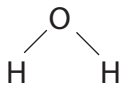
2 Water is a polar molecule. The diagram shows a molecule of water.



(a) Complete the diagram to show the dipole nature of this water molecule.

(2)

(b) Name the type of reaction in which a molecule of water is involved in the breaking of a bond in another molecule.

(1)

.....

(c) Explain how the properties of water make it an ideal transport medium.

(3)

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(Total for Question 2 = 6 marks)

3 Blood plasma contains glucose dissolved in water. Glucose is a polar molecule that is taken up by muscle cells and used in the synthesis of glycogen.

(a) Explain why water is a good solvent.

(2)

(b) Describe how glucose enters muscle cells through the cell membrane.

(2)

(c) The ratio of glucose to glycogen inside a cell can affect the uptake of water by the cell. This results in a change in cell mass.

Cells with different ratios of glucose to glycogen were placed in tissue fluid and the percentage change in cell mass was recorded.

Ratio of glucose to glycogen	Percentage change in cell mass (%)
100:0	25.0
80:20	16.5
60:40	4.0
40:60	0.0
20:80	0.0

Analyse the data to explain the effect of these ratios on the percentage change in cell mass.

(3)

(d) Glucose is used in the synthesis of glycogen in muscle cells.

(i) Describe the formation of glycogen from glucose.

(2)

(ii) Describe how the structure of glycogen is related to its function as a storage molecule.

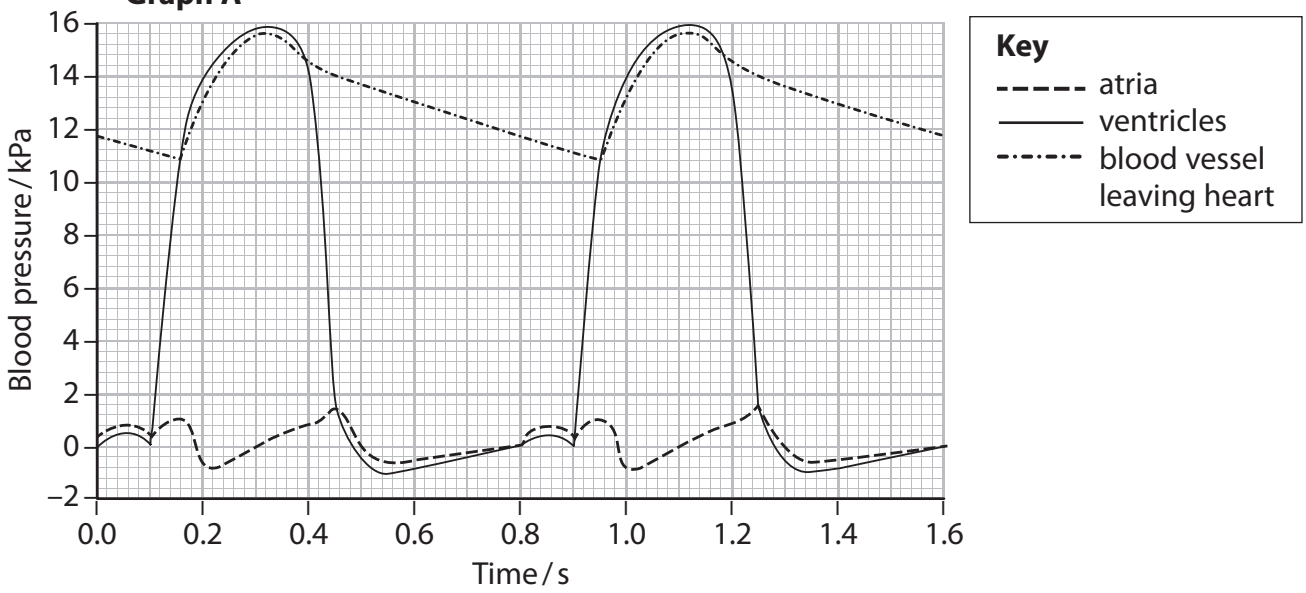
(2)

(Total for Question 3 = 11 marks)

