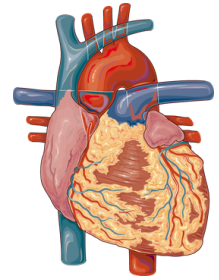


GCSE (9–1) BIOLOGY

The Heart and Blood Vessels

Pearson Edexcel-style Topic Practice

Based on Pearson Edexcel GCSE Biology (1BI0)



Name _____

Date _____

Instructions

- Answer all questions.
- Write your answers in the spaces provided.
- Show all working in calculations. A calculator may be used.
- For multiple-choice questions, put a cross in the box next to your answer.

Information

- The marks for each question are shown in brackets.
- Questions marked with an asterisk (*) require a structured extended response. Organise your answer clearly and make logical links between your points.
- The total mark for this paper is 64.

These are original practice questions written in the style of Pearson Edexcel GCSE Biology. They are not official Pearson examination questions.

Total marks

64

1 The heart pumps blood around the body through a system of blood vessels.

(a) Which blood vessel carries oxygenated blood from the lungs to the heart?

- A** ☐ aorta
- B** ☐ pulmonary artery
- C** ☐ pulmonary vein
- D** ☐ vena cava

(1)

(b) A cyclist has just finished a hill climb. Which of these blood vessels carries the blood that is richest in carbon dioxide?

- A** ☐ aorta
- B** ☐ coronary artery
- C** ☐ pulmonary vein
- D** ☐ vena cava

(1)

(c) The left ventricle contracts. Which valve does blood pass through as it leaves the heart?

- A** ☐ bicuspid valve
- B** ☐ tricuspid valve
- C** ☐ semilunar valve at the base of the aorta
- D** ☐ semilunar valve at the base of the pulmonary artery

(1)

(d) The table describes three blood vessels, X, Y and Z.

Vessel	Wall	Lumen	Valves
X	thin, with little muscle	large	present
Y	one cell thick	very narrow	absent
Z	thick, muscular and elastic	narrow	absent

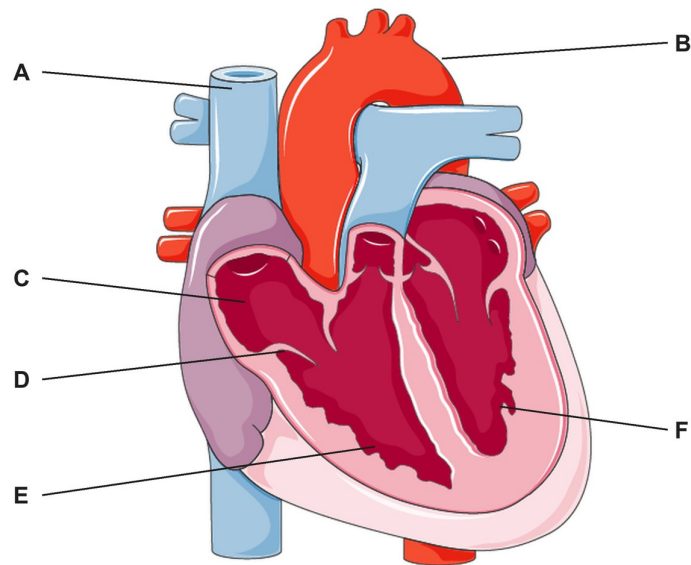
Which row names vessels X, Y and Z correctly?

		X	Y	Z
A	☐	artery	capillary	vein
B	☐	vein	capillary	artery
C	☐	capillary	vein	artery
D	☐	vein	artery	capillary

(1)

(Total for Question 1 = 4 marks)

- 2 The diagram shows a section through a human heart, seen from the front.



A section through the human heart.

- (a) Name the structures labelled A, B and C.

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(3)

- (b) Structure D is a valve. Explain why this valve is important.

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(2)

- (c) Give the letter of the chamber that pumps blood to the lungs.

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(1)

- (d) Explain why the wall of chamber F is thicker than the wall of chamber E.

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(2)

(Total for Question 2 = 8 marks)

- 3** Blood is carried around the body in arteries, veins and capillaries.

- (a) The walls of arteries contain a lot of elastic tissue. Explain how this helps an artery carry out its function.

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(2)

- (b) Compare the structure of an artery with the structure of a vein.

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(3)

- (c) Explain how the structure of a capillary is adapted for exchanging substances with body cells.

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(2)

- (d) Veins in the legs contain many valves. Explain why.

