PEARSON EDEXCEL IAL BIOLOGY · YBI11

BIOLOGY



EXAM QUESTION PACK

UNIT 5: RESPIRATION, MUSCLES AND THE INTERNAL ENVIRONMENT

SCORE	PERCENTAGE
/213	%

STEMUP

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Q1.

Alpha-1 antitrypsin (AAT) deficiency is an inherited disease that can affect different organ systems.

Alpha-1 antitrypsin (AAT) is a protein produced in the liver.

(a) Investigation of the breathing of a patient with AAT deficiency found that the:

- resting tidal volume (V_T) was 500 cm^3
- dead space (DS) was 150 cm^3
- resting respiratory rate (RR) was 12 breaths per minute.

Calculate the volume of air that enters the alveoli (A_V) **each hour**.

$$A_V = (V_T - DS) \times RR$$

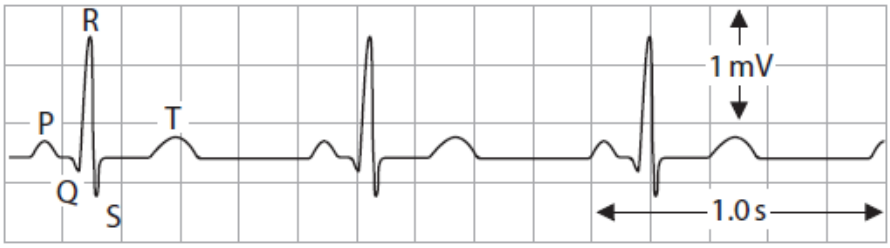
Give your answer to 2 significant figures with appropriate units.

(3)

Answer .....

(b) Activity of the heart was investigated in the same patient.

The trace shows a normal electrocardiogram (ECG).



(i) Name the stage of the cardiac cycle at T on this ECG.

(1)

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(ii) The ECG of the patient with AAT is shown in the trace.



Calculate the mean heart rate shown in this ECG trace.

(1)

Answer .....

(iii) Compare and contrast the ECG trace of this patient with the normal ECG trace.

(3)

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(c) One potential treatment for AAT deficiency uses adenoviruses to genetically modify cells in an affected person.

Adenoviruses contain double-stranded DNA.

Explain how adenoviruses can be used to treat AAT deficiency in a person.

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(Total for question = 12 marks)

Q2.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The photograph shows a camel.



(Source: © Shengyong Li/Shutterstock)

Camels are an important livestock species. They are adapted to living in hot, dry environments.

(a) How many of the following adaptations enable a camel to reduce its water loss?

- production of very concentrated urine
- high glomerular filtration rate
- long loop of Henle
- reduced release of ADH

(1)

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(b) The table shows the water use of five species of animal.

Species	Water use / $cm^3\,kg^{-1}\,day^{-1}$	Mean mass / kg
buffalo	150	697
camel	57	850
goat	136	80
sheep	95	110
zebu	120	195

(i) Calculate the difference in the volume of water use in a day by a buffalo and a camel.

Give your answer in dm^3 to two significant figures.

(2)

Answer ..... dm^3

(ii) Suggest two reasons why there is no correlation between water use and mean mass for the species given in the table.

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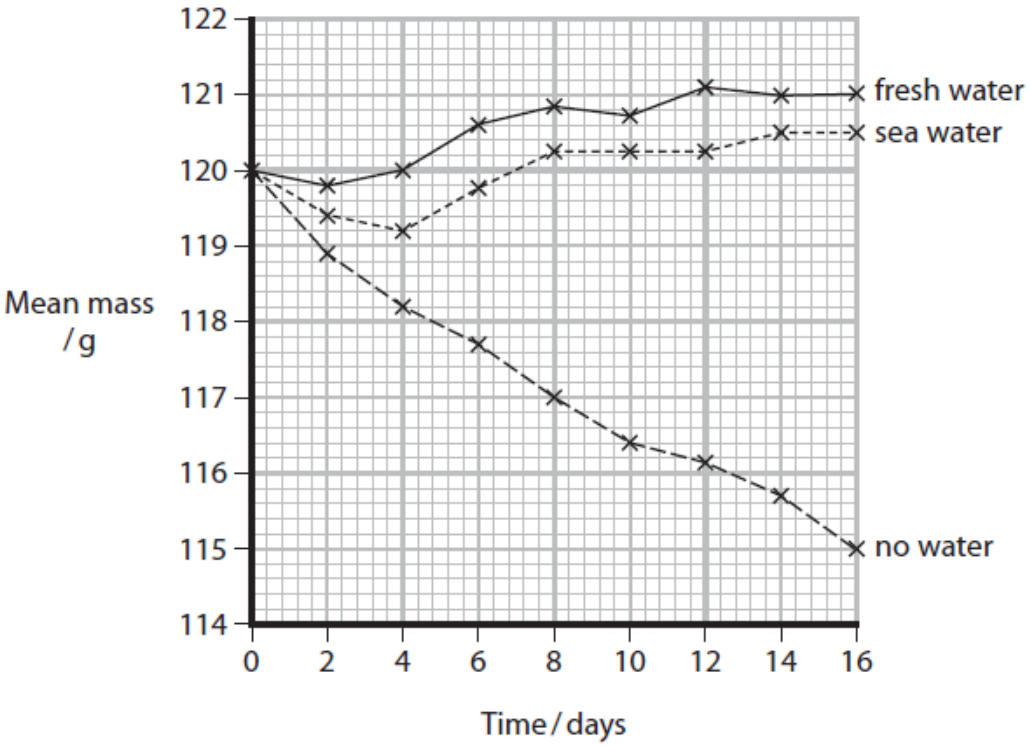
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(c) The kangaroo rat is another animal that lives in a hot, dry environment.

In an investigation, kangaroo rats were given either fresh water, sea water or no water.

The graph shows the mean body mass of kangaroo rats which were fed on a diet of soya beans over a 16-day period.



Determine the effect of the type of water given on the mean mass of the kangaroo rats in this investigation.

Use the information in the graph to support your answer.

(3)

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(d) The kangaroo rat's kidneys play an important role in the process of conserving water.

Explain how the nephrons (kidney tubules) in the kidneys of the kangaroo rat are able to produce very concentrated urine.

(2)

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(Total for question = 10 marks)

Q3.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

Animals use aerobic and anaerobic respiration to produce ATP.

(a) Aerobic respiration has three stages where reactions occur between enzymes and substrates.

(i) Which row of the table shows the location of each stage?

(1)

		Glycolysis	Link reaction	Krebs cycle
☒	**A**	cytoplasm	cytoplasm	cytoplasm
☒	**B**	cytoplasm	mitochondrial matrix	mitochondrial matrix
☒	**C**	mitochondrial matrix	cytoplasm	cytoplasm
☒	**D**	mitochondrial matrix	mitochondrial matrix	mitochondrial matrix

(ii) A student calculated the volume of oxygen used by a cockroach as 1.7 cm^3 $hour^{-1}$. The same cockroach produced 1.3 cm^3 $hour^{-1}$ of carbon dioxide in the same time.

What is the respiratory quotient (RQ) of this cockroach?

(1)

☒ **A** 0.7

☒ **B** 0.8

☒ **C** 1.3

☒ **D** 2.2

(iii) Hydramethylnon is an insecticide that is used to treat termite infestations.