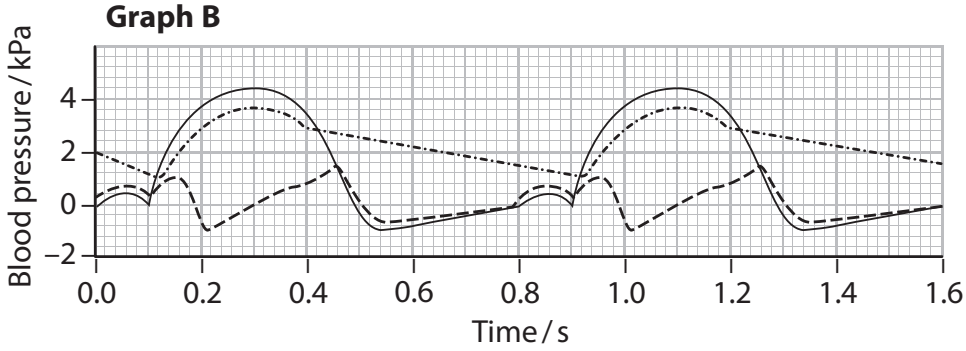
5 The pressure of the blood passing through the heart can vary.

Graph A shows the changes in blood pressure in one side of the heart. Graph B shows the changes in blood pressure in the other side of the heart over the same time period.

Graph A



Graph B



(a) (i) Calculate the heart rate.

(2)

Answer .....

(ii) Increased heart rate is often associated with high blood pressure.

Which of the following will reduce blood pressure?

(1)

☒ **A** anticoagulants

☒ **B** antihypertensives

☒ **C** cholesterol

☒ **D** platelet inhibitors

(b) (i) Explain which side of the human heart is represented by graph B.

(2)

(ii) In graph A, which blood vessel carries the blood leaving the heart?

(1)

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

(iii) In graph A, the blood pressure inside the ventricle changes between 0.0 and 0.45 seconds.

Explain how these changes in blood pressure occur in this part of the cardiac cycle.

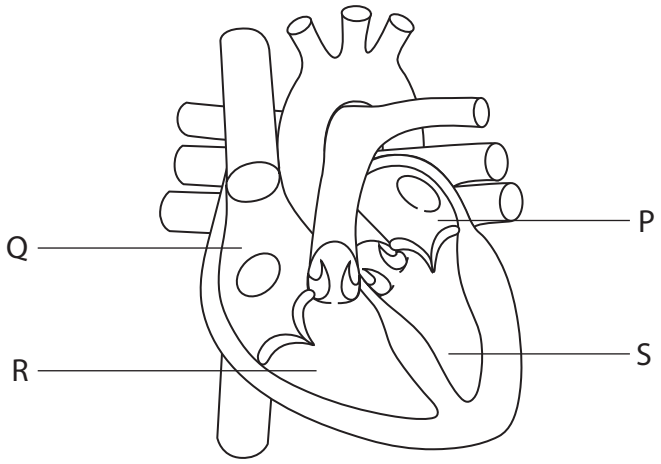
(4)

(c) Explain how the structure of the walls of the blood vessels carrying blood away from the heart in graph A and graph B are different.

(3)

(Total for Question 5 = 13 marks)

8 This diagram shows the structure of a normal human heart.



(a) (i) Which chamber of the heart generates the highest blood pressure?

(1)

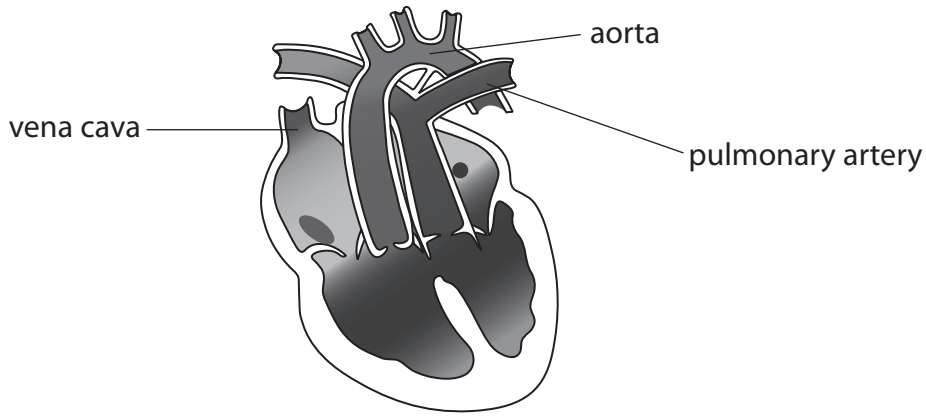
- ☒ **A** P
- ☒ **B** Q
- ☒ **C** R
- ☒ **D** S

(ii) Which stage of the cardiac cycle is shown in the diagram of the heart?

(1)

- ☒ **A** atrial diastole
- ☒ **B** atrial systole
- ☒ **C** ventricular diastole
- ☒ **D** ventricular systole

(b) A baby was born with an abnormal heart. The diagram shows the heart of this baby. There is a hole in the septum between the two ventricles.



