble pigment.

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

Distance travelled = ... mm

R_f = ...

[3]

(ii) The student noticed that the spots were very faint and thought that there might be other pigments present in the mixture that were too faint to be seen.

Describe how the student could increase the intensity of the spots using the same chloroplast extract.

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

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(iii) Describe how the student could use the same equipment but increase the accuracy of the calculated R_f value.

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

(iv) The student was not able to identify any of the pigments using R_f values from a data book.

Suggest an explanation for this.

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

(v) Describe how the student could use TLC to identify the pigments present in the mixture without calculating R_f values.

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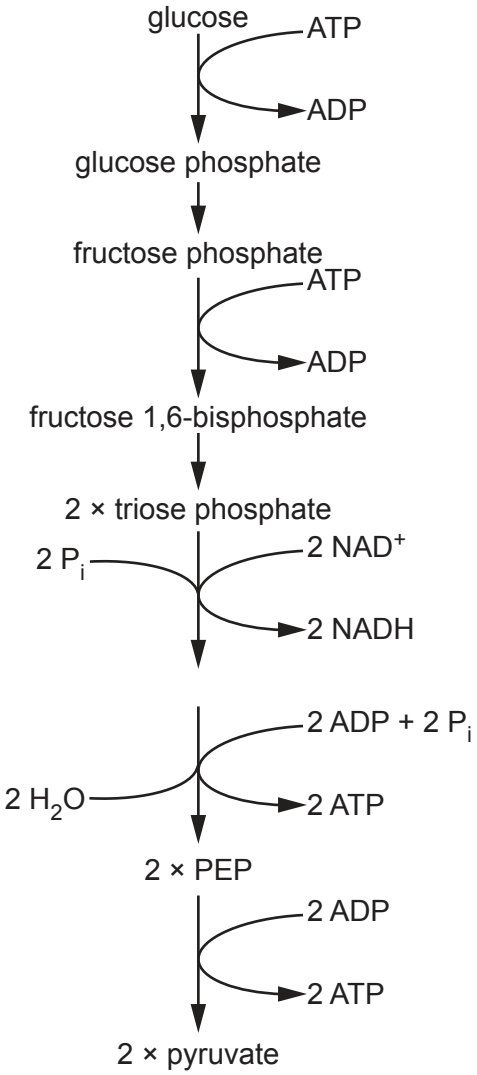
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17

(a) The diagram shows some of the steps in glycolysis.



The enzyme phosphofructokinase (PFK) catalyses the conversion of fructose phosphate to fructose 1,6-bisphosphate (hexose bisphosphate).

(i) State the type of reaction that is catalysed by PFK.

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

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(ii) The intermediate compound PEP is a reversible non-competitive inhibitor of PFK.

Explain how PEP inhibits PFK.

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(iii) ATP is also an inhibitor of PFK.

Suggest **and** explain why ATP cannot be a competitive inhibitor of PFK.

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

(iv) Inhibition of PFK by ATP and PEP is an example of a negative feedback control mechanism.

State the name of this type of inhibition in metabolic pathways such as glycolysis.

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

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(v) ATP is converted to ADP and then AMP (adenosine monophosphate) when ATP provides energy for processes in the cell.

AMP reverses the inhibition of PFK by ATP.

Use this information to suggest how PFK acts as a key enzyme in the regulation of the rate of glycolysis.

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

(b) Complete the following sentence.

Some inhibitors form strong covalent bonds with enzymes and are known as

..... inhibitors.

[1]

(c) The chemical equation for aerobic respiration with glucose as substrate is:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

(i) State the name of the type of reaction in aerobic respiration that produces CO_2.

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

(ii) State the names of the **two** stages in respiration where CO_2 production occurs.

1 .....

2 .....

[2]

(iii) Respiration of glucose involves a series of oxidation reactions.

Explain how oxidation occurs in glycolysis.

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18

(a) Describe the role of plant hormones in the control of seed germination.

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

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(b)* Scientists investigate the effect of gibberellin on stem length in young soybean plants.

This is the method they use:

- Select young plants with 4 pairs of leaves.
- Apply gibberellin solution to the leaves of 8 young plants.
- Select 8 more young plants as a control group.
- Allow young plants to grow until they develop 7 pairs of leaves.
- Measure the distance between the fifth and sixth pairs of leaves in each young plant. This is called the internode distance.
- Calculate the mean and standard deviation of the internode distance for each group.

Their results are shown in the table.

