Organisation

Model answers and marking points

GCSE science 6-mark questions

This topic online

1 Kwame's grandfather has had a check-up at his GP surgery. The nurse explained how blood travels through the heart.

Describe the route blood takes from the moment it enters the heart from the body until it leaves the heart again to go back to the body.

(6 marks)

Model answer

Blood that has given up its oxygen to the body cells returns to the heart through the vena cava and enters the right atrium.

The right atrium contracts and pushes the blood through a valve into the right ventricle. The right ventricle then contracts and pumps the blood into the pulmonary artery, which carries it to the lungs.

In the lungs the blood loses carbon dioxide and picks up oxygen, so it becomes oxygenated. It then returns to the heart through the pulmonary vein and enters the left atrium.

The left atrium contracts and pushes the blood through another valve into the left ventricle. The left ventricle has the thickest muscular wall. When it contracts it pumps the blood at high pressure into the aorta, which carries it to the rest of the body.

Throughout this journey, valves between the chambers and at the start of the arteries close to stop blood flowing backwards. Because blood passes through the heart twice for each trip round the body, this is called a double circulatory system.

Marking points (credit any 6 relevant points, linked in a sensible order)

- deoxygenated blood enters the right atrium through the vena cava
- the right atrium contracts and pushes blood through a valve into the right ventricle
- the right ventricle contracts and pumps blood into the pulmonary artery
- blood goes to the lungs, where it picks up oxygen and loses carbon dioxide
- oxygenated blood returns to the left atrium through the pulmonary vein
- blood passes through a valve into the left ventricle
- the left ventricle contracts and pumps blood into the aorta to the rest of the body
- valves stop blood flowing backwards
- this is a double circulatory system: blood passes through the heart twice in each full circuit

How it is marked

- 5-6 marks: gives the full sequence in the correct order, naming the chambers, blood vessels and the visit to the lungs, and the role of valves.
- 3-4 marks: gives most of the sequence with one or two errors in order or naming, or misses the lungs.
- 1-2 marks: names some parts of the heart or vessels with no clear sequence.

What loses marks

- mixing up the pulmonary artery and pulmonary vein
- putting the left and right sides in the wrong order
- saying the lungs give the blood oxygen without naming the vessels in and out

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2 A student is writing a revision card about the three types of blood vessel.

Compare the structure of arteries, veins and capillaries, and explain how each structure is linked to the job of the vessel.

(6 marks)

Model answer

Arteries carry blood away from the heart at high pressure. They have thick walls containing layers of muscle and elastic fibres, which stop them bursting and let them stretch and recoil as each surge of blood passes. Their lumen is fairly narrow.

Veins carry blood back to the heart at much lower pressure, so their walls are thinner than those of arteries. They have a wider lumen, which makes it easier for the slow-moving blood to flow. Unlike arteries, veins have valves that close to stop the blood flowing backwards.

Capillaries are the smallest vessels and connect arteries to veins. Their walls are only one cell thick, which is much thinner than either arteries or veins. This gives a very short distance for diffusion, so oxygen and glucose can diffuse out to the body cells and carbon dioxide can diffuse in. Capillaries are also very narrow and form large networks, so every cell is close to a capillary.

So arteries are built for pressure, veins for return flow and capillaries for exchange.

Marking points (credit any 6 relevant points, linked in a sensible order)

- arteries carry blood away from the heart at high pressure
- arteries have thick walls with muscle and elastic fibres to withstand and even out high pressure
- veins carry blood back to the heart at low pressure
- veins have thinner walls and a wider lumen than arteries
- veins have valves to stop blood flowing backwards
- capillaries are very narrow, so blood passes close to body cells
- capillary walls are only one cell thick, giving a short diffusion distance
- substances such as oxygen and glucose diffuse out of capillaries and waste such as carbon dioxide diffuses in
- arteries have a narrow lumen compared with veins

How it is marked

- 5-6 marks: compares all three vessels point by point and links each structural feature to its function.
- 3-4 marks: describes features of all three vessels with only some links to function, or compares two vessels well.
- 1-2 marks: gives one or two isolated features with no link to function.

What loses marks

- saying arteries carry oxygenated blood rather than blood away from the heart
- describing each vessel separately without comparing
- saying capillary walls are one cell membrane thick

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3 Mrs Okafor, aged 62, has coronary heart disease. Her doctor gives her information about three treatments.

Treatment	Information
Statins	Daily tablets. Lower blood cholesterol. Take weeks to have an effect. Rare side effects such as muscle pain.
Stent	Small mesh tube placed in the artery under local anaesthetic. Home the next day. The artery can narrow again over time.
Bypass surgery	Major operation using a blood vessel from the leg. Several weeks to recover. Long-lasting.

Evaluate these treatments for Mrs Okafor. Give a justified conclusion. (6 marks)

Model answer

In coronary heart disease, layers of fatty material build up inside the coronary arteries. This narrows them, so less blood and oxygen reach the heart muscle.

Statins lower the cholesterol in the blood, which slows down the build-up of fatty material. They are easy to take and avoid any surgery. However, they take weeks to work, they do not remove the existing blockage, she would have to take them every day for life, and they can cause side effects such as muscle pain.

A stent holds the narrowed artery open, so blood flow to the heart muscle improves straight away. It only needs a local anaesthetic and she could go home the next day. The disadvantage is that the artery may narrow again, and there is a small risk of a blood clot forming.

Bypass surgery gives a long-lasting new route for blood around the blockage. But it is a major operation with greater risks at her age and a recovery of several weeks.

I think the best option is a stent together with statins. The stent fixes the blockage quickly with low risk, and the statins reduce the chance of the artery narrowing again.