(i) Identify the problem with the blood vessels of this heart.

(1)

(ii) The baby survived because of the hole in the septum of the heart.

Explain how the hole in the septum allowed this baby to survive.

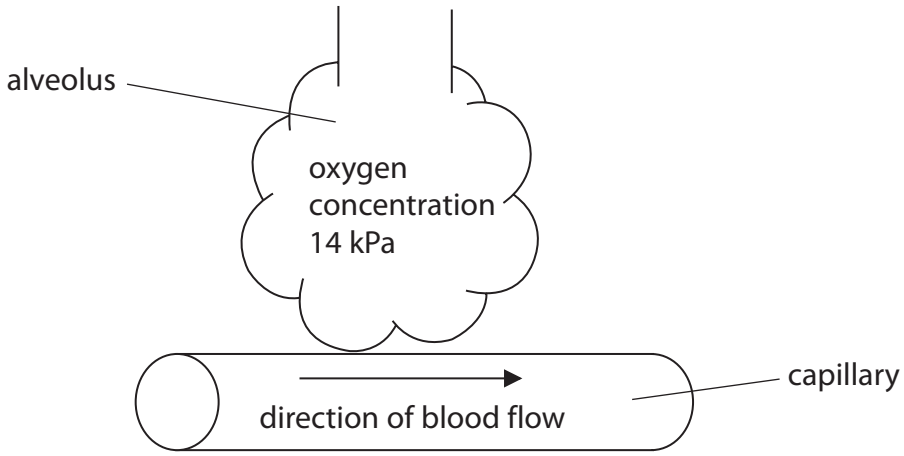
(3)

(iii) Oxygen diffuses between the alveoli of the lungs and the blood.

Fick's Law shows how three factors affect the rate of diffusion:

$$\text{Rate of diffusion} = \frac{\text{surface area} \times \text{concentration difference}}{\text{diffusion distance}}$$

The diagram and the table give information about the oxygen concentration in the alveoli and in the blood.



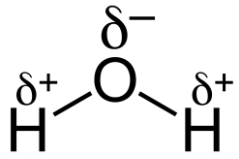
Heart	Oxygen concentration / kPa	
	Blood entering the lungs	**Blood leaving the lungs**
Normal	5	13
With hole in the septum between the ventricles	8	10

*Assess the effect of this heart defect on the rate of oxygen diffusion between the alveoli and the blood.

(6)

(Total for Question 8 = 12 marks)

TOTAL FOR PAPER = 80 MARKS

Question Number	Answer	Additional Guidance	Mark
2(a)	• correct symbol and charge on the oxygen atom (1) • correct symbol and charge on both hydrogen atoms (1)	e.g.  ALLOW one mark for all correct charges without symbols	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)	• hydrolysis (reaction)		**(1)**

Question Number	Answer	Additional Guidance	Mark
2(c)	An explanation that makes reference to the following: • water is a solvent (1) • because water molecules surround { polar molecules / ions } / hydrogen bonds form between water molecules and solute molecules (1) • water is liquid so has the ability to flow (1)	ALLOW allows { polar / ionic molecules / ions } to dissolve ALLOW separation of ions by water molecules ALLOW reference to cohesion between water molecules	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(a)	An explanation which includes reference to two of the following: • description of water as a {polar / dipole / dipolar} molecule (1) • water surrounds (polar) molecules allowing them to dissolve (1) • hydrogen bonds form (1)	ALLOW correct description of uneven charges	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)	A description that makes reference to the following: • carrier proteins (located in membrane) (1) • (glucose enters by) facilitated diffusion (1)	ALLOW channel proteins	**(2)**

Question Number	Answer	Additional Guidance	Mark
3 (c)	An explanation which makes reference to three of the following: • the percentage change in cell mass decreases as glucose decreases (1) • glucose is soluble / comparison between solubility (1) • higher ratio of glucose molecules has an osmotic effect (on the cell) / glycogen molecules does not have an osmotic effect (on the cell) (1) • water enters by osmosis (and increases cell mass) (1)	ALLOW converse ALLOW converse for glycogen ALLOW converse for glycogen ALLOW water molecules are not attracted to glycogen molecules ALLOW correct references to {water / osmotic / solute} potential	**(3)**

