TCOLC Sixth Form

Yr11 – 12 Transition Activities

Subject: A level Biology

THE HEART

THE CITY OF LEICESTER COLLEGE

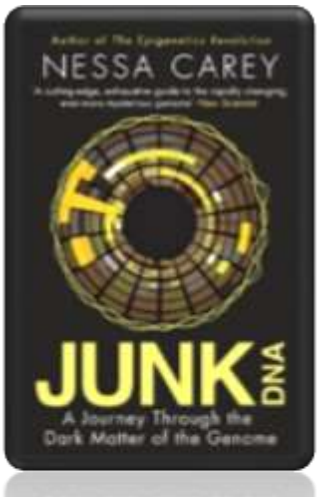
The Heart

What is included:

- Book recommendations
- Video recommendations – TED Ed and TED Talks
- Notes on the topic
- Video's to watch to aid subject knowledge
- **TASKS – 4 tasks (1 GCSE recap and 3 A level) – all must be completed**
- **A level exam questions (task 4) – these need to be printed and completed**

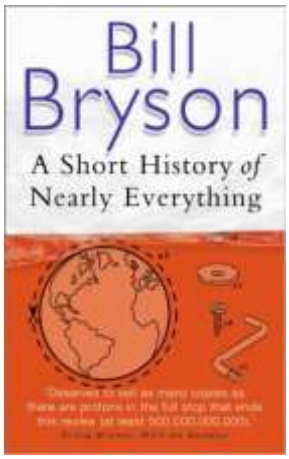
Book Recommendations

Kick back this summer with a good read. The books below are all popular science books and great for extending your understanding of Biology



Junk DNA

Our DNA is so much more complex than you probably realize, this book will really deepen your understanding of all the work you will do on Genetics. Available at amazon.co.uk



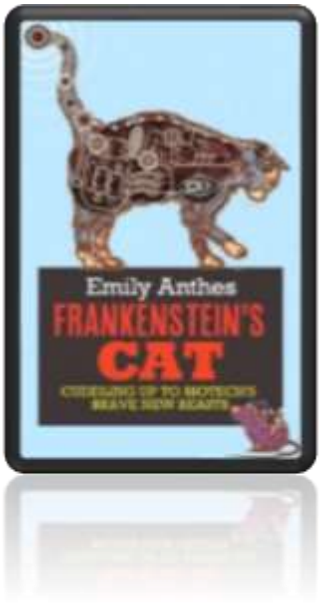
A Short History of Nearly Everything

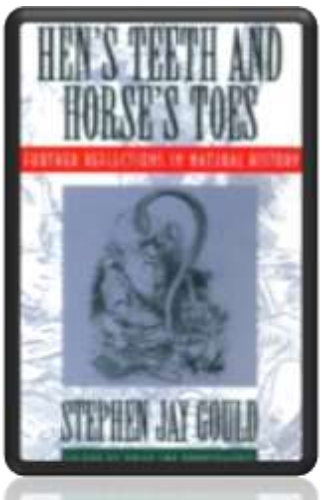
A whistle-stop tour through many aspects of history from the Big Bang to now. This is a really accessible read that will re-familiarise you with common concepts and introduce you to some of the more colourful characters from the history of science! Available at amazon.co.uk

An easy read..

Frankenstein's cat

Discover how glow in the dark fish are made and more great Biotechnology breakthroughs. Available at amazon.co.uk





Studying Geography as well?

Hen's teeth and horses toes

Stephen Jay Gould is a great Evolution writer and this book discusses lots of fascinating stories about Geology and evolution. Available at amazon.co.uk

Approximately seven million people around the world die from heart attacks every year. And cardiovascular disease, which causes heart attacks and other problems like strokes, is the world's leading killer. So what causes a heart attack? Krishna Sudhir examines the leading causes and treatments of this deadly disease.

