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EDEXCEL COMBINED SCIENCE BIOLOGY: QUESTIONS BY TOPIC

Exchange and Transport in Animals (8)

Combined Science Biology (Higher) Topic 8

13 questions · 125 marks · Mark schemes included

Pearson Edexcel Combined Science (9-1) Biology 1SC0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

13 questions · 125 marks · lowest tariff first



7-MARK QUESTIONS

1 question in this booklet



- 2 (a) Figure 3 shows a cross-section of an artery and a vein.



(Source: © The University of Kansas Medical Center)

Figure 3

- (i) Explain **one** difference between the artery wall and the vein wall shown in Figure 3.

(2)

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.....

- (ii) Name **one** structure that is found in veins but not found in arteries.

(1)

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(b) A human body has 5 dm^3 of blood.

At rest 20% of the blood travels to the muscles.

During exercise 60% of the blood travels to the muscles.

(i) Calculate the volume of blood travelling to the muscles during exercise.

(2)

..... dm^3

(ii) Explain **one** reason why there is an increase in blood flow to muscles during exercise.

(2)

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(Total for Question 2 = 7 marks)



8-MARK QUESTIONS

1 question in this booklet



3 Figure 5 shows the estimated blood flow through some parts of the body when a person is at rest and during exercise.

part of the body	estimated rate of blood flow in cm ³ per minute	
	at rest	during exercise
brain	750	748
heart muscle	350	1 150
digestive system	2 500	1 200
other muscles	1 200	14 500
all other organs (except lungs)	1 423	1 420

Figure 5

(a) Compare the rate of blood flow through the body when this person is at rest and during exercise.

(3)

(b) Explain why there is a change in the rate of blood flow through the digestive system during exercise.

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- (c) The stroke volume is the amount of blood leaving one chamber of the heart per beat.

From which chamber of the heart does this volume of oxygenated blood flow?

(1)

- ☒ A left atrium
☒ B left ventricle
☒ C right atrium
☒ D right ventricle

- (d) A person has a cardiac output of 4.9 litres per minute. The stroke volume of each heart beat is 70 ml.

Calculate the heart rate.

(2)

..... beats per minute

(Total for Question 3 = 8 marks)



9-MARK QUESTIONS

6 questions in this booklet



- 1 (a) Figure 1 shows a diagram of a red blood cell from a turtle and a diagram of a red blood cell from a human.

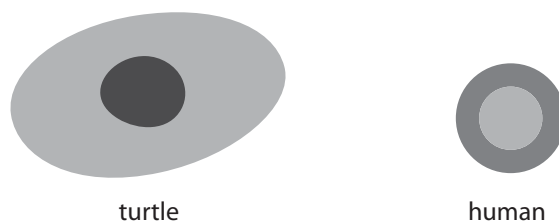


Figure 1

- (i) These cells are animal cells.

Animal cells do not have

(1)

- ☐ A cytoplasm
- ☐ B a cell membrane
- ☐ C a cell wall
- ☐ D mitochondria

- (ii) The actual length of the red blood cell from a turtle is $20.5\text{ }\mu\text{m}$.

Calculate the length of the magnified image of the red blood cell of the turtle when magnified $400\times$.

(2)

..... μm



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(iii) The width of the human red blood cell, when magnified $400\times$, is 3.08 mm.

Calculate the actual width of the cell and show your answer in standard form.

(2)

.....mm

(b) Red blood cells are carried in veins and arteries.

Figure 2 shows the equipment used to measure the elasticity of an artery.

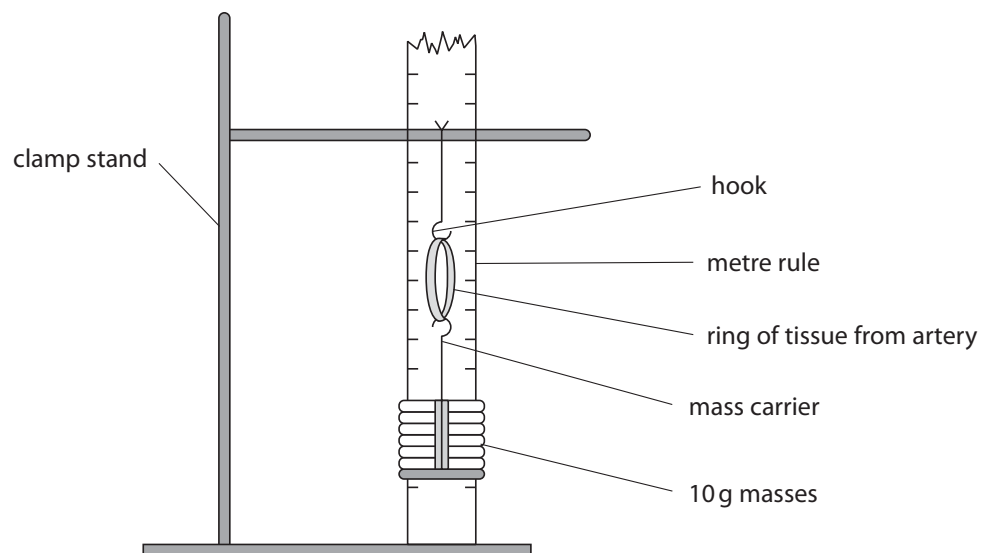


Figure 2

(i) Describe a method you could use to see how much the ring of tissue from an artery could stretch before it no longer returned to its original size.

