

Write your name here

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Pearson Edexcel

Level 3 GCE

Centre Number

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Candidate Number

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Biology B

Advanced

Paper 2: Advanced Physiology, Evolution and Ecology

Sample Assessment Material for first teaching September 2015
Time: 1 hour 45 minutes

Paper Reference
9BI0/02

You may need a ruler, a pencil and a calculator.

Total Marks

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Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
– there may be more space than you need.
- You may use a scientific calculator.
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
– use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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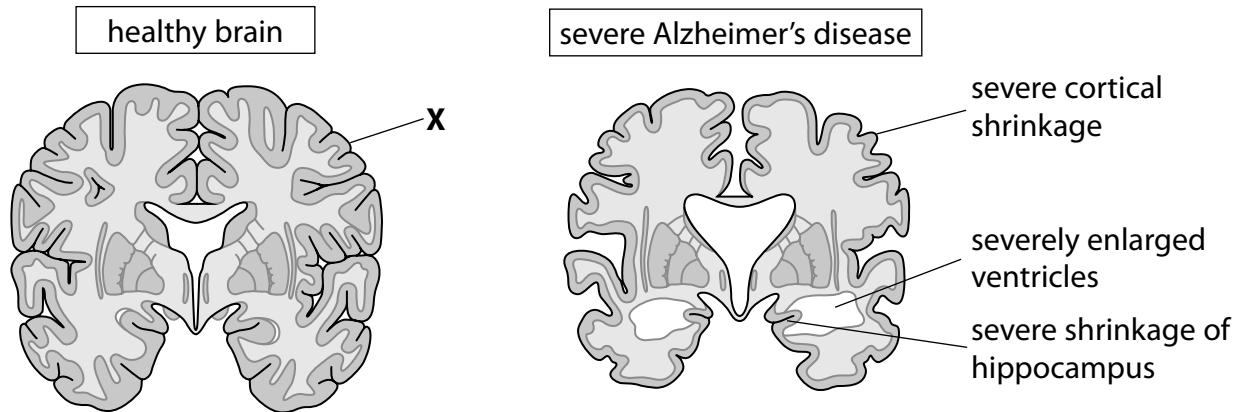
PEARSON

Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

- 1** The diagrams below show a horizontal cross section of a healthy human brain and a brain from a person with severe Alzheimer's disease.



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- (a) Name the part of the brain which is labelled **X**.

(1)

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- (b) Explain why a person with Alzheimer's disease may show a change in behaviour.

(2)

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(c) Drug treatments are available to reduce the symptoms of Alzheimer's disease.

One of the drugs available works as a non-competitive inhibitor of cholinesterase, the enzyme that breaks down acetylcholine in the synapse.

Describe how the action of this drug helps reduce the symptoms of Alzheimer's disease.

(3)

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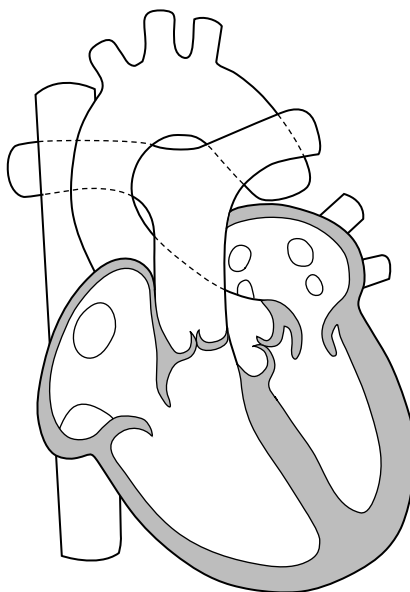
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(Total for Question 1 = 6 marks)

