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A Level Biology A

H420/01 Biological processes

Thursday 7 June 2018 – Morning

Time allowed: 2 hours 15 minutes

You must have:
- the Insert (inserted)

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

First name									
Last name									
Centre number						Candidate number				

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

INFORMATION
- The total mark for this paper is **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 **32** 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 Which of the following statements, **A** to **D**, correctly explains a feature of an efficient gaseous exchange surface?

A The layers are thin for a short diffusion distance.

B There is a good blood supply, so the system reaches equilibrium quickly.

C There is an increased surface area to reduce surface area to volume ratio.

D Ventilation takes place to reduce concentration gradient of dissolved gases.

Your answer ☐ **[1]**

2 The following are a series of organic molecules and the chemical processes that occur to convert them into different molecules.

Which of the rows, **A** to **D**, is correct?

A nucleic acid $\xrightarrow{\text{hydrolysis}}$ nucleotide $\xrightarrow{\text{hydrolysis}}$ polynucleotide

B α-glucose $\xrightarrow{\text{condensation}}$ amylopectin $\xrightarrow{\text{hydrolysis}}$ α-glucose

C amino acid $\xrightarrow{\text{condensation}}$ dipeptide $\xrightarrow{\text{hydrolysis}}$ polypeptide

D β-glucose $\xrightarrow{\text{condensation}}$ cellulose $\xrightarrow{\text{condensation}}$ maltose

Your answer ☐ **[1]**

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3 The following table describes the approximate percentage mass of different chemical elements in organic polymers.

	Polymer	N (%)	C (%)	O (%)	H (%)	P (%)
A	nucleic acid	20.0	30.0	20.0	10.0	20.0
B	carbohydrate	0.0	33.3	33.3	33.3	0.0
C	protein	30.0	10.0	10.0	0.0	50.0
D	lipid	0.0	50.0	49.0	1.0	0.0

Which of the rows, **A** to **D**, is correct?

Your answer ☐ **[1]**

Turn over for the next question

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4 Which of the following statements, **A** to **D**, about DNA replication is correct?

A RNA will bind to DNA through complementary base-pairing.

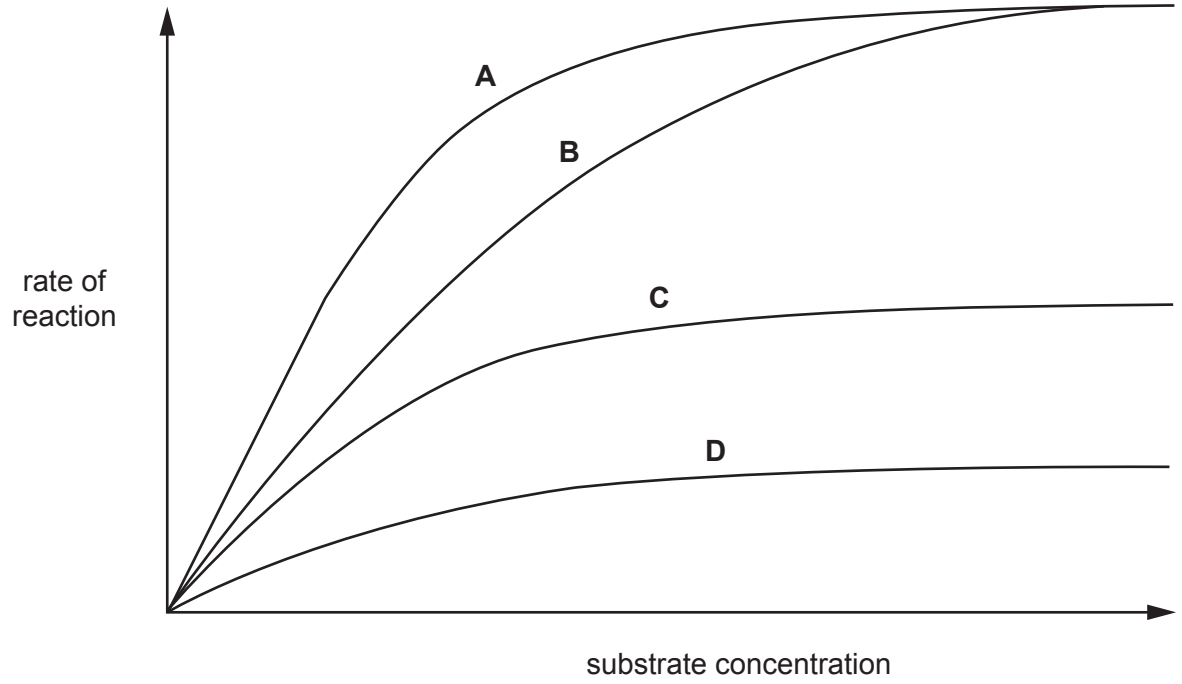
B The distance between the strands in the double helix will always be the same.

C The proportion of adenine in a nucleic acid will always equal the proportion of guanine.

D The formation of phosphodiester bonds will occur in the same direction on each strand during DNA replication.

Your answer ☐ **[1]**

5 The following graph shows the rate of reaction of an enzyme in different substrate concentrations.



Which letter, **A** to **D**, shows the rate of reaction with a fixed quantity of competitive inhibitor?

Your answer ☐ **[1]**

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6 Which of the statements, **A** to **D**, applies to transpiration **and** evaporation?

