Lesson 1 - The blood

Reading

Blood has four main components: red blood cells, white blood cells, platelets all of which are carried in a fluid called plasma. Within the plasma dissolved substances like glucose (plus other products of digestion, urea and carbon dioxide will also be carried.

Red blood cells carry the oxygen from the air in our lungs to our respiring cells. Red blood cells have certain adaptations that make them efficient at their job. They are biconcave disks which increases their surface area to volume ratio which increase diffusion. They are packed with haemoglobin which binds to oxygen. They also have no nucleus which makes space for more haemoglobin.

White blood cells form part of the immune system. Some white blood cells (lymphocytes) produce antibodies whilst others produce antitoxins and yet others (phagocytes) engulf and digest invading microorganisms.

Platelets are small fragments of cells without a nucleus. They are involved in the clotting of blood. Blood clotting is a series of enxyme controlled reactions that results in the conversion of fibrinogen into fibrin. This forms a network of fibres that traps more platelets and red blood cells forming a scan which protects the new skin as it grows.

Comprehension

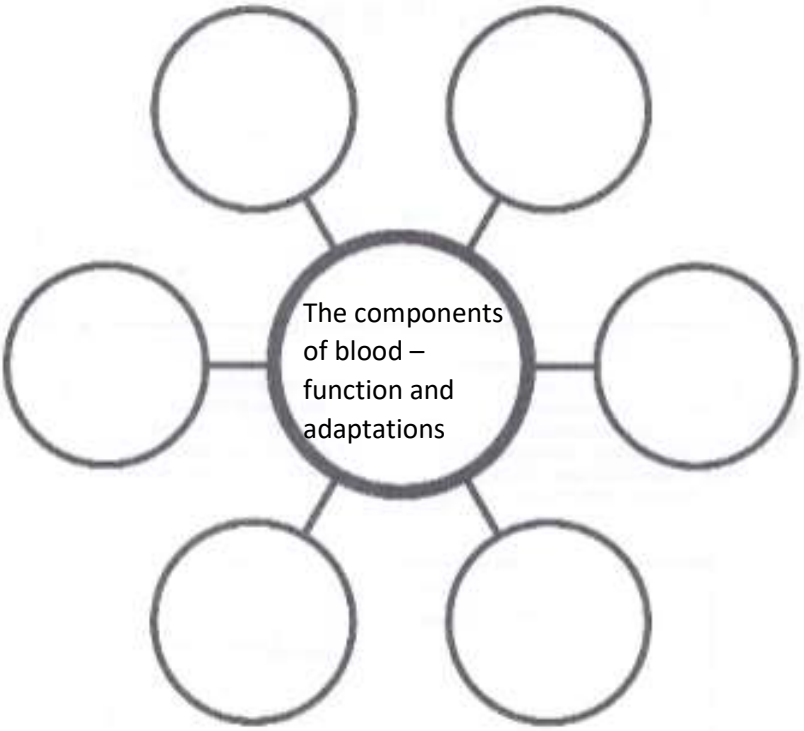
1. **What is blood made up of?**
2. **Name 5 things found in plasma**
3. **What is the job of red blood cells?**
4. **What is the job of haemoglobin?**
5. **State two adaptations of red blood cells**
6. **Explain how being biconcave is useful**
7. **How can white blood cells protect us against infection?**
8. **What type of cell contains 0 chromosomes?**
9. **How do platelets form scabs?**

Task 4: Sophisticated sentences (Complete graphic organiser on next page first)

Using your graphic knowledge organiser and the key words below create a set of sophisticated sentences about the stomach.

Key words to use: The function of X is to, X allows, X's role is, If X were to stop working, Example – Needs to be completed by student
The function of the red blood cell is…., platelets role is….
If white blood cells were to stop working

Graphic organiser – The components of blood



Extended response questions

1. Discuss the main ways in which the blood helps you avoid infection. Include a description of the parts of the blood involved.

Lesson 2 – The blood vessels

Reading

Blood is carried round our body in three main types of vessel. Each vessel is adapted for a different function.

Arteries carry blood away from the heart to the organs or body. The blood is usually oxygenated with the exception of the pulmonary artery. Blood in the arteries is under high pressure. Arteries have a thick layer of muscle and elastic fibres along with thick walls to allow them to withstand the high pressure and to stretch. Arteries have a small lumen.

Veins carry blood away from organs towards the heart. The blood is low in oxygen , except for the pulmonary vein. veins have a larger lumen and relatively thin walls. This is because the blood is under less pressure. Veins have valves to prevent blood flowing backwards.