Hydramethylnon inhibits the electron transport chain.

Which row of the table shows the expected changes caused by hydramethylnon?

(1)

		Oxygen consumption	Lactate production
☒	**A**	decrease	decrease
☒	**B**	decrease	increase
☒	**C**	increase	decrease
☒	**D**	increase	increase

(b) The table shows the oxygen consumption and body mass of two animals.

Animal	Oxygen consumption / $cm^3 h^{-1}$	Body mass / g
Southern elephant seal	1.82×10^4	5.00×10^6
Field mouse	20.00	10.00

These figures can be used to calculate the metabolic rate of each animal in $cm^3\ g^{-1}\ h^{-1}$.

Calculate how many times greater the metabolic rate of the field mouse is compared with that of the southern elephant seal.

(2)

Answer .....

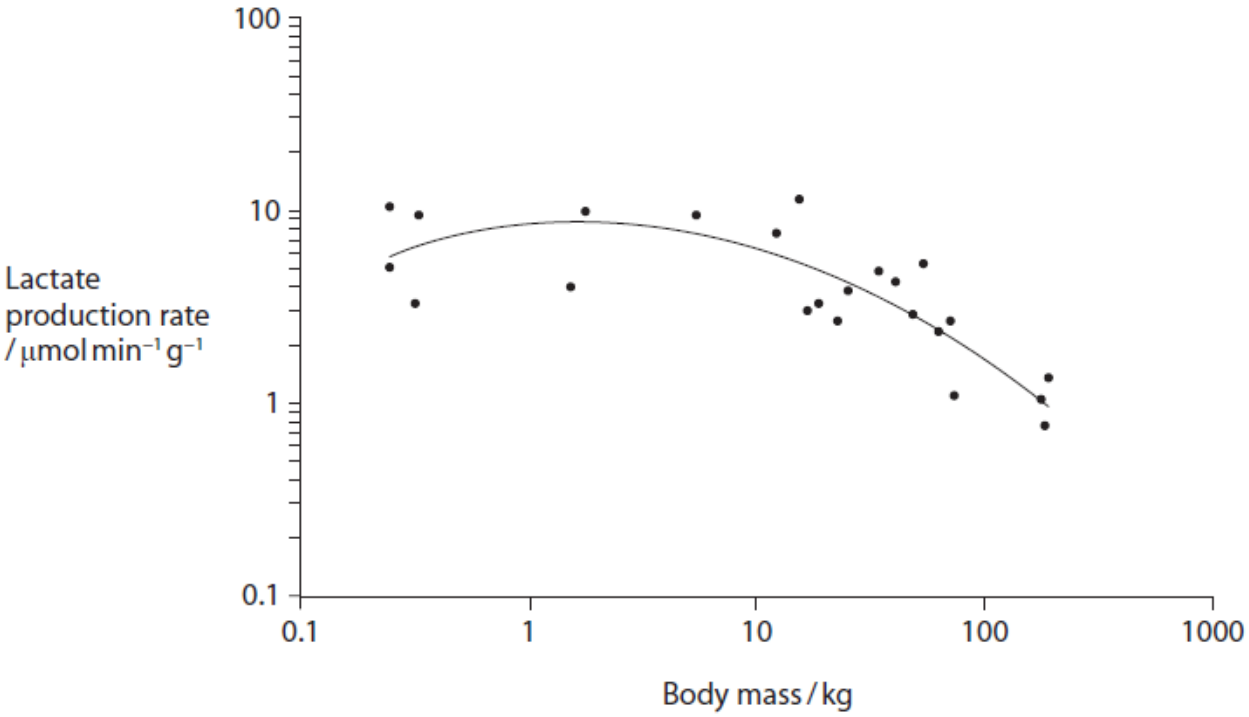
* (c) The photograph shows a crocodile (*Crocodylus porosus*) that lives in saltwater habitats.



(Source: © Danny Ye/Shutterstock)

An investigation measured the lactate production rate of these crocodiles when they were active.

The graph shows the results of this investigation.



Each plotted point on the graph represents a single crocodile.

Discuss the roles of the different types of respiration in these active crocodiles.

Use the information in the graph and your own knowledge to support your answer.

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(Total for question = 11 marks)

Q4.

In cells, energy can be released from substrates by anaerobic and aerobic respiration.

(a) Most eukaryotic cells can respire anaerobically.

(i) Which of the following describes a step in the process of anaerobic respiration?

(1)

☒ **A** decarboxylation of lactate

☒ **B** phosphorylation of hexoses

☒ **C** oxidation of pyruvate

☒ **D** removal of phosphate groups from glucose

(ii) What happens to the lactate concentration during a period of anaerobic respiration?

(1)

☒ **A** decreases, causing a decrease in blood pH

☒ **B** decreases, causing an increase in blood pH

☒ **C** increases, causing a decrease in blood pH

☒ **D** increases, causing an increase in blood pH

(b) Most eukaryotic cells are also able to respire aerobically.

(i) How do respiratory substrates enter the Krebs cycle?

(1)

☒ **A** as molecules containing 2 carbon atoms produced by the link reaction

☒ **B** as molecules containing 3 carbon atoms produced by the link reaction

☒ **C** as molecules containing 2 carbon atoms produced by RUBISCO

☒ **D** as molecules containing 3 carbon atoms produced by RUBISCO

(ii) Draw a diagram of a mitochondrion.

Label only the part of the mitochondrion where the Krebs cycle occurs.

(2)

(iii) Describe the role of chemiosmosis in the synthesis of ATP.

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(Total for question = 10 marks)

Q5.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

Aerobic respiration involves four main stages:

glycolysis, link reaction, Krebs cycle and oxidative phosphorylation.

(a) One product of all three stages shown in the table is ATP (adenosine triphosphate).

Complete the table to show one other product of each stage.

(3)

Stage	One other product
glycolysis	
Krebs cycle	
oxidative phosphorylation	

(b) An incomplete equation for the aerobic respiration of a substrate is shown below.

Complete the equation by inserting the numbers on the dotted lines to balance it.

(2)

$$C_{57}H_{104}O_6 + \ldots\ldots O_2 \rightarrow \ldots\ldots CO_2 + 52\ H_2O$$

(c) One molecule of glucose contains 2867.48 kJ of energy.

One molecule of glucose generates a maximum of 38 molecules of ATP in aerobic respiration.

A molecule of ATP contains 30.51 kJ of usable energy. Usable energy is available for chemical reactions in the cell.

(i) Which reaction releases energy from ATP?

(1)

☒ **A** the conversion of ADP to ATP

☒ **B** the phosphorylation of ADP

☒ **C** the hydrolysis of ATP

☒ **D** the removal of adenosine molecules from ATP

(ii) Calculate the maximum percentage of energy in a glucose molecule that can be converted to usable energy in ATP.

(2)

Answer .....

(iii) Describe what happens to the energy that is not converted to usable energy in a muscle cell.

(2)

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(d) Describe how oxygen is involved in the production of ATP on the cristae in the mitochondria.

(2)

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(Total for question = 12 marks)

Q6.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The human body responds to changes in both its internal and external environments.

(a) How many of these statements describe the effects of adrenaline in the "fight or flight" response?