https://ed.ted.com/lessons/what-happens-during-a-heart-attack-krishna-sudhir

If you lined up all the blood vessels in your body, they'd be 60 thousand miles long. And every day, they carry the equivalent of over two thousand gallons of blood to the body's tissues. What effect does this pressure have on the walls of the blood vessels? Wilfred Manzano gives the facts on blood

https://ed.ted.com/lessons/how-blood-pressure-works-wilfred-manzano

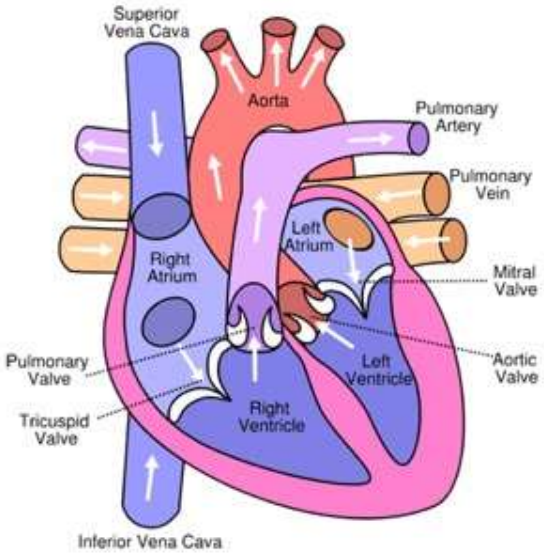
How I repaired my own heart

Tal Golesworthy is a boiler engineer -- he knows piping and plumbing. When he needed surgery to repair a life-threatening problem with his aorta, he mixed his engineering skills with his doctors' medical knowledge to design a better repair job.

Tal Golesworthy is an engineer and entrepreneur, working in research and development of combustion and air pollution control — until he decided to innovate in his own health.

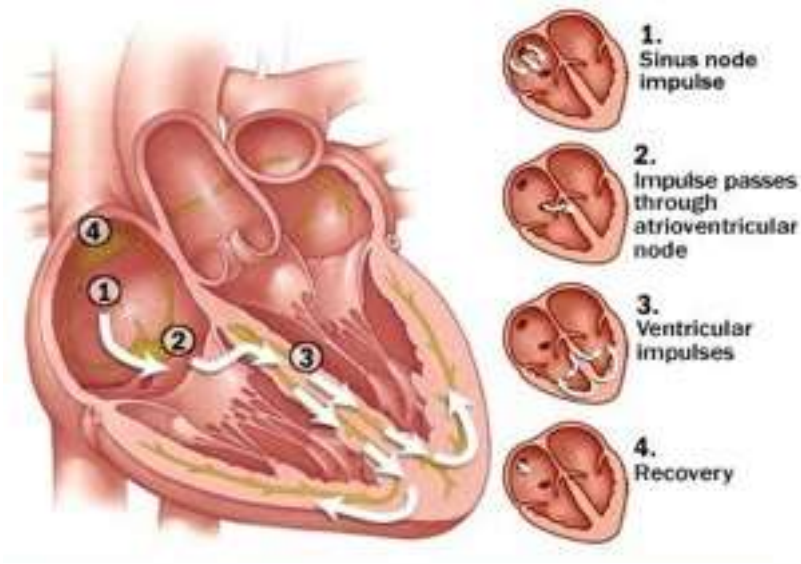
Summary Notes

- The heart is a hollow muscular organ that lies in the middle of the chest cavity. It is enclosed in the pericardium, which protects the heart and facilitates its pumping action.
- The heart is divided into four chambers:
    - The two atria (auricles): these are the upper two chambers. They have thin walls which receive blood from veins.
    - The two ventricles: these are the lower two chambers. They have thick, muscular walls which pump blood through the arteries.
- The heart is divided longitudinally into two sides by means of muscular walls.
- Each atrium is connected to its own ventricle through an opening which is guarded by a valve. Blood is permitted to flow only from the atrium into the ventricle, not in the reverse direction. The right valve (the tricuspid valve) is made up of three flaps. The left valve (the bicuspid valve or the mitral valve) has two flaps.
- The semi-lunar valve can be found where the heart connects with both the aorta and pulmonary artery.