2 The diagram below shows the structure of a mammalian heart.

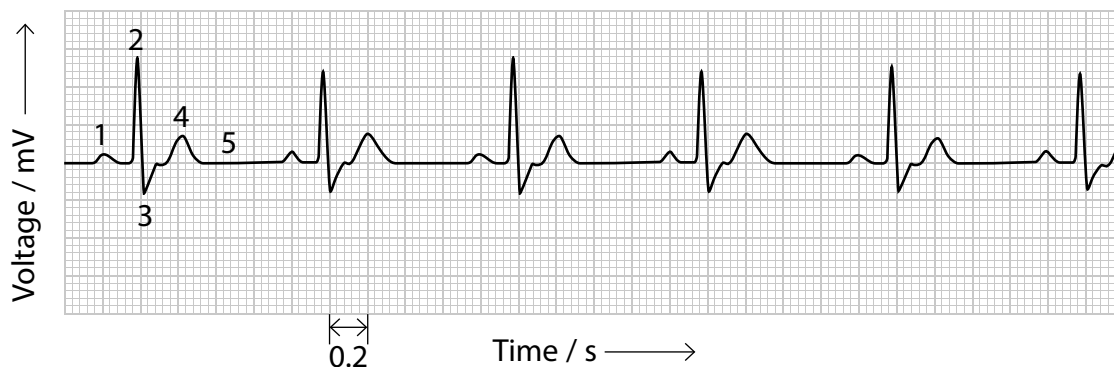


(a) Which stage of the cardiac cycle is shown by this heart?

- ☐ **A** atrial systole and ventricular systole
- ☐ **B** atrial systole and ventricular diastole
- ☐ **C** atrial diastole and ventricular systole
- ☐ **D** atrial diastole and ventricular diastole

(1)

(b) The diagram below shows an ECG trace for a person with a healthy heart.



(i) Which label identifies depolarisation of the sinoatrial node (SAN) in the cardiac cycle?

(1)

- ☐ **A** label 1
- ☐ **B** label 3
- ☐ **C** label 4
- ☐ **D** label 5

(ii) Which label identifies repolarisation of the ventricles in the cardiac cycle?

(1)

- ☐ **A** label 2
- ☐ **B** label 3
- ☐ **C** label 4
- ☐ **D** label 5

(c) Calculate the heart rate for this person.

(2)

Answer

(d) Describe how the cardiac centre brings about a change in heart rate when the activity level of a person increases.

(4)

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(Total for Question 2 = 9 marks)

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Turn over for question 3

- 3 Of the five rhino species, Javan rhinos (*Rhinoceros sondaicus*) are the most in threat of extinction, with as few as 35 individuals surviving in Ujung Kulon National Park in Java, Indonesia.

This national park is highly vulnerable to tsunamis and volcanic activity. In Java, large areas have been planted with *Arenga pinnata*, which is a source of palm oil. This plant has now colonised 50% of this national park.



© topimages/shutterstock

- (a) Give **one** biotic factor which contributes to *Rhinoceros sondaicus* becoming a critically endangered species.

(1)

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- (b) Explain why a species may become endangered when its population falls to a very low number.

(2)

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(c) Conservationists are working with the national park in order to conserve the Javan rhino.

Give **two** methods that could be used to conserve the Javan rhino.