A It occurs at a faster rate at higher humidity.

B It occurs at a slower rate at greater wind speed.

C It occurs at a slower rate at higher temperature.

D It occurs at the surface of leaves.

Your answer [ ] **[1]**

7 Which of the statements, **A** to **D**, explains why diastole follows systole in the mammalian heart?

A Cardiac muscle is myogenic.

B Cardiac muscle takes a short time to repolarise after being stimulated.

C The aorta is capable of maintaining the pressure generated by the left ventricle.

D The SAN receives impulses from the AVN.

Your answer [ ] **[1]**

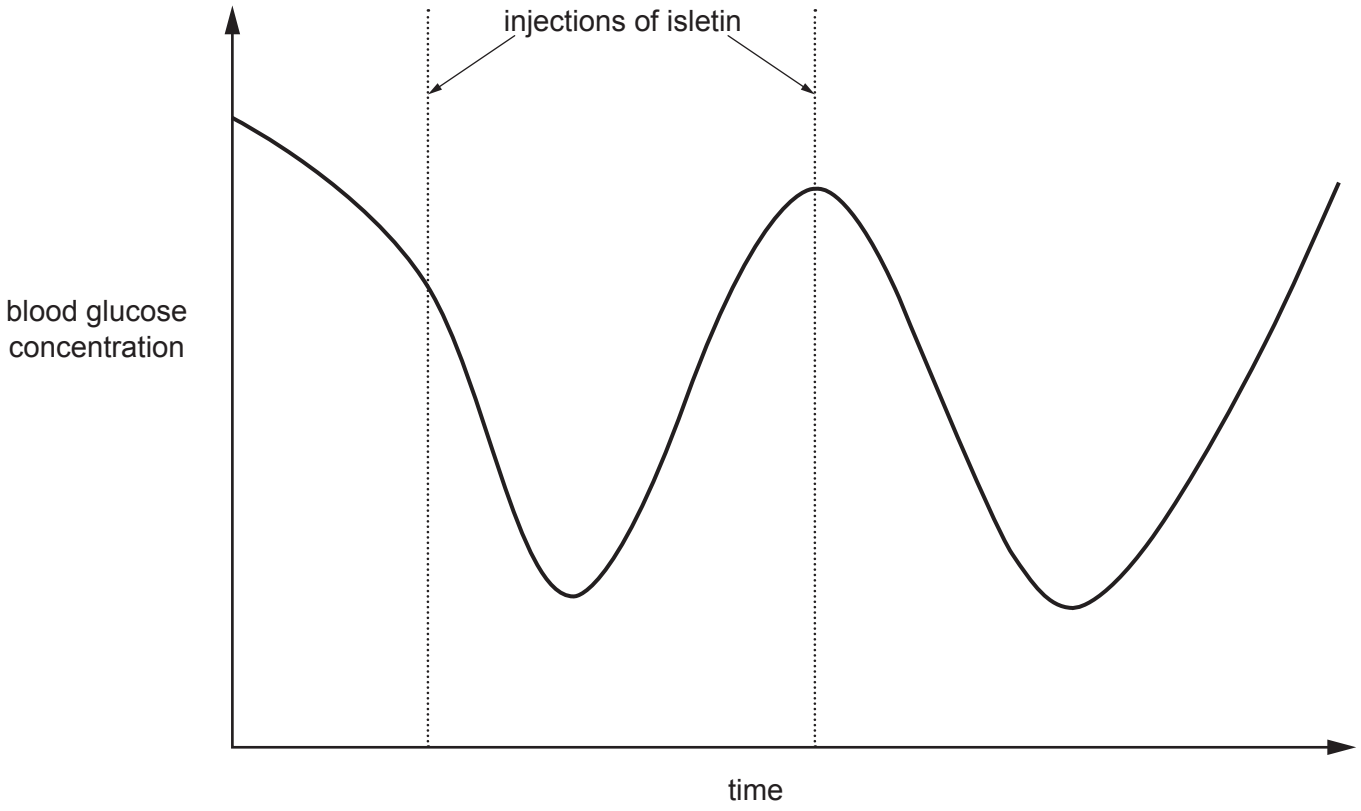
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8 Banting and Best pioneered experiments into the functions of the pancreas.

In one experiment, they removed the pancreas of dogs. Shortly afterwards, the dogs developed the symptoms of diabetes.

- Banting ground up the removed pancreas to produce an extract.
- He called the extract “isletin”.
- The isletin was then injected into dogs that had had their pancreas removed.
- He then tested the blood glucose concentration.

The graph below is a summary of the results.



Which of the following statements correctly explains these results?

1 Isletin is made in the α cells in the islets of Langerhans.
2 Isletin reduces blood glucose concentration.
3 The effects of isletin are short-lived.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

