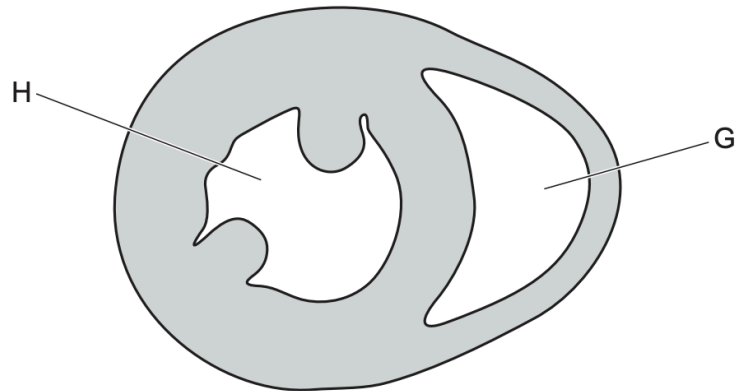


8. Transport in mammals

1.

The diagram shows a cross-section through a mammalian heart.



Which chambers of the heart are represented by G and H?

	G	H
A	left ventricle	right ventricle
B	right atrium	left atrium
C	right atrium	right ventricle
D	right ventricle	left ventricle

Ans: D

- H = ventricular side, so B can be ruled out
- Cross section NOT longitudinal section, so both must be ventricles
- Left ventricle is thicker than right, thus D

2.

Blood entering the heart from the vena cava passes through, or past, several structures before entering the lungs.

Five of these structures are included in this list.

atrioventricular node

aorta

semilunar valve

left atrium

pulmonary vein

Purkyne tissue

sinoatrial node

pulmonary artery

After arranging these five structures in the correct order of blood flow from the vena cava to the lungs, which structure will be third?

- A** atrioventricular node
- B** Purkyne tissue
- C** semilunar valve
- D** sinoatrial node

Ans: B

Right atrium → sinoatrial node → atrioventricular node → Purkyne tissue →
tricuspid valve → right ventricle → semilunar valve → pulmonary artery

Thus Purkyne tissue is 3rd

3.

The maximum pressure in each of the four chambers of a healthy human heart was recorded during one cardiac cycle. The maximum pressures recorded were 3 mmHg, 10 mmHg, 25 mmHg and 120 mmHg.

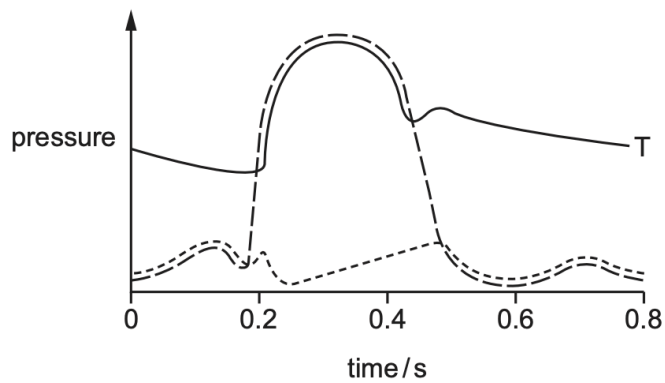
Which value was recorded for the right ventricle?

- A** 3 mm Hg
- B** 10 mm Hg
- C** 25 mm Hg
- D** 120 mm Hg

Ans: C

4.

The graph shows the pressure changes in three structures of the **right side** of the heart during the cardiac cycle.



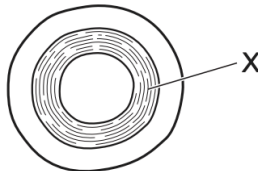
What is represented by the line labelled T?

- A** pressure changes in the pulmonary artery
- B** pressure changes in the right atrium
- C** pressure changes in the right ventricle
- D** pressure changes in the vena cava

Ans: A

5.

The diagram shows a transverse section through an artery.



Which tissues are present in layer X?

- A** collagen and smooth muscle only
- B** elastic fibres and collagen only
- C** elastic fibres and smooth muscle only
- D** elastic fibres, collagen and smooth muscle

