

1. Sarah is feeling unwell so she goes to her doctor. Her doctor thinks she may have Chronic Fatigue Syndrome (CFS).

CFS is difficult to diagnose. Before diagnosis doctors rule out a condition called anaemia by carrying out a blood test.

A blood test checks the number of blood cells in Sarah's blood.

- (i) What is the role of the red blood cell?

----- [1]

- (ii) Extreme tiredness is one symptom of CFS.
The table shows the results of Sarah's blood test.

	Red blood cell (per mm ³)	White blood cell (per mm ³)	Platelets (per mm ³)
Normal level	3 800 000	8 500	250 000
Sarah	2 700 000	9 000	245 000

Explain how the results in the table show the possible cause of Sarah's tiredness.

----- [3]

- (iii) The table below shows some information about red blood cells and cheek cells taken from a human.

	Red blood cell	Cheek cell
Surface area (µm ²)	136	7854
Volume (µm ³)	90	65 450
Surface area: volume ratio		0.12 : 1

Calculate the surface area to volume ratio of the red blood cell.

Show your working.

Give your answer to **two** significant figures.

Surface area : volume ratio =

----- [1]

(iv) Red blood cells have a greater surface area : volume ratio than cheek cells.

Explain how this allows red blood cells to carry out their function.

----- [1]

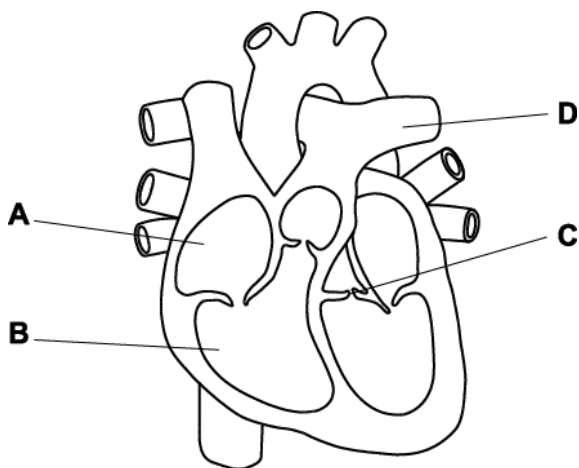
(v) The doctor will check to see if Sarah has an underactive thyroid gland as this could also make her feel tired.

The thyroid gland produces a hormone.

What is the role of a hormone?

----- [1]

2. Look at the diagram of the heart.



(i) Which letter on the diagram, A, B, C or D, shows how the backflow of blood is prevented?

Place a tick (✓) in the correct box.

A	
B	
C	
D	

[1]

(ii) The blood vessels in the circulatory system are adapted to their function.

The table shows features of the three different blood vessels, X, Y and Z.

Vessel	Smooth inner lining	Valves	Muscular tissue	Elastic tissue
X	Yes	Yes	Yes	Yes
Y	Yes	No	Yes	Yes
Z	Yes	No	No	No

Using the table, identify the **type** of blood vessel for X, Y and Z.

Blood vessel X _____

Blood vessel Y -----

Blood vessel Z -----

[3]

3(a). The function of the heart is to pump blood round the circulatory system.

The coronary arteries provide the cardiac muscle of the heart with a blood supply although the heart is full of blood.

Explain why coronary arteries are still needed.

----- [2]

(b).

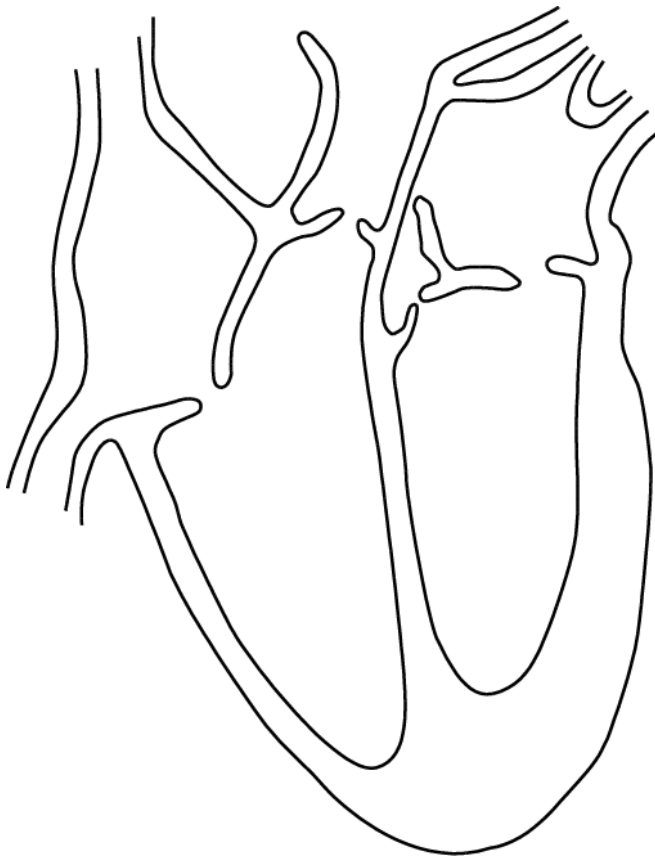
(i) Jon carries out a heart dissection of a heart from a lamb.