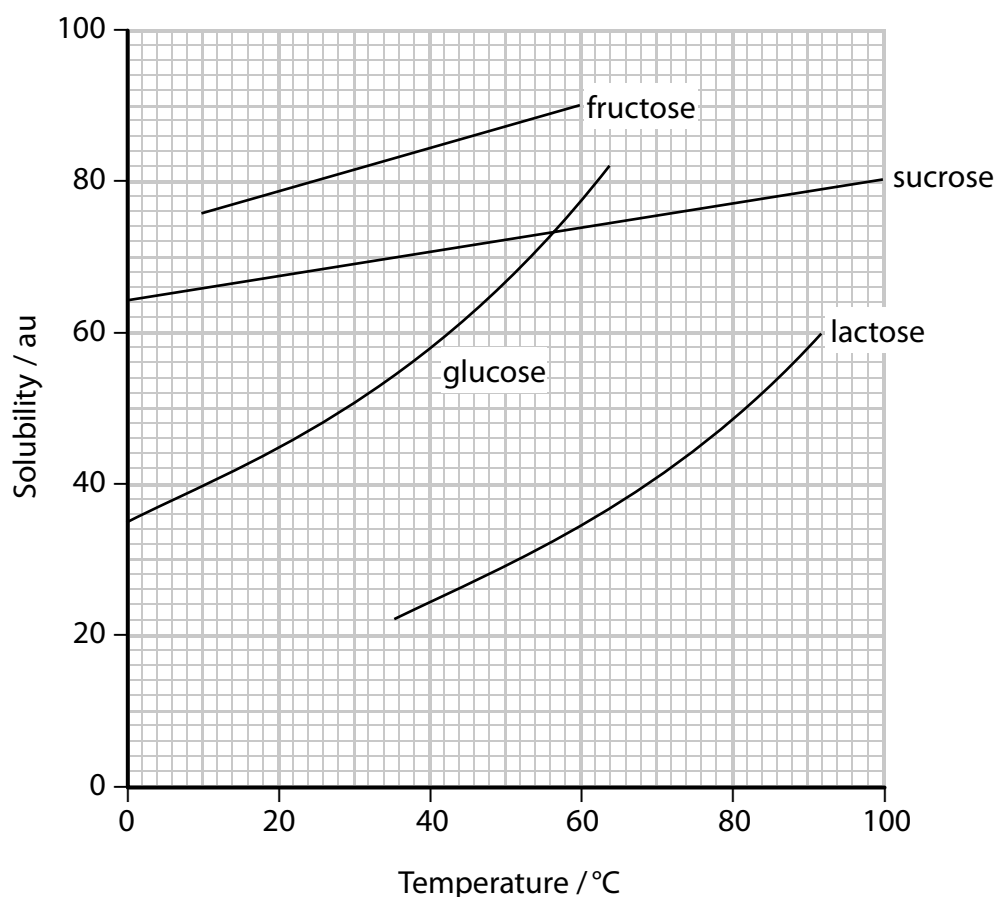
(2)

(Total for Question 3 = 5 marks)

- 4 An investigation into the effect of temperature on the solubility of some monosaccharides and some disaccharides was carried out.

Each monosaccharide and disaccharide was dissolved in water at different temperatures.

The graph below shows the solubility of some monosaccharides and some disaccharides in water at different temperatures.



(a) The graph shows that as water temperature increases, the solubility of

(1)

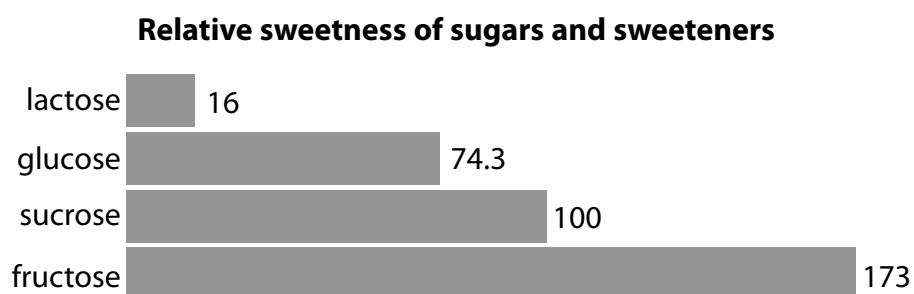
- ☐ A monosaccharides increases more than that of disaccharides
- ☐ B monosaccharides increases less than that of disaccharides
- ☐ C monosaccharides is always more than that of disaccharides
- ☐ D monosaccharides is always less than that of disaccharides

(b) Which row of the table below is correct for carbohydrates?

(1)

	Contains only six carbon atoms	Can be split by hydrolysis
☐ A	glucose	glucose
☐ B	glucose	lactose
☐ C	lactose	glucose
☐ D	lactose	lactose

(c) The graph below shows the relative sweetness of the monosaccharides and disaccharides.



People who are obese are at an increased risk of developing health problems.

Explain why the food industry uses the enzyme glucose isomerase to convert glucose into fructose when manufacturing its slimming products.

(3)

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(Total for Question 4 = 5 marks)

5 Tapirs are nocturnal mammals that are found in South America.

In 2013, the Journal of Mammalogy published an article describing the discovery of a new species of tapir, *Tapirus kabomani*.

Scientists already knew about the animal but thought that it was the same species as *Tapirus terrestris*.



© 20 minutos.es, Creative Commons

- (a) Give **one** reason why scientists thought that *Tapirus kabomani* was the same species as *Tapirus terrestris*.

(1)

(b) These two species of tapir can be distinguished using gene sequencing.

Describe how sufficient amounts of DNA could be obtained in preparation for gene sequencing.

