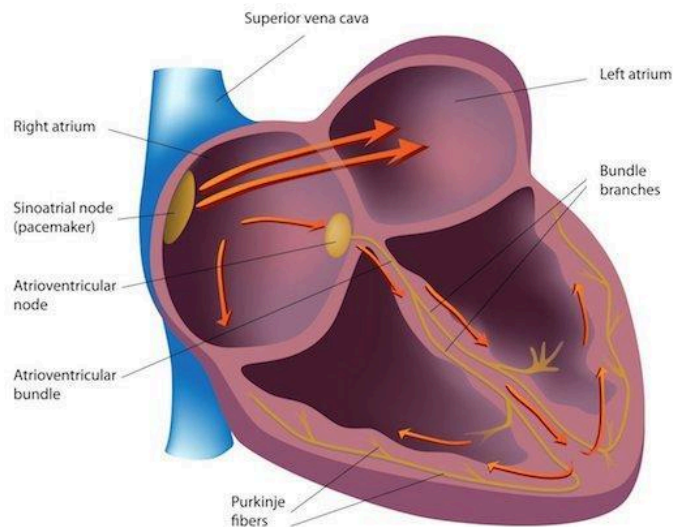


IB Biology

Revision

Topic 6.2 – The Blood System

D4 – The Heart

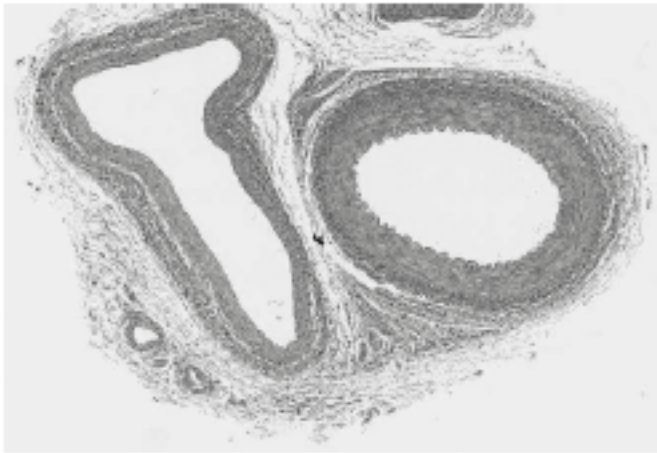


Name:

Teacher: Mr Trent

1. [1 mark]

The light micrograph shows two blood vessels, an artery and a vein, in transverse section.

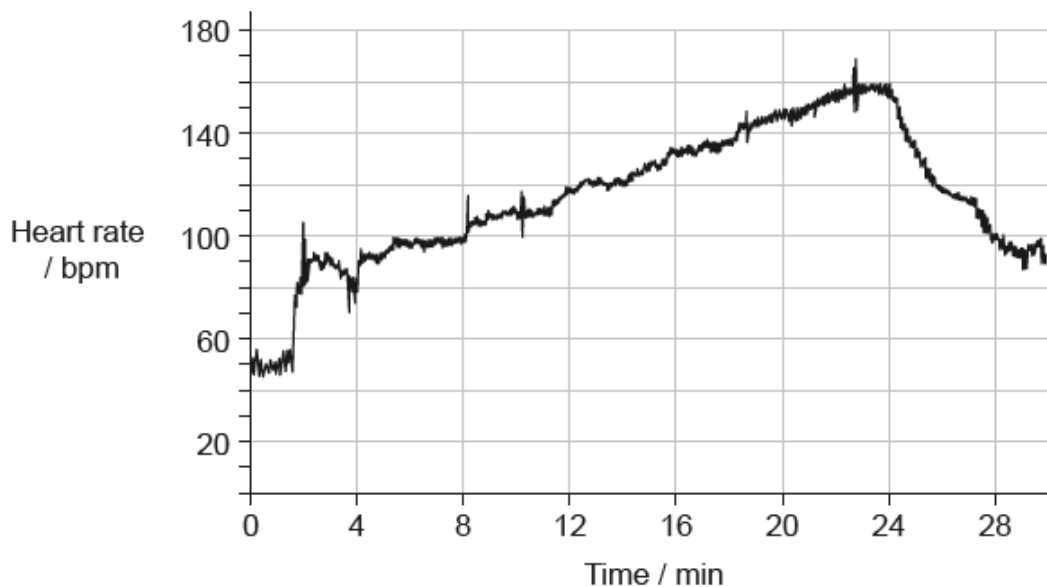


What explains the different shapes of these blood vessels?

- A. Arteries do not have valves.
- B. Muscle cells are found only in the walls of veins.
- C. Arteries have a larger lumen-to-wall thickness ratio.
- D. There are fewer elastic fibres in the walls of veins.

2. [1 mark]

The image shows the changes in heart rate of an athlete during exercise.