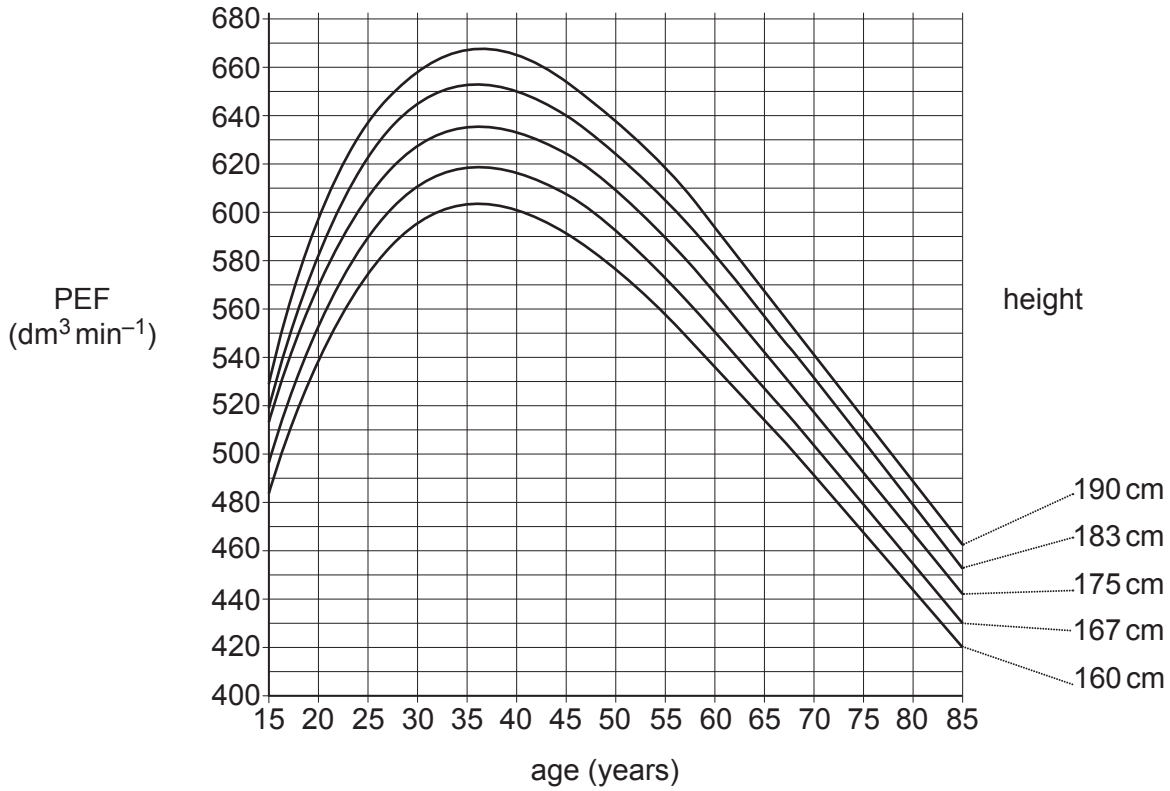
D Only 1

Your answer ☐ **[1]**

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9 Peak expiratory flow (PEF) is a measure of the maximum rate at which a person can exhale.

The graph below shows the typical PEF values for men of different ages and heights.



Which of the following is the percentage increase from the PEF of a 20 year old man of 175 cm to the PEF of a 45 year old man of 183 cm?

A 19.4%

B 10.9%

C 12.3%

D 8.1%

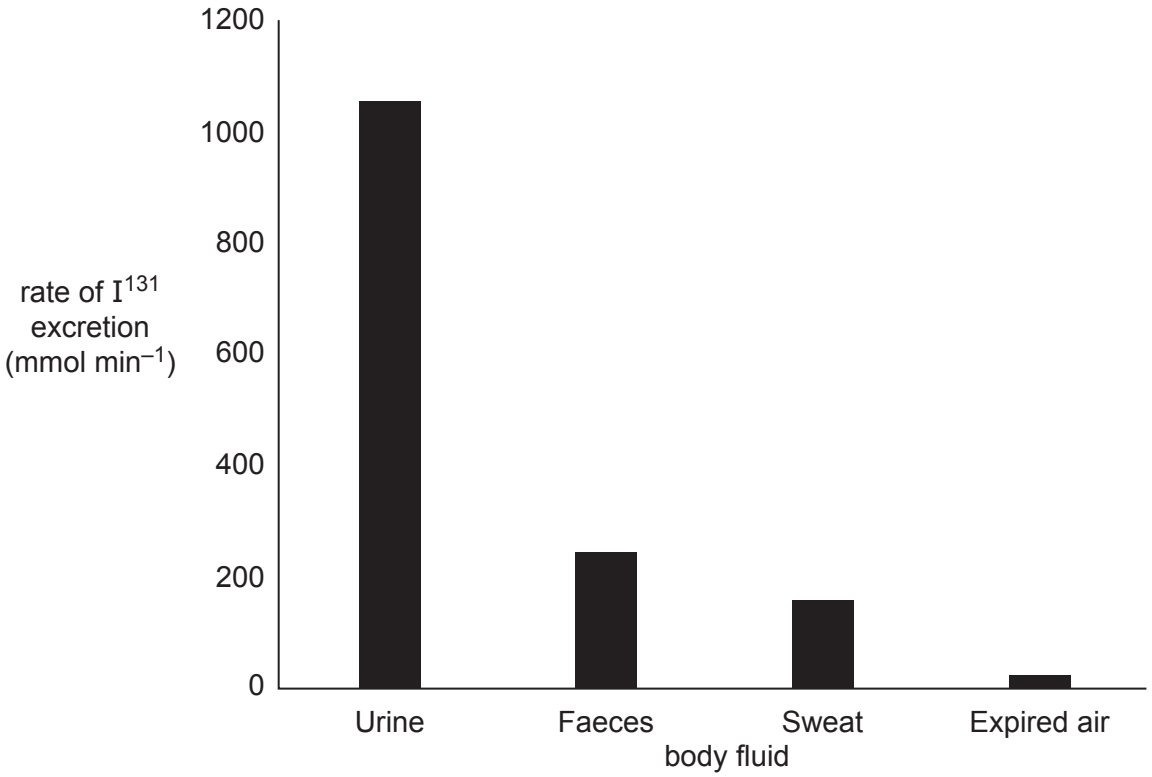
Your answer ☐ **[1]**

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10 One treatment for thyroid cancer is radioactive iodine. The radioisotope I^{131} is used.