Ans: D

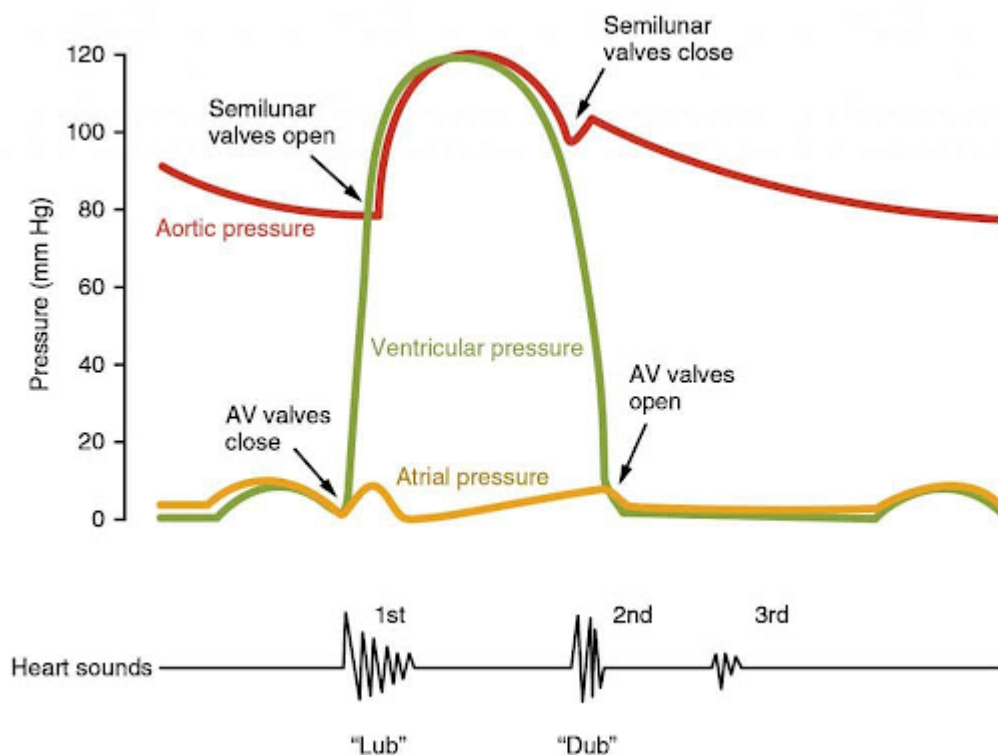
6.

What is systolic blood pressure?

- A** the blood pressure in the arteries when the heart is relaxing
- B** the blood pressure in the left ventricle at the start of a contraction
- C** the maximum blood pressure in the arteries
- D** the maximum blood pressure in the right ventricle

Ans: C

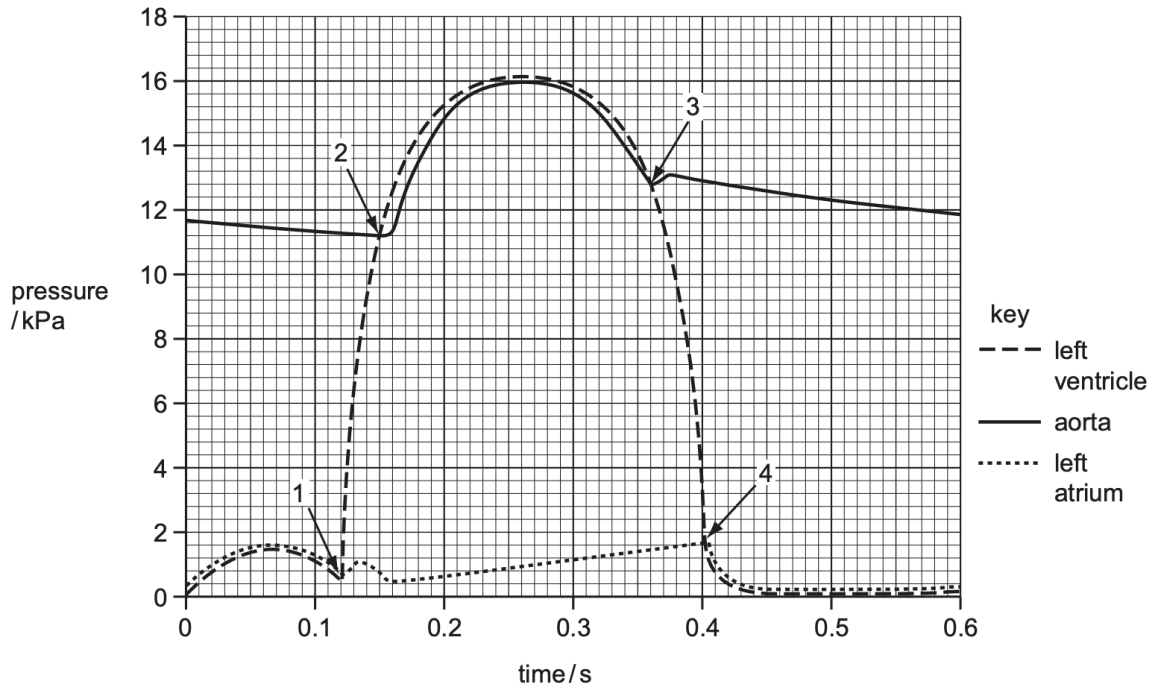
NOTE:



- Yellow = left atrium; Green = left ventricle; Red = aorta
- When ventricles contract, semilunar valves open and AV valves close
- When atria contract, AV valves open and semilunar valves close

7.