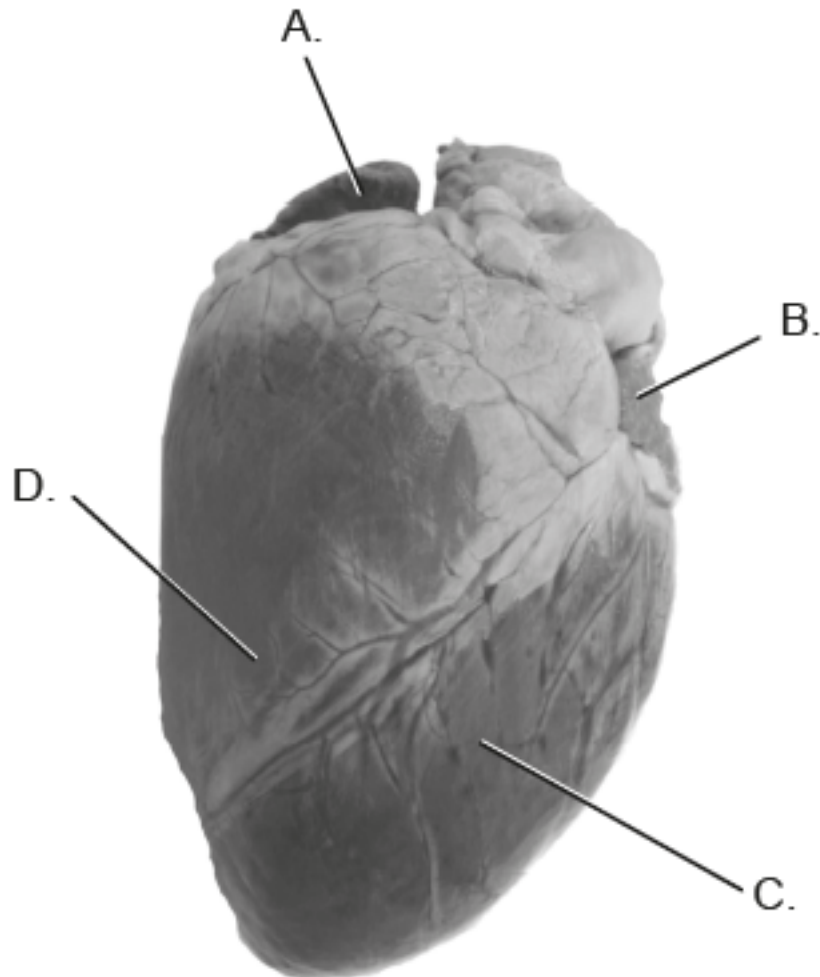
[Source: Liddle, P.F., 2010. Heart Rate Variability (HRV) during exercise. [online] Available at: <https://canute1.wordpress.com/2010/07/> [Accessed 1 August 2019].]

What is likely to have occurred between 0 and 4 minutes and between 24 and 28 minutes?

	Between 0 and 4 minutes	Between 24 and 28 minutes
A.	Epinephrine is secreted	More blood is sent to the rest of the body than to the lungs
B.	More blood is sent to the lungs than to the rest of the body	Epinephrine is secreted
C.	Epinephrine is secreted	Impulses are sent from the medulla of the brain to the heart
D.	Impulses are sent from the medulla of the brain to the heart	Epinephrine is secreted

3. [1 mark]

The image shows the four chambers of the mammalian heart viewed from the ventral side. The sinoatrial node is located in the wall of one of these chambers. Which chamber is it?



4. [1 mark]

An individual was presented with a stimulus resulting in the release of epinephrine. What was the most likely nature of the stimulus?

- A. Sunset and the onset of darkness
- B. An image of a close friend
- C. The intake of glucose
- D. A coach shouting to begin physical activity

5. [1 mark]

What feature of arteries is most important in maintaining sufficiently high blood pressure?

- A. A wide lumen
- B. Elastic fibres in the wall
- C. Valves at intervals
- D. A thin wall

6. [1 mark]

What happens in the heart when epinephrine is secreted into the blood?

- I. Pressure in the heart falls.
 - II. The pulmonary artery transports oxygenated blood at a faster rate.
 - III. The sinoatrial node increases the rate of electrical signals.
- A. I only
 - B. I and II only
 - C. II and III only
 - D. III only

7. [3 marks]

Explain the heart sounds.

8. [1 mark]

What is an advantage of capillary walls being one cell thick in the systemic circulation?

- A. To allow carbon dioxide to diffuse into tissues
- B. To allow oxygen to diffuse out of tissues
- C. To allow glucose to diffuse into tissues

D. To allow urea to diffuse into tissues

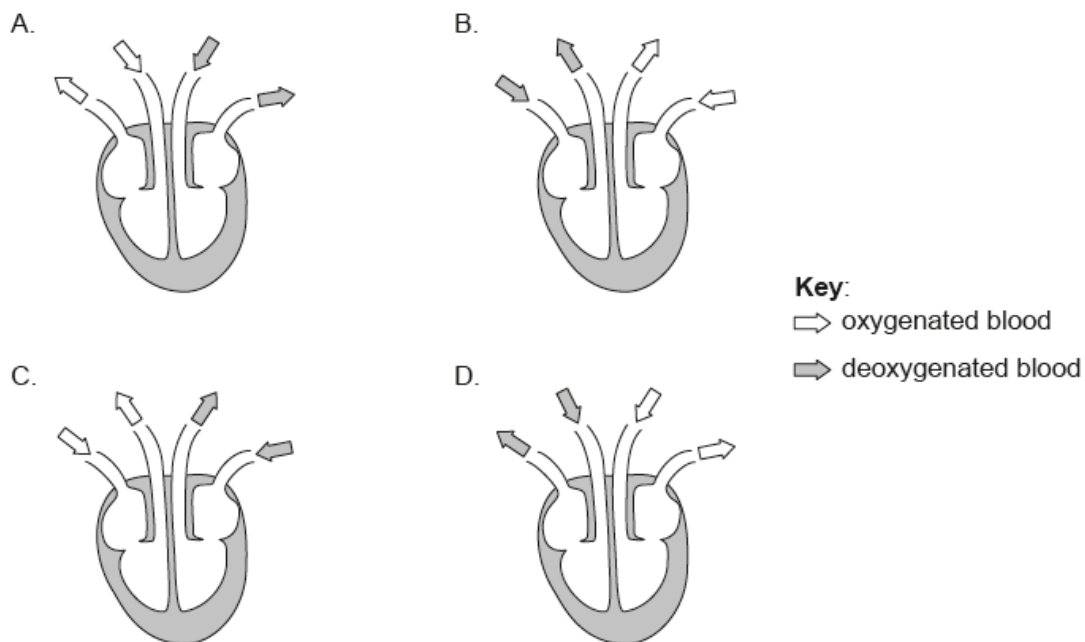
9. [1 mark]

What causes the atrioventricular valves to close during a heartbeat?

