1(a). A sphygmomanometer and stethoscope can be used to measure blood pressure. The cuff of the sphygmomanometer is put around the arm and inflated to around 200 mmHg. The stethoscope is placed over the artery and the pressure in the cuff is slowly released.

Describe the role of the stethoscope in taking blood pressure readings.

---

[2]

(b). An epidemiological study was carried out on 614 individuals on the effects of hypotension **and** hypertension on the cardiovascular system.

The results are shown below in **Fig. 24.2.**

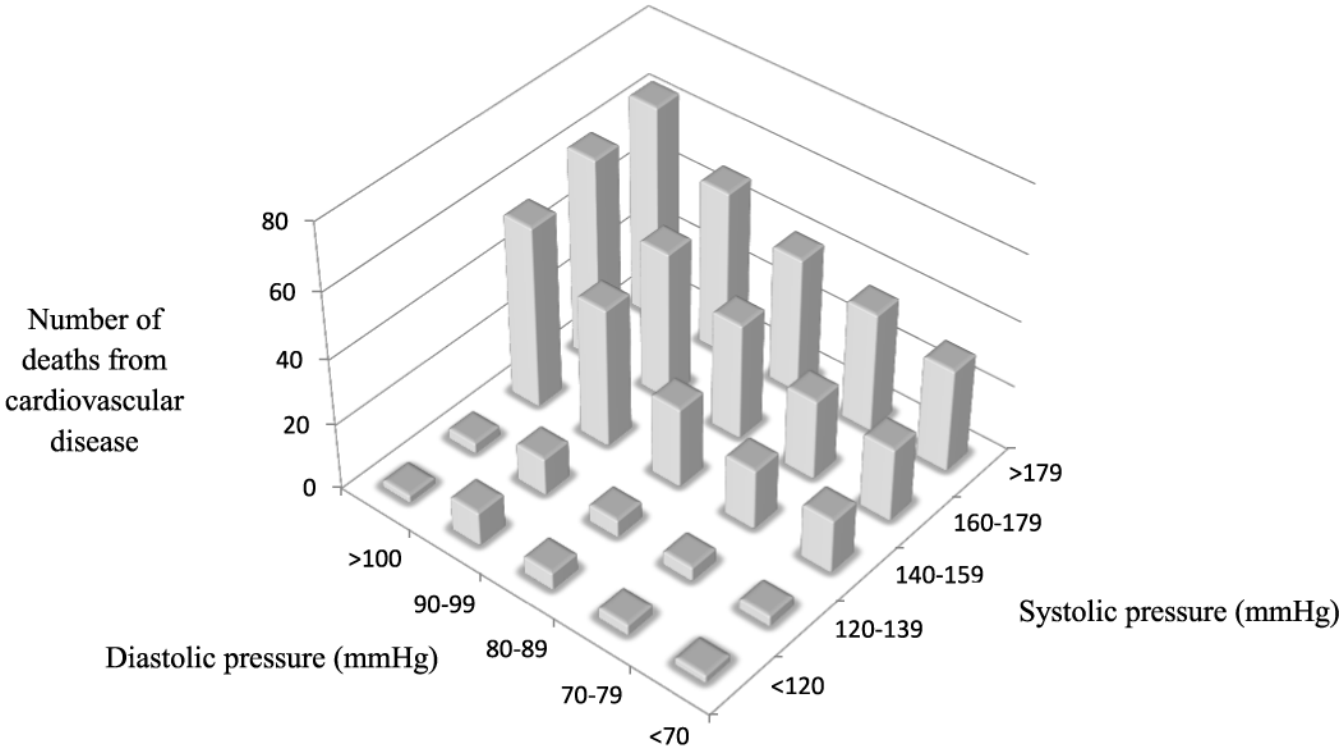


Fig. 24.2

Using the information in **Fig. 24.2**, what can you conclude about the impact of blood pressure on the number of deaths from cardiovascular disease?

---

[3]

2. High blood pressure is a major cause of chronic kidney disease (CKD).

Progression of the disease can be slowed by controlling blood pressure. Enalapril is a drug used for this purpose.

The blood pressure of a CKD patient during treatment with enalapril is shown in Fig. 33.2.