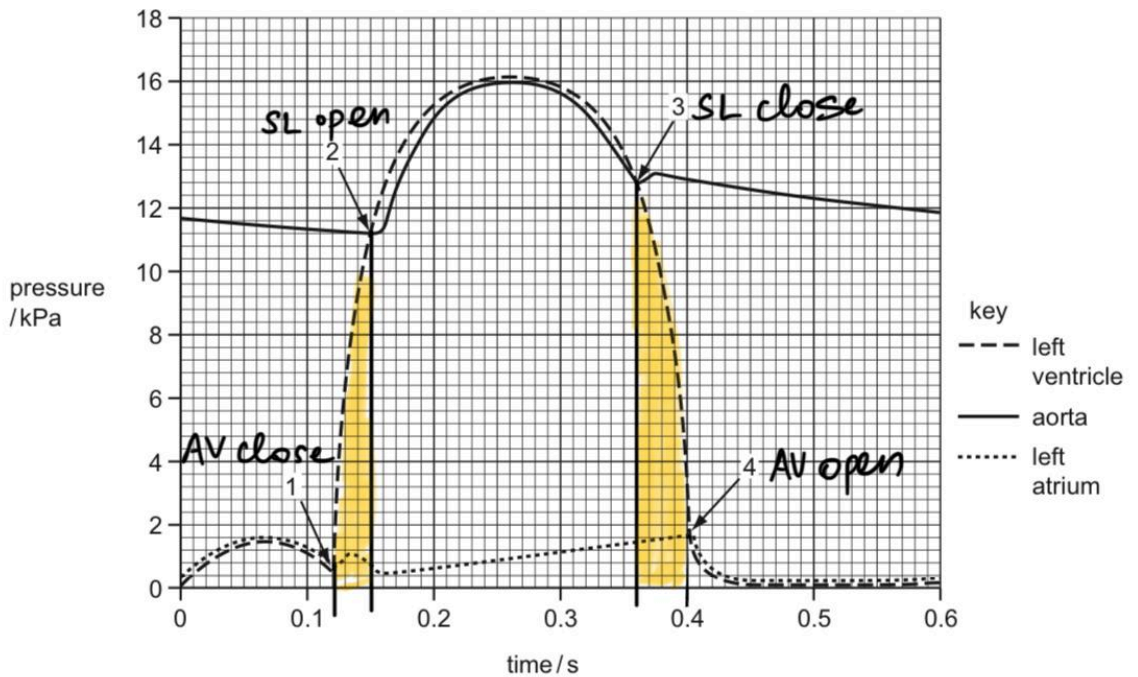
32 The diagram shows pressure changes in the left side of the heart and aorta over time. The length of this cardiac cycle is 0.6s. Points 1, 2, 3 and 4 indicate when atrioventricular valves and semilunar valves either open or close.



What is the total time during one cardiac cycle that the atrioventricular valves and the semilunar valves are both closed at the same time?

- A 0.03s B 0.04s C 0.07s D 0.21s

Ans: C



$$(0.15 - 0.12) + (0.4 - 0.36) = 0.07$$

8.

Which reactions take place in the capillaries surrounding an alveolus?

- 1 carbon dioxide + water \rightarrow carbonic acid
- 2 carbon dioxide + haemoglobin \rightarrow carbaminohaemoglobin
- 3 haemoglobinic acid \rightarrow haemoglobin + hydrogen ions
- 4 hydrogencarbonate ions + hydrogen ions \rightarrow carbonic acid \rightarrow carbon dioxide + water

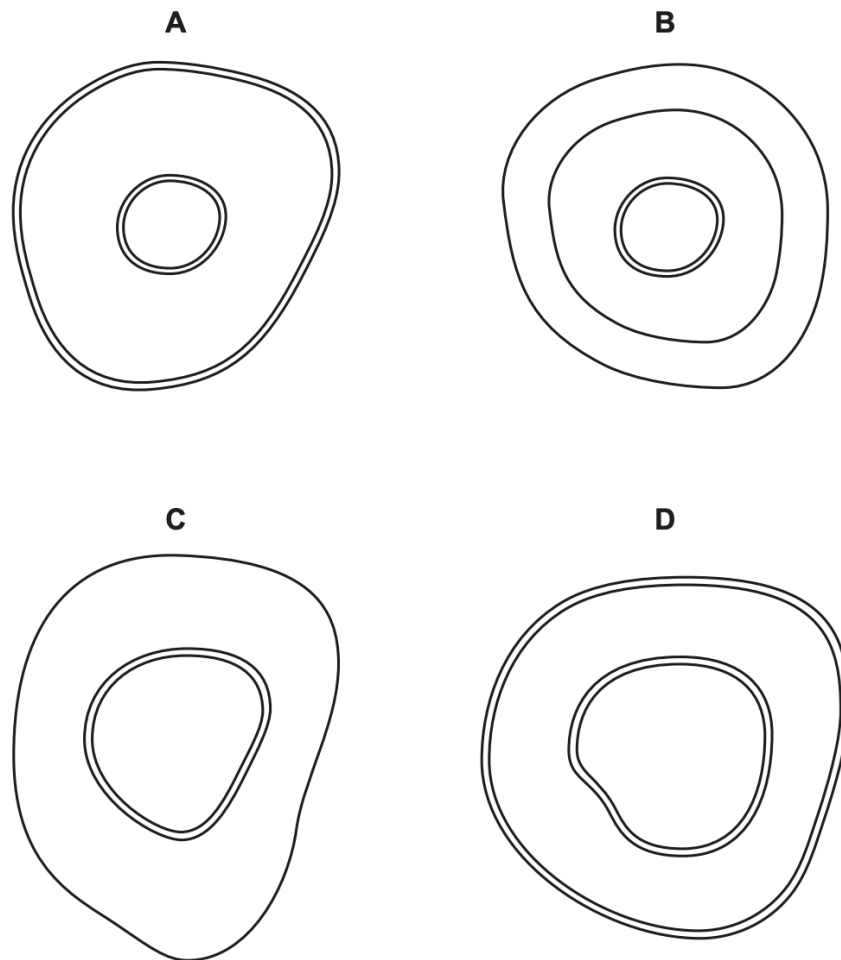
A 1 and 2 **B** 3 and 4 **C** 3 only **D** 4 only