- A. Pressure in the atria is higher than in the ventricles.
- B. Pressure in the atria is lower than in the ventricles.
- C. Pressure in the arteries is higher than in the ventricles.
- D. Pressure in the arteries is lower than in the ventricles.

10. [1 mark]

Which diagram represents blood flow through the mammalian heart?



11. [1 mark]

What observation did William Harvey use as evidence for the circulation of blood?

- A. The ventricles of the heart pump blood out into arteries.
- B. Valves ensure unidirectional flow of blood.
- C. Capillaries carry blood from arteries to veins.
- D. All organs of the body have a separate blood supply.

12. [1 mark]

Which vessel carries deoxygenated blood away from the heart?

- A. Aorta
- B. Pulmonary artery
- C. Vena cava
- D. Pulmonary vein

13. [1 mark]

When intense physical activity is anticipated, which factor in the blood will increase the frequency of sinoatrial signals to heart muscle?

- A. pH
- B. Oxygen level
- C. Thyroxin
- D. Epinephrine

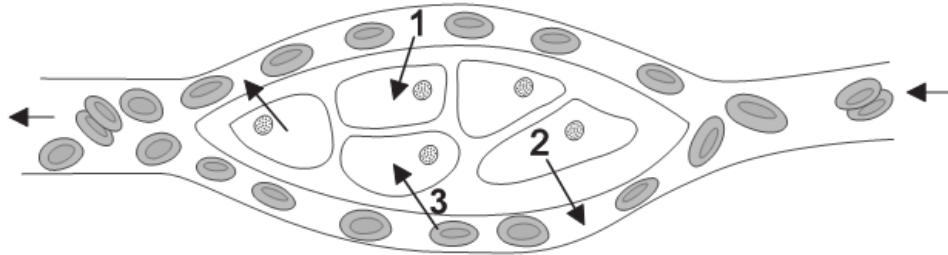
14. [1 mark]

How are fats and cholesterol transported in the blood?

- A. As groups of molecules inside vesicles
- B. As individual molecules coated in phospholipids
- C. As individual molecules bound to a protein
- D. As groups of molecules in lipoprotein complexes

15. [1 mark]

The diagram shows red blood cells and undifferentiated tissue cells.



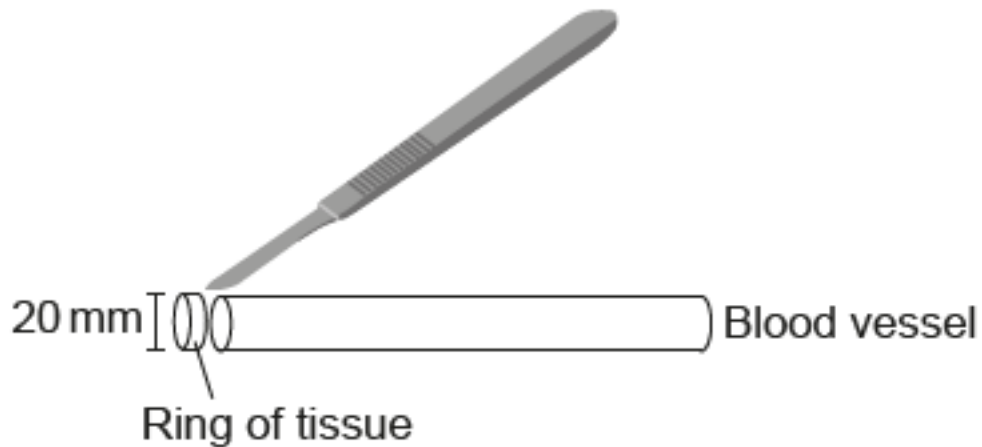
[Source: © International Baccalaureate Organization 2017]

Diffusion of oxygen from blood cells to tissue cells is represented by arrow 3 in the diagram. What molecules are shown diffusing by arrow 1 and arrow 2?

	Arrow 1	Arrow 2
A.	carbon dioxide	urea
B.	water	glucose
C.	glucose	carbon dioxide
D.	fatty acids	amino acids

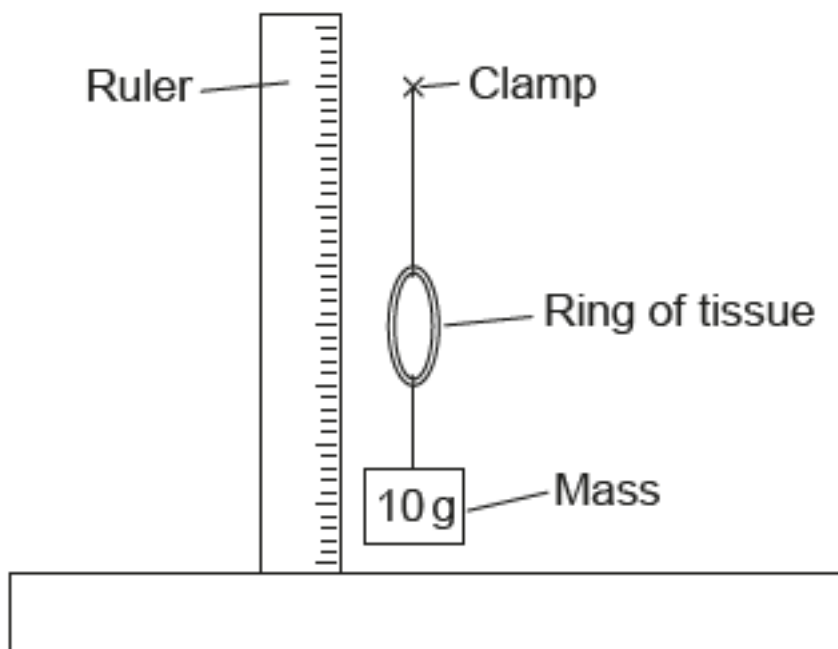
16a. [2 marks]

In an investigation to compare the elasticity of arteries and veins, rings of the same diameter (20 mm) of artery and vein tissue were cut from blood vessels obtained from a mammal.