(3)

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- (ii) Give **one** safety precaution you need to take when handling animal tissue such as blood vessels.

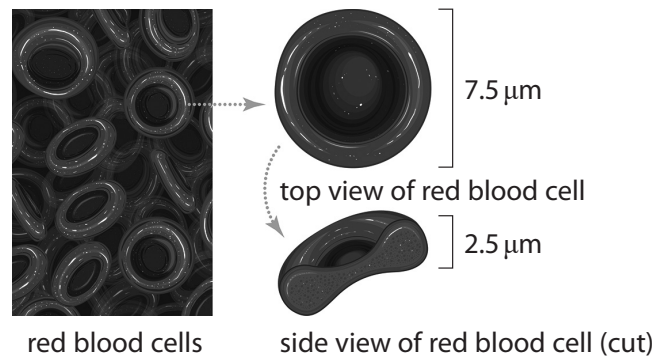
(1)

DO NOT WRITE IN

(Total for Question 1 = 9 marks)



3 Figure 6 shows the structure and actual size of red blood cells (erythrocytes).



(Source: © N.Vinoth Narasingam/Shutterstock)

Figure 6

- (a) (i) Calculate the image size of the top view of this red blood cell if this cell is magnified $400\times$.

Give your answer in mm.

(2)

..... mm

- (ii) Explain how the shape of a red blood cell is related to its function.

(3)

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(iii) State the role of haemoglobin inside the red blood cell.

(1)

(b) Some blood transfusions contain red blood cells.

Red blood cells are stored in a solution containing 5.0% glucose and 0.9% salt.

Explain why red blood cells cannot be stored in pure water.

(3)

(Total for Question 3 = 9 marks)

- 4 A student investigated the fat content of two types of milk: milk A and milk B.

Before starting the investigation, the student added a drop of oil from a pipette into a test tube of water as shown in Figure 3.

The drop of oil rose to the surface of the water.



(Source: © Nana_studio/Shutterstock)

Figure 3

- (a) The student then placed a drop of milk A into one test tube of water and a drop of milk B into a different test tube of water.

The drop of milk A sank to the bottom and the drop of milk B rose to the surface.

Give **one** reason for the drop of milk B rising to the surface.

(1)

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.....

(b) 5 cm³ of milk B and 1 cm³ of lipase were added to a different test tube.

The pH of this mixture was pH 7.

This test tube was placed in a water bath for 10 minutes.

The pH of the mixture changed from pH 7 to pH 5.

(i) Explain what caused this change in pH.

(3)

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(ii) This procedure was repeated with milk A.

There was no change in the pH of this mixture after 10 minutes.

Explain why there was no change in the pH of the mixture containing milk A.

(2)

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(iii) The student repeated this procedure with lipase that had been boiled and left to cool.

This was added to another sample of milk B.

Describe why the pH did not change in this mixture.

(3)

(Total for Question 4 = 9 marks)



2 Respiration occurs in cells.

(a) Why do cells respire?

(1)

- ☐ **A** to produce nitrogen
- ☐ **B** to release oxygen
- ☐ **C** to produce glucose
- ☐ **D** to release energy

(b) An athlete runs every day as part of their training.

(i) Explain why the breathing rate of the athlete increases when running.

(2)

.....

.....

.....

.....

.....

(ii) When the athlete is running, their muscle cells use both aerobic respiration and anaerobic respiration.

State **two** differences between aerobic respiration and anaerobic respiration.

(2)

1

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2

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.....

.....



(c) Bromothymol blue (BTB) solution is an indicator of pH.

Figure 2 shows the colour of BTB at different pH levels.

pH	4	5	6	7 (neutral)	8
colour	yellow	yellowy green	light green	green	blue

Figure 2

When air is passed through green BTB, for one minute, the solution stays green.

When a person breathes out through a straw into BTB for one minute the solution turns yellow.

(i) Explain why the air breathed out turns the BTB solution yellow.

(2)

- (ii) A scientist placed pondweed into two sealed test tubes containing green BTB solution.

Test tube A was kept in the dark.

Test tube B was kept in the light.

All other conditions were kept the same.

Figure 3 shows these test tubes at the start of the investigation.

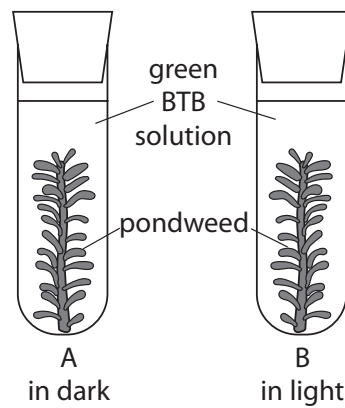


Figure 3

Figure 4 shows the colour of the BTB solution after 5 hours.

Tube A (in dark)	Tube B (in light)
yellowy green	green

Figure 4

Explain the results for tube A and tube B shown in Figure 4.

(2)

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(Total for Question 2 = 9 marks)

1 A centrifuge can be used to separate the different parts of human blood.

Figure 1 shows blood separated into different parts.