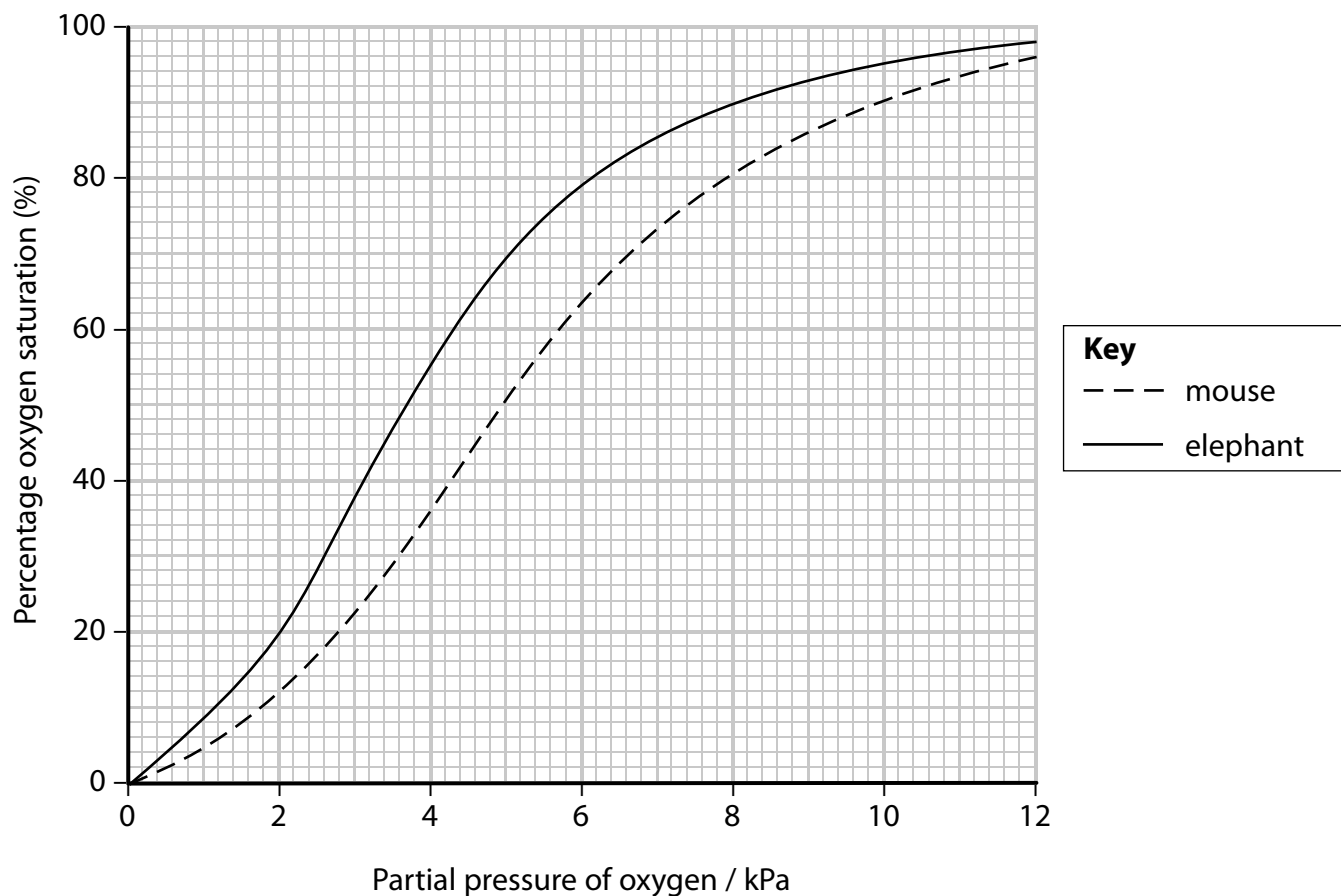
(4)

(c) Explain how distinguishing *Tapirus kabomani* as a separate species could affect the index of diversity of the area.

(2)

(Total for Question 5 = 7 marks)

- 6 The graph below shows the oxygen haemoglobin dissociation curves for a blood sample from an elephant and a mouse.