The thyroid gland absorbs any iodine that enters the body, so the radioactive isotope kills the cancerous cells in the thyroid gland. The I^{131} is then excreted from the body.

Different body fluids excrete different proportions of I^{131}, as shown in the following graph.



Which of the following, **A** to **D**, correctly explains the different proportions of I^{131} in each body fluid?

A I^{131} is very soluble in water.

B I^{131} is able to cross capillary walls.

C The kidneys are more efficient at excreting I^{131} than the lungs.

D The thyroid gland is well supplied with blood.

Your answer ☐ **[1]**

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11 Which of the following, **A** to **D**, is a similarity in the way ATP is made in respiration and photosynthesis?

A both involve NAD

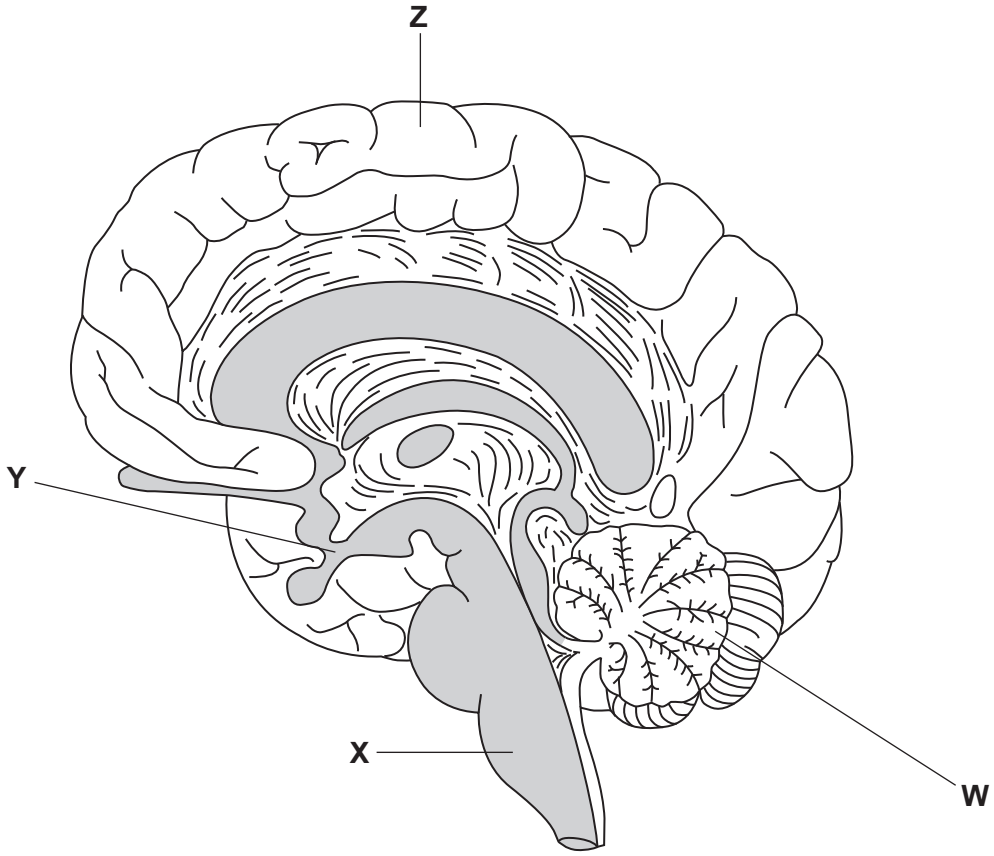
B both involve substrate level phosphorylation

C both involve photons

D both involve proton gradients

Your answer ☐ **[1]**

12 The image below is a diagram of the human brain.



Which of the labelled regions would be directly involved in learning to play a musical instrument?

A **W** and **X**

B **W** and **Y**

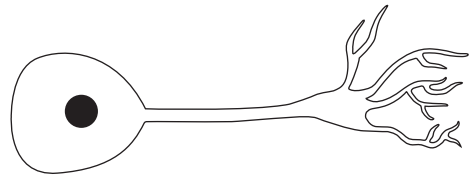
C **W** and **Z**

D **Y** and **Z**

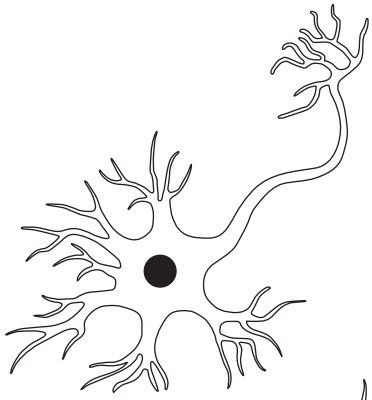
Your answer ☐ **[1]**

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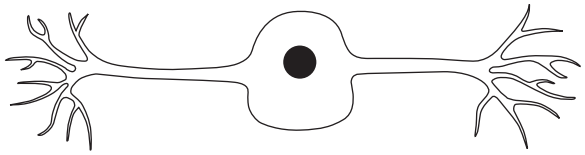
13 Which of the following diagrams, **A** to **D**, shows a sensory neurone?