- arterioles constrict in skeletal muscles
- glycogen is released from the liver
- the rate of food digestion decreases

(1)

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(b) The heart responds to adrenaline by increasing cardiac output.

Cardiac output = heart rate × stroke volume

(i) Calculate the cardiac output for a person who has a heart rate of 77 bpm and a stroke volume of 70 cm^3.

Give your answer to two significant figures in dm^3 $hour^{-1}$.

(2)

Answer ..... dm^3 hour–1

(ii) The formula shows how to calculate the cardiac index. This is a method of adjusting cardiac output values for the body surface area of an individual.

$$\text{cardiac index} = \frac{\text{cardiac output in } dm^3\ min^{-1}}{\text{body surface area in } m^2}$$

The table shows some information for cardiac output, body surface area and cardiac index for two individuals.

Individual	Cardiac output / $dm^3\ min^{-1}$	Body surface area / m^2	Cardiac index
A	6.7	1.92	
B		1.49	2.8

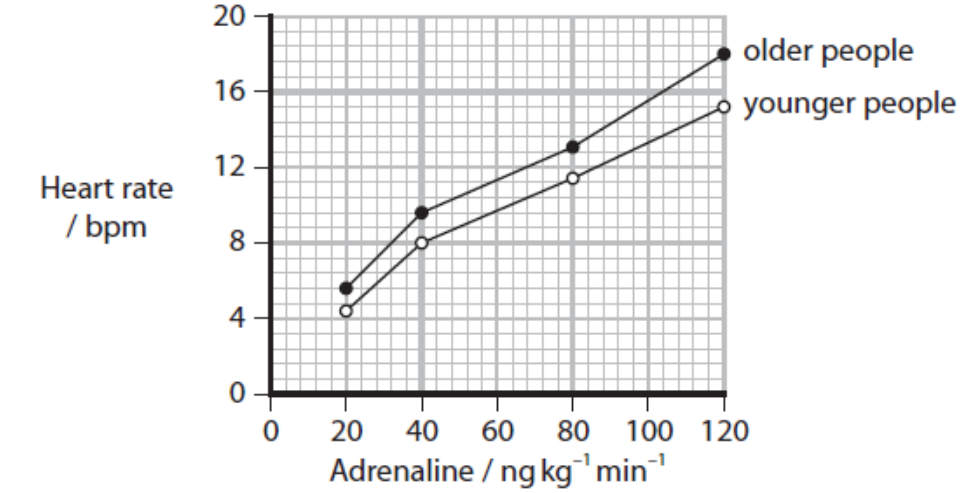
Complete the table to show the units for cardiac index, the cardiac index for individual A and the cardiac output for individual B.

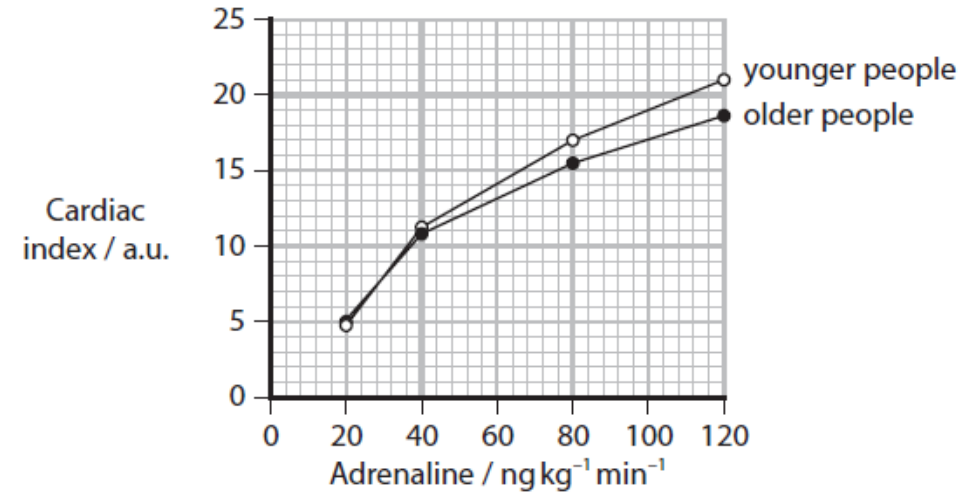
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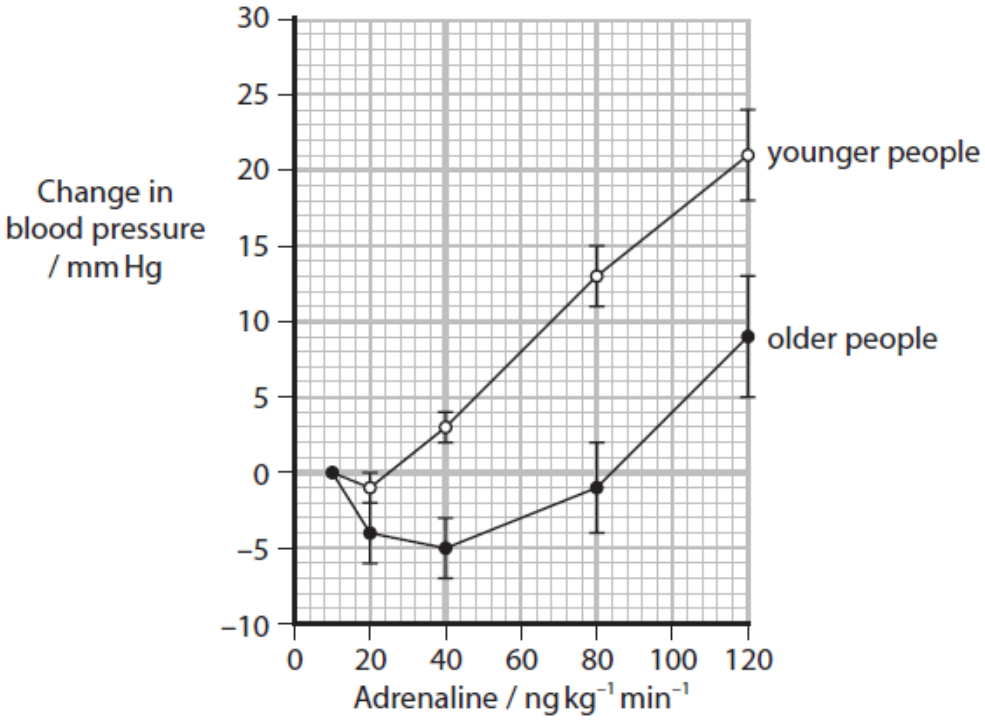
*(iii) Ageing is associated with changes in the way the heart responds to adrenaline.

In an investigation, the effects of adrenaline on the hearts of young people and old people were recorded.

The graphs show the results of this investigation.







Discuss the effect of ageing on the response of the heart to adrenaline.

Use the information in the graphs to support your answer.

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(Total for question = 12 marks)

Q7.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

The kidney is involved in the process of homeostasis in a mammal.

(a) Antidiuretic hormone (ADH) is required for homeostasis.

How many of these parts of the kidney respond to ADH?