Ans: B

- At the alveolus, carbon dioxide leaves the blood and oxygen enters the blood
- Reaction 1 and 2 occurs when carbon dioxide enters the blood at respiring tissues, so are wrong
- Reaction 3 occurs to increase affinity of haemoglobin to oxygen, so oxygen can bind with haemoglobin
- Reaction 4 produces carbon dioxide which can be excreted

9.

Which plan diagram represents the tissues in a major vein?

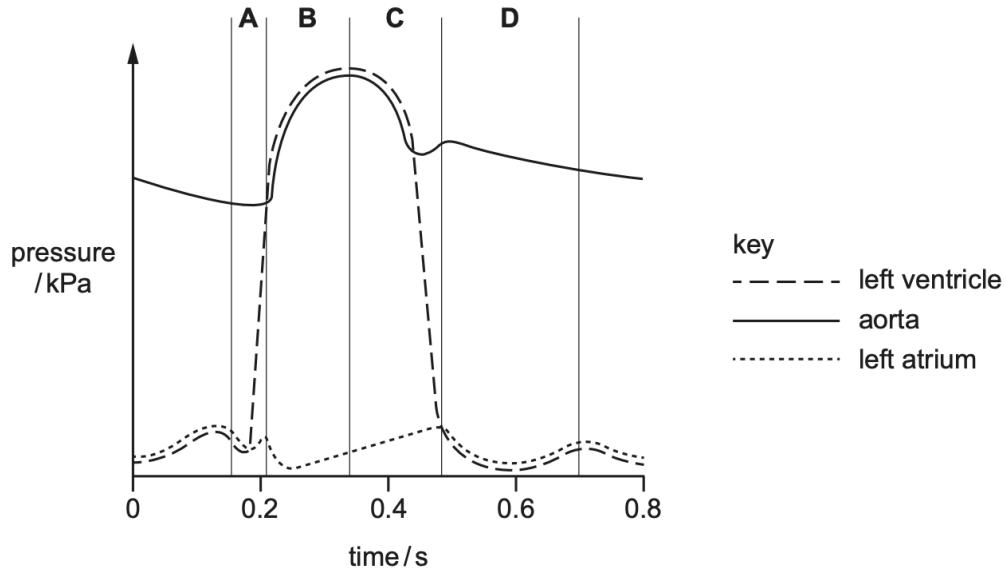


Ans: D

10.

The diagram shows the pressure changes in various structures of the left side of the heart during the cardiac cycle.

At the end of which period is the ventricle full of blood?



Ans: A

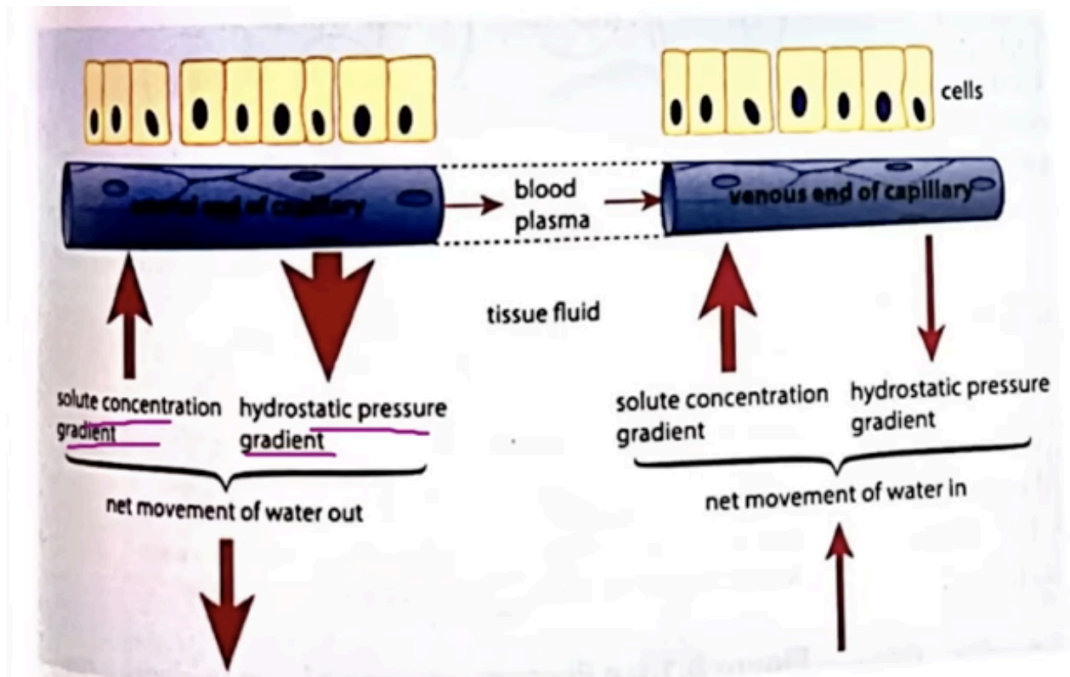
11.