Capillaries connect arteries to veins. Capillaries are very narrow with thin walls. This ensures there is a short diffusion distance the inside of the capillary and surrounding cells. This enables substances such as glucose and oxygen to easily diffuse out of your blood into cells. Conversely carbon dioxide can easily do the opposite. Cappilaries have very narrow lumens which only allow 1 cell to pass through at a time and their walls are only 1 cell thick.

Humans have a double circulation system. One transport system carries blood from your heart to the lungs and back again and the other system carries blood from the heart to all other organs of your body and back again. This double circulation system is advantageous to us as we need lots of oxygen and glucose transported round our body. The double circulation system allows lots of oxygenated blood to be transported quickly where it needs to go

Comprehension

1. What are the three types of blood vessel?
2. What type of blood vessel carries blood away from the heart
3. Why do the arteries have a thick layer of elastic fibres and muscle tissue?
4. What is the pressure like inside the arteries?
5. What do veins have that prevent back flow?
6. How is the pulmonary vein different to other veins?
7. Order the blood vessels from largest lumen to smallest lumen
8. What is the benefit of the walls of capillaries only being 1 cell thick
9. Why is our circulation system described as a double circulation system?
10. What diffuses from the capillaries into cells?

<u>Sophisticated sentences</u>

Using your graphic knowledge organiser and the key words below create a set of sophisticated sentences about blood vessels.

Key words to use: While, whereas, similarly, contrastingly, in much the same way

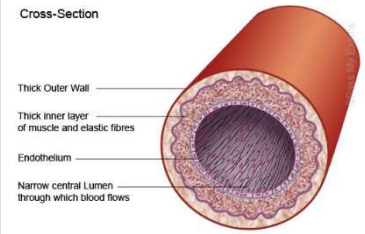
Example – Needs to be completed by student

The walls of the artery… whereas…. .
Oxygenated blood is found mainly in… contrastingly….
Now create your own ☺

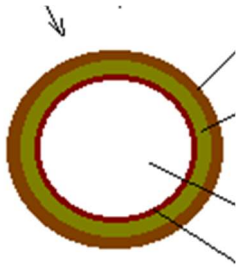
Differences

Similarities

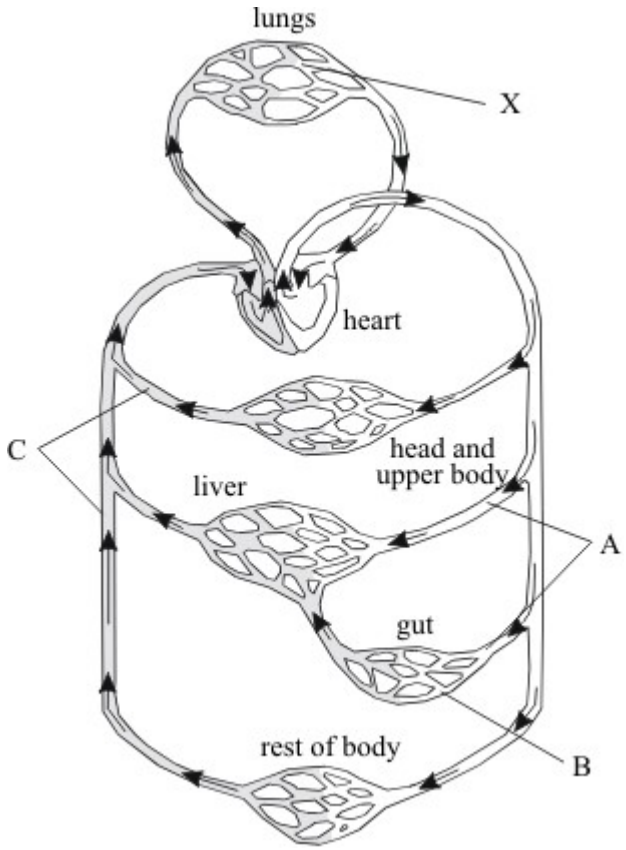
Differences



Artery



Vein



(1a) Name the types of blood vessel labelled A, B and C on the diagram.

A _____

B _____

C _____

(3)

(b) What is the job of the circulatory system?

_____

_____

(1)

(c) Give **two** ways in which the composition of blood changes as it flows through the vessels labelled X on the diagram.