Heart beats

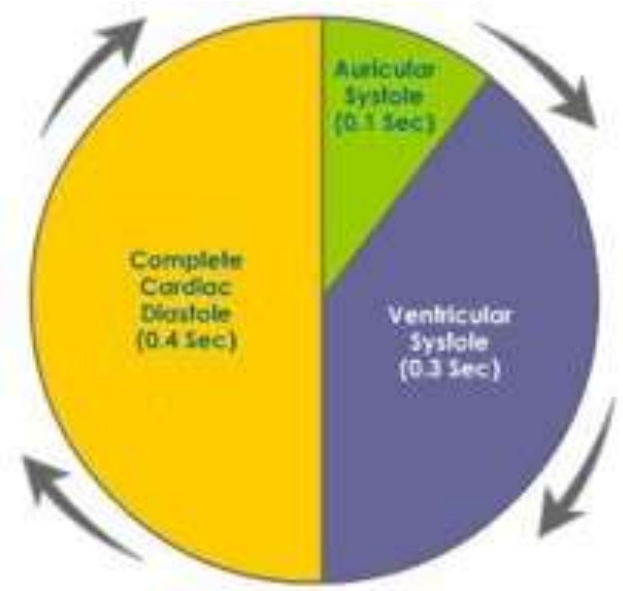
- The rhythmic heart beats are actually spontaneous, as they originate from the cardiac tissue itself. It has been proven that the heart continues beating regularly even after it has been disconnected from the body and the cardiac nerves.
- The sino-atrial node (the pace maker) is a specialized bundle of thin, cardiac, muscular fibers buried in the right atrial wall, near the connection between the right auricle and the large veins
- The sino-atrial node sends impulses over the two atria which are then stimulated to contract. When the electrical impulses reach the atrioventricular node (at the junction between the atria and the ventricles), the impulses will spread rapidly through special fibers from the inter-ventricular septum to the walls of both ventricles, where the muscles are stimulated to contract.
- The sino-atrial node beats at a regular rate of 70 beats/minute. It is connected to two nerves: the vagus nerve which lowers the heart rate during sleep and in states of grief, and the sympathetic nerve which accelerates the heart rate after waking up and in states of joy. Heart rate also increases with severe physical effort. The number of cardiac beats per minute changes according to the physical and psychological state of the body.
- We can distinguish two sounds in the heartbeat: the long and low-pitched ‘lubb’, which is due to closure of the two valves between the atria and the ventricles during ventricular contraction, and the shorter and high-pitched ‘dupp’, which is due to the closure of the aortic and pulmonary valves during ventricular relaxation.

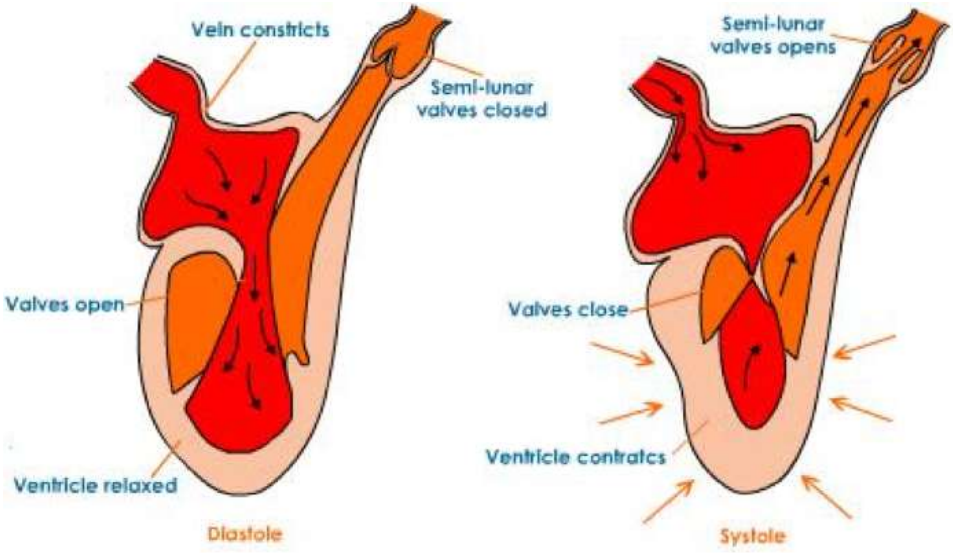


Phases of the Cardiac Cycle

- The heart has an increasing rhythmic activity. It pumps blood through the process of contraction and relaxation. The contraction of the heart is called ‘systole’ and the relaxation is called ‘diastole’. The contraction and relaxation together constitute the heartbeat. The heart beats at an average rate of 70 beats per minute. The changes that occur in the heart during a beat are repeated in the same order in the next beat, and the next one. This cyclical repetition is called the cardiac cycle. During the cardiac cycle, blood flows through the cardiac chambers in a specific manner and direction, the backward flow being prevented by the valves. There are the main events in the cardiac cycle, namely:

1. The auricular systole.
2. The ventricular systole.
3. The joint diastole.



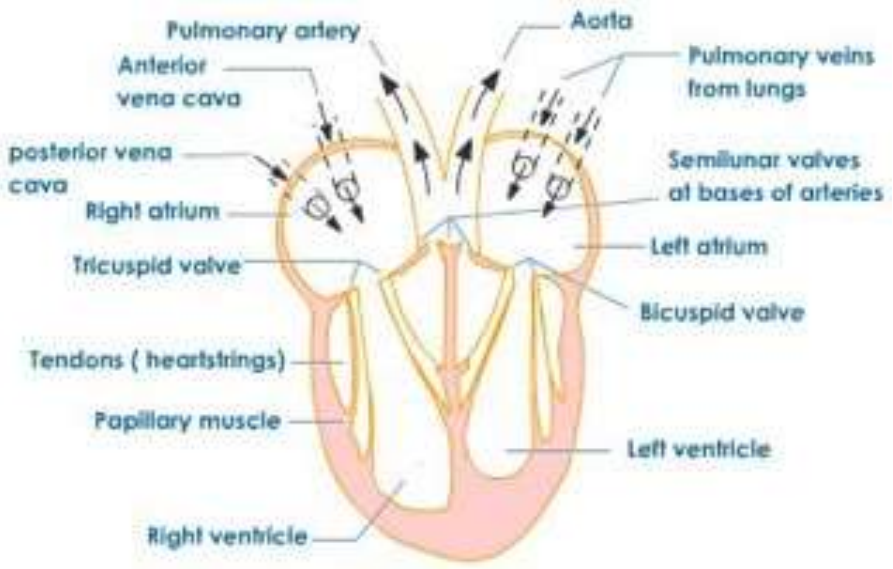


Auricular Systole (Atrial Systole)

- This phase involves the contraction of the two auricles, pushing the blood into the respective ventricles. There is no backflow of blood due to the presence of the bicuspid and the tricuspid valves. The atrial systole takes 0.1 seconds. This is followed by the atrial diastole, whre both the auricles relax simultaneously. This takes about 0.7 seconds.

Ventricular Systole

- This takes place alongside auricular diastole. The pressure on the blood in the ventricles increases and the auriculo ventricular valves close rapidly to prevent the backward flow of blood into the auricles. This closing of the auriculo ventricular valves at the start of ventricular systole produces the first heart sound, called lubb.
- As the pressure in the ventricle increases, (and becomes greater than that of the pulmonary artery and the aorta), the semilunar valves guarding the openings of these arteries open, and blood enters them. From the right ventricle, the deoxygenated blood enters the pulmonary artery. From the left ventricle, the oxygenated blood enters the dorsal aorta, to be taken to other body parts. Ventricular systole takes about 0.3 seconds.