[Source: © International Baccalaureate Organization 2020.]

Each ring was attached to a clamp. Multiple masses of 10 g were added and removed. The vertical diameter of the artery and the vein was measured, both with the mass and once the mass had been removed.



The results are shown in the table.

Mass / g	Diameter of vein / mm		Diameter of artery / mm	
	With mass	Mass removed	With mass	Mass removed
0	20	20	20	20
10	26	26	26	22
20	34	33	30	23
30	38	36	35	23
40	40	37	38	24

State the independent and dependent variables in this experiment.

Independent:

Dependent:

16b. [1 mark]

State **one** feature of the rings that has to be kept constant apart from their initial diameter.

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16c. [3 marks]

Explain the differences between the results shown for vein and artery.

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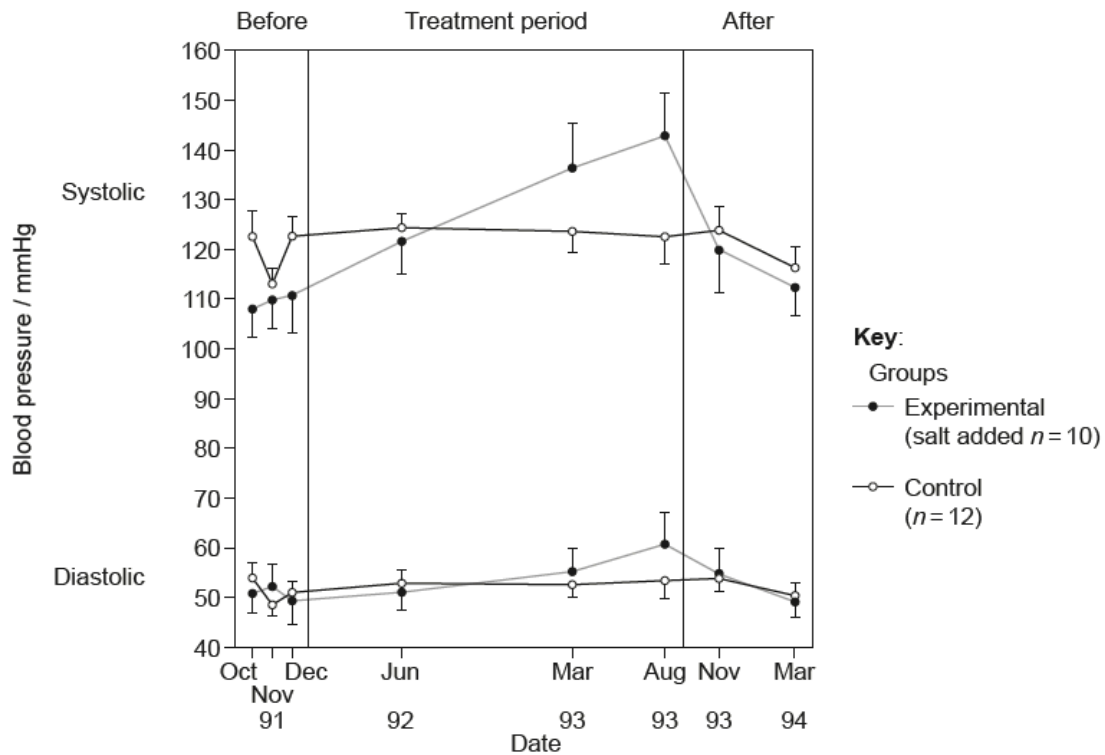
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17a. [2 marks]

Blood pressure changes in chimpanzees (*Pan troglodytes*) fed a salt-supplemented diet during a two-and-a-half-year treatment period were compared to the blood pressure of those fed a normal diet. The graph shows the mean systolic and diastolic blood pressure ($\pm$ standard deviation) before, during and after the treatment period.



Evaluate the effect of salt on blood pressure using the data in the graph.

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17b. [1 mark]

State the instrument used by doctors to measure blood pressure.

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17c. [2 marks]

Describe the mechanism by which the heartbeat is initiated.

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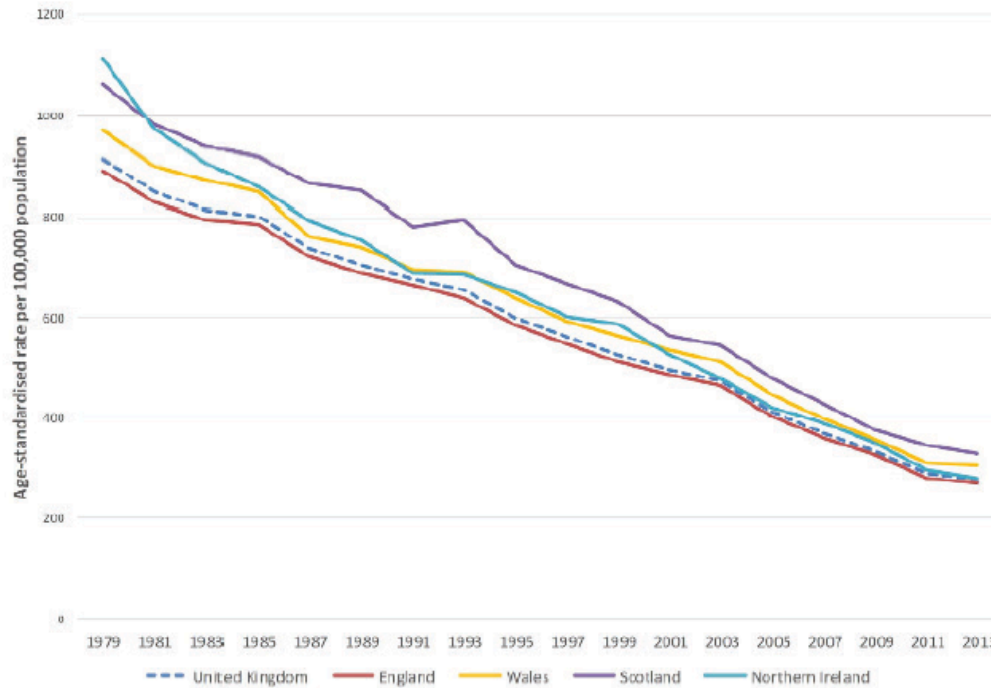
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18a. [1 mark]

The figure below shows the average death rates from coronary heart disease in the UK.