He discovers that the wall of the left ventricle of the heart is made from thicker cardiac muscle than the walls of the right ventricle.

Explain the difference in thickness of the two ventricle walls.

----- [2]

The diagram below shows a line drawing that Jon does of his dissection.



(ii) Label the left ventricle with a straight line.

[1]

(iii) Place arrows on the drawing to show the direction of blood flow out of the heart through the left and right sides of the heart.

[2]

4(a). Human blood contains four main components.

One of these is red blood cells.

Name and explain the functions of the other **three** main components.

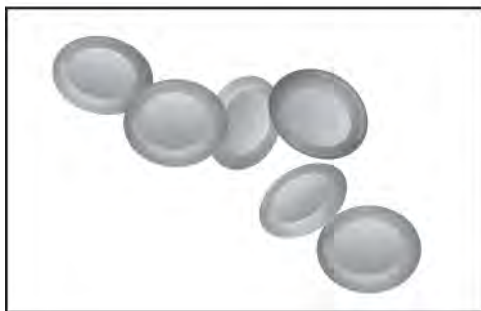
1

2

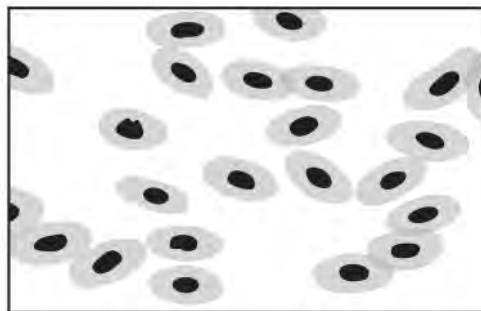
3

[3]

(b). Look at the diagrams.
show human red blood cells and frog red blood cells.



Human red blood cells



Frog red blood cells


Human red blood cells are better adapted to the job that they do than frog red blood cells.

Use the diagrams to suggest how.

[2]

5. Helene is a deep sea diver.

She reads these two articles in a magazine.




The deeper you dive, the greater the pressure of the water.

The longer you stay under water, the more air dissolves in your blood.

Air bubbles in the blood can block blood flow to organs causing pain and damage.

Fizzy drinks



Fizzy drinks get their fizz from a gas that is dissolved in the drink under great pressure.

When the bottle is opened the pressure is released and bubbles of gas appear in the drink.

If the bottle is opened slowly fewer bubbles appear in the drink.

Helene plans to dive with a supply of air.

Predict what might happen in Helene's body as she returns to the surface.

Explain any possible problems and how she might avoid them.

Use information from the articles in your answer.

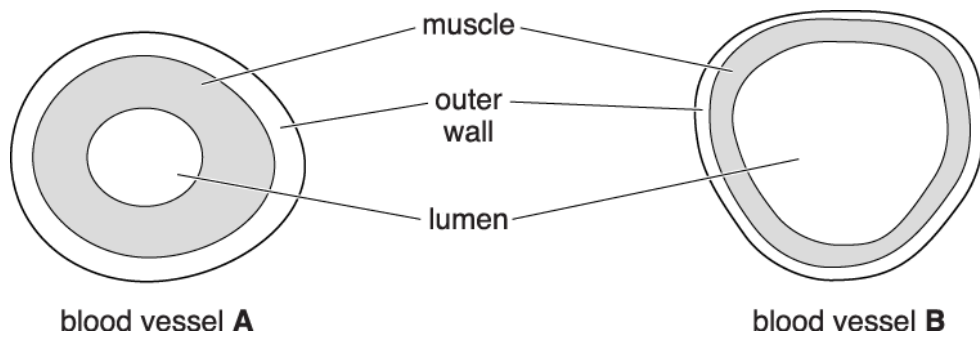


The quality of written communication will be assessed in your answer.

----- [6]

6. Blood vessels are tubes that carry blood.

The diagram shows cross-sections through blood vessels **A** and **B**.



not to scale

(i) The diameter of the lumen of blood vessel **A** is 1 cm in real-life.

Calculate the cross-sectional area of the **lumen** of blood vessel **A**.

Use the formula, $\text{area} = \pi r^2$ (where π is 3.14).

Show your working. Give your answer to two decimal places.

cross-sectional area of **A** = cm^2 [2]

(ii) The cross-sectional area of the lumen of blood vessel **B** is approximately 1.40 cm^2

Explain the reason for the difference between the cross-sectional area of the lumens of the two blood vessels.

----- [2]

7. Blood consists of many different components.

The table shows the normal level of three different blood components.

It also shows the level in three different people, A, B and C.

	Red blood cell haemoglobin g per 100 cm ³	White blood cells per mm ³	Platelets per mm ³
normal level	15	8500	250 000
person A	15	3000	255 000
person B	9	9000	245 000
person C	15	8000	130 000

What is the consequence of this data for the health of each person?