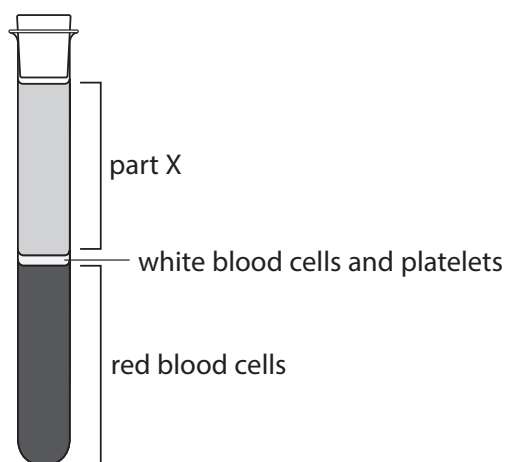


Figure 1

(a) (i) Name part X.

(1)

(ii) Which substance, needed for cellular respiration, is carried by red blood cells?

(1)

- ☒ A carbon dioxide
- ☒ B urea
- ☒ C amino acids
- ☒ D oxygen

(iii) Name **two** types of white blood cell.

(2)

1

2

(b) (i) When a person donates blood, 470 cm^3 of blood is removed from their body.

Red blood cells make up 44% by volume of the blood.

Calculate the volume of red blood cells in 470 cm^3 of donated blood.

Give your answer to the nearest whole number.

(3)

..... cm^3

(ii) Before donating blood, a person has a small blood sample taken to check that the blood is healthy.

State **two** precautions a doctor should take when collecting this sample.

(2)

1

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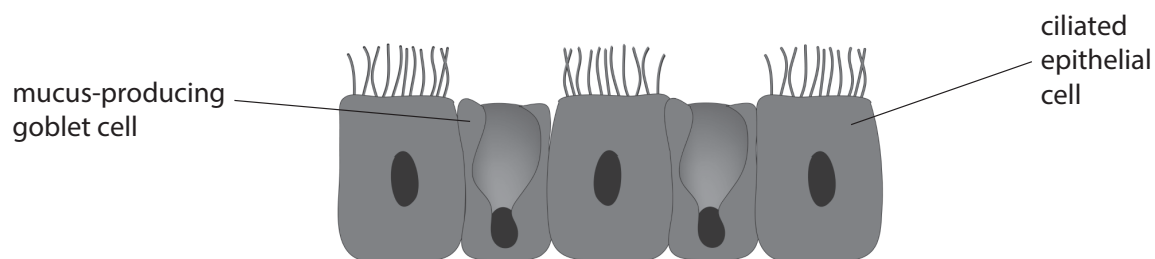
2

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(Total for Question 1 = 9 marks)



- 1 (a) Figure 1 shows a diagram of mucus-producing goblet cells and ciliated epithelial cells in the airways of the lungs.



(Source: © K.K.T Madhusanka/Shutterstock)

Figure 1

Describe how pathogens are removed from the airways by ciliated epithelial cells.

(2)

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.....

(b) During a race, athletes respire aerobically and anaerobically.

Figure 2 shows an athlete after a race.



(Source: © voronaman/Shutterstock)

Figure 2

Explain how aerobic respiration provides energy for running.

(2)

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- (c) The rate of respiration of maggots was investigated using the equipment shown in Figure 3.

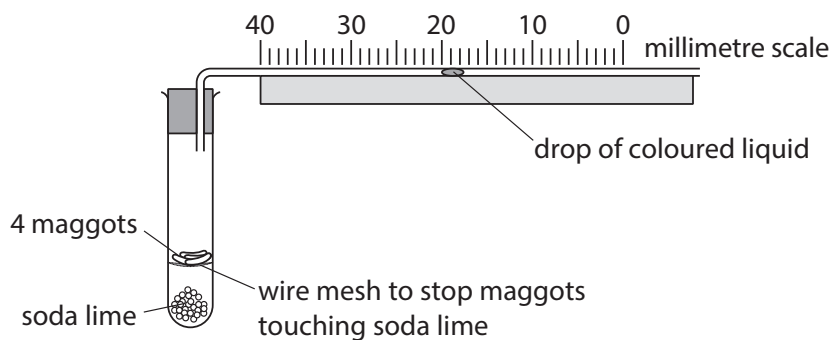


Figure 3

- (i) State the reason why the soda lime is placed in the test tube.

(1)

- (ii) The drop of liquid in Figure 3 is at 20 mm.

The drop of coloured liquid moved at a mean rate of 2 mm per minute.

Draw, on Figure 4, the new position of the bubble after the five minutes.

(1)



Figure 4

(iii) The investigation was repeated with two maggots.

Explain how the movement of the drop of coloured liquid would be affected if the investigation was repeated using fewer maggots.

(2)

(iv) State **one** way this investigation can be improved to obtain more reliable results.

(1)

(Total for Question 1 = 9 marks)



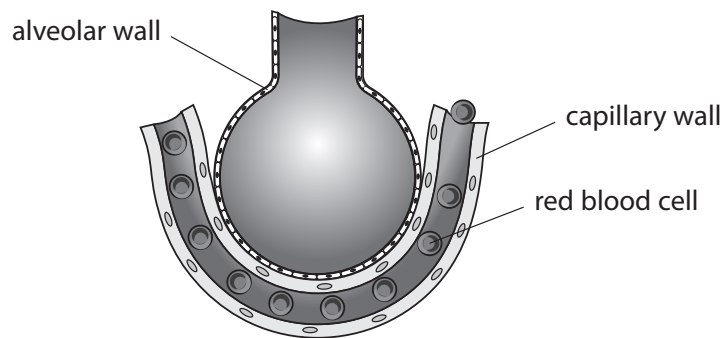
10-MARK QUESTIONS

1 question in this booklet



4 Gas exchange happens in the alveoli in the lungs.

Figure 7 shows an alveolus and a capillary.