- Bowman's capsule
- collecting duct
- loop of Henle
- proximal tubule

(1)

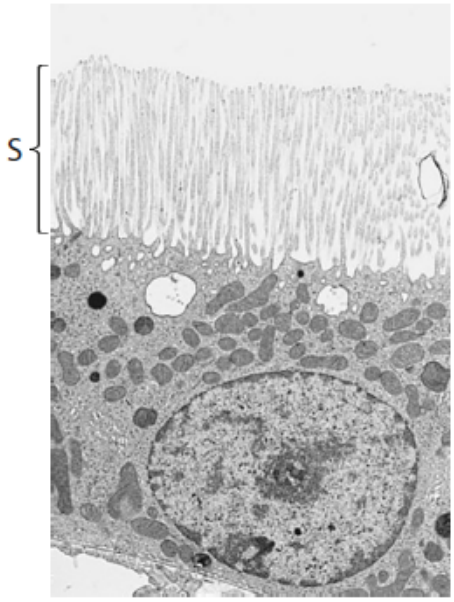
☒ **A** 1

☒ **B** 2

☒ **C** 3

☒ **D** 4

(b) The electron micrograph shows a transverse section of part of a proximal tubule.



(Source: https://veteriankey.com/solute-reabsorption/)

(i) Name the process by which the fluid moves from the plasma into the renal tubule (nephron).

(1)

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(ii) Name the structures labelled S.

(1)

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(c) A student compared the left renal veins of two individuals.

(i) The diameter of the left renal vein of one individual was 4.71 mm.

Calculate the cross-sectional area of this vein.

(2)

Answer ..... mm^2

(ii) The cross-sectional area of the left renal vein of the second individual was 0.194 cm^2.

Calculate the difference in the cross-sectional area in the left renal vein of these two individuals.

(1)

Answer .....

(d) The table shows the concentration of glucose and urea in the blood plasma, glomerular filtrate and urine of an individual.

Substance	Concentration in blood plasma / g dm^{-3}	Concentration in glomerular filtrate / g dm^{-3}	Concentration in urine leaving collecting duct / g dm^{-3}
glucose	1.50	1.50	0.00
urea	0.30	0.30	21.00

Explain the concentration of glucose and urea in the urine.

Use the information in the table to support your answer.

(3)

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(e) An individual produced 0.83 cm^3 of urine each minute.

Calculate the volume of urine produced by this individual in 24 hours.

Assume the urine production is at a constant rate.

Give your answer in dm^3, to two significant figures.

(2)

Answer ..... dm^3

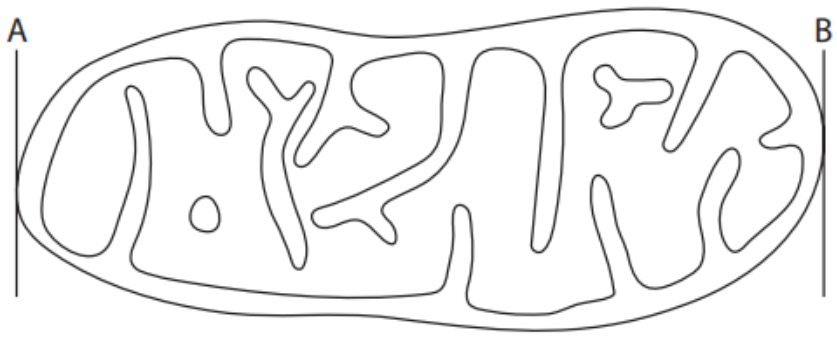
(Total for question = 11 marks)

Q8.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

In eukaryotic organisms aerobic respiration takes place in mitochondria.

(a) The diagram shows a mitochondrion.



The actual length of the mitochondrion between A and B was 0.75 µm.

Calculate the magnification of the mitochondrion shown in the diagram.

Give your answer in standard form.

(2)

Answer .....

(b) In an investigation, the rate of production of carbon dioxide by mitochondria was measured.

Three samples of mitochondria had the following chemicals added to them:

- Sample 1: pyruvate
- Sample 2: pyruvate and ADP
- Sample 3: pyruvate and pyruvate transport inhibitor.

The table shows the results of this investigation.

Sample	Chemicals added	Rate of carbon dioxide production in 20 minutes / nmol per mg of mitochondria
1	pyruvate	62.6
2	pyruvate and ADP	85.0
3	pyruvate and pyruvate transport inhibitor	11.6

(i) Which is the approximate rate at which carbon dioxide is produced in sample 1?

(1)

☒ **A** 3 nmol mg min

☒ **B** 180 nmol mg min

☒ **C** 3 nmol mg^{-1} min^{-1}

☒ **D** 180 nmol mg^{-1} min^{-1}

(ii) Explain the results of this investigation.

Use the information in the table and your own knowledge of the Krebs cycle to support your answer.

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(c) Fast twitch and slow twitch muscle fibres contain different numbers of mitochondria.

(i) Explain the difference in the number of mitochondria in these two types of muscle fibre.

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(ii) Describe the role of ATP in muscle contraction.

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(Total for question = 14 marks)

Q9.

The scientific document you have studied is adapted from articles in *StatPearls: Anatomy, Autonomic Nervous System, British Journal of Cardiology: Postural Orthostatic Tachycardia Syndrome (POTS) and Cellular and Molecular Life Sciences: The enteric nervous system in gastrointestinal disease etiology*.

Use the information from the scientific document and your own knowledge to answer the following questions.

(a) The autonomic nervous system regulates aspects of respiration (paragraph 1).

Describe how the autonomic nervous system regulates the breathing rate when a person is resting.

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(b) Explain how neurones can respond to different neurotransmitter substances (paragraph 4).

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(c) Suggest how the activity of the sympathetic nervous system in immune organs could regulate
inflammation (paragraph 7).

(2)

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(d) Explain how an electrocardiogram could be used to show that a person has postural orthostatic tachycardia syndrome (POTS) (Box 1).

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(e) Explain how reflex circuits in the gut cause a bolus to move (paragraphs 10 and 11).

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(f) State what is meant by the term ischemia (paragraph 12).

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(g) Suggest why embryological ENS cells may fail to colonise the bowel in a developing embryo (paragraph 13).

(1)

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(h) Explain how the interaction of microbial and other factors could result in gastrointestinal inflammation such as IBD (Box 2).

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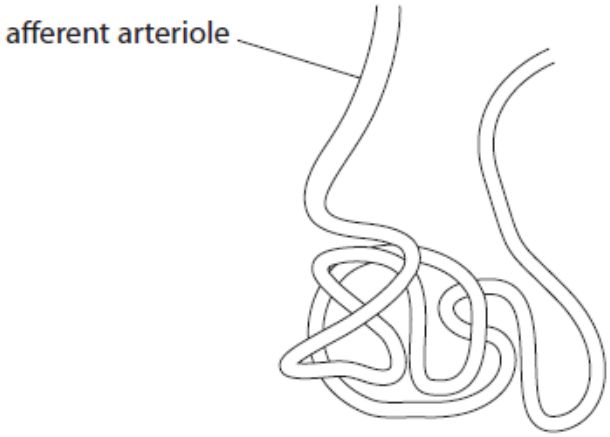
(Total for question = 20 marks)

Q10.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The kidney is an organ that is involved in the removal of waste metabolites from the blood.

(a) The drawing shows the blood supply inside a Bowman's capsule (renal capsule).



(i) Complete the diagram to show the Bowman's capsule and label two structures in this diagram.

(3)

(ii) Which substances are normally filtered from the blood in the Bowman's capsule?