1. _____

_____

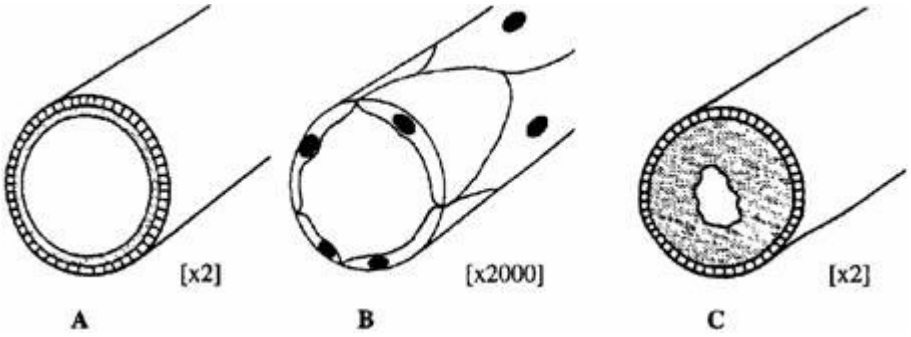
2. _____

_____

(2)

(Total 6 marks)

2.The drawings show the structure of three types of blood vessel, **A**, **B** and **C**. They are drawn to the scales indicated.



(a) Name the **three** types of blood vessel.

A _____

B _____

C _____

(3)

(b) Describe the job of blood vessel **B**.

_____

_____

_____

_____

(2)

(Total 5 marks)

Mark scheme

(a) A – artery
B – capillary
C – vein

3

(b) transport OWTTE

1

(c) increased oxygen decreased carbon dioxide

2

[6]

(a) A vein / venule
B capillary
C artery / arteriole

each for 1 mark

3

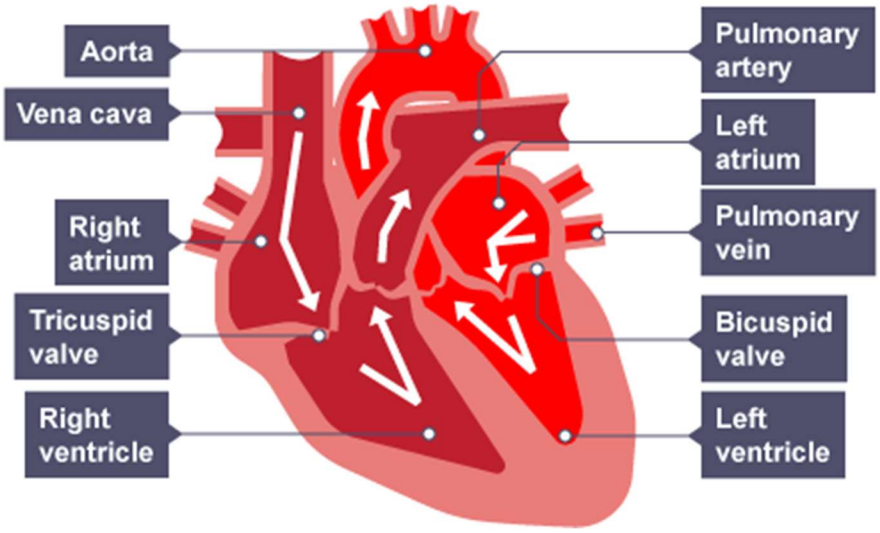
(b) *idea that* substances or named substance pass in or out / diffuses between blood and tissue

each for 1 mark
e.g. oxygen passes from blood to cells gains 2 marks

2

Lesson 3 – The heart

Your heart is the organ that pumps blood round our body. It is made up of two pumps. The walls of your heart are almost entirely muscle and the blood vessel that supplies the heart with oxygen is called the coronary artery.