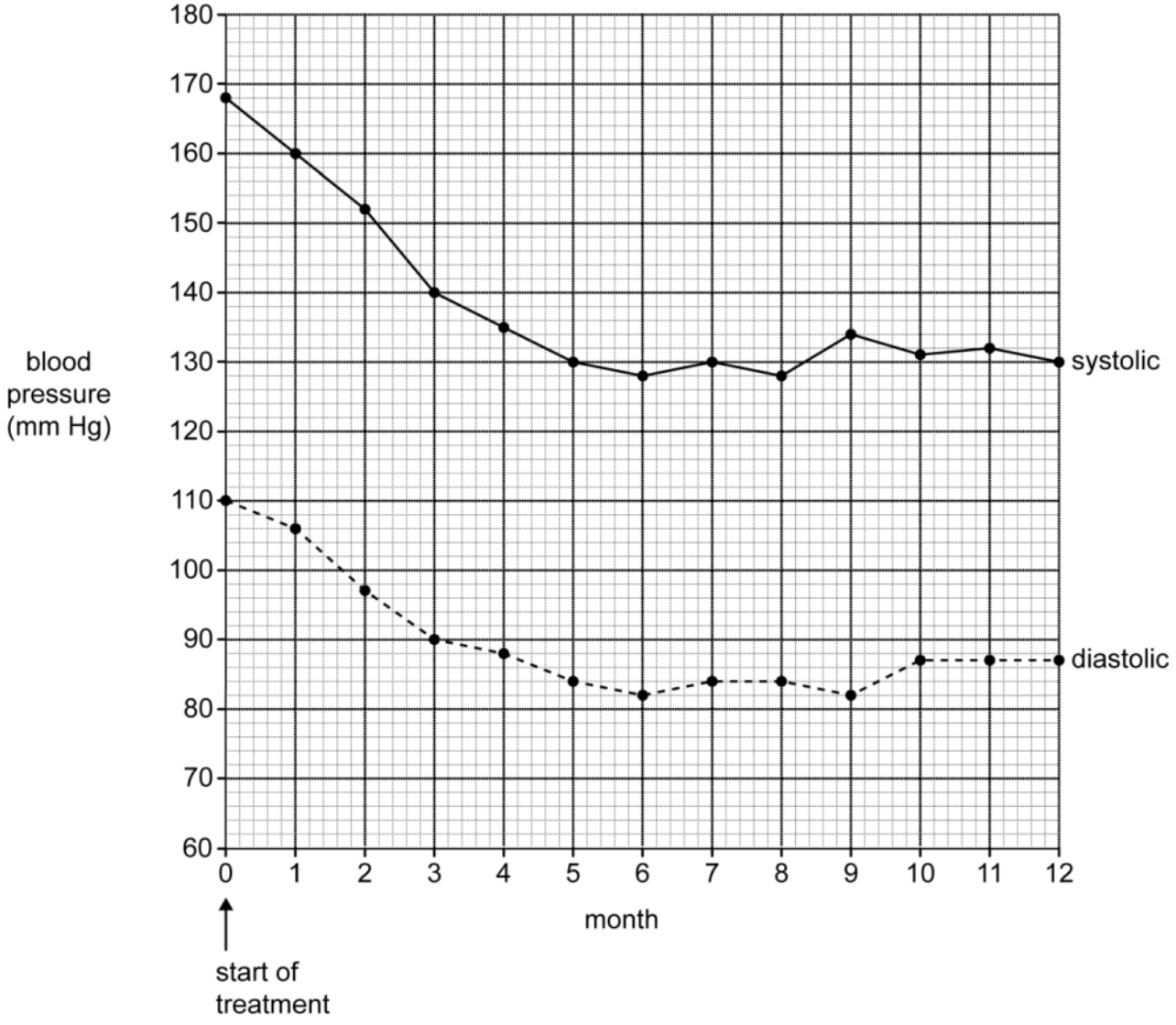


Fig. 33.2

(i) Calculate the percentage decrease in **diastolic** blood pressure after the first **three** months of treatment. Show your working.

Answer = _____ % **[2]**

(ii) Outline how blood pressure can be measured manually.

_____

_____

_____

_____

_____

_____

_____

_____ **[3]**

3. Fig. 26 is a light micrograph of a cross section through lung tissue.

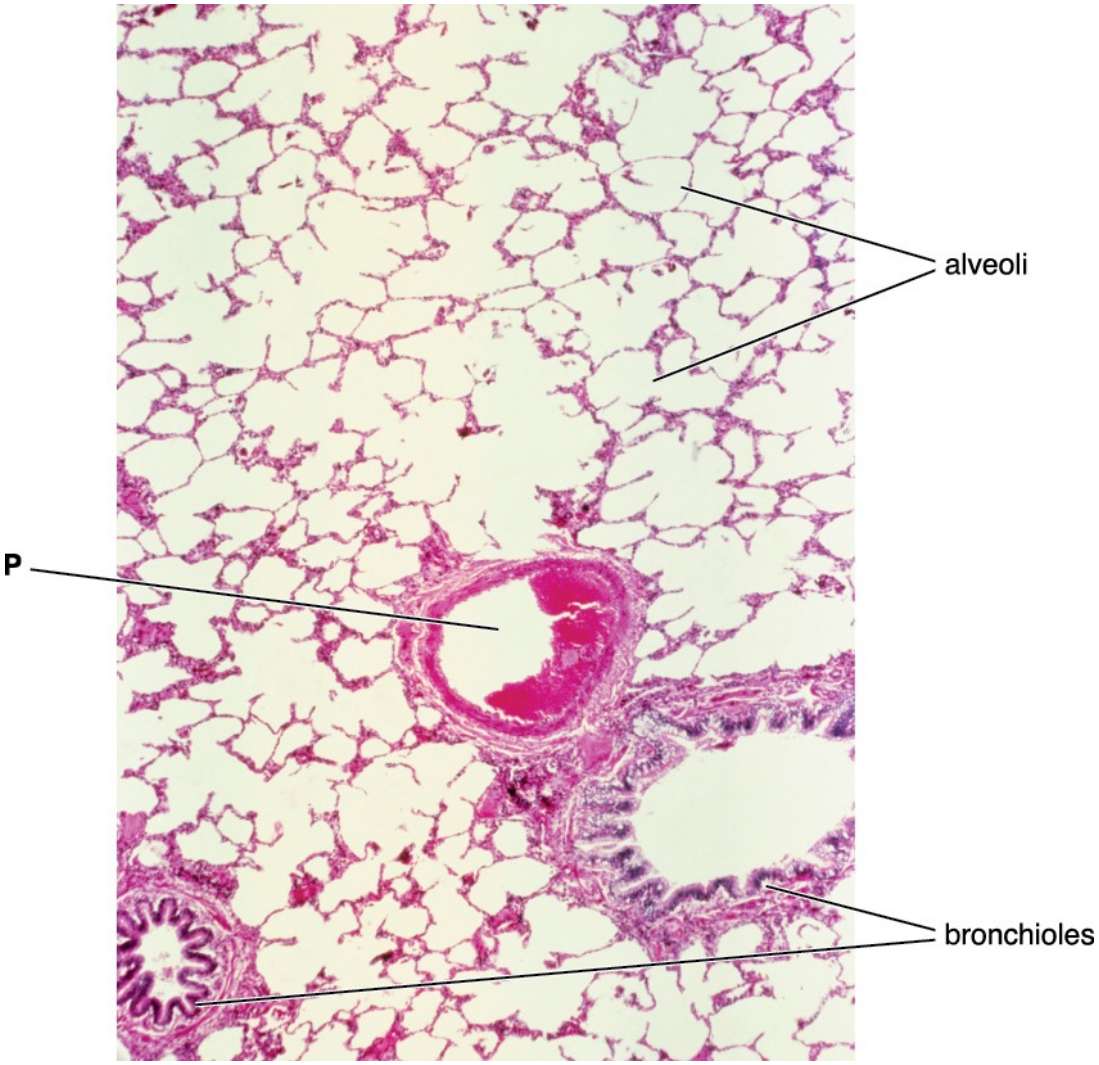


Fig. 26

(i) Identify **P** labelled on Fig. 26.