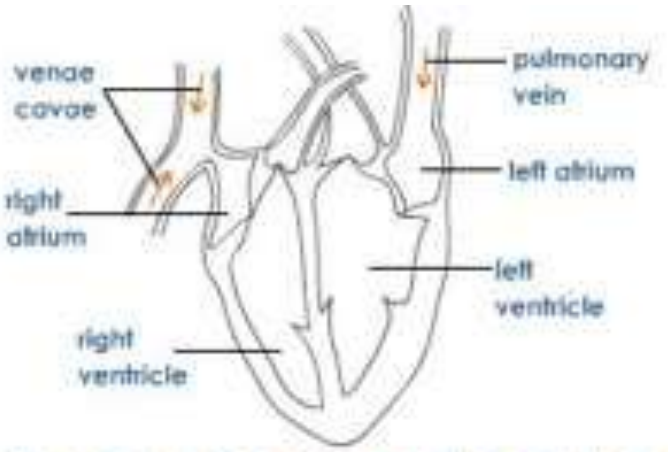


Joint Diastole

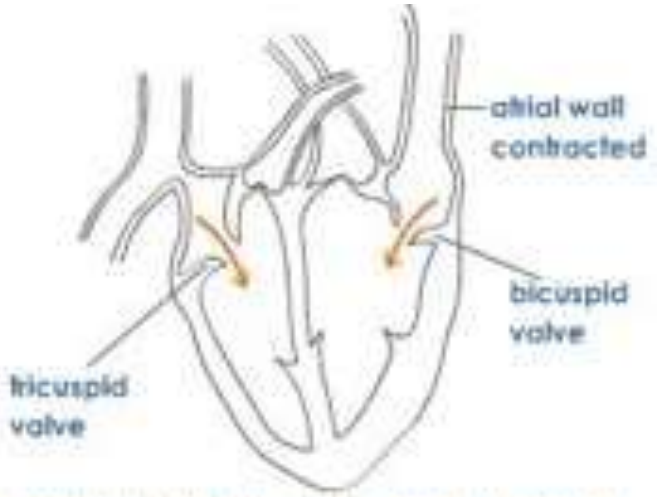
- Ventricular systole is followed by ventricular diastole. The auricles are already in diastole, so all the chambers of the heart are in diastole. When the ventricles are in diastole, the pressure in the ventricles decreases compared to the pressure in the great arteries. So, to prevent the backward

flow of blood, the semilunar valves close rapidly. This produces the second heart sound, called dupp.

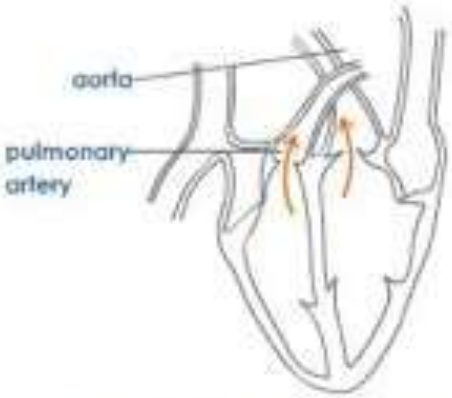
- During a complete cardiac diastole, blood from the superior and inferior vena cava slowly flows into the auricles. The pressure in the ventricles then decreases and eventually becomes lower than the atrial pressure. The AV (auriculo-ventricular) valves then open, and blood from the atria starts entering into the relaxing ventricles. A complete cardiac diastole takes only 0.4 seconds.
- An entire cardiac cycle is completed in 0.8 seconds.



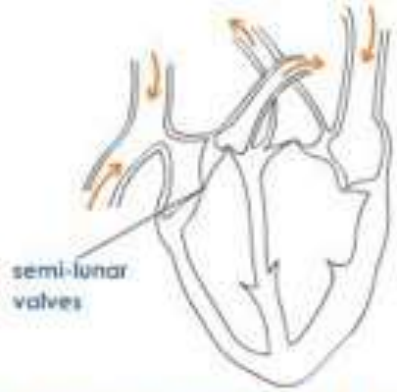
a) Atria in state of diastole, and filling with blood



b) Atrial systole forces blood into ventricles. Bicuspid and tricuspid valves open



c) Atria relax, ventricles contract (systole). Blood propelled into aorta and pulmonary artery



d) Semi-lunar valves of aorta and pulmonary artery close. Atria begin to refill. Ventricles in state of diastole.

----------END OF NOTES ----------

Tasks

Circulatory system of a mammal

Mammals have a closed, double circulatory system in which blood is confined to vessels and passes twice through the heart for each complete circuit of the body. This is because when blood passes through the lungs, its pressure is reduced. If it were to pass immediately to the rest of the body, its low pressure would make circulation very slow. Blood is therefore returned to the heart to boost its pressure before being circulated to the rest of the tissues.

Task 1-GCSE RECAP

Visit the site below and read **pages 1-6** making notes on key points

https://www.bbc.co.uk/bitesize/guides/zhnk7ty/revision/1

Then take the **TEST**

Task 2

Compare and contrast the 3 main types of blood vessels; arteries, veins and capillaries.