(1)

☒ **A** amylose and glucose

☒ **B** glucose and sodium chloride

☒ **C** potassium ions and haemoglobin

☒ **D** urea and prothrombin

(iii) Which row shows the route taken by a water molecule through a nephron in the kidney?

(1)

		Route through a nephron →			
☒	**A**	collecting duct	proximal tubule	distal tubule	loop of Henle
☒	**B**	loop of Henle	proximal tubule	collecting duct	distal tubule
☒	**C**	proximal tubule	distal tubule	loop of Henle	collecting duct
☒	**D**	proximal tubule	loop of Henle	distal tubule	collecting duct

(b) Describe how glucose reabsorption takes place in the nephron.

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(c) Urea is produced by the metabolic breakdown of some organic molecules.

Which statement describes the production of urea?

(1)

☒ **A** in the kidneys from excess amino acids

☒ **B** in the kidneys from glycogen

☒ **C** in the liver from excess amino acids

☒ **D** in the liver from glycogen

(Total for question = 9 marks)

Q11.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

The nervous system of an organism enables it to respond to a stimulus.

(a) A reflex action is a rapid involuntary movement in response to a stimulus. The response to a pinprick in a finger is an example of a reflex action.

(i) Which component of the nervous system continues a reflex arc immediately after the receptor has been stimulated by the stimulus?

(1)

☒ **A** motor neurone

☒ **B** relay neurone

☒ **C** Schwann cell

☒ **D** sensory neurone

(ii) Which pathway shows a reflex arc?

(1)

☒ **A** muscle → receptor → brain

☒ **B** muscle → spinal cord → brain

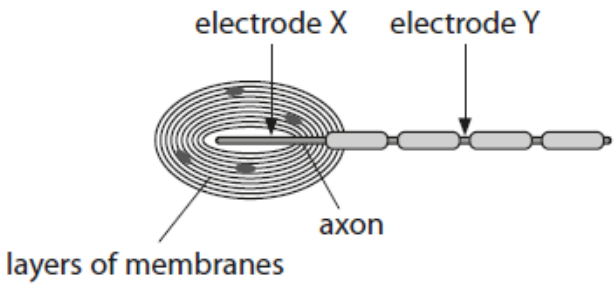
☒ **C** receptor → spinal cord → muscle

☒ **D** spinal cord → brain → muscle

(b) Pacinian corpuscles are pressure receptors found in the skin of the fingertip.

The effect of different pressures applied to the finger tip, on electrode potentials across the axon membrane of the neurone of a Pacinian corpuscle was investigated.

The diagram shows the structure of a Pacinian corpuscle and the location of electrodes, X and Y, used to measure axon membrane potentials.



The table shows the results of the investigation.

Pressure applied to the fingertip	Membrane potential at electrode X / mV	Membrane potential at electrode Y / mV
None	−70	−70
Low	−60	−70
Medium	+20	+40
High	+40	+40

(i) Describe how the resting potential of −70mV is maintained in the axon when no pressure is applied.

(3)

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(ii) Suggest how a change in pressure at the Pacinian corpuscle causes an action potential in the axon.

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(iii) Explain why the membrane potential at electrode Y was the same when medium or high

pressure was applied to the fingertip.

(3)

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(Total for question = 11 marks)

Q12.

Skeletal muscle is made of bundles of fibres.

(a) Describe the role of calcium ions in producing contraction of a muscle fibre.

(2)

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(b) The table shows some features of slow and fast twitch muscle fibres.

Feature of fibre	Slow twitch fibre	Fast twitch fibre
Number of mitochondria per fibre	Many	Few
Number of myoglobin molecules per fibre	Many	Few
Capillary network	Larger	Smaller
Contraction	Slow and sustained	Rapid and intense

Olympic marathon runners have a high proportion of slow twitch fibres in their muscles.

Explain how the features of slow twitch fibres, shown in the table, are of benefit to an Olympic marathon runner.

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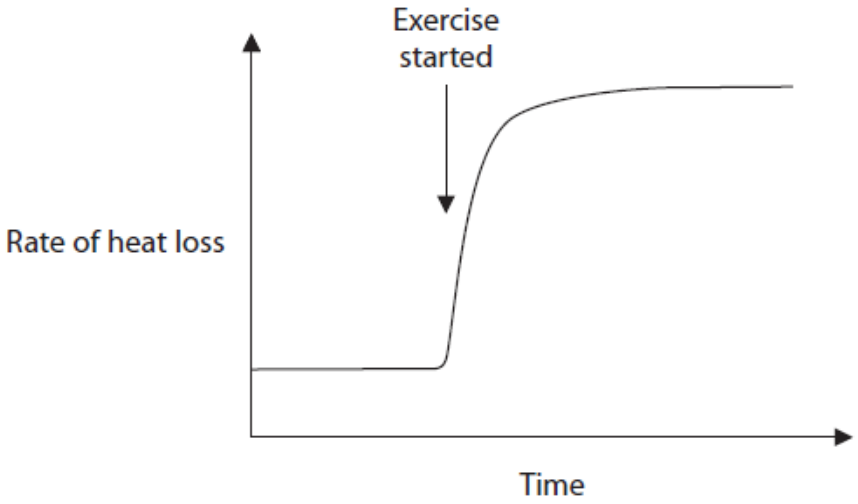
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(c) The graph shows the rate of heat loss at rest and during exercise.



Comment on the rate of heat loss during exercise.

(2)

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(Total for question = 8 marks)

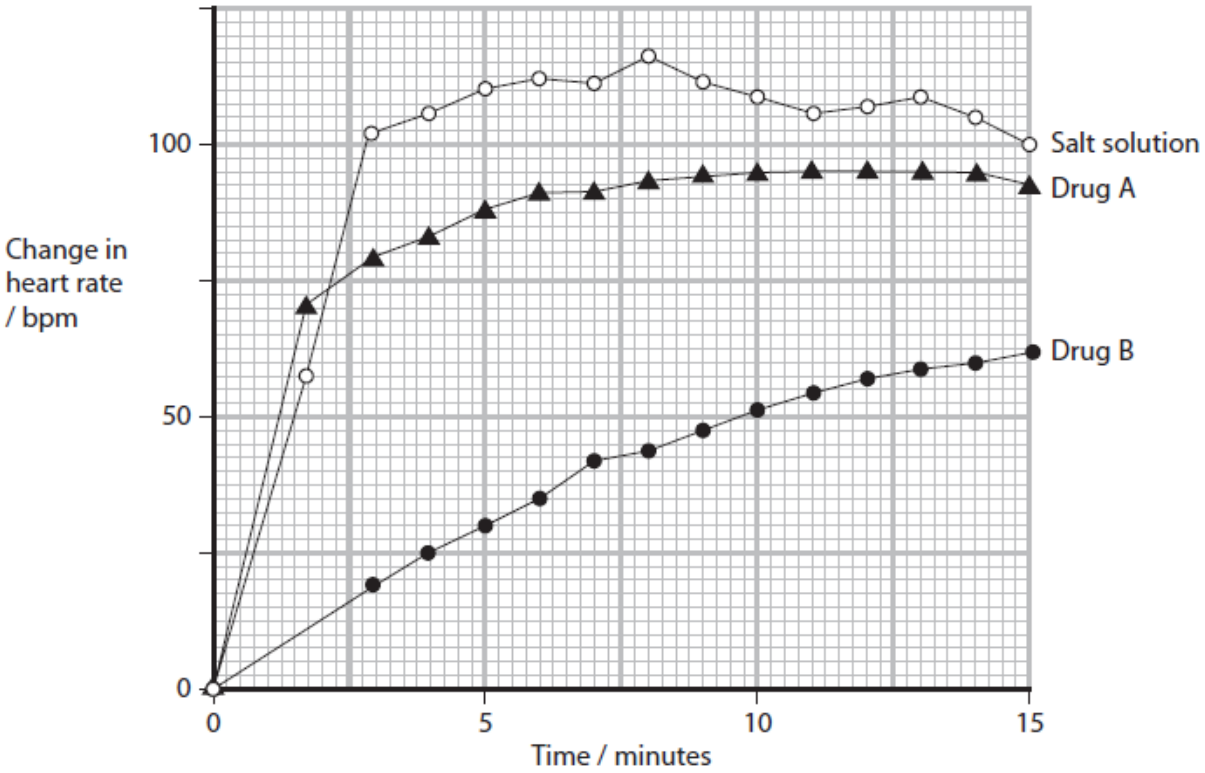
Q13.