(adapted from : sciencepics/shutterstock)

Figure 7

- (a) (i) Name the gas used in respiration that moves from the alveolus into the capillary.

(1)

- (ii) Name the gas produced by respiration that moves from the capillary into the alveolus.

(1)

- (iii) The capillary wall is only one cell thick.

Explain how gases move from the alveolus to the capillary.

(3)

- (iv) Explain the advantages of red blood cells passing one at a time through this narrow capillary.

(3)

- (b) The average number of alveoli in each human lung is 280 million.

The surface area of 1 million alveoli is 0.25 m^2 .

Calculate the total surface area of a human lung.

(2)

.....
(Total for Question 4 = 10 marks)



11-MARK QUESTIONS

2 questions in this booklet



6 Exercise causes changes in the circulation of the blood.

In an investigation, the change in blood flow to different parts of the body during exercise was measured.

All the volunteers used in the study were healthy females of the same age.

Figure 9 shows the results of this investigation.

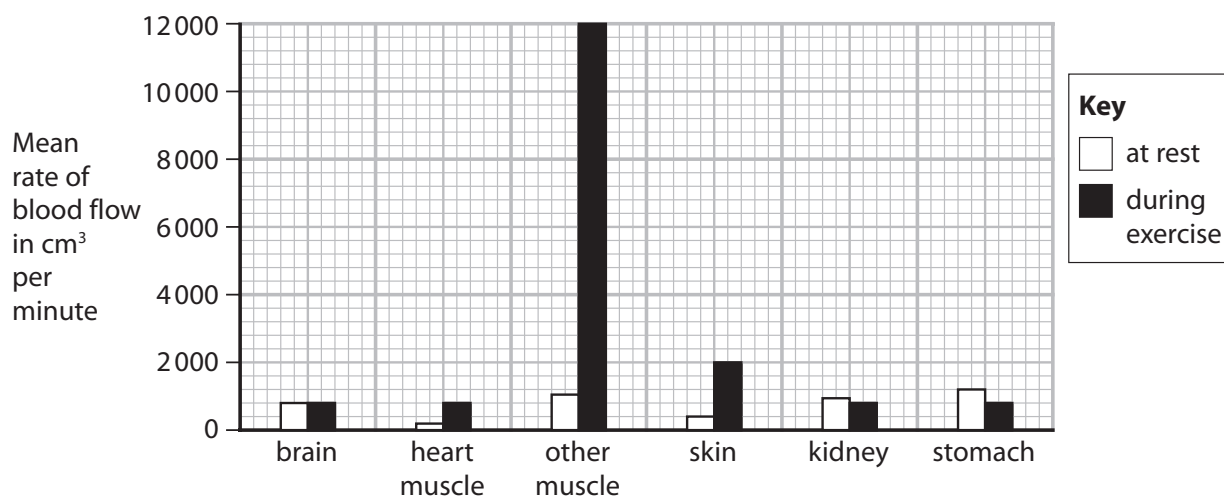


Figure 9

- (a) (i) During exercise, the blood flow to the stomach changes.

Calculate the percentage change in blood flow to the stomach in response to exercise.

Give your answer to the nearest whole number

(3)

..... %

- (ii) Suggest **two** other variables that should be controlled in this investigation.

(2)

1

2



*(iii) Explain the changes in blood flow, shown in Figure 9, that are caused by exercise.

(6)

(Total for Question 6 = 11 marks)



5 (a) Figure 6 shows a human heart.

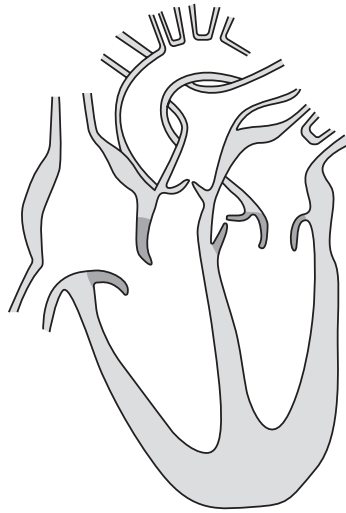


Figure 6

(i) Draw arrows on Figure 6 to show the direction of blood flow through the left side of the heart.

(2)

(ii) Name the main blood vessel that carries deoxygenated blood into the heart.

(1)

(b) Figure 7 shows the heart rate and stroke volume of a person when at rest and when doing exercise.

level of activity	heart rate in beats per minute	stroke volume in cm ³
at rest	68	72
during exercise	112	124

Figure 7

(i) Calculate the difference in cardiac output when at rest and when doing exercise.

Give your answer to 3 significant figures and include units in your answer.

(4)

answer

(ii) Explain why the cardiac output needs to increase during exercise.

(4)

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(Total for Question 5 = 11 marks)

12-MARK QUESTIONS

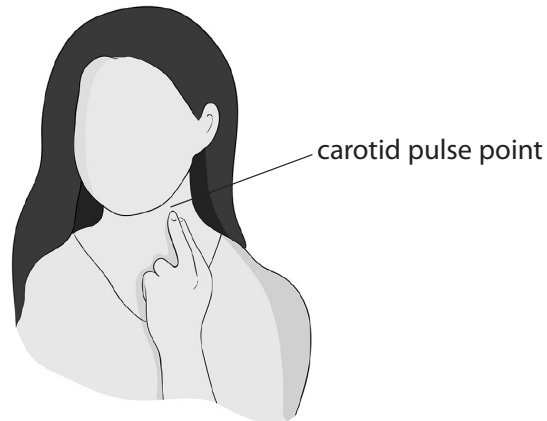
2 questions in this booklet



- 5 The effect of different types of exercise on the heart rate of an athlete was investigated.