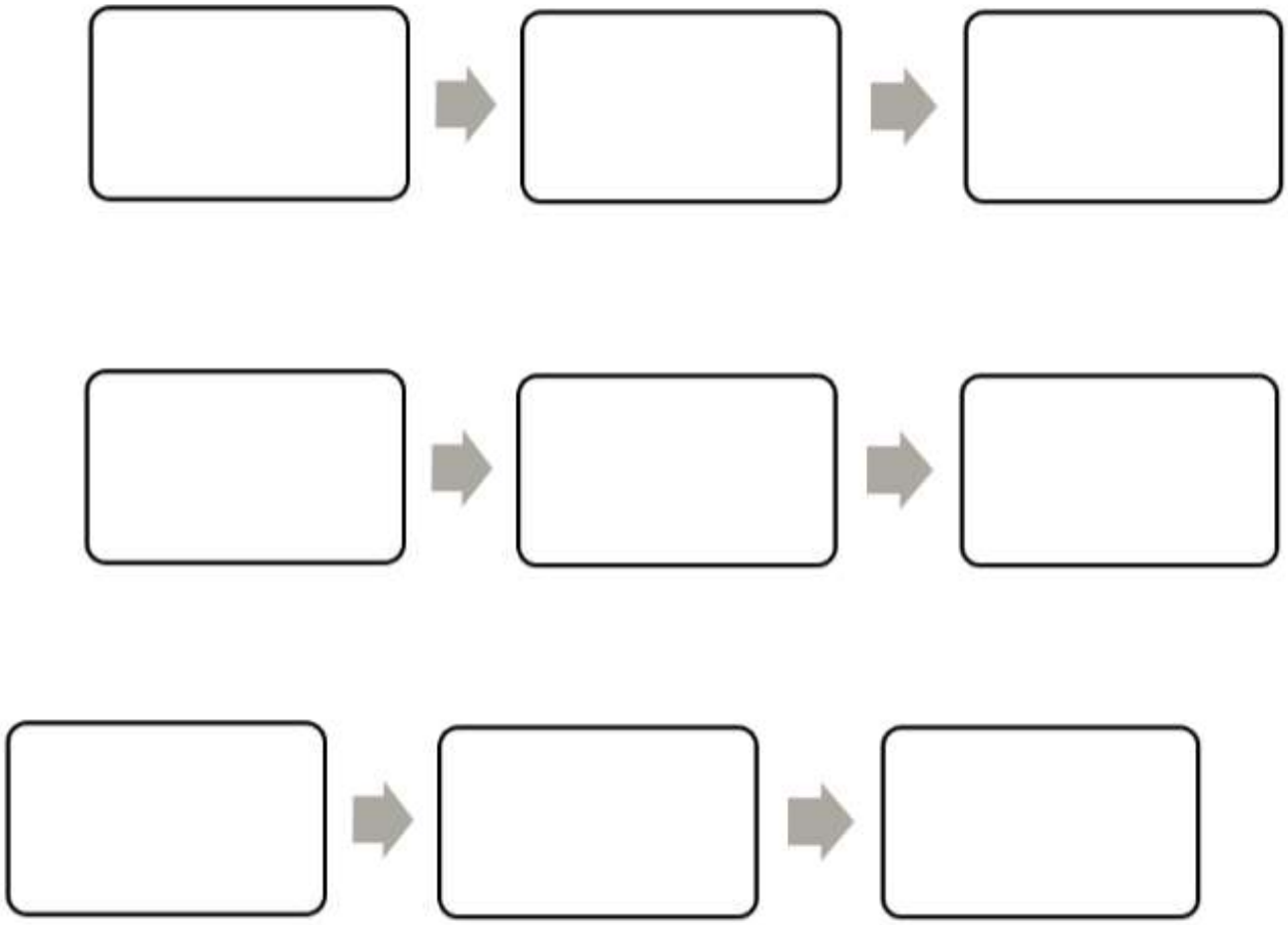


Blood enters the right atrium through the vena cava (a vein that brings deoxygenated blood back to the heart). Blood will then travel from the right atrium to the right ventricle. The tricuspid valve will then close to prevent backflow. When the right ventricle contracts deoxygenated blood is forced into the pulmonary artery which travels to the lungs to pick up oxygen. This newly oxygenated blood is returned to the heart by the pulmonary vein into the left atrium. Blood flows into the left ventricle, the bicuspid valve closes to prevent backflow. The left ventricle pumps oxygenated blood around the body via the aorta. Whenever blood enters the aorta or pulmonary artery valves at the beginning of these vessels close. The muscle wall of the left ventricle is thicker than elsewhere. This allows the blood leaving the left ventricle to be under the high pressure needed to pump it round the body.

Coronary heart disease is caused by the narrowing the coronary arteries that supply the heart. This is caused by a build-up of fatty material on the lining of the vessels which reduces the supply of oxygen to the heart. Coronary heart disease can be treated with a stent. A stent is a metal mesh placed in the artery. A tiny balloon is then inflated to open up the blood vessel and the stent. The balloon is then removed but the stent ensures the blood vessel remains widened. Stents don't require general anaesthetic and can be placed anywhere in the body. Another option is bypass surgery where the blocked artery is replaced with bits of veins. This require surgery and general anaesthetic but can be used on extremely blocked arteries where stents can't help. Another option is to prescribe statins. Statins reduce blood cholesterol levels and slows down the rate at which fatty material is deposited. However it can't be used to treat already affected arteries.