Suggest **one** reason for the general decrease in the incidence of coronary heart disease.

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18b. [2 marks]

Outline the use of a defibrillator.

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18c. [3 marks]

Explain the heart sounds.

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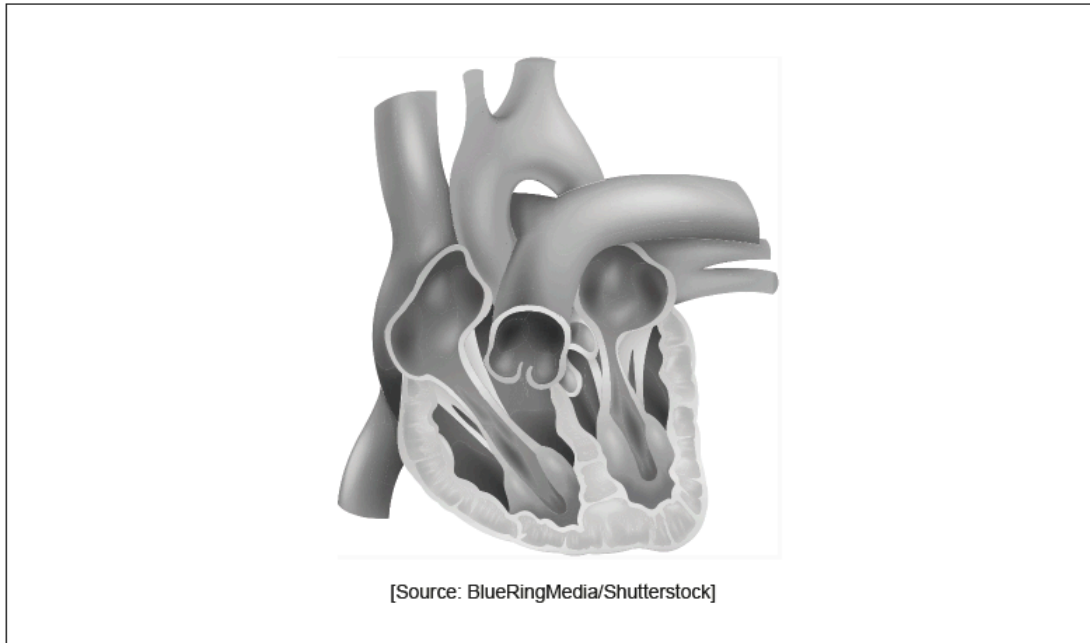
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19a. [1 mark]

The diagram shows the human heart.



On the diagram, label the aorta.

19b. [1 mark]

On the diagram, label the right atrium.

19c. [2 marks]

Explain how valves control the flow of blood through the heart.

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19d. [2 marks]

Outline the causes and consequences of blood clot formation in coronary arteries

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20a. [1 mark]

Outline **one** consequence for the heart of the eating disorder anorexia nervosa.

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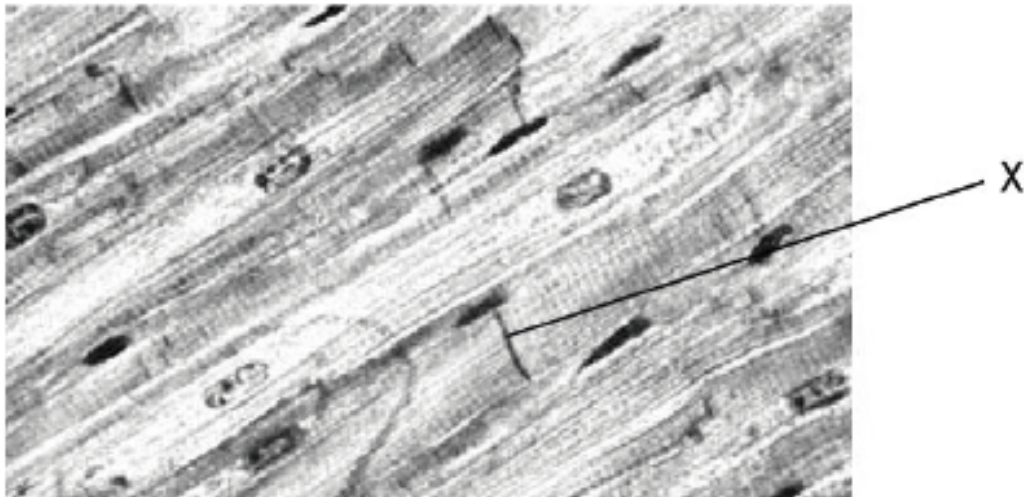
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20b. [1 mark]

The micrograph shows cardiac muscle.



The structure labelled X in the micrograph is a junction between two cardiac muscle cells.
Identify the structure labelled X.