The athlete counted the number of beats in 10 seconds at the carotid artery pulse point, as shown in Figure 7.

This measurement was used to calculate the heart rate.



(Source: © dityazemli/Shutterstock)

Figure 7

The athlete exercised for 20 minutes.

The heart rate was recorded every 5 minutes during each type of exercise.

- (a) (i) State how the heart rate was calculated using this method.

(1)

.....

.....

- (ii) Give **two** ways of improving the method used to obtain the data needed to calculate the heart rate.

(2)

1

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2

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Figure 8 shows the results of this investigation.

type of exercise	heart rate in bpm				
	0 minutes	5 minutes	10 minutes	15 minutes	20 minutes
running	90	156	168	180	180
walking	90	96	90	96	90

Figure 8

(iii) Comment on the difference in the heart rates during these types of exercise. (3)

(b) Exercise increases adrenalin levels.

(i) State which endocrine gland secretes adrenalin.

(1)

(ii) Explain the effect of adrenalin on liver cells during exercise.

(3)

(c) After high intensity exercise, the pH of muscles can decrease from pH 7.0 to pH 6.3.

Explain this change in pH.

(2)

(Total for Question 5 = 12 marks)



5 (a) Figure 9 is a diagram of the human heart.

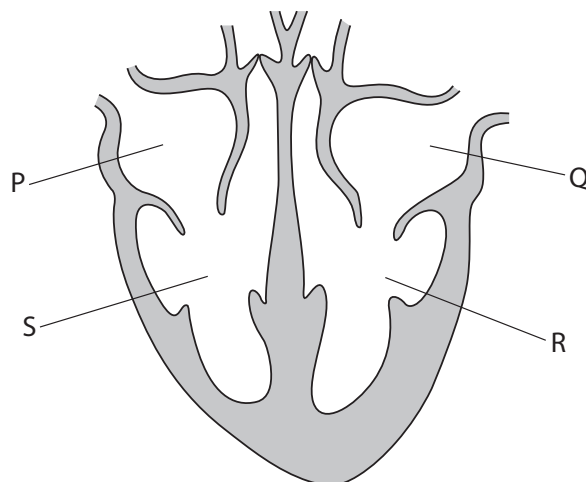


Figure 9

(i) Which chambers of the heart contain only oxygenated blood?

(1)

- ☐ A chamber P and chamber Q
- ☐ B chamber S and chamber R
- ☐ C chamber P and chamber S
- ☐ D chamber Q and chamber R

(ii) The heart has a valve called the bicuspid valve between chamber Q and chamber R.

Explain the role of this valve.

(2)

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(ii) Erythrocytes (red blood cells) transport oxygen to respiring cells.

Explain how erythrocytes (red blood cells) are adapted to carry and release oxygen.

(3)

(Total for Question 5 = 12 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Additional guidance	Mark
2(a)(i)	An explanation linking: - artery has {thicker / more muscular} wall (1) - because of the (blood) pressure (higher in artery than in vein) (1)	accept prevent the artery bursting / maintain blood pressure	(2) AO2 1

Question Number	Answer	Mark
2(a)(ii)	valve / valves	(1) AO1 1

Question Number	Answer	Additional guidance	Mark
2(b)(i)	$5 \times 60 = 300$ (1) OR $60 \div 100 = 0.6$ (1) $(300 \div 100) = 3$ (dm ³)	award full marks for correct answer with no working accept other correct methods of calculation which is a percentage calculation	(2) AO2 1

Question Number	Answer	Mark
2(b)(ii)	An explanation linking: - because (during exercise muscles) require more {oxygen / glucose} (1) - for respiration / to release energy (1) OR - to remove more carbon dioxide / to remove lactic acid (1) - as this is a product of respiration (1)	(2) AO2 1

(Total for question 2 = 7 marks)

Question number	Answer	Additional guidance	Mark
3(a)	A description including the following: - the blood flow through the {brain/other organs} stays the same (1) - the blood flow through the {muscles /heart} is increased during exercise (1) - the blood flow through the digestive system is decreased during exercise (1)	accept the blood flow through the brain decreases a small amount	(3) AO 3 1a AO 3 1b

Question number	Answer	Additional guidance	Mark
3(b)	An explanation that links two of the following: - there is increased blood flow to the muscles (1) - to allow for { respiration/ release of energy} (in the muscles) (1)	accept heart for muscle accept there is a {reduced /restricted} blood flow through the digestive system accept to supply oxygen/glucose to the muscles/remove carbon dioxide	(2) AO 2 1

Question number	Answer	Mark
3(c)	B left ventricle 1. The only correct answer is B <i>A is not correct because the left atrium receives blood from the pulmonary vein</i> <i>C is not correct because The right atrium receives blood from the vena cava</i> <i>D is not correct because the right ventricle has deoxygenated blood</i>	(1) AO 1 1

Question number	Answer	Additional guidance	Mark
3(d)	Substitution $4.9 \div 0.07$ / $4\,900 \div 70$ (1) Evaluation 70 (beats per minute)	full marks for correct answer no working accept $4.9 \div 70 = 0.07$ for 1 mark	(2) AO 1 2