Comprehension

1. What is the name of the blood vessels that supply the heart with oxygen?
2. What is the name given to the top chambers of tey heart?
3. What blood vessel supplies the left atrium with blood?
4. What blood vessel supplies the right atrium with blood?
5. What is special about the pulmonary artery?
6. What type of blood is found in the right ventricle?
7. What causes coronary heart disease?
8. What are three methods of treating coronary heart disease?
9. Why does the left ventricle have thick muscular walls?
10. What is an advantage of stents?
11. How do stents work?
12. What is a disadvantage of bypass surgery?
13. **Task 3: Graphic organiser – the movement of blood through the heart**



Extended response questions

1. evaluate the use of three methods of combating coronary heart disease

2. The circulatory system contains arteries and veins.

(a) (i) Describe how the structure of an artery is different from the structure of a vein.

(2)

(ii) A comparison is made between blood taken from an artery in the leg and blood taken from a vein in the leg.

Give **two** differences in the composition of the blood.

(2)

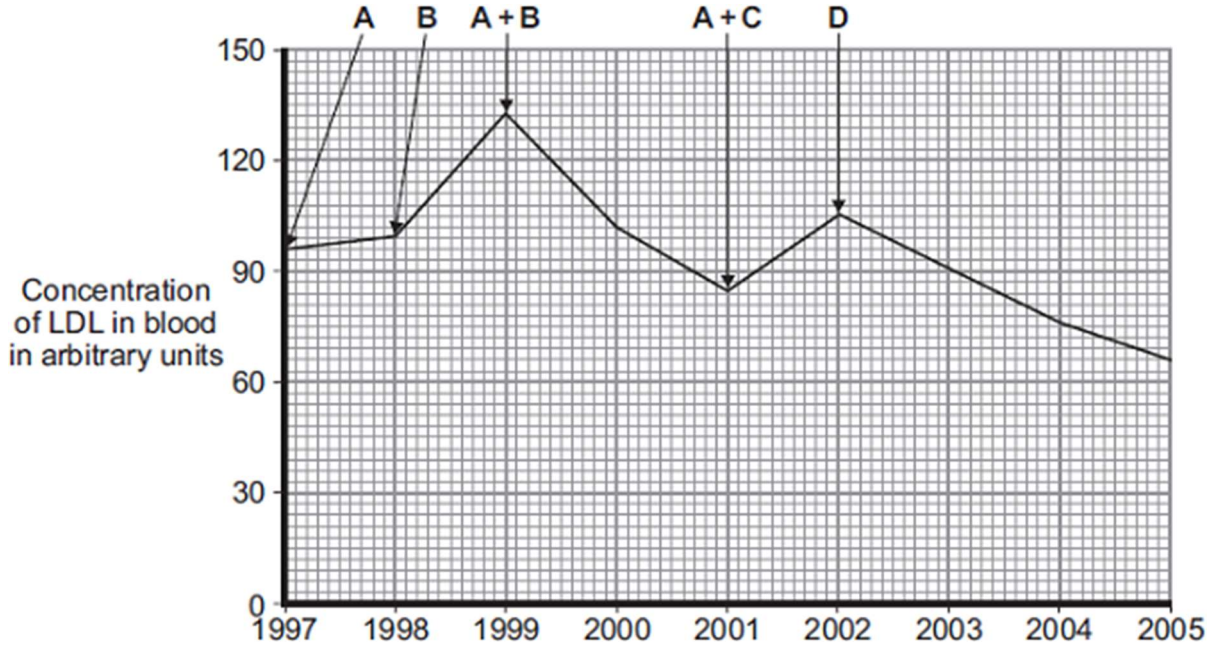
3. LDL is one form of cholesterol found in the blood.

People with a high concentration of LDL in their blood may be treated with drugs called statins.

A high concentration of LDL cholesterol in the blood may result in an increased risk of heart and circulatory diseases.

The graph shows the effects of the treatment of one person with four different statins, **A**, **B**, **C** and **D**, over a period of 8 years. The arrows show when each new treatment was started.

Each treatment was continued until the next treatment was started.