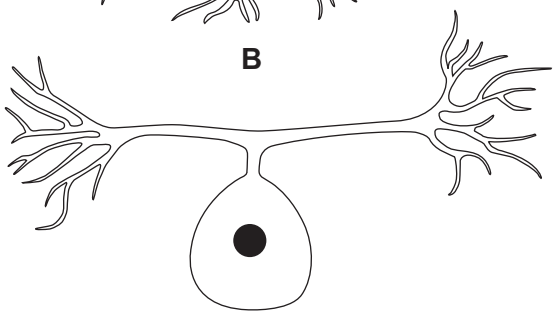
A



B



C



D

Your answer ☐ **[1]**

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14 The table below shows the membrane potentials of different neurones at a cholinergic synapse. The data were recorded on five separate occasions, as shown in the five rows.

	Membrane potential (mV)			
	Presynaptic neurone A	*Presynaptic neurone B*	*Presynaptic neurone C*	*Postsynaptic neurone*
1	+40	–70	–70	–70
2	–70	+40	–70	–70
3	–70	–70	+40	–70
4	+40	+40	–70	–70
5	+40	+40	+40	+40

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

A divergence

B hyperpolarisation

C spatial summation

D temporal summation

Your answer ☐ **[1]**

15 The drug metoprolol prevents stimulation of post-synaptic receptors in the sympathetic nervous system.

Which of the following conditions could this drug be used to treat?

1 Muscle fatigue
2 Tachycardia
3 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) Gestational diabetes is a medical condition that affects pregnant women. It results in high levels of glucose in the blood, even though the woman produces normal levels of insulin.

(i) Gestational diabetes is most similar to which **other** type of diabetes?

Explain your answer.

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(ii) Suggest **two** ways a woman with gestational diabetes can manage her condition.

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[2]

(b) (i) Skeletal muscle is one of the main tissues where glucose is removed from the blood in response to insulin.

Name the other tissue.

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

(ii) Explain why glucose is required for the contraction of skeletal muscle.

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(c) During late pregnancy, women find ventilation more difficult, as the developing foetus reduces the volume of the thorax. This can lead to tiredness and difficulty breathing.

A student used a spirometer to measure ventilation in a woman who was 36 weeks pregnant.

Fig. 16.1 shows the trace produced.

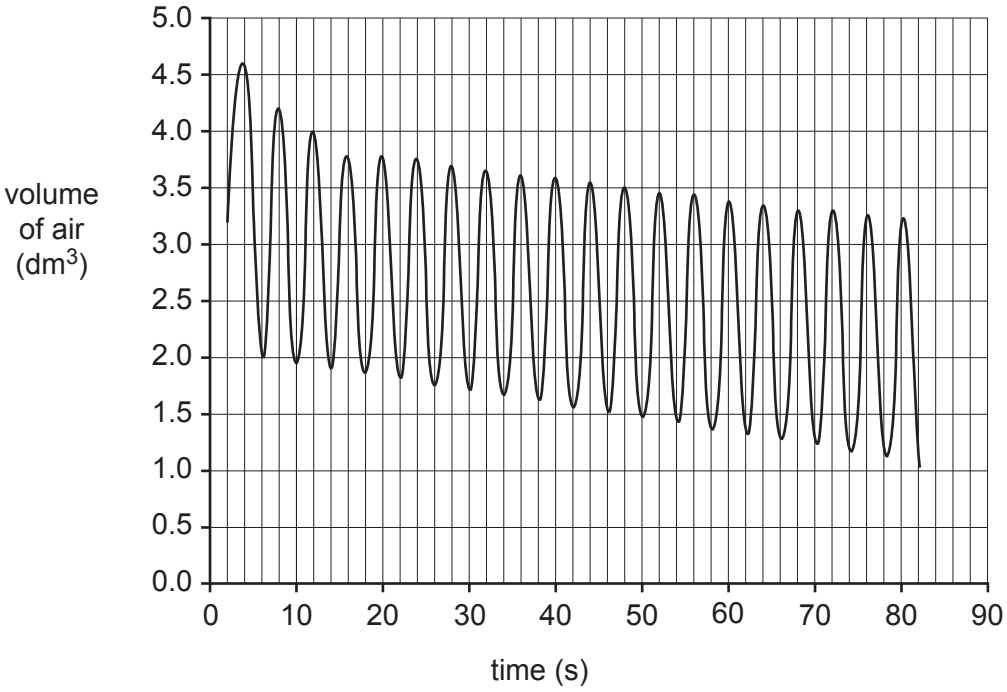


Fig. 16.1

Mean oxygen uptake rate at rest in women is around 0.020 $dm^3 s^{-1}$.

Using these data, the student made the following conclusion:

My data show that being pregnant reduces rate of oxygen uptake by up to 20%.

Evaluate this claim, using the data in Fig. 16.1.

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17 (a) Chromista are photosynthetic protoctists that live in water.

Chromista are different from other photosynthetic organisms because they contain the pigment chlorophyll *c*.

Chlorophyll *c* is not found in plants.

(i) Outline the importance of photosynthetic pigments in photosynthesis.