Which description of movement of substances during tissue fluid formation is correct?

- A** Low hydrostatic pressure forces substances out of the capillary at the arterial end allowing small substances to enter the fluid that bathes the cells.
- B** Tissue fluid moves back into the venule due to a net hydrostatic pressure change in the capillary.
- C** Movement of water in tissue fluid into the capillary by osmosis is due to the low water potential and low hydrostatic pressure inside the capillary.
- D** A high water potential of the surrounding tissue fluid causes substances to leave the capillaries at the arterial end.

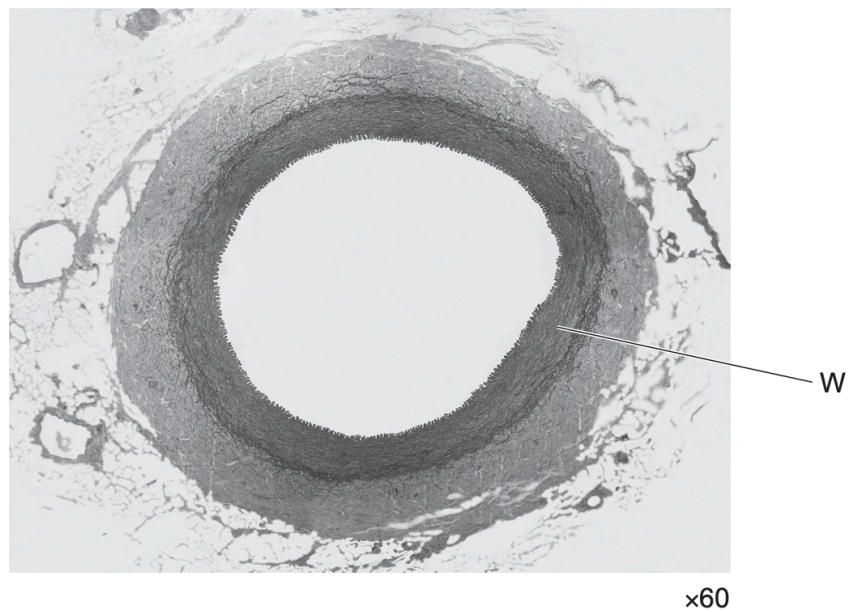
Ans:

- At the arterial end, substances out down the hydrostatic pressure gradient
- At the venous end, substances move in down the solute concentration gradient
- Thus water moves from tissue fluid back into capillary by osmosis due to low water potential and low hydrostatic pressure inside the capillary



12.

The photomicrograph shows a section through a structure found in mammals viewed using a light microscope.



What are the main components of layer W?

- A collagen fibres only
- B elastic fibres and collagen fibres
- C smooth muscle and elastic fibres
- D squamous epithelial cells forming an endothelium

Ans: C

- Not D since this is in capillaries, which are only one cell thick
- This structure has large lumen, hence it is a vein
- Tunica media of vein = smooth muscle & elastic fibres but NO collagen fibres

NOTE:

Arteries	Veins
Narrow lumen	Large lumen
Tunica interna/intima = endothelium = single layer of cells = squamous epithelium	Tunica interna/intima = endothelium = single layer of cells = squamous epithelium
Tunica media = smooth muscle + elastic fibres + collagen fibres	Tunica media = smooth muscle + elastic fibres
Tunica externa/adventitia = collagen fibres + some elastic fibres	Tunica externa/adventitia = collagen fibres

- Elastic arteries = nearest to the heart
- Muscular arteries = away from heart/ nearest to rest of the body/muscles

13.

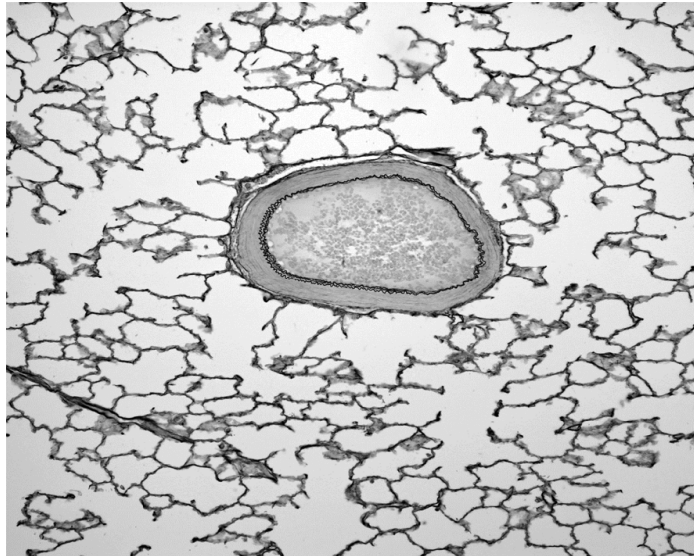
Which statement correctly links muscular or elastic arteries to their function?