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(2)

(Total for Question 3 = 9 marks)

4 Different animals transport blood around their bodies in different ways.

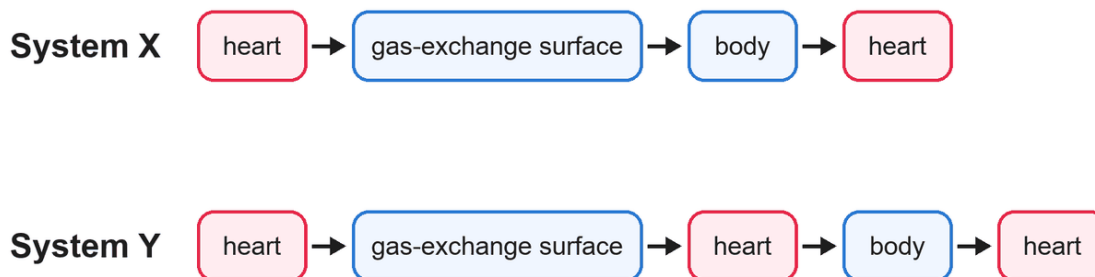
- (a) A fish has a single circulatory system. Blood flows from the heart to the gills before travelling to the other organs of the body.

Which sequence shows the path taken by the blood?

- A ☐ heart → body → gills → heart
B ☐ heart → gills → body → heart
C ☐ heart → gills → heart → body → heart
D ☐ heart → lungs → heart → body → heart

(1)

- (b) The diagram shows two circulatory systems, X and Y.



Two circulatory systems.

Give one difference between circulatory systems X and Y.

(1)

- (c) System Y is found in mammals. Explain why system Y can supply respiring body cells with substances more rapidly than system X.

(3)

(Total for Question 4 = 5 marks)

- 5 An *Amoeba* is a single-celled organism that lives in ponds. It gets all the oxygen it needs by diffusion across its cell membrane.

A student used two cubes to model an *Amoeba* and a larger organism.

Cube	Length of side	Surface area	Volume
P	1 mm	6 mm ²	1 mm ³
Q	4 mm	96 mm ²	64 mm ³

- (a) Calculate the surface area : volume ratio of cube Q. Give your answer in its simplest form.

Answer

(2)

- (b) Use the model to explain why a large multicellular animal needs a circulatory system, but an *Amoeba* does not.

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(3)

(Total for Question 5 = 5 marks)

- 6 Cardiac output is the volume of blood pumped by one ventricle of the heart each minute. It can be calculated using the equation:

$$\text{cardiac output} = \text{stroke volume} \times \text{heart rate}$$

Stroke volume is the volume of blood pumped out of a ventricle in one heartbeat. The table shows data for two students at rest.

Student	Heart rate (beats per minute)	Stroke volume (cm ³)	Cardiac output (cm ³ per minute)
R, does not train	72	70	
S, a long-distance runner	50		5000

- (a) Calculate the cardiac output of student R at rest.

Answer cm³ per minute

(2)

- (b) Calculate the stroke volume of student S at rest.

Answer cm³

(2)

- (c) Suggest why student S can have a lower resting heart rate than student R and still pump a similar volume of blood each minute.

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(2)

- (d) During a race, the cardiac output of student S rose to 20 000 cm³ per minute. Calculate the percentage increase in cardiac output from rest.

Answer %

(2)

- (e) Explain why cardiac output increases during exercise.