Researchers investigated how groups of rats, treated with drugs, responded to stress.

Groups of rats were stressed by moving them into a new environment. The rats were then treated with a salt solution, drug A or drug B.

Group	Treatment
1	Salt solution
2	Drug A
3	Drug B

The graph shows the change in mean heart rate measured over a 15-minute period.



(a) Calculate the percentage difference in the change in heart rate when using drug B between 5 and 12.5 minutes.

(3)

Answer ..... %

(b) Compare and contrast the effects of drug A and drug B on the heart rate during the investigation.

(3)

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(c) Explain the effect of these drugs on the control of the heart rate.

(3)

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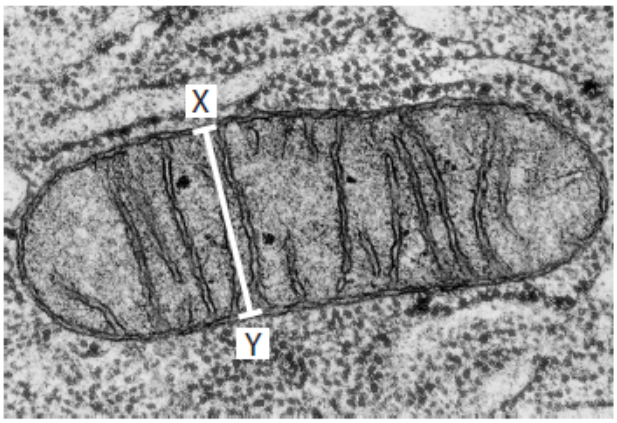
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(Total for question = 9 marks)

Q14.

The photograph shows a transmission electron micrograph of a mitochondrion and surrounding cytoplasm.



(Source: © CNRI / SCIENCE PHOTO LIBRARY)

(a) The mitochondrion shown in the diagram is 2000 nm in length.

Calculate the width of this mitochondrion between X and Y.

(2)

Answer ..... nm

(b) Describe how ATP is synthesised by oxidative phosphorylation in the mitochondrion.

(3)

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(c) Describe how ATP is used to supply energy for biological processes.

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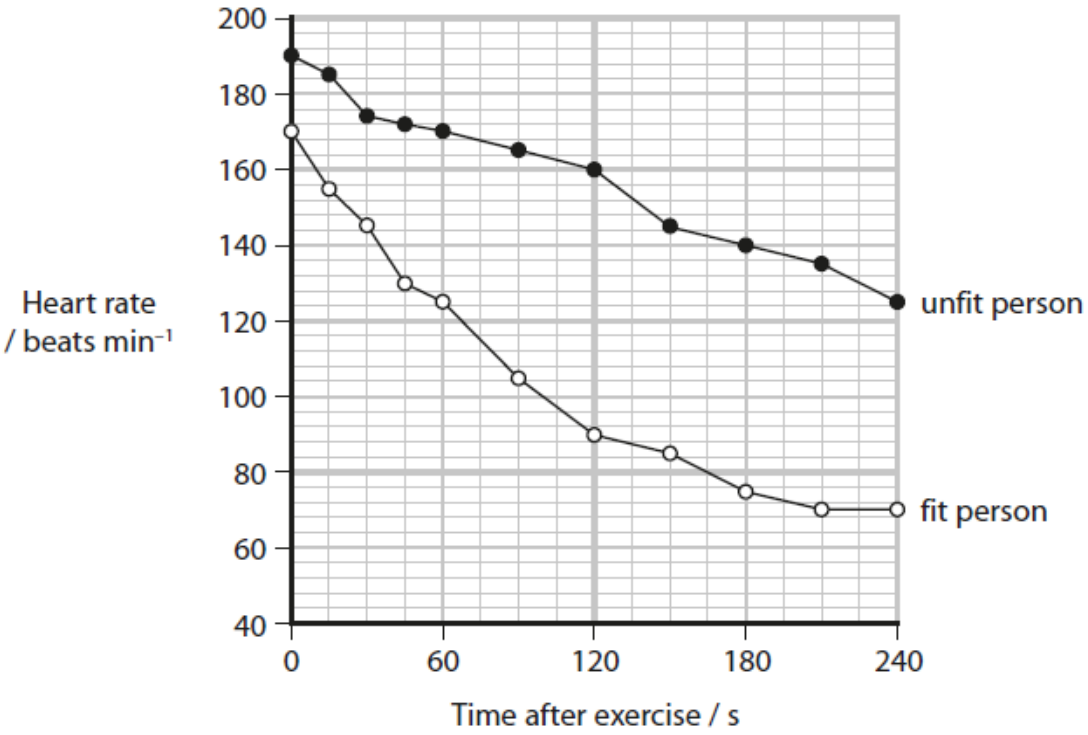
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(Total for question = 7 marks)

Q15.

Exercise affects the cardiac output of a person.

The graph shows the change in heart rate following exercise for an unfit person and for a fit person.



(a) The heart rate of the unfit person decreased by 16%, 120 seconds after exercise.

Calculate the difference in percentage decrease in heart rate of these two people, 120 seconds after exercise.

Give your answer to an appropriate number of decimal places.

(3)

Answer .....

(b) Calculate the heart rate of the unfit person at 5 minutes.

The change in heart rate of the unfit person is a linear relationship.
Use the equation for a straight line $y = mx + c$.

(3)

Answer .....

(c) Explain the difference in the time it would take for these two individuals to recover from the exercise.

(3)

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(d) Describe how heart rate is controlled in response to changes in the blood, following exercise.