- A** The aorta is an example of a muscular artery as it transports blood from the left ventricle of the heart.
- B** Arteries further away from the heart are muscular arteries as they transport blood at high pressure.
- C** Elastic arteries expand when the heart contracts and then recoil as the heart relaxes to maintain pressure.
- D** Muscular arteries facilitate smoother blood flow than elastic arteries as their walls expand and recoil.

Ans: C

14.

The photomicrograph shows a section through a tissue with an artery.



Which row correctly shows the type of artery and whether the blood inside the artery is oxygenated or deoxygenated?

	type of artery	blood
A	muscular	deoxygenated
B	muscular	oxygenated
C	elastic	deoxygenated
D	elastic	oxygenated

Ans: A

- The image shown is lung tissue, due to the alveoli surrounding it
- Thus the artery is pulmonary artery, which carries deoxygenated blood to the lungs
- Pulmonary artery is muscular!!

15.

Heart surgery may cause a decrease in the transmission of impulses in the Purkyne tissue to the right side of the heart.

What is a possible effect of this decrease?

- A** Impulses would be delayed by the atrioventricular node.
- B** The muscle of the right ventricle would contract slightly more slowly than the muscle of the left ventricle.
- C** The muscle of the right atrium would not contract as fully as the muscle of the left atrium.
- D** The sinoatrial node would transmit fewer impulses.

Ans: B

16.

Scientists have shown that the oxygen dissociation curves for haemoglobin of smaller mammals are to the right of those of larger mammals.

What does this suggest about the haemoglobin of smaller mammals?

- A** At low partial pressures of oxygen, it binds to oxygen more strongly than the haemoglobin of larger mammals.
- B** It saturates with oxygen at lower partial pressures of oxygen than the haemoglobin of larger mammals.
- C** It releases oxygen more easily than the haemoglobin of larger mammals.
- D** When the partial pressure of oxygen is high, it carries more oxygen than the haemoglobin of larger mammals.

Ans: C

17.

What are found in blood and tissue fluid?

- 1 carbon dioxide
- 2 fatty acids
- 3 white blood cells
- 4 proteins

- A** 1, 2, 3 and 4
- B** 1, 2 and 3 only
- C** 1, 2 and 4 only
- D** 3 and 4 only

Ans: A

18.

Which reactions would be slowed down by an inhibitor of carbonic anhydrase?

- 1 $\text{CO}_2 + \text{haemoglobin} \rightarrow \text{carbaminohaemoglobin}$
- 2 $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
- 3 $\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

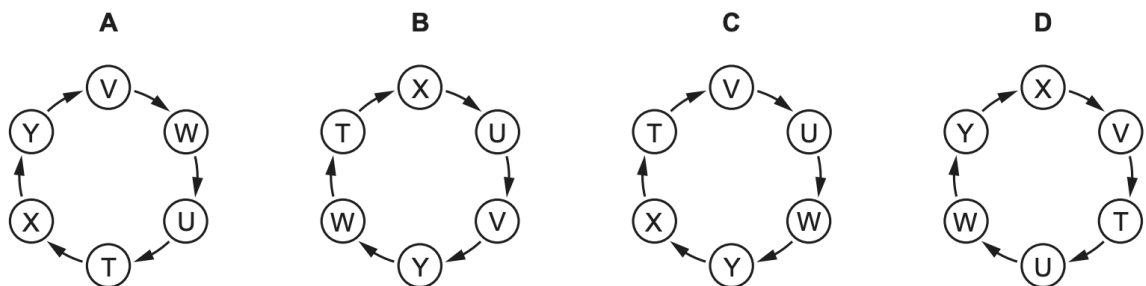
Ans: D

- If less H_2CO_3 produced, then rate of dissociation decreases

19.

32 Which sequence of letters correctly identifies the order of events during the cardiac cycle?

- T atrial walls contract
- U impulse is delayed by a fraction of a second
- V wave of excitation enters the atrioventricular node
- W wave of excitation passes down the Purkyne tissue
- X wave of excitation spreads from the sinoatrial node
- Y ventricles contract



Ans: C

- Sequence: X, T, V, U, W, Y

20.

Which property of water, related to its role in blood and tissue fluid, is correctly described?

- A** Water is a solvent for all biological molecules.
- B** Water is a solvent for most non-polar molecules.
- C** Water requires little energy to increase its temperature because it has a high specific heat capacity.
- D** Water cools down slowly because it has a high specific heat capacity.

Ans: D

21.

Oxyhaemoglobin, carbaminohaemoglobin, haemoglobinic acid and carbonic anhydrase are found inside red blood cells.

How many of these substances will show an overall decrease in concentration as a red blood cell passes through capillaries in the lungs?