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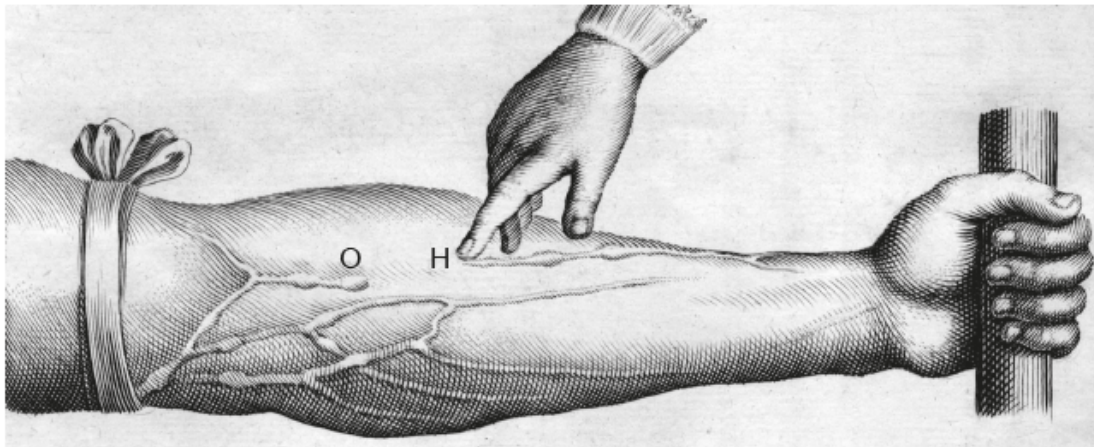
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21a. [1 mark]

In 1628, the physician William Harvey described details of the circulation of blood for the first time. In one experiment, he tied a tight bandage around the upper arm of a volunteer to display the blood vessels in the lower arm more clearly. He pressed his finger on the blood vessel at H. At the same time, he pushed the blood in the vessel from H to O with a second finger, removing the blood as shown in the diagram. When the finger at H was released, the blood vessel refilled with blood.



[Source: adapted from William Harvey original plate]

Identify the type of blood vessels shown in the diagram.

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21b. [2 marks]

Deduce what the experiment demonstrated about the circulation of blood.

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22a. [2 marks]

Describe the structure of cardiac muscle cells.

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22b. [1 mark]

State the name of the valves that prevent blood flowing from the arteries back into the heart.

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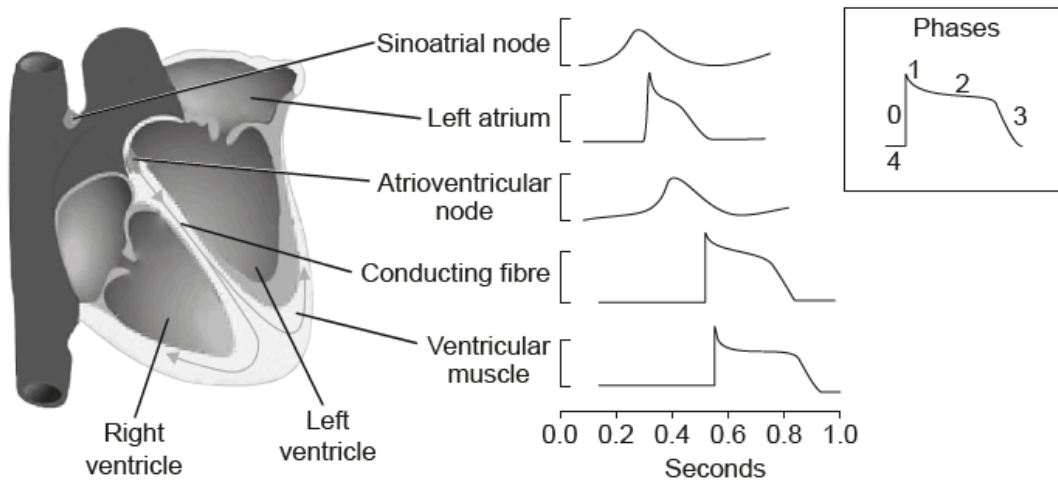
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22c. [2 marks]

The drawing shows the typical action potential waveforms with the different phases of the cardiac cycle recorded in different regions of a human heart.



Distinguish between the different phases of the cardiac cycle in the atria and in the ventricular muscle.

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22d. [3 marks]

Sketch the pattern seen in a typical electrocardiogram (ECG) trace for one complete cardiac cycle, including labels of the main features.

23. [7 marks]

Explain the control mechanism of the heart rate.

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24. [4 marks]

Describe the functions of valves in the mammalian heart.

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25a. [3 marks]

The human circulatory system is structured to serve the organs and tissues of the body efficiently.

Outline the exchange of materials between capillaries and tissues.

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25b. [8 marks]

Explain the structures and functions of arteries and veins.

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1. [1 mark]

D

2. [1 mark]

C

3. [1 mark]

A

4. [1 mark]

D

5. [1 mark]

B

6. [1 mark]

D

7. [3 marks]

Markscheme

a. «heart sounds» produced by the closing of the valves ✓

b. first sound «lub» is due to «closure of» the atrioventricular valves ✓ *Accept bicuspid/mitral and tricuspid.*

c. second sound «dup» is due to «closure of» the semilunar valves ✓ *Accept pulmonary/aortic valves.*

d. sequence of sounds is lub dup ✓ *OWTTE*

8. [1 mark]

C

9. [1 mark]

B

10. [1 mark]

B

11. [1 mark]

B

12. [1 mark]

B

13. [1 mark]

D

14. [1 mark]

D

15. [1 mark]

C

16a. [2 marks]

Markscheme

a. Independent: mass;

b. Dependent: (vertical) diameter/length;

Do not accept elasticity

16b. [1 mark]

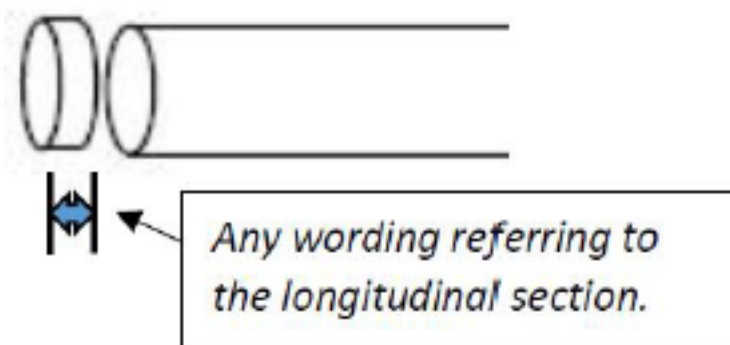
Markscheme

a. width/section depth/slice of the ring;

b. same animal/age/freshness/temperature;

Don't accept thickness or diameter.