---

[1]

(ii) The walls of the alveoli consist of squamous epithelial cells.

How does the structure of these cells differ from the epithelial cells lining bronchioles?

---

[1]

(iii) Bronchiole walls contain smooth muscle and elastic fibres.

Describe the role of each of these tissues.

smooth muscle ----------

---

elastic fibres ----------

---

[2]

4(a). Atrial septal defect (ASD) is a condition caused when the septum of the heart has not formed correctly. This is also known as 'a hole in the heart' and is shown in Fig. 3.3.

In an adult with ASD, blood will leak from the left atrium into the right atrium.

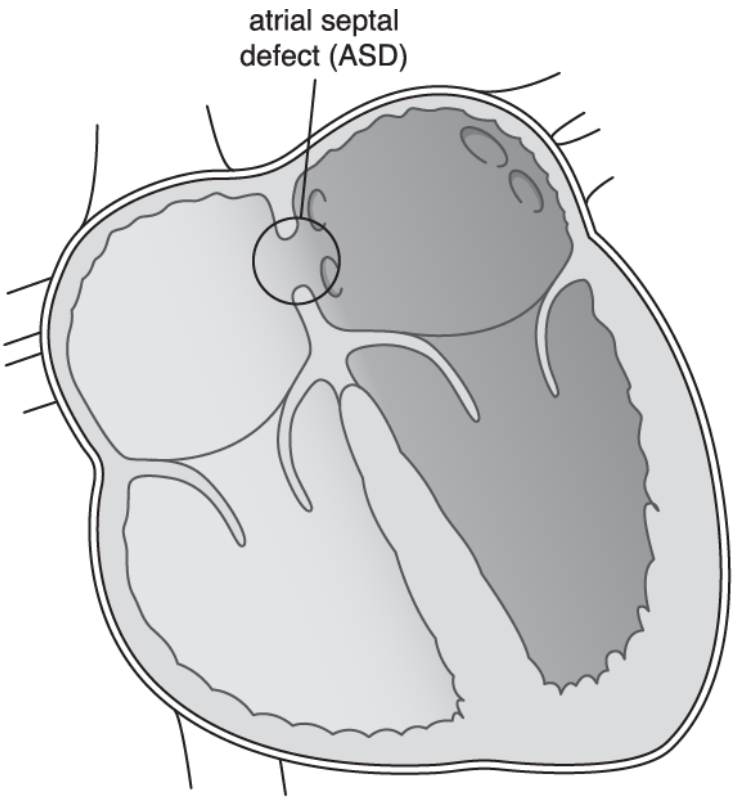


Fig. 3.3

(i) Suggest why an adult with ASD would have an increased cardiac output from the right ventricle.

---

[1]

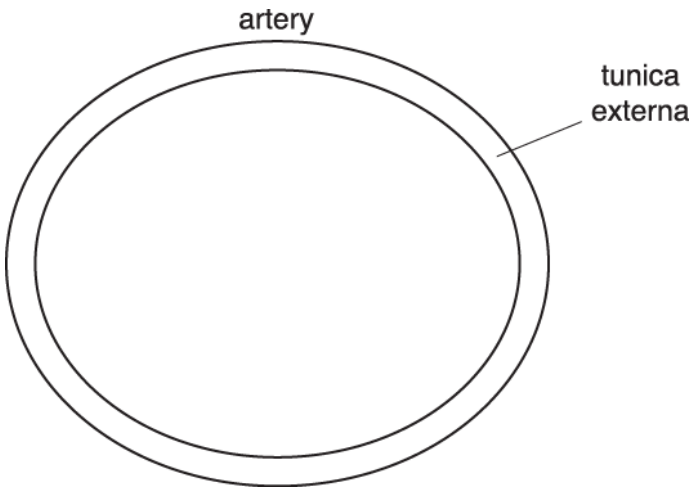
(ii) Suggest why the muscles of an adult with ASD will fatigue more quickly.

---

[2]

(b). ASD can cause the pulmonary artery to become enlarged.

Complete the diagram in the space below to show the structure of a **healthy artery** as seen in transverse section.



[2]

5. Valves help to regulate the flow of blood through the heart.

Valve stenosis is a heart condition caused by a narrowing of the opening between the atrium and ventricle.

Fig. 4.1 is a diagram that shows the flow of blood through one side of heart **Y**, a normal heart, and one side of heart **Z**, a heart with valve stenosis.