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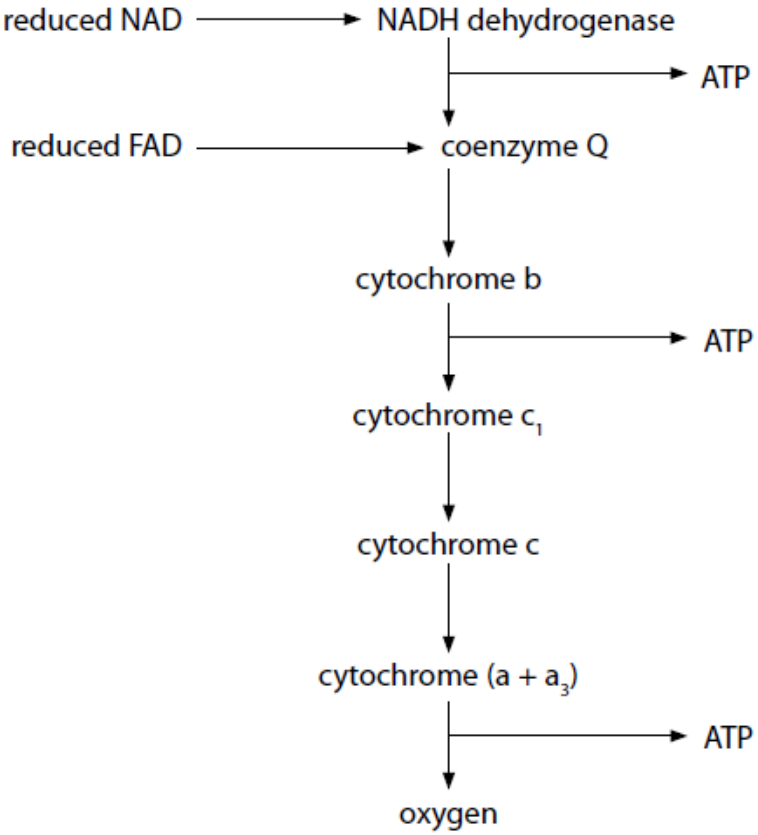
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(Total for question = 13 marks)

Q16.

The diagram shows the sequence of electron carriers in the electron transport chain.
The diagram also shows the stages where ATP is generated.



(a) Where is the site of the electron transport chain?

(1)

☒ **A** cytoplasm

☒ **B** inner mitochondrial membrane

☒ **C** matrix

☒ **D** outer mitochondrial membrane

(b) The table gives some information about inhibitors of the electron transport chain.

Inhibitor	Site of inhibition
Cyanide	between cytochrome $(a + a_3)$ and oxygen
Rotenone	between NADH dehydrogenase and coenzyme Q

(i) Explain the effect that cyanide will have on ATP production by the electron transport chain.

(2)

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(ii) Metabolism of succinate results in the production of reduced FAD.

Explain the effect that rotenone will have on ATP production by the electron transport chain.

(2)

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(iii) Explain why these inhibitors will not affect the production of ATP from anaerobic respiration. Use the information in the table to support your answer.

(2)

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(Total for question = 7 marks)

Q17.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new

answer with a cross ☒ .

Homeostasis is the state maintained by living systems.

(a) Feedback mechanisms are involved in maintaining homeostasis.

Describe the difference between a negative feedback mechanism and a positive feedback mechanism.

(2)

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(b) Which statement about the homeostasis of thermoregulation when the human body temperature is 37 °C is correct?

(1)

☒ **A** thermoregulation is no longer required

☒ **B** the body no longer generates any heat

☒ **C** the body will be generating more heat than it can lose

☒ **D** the body temperature is maintained in a dynamic equilibrium

(c) The health of a kidney can be determined by measuring the glomerular filtration rate (GFR).

This method measures the rate at which a small molecule called creatinine is filtered from the blood.

(i) Explain how small molecules like creatinine are filtered from the blood in the glomerulus.

(3)

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(ii) In 15 hours, a person excreted 1960 mg of creatinine in the urine.

Calculate the GFR for this person.

Give your answer to 3 significant figures.

(1)

Answer .....

(d) In type II diabetes, body cells take up less glucose in response to insulin.

Many people with type II diabetes are overweight or obese.

Some of these individuals have been given surgery to help weight loss.

A clinical trial investigated the effect of surgery on the uptake of glucose by body cells in the presence of insulin.

This trial used groups of people who were non-diabetic, people in the early stage of diabetes (pre-diabetic) and people who were type II diabetics.

Group	Mean uptake of glucose / a.u.	
	Before surgery	After surgery
Non-diabetic	1.07 ± 0.29	1.39 ± 0.58
Pre-diabetic	0.55 ± 0.32	1.30 ± 0.88
Type II diabetic	0.40 ± 0.24	1.10 ± 0.87

(i) Comment on the results of this trial.

(3)

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(ii) Calculate the difference that surgery makes to the mean uptake of glucose in the non-diabetic group and the type II diabetic group.

(2)

Answer .....

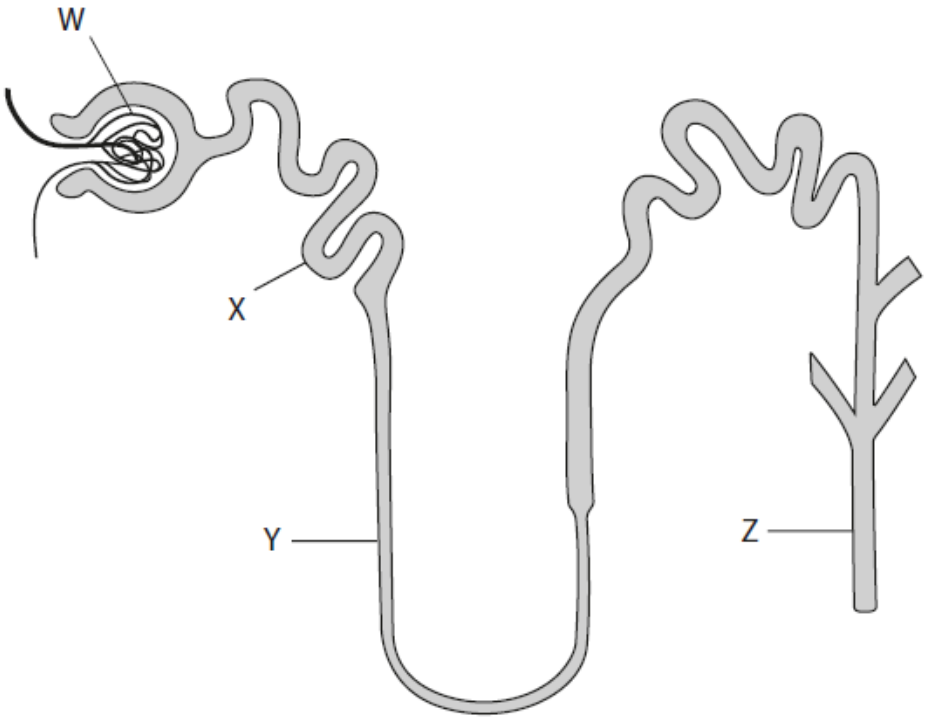
(Total for question = 12 marks)

Q18.

The kidney is an organ involved in the excretion of waste materials and in the regulation of blood volume and plasma concentration.

(a) The functional unit of the kidney is the nephron.

The diagram shows a single nephron.



(i) In which part of the kidney are structures W and X located?

(1)

☒ **A** cortex

☒ **B** inner medulla

☒ **C** outer medulla

☒ **D** renal pelvis

(ii) In which structure does ultrafiltration take place?

(1)

☒ **A** W

☒ **B** X

☒ **C** Y

☒ **D** Z

(iii) Which structures form part of the loop of Henle?

(1)

☒ **A** X only

☒ **B** X and Y

☒ **C** Y only

☒ **D** Y and Z

(b) Urea is a toxic substance that is excreted from the body.