Question Number	Answer	Additional Guidance	Mark
3 (d)(i)	A description which includes reference to the following: • joining together in condensation reactions (1) • forming {1,4 and 1,6} glycosidic bonds (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
3 (d)(ii)	A description which includes reference to the following: • branched molecule for more rapid hydrolysis (1) • compact so more can be stored (1)	ALLOW broken down ALLOW 'doesn't take up much space'	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	• correct figures from graph • correct answer with unit	Example of calculation e.g. 120 and 1.6 or 60 and 0.8 120 ÷ 1.6 / 60 ÷ 0.8 75 bpm	(2)

Question Number	Answer	Mark
5 (a)(ii)	***The only correct answer is B as antihypertensives lower blood pressure*** ***A*** *is not correct because anticoagulants do not reduce blood pressure* ***C*** *is not correct because cholesterol does not reduce blood pressure* ***D*** *is not correct because platelet inhibitors do not reduce blood pressure*	(1)

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	An explanation that makes reference to the following: • right (1) • because the pressure is lower (in blood transported from heart to the lungs) (1)		(2)

Question Number	Answer	Mark

5(b)(ii)	***The only correct answer is A because it carries blood under high pressure away from the heart*** ***B*** *is not correct because this is shown in graph B* ***C*** *is not correct because pulmonary veins do not leave the heart* ***D*** *is not correct because the vena cava does not leave the heart*	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	An explanation which makes reference to the following: • from 0 s (to 0.05 s) pressure increases due to atrial systole (1) • ventricle fills with blood { from the atrium / due to atrial systole } (1) • after atrial systole finishes (from 0.05s to 0.1s) there is a fall in ventricular pressure (1) • from 0.1s (to 0.32 s) increase in pressure due to ventricular systole (1) • (from 0.32 s) ventricular pressure decreases due to (ventricular) diastole (1)	ALLOW contraction of (muscular)walls of atria ALLOW contraction of (muscular walls of) ventricle ALLOW relaxation of (muscular walls of) ventricle	**(4)**

Question Number	Answer	Additional Guidance	Mark
5(c)	An explanation which makes reference to three of the following: • aorta has {a thicker layer of / more} {collagen / elastic tissue / muscular tissue} (1) • collagen (in walls of aorta) to withstand higher blood pressure (1) • muscular tissue (in walls of aorta) to maintain higher blood pressure (1) • elastic tissue (in walls of aorta) for {(elastic) recoil / to maintain blood pressure} (1)	Accept converse argument for B ALLOW A for blood vessel in graph A instead of aorta ALLOW muscle for muscular tissue	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	D - S		**(1)**

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	D - ventricular systole		**(1)**

Question Number	Answer	Additional Guidance	Mark
8(b)(i)	The aorta and pulmonary artery are { attached to the wrong ventricles / the wrong way around }	Allow aorta leaves the right ventricle and the pulmonary artery leaves the left ventricle	**(1)**

Question Number	Answer	Additional Guidance	Mark
8(b)(ii)	An explanation that makes reference to the following: • the hole allows oxygenated and deoxygenated blood to mix (between the two ventricles) (1) • oxygenated blood { travels to the body / enters aorta } / deoxygenated blood { travels to the lungs / enters pulmonary artery } (1) • providing some oxygen for respiration (1)	Allow converse	**(3)**

<table>
<tr><th>Question Number</th><th colspan="2">Answer</th></tr>
<tr><td>8 (b)(iii)</td><td colspan="2">Answers will be credited according to candidate’s knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.
The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.
• rate of diffusion would be lower with abnormal heart
• blood entering lungs from an abnormal heart has more oxygen, 8kPa, than blood entering lungs from a normal heart, 5kPa
• oxygen in blood increased by only 2kPa instead of 8kPa with abnormal heart
• resulting in a smaller difference in concentration between the alveoli and the red blood cells i.e. 14-8/14-5 or 6 and 9kPa
• the surface area of the alveoli and distance for diffusion are not affected
• Fick's law states that concentration gradient is proportional to rate of gas exchange
• a lower concentration gradient for oxygen between the alveoli and the blood results in a lower rate of oxygen diffusion
NOTE – ‘the pieces of scientific information provided’ could be any from: the information about the defective heart / diagram of alveolus / table of data</td></tr>
<tr><td>Level</td><td>Mark</td><td>Descriptor</td></tr>
<tr><td>0</td><td>0</td><td>No awardable content</td></tr>
<tr><td>1</td><td>1-2</td><td>An answer may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information.
The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.</td></tr>
<tr><td>2</td><td>3-4</td><td>An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of the pieces of scientific information provided.
The explanation shows some linkages and lines of scientific reasoning with some structure.</td></tr>
<tr><td>3</td><td>5-6</td><td>An answer is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of the pieces of scientific information provided.
The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.</td></tr>
</table>