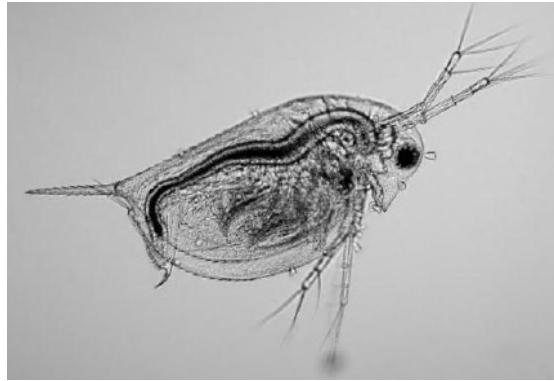


1(a). A group of students are conducting an experiment on *Daphnia* (water fleas) to investigate the effect of temperature on living things.



*Daphnia* are very small organisms. The students viewed the *Daphnia* using a light microscope.

It is possible to observe the heart of the *Daphnia* beating while observing it using the microscope.

The group place the *Daphnia* in water set at different temperatures to see the effect on the heart rate of the *Daphnia*.

Their results are shown below.

Temperature (°C)	Heart rate of the <i>Daphnia</i> (beats per minute)				
	Group A	Group B	Group C	Group D	Mean
17	25	22	25	24	24
20	27	27	25	25	26
23	30	30	30	34	31
25	33	57	36	39	36

The students could see the *Daphnia's* heart beating. In humans the heart forms part of the circulatory system.

What role does the heart play in these systems?

----- [1]

(b). Which organ is responsible for maintaining the water balance of the blood?

Put a tick (✓) in the correct box.

Heart

Kidneys

Lungs

Skin

[1]

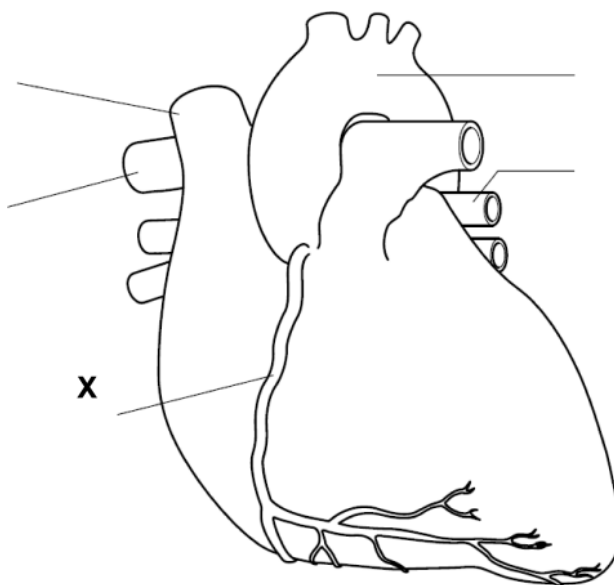
(c). The skin contains stem cells. Stem cells are unspecialised cells.

How does this make them useful to scientists?

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[2]

2(a). The diagram below shows a mammalian heart.



(i) Label **one** vessel on the heart diagram that carries deoxygenated blood.

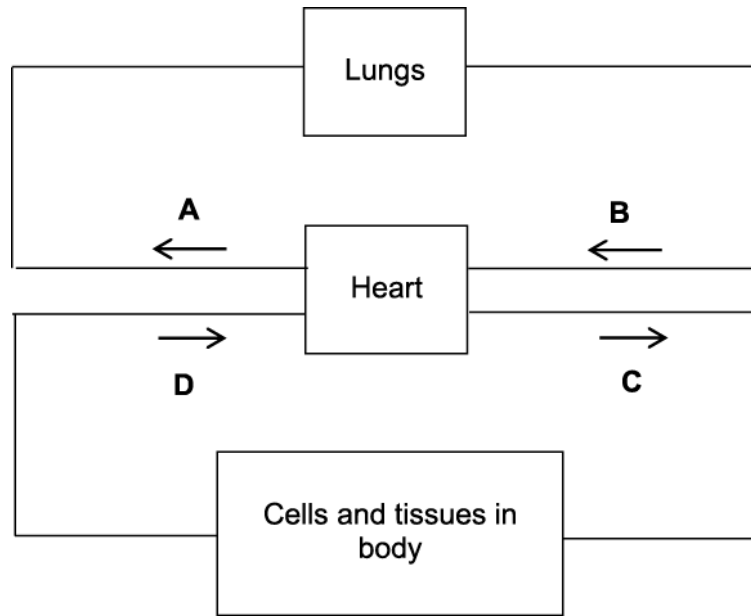
[1]

(ii) A heart attack is caused by a blockage in the blood vessel labelled X.