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(ii) The wavelengths of light absorbed by chlorophyll *c* are different from those wavelengths absorbed by chlorophyll *a* and chlorophyll *b*.

Suggest why Chromista need pigments that are different from those of other photosynthetic organisms.

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(b) Fig. 17.1 is a diagram of the chloroplast found in a Chromista cell.

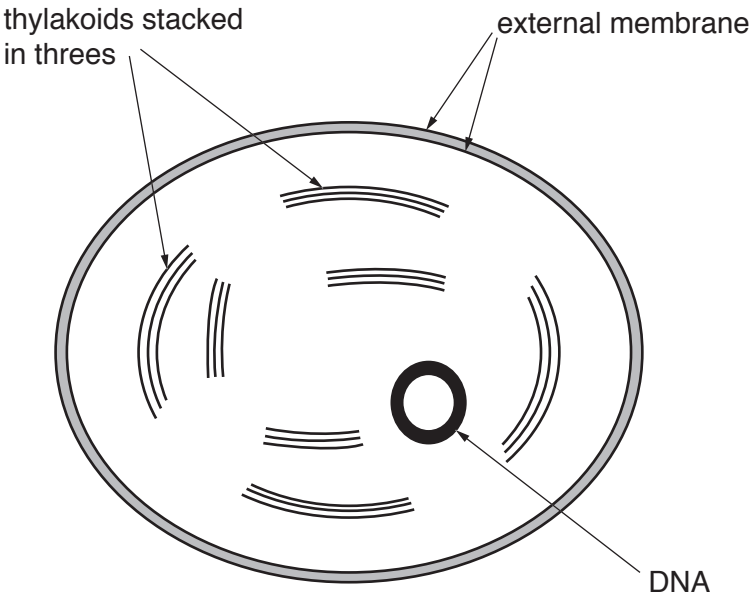


Fig. 17.1

Outline the structural differences between the Chromista chloroplast in Fig. 17.1 and the chloroplasts found in flowering plants.

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(c) Fig. 17.2 is a diagram of part of the plasma membrane of a Chromista cell.

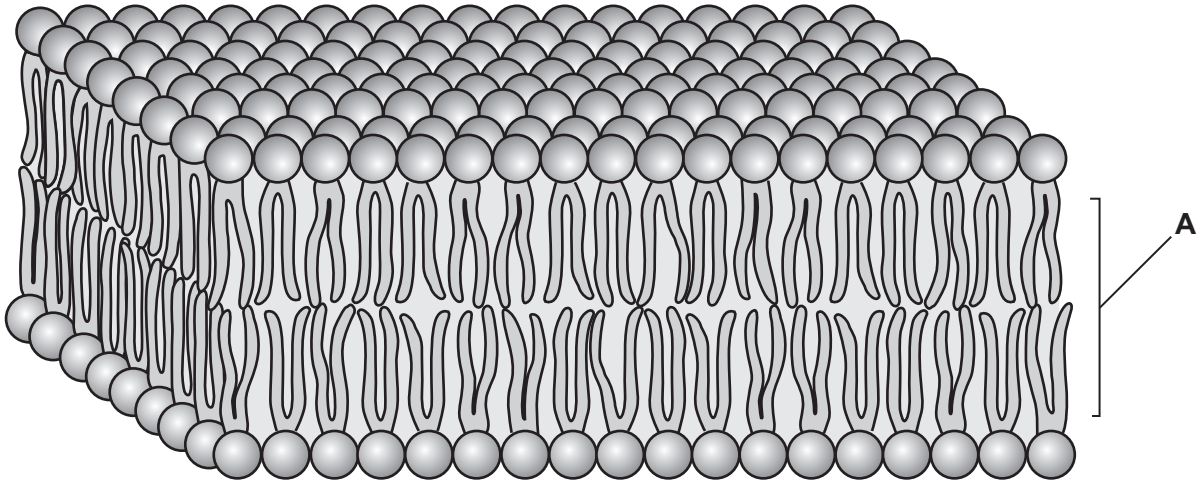


Fig. 17.2

(i) State and explain how **one** property of region **A** in Fig. 17.2 contributes to the stability of the plasma membrane.

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(ii) There are differences between the plasma membrane and membranes within cells.

Outline the role of membranes **within** cells.

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18 (a)* Plants lose water by transpiration.

The rate of transpiration varies between different species of plant.

The rate of transpiration can be measured using a potometer.

Plan an investigation into the rate of transpiration in two species of plant that would allow valid data to be collected.

Details of how to set up a potometer are not required.

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(b) Plant cell walls are made of cellulose. Cellulose is a polymer of β-glucose.

Give **three** properties of cellulose that make it suitable as the basis of plant cell walls.

1 .....

2 .....

3 .....

[3]

(c) Cellulose cannot be digested by animals. Some mammals have bacteria in their stomachs that produce enzymes that can digest cellulose.

Explain whether the action of these enzymes is intracellular or extracellular.

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Turn over for the next question

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19 Honeypot ants belong to several different genera. Some specialised individuals are used as food storage vessels. These individuals have swollen abdomens that store various foods, which can be given to members of the colony when required.

One such individual is shown in Fig. 19.1.



Fig. 19.1

An investigation was carried out into the respiratory substrate of three different genera of honeypot ant, by measuring oxygen uptake and carbon dioxide production.

The data are shown in Table 19.1.