Do not accept thickness or diameter.



16c. [3 marks]

Markscheme

a. veins have thinner walls (than arteries);

- b. veins sustain lower (blood) pressure (than arteries);
- c. when stretched, veins become longer (than arteries);
- d. veins have less muscle/elastic (fibre in their) walls (than arteries);
- e. veins have lower elasticity/recover less/remain more stretched (than arteries after weights removed);

Accept inverse for arteries in all cases.

Do not accept a listing of numerical values without explanation.

17a. [2 marks]

Markscheme

- a. systolic pressure increases with salt in diet during treatment;
- b. diastolic pressure is slightly higher/no change with salt during treatment
OR
diastolic pressure only changes towards the end of the period;
- c. (blood) pressure goes back to normal after treatment
OR
salt causes increased (blood) pressure;
- d. standard deviation values overlap therefore not statistically significant;

17b. [1 mark]

Markscheme

sphygmomanometer/blood pressure monitor;

17c. [2 marks]

Markscheme

- a. sinoatrial node/SAN initiates contraction of atria;
- b. SAN sends messages to the atrioventricular/AV node;
- c. AV node initiates ventricular contraction;
- d. through conducting fibres;

18a. [1 mark]

Markscheme

improvement in medical care *Accept improvements in medication.*

OR

healthier diet

OR

decrease in blood cholesterol/pressure

OR

decrease in cigarette smoking

OR

increase in exercise ✓

Accept other answers relating to greater awareness about health issues.

18b. [2 marks]

Markscheme

a. used in life-threatening cardiac conditions/arrhythmia/ventricular fibrillation ✓

b. delivers therapeutic/small dose/shock of electrical energy ✓

c. depolarizes the heart muscle

OR

allows normal rhythm to be re-established ✓

18c. [3 marks]

Markscheme

a. «heart sounds» produced by the closing of the valves ✓

b. first sound «lub» is due to «closure of» the atrioventricular valves ✓ *Accept bicuspid/mitral and tricuspid.*

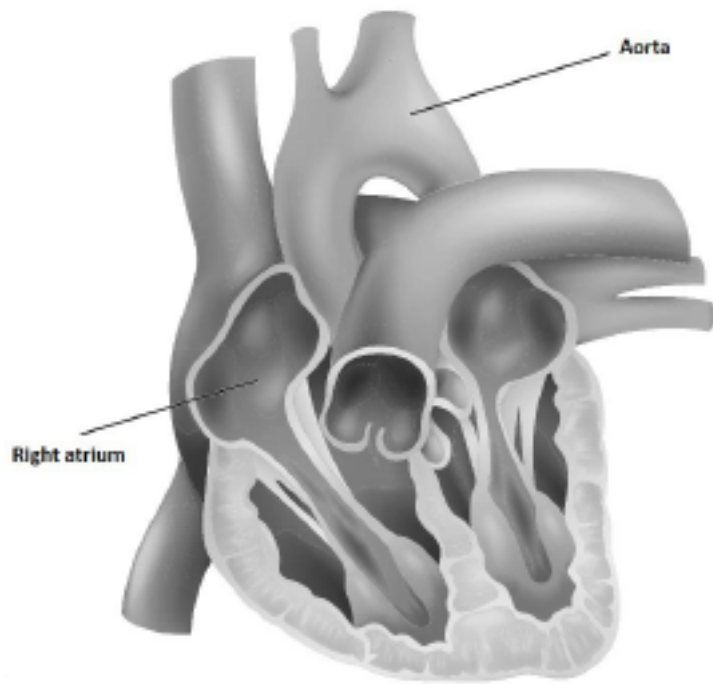
c. second sound «dub» is due to «closure of» the semilunar valves ✓ *Accept pulmonary/aortic valves.*

d. sequence of sounds from a healthy heart is lub dub «pause lub dub pause» ✓ *OWTTE*

19a. [1 mark]

Markscheme

both labelled clearly as in diagram ✓

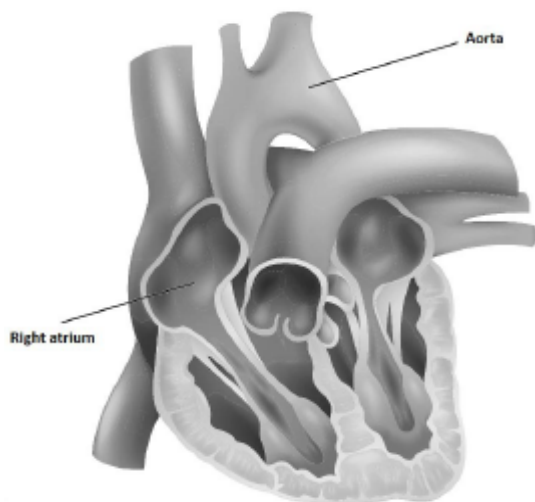


[Source: BlueRingMedia/Shutterstock]

19b. [1 mark]

Markscheme

both labelled clearly as in diagram ✓



19c. [2 marks]

Markscheme

a. valves open and close in response to changes in blood pressure/heart contraction/pumping ✓

b. valve prevents backflow/maintains direction of blood flow ✓

c. valves allow heart chambers to fill/to empty ✓

19d. [2 marks]

Markscheme

a. coronary heart disease/CHD/coronary artery disease/CAD occurs when there is reduction of oxygen to the heart muscle ✓

b. high ratio of LDL to HDL/fatty diet leads to plaque formation in arteries ✓

c. plaque breaks off causing damage that activates blood clot formation ✓

d. clots «in the bloodstream» may block a coronary artery/coronary thrombosis reducing blood flow/oxygen