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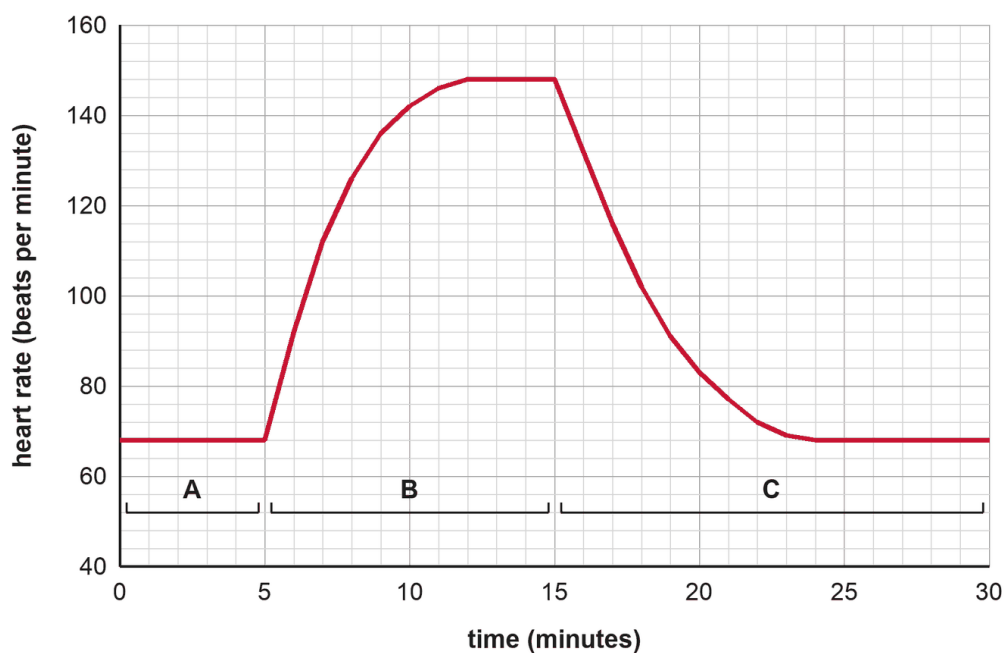
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(3)

(Total for Question 6 = 11 marks)

- 7 A student investigated the effect of exercise on heart rate. She measured her heart rate while sitting still (period A), while running on a treadmill (period B) and while sitting still again afterwards (period C). The graph shows her results.



Heart rate before, during and after exercise.

- (a) State her resting heart rate.

Answer beats per minute

(1)

- (b) Calculate the increase in her heart rate between rest and the highest rate during exercise.

Answer beats per minute

(1)

- (c) Give one variable she should control to make the investigation a fair test.

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(1)

- (d) Explain the change in heart rate during period B.

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(3)

- (e) Her friend repeated the investigation. His heart rate took 15 minutes to return to its resting rate after he stopped running. Suggest what this indicates about her friend's fitness compared with hers. Use information from the graph to support your answer.

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(2)

(Total for Question 7 = 8 marks)

- 8** The heart is made of cardiac muscle, which contracts continuously throughout life.

- (a) A giraffe's head can be two metres above its heart. The wall of a giraffe's left ventricle is much thicker, compared with the size of its heart, than the wall of a human's left ventricle.

Using this information and your own knowledge, suggest why the wall of a giraffe's left ventricle is so thick.

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(3)

- (b) The chambers of the heart are full of blood. Even so, the heart muscle has its own blood supply, through the coronary arteries.

Explain why the heart muscle needs its own blood supply.

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(2)

(Total for Question 8 = 5 marks)

- 9** A baby is born with a hole in the septum between the left and right ventricles. The baby tires quickly when feeding.

Explain why a hole in the septum could cause the baby to tire quickly.

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(3)

(Total for Question 9 = 3 marks)

- *10** Explain how the structure of the heart and the blood vessels is related to their functions in the circulation of blood.

(6)

(Total for Question 10 = 6 marks)

TOTAL FOR PAPER = 64 MARKS

Mark scheme

General marking guidance: credit any answer that is scientifically correct and conveys the same meaning as the answer given, unless the additional guidance says otherwise. Words in brackets are not needed to gain the mark.

Question number	Answer	Additional guidance	Mark
1(a)	C pulmonary vein	The only correct answer is C. A is not correct because the aorta carries blood away from the heart. B is not correct because the pulmonary artery carries deoxygenated blood to the lungs. D is not correct because the vena cava carries deoxygenated blood from the body.	(1)
1(b)	D vena cava	The only correct answer is D. A, B and C are not correct because they carry oxygenated blood, which has just released carbon dioxide in the lungs.	(1)
1(c)	C semilunar valve at the base of the aorta	The only correct answer is C. A and B are not correct because they are between the atria and the ventricles. D is not correct because the pulmonary artery leaves the right ventricle.	(1)
1(d)	B (X vein, Y capillary, Z artery)	The only correct answer is B.	(1)

(Total for Question 1 = 4 marks)

Question number	Answer	Additional guidance	Mark
2(a)	- A vena cava (1) - B aorta (1) - C right atrium (1)	Accept superior vena cava for A. Do not accept "vein" alone for A. Do not accept "atrium" alone for C.	(3)
2(b)	An explanation linking: - prevents backflow of blood (from the ventricle into the atrium) (1) - therefore maintains one-way movement of blood through the heart (1)	Accept prevents blood returning to the atrium. Ignore vague references to "the wrong direction" unless backflow is clearly implied.	(2)
2(c)	E	Ignore "right ventricle" if the letter E is also given.	(1)