Make a poster/factsheet

Include how they differ in structure and function

EXTENTION relate the structure of each blood vessel to its function

Task 3

- Read through notes section above and highlight key points
- Watch the following videos

How heartbeats are initiated https://www.youtube.com/watch?v=xa1378-Aqp4

Structure of the heart https://www.youtube.com/watch?v=ruM4Xxhx32U

The mammalian heart and the cardiac cycle **https://www.youtube.com/watch?v=p8Jj-n5KdjM**

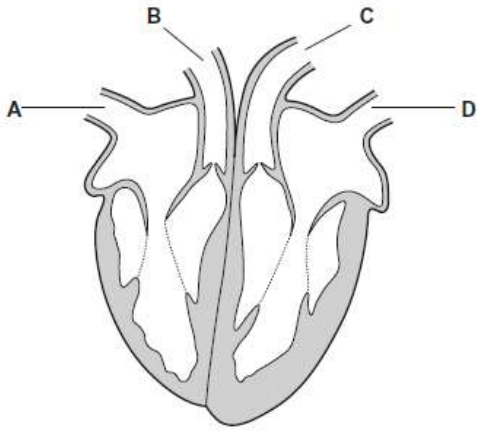
Task 4 – Application

Complete the exam questions below.

***Print them off and answer on the lines provided. These will need to be handed in on your return to school, in order to marked

TASK 4 Exam Questions (Application)

Q1. The diagram shows a section through the heart. The main blood vessels are labelled **A**, **B**, **C** and **D**.



(a) Write a letter, **A**, **B**, **C** or **D**, in the box to represent the correct blood vessel.

(i) Which blood vessel carries oxygenated blood away from the heart?

☐

(1)

(ii) Which blood vessel carries deoxygenated blood to the heart?

☐

(1)

(b) Explain how the highest blood pressure is produced in the left ventricle.

_____

_____

_____

(1)

(c) Some babies are born with a hole between the right and the left ventricles.

These babies are unable to get enough oxygen to their tissues.
Suggest why.

_____

_____

_____

_____

_____

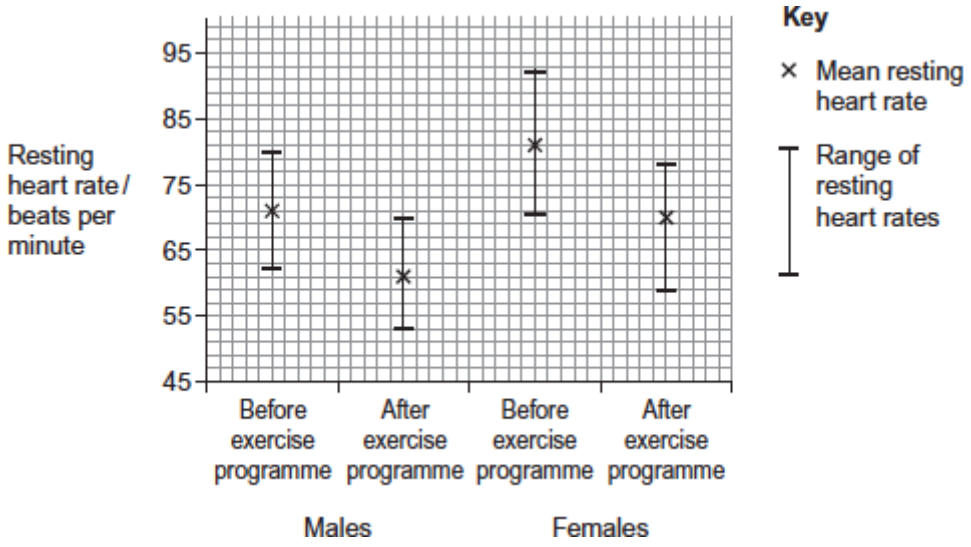
(2)

(Total 5 marks)

Q2. Scientists investigated the effect of a 6-week exercise programme on the resting heart rate of males and females.

The scientists recruited a large group of male volunteers and a large group of female volunteers. They measured the resting heart rate of each volunteer before the exercise programme. Both groups took part in the same exercise programme. The scientists measured the resting heart rate of each volunteer after the exercise programme.

The scientists determined the mean resting heart rate and the range of resting heart rates for each group before and after the exercise programme. The graph shows their results.



(a) What was the range of the resting heart rates in males after the exercise programme?

_____

(1)

(b) Calculate the percentage decrease in the mean resting heart rate of females after the exercise programme. Show your working.

Answer = _____ %

(2)

(c) The scientists used the percentage change in the mean resting heart rate after the exercise programme to compare the results for males and females.

Explain why they used percentage change in the resting heart rate.

_____

_____

_____

(2)

(d) The scientists calculated the cardiac output of the volunteers before and after the exercise programme. In some volunteers, their cardiac output stayed the same, even though their resting heart rate decreased.