- (a) Use the information in the graph to determine the difference in percentage saturation between elephant haemoglobin and mouse haemoglobin at a partial pressure of oxygen of 4 kPa.

(1)

Answer

*(b) Explain the effect that body size has on the metabolic rate of these two mammals.

(6)

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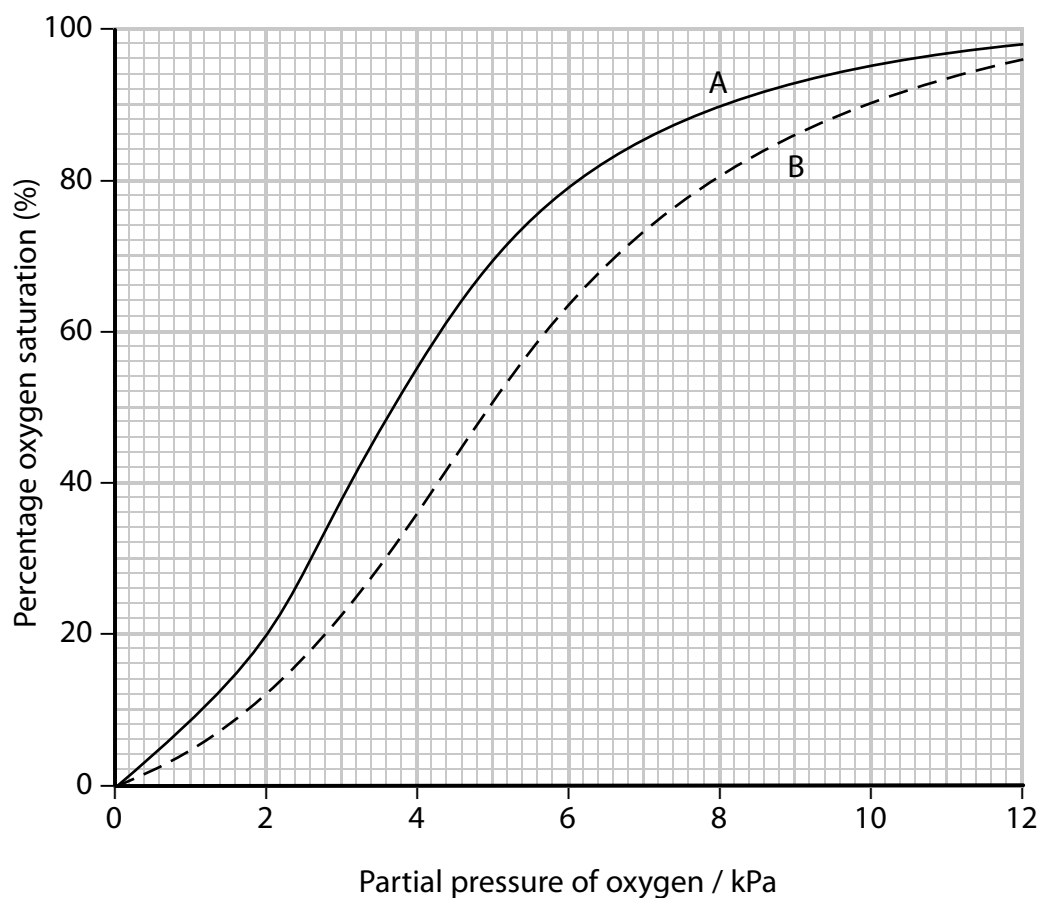
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- (c) The graph below shows the oxygen haemoglobin dissociation curves when two different blood samples, A and B, are compared.



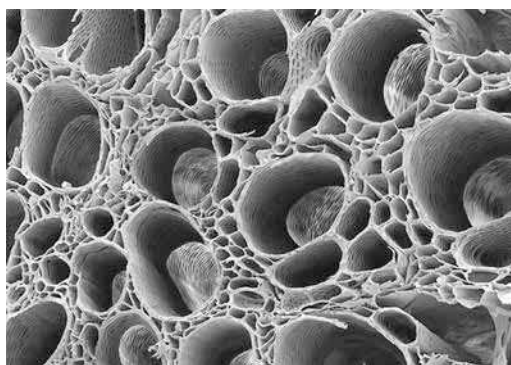
Which row of the table below shows the correct comparison of the blood samples?