- A** 1
- B** 2
- C** 3
- D** 4

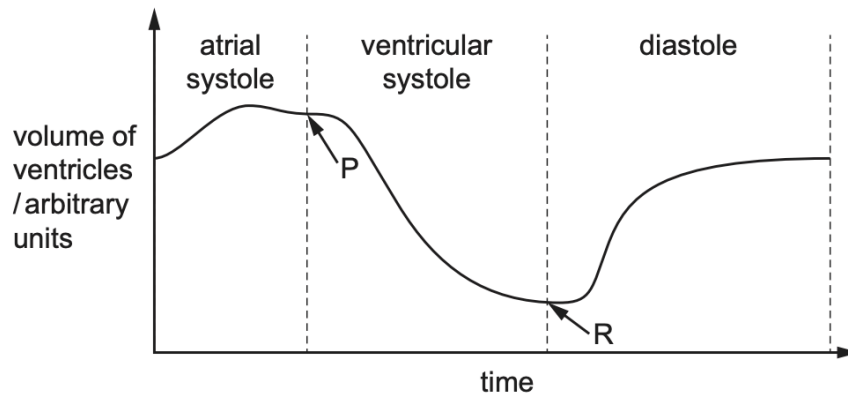
Ans: B

- Oxyhaemoglobin increases in concentration

- Carbaminohaemoglobin decreases in concentration
- Haemoglobinic acid decreases in concentration, to increase affinity of haemoglobin for oxygen
- Carbonic anhydrase concentration remains constant

22.

The graph shows changes in the volume of the ventricles during a single cardiac cycle.



Which row is correct for the atrioventricular valve at P and for the semilunar valve at R?

	atrioventricular valve at P	semilunar valve at R
A	closes	closes
B	closes	opens
C	opens	closes
D	opens	opens

Ans: A

23.

Which statement is correct about how oxygen combines with haemoglobin?

- A** Combining all four oxygen molecules with haemoglobin does **not** affect the shape of haemoglobin.
- B** One oxygen molecule can combine with each haem group of the haemoglobin molecule.
- C** The first oxygen molecule to combine with haemoglobin does **not** affect the shape of haemoglobin.
- D** The third oxygen molecule to combine with haemoglobin makes it more difficult for the fourth oxygen molecule to combine with haemoglobin.

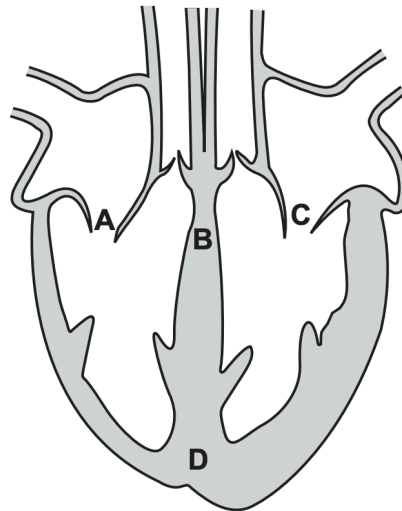
Ans: B

NOTE: as each oxygen molecule binds, the shape of haemoglobin is altered, making it easier for the next oxygen molecule to bind.

24.

The diagram shows the internal structure of the mammalian heart.

Which letter identifies the location of the atrioventricular node?



Ans: B

25.

Which components of blood are present in tissue fluid?

	phagocytes	some proteins	sodium ions
A	✓	✓	✓
B	✓	x	x
C	x	✓	✓
D	x	✓	x

key

✓ = present

x = not present

Ans: A

Components of tissue fluid

- water, amino acids, fatty acids, salts, sugars, hormones, coenzymes, white blood cells and metabolic waste products.

26.

In the lungs, movement of dissolved carbon dioxide out of the capillaries occurs in one of two ways:

- by diffusion through the endothelial cells of the capillaries
- by leakage through pores in the endothelial cells of the capillaries.

What is the **minimum** number of times that a carbon dioxide molecule that has been transported to the lungs in a red blood cell must cross a cell surface membrane to reach an air space in an alveolus?

A 2 **B** 3 **C** 4 **D** 5

Ans: B

NOTE:

When something passes across capillary / alveoli, it passes across 2 cell membranes. Remember to account for the membrane on either side of the cell.

27.

Which reactions will be taking place in blood in a capillary that is next to an alveolus?

- 1 $\text{Hb} + 4\text{O}_2 \rightarrow \text{HbO}_8$ key
- 2 $\text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}_2\text{CO}_3$ Hb = haemoglobin
- 3 $\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$

A 1 and 2 **B** 1 only **C** 2 and 3 **D** 2 only

Ans: B

28.

Some babies are born with a hole between the right and left atria. These babies are found to have an increased number of red blood cells.

What is the reason for this increase in red blood cells in these babies?

- A** Blood is pumped faster, which causes more blood to circulate in the heart.
- B** More blood is needed in the heart because the pressure is lower.
- C** Their haemoglobin has a higher affinity for oxygen.
- D** There is a lower oxygen concentration in the body of the newborn baby.

Ans: D

DOUBT!!

29.

An increase in carbon dioxide in human blood shifts the oxyhaemoglobin dissociation curve to the right.

What is the explanation for this effect?

- A** An increase in carbon dioxide concentration increases the breathing rate.
- B** Carbon dioxide is more soluble than oxygen and displaces it.
- C** Diffusion of carbon dioxide between the alveoli and the blood is more rapid.
- D** Increasing the H^+ concentration decreases haemoglobin affinity for oxygen.

Ans: D

30.