Explain how their cardiac output could stay the same even when their resting heart rate had decreased.

(2)

(Total 7 marks)

Q3.

(a) Describe how a heartbeat is initiated and coordinated.

(5)

(b) Explain how the heart muscle and the heart valves maintain a one-way flow of blood from the left atrium to the aorta.

_____

_____

_____

_____

_____

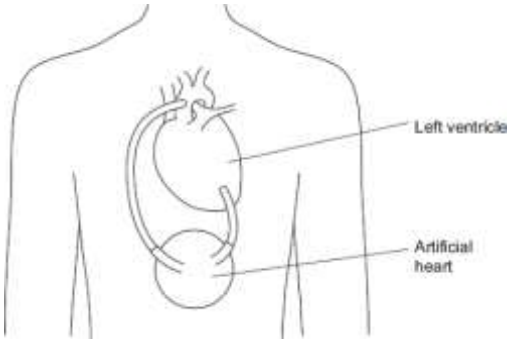
(5)

(Total 10 marks)

Q4.

Some people have a form of *heart failure* where their heart is not pumping blood as well as it used to. Some people with heart failure are given an artificial heart to improve circulation of blood from the left ventricle.
Figure 1 shows where this type of artificial heart is connected.

Figure 1



(a) Name the blood vessel to which the artificial heart is connected.

_____

(1)

(b) In these patients, the right ventricle still produces sufficient blood flow to keep the patient alive.

Suggest why the left ventricle requires the help of the artificial heart but the right ventricle does not.

_____

_____

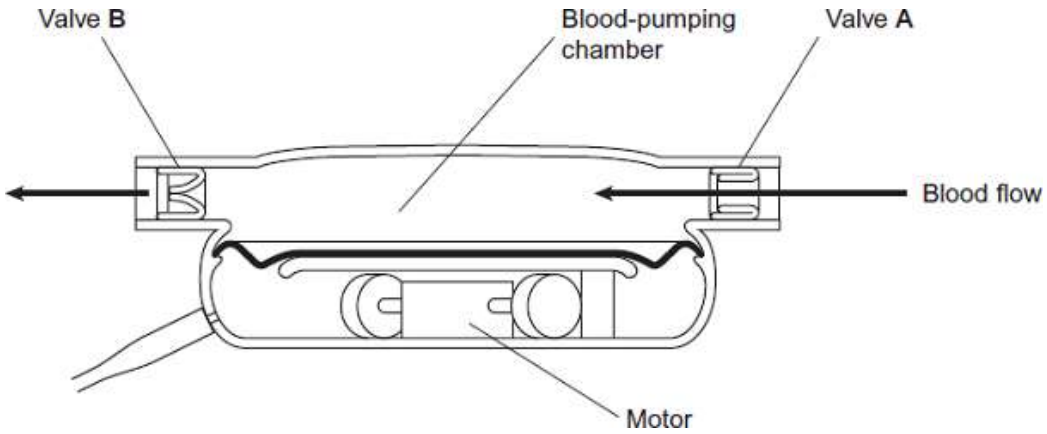
_____

_____

_____

(2)

(c) **Figure 2** shows the internal structure of this type of artificial heart.



Valves **A** and **B** have the same functions as heart valves involved in the cardiac cycle. Name the heart valve that has the same function as:

valve **A** _____

valve **B** _____

(2)

(d) There are different designs of artificial heart. Doctors compared results for patients who received two different types of artificial heart, **X** and **Y.**

They recorded information 2 years after the artificial hearts were implanted. Their results are **shown in Figure 3**.

Figure 3

	Information recorded 2 years after artificial heart implanted		
Type of artificial heart	**Number of patients surviving without replacement of artificial heart**	**Number of patients surviving but who required repair or replacement of artificial heart**	**Number of patients who died**
X (119 patients)	62	13	44
Y (58 patients)	7	24	27

Which type of artificial heart was the more successful? Use calculations to support your answer.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q5.

(a) What is the function of the coronary arteries?