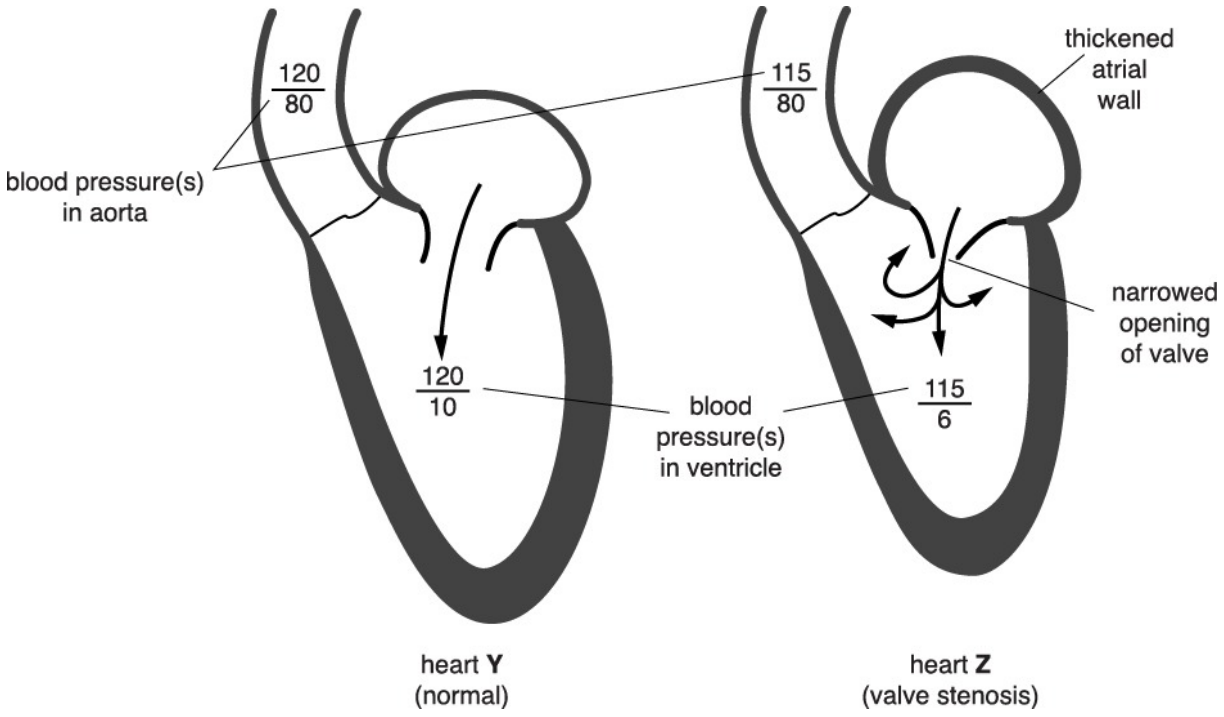


Fig. 4.1

(i) Name the valve shown in Fig. 4.1 that is affected by valve stenosis.

---

[1]

(ii) Using the information in Fig. 4.1, compare the blood pressure within heart **Y** and heart **Z**.

---

[1]

(iii) Suggest why the atrial wall becomes thickened in heart **Z**.

---

[1]

6(a). The circulatory system in humans is a closed system in which blood flows under pressure within vessels. Medical professionals often need to monitor blood pressure.

Diagrams **E**, **F** and **G** in Fig. 4.1 show the stages in measuring blood pressure using a sphygmomanometer.

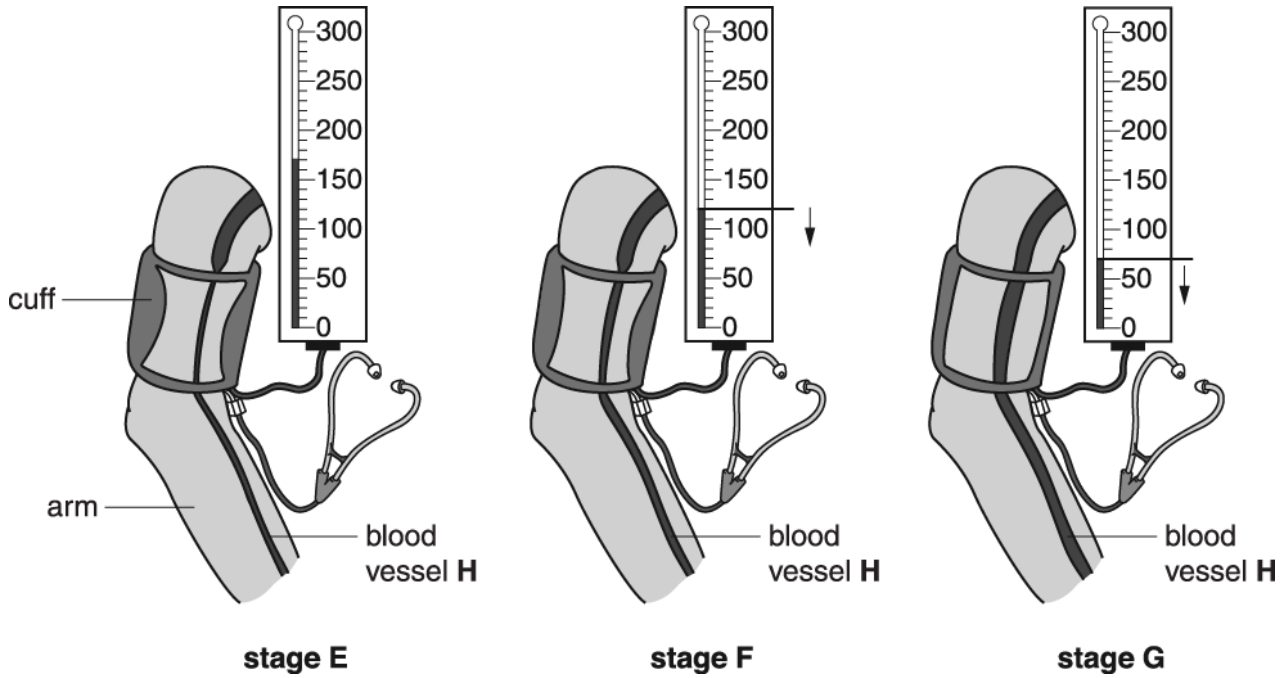


Fig. 4.1

(i) Name the blood vessel labelled **H** in Fig. 4.1.

---------- [1]

(ii) Korotkov sounds are the tapping sounds heard in the stethoscope.

At which stage, **E**, **F** or **G**, are Korotkov sounds most likely to be heard?

---------- [1]

(iii) At which stage, **E**, **F** or **G**, is the **diastolic** pressure being measured?

---------- [1]

(iv) At which stage, **E**, **F** or **G**, will blood be flowing freely in blood vessel **H**?

---------- [1]

(v) Using the readings shown in Fig. 4.1, give the blood pressure measurement for this person.

Answer = _____ mm Hg

[1]

(b). Pressure must be maintained as blood flows through organs and vessels of the circulatory system.

Describe **two** features of the circulatory system that could affect blood pressure.

1

2

---

[2]

7. Blood contains erythrocytes and neutrophils.

Tissue fluid may contain neutrophils but does not contain erythrocytes.

Tissue fluid is formed from plasma by pressure filtration through the capillary walls.

All materials exchanged between the blood and cells pass through the capillary wall.

Explain why tissue fluid does not contain erythrocytes.

---

[2]

8(a). Different types of monitors are available for medical practitioners to measure the blood pressure of their patients.

These may include:

- digital upper arm monitor
- digital wrist monitor
- manual upper arm monitor

These blood pressure monitors all have inflatable cuffs.