(1)

	Blood sample A	Blood sample B
☐ A	blood before exercise	blood after exercise
☐ B	adult blood	fetal blood
☐ C	blood at lower pH	blood at higher pH
☐ D	blood at higher temperature	blood at lower temperature

(Total for Question 6 = 8 marks)

7 The photograph below shows an electronmicrograph of xylem tissue.



© B705/0112 Xylem tissue, SEM Steve Gschmeissner/Science Photo Library

(a) Give **three** ways in which xylem tissue is adapted for its functions.

(3)

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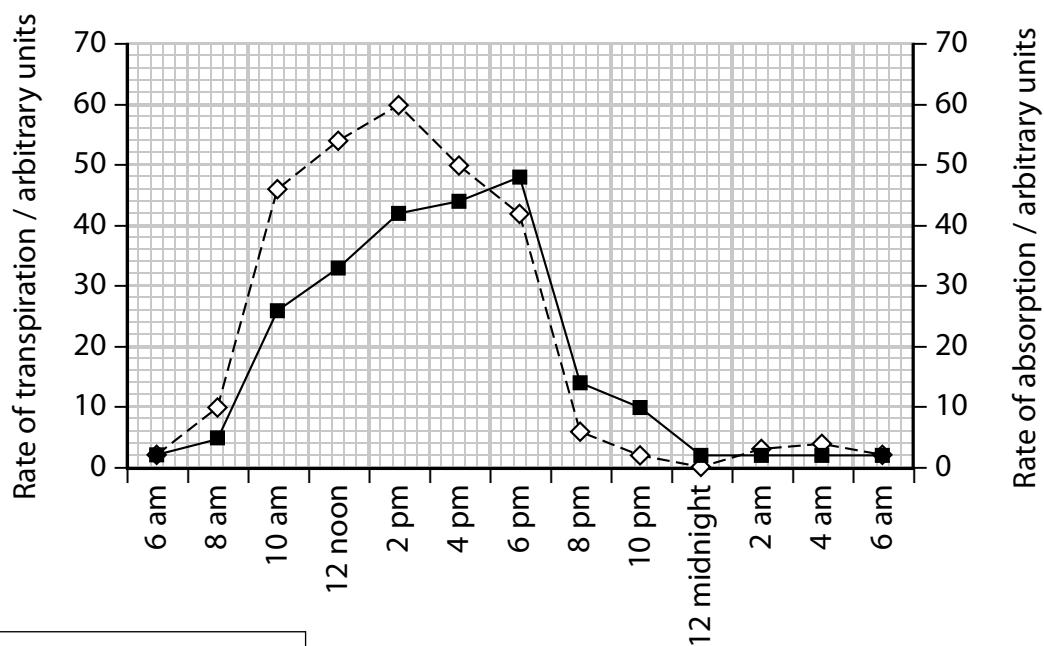
(b) Which statements describe some properties of water that are useful to plants?

- 1 Hydrogen bonding makes water a polar solvent.
- 2 Cohesive forces between water molecules allow the water to move in an unbroken stream.
- 3 Weak hydrogen bonds between water molecules attract the molecules to each other and allow water molecules to move easily in relation to one another.

(1)

- ☒ **A** 1 and 2 only
- ☒ **B** 2 and 3 only
- ☒ **C** 1 and 3 only
- ☒ **D** 1, 2 and 3

(c) The graph below shows the rates of transpiration and water absorption by a Jerusalem pine tree (*Pinus halepensis*), during a 24-hour period.



Key

- ◇-- rate of transpiration
- rate of absorption

Analyse the data to explain the relationship between these two rates during this 24-hour period.

(4)

(Total for Question 7 = 8 marks)

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Turn over for question 8

8 The velocity of the conduction of nerve impulses along an axon can be studied.

(a) Describe the structure of the cell surface membrane of an axon.