Name blood vessel X.

----- [1]

(b). The diagram below shows some of the blood vessels, A, B, C and D, going into and out of the heart and to other parts of the body.



→ direction of blood flow

(i) Give the letter of a blood vessel that is an artery. ....

[1]

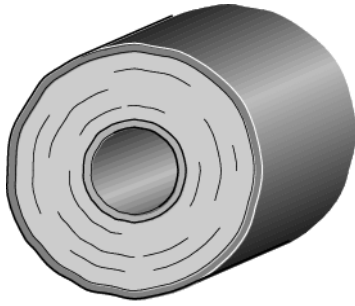
(ii) Give the letter of a blood vessel that is a vein. ....

[1]

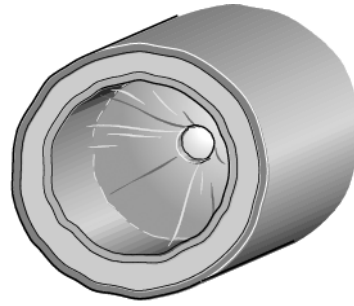
(c). The table below shows some data about the elasticity of arteries and veins when masses are attached to rings of the tissue.

Mass (g)	Length of artery (mm)		Length of vein (mm)	
	Artery with mass attached	Vein with mass attached	Vein once mass removed	Artery once mass removed
0 (original length)	20	21	21	20
10	45	36	36	25
20	53	38	37	27

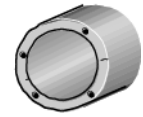
30	58	40	39	28
40	63	41	39	33
50	65	41	41	33



Artery



Vein



Capillary

Explain how arteries, veins and capillaries are adapted to their functions.


Use the diagrams, draw conclusions from the data and use your own knowledge in your explanation.

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[6]

3. 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.*

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[6]

4(a). Red blood cells contain haemoglobin.

Suggest a reason why red blood cells do not have a nucleus.

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[1]

(b). Faulty gas fires can release carbon monoxide.

Haemoglobin combines with carbon monoxide more quickly than haemoglobin combines with oxygen.

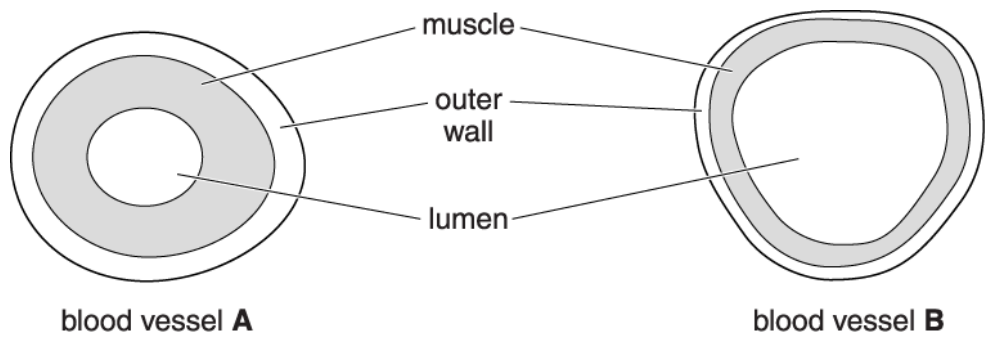
Explain why carbon monoxide is poisonous to humans.

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[3]

5. Blood vessels are the tubes that carry blood around the body.

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



**Not to scale**

(i) Fred thinks that **A** is an artery and **B** is a vein.

Is Fred correct? Describe the evidence **shown in the diagram** that supports your decision.

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----- [2]