Total for Question 3 = 8 marks



Question number	Answer	Mark
1(a)i	C a cell wall 1. The only correct answer is C <i>A is not correct because both plant and animal cells have cytoplasm</i> <i>B is not correct because both plant and animal cells have a cell membrane</i> <i>D is not correct because both plant and animal cells have mitochondria</i>	(1) AO 1 1

Question number	Answer	Additional guidance	Mark
1(a)ii	Substitution 20.5 x 400 (1) Evaluation 8 200 (μm)	2 marks for correct answer with no working	(2) AO 1 2

Question number	Answer	Additional guidance	Mark
1(a)iii	Substitution (3.08 ÷ 400) = 0.0077 (1) Evaluation 7.7 x 10⁻³	Award full marks for correct answer with no working accept 0.008 accept 8.0 x 10⁻³	(2) AO 2 2

Question number	Answer	Additional guidance	Mark
1(b)(i)	An answer that combines three of the following points to provide a method: • measure the length of the tissue (1) • add masses / mass (1) • remove the mass and measure length of the tissue (1) • repeat until the tissue no longer returns to its original length (1)	accept remove the mass and see if the tissue returns to its original size	(3) AO 3 3a

Question number	Answer	Additional guidance	Mark
1(b)(ii)	Any one from: • wash hands (1) • wear gloves (1) • sterilise the apparatus after use / disinfect working area (1)	ignore standard lab rules accept cover open wounds	(1) AO 2 2

Total for Question 1 = 9 marks

Question Number	Answer	Additional guidance	Mark
3(a)(i)	calculation $(7.5 \times 400 =) 3000$ (1) conversion $(3000 \div 1000 =) 3$ (mm)	ecf using 2.5 for 1 mark award full marks for correct answer with no working	(2) AO2 1

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	An explanation linking: - the biconcave disc shape (1) - results in a larger surface area (1) - so (more) oxygen can be carried (1)	accept description of biconcave disc accept (more) oxygen diffused	(3) AO1 1

Question Number	Answer	Additional guidance	Mark
3(a)(iii)	for oxygen to bind (inside the erythrocyte / red blood cell)	accept to carry oxygen	(1) AO1 1

Question Number	Answer	Additional guidance	Mark
3(b)	An explanation linking three from: - water will move into the erythrocyte (1) - by osmosis (1) - down a concentration gradient (1) - causing the erythrocyte to {burst/lyse} (1)	accept red blood cell for erythrocyte accept from high water concentration to low water concentration	(3) AO2 1

(Total for question 3 = 9 marks)



Question number	Answer	Additional guidance	Mark
4(a)	milk B contains fat / milk B had a high fat content	accept milk B is less dense accept lipid / oil	(1) A02 2

Question number	Answer		Mark
4(b)(i)	An explanation including the following: - lipase digests {fat/lipid} (1) - forming fatty acids (and glycerol) (1) - which are acidic / lowering the pH of the mixture / making the mixture more acidic (1)	accept breakdown for digest accept removing fat makes the milk more acidic	(3) A01 2

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An explanation linking two from: - milk A did not contain any/much fat (1) - fatty acids were not produced - as there was no substrate (1)	accept lipids accept fewer fatty acids were produced	(2) A02 2

Question number	Answer	Additional Guidance	Mark
4(b)(iii)	An explanation linking three of the following: - the temperature is above the optimum (1) - the {lipase / enzyme} denatures (1) - so active site changes shape (1) - no enzyme -substrate complexes formed / no longer complementary to the substrate / cannot bind the substrate (1)	accept the temperature was high reject {enzyme / lipase} is killed accept so it could not break down the fat / no fatty acids produced	(3) A02 2

Total for question 4 = 9 marks



Question number	Answer	Mark
2(a)	The only correct answer is D to release energy A is incorrect because nitrogen is not involved in respiration. B is incorrect because oxygen is used during respiration, not released C is incorrect because glucose is used during respiration, not produced	(1)

Question number	Answer	Additional guidance	Mark
2(b)(i)	An explanation linking two from: - to absorb more oxygen (into the blood / body) (1) - so that more respiration can occur / more energy is released (1) OR - to remove more carbon dioxide (from the blood / body) (1) - from more respiration / because carbon dioxide makes the blood more acidic (1)	accept to absorb oxygen (into the blood) more quickly accept so that respiration can occur more quickly / energy is released more quickly	(2)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	An answer including two from: - aerobic respiration uses oxygen / anaerobic does not use oxygen (1) - aerobic respiration releases more energy / anaerobic releases less energy (1) - aerobic produces {carbon dioxide / water} / anaerobic respiration produces lactic acid (1)	accept ATP for energy accept lactate for lactic acid accept aerobic respiration takes place in the mitochondria / anaerobic respiration takes place in the cytoplasm (1) ignore references to types of exercise / when the types of respiration occur	(2)

Question number	Answer	Additional guidance	Mark
2(c)(i)	An explanation linking: - you breathe out (air with a high concentration of) carbon dioxide (1) - which forms a (weak) acid (when it dissolves) (1)	accept it contains carbon dioxide accept lowers the pH	(2)

Question number	Answer	Mark
2(c)(ii)	An explanation linking: - tube A - respiration took place (producing carbon dioxide) / photosynthesis did not take place (1) - tube B - photosynthesis took place (using up the carbon dioxide) (1)	(2)