Genus	**CO_2 produced ($mm^3 s^{-1}$)**	**O_2 consumed ($mm^3 s^{-1}$)**
Camponotus	0.89	0.88
Melophorus	0.59	0.66
Cataglyphis	1.01	1.47

Table 19.1

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(a) Use the data in Table 19.1 to suggest the likely diet of each genus of honeypot ant.

Justify your answer.

Genus	Diet	Justification
Camponotus	mainly carbohydrate	....
Melophorus	....	....
Cataglyphis	....	....

[3]

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(b) Chitin is a polysaccharide found in insects. It is used to form the hard outer casing of their bodies.

Fig. 19.2 shows the chemical structure of chitin.

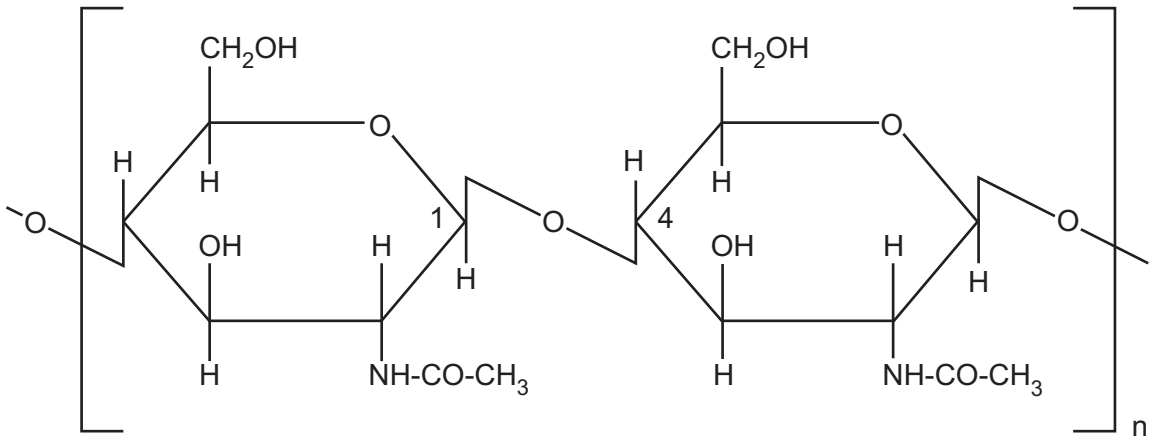


Fig. 19.2

Using information from Fig. 19.2, state **two** similarities and **two** differences between the structures of chitin and glycogen.

Similarity 1 .....

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Similarity 2 .....

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Difference 1 .....

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Difference 2 .....

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[4]

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(c)* Insects use glucose to generate ATP.

Outline the processes involved in the generation of ATP through **chemiosmosis**.

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20 (a) A student carried out an investigation into the effect of ethanol on the permeability of cell membranes in beetroot.

The student's method comprised the following five steps:

1. Cut equal sized pieces of beetroot using a cork borer.
2. Wash the pieces in running water.
3. Place the pieces in 100 cm^3 of different concentrations of ethanol.
4. After 5 minutes, remove samples from each of the ethanol solutions.
5. Place each of the samples into a colorimeter to collect quantitative data.

(i) Each step in the student's method relies on certain assumptions.

For each assumption listed below, select the **numbered step** from the student's method that relies upon that assumption.

*Assumption **A***

Pigment will only leak into the solution if membranes are disrupted.

*Assumption **A** relates to step* …….

*Assumption **B***

Absorbance is proportional to concentration of pigment.

*Assumption **B** relates to step* …….

*Assumption **C***

Pigment will be released when the beetroot is sliced.

*Assumption **C** relates to step* …….

[3]

(ii) The student kept the ethanol solutions at a constant temperature. State **two other** variables which need to be controlled in this investigation to ensure the data collected are valid.

1 .....

2 .....

[2]

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(b) Fig. 20.1 shows the graph plotted by the student.