Explain your answer.

person A

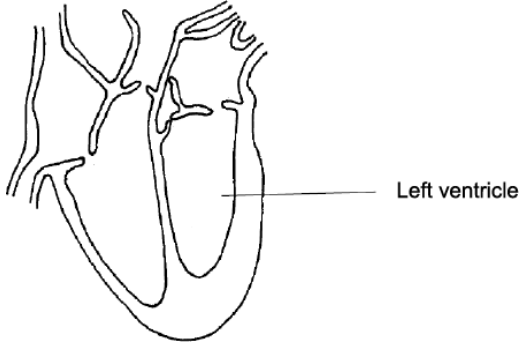
person B

person C

[3]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	Transports oxygen ✓	1	ALLOW carries oxygen / carries carbon dioxide / transports carbon dioxide
		ii	Any three from 1. Sarah has fewer red blood cells than normal ✓ 2. Less oxygen transported ✓ 3. So less ATP produced ✓ 4. As less respiration ✓	3	MP3 DO NOT ALLOW less energy produced
		iii	$136 / 90 = 1.5 : 1$ ✓	1	
		iv	Increases rate of diffusion of oxygen into cell ✓	1	
		v	A (chemical) messenger ✓	1	
Total				7	
2		i	✓ C	1	
		ii	Blood vessel X – vein ✓ Blood vessel Y – artery ✓ Blood vessel Z – capillary ✓	3	
Total				0	
3	a		Any two from Supply sugar / oxygen ✓ Thick walls of heart do not otherwise get enough sugar / oxygen ✓ By diffusion ✓	2	
	b	i	Greater pressure generated (by thicker muscle) ✓ To push blood further (round the body) ✓	2	
		ii	Label pointing to left ventricle on diagram ✓ 	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	Arrows as shown below ✓ ✓ 	2	1 mark for correct on each side
			Total	0	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
4	a	White blood cells fight infection / fight microbes / produce antibodies; Platelets clot blood; Plasma transports or carries (substances / cells);	3	<p>Examiner' Comments</p> <p>Although this question was answered well by most candidates, a significant number failed to score all three marks. Credit was not given for simply naming the parts. Good answers stated that white blood cells fought infection, platelets clot blood and plasma transported nutrients around the body. Answers that referred to red blood cells did not score.</p>
	b	No nucleus; Concave / bi concave / large surface area;	2	<p>Examiner' Comments</p> <p>This question was surprisingly well answered and most candidates were not put off by the context. Many candidates scored both marks for realising that a lack of a nucleus provided extra space for haemoglobin and the shape gave a large surface area for the absorption of oxygen.</p>
		Total	0	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
5	<p>[Level 3] Answer includes point or points from 3 areas. Quality of written communication does not impede communication of the science at this level.</p> <p style="text-align: right;">(5 – 6 marks)</p> <p>[Level 2] Answer includes point or points from 2 areas. Quality of written communication partly impedes communication of the science at this level.</p> <p style="text-align: right;">(3 – 4 marks)</p> <p>[Level 1] Answer includes point or points from 1 area. Quality of written communication impedes communication of the science at this level.</p> <p style="text-align: right;">(1 – 2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit.</p> <p style="text-align: right;">(0 marks)</p>	6	<p>This question is targeted at grades up to C</p> <p>Predictions may include:</p> <ul style="list-style-type: none"> • air bubbles form (in blood) when surfacing <p>Problems may include:</p> <ul style="list-style-type: none"> • pain • bends • damage to organs • could prevent blood flow / death <p>Prevention points may include:</p> <ul style="list-style-type: none"> • need to come up slowly • dive for less time • not go as deep <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p> <p>Examiner's Comments</p> <p>This was the third of the level of response questions and was overlap with the foundation tier. It was targeted at candidates up to grade C.</p> <p>As expected for higher tier candidates, this question was answered well by most candidates. Examiners were looking for three specific areas in candidates answers. Credit was given for predicting what would happen to Helene as she rose to the surface, what problems this would cause her and finally how these problems could be prevented.</p>
	Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6		i	0.79 (2) 0.5 x 0.5 x 3.14 (1)	2	two marks for correct answer 0.785 1 mark maximum if answer is incorrect, accept correct working for one mark must specify 3.14 in working out <u>Examiner's Comments</u> This was a well answered question. Where candidates did not get the marks, they had not given the answer to the required number of decimal places.
		ii	A / artery needs thick muscle / wall to withstand high pressure (1) B / vein only need thin muscle / wall to carry low pressure of blood (1)	2	Artery with thicker muscle walls to withstand higher pressure = 2 marks ORA for veins <u>Examiner's Comments</u> This was a challenging question. Candidates had to describe the relationship between the wall thickness of the blood vessel and pressure in the correct context to gain the marks.
			Total	0	
7			A – (low white blood cell count), likely to get infection / disease / weak immune system (1) B – (low haemoglobin so) anaemic / get tired easily / less oxygen / breathless (1) C – (low platelets so) blood not clot as quickly / bleed for longer (1)	3	ignore illness ignore pale ignore scabs / wounds not healing <u>Examiner's Comments</u> This question discriminated well and stronger candidates scored all three marks on this question. Regarding A, credit was not given for reference to illness and to score candidates had to refer to disease, infection, or the immune system. In C credit was not given for reference to scabs or wounds not healing.
			Total	0	