(4)

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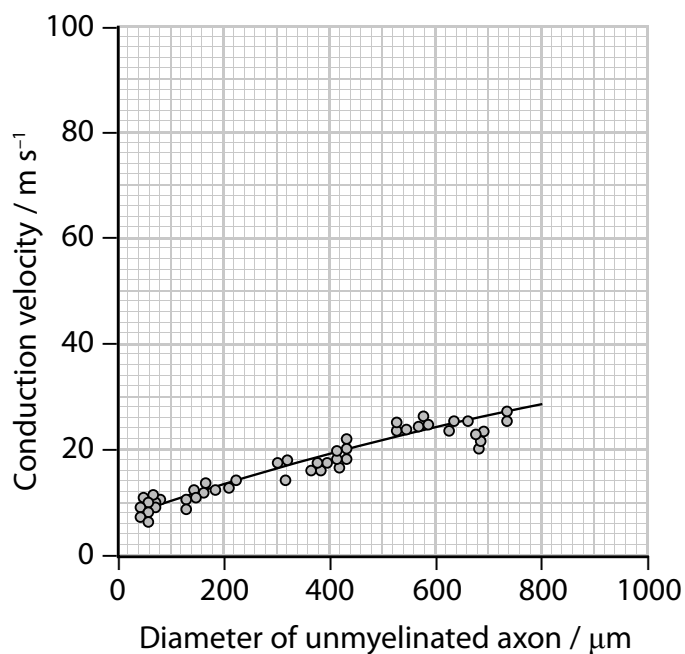
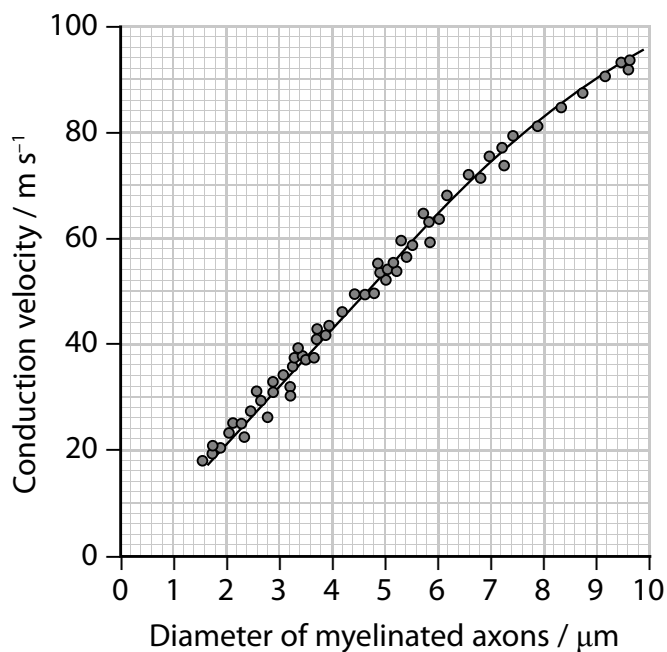
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(b) The graphs below show the conduction velocity and diameter of myelinated and unmyelinated axons.



(Source: <http://blp6.atw.hu/BLP6/HTML/C0059780323045827.htm>)

- (i) Calculate the time it would take for a nerve impulse to travel 80 cm in a myelinated axon with a diameter of 7 μm .

(2)

Answer s

(6)

70

- 9 The photograph below shows a desert mammal.



(Source: <http://www.ardea.com>)

Some desert mammals do not drink water. They obtain water from the food they eat and from respiration.

- (a) Explain how water is formed in respiration.

(2)

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- (b) The table below shows the percentage of plant roots and insects in the diet of two different species of desert mammal.

Food	Percentage of food in diet (%)	
	<i>M. hurrianae</i>	<i>T. indica</i>
Plant roots	40	20
Insects	10	25

- (i) The desert mammals eat 8 g of food in one day. Calculate how many more grams of insects are eaten by *T. indica* than by *M. hurrianae*.

(2)

Answer g

- (ii) Which species has kidneys that will produce the most concentrated urine?
Justify your answer.

(2)

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- (c) Which row of the table below shows the correct changes to the concentration of sodium ions as fluid moves along the descending and ascending loop of Henle?

(1)

	Concentration of sodium ions (Na^+) in descending loop of Henle	Concentration of sodium ions (Na^+) in ascending loop of Henle
☐ A	increases	increases
☐ B	increases	decreases
☐ C	decreases	increases
☐ D	decreases	decreases

- (d) The concentration of urine is controlled by osmoreceptors and the secretion of ADH.