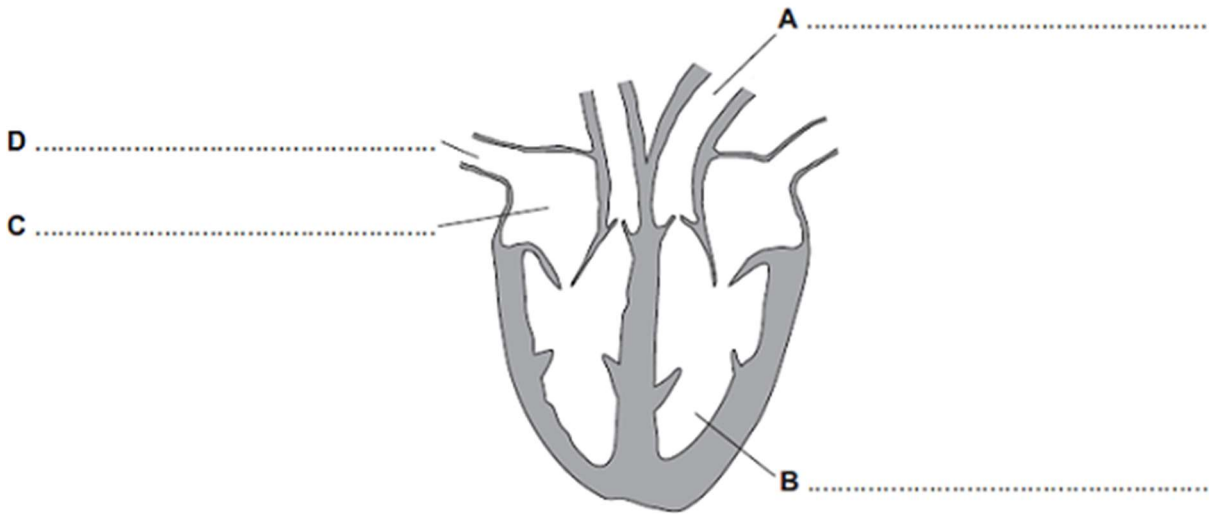


Compare the effectiveness of the five treatments in reducing the risk of heart and circulatory diseases for this person.

(Total 4 marks)

4. Diagram 1 shows a section through the heart.

Diagram 1



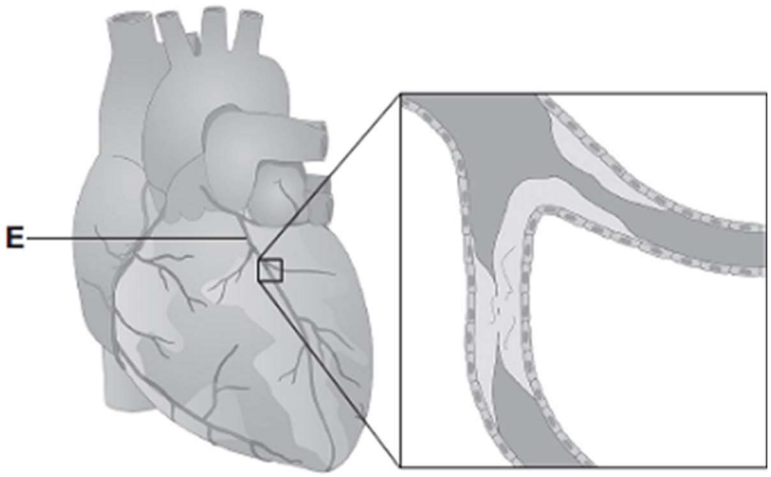
(a) On the diagram, name the parts labelled **A**, **B**, **C** and **D**.

(4)

(b) **Diagram 2** shows the blood vessels that supply the heart muscle.

Part of one of the blood vessels has become narrower.

Diagram 2



(i) Name blood vessel **E**.

(1)

(ii) Give **one** method of treating the narrowed part of blood vessel **E**.

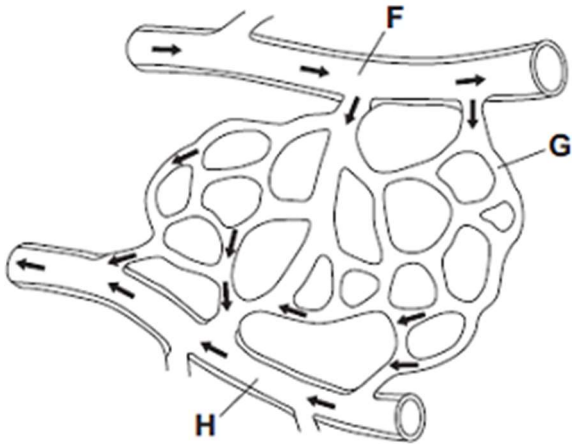
(1)

(iii) Explain how the method of treatment works.

(2)

(c) **Diagram 3** shows part of the blood supply in the lungs.

Diagram 3



(i) Name the types of blood vessel labelled **F**, **G** and **H**.

F _____

G _____

H _____

(3)

(ii) Give **one** way in which the composition of the blood in vessel **F** is different from the composition of the blood in vessel **H**.