Group	Mean internode distance (cm)	Standard deviation
Gibberellin treated	6.33	1.44
Control	3.58	1.27

Here are the critical values for *t*.

Degrees of freedom (df)	Probability (%)	
	5.0	**1.0**
6	2.45	3.71
7	2.36	3.50
8	2.31	3.36
10	2.23	3.17
12	2.18	3.05
14	2.15	2.98
16	2.12	2.92

The scientists used Student's *t*-test to compare the mean internode distances in the treated and control groups.

Their calculated value for *t* was 4.05.

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The scientists concluded that gibberellin caused a significant increase in stem length in young soybean plants.

Suggest a null hypothesis for the investigation **and** evaluate this conclusion.

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Extra answer space if required.

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(c) Soybeans are important food crops.

Farmers often grow soybeans with the plants close together but this causes the stems to grow too long so that the plants fall over, which reduces the crop yield.

A scientist suggested that spraying soybean plants with a chemical that inhibits gibberellin production could increase yields.

Explain the scientist's suggestion.

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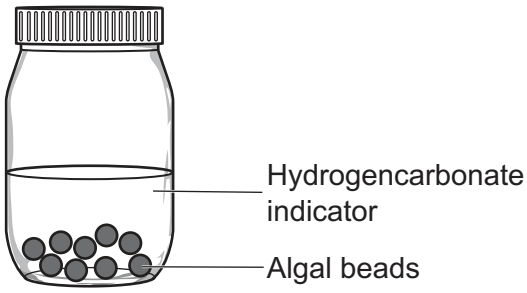
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19

(a) A student investigates the effect of light intensity on the rate of photosynthesis in algae that had been immobilised in calcium alginate to make algal beads.

The student places the algal beads in small screw-cap bottles containing hydrogencarbonate indicator.

The indicator turns from orange to red and then purple as CO_2 is removed from the solution.



The student uses the time taken for the indicator to turn purple as a measure of the rate of photosynthesis.

(i) State **two** variables that the student should keep constant during this experiment.

1 .....

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2 .....

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[2]

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(ii) The student places the bottles at different distances from a light source.

There are four replicates at each distance.

The student's results are shown in the table.

Distance (D) from light source (cm)	**Relative light intensity ($1/D^2$)**	**Time taken for indicator to turn purple (min)**				
		Replicate 1	Replicate 2	Replicate 3	Replicate 4	Mean
250	1.60×10^{-5}	65	63	66	67	65.3
375		77	80	82	78	
500	4.00×10^{-6}	103	99	101	95	99.5
1000	1.00×10^{-6}	185	190	130	195	190.0

The student calculates relative light intensity using the following formula:

$$\text{Relative light intensity} = \frac{1}{\text{distance}^2}$$

Calculate the relative light intensity and mean for the 375 cm distance.

Relative light intensity = ...

Mean = ... min

[2]

(iii) Outline an improvement to the method that the student could use to get a more accurate measure of the rate of photosynthesis.

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

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(b) The student wants to use the algal beads method to investigate the effect of CO_2 concentration on the rate of photosynthesis.

(i) Explain why it would **not** be possible to use the hydrogencarbonate indicator method to investigate the effect of CO_2 concentration.

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(ii) Suggest how the student could modify the method so the effect of CO_2 concentration on the rate of photosynthesis could be measured.