Which row of the table below shows the location of the osmoreceptors and the correct level of ADH secretion in a desert mammal that produces concentrated urine?

(1)

	Location of osmoreceptors	Level of ADH
☐ A	carotid body	high
☐ B	carotid body	low
☐ C	hypothalamus	high
☐ D	hypothalamus	low

(e) Explain how the nephrons of desert mammals enable them to survive in a dry environment.

(4)

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(Total for Question 9 = 12 marks)

10 A defect in the cone cells of the retina can result in colour blindness.

(a) Which is the visual pigment found in cone cells?

(1)

- ☐ **A** iodopsin
- ☐ **B** opsin
- ☐ **C** retinol
- ☐ **D** rhodopsin

(b) The table below shows the distribution of different cones involved in colour blindness.

Population	Distribution of different cones / percentage of population (%)			
	Normal cones	L-cone defect	M-cone defect	S-cone defect
Men	91.40	2.45	6.14	0.01
Women	99.52	0.04	0.36	0.04

(i) The population of London is 12 million, of which 55% are men.

Calculate the number of men in London who are colour blind.

(3)

Answer

(ii) The allele for one defect in cone cells is recessive and carried on the X chromosome.

Explain why more men than women are colour blind.

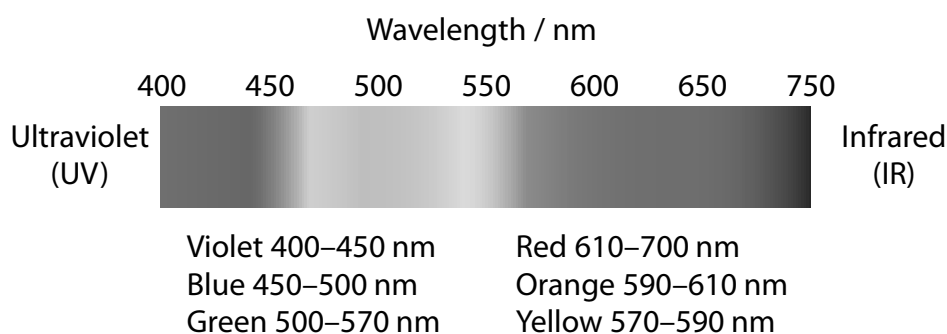
(2)

(iii) L-cones respond to long wavelengths of light.

M-cones respond to medium wavelengths of light.

S-cones respond to short wavelengths of light.

The visible light spectrum is shown below.



Analyse the data to explain why red/green colour blindness is the most common throughout the population.

(4)

(Total for Question 10 = 10 marks)

11 Light is involved in the germination of lettuce seeds. This is an example of photomorphogenesis.

The germination is affected by the wavelength of light the seeds receive.

The table below shows the percentage germination of lettuce seeds when exposed to light of different wavelengths.

Wavelength of light	Percentage germination (%)
red only	97
far red only	4
period of red followed by a period of far red	4
period of far red followed by a period of red	96

(a) Explain how red and far red light affects the germination of lettuce seeds.

(4)

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- (b) Sea plantain and bog sedge grow at a range of latitudes. A student carried out an investigation into the effect of temperature on the growth of seedlings of these two species.

Sets of seeds from each species were germinated at 18 °C. As soon as they germinated, the seedlings were placed in three temperature-controlled rooms at 10 °C, 14 °C and 18 °C.

They were allowed to grow for 50 days. Samples of seedlings were taken at 10-day intervals and their mean dry masses were recorded.

The results of this investigation are shown in the tables below.

Table 1 – Sea plantain

Day	Mean dry mass / mg		
	10 °C	14 °C	18 °C
10	3	4	6
20	7	12	20
30	13	25	47
40	20	40	109
50	28	80	210

Table 2 – Bog sedge

Day	Mean dry mass / mg		
	10 °C	14 °C	18 °C
10	1	1	1
20	1	2	2
30	2	3	5
40	3	5	12
50	5	7	22

Analyse the data to explain which of the two species is better for growth at a wider range of latitudes (distance from the equator).

(4)

(Total for Question 11 = 8 marks)

TOTAL FOR PAPER = 90 MARKS

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