(1)

(Total 12 marks)

Mark scheme

3. A + B most effective (treatment)

ignore descriptions of LDL levels

1

D is (the most) effective (treatment)

D is the best single (treatment)

1

neither A nor B (alone) are effective

allow increase risk of heart disease instead of not effective

1

can't tell if C is effective
OR
A + C is not effective

1

[4]

4. (a) A aorta

ignore left and right

1

B ventricle

1

C atrium

allow atria

1

D vena cava

1

(b) (i) (coronary) artery

allow arteriole

1

(ii) stent / description

accept (coronary) by-pass operation
allow statins
allow diets low in cholesterol
allow balloon (angioplasty)

1

(iii) (stent) keeps artery open

must relate to (b)(ii)

1

or

ignore reference to capillary / vein

(by-pass) new blood vessel / vein connecting around narrowed region;

or

(statins / low cholesterol diet) remove some of the cholesterol blockage

or

(balloon) widens / opens the blood vessel

1

which allows (more) blood through or allows blood to go around the blockage

(c) (i) F artery

accept arteriole / branch of pulmonary artery

1

G capillary

1

H vein

H accept venule / branch of pulmonary vein;

1

(ii) F (Pulmonary artery) has <u>less</u> oxygen / <u>more</u> carbon dioxide / <u>more</u> glucose / sugar

accept F (Pulmonary artery) is deoxygenated
accept converse for H (Pulmonary vein)

'It' refers to F

1

[12]

Lesson 4 – helping the heart

Reading

Heart valve shave to withstand a lot of pressure. As such they may start to leak. Doctors can operate and replace faulty valves with mechanical valves made of titanium. These mechanical valves are long lasting but require medication to prevent blood clotting around it. Biological valves are based on valves from pigs or even human donors. These do not require any medication but only last 12-15 years.

The heart normally beats at 70bpm. The beating of the heart is controlled by a group of cells found in the walls of the right atrium. This cluster of cells can stop working and needs replacing with an artificial pacemaker. If a persons heart beats too slowly they won't get enough oxygen. The most common disease treated by pacemakers is arrhythmia (abnormal heart rhythm). An artificial pacemaker is an electronic device that weighs between 20-50g and is connected to your heart by two wires. They control when the heart beats by sending strong , regular electronic signals to the heart. Modern pacemakers are very sensitive and only act when something is amiss and can even stimulate the heart to beat faster when you exercise. If you have a

pacemaker fitted you will need regular check-ups throughout your life, however, this is a small price to pay when weighed against the increased quality and quantity of life gained by having one.

Artificial hearts are used when a person's heart stops working completely. It can take a long time for a donor heart to become available so artificial hearts are used to keep the patient alive in the meantime. There is a risk of blood clotting with artificial hearts.

Comprehension

1. What two methods of replacing heart valves?
2. What is an advantage and disadvantage of each method?
3. What is the danger if a persons heart beats too slowly?
4. What is a disadvantage of wearing a pacemaker?
5. Why are artificial hearts used?
6. What is a risk of artificial hearts?

Lesson 5: breathing and gas exchange

Your lungs are found in your chest or thorax and are protected by your ribcage. They are found above the organs of your digestive system and are separated from by a layer of muscle called the diaphragm. The lungs are a part of the gas exchange or ventilation system and the role of this system is to move air in and out the lungs. The lungs are made up of tiny air sacs called alveoli which increase the surface area for gas exchange. The walls of the alveoli are very thin (only 1 cell thick) to provide a short diffusion distance for gas exchange. The alveoli also have a rich supply of blood capillaries to maintain a concentration gradient. Ventilation of the lungs is controlled by the contraction or relaxation of the intercostal muscles and the diaphragm which

changes the pressure of the lungs resulting in the movement of gases like oxygen in and out the lungs. Oxygen is used for aerobic respiration and so is important as without it we could not release energy

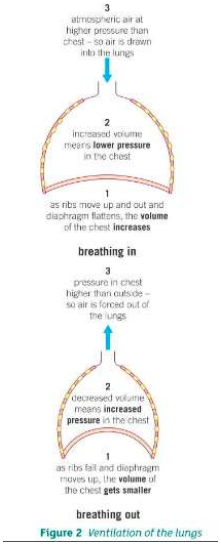
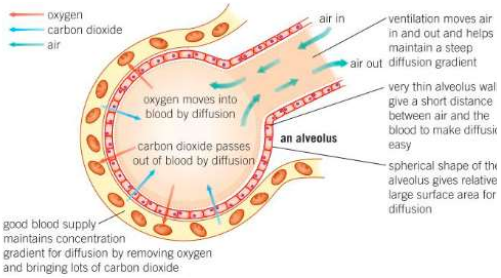


Figure 2 *Ventilation of the lungs*

Shown to the left is the process of breathing in and out. When you breathe in, oxygen rich air will move into the lungs. This means there is a high concentration of oxygen in the lungs and maintains a steep concentration gradient between the lungs and the bloodstream. Diffusion causes particles to go from a high concentration to a low concentration and therefore oxygen moves from the lungs to the blood by this process. Breathing out removes carbon dioxide rich air from lungs maintaining a concentration gradient between the bloodstream and the lungs with the blood stream having a higher concentration of carbon dioxide resulting in carbon dioxide continually diffusing out of the blood stream.