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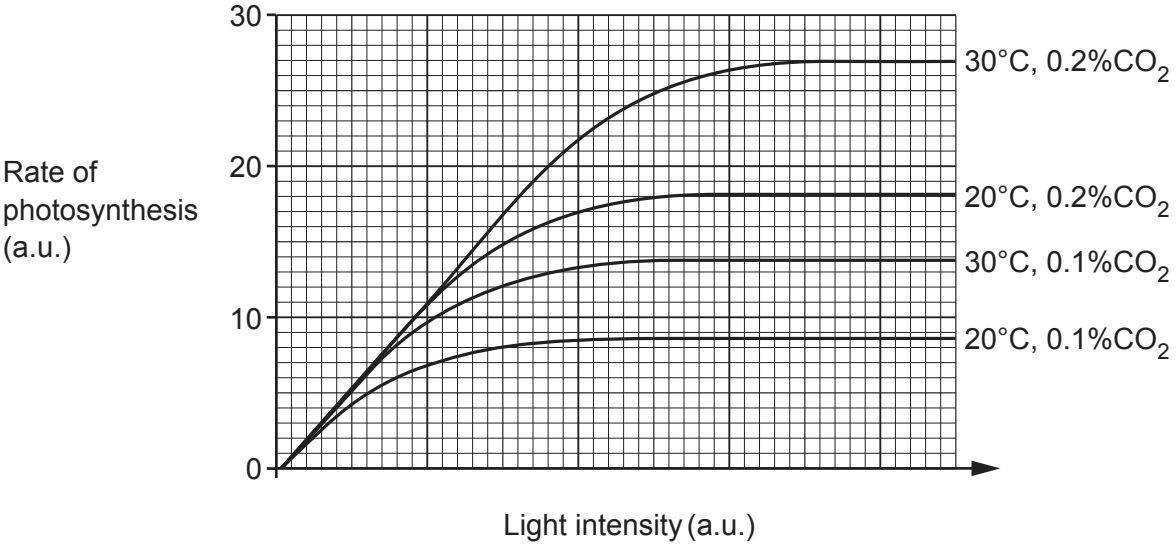
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(c) The graph shows the effect of light intensity on the rate of photosynthesis at two temperatures and two CO_2 concentrations.



(i) Explain the evidence from the graph that shows that CO_2 concentration is a limiting factor in these experiments.

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

(ii) A student looked at the graph and concluded that CO_2 concentration has a greater effect on the rate of photosynthesis than temperature.

Use your knowledge of Q_{10} and a calculation to support the student's conclusion.

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20

(a) The table compares features of different types of blood vessel in mammals.

Feature	Blood vessel type			
	E	**F**	**G**	**H**
Diameter of lumen	largest	large	small	smallest
Thickness of wall	thin	thickest	thick	thinnest
Proportion of smooth muscle and elastic fibres in wall	more smooth muscle than elastic fibres	more elastic fibres than smooth muscle	similar proportions of both	none present

Use the letters **E** to **H** to complete the following table.

Each letter may be used once, more than once, or not at all.

Description	**Blood vessel type**
This blood vessel type transports deoxygenated blood to the lungs.	.....
This blood vessel type is the site of exchange of gases and nutrients.	.....
This blood vessel type is involved in regulation of blood flow near the surface of the skin.	.....

[3]

(b) Unlike most other veins, pulmonary veins do not have valves.

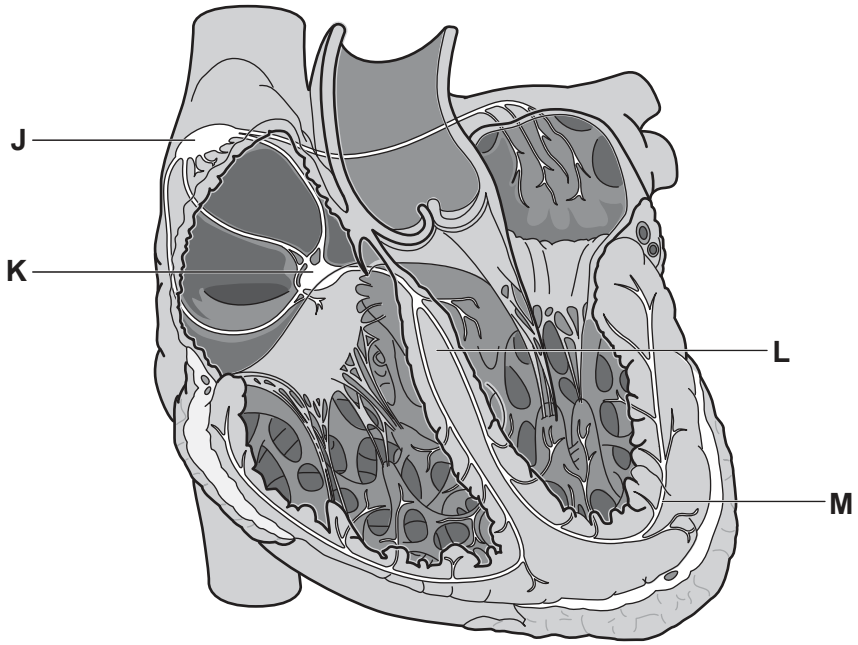
Suggest why valves are **not** needed in pulmonary veins.

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(c) This is a drawing of a dissected human heart.



Identify the structures labelled **J** to **M**.

J .....

K .....