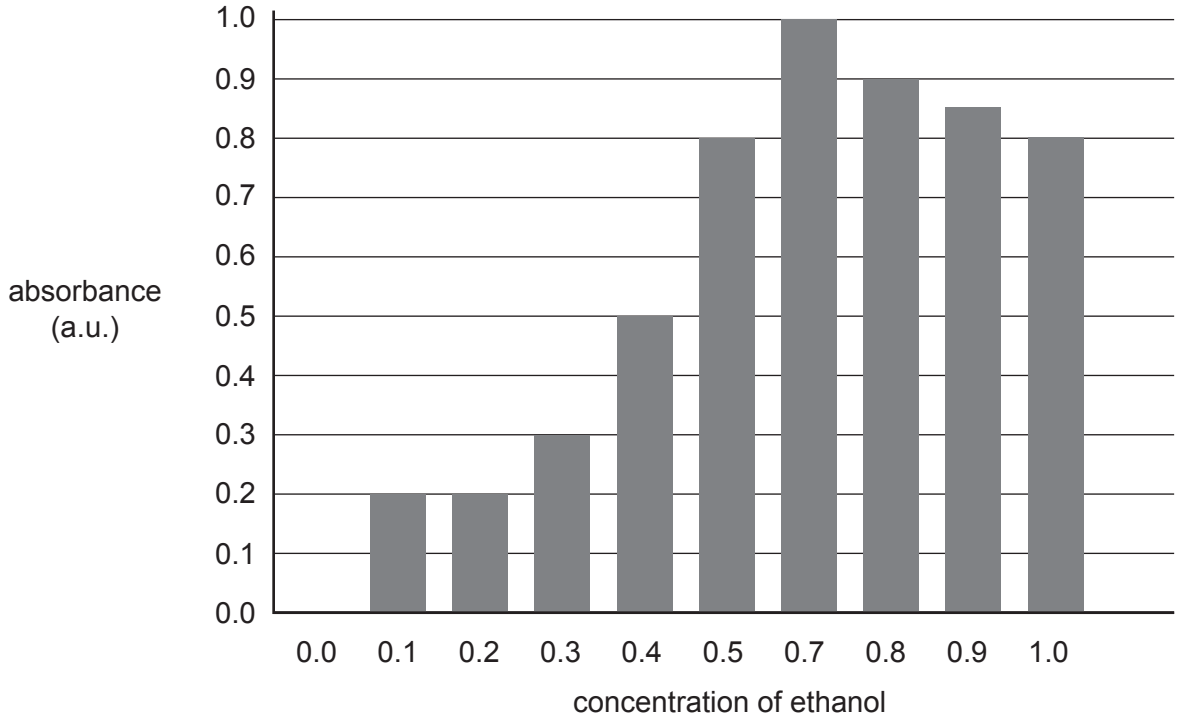


Fig. 20.1

(i) Make **three** criticisms of the way the student has displayed these results.

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(ii) Explain how carrying out replicates would improve this investigation.

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21 (a) The greater blue-ringed octopus, *Hapalochlaena lunulata*, is one of the most venomous of all animals.

Its bite contains tetrodotoxin (TTX), a neurotoxin that can cause paralysis and death within minutes.

(i) The following information has been discovered about the effects of TTX on nerve cells:

- TTX binds to the external surface of the voltage-gated sodium ion channels in the axon membrane.
- Binding of TTX changes the tertiary structure of the channel.
- This means the channel cannot open.

Using the information provided, explain how TTX affects the activity of neurones.

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(ii) A common cause of death from TTX poisoning is suffocation (not getting enough oxygen) as a result of paralysis of the diaphragm.

Explain how paralysis of the diaphragm could lead to suffocation.

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(iii) TTX is also known to reduce the speed of conduction in the Purkyne fibres of the heart.

Suggest and explain what effect this would have on the heart rate.

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(b) Molluscs such as *H. lunulata* have unmyelinated neurones. Saltatory conduction cannot occur in these neurones.

Why is transmission of action potentials along the axon slower in the absence of saltatory conduction?

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22 (a) A scientist used a respirometer to investigate the rate of respiration and photosynthesis of maize in different light intensities.

- The scientist placed ten maize seedlings in a respirometer and kept it in the dark for three hours.
- The respirometer contained soda-lime to remove any CO_2 produced by the seedlings.
- The scientist placed ten maize seedlings in a separate respirometer without soda-lime and placed it in different light intensities for three hours at a time.

Light intensity (lux)	Distance moved by fluid in respirometer (mm)
0	–3.7
1020	–0.8
1510	0.0
1700	1.2
2000	2.9

Table 22.1

(i) The diameter of the capillary tubing was 0.1 mm.

The volume of a cylinder can be calculated using the following formula:
volume of cylinder = $\pi r^2 l$

Calculate the **rate of oxygen uptake** by the seedlings in the dark. Give your answer to **two** significant figures. Show your working.

Answer = ... $mm^3 h^{-1}$ **[3]**

(ii) 1700 lux is a typical light intensity on a cloudy day in the UK. Calculate the percentage increase in gas production between 1700 and 2000 lux. Show your working.

Answer = ... % **[2]**

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(iii) Suggest why soda-lime was **not** placed in the respirometer with the seedlings grown in the light.

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(b) The scientist made the following claim:

These results suggest that, in maize seedlings, the rate of photosynthesis only exceeds the rate of respiration when the light intensity is above 1510 lux.

Use the data in Table 22.1 to explain why the scientist made this claim.

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23 **(a)** A student looked at slides of different tissues under a light microscope.

The four viewed images are labelled **W**, **X**, **Y** and **Z** in Fig. 23.1, **on the insert**.

Identify tissues **W**, **X** and **Y**.

W .....

X .....

Y .....

[3]

(b) The student wrote the following summary about the control of heart rate.

When the heart rate is too low the level of carboxylic acid in the blood becomes higher than normal. The vagus nerve sends action potentials to the AVN to increase the contraction rate of the heart muscle. The baroreceptors in the walls of the blood vessels then detect that the pH of the blood is normal, so heart rate can return to resting.

The endocrine system can also change heart rate. Release of the hormone adrenaline from the adrenal medulla causes the smooth muscle of the heart to contract more frequently.

Identify **and** correct any biological errors in the student's summary.

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(c) Reflex actions are rapid responses that protect the body from harm.

The Moro reflex is found in babies up to five months of age, and occurs when the baby feels its head is suddenly no longer supported. The Moro reflex is made up of the following responses:

- The baby spreads out its arms then brings them together rapidly.
- The baby cries.

(i) Suggest how the Moro reflex helps to prevent harm to a newborn baby.

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

(ii) The Moro reflex gradually disappears and usually stops completely after babies reach nine months. Other reflexes develop as children grow older.

Describe a reflex response a 3-year-old child would make to an object moving towards their eyes **and** explain the advantage of this response.

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

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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