(i) Give **one** advantage of using a digital monitor for measuring blood pressure.

---

[1]

(ii) Sources of error when taking blood pressure measurements using these monitors include improper technique and observer bias.

Suggest **two other** sources of error when using these monitors for measuring blood pressure.

---

[2]

(iii) Fig. 24 shows the variation in systolic pressure in different arteries.

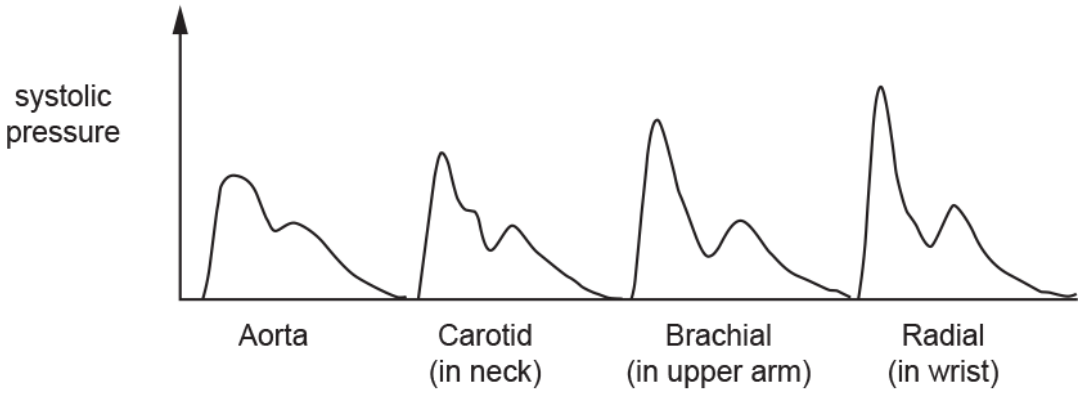


Fig. 24

Using the information in Fig. 24, comment on the suitability of using a digital wrist monitor for measuring blood pressure.

[2]

(b). Hemorrhagic shock is a clinical syndrome resulting from decreased blood volume caused by blood loss. Hypotension may occur in hemorrhagic shock patients where blood loss is greater than 15% of the total blood volume.

(i) Explain how the production of tissue fluid is affected in patients suffering from hemorrhagic shock syndrome.

---

[2]

(ii) In cases of severe blood loss, the body actively reabsorbs fluid from the tissues to restore blood volume.

Suggest how the composition of this restored blood would differ from that of the blood that has been lost.

---

[2]

9(a). Fig. 3.1, below and on the insert for H422/03, June 2018, shows a light photomicrograph of a cross-section of a healthy artery.

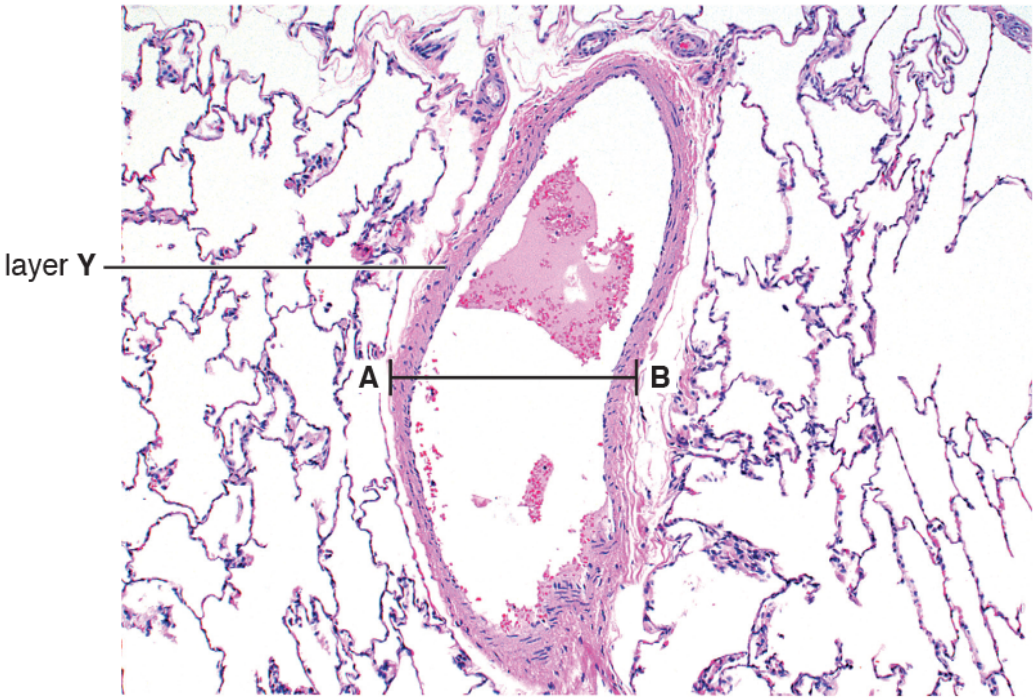


Fig. 3.1

(i) Identify layer **Y**.

---

[1]

(ii) Describe the importance of layer **Y** in the normal functioning of an artery.

---

[1]

(b).

(i) The artery in Fig. 3.1 has a diameter of 0.40 mm measured between A and B.

Calculate the magnification of this image.

Show your working.

Answer = ... **[2]**

(ii) Fig. 3.2, below and on the insert for H422/03, June 2018, shows a light photomicrograph of a cross-section of a diseased artery. The diseased artery has a diameter 14.3% greater than the healthy artery in Fig. 3.1. The diameter of the healthy artery is 0.40 mm.