OR

clots can cause heart attack/muscle death ✓

e. sickle cell anemia «crisis» produces blood clots «that can cause coronary/arterial blockage» ✓

20a. [1 mark]

Markscheme

breakdown/weakening of heart muscle

OR

electrolyte imbalance affecting the cardiac cycle

OR

low blood pressure/heart rate ✓

20b. [1 mark]

Markscheme

intercalated disc ✓

21a. [1 mark]

Markscheme

vein/veins

21b. [2 marks]

Markscheme

a. blood flows towards the heart ✓

- b. valves prevent backflow ✓
- c. blood flow is unidirectional ✓

22a. [2 marks]

Markscheme

- a. cardiac muscle cells are branched ✓
- b. rich in mitochondria ✓
- c. rich in glycogen granules ✓
- d. formed by short cylindrical cells ✓
- e. contains intercalated discs ✓
- f. has gap junctions ✓
- g. «intercalated discs are» transverse cross-bands which represent the attachment site between adjacent cells ✓

Do not accept myogenic as it is not a structure.

22b. [1 mark]

Markscheme

semilunar / sigmoid / pulmonary and aortic valve ✓

22c. [2 marks]

Markscheme

- a. action potential of atrium precedes the ventricle
OR
the phases happen later in ventricle
OR
atrium contracts before the ventricle ✓
- b. atrium has a shorter phase 2/longer phase 2 in ventricle
OR
atrium falls abruptly in phase 2/ventricle shows a plateau in phase 2 ✓
- c. phase 3 is more distinct/falls more abruptly in ventricular action potential ✓
- d. ventricular phase is overall longer than atrial phase ✓

22d. [3 marks]

Markscheme

- a. sketch with the correct shape ✓

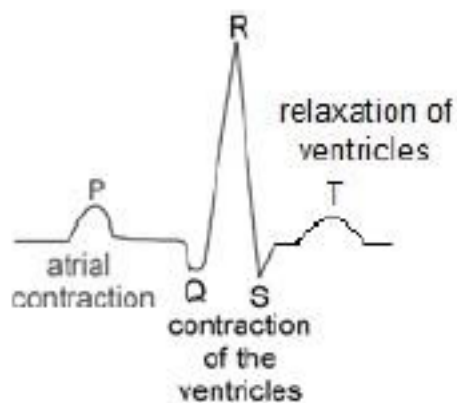
b. P, Q, R, S and T indicated ✓

c. atrial contraction/systole/depolarisation labelled ✓

d. ventricular contraction/systole/depolarisation labelled ✓

e. ventricular relaxation/diastole/repolarization labelled ✓

Correct shape should show peaks at P R and T and dips at Q and S



23. [7 marks]

Markscheme

a. sinoatrial node/SAN is a specialized group of muscle cells

OR

sinoatrial node/SAN is located in the right atrium ✓

b. acts as a pacemaker/controls the heart rate

OR

initiates/generates the heart beat/starts the cardiac cycle ✓

c. sends out electrical signal/impulses/depolarisations ✓

d. electrical signal stimulates contraction «of heart muscle» ✓

e. signal passes through walls of atria/passes to AV node ✓

f. then through walls of the ventricles ✓

g. medulla «oblongata of brain» can change/increase/decrease the rate ✓

h. through nerves/named example of nerve/autonomic/sympathetic/ parasympathetic nervous system ✓ *In mph, only accept vagus nerve for slowing heart rate and sympathetic nerve for accelerating it.*

i. one nerve increases the rate and the other decreases it ✓

j. epinephrine/adrenaline increases heart rate/force of contraction ✓

k. epinephrine/adrenaline prepares the body for vigorous activity/is part of fight or flight response ✓

24. [4 marks]

Markscheme

a. prevents backflow/ensures one-way flow/controls direction of flow ✓

b. open valves allow blood to flow through

OR

opening and closing of valves controls timing of blood flow «during cardiac cycle» ✓

c. closed «semilunar» valves allow ventricles/chambers to fill with blood

OR

closed «semilunar» valves allow pressure in ventricles to rise «rapidly» ✓

d. valves open when pressure is higher upstream/*OWTTE*/converse for closed valves ✓

e. AV/bicuspid/tricuspid/mitral valves prevent backflow from ventricle to atrium

OR

AV/bicuspid/tricuspid/mitral valves open when pressure in atrium is higher «than in the ventricle»/when atrium is pumping/contracting ✓

f. semilunar/aortic/pulmonary valves prevent backflow from artery to ventricle

OR

semilunar/aortic/pulmonary valves open when pressure in ventricle is higher «than in the artery»/when ventricle is pumping/contracting ✓

Allow mpa, mpb, mpc or mpd if the point is made through the example of one specific valve.

25a. [3 marks]

Markscheme

a. molecules move by diffusion / move down a concentration gradient

b. nutrients move into tissues

c. gas exchange / Oxygen and carbon dioxide exchange between tissues and blood/capillaries

d. (nitrogenous) wastes/excess water move from cells/tissues into blood/capillaries

e. hormones leave capillaries in target tissues/to attach to receptors on cells / (endocrine) organs/gland tissues release hormones into the bloodstream

25b. [8 marks]

Markscheme

a. arteries and veins have three layers in their walls

OR

walls of arteries and veins have tunica externa, media and intima

b. pressure is high in arteries/pressure is low in veins

c. arteries receive blood from ventricles/heart / carry blood away from heart

d. lumen of artery is small to keep pressure high

e. arteries have thick (muscular) walls (with elastic fibres) to withstand pressure

f. elastic fibres recoil in response to ventricle/heart contraction

g. muscle / elastic fibres help maintain pressure between heartbeats

OR

muscle / elastic fibres help propel blood toward capillary beds

h. veins receive blood from capillaries/capillary beds / carry blood to heart

i. large lumen of veins so there is less resistance to blood flow

j. valves in veins keep blood flowing toward heart/prevent backflow