Explain how ultrafiltration removes urea from the blood.

(2)

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(c) The kidney controls blood volume and plasma concentration by regulating the loss of water in urine.

Some mammals have adaptations to their kidneys that enable them to live in different habitats.

The table shows information about two small mammals.

Mammal	Urine concentration / mOsmol dm^{-3}	Relative number of mitochondria in the thick ascending loop of Henle	Sodium ion concentration of extracellular fluid in the medulla / mmol dm^{-3}
brown rat	2900	3.6	45
kangaroo rat	5500	5.5	95

Deduce why the kangaroo rat is more successful than the brown rat at living in desert habitats.

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(Total for question = 8 marks)

Q19.

Answer the question with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Whales are large mammals.

The photograph shows a beluga whale and a human diver.



(Source: © Andrey Nekrasov/Alamy Stock Photo)

(a) (i) A beluga whale can become habituated to human divers.

How many of the following statements about habituation are correct?

(1)

- habituation is an example of anatomical adaptation
- habituation is only observed in mammals
- habituation only occurs after repeated exposure to the same stimulus

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(ii) A beluga whale can respond to a stimulus using a spinal reflex arc.

Which row is correct?

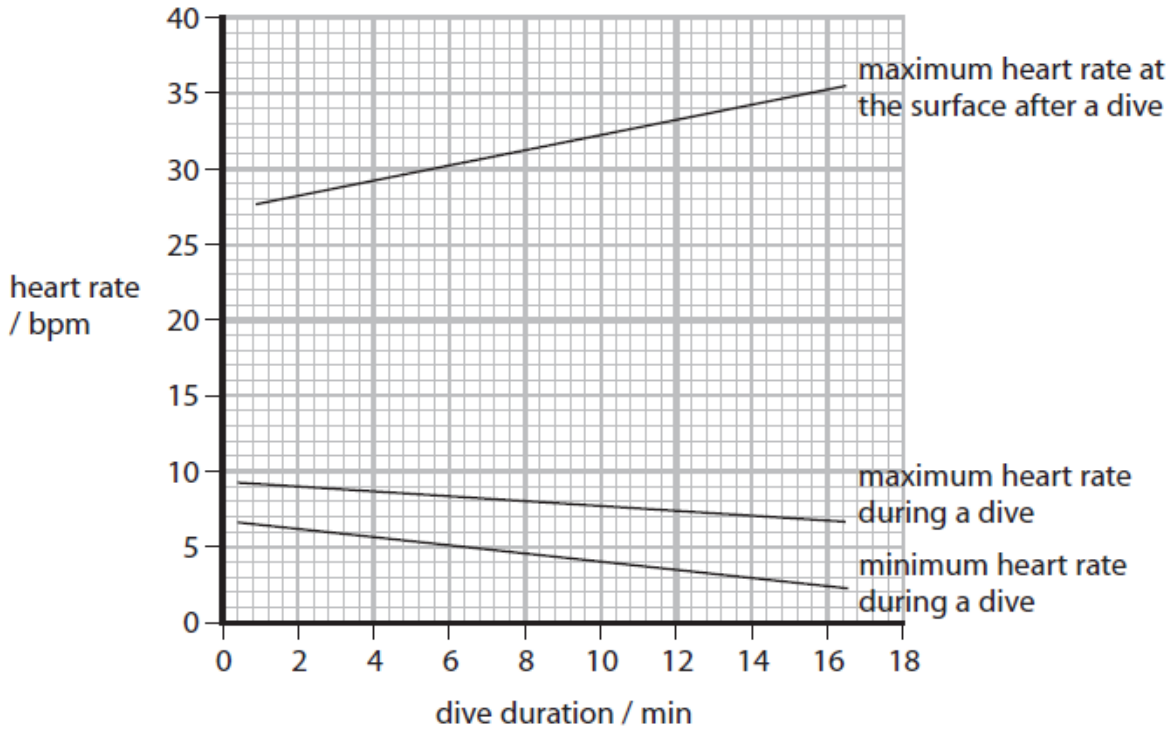
(1)

	Location of relay neurone	Location of cell body on the sensory neurone
☒ **A**	grey matter of spinal cord	at the end of the axon
☒ **B**	grey matter of spinal cord	in the middle of the axon
☒ **C**	white matter of spinal cord	at the end of the axon
☒ **D**	white matter of spinal cord	in the middle of the axon

(b) The heart rate of a whale changes when it is diving.

The graph shows the changes in heart rate that occur during dives of different durations.

The maximum heart rate at the surface is when the whale returns to the surface after a dive.



(i) Comment on the changes in heart rate of the whale when diving.

(3)

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(ii) Explain how the changes in heart rate are controlled when the whale returns to the surface immediately after the dive.

(3)

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(Total for question = 8 marks)

Q20.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Chemicals are used to regulate responses in both plants and animals.

(a) In mammals antidiuretic hormone (ADH) is involved in regulating plasma concentration and blood volume.

(i) Which of the following produces ADH?

(1)

☐ **A** adrenal gland

☐ **B** hypothalamus

☐ **C** medulla oblongata

☐ **D** pituitary gland

(ii) Which structures does ADH act on?

(1)

☐ **A** capillaries

☐ **B** collecting ducts

☐ **C** proximal tubules

☒ **D** ureters

(iii) The control of plasma concentration and blood volume in the body is an example of which type of process?

(1)

☒ **A** countercurrent multiplier

☒ **B** habituation

☒ **C** negative feedback

☒ **D** positive feedback

(iv) Name the type of receptor in the body that detects changes in the plasma concentration.

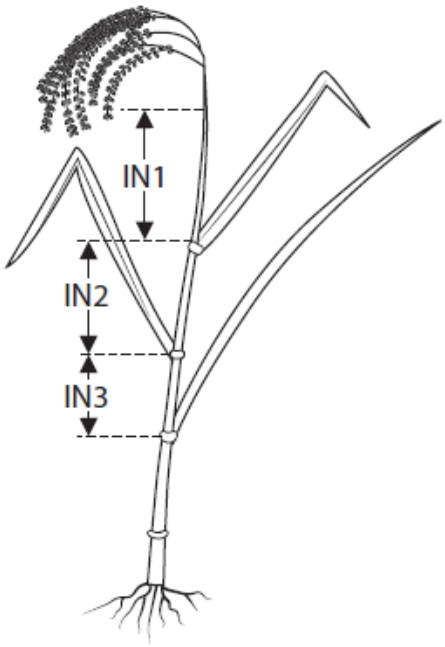
(1)

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(b) The effect of a gibberellin on the growth of cereal plants was investigated.

Different concentrations of the gibberellin were sprayed on cereal plants.

The lengths of the first, second and third internodes (IN1, IN2, IN3) were measured, as shown in the diagram.



The table shows the effect of the gibberellin on the mean lengths of the first, second and third internodes.

Concentration of the gibberellin / ppm	Mean length / cm		
	first internode	second internode	third internode
0	36	19	14
10	36	19	14
100	41	21	14
1000	52	22	15
2500	56	22	15

(i) Comment on the effect of the gibberellin on the growth of cereal plants.

(2)

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(ii) Suggest how the gibberellin causes this effect.

(3)

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(Total for question = 9 marks)