(Total for question 2 = 9 marks)

Question Number	Answer	Mark
1(a)(i)	plasma (accept phonetic spellings)	(1) A02 1

Question Number	Answer	Mark
1(a)(ii)	The only correct answer is D oxygen A is incorrect because carbon dioxide is not needed for respiration B is incorrect because urea is not carried by red blood cells or needed for respiration C is not correct because amino acids are not needed for respiration	(1) A01 1

Question Number	Answer	Additional guidance	Mark
1(a)(iii)	- phagocytes (1) - lymphocytes / B cells / memory cells (1)	answers can be in either order accept T cells accept other correctly named white blood cells (1)	(2) A01 1

Question Number	Answer	Additional guidance	Mark
1(b)(i)	$470 \div 100$ or 4.7 (1) $(4.7 \times 44) = 206.8$ (1) 207 OR $44 \div 100$ or 0.44 (1) $(0.44 \times 470) = 206.8$ (1) 207 OR 44×470 or 20680 (1) $(20680 \div 100) = 206.8$ (1) 207	accept correct answer on answer line for 3 marks award two marks for $206.8 / 206$ ecf for a calculated number in the working to the nearest whole number accept alternative methods of calculating percentages award two marks for 263 award one mark for 263.2	(3) AO2 1

Question Number	Answer	Additional guidance	Mark
1(b)(ii)	Any two from: • wear gloves / wash hands (1) • sterilise skin (of donor) (1) • use sterile needle (1) • cover the wound after taking the blood (1)	accept wear a mask accept use hand gel accept the doctor covers any open wounds / cuts accept clean the skin accept sterilise equipment	(2) AO2 1

(Total for question 1 = 9 marks)



Question number	Answer	Additional guidance	Mark
1(a)	A description including: (pathogens) get stuck in the mucus (1) cilia {move / waft} the {pathogens / mucus} (1) - to the throat / up the {trachea / bronchiole} / to be swallowed (1)	accept micro-organisms for pathogens accept hairs for cilia accept away from the lungs	(2)

Question number	Answer	Additional guidance	Mark
1(b)	An explanation linking two from: - glucose and oxygen (1) (to form) carbon dioxide and water (1) - in an exothermic reaction (1) - which takes place in the mitochondria (1)	accept $C_6H_{12}O_6 + O_2$ accept $CO_2 + H_2O$ accept correct equation for aerobic respiration for 2 marks	(2)

Question number	Answer	Additional guidance	Mark
1(c)(i)	to absorb the carbon dioxide	accept CO ₂	(1)

Question number	Answer	Mark
1(c)(ii)		(1)

Question number	Answer	Additional guidance	Mark
1(c)(iii)	An explanation linking two from: • (the drop) would move more slowly / shorter distance (1) • as less oxygen would be used (1) • so less respiration would occur (1)	accept less carbon dioxide {produced / absorbed}	(2)

Question number	Answer	Mark
1(c)(iv)	repeat the investigation / calculate a mean	(1)

Total for Question 1 = 9 marks

Question number	Answer	Mark
4(a)(i)	oxygen / O ₂	(1)

Question number	Answer	Mark
4(a)(ii)	carbon dioxide / CO ₂	(1)

Question number	Answer	Mark
4(a)(iii)	An explanation including the following: - by diffusion (1) - down a concentration gradient / from high concentration to a low concentration (1) - through a membrane (1)	(3)

Question number	Answer	Additional guidance	Mark
4(a)(iv)	An explanation including three from the following: - to reduce the distance over which diffusion occurs (1) - makes the blood flow slower (1) - increases the surface area (1) - to increase {diffusion / gas exchange} (1) - to maximise the amount of oxygen taken up by the red blood cells (1)	accept large surface area accept more time to diffuse accept the reverse argument for oxygen being released	(3)

Question number	Answer	Mark
4(b)	calculation (280 × 0.25 =) 70 (1) m² (1)	(2)

(Total for question 4 = 10 marks)



Question Number	Answer	Additional guidance	Mark
6(a)(i)	selection (1200 - 800 =) 400 (1) calculation $400 \div 1200 = 33.33$ (1) significant figures (-) 33%	ecf for incorrect calculation rounded to a whole number award full marks for correct answer with no working	(3) AO2 1

Question Number	Answer	Additional guidance	Mark
6(a)(ii)	Any two from: - length of exercise (1) - intensity of exercise (1) - type of exercise (1) - BMI of volunteer / body mass of volunteer (1) - diet / food intake (1) - fitness levels (1)	accept weight / height accept lifestyle similarities	(2) AO2 2

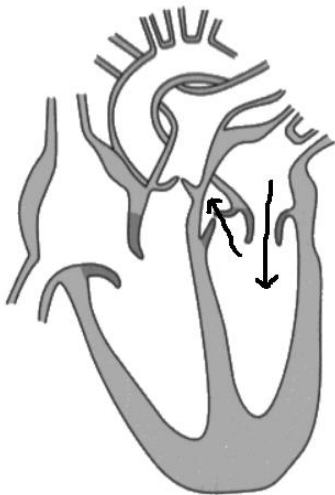
Question number	Indicative content	Mark
6*(a)(iii)	AO2 increased blood flow • pump more blood • increased blood flow to the heart muscle • increased blood flow to the other muscles • to deliver more oxygen and glucose • for increased respiration • releasing more energy for exercise • to remove more carbon dioxide • to remove more lactic acid • increased blood flow to the skin • to help cool the body decreased blood flow • decreased blood flow to the kidney • decreased blood flow to the stomach • to allow more blood to flow to the working muscles same blood flow • blood flow to the brain remains the same • as the brain needs a constant amount of oxygen and glucose to function	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic consequences connections made between elements in the context of the question. The lines of reasoning are unsupported or unclear.
Level 2	3–4	The explanation is mostly supported throughout by linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. Lines of reasoning are mostly supported through the application of relevant evidence.
Level 3	5–6	The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. Lines of reasoning are supported by sustained application of relevant knowledge.