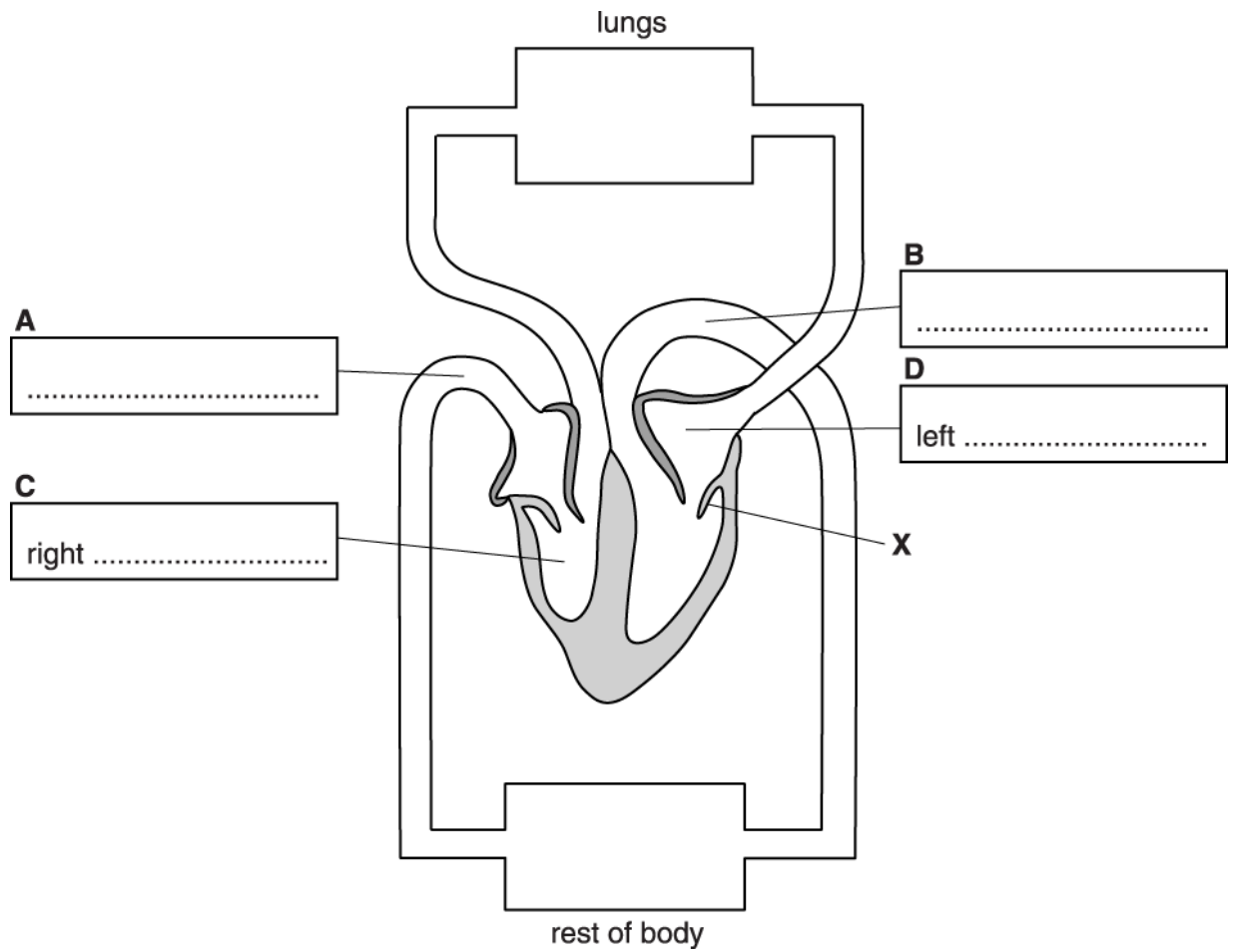
(ii) Suggest another feature **not shown** in the diagram that would be found in a vein.

----- [1]



6(a). The heart and blood vessels are adapted to the job that they do.

Complete the diagram of the blood system by writing the correct labels in the boxes A, B, C and D.

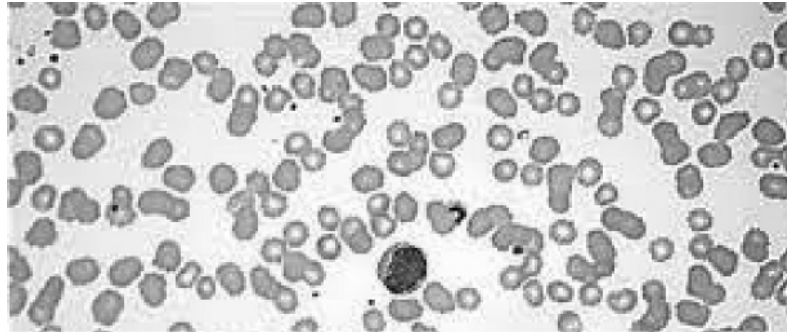


(b). Draw an arrow in the box labelled **lungs** and the box labelled **rest of body** to show the direction of blood flow. [2]

(c). What type of structure is X and what is its job? [1]

----- [2]  
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7. Blood consists of many different components.



sample of human blood

Name these components and describe their jobs in the human body.