Question number	Answer	Additional guidance	Mark
2(d)	An explanation linking: • (chamber) F / the left ventricle pumps blood around the whole body, but E / the right ventricle pumps blood only to the lungs (1) • so F must generate a higher pressure / contract more strongly (1)	Accept the lungs are close to the heart for the idea of a short distance. Allow more (cardiac) muscle to produce more force for the second marking point. Ignore "pumps harder" without reference to pressure or distance.	(2)

(Total for Question 2 = 8 marks)

Question number	Answer	Additional guidance	Mark
3(a)	An explanation linking: • elastic tissue allows the wall to stretch as a surge of high-pressure blood arrives (from the ventricle) (1) • and then recoil, which smooths out the flow / maintains the pressure (1)	Accept stops the artery bursting for the second marking point. Ignore "flexible" without reference to stretching or recoiling.	(2)
3(b)	A comparison including three from: • arteries have thicker walls than veins (1) • arteries have more muscle / elastic tissue than veins (1) • arteries have a narrower lumen than veins (1) • veins have valves, whereas arteries do not (1)	Each point must compare both vessels. A statement about only one vessel does not score. Accept the converse statements about veins. Allow arteries have valves only at the base of the aorta and pulmonary artery.	(3)
3(c)	An explanation linking: • the wall is one cell thick (1) • so the diffusion distance is short / substances such as oxygen and glucose diffuse quickly (1)	Accept "very thin wall" for the first marking point. Allow capillaries form large networks, so there is a large surface area for exchange, for either marking point.	(2)
3(d)	An explanation linking: • blood in the veins is at low pressure / must travel upwards against gravity (1) • valves prevent backflow / keep blood moving towards the heart (1)	Do not accept valves pump or push blood.	(2)

(Total for Question 3 = 9 marks)

Question number	Answer	Additional guidance	Mark
4(a)	B heart → gills → body → heart	The only correct answer is B. A is not correct because the information states that blood goes to the gills before the body. C is not correct because the blood does not return to the heart between the gills and the body. D is not correct because a fish has gills, not lungs.	(1)
4(b)	Blood passes through the heart once per circuit in X, but twice in Y	Accept in Y blood returns to the heart after the gas-exchange surface, but in X it goes straight to the body. Accept Y has two circuits / loops and X has one. Ignore "Y is a double system" without a description of the difference.	(1)
4(c)	An explanation linking three from: - in Y, blood returns to the heart after the gas-exchange surface and is pumped again (1) - so the pressure of the blood is increased (1) - so blood reaches the body tissues more rapidly (1) - so oxygen / glucose are delivered more quickly for (aerobic) respiration, or waste such as carbon dioxide is removed more rapidly (1)	Ignore "more efficient" without explanation. Do not accept energy is made / produced.	(3)

(Total for Question 4 = 5 marks)

Question number	Answer	Additional guidance	Mark
5(a)	96 : 64 (1) 3 : 2 (1)	Award full marks for a correct answer with no working. Award 1 mark for 1.5 : 1, which is correct but not in its simplest form.	(2)
5(b)	An explanation linking: - cube P has a larger surface area : volume ratio (6 : 1) than cube Q (3 : 2) (1) - a small organism has a large surface compared with its volume / short diffusion distances, so diffusion across its surface supplies enough oxygen (1) - a large organism has a small surface compared with its volume / its cells are too far from the surface, so it needs a circulatory system to transport substances to its cells (1)	ECF from an incorrect ratio in (a). Accept 1.5 : 1 for cube Q.	(3)

(Total for Question 5 = 5 marks)

Question number	Answer	Additional guidance	Mark
6(a)	• 70×72 (1) • 5040 (cm³ per minute) (1)	Award full marks for a correct answer with no working.	(2)
6(b)	• $5000 \div 50$ (1) • 100 (cm³) (1)	Award full marks for a correct answer with no working.	(2)
6(c)	An explanation linking: • student S has a larger stroke volume / pumps more blood with each beat (1) • because training has made the heart muscle / ventricle wall stronger / larger (1)	Accept the larger stroke volume makes up for the lower heart rate for the first marking point. Ignore "S's heart is fitter" without explanation.	(2)
6(d)	• $(20\,000 - 5000) \div 5000 \times 100$ (1) • 300 (%) (1)	Award full marks for a correct answer with no working. Award 1 mark for 400 (%), from $20\,000 \div 5000 \times 100$.	(2)
6(e)	An explanation linking three from: • muscles respire faster / more aerobic respiration takes place in muscle cells (1) • so more oxygen and glucose must be delivered (1) • and more carbon dioxide must be removed (1) • a higher cardiac output carries more blood to and from the muscles each minute (1)	Do not accept energy is made / produced.	(3)