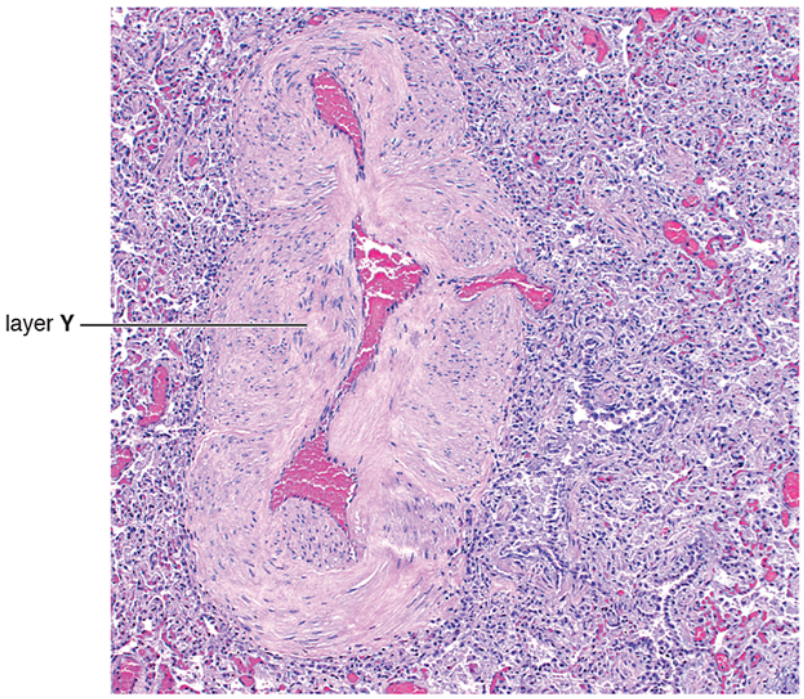


Fig. 3.2

Calculate the actual diameter of the diseased artery. Give your answer to 2 significant figures.

Show your working.

Diameter = ... mm **[2]**

(c). Suggest why layer **Y** is much thicker in this diseased artery than in the healthy artery shown in Fig. 3.1.

---**[2]**

(d).

(i) Capillaries do not have a layer **Y**.

Explain why the absence of layer **Y** is important in the formation of tissue fluid.

---

[1]

(ii) Complete this passage about the formation of tissue fluid using the most appropriate words.

Tissue fluid is formed at the ..... end of capillaries due to the high ..... pressure. The high ..... concentration in capillaries produces a high ..... pressure. This enables fluid to diffuse back into the capillaries.

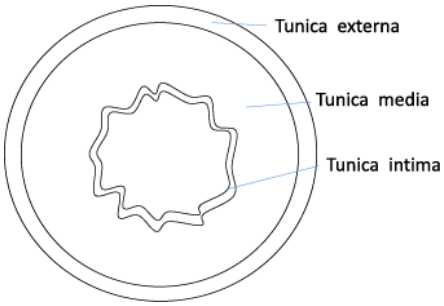
[4]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		**Any 2 from:** (nurse) listens for pulse (1) start of sound indicates systole pressure (1) absence of sound indicates diastole pressure (1)	2	
	b		**Any 3 from:** diastolic blood pressure has little effect on the number of deaths (1) low systolic blood pressure (<140) has little effect on the number of deaths (1) high systolic blood pressures (>140) significant increase in the number of deaths observed (1) at low systolic, increasing diastolic has little effect / AW (1) at high systolic, increasing diastolic has great effect / AW (1) correct quotation of figures in support of any statement (1)	3	
			Total	**5**	
2		i	((110 – 90) ÷ 110) × 100 **OR** (20 ÷ 110) / 100 18 / 18.2 % (1)(1)	2	**ALLOW** 1 mark for correct method of calculation **ALLOW** 18.18% **DO NOT ALLOW** more than 2 d.p.
		ii	**any 3 from:** cuff of sphygmomanometer cuts off blood flow (1) to brachial artery (of arm) (1) stethoscope used to listen to blood flow (1) cuff slowly relaxed / valve released (1) first sound indicates systolic pressure (1) disappearance of sound indicates diastolic pressure (1)	3	
			Total	**5**	

Question			Answer/Indicative content	Marks	Guidance
3		i	lumen of, blood vessel / arteriole / artery ✓	1	IGNORE capillary Examiner's Comments This question provided a straightforward end to the question paper with short answers involving AO1 recall or straightforward AO2 'suggest' style questions. Timing issues were the most likely cause of 'no responses' for some of the question parts. The label line on the diagram was indicating the lumen of the blood vessel which was required to gain the mark point.
		ii	(squamous epithelial cells) do not have cilia ✓ (squamous epithelial cells) are flattened ✓ (squamous epithelial cells) have fewer mitochondria ✓	1 max	CREDIT ORA for epithelial cells lining bronchioles ACCEPT thinner Examiner's Comments This question provided a straightforward end to the question paper with short answers involving AO1 recall or straightforward AO2 'suggest' style questions. Timing issues were the most likely cause of 'no responses' for some of the question parts. There were few correct responses to required knowledge of the different types of epithelial cell present in the respiratory system and good responses gave either *'lack of cilia'* or *'flattened, thin cells'* as a difference for squamous epithelial cells.

Question			Answer/Indicative content	Marks	Guidance
		iii	*smooth muscle* contracts to, control / adjust / reduce lumen size ✓ *elastic fibres* allow, stretch / recoil OR allow lumen to, dilate / return to usual size ✓	2	Examiner's Comments This question provided a straightforward end to the question paper with short answers involving AO1 recall or straightforward AO2 'suggest' style questions. Timing issues were the most likely cause of 'no responses' for some of the question parts. There were some confident responses seen when describing the roles of elastic tissue and smooth muscle in the bronchioles. However, there is still some confusion over the correct terms to use and some candidates confused 'expand' with 'relax' or 'contract' with 'stretch'. There was also some ambiguity as to the 'stretching of the bronchioles' which could suggest that the bronchioles were lengthening rather than the lumen of the bronchiole being widened.
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
4	a	i	increased stroke volume / described ✓	1	<u>Examiner's Comments</u> Very few candidates stated increased stroke volume for (i): those that did get the mark usually got it for a description of more blood leaving the heart.
		ii	less blood (supplied to muscles) ✓ less oxygen / glucose (supplied to muscles) ✓ less (aerobic) respiration ✓	2 Max	ACCEPT less oxygenated blood <u>Examiner's Comments</u> Candidates often lost marks in (ii) for referring to less blood or oxygen to the body in general rather than muscles. Oxygen supply was often not considered.
	b		tunica media thicker than tunica externa **and** endothelium ✓ two of the following labels, lumen / tunica intima / endothelium / tunica media / smooth muscle / elastic fibres / squamous cells ✓	2	 **Examiner's Comments** Generally, this was well answered with students drawing correctly and labelling at least two correctly less often.
			Total	5	