_____

_____

_____

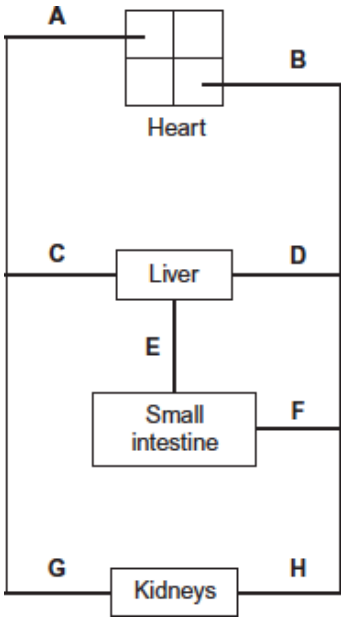
_____

_____

(2)

(b) **Figure 1** shows some of the large blood vessels in a mammal.

Figure 1



(i) Which of the blood vessels **A** to **H** is the vena cava?

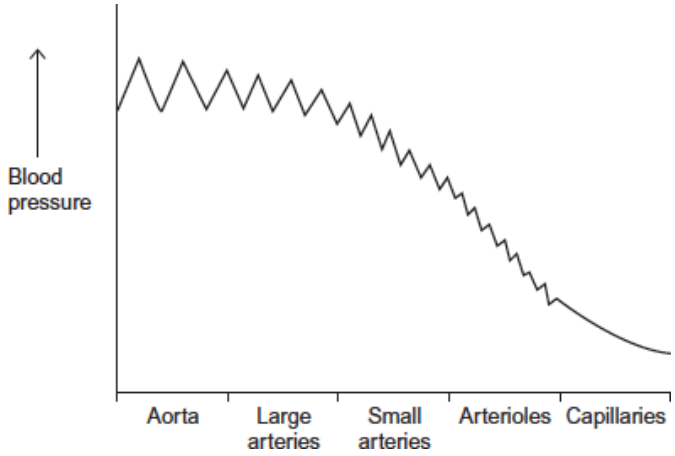
(1)

(ii) Which of the blood vessels **A** to **H** is the renal artery?

(1)

(c) **Figure 2** shows how the blood pressure changes as blood travels from the aorta to the capillaries.

Figure 2



The rise and fall in blood pressure in the aorta is greater than in the small arteries.Suggest why.

_____

_____

_____

_____

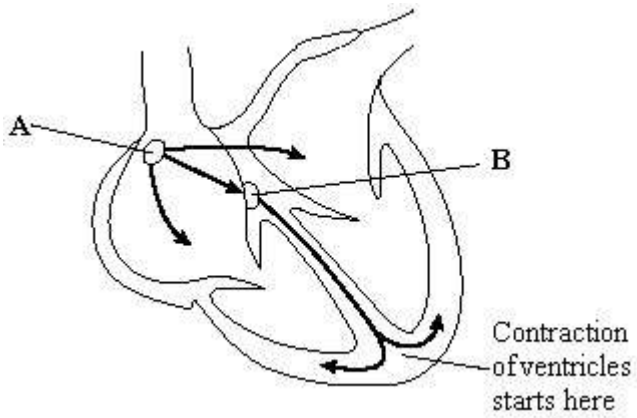
_____

_____

(3)

(Total 7 marks)

Q6. The diagram shows the pathways in the heart for the conduction of electrical impulses during the cardiac cycle.



(a) The table shows the blood pressure in the left atrium, the left ventricle and the aorta at different times during part of a cardiac cycle.

	Blood pressure / kPa		
Time / s	**Left atrium**	**Left ventricle**	**Aorta**
0.0	0.5	0.4	10.6
0.1	1.2	0.7	10.6

0.2	0.3	6.7	10.6
0.3	0.4	17.3	16.0
0.4	0.8	8.0	12.0

(i) At which time is blood flowing into the aorta?

_____

(1)

(ii) Between which times are the atrioventricular valves closed?

_____

(1)

(b) The maximum pressure in the left ventricle is higher than the maximum pressure in the right ventricle. What causes this difference in pressure?

_____

_____

(1)

(c) The information below compares some features of different blood vessels.

		Blood vessel		
		Artery	**Capillary**	**Vain**
Property	Mean diameter of vessel	4.0 mm	8.0 μm	5.0 mm
	Mean thickness of wall	1.0 mm	0.5 μm	0.5 mm
		Relative thickness (shown by length of bar)		
Tissues present in wall	Endothelium			
	Elastic tissue			
	Muscle			

Use the information to explain how the structures of the walls of arteries, veins and capillaries are related to their functions.

_____

(6)

(Total 9 marks)