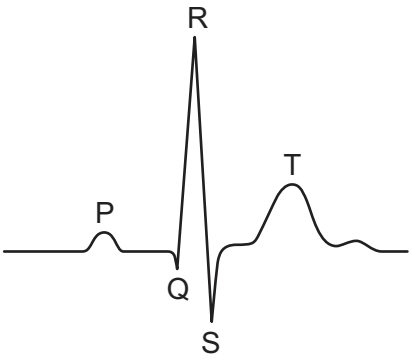
L .....

M .....

[4]

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(d)* This is an electrocardiogram (ECG) trace of a single heartbeat.



Describe how contraction of the heart muscle at rest is initiated and relate this process to the electrical activity recorded by the ECG.

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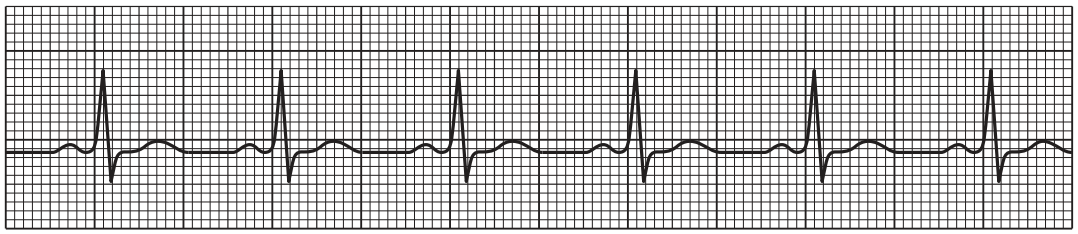
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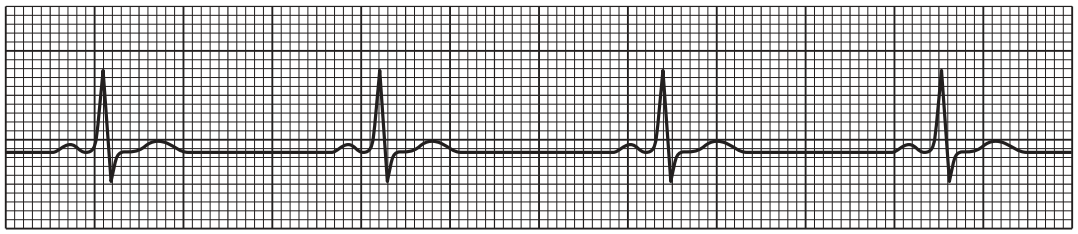
(e) **Fig. 20.1** shows a normal ECG trace.

Fig. 20.1



(i) **Fig. 20.2** shows an ECG trace from a patient with abnormal heart activity.

Fig. 20.2



Identify this abnormality.

Give a reason for your identification.

Abnormality .....

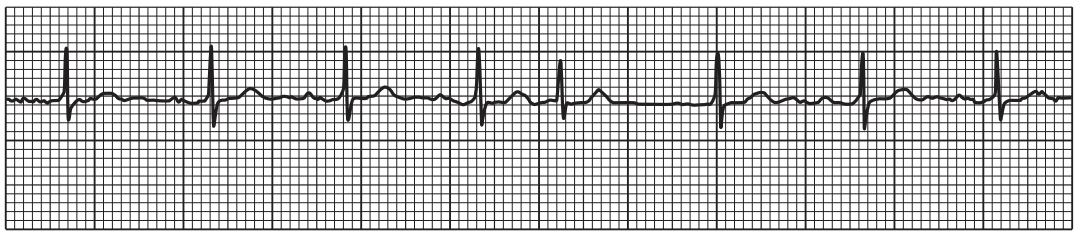
Reason .....

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[1]

(ii) **Fig. 20.3** shows an ECG trace from another patient with abnormal heart activity.

Fig. 20.3



Identify this abnormality.

Give a reason for your identification.

Abnormality .....

Reason .....

.....

[1]

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21

(a)

(i) Describe **three** ways fish gills are adapted for efficient gas exchange.

1 .....

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2 .....

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3 .....

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[3]

(ii) Explain why insects can function with open circulatory systems.

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

(iii) The largest fish is the whale shark. Whale sharks have an average mass of 20 tonnes.

The largest marine mammal is the blue whale. Blue whales have an average mass of 150 tonnes.

Use your knowledge of gas exchange and circulatory systems to suggest why marine mammals can grow to a much larger size than fish.

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

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(b) Explain how the structure of haemoglobin allows it to transport oxygen from the lungs to the tissues.

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

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

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