The pumping action of the heart creates hydrostatic pressure in the blood. The table shows the hydrostatic pressure in a blood capillary.

	arteriole end of capillary / KPa	venule end of capillary / KPa
hydrostatic pressure in blood	4.2	1.7

About 90% of the tissue fluid which surrounds a capillary is returned to the blood at the venule end.

How is this achieved?

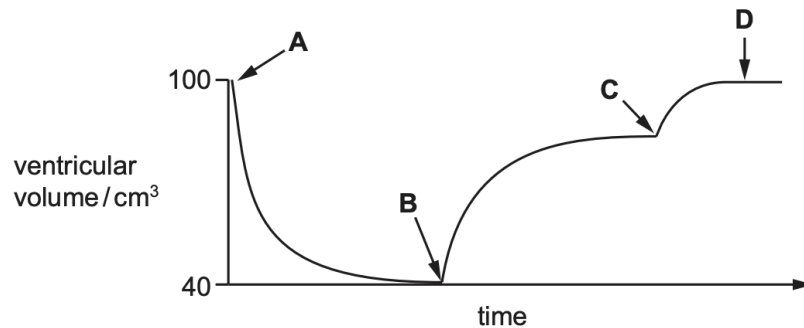
- A** The capillary wall is more permeable at the arteriole end than the venule end.
- B** The hydrostatic pressure in tissue fluid is higher than in blood.
- C** There is a higher concentration of dissolved solutes in tissue fluid than in blood.
- D** There is osmotic movement of water from the tissue fluid into the blood.

Ans: D

31.

The graph shows how the volume of the left ventricle changes during one cardiac cycle.

Which point on the graph represents the start of atrial systole?



Ans: C

- Ventricular systole at A → ventricular & atrial diastole at B → atrial systole at C

32.

Which row is correct for an artery?

	inner layer	middle layer	outer layer
A	smooth layer of endodermis cells	collagen, elastic fibres and smooth muscle	collagen only
B	smooth layer of endodermis cells	elastic fibres and smooth muscle only	collagen and elastic fibres
C	smooth layer of squamous cells	collagen, elastic fibres and smooth muscle	collagen and elastic fibres
D	smooth layer of squamous cells	elastic fibres and smooth muscle only	collagen only

Ans: C

NOTE: inner layer of artery = squamous endothelial cells NOT endodermis!!!

Blood vessel	Tunica interna	Tunica media	Tunica externa
Artery	Squamous endothelial cells	Collagen, elastic fibres, smooth muscle	Collagen, elastic fibres
Vein	Squamous endothelial cells	Elastic fibres, smooth muscle (but lesser than in arteries)	Mostly collagen, some elastic fibres

33.

What happens in the heart at the start of ventricular diastole?

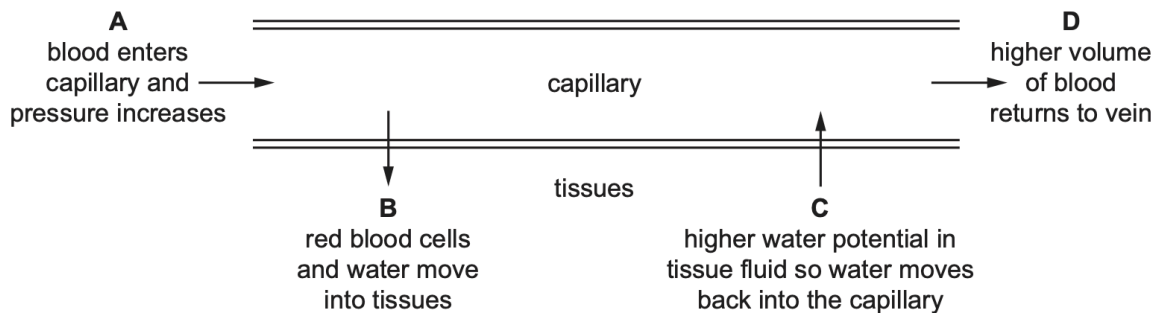
- A The semilunar valves open.
- B The atrioventricular valves open.
- C The pressure in the atria rises above the pressure in the ventricles.
- D The pressure in the left atrium rises more than the pressure in the right atrium.

Ans: B
DOUBT!!

34.

33 A student drew a sketch to show the formation of tissue fluid.

Which label is correct?



Ans: C

	AV valves	SL valves
Atrial Systole & Ventricular Diastole	Open (to allow blood to flow from atria to ventricles)	Closed (to prevent backflow into ventricles)
Ventricular Systole & Atrial Diastole	Closed (to prevent backflow into atria)	Open (to pump blood out of ventricles into arteries)
Overall Cardiac Diastole = Atrial + Ventricular Diastole	<u>Early diastole</u> : Closed (because ventricular pressure is still higher than atrial pressure) <u>Late diastole</u> : Open (as atrial pressure increases and allows blood flow into ventricles)	Closed throughout (to prevent backflow from arteries)

35.

Which properties of water are essential for its role in the transport of blood in mammals?

	high latent heat of vaporisation	solvent for polar substances
A	✓	x
B	x	✓
C	✓	✓
D	x	x

key

✓ = essential

x = not essential

Ans: B