Question			Answer/Indicative content	Marks	Guidance
5		i	bicuspid OR left, atrioventricular / AV;	1	Examiner's Comments Very few candidates picked up on the 'clue' in the diagram which showed the aorta indicating this was the left side of the heart. Hence, although most could identify the atrioventricular valve, few specified it was the left valve.
		ii	systolic AND diastolic pressure is lower in heart Z;	1	CREDIT ora for heart Y ACCEPT 'BP is lower in Z' if statement supported by correct figures for systolic and diastolic pressure e.g systolic has dropped by 5 and diastolic by 4 OR Z 115/6 and Y 120/10. DO NOT CREDIT reference to aortic pressure figures (120/80 and 115/80) Examiner's Comments In (ii) good responses referred to correct data for systolic and diastolic pressure in the chambers of the heart while weaker candidates simply referred to 'blood pressure' or used data from the aorta.

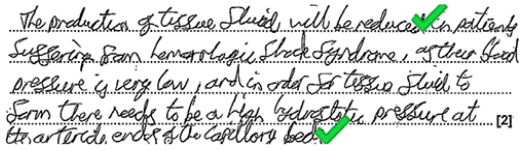
Question			Answer/Indicative content	Marks	Guidance
		iii	*idea that* needs to generate higher pressure or more force to overcome the resistance (caused by narrower opening);	1	**e.g.** valve does not open so far so more pressure has to be applied to make sure the same volume of blood is moved into the ventricles needs to be stronger to push blood through the narrowed opening IGNORE reference to the atrium working harder Examiner's Comments Part (iii) was well answered although some candidates did imply that the change in the wall was a cause of the heart defect rather than a consequence of it.
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
6	a	i	brachial artery;	1	Examiner's Comments In this question, the context of blood pressure measurements provided candidates with the opportunity to demonstrate their knowledge of the circulatory system and respond to 'How Science Works' style questions involving the sphygmomanometer. Overall, there were good responses to parts **(i)–(iv)** although many candidates did not refer to 'brachial' in **(i)** so did not gain credit. In **(v)**, candidates were required to read a blood pressure measurement from the diagram and many candidates found this challenging; centres are encouraged to provide practical opportunities for candidates to take measurements using a variety of meters and apparatus and also to practice interpreting readings from secondary data. Some candidates correctly read the blood pressure but then performed a calculation to divide the systolic pressure by the diastolic pressure; others added the two readings together.
		ii	**F**;	1	
		iii	**G**;	1	
		iv	**G**;	1	
		v	120/70 (mmHg);	1	

Question			Answer/Indicative content	Marks	Guidance
	b		force of ventricular contractions; strength of elastic recoil (of blood vessels); resistance to blood flow / AW;	2 max	ACCEPT lumen diameter of blood vessels qualified e.g. narrower lumen would increase pressure CREDIT *idea of* vasodilation or vasoconstriction occurring IGNORE reference to cardiovascular disease Examiner's Comments In this question, the context of blood pressure measurements provided candidates with the opportunity to demonstrate their knowledge of the circulatory system and respond to 'How Science Works' style questions involving the sphygmomanometer. A wide range of responses were seen in this part. Some candidates identified a factor, for example, lumen size of a vessel, but did not qualify their response with a description to gain credit for the marking point.
			Total	7	

Question			Answer/Indicative content	Marks	Guidance
7			gap(s) between endothelium cells (too) small ; (erythrocytes) too large / cannot change shape (much) ; to, fit / move / pass, between (endothelium) cells **OR** through, gaps / pores / fenestrations;	2 max	**IGNORE** holes in wall **ACCEPT** pores / fenestrations too small Look for idea that they are **too** big not just big **ACCEPT** not small enough **ACCEPT** squeeze **DO NOT CREDIT** diffusion of cells **IGNORE** to pass through capillary wall (it is in question and we want to know how they get through) **Note:** too big to pass through gaps = 2 marks (mp2 and 3) **Examiner's Comments** Candidates were asked why erythrocytes do not enter the tissue fluid. The majority of candidates knew that red blood cells are too large. The better candidates realised that they needed to give a little more detail than simply stating that the cells were too large to 'pass through the capillary wall'. This level of detail is given in the stem of the question. These candidates usually scored the second mark by suggesting that the cells had to pass through pores or gaps between the cells of the capillary wall. Very few candidates used the term endothelium.
			Total	2	

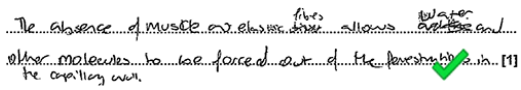
Question			Answer/Indicative content	Marks	Guidance
8	a	i	readings appear on screen ✓ easier for person to take their own blood pressure ✓ data can be collected remotely ✓ blood pressure can be monitored over longer periods of time ✓ easier to take repeat readings / AW ✓ less misinterpretation of data ✓	1 max	ALLOW easier to read ALLOW can be used at home / non-trained person can use it ALLOW can be monitored more regularly <u>Examiner's Comments</u> Examiners were looking for the idea that the digital monitor would be easier to read, so there would be less misinterpretation of data. There is no evidence that these monitors are more accurate, which was a common response. Candidates were not penalised for using the term 'accuracy', so could still gain credit if they had added credit-worthy information in their response.
		ii	person may be, active / moving / not sitting down ✓ *idea that* cuff may be wrong size for the person ✓ AVP ✓	2 max	IGNORE any references to improper technique or observer bias IGNORE references that relate to only digital monitors or faulty monitors ALLOW person not been at rest before starting e.g. cuff does not inflate correctly e.g. patient is nervous e.g. patient is stressed e.g. patient has 'white coat syndrome' <u>Examiner's Comments</u> AO3 was being assessed in this part of the question. The AVP (any valid point) mark enabled many candidates to achieve at least one mark for this part of the question. There were many good responses which included the idea that people may suffer from 'white coat syndrome' or be nervous about having their blood pressure monitored. There were some excellent responses from candidates who realised that all of the monitors used cuffs, which could introduce a source of error if it did not fit or inflate correctly.