Level	Mark	
	0	No rewardable material.
Level 1	1–2	A simple statement, referencing whether the blood through an organ is increased, decreased OR remained the same. Linked to a simple explanation.
Level 2	3–4	References to whether blood flow is increased, decreased or remained the same for TWO scenarios. Linked to two or more reasons.
Level 3	5–6	References to the blood through organs where it has increased, decreased AND remained the same. Linked to the need for more oxygen and glucose to the muscles / heart for increased respiration.

(Total for question 6 = 11 marks)



Question number	Answer	Additional guidance	Mark
5(a)(i)	 arrow indicating blood flow through the atrioventricular valve (1) arrow indicating blood flow through the semi-lunar valve (1)	no marks awarded if any arrows on right side of heart	(2) A02 1

Question number	Answer	Additional guidance	Mark
5(a)(ii)	vena cava / superior vena cava		(1) A01 1

Question number	Answer	Additional guidance	Mark
5(b)(i)	(at rest 68×72) = 4896 (exercise 112×124) = 13 888 (1) 13 888 - 4896 = 8 992 (1) 8 990 units (1) cm^3 per min cm^3/min $\text{cm}^3 \cdot \text{min}^{-1}$	accept either value for 1 mark accept 8992 for 2 marks accept 8990 for 3 marks with no working accept ml/min $\text{ml} \cdot \text{min}^{-1}$ accept minute	(4) AO3 2ab

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An explanation linking four of the following: - to deliver more oxygen (to the muscles) (1) - to deliver more glucose (to the muscles) (1) - to remove more carbon dioxide (1) - to prevent build-up of lactic acid (1) - to increase (the rate of aerobic) respiration (1) - and therefore release more energy (1)	accept more oxygenated blood accept remove lactic acid ignore produce energy	(4) AO1 1

(Total for question 5 = 11 marks)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	multiply the number of beats (in 10 seconds) by 6	accept times by six	(1) AO2

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	Any two from: • use a heart rate monitor / electronic device (to measure HR) (1) • take readings more frequently than 5 minutes (1) • record the pulse for longer than 10 seconds (1) • take repeat readings / calculate a mean (1)	ignore use a stopwatch accept repeat it	(2) AO3b

Question Number	Answer	Additional Guidance	Mark
5(a)(iii)	An answer linking three from: - heart rate {remains relatively constant / fluctuates slightly} when walking (1) - heart rate increases when running (1) - heart rate levels off {at 15 minutes / at 180 b.p.m.} when running (1)	accept heart rate stays at 90 b.p.m. to 96 b.p.m. when walking accept heart rate is higher when running / data illustrating the difference	(3) AO3

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	adrenal (glands)	ignore kidney / adrenalin glands	(1) AO1

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	An explanation linking three from: • binds to receptors (on the liver) (1) • (triggers liver cells to) convert glycogen (1) • into glucose (1) • increasing the concentration (of glucose) in the blood / which is released into the blood (1)	ignore sugar accept blood sugar	(3) AO2

Question Number	Answer	Additional Guidance	Mark
5(c)	An explanation linking: • because of lactic acid (1) • from anaerobic respiration (1)		(2) AO2

(Total for question 5 = 12 marks)

Question number	Answer	Mark
5(a)(i)	The only correct answer is D chamber Q and R A is incorrect as chamber P contains deoxygenated blood B is incorrect as chamber S contains deoxygenated blood C is incorrect as chamber P and S contain deoxygenated blood	(1)

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An explanation linking: - prevents the backflow (of blood) (1) - into the {(left) atrium / Q} (1)	accept blood flows in one direction accept from the (left) ventricle to the (left) atrium	(2)

Question number	Answer	Additional guidance	Mark
5(b)	An explanation linking three from: - pumps blood faster (1) - to provide more oxygen / glucose (1) - for increased respiration (1) - more energy to the muscles (1) - to remove carbon dioxide (1)	accept pumps more blood accept to prevent oxygen debt / prevent build-up of lactic acid / prevent anaerobic respiration	(3)

Question number	Answer	Additional guidance	Mark
5(c)(i)	Substitution $190 \div 100 \times 65 / 0.65 \times 190$ (1) Evaluation 123.5 Three significant figures 124	full marks for correct answer with no working Award 2 marks for 123 / 123.5	(3)

Question number	Answer	Additional guidance	Mark
5(c)(ii)	An explanation linking three from: • no nucleus (to carry more oxygen) (1) • biconcave {to allow more diffusion / to increase surface area} (1) • {flexible / small / thin} to fit through capillaries (1) • contain haemoglobin to bind oxygen (1) • thin so short diffusion pathway (1)	accept large SA:V ratio for more diffusion	(3)

Total for Question 5 = 12 marks