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

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[6]

**END OF QUESTION PAPER**

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1	a		Acts as a pump ✓	1	
	b		Kidneys ✓	1	If more than one box is ticked, do not award the mark even if the correct box is also ticked
	c		They can specialise into other cells ✓ Could be used to treat disease ✓	2	
			<b>Total</b>	<b>3</b>	
2	a	i	Correctly labelled vena cava / pulmonary artery ✓	1	
		ii	Coronary artery ✓	1	
	b	i	A / C ✓	1	Mark first answer on the line A second letter given which is incorrect = 0 marks
		ii	B / D ✓	1	Mark first answer on the line A second letter given which is incorrect = 0 marks

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	c	<p>Please refer to the marking instructions for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b></p> <p><i>Explains the function of three vessels and relates this to their structure using evidence from the diagrams</i>  <b>AND</b>  <i>Draws a conclusion from the data in support of the functions.</i></p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated</i></p> <p><b>Level 2 (3–4 marks)</b></p> <p><i>Explains the function of two vessels and relates this to their structure using evidence from the diagrams</i>  <b>AND</b>  <i>Makes reference to the data.</i></p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b></p> <p><i>Explains the function of one vessel and relates this to its structure using evidence from the diagram.</i></p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p> <p><b>0 marks</b>  <i>No response or no response worthy of credit.</i></p>	6	<p><b>AO1.1 Description of structure related to function</b>  For example:  <b>Arteries:</b></p> <ul style="list-style-type: none"> <li>• Blood carried away from the heart</li> <li>• Under high pressure</li> <li>• Thick outer walls</li> <li>• Thick layer of muscle</li> <li>• Thick layer of elastic fibres</li> </ul> <p><b>Veins:</b></p> <ul style="list-style-type: none"> <li>• Carry blood back to the heart</li> <li>• Under lower pressure than arteries</li> <li>• Thin walls</li> <li>• Thin layer of muscle</li> <li>• Thin layer of elastic fibres</li> <li>• Valves to ensure one way flow of blood</li> </ul> <p><b>Capillaries:</b></p> <ul style="list-style-type: none"> <li>• Exchange materials / oxygen / carbon dioxide</li> <li>• Thin walls</li> <li>• One cell thick</li> <li>• Thin lumen brings red blood cells close to body cells</li> </ul> <p><b>AO3.2b Analyse the data in the table and draw a conclusion</b>  For example:  <b>Data:</b></p> <ul style="list-style-type: none"> <li>• Veins more stretchy than arteries</li> <li>• Arteries have more recoil than veins</li> <li>• Quote of data</li> </ul>
		<b>Total</b>	<b>0</b>	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
3		<p><b>[Level 3]</b>                      Answer includes point or points from 3 areas.                      Quality of written communication does not impede communication of the science at this level.                      (5 – 6 marks)</p> <p><b>[Level 2]</b>                      Answer includes point or points from 2 areas.                      Quality of written communication partly impedes communication of the science at this level.                      (3 – 4 marks)</p> <p><b>[Level 1]</b>                      Answer includes point or points from 1 area.                      Quality of written communication impedes communication of the science at this level.                      (1 – 2 marks)</p> <p><b>[Level 0]</b>                      Insufficient or irrelevant science. Answer not worthy of credit.                      (0 marks)</p>	6	<p>This question is targeted at grades up to C</p> <p><b>Predictions may include:</b></p> <ul style="list-style-type: none"> <li>• air bubbles form (in blood) when surfacing</li> </ul> <p><b>Problems may include:</b></p> <ul style="list-style-type: none"> <li>• pain</li> <li>• bends</li> <li>• damage to organs</li> <li>• could prevent blood flow / death</li> </ul> <p><b>Prevention points may include:</b></p> <ul style="list-style-type: none"> <li>• need to come up slowly</li> <li>• dive for less time</li> <li>• not go as deep</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p> <p><b>Examiner's Comments</b></p> <p>This extended writing question had a wide spread of marks. Many candidates were able to take the information from both areas and produce a response that answered the question, namely 'prediction and explanation'.</p>
		<b>Total</b>	<b>6</b>	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
4	a	(Increase volume for) more haemoglobin / (carry) more oxygen;	1	Needs idea of more / increased amount Ignore increased surface area  <b>Examiner's Comments</b>  The idea that red blood cells do not have a nucleus to allow for more haemoglobin or to allow more oxygen to be carried was very poorly understood.
	b	Stops blood / haemoglobin absorbing oxygen; Oxygen not supplied to cells / tissues / organs; Cells / tissues / organs die / cannot respire;	3	Ignore body  <b>Examiner's Comments</b>  The problems associated with carbon monoxide was very poorly understood, very few candidates gaining many marks here.
		<b>Total</b>	<b>0</b>	