Marking points (credit any 6 relevant points, linked in a sensible order)

- in coronary heart disease fatty material builds up in the coronary arteries
- this narrows the arteries, so less oxygen reaches the heart muscle
- statins lower cholesterol, which slows the build-up of fatty material
- statins avoid surgery but must be taken for life, act slowly and have possible side effects
- a stent holds the artery open so blood flow improves straight away
- a stent has a quick recovery but the artery may narrow again, and there is a small risk of infection or clots
- bypass surgery gives a long-lasting new route for blood around the blockage
- bypass surgery has higher risks from a major operation and anaesthetic, and a long recovery
- a justified conclusion, for example a stent plus statins

How it is marked

- 5-6 marks: explains the problem in coronary heart disease, weighs an advantage and a disadvantage of each treatment and gives a conclusion supported by the points.
- 3-4 marks: gives advantages or disadvantages of at least two treatments, with a weak or unsupported conclusion.
- 1-2 marks: repeats one or two facts from the table with no evaluation.

What loses marks

- saying statins remove the blockage
- describing the treatments without saying which is best and why
- confusing coronary arteries with arteries in general or with veins

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4 Aisha measured how much water a leafy shoot lost in one hour under different conditions.

Condition	Water lost in g per hour
Still air, 20 °C	1.2
Fan blowing, 20 °C	2.1
Still air, 30 °C	1.9
Still air, 20 °C, bag over the shoot (humid)	0.4

Use the data and your knowledge of transpiration to explain the results. (6 marks)

Model answer

Transpiration is the loss of water vapour from leaves. Water evaporates from the cells inside the leaf and the vapour diffuses out through the stomata into the air. This water is replaced by water pulled up the xylem from the roots.

In still air at 20 °C the shoot lost 1.2 g per hour. With the fan this rose to 2.1 g per hour. Moving air carries water vapour away from the leaf surface, so the concentration of water vapour outside stays low and the concentration gradient stays steep, so diffusion is faster.

Raising the temperature to 30 °C increased the loss to 1.9 g per hour. At a higher temperature the water molecules have more kinetic energy, so they evaporate and diffuse out of the stomata more quickly.

With a bag over the shoot, the loss fell to 0.4 g per hour. The air inside the bag became very humid, so there was a lot of water vapour outside the leaf. This made the concentration gradient much smaller, so less water diffused out.

Marking points (credit any 6 relevant points, linked in a sensible order)

- transpiration is the loss of water vapour from the leaves, mainly through the stomata
- water evaporates from cells inside the leaf and diffuses out through the stomata
- the fan increased loss from 1.2 g to 2.1 g per hour
- moving air removes water vapour from around the leaf, keeping a steep concentration gradient
- the higher temperature increased loss from 1.2 g to 1.9 g per hour
- at higher temperature water molecules have more energy, so evaporation and diffusion are faster
- the humid bag reduced loss from 1.2 g to 0.4 g per hour
- humid air has more water vapour outside the leaf, so the concentration gradient is smaller
- water lost is replaced by water drawn up the xylem from the roots

How it is marked

- 5-6 marks: quotes data for each condition compared with the control and explains each change using evaporation, diffusion and concentration gradient.
- 3-4 marks: describes the effect of each condition with some data and some explanation, but explanation is incomplete for one or more factors.
- 1-2 marks: states the pattern for one or two conditions with no data or explanation.

What loses marks

- describing the results without quoting any numbers
- saying water moves out through the stomata by osmosis
- confusing transpiration with translocation in the phloem

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5 Liam eats a cheese sandwich made with white bread and butter.

Explain how enzymes and bile help Liam to digest the starch, protein and fat in the sandwich. (6 marks)

Model answer

The starch, protein and fat in the sandwich are large, insoluble molecules. They must be broken down into small, soluble molecules so they can be absorbed into the blood in the small intestine.

Starch in the bread is broken down into sugars by amylase. Amylase is made in the salivary glands and the pancreas. Protein in the cheese is broken down into amino acids by protease enzymes, which are made in the stomach, pancreas and small intestine. Fat in the butter and cheese is broken down into fatty acids and glycerol by lipase, made in the pancreas and small intestine.

Each enzyme has an active site with a particular shape. Only its own substrate fits, so each food needs its own enzyme.

Bile is made in the liver and stored in the gall bladder. It emulsifies fat, breaking it into small droplets. This gives a much larger surface area, so lipase can break the fat down faster. Bile is also alkaline, so it neutralises the hydrochloric acid from the stomach. This gives the right pH for the enzymes in the small intestine to work well.

Marking points (credit any 6 relevant points, linked in a sensible order)

- large insoluble molecules must be broken into small soluble molecules to be absorbed
- amylase, a carbohydrase, breaks starch down into sugars
- amylase is made in the salivary glands and the pancreas
- protease breaks protein down into amino acids
- protease is made in the stomach, pancreas and small intestine
- lipase breaks fat down into fatty acids and glycerol
- lipase is made in the pancreas and small intestine
- each enzyme has an active site that fits only its own substrate
- bile from the liver emulsifies fat into small droplets, giving a larger surface area for lipase
- bile is alkaline and neutralises stomach acid, giving a suitable pH for enzymes in the small intestine

How it is marked

- 5-6 marks: names the correct enzyme and products for all three food types, explains enzyme specificity, and explains both roles of bile.
- 3-4 marks: gives enzymes and products for two food types, or all three with no explanation of bile.
- 1-2 marks: names one enzyme or states that food is broken down, with little detail.

What loses marks

- saying bile is an enzyme or that it breaks down fat chemically
- giving the wrong products, such as fat into amino acids
- saying enzymes are killed rather than denatured

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