Question			Answer/Indicative content	Marks	Guidance
		iii	*less suitable because:* *idea that* (systolic) , pressure / reading taken , would be higher ✓ *idea that* (systolic) , pressure / reading taken , would be most different to that in aorta / AW ✓ *idea that* radial artery is furthest away from aorta / AW ✓ *more suitable because:* easier to use on the wrist ✓	2 max	**ALLOW** ORA **ALLOW** ORA **ALLOW** ORA <u>Examiner's Comments</u> As this question asked candidates to comment on the suitability of the wrist monitor, candidates were credited for commenting on whether it was more suitable or less suitable for measuring blood pressure. Many candidates applied their knowledge of blood pressure measurements to the information in Fig. 24, suggesting that it was not suitable due to differences in systolic pressure readings between the wrist and the aorta.
	b	i	less tissue fluid is formed ✓ (because) less (hydrostatic) pressure at arteriole end of capillary ✓	2	**ALLOW** less blood plasma forced , out of capillaries / into tissues <u>Examiner's Comments</u> Many candidates deduced that less tissue fluid would be formed in patients suffering from haemorrhagic shock. Few responses gained credit for the second mark point as candidates had already been told that these patients would have hypotension (low blood pressure) so needed more detail. Exemplar 4  The production of tissue fluid will be reduced in patients suffering from hemorrhagic shock syndrome, as their blood pressure is very low, and in order for tissue fluid to form there needs to be a high hydrostatic pressure at the arteriole end of the capillary bed. [2] This is an excellent response with the candidate applying knowledge of tissue fluid formation to the context of the question.

Question			Answer/Indicative content	Marks	Guidance
		ii	*restored blood would have* fewer blood cells ✓ lower concentration of (plasma) proteins ✓ lower concentration of glucose / oxygen ✓ higher concentration of carbon dioxide ✓	2 max	**ALLOW** ORA for *blood that has been lost* **ALLOW** named blood cells / platelets **ALLOW** named plasma protein e.g. albumin **NOTE**: '**concentration**' need only be seen once for MPs 2-4 e.g. 'lower concentration of plasma proteins and higher carbon dioxide' = **2 marks** If '**concentration**' has not been used in MPs 2-4 one mark can be awarded for two correct 'ideas' e.g. **fewer** proteins and **less** oxygen =**1 mark** Examiner's Comments Many candidates gained credit for making the connection between restored blood and its likely similarity to tissue fluid and the suggestion that there would be fewer blood cells, to gain credit. In good responses candidates extended their suggestions to include information about the concentration of proteins and blood gases, thereby gaining both mark points.
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
9	a	i	smooth muscle / elastic fibres / tunica media ✓	1	Enter text here.
		ii	*Explanation should link to correct tissue if named in provided for (i)* (elastic fibres enable) recoil OR (muscle) contracts to, reduce the size of the lumen ✓	1	 DO NOT ALLOW reference to elastic fibres 'relaxing/contracting' ALLOW regulates blood pressure by altering (width of lumen) IGNORE references to maintain blood pressure Examiner's Comments Candidates were not all confident in identifying layer Y. A common error in 3aii was the use of incorrect terms for the tissue identified in e.g. smooth muscle stretching and recoiling or elastic fibres contracting.
	b	i	x 80 ✓✓	2	If incorrect answer then **award one mark maximum** for either correct working i.e. 32/0.4 OR '80' **ALLOW one mark maximum** for correct formula and correctly formatted answer if the candidate has measured incorrectly e.g. 32.5/0.4 = x 81.125 (accept a tolerance of +/-0.5 mm)

Question			Answer/Indicative content	Marks	Guidance
		ii	0.46 ✓✓	2	If answer is incorrect or missing: **ALLOW** one mark for correct working e.g. 1.143 × 0.4 or (14.3 / 100 × 0.4) + 0.4 **ALLOW** one mark for correct answer to incorrect number of d.p. e.g. 0.4572 mm Examiner's Comments Some candidates did not give their answer to 2 significant figures and as such did not score full marks. Candidates should be encouraged to give their working in the space provided. Some candidates gave an incorrect answer, but with no working missed the opportunity to make one mark.
	c		hypertrophy/ hyperplasia (of smooth muscle cells) ✓ to withstand a higher blood pressure OR to enable greater, contraction (of the artery wall) ✓ more / thicker, elastic fibres ✓ to withstand a higher blood pressure OR for greater, recoil ✓ plaque formation/ atheroma / atherosclerosis / increased cholesterol in the artery wall ✓ cancer / uncontrolled cell division results in more cells ✓	2 max	**IGNORE** generic references to high blood pressure (as a sign of disease) **ALLOW** more / bigger, (smooth) muscle cells Examiner's Comments This question required candidates to consider possible reasons for the tunica media to thicken. It mainly assessed AO2. Able candidates gave 2 appropriate suggestions but other candidates gave one suggestion, which diverted away from the question, describing the causes of coronary heart disease. A common error was the deposition of fats/lipids in the lumen or on the wall (rather than in the artery wall).

Question			Answer/Indicative content	Marks	Guidance
	d	i	allows leakage of liquid through fenestrations ✓ reduces diffusion distance/ increases rate of diffusion, to meet the demand for nutrients / removal of waste products AW ✓	1	ALLOW 'gaps between cells' as alternative wording for fenestrations <u>Examiner's Comments</u> Able candidates related the role of fenestrations in the formation of tissue fluid. Some candidates used terms plasma and tissue fluid incorrectly and as such did not gain a mark. Several candidates appreciated the diffusion distance would be reduced but did not then link this to either meeting the demand for nutrients or removing waste products adequately. Exemplar 4 
		ii	arterial ✓ hydrostatic ✓ solute ✓ osmotic ✓	4	ACCEPT arteriole / artery ACCEPT protein ACCEPT oncotic (if protein is the given as mp3)
			Total	13	