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5		i	<p><i>Fred is correct</i>  <i>any two from:</i>                      A / artery has thicker muscle or B / Vein has thinner muscle (1)                      A / artery has a thicker wall or B / Vein has thinner wall (1)                      A / Artery has smaller lumen or B / vein has larger lumen (1)</p>	2	<p>if candidate indicates Fred is incorrect = 0 credit comparative responses e.g artery wall is thick, vein wall is thin</p> <p>ignore hole / space</p> <p><b><u>Examiner's Comments</u></b></p> <p>In this question candidates were asked to describe the evidence from the diagram that a blood vessel was an artery. Many candidates performed well on this question, with over half gaining one or both marks. Candidates that did not score well lost marks due to the statements not being comparative. Some merely stated that Fred was correct as 'arteries have a thick outer wall' for example. Some candidates scored 0 for this question as they incorrectly claimed that Fred was incorrect and that Vessel A was a vein.</p>
		ii	valves	1	<p><b><u>Examiner's Comments</u></b></p> <p>Candidates found this question very difficult. A small percentage of candidates identified valves as the feature. A common incorrect answer was blood.</p>
			<b>Total</b>	<b>0</b>	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
6	a	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">                     vena cava ventricle                 </div> <div style="width: 45%;">                     aorta auricle / atrium                 </div> </div>	2	4 correct = 2 marks 2 or 3 correct = 1 mark  <b>Examiner's Comments</b>  Many candidates struggled with the correct names for the blood vessels and the chambers.
	b	<div style="text-align: center;"> <p>lungs</p> <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto; position: relative;"> <span style="position: absolute; left: 50%; top: 50%; transform: translate(-50%, -50%);">→</span> </div>    <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto; position: relative;"> <span style="position: absolute; left: 50%; top: 50%; transform: translate(-50%, -50%);">←</span> </div> <p>rest of body</p> </div>	1	both boxes correct for mark  <b>Examiner's Comments</b>  Disappointingly only half the candidates were aware of the direction of blood flow around the body. Candidates were instructed to place two arrows on the diagram, many also placed other contradictory ones at various points.
	c	valve (1)  stops back flow of blood / blood flows in one direction (1)	2	accept (stops blood) backtracking / wrong direction  <b>Examiner's Comments</b>  Candidates responses here showed a clear attempt to engage with the question. Many knew that the structure was a valve and what its function was; many other candidates gained one mark either for the name or its function.
<b>Total</b>			<b>0</b>	



### Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
7	<p><b>Level 3 (5–6 marks)</b> Includes some basic and some higher components with an explanation of what they do. Quality of written communication does not impede communication of science at this level.</p> <p><b>Level 2 (3–4 marks)</b> Include some structural components with an explanation of what they do. Quality of written communication partly impedes communication of science at this level.</p> <p><b>Level 1 (1–2 marks)</b> Include some basic structural component(s) OR one component explained Quality of written communication impedes communication of science at this level.</p> <p><b>Level 0</b> Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades up to G Indicative scientific points may include:</p> <p><i>Specific</i></p> <p><b>Higher</b></p> <ul style="list-style-type: none"> <li>• hormones – chemical messengers</li> <li>• glucose – for respiration</li> <li>• carbon dioxide – from respiration</li> <li>• urea – waste</li> <li>• plasma (explained) carries substances</li> </ul> <p><b>Basic</b></p> <ul style="list-style-type: none"> <li>• red blood cells – haemoglobin – transport oxygen</li> <li>• white blood cells – destroy micro-organisms</li> <li>• platelets – clot blood</li> <li>• plasma (identified) – liquid part of blood</li> </ul> <p><i>General</i></p> <ul style="list-style-type: none"> <li>• Level 2 and 3 should include an explanation of what the components do.</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p> <p><b>Examiner's Comments</b></p> <p>This six-mark extended-writing question differentiated well with many candidates showing that they had learned the basic structures associated with blood. However a number of candidates were confused with the functions of the red and white blood cells.</p>
	<b>Total</b>	0	