(Total for Question 6 = 11 marks)

Question number	Answer	Additional guidance	Mark
7(a)	68 (beats per minute)	Accept 67–69.	(1)
7(b)	80 (beats per minute)	Accept 78–82. ECF: 148 – their answer to (a).	(1)
7(c)	One from: • the same speed / intensity of running • the same length of time running • the same time spent sitting before measuring • the same method of measuring heart rate	Ignore "the same conditions" without detail.	(1)
7(d)	An explanation linking: • heart rate increases quickly, then levels off at about 148 beats per minute (1) • because the muscles respire faster / need more energy for contraction (1) • so more oxygen and glucose must be delivered / more carbon dioxide removed, by pumping blood faster (1)	Allow a description of the increase only for the first marking point. Do not accept energy is made / produced.	(3)

Question number	Answer	Additional guidance	Mark
7(e)	An explanation linking: - her friend is likely to be less fit (1) - her heart rate returned to its resting rate in about 9 minutes (from 15 to 24 minutes), which is shorter than his 15 minutes (1)	The second marking point needs a value taken from the graph. Accept 8–10 minutes. Accept "has a lower level of fitness".	(2)

(Total for Question 7 = 8 marks)

Question number	Answer	Additional guidance	Mark
8(a)	An explanation linking: - blood must be pumped a long distance upwards / against gravity to reach the head (1) - so the left ventricle must generate a high pressure (1) - a thicker wall has more (cardiac) muscle, which contracts more strongly (1)	Ignore "pumps harder" without reference to pressure.	(3)
8(b)	An explanation linking: - cardiac muscle cells respire continuously / need a constant supply of oxygen and glucose for aerobic respiration (1) - blood inside the chambers cannot supply all the muscle cells by diffusion, because the wall is too thick / the blood moves through too quickly (1)	Accept "the diffusion distance is too great" for the second marking point. Do not accept energy is made / produced.	(2)

(Total for Question 8 = 5 marks)

Question number	Answer	Additional guidance	Mark
9	An explanation linking: - oxygenated and deoxygenated blood mix (through the hole) (1) - so the blood pumped to the body carries less oxygen (1) - so less aerobic respiration takes place in the baby's cells / less energy is released, so the baby tires quickly (1)	Do not accept energy is made / produced. Ignore "blood leaks out of the heart".	(3)

(Total for Question 9 = 3 marks)

Question 10 is marked using levels of response. Decide which level descriptor best matches the answer, then award a mark within that level.

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	Demonstrates isolated elements of biological understanding. Some relevant structures or functions are identified, but links between structure and function are limited. The response may lack clarity or logical organisation.
Level 2	3–4	Demonstrates mostly relevant biological understanding. Several relationships between structures and functions are explained, although some reasoning may be incomplete. The response has some logical structure.
Level 3	5–6	Demonstrates accurate and relevant biological understanding throughout. Relationships between heart and/or blood-vessel structures and their functions are explained in detail. The response is clear, coherent and logically structured.

Question number	Answer	Additional guidance	Mark
*10	Indicative content: • atria receive blood (from the veins) • ventricles pump blood out of the heart • ventricle walls are thicker than atrial walls, because the ventricles pump blood further • the left ventricle wall is thickest because it pumps blood around the whole body • the right ventricle pumps blood only to the nearby lungs • the septum separates oxygenated and deoxygenated blood • valves prevent backflow, so blood flows one way • coronary arteries supply the heart muscle with oxygen and glucose • arteries have thick, muscular, elastic walls to withstand high pressure • veins have thinner walls, a wider lumen and valves • capillaries have walls one cell thick, giving a short diffusion distance • capillary networks provide a large surface area for exchange	The indicative content is not a checklist. Other scientifically correct points can receive credit. To reach Level 3, the answer must explain relationships between structure and function in detail, not simply list structures.	(6)

(Total for Question 10 = 6 marks)