Comprehension



1. What protects your lungs?
2. What makes red blood cells special?
3. What structure makes up the lungs?
4. Give two adaptations of alveoli
5. State two gasses that are moved in and out of the lungs by ventilation.
6. What two sets of muscles control gas exchange
7. What is the relationship between volume of the chest and pressure?
8. Describe the changes that will occur in the lungs when breathing in and out
9. Describe the changes that will occur in the lungs when emerging from a dive in water
10. If the pressure in the lung is high, am I breathing in or out?
11. Label the table below with <u>% of air breathed in</u> and <u>% of air breathed out</u>

Atmosphere gas		
Nitrogen	80	80
Oxygen	16	20
Carbon dioxide	4	0.04

Graphic organiser – Draw a bar chart to show the difference between the air you breathe in and the air you breathe out (use table above)

1. Describe the changes in the composition gases in inhaled air and exhaled air. (include magnitude of any difference)
2. A student says “we breathe in oxygen and breathe out carbon dioxide” explain whether the student is correct. Use data from table 1.

Lesson 5 – Tissues and organs in plants

Reading

The same way that animals contain tissues (a group of similar specialised cells that work together to complete a certain function) so do plants. The main tissues in plants are as follows: epidermal tissues which cover the surface and protect them similar to their function in animals. Palisade mesophyll contains lots of chloroplast. Spongy mesophyll contains large air spaces and has a large surface area to increase diffusion of gases. Xylem

carries water and dissolved mineral ions from the roots (water enters the roots by osmosis) upwards and the phloem transports glucose from the leaves around the plant. Another type of plant tissue is the meristem which contains stem cells which can divide rapidly to allow plants to grow.

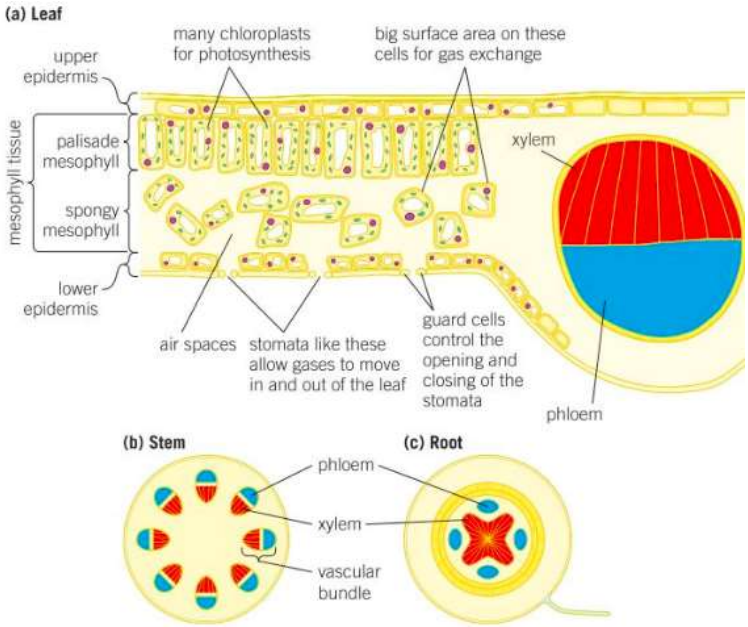


Figure 3 *Plants have specific tissues to carry out particular functions. They are arranged in organs such as the: **a** leaf, **b** stem, and **c** roots.*

Comprehension

1. What is a tissue?
2. What is the function of the palisade mesophyll?
3. What is the function of the xylem?
4. By what process does water enter the roots?
5. What structures in animals have a large surface area ((try to name at least three)
6. What two plant tissues make up the vascular bundle?
7. In what part of a cell does photosynthesis take place?
8. Where are stem cells found in plants?

Extended response questions (Complete graphic organiser first)

1. A large surface area is important for plants and animals. Discuss. Include examples of plants and animals and the function of the cells or structure in question (6 marks)
2. Suggest how the following tissues work together to enable plant roots to grow: meristem tissue, xylem, phloem, palisade mesophyll, and spongy mesophyll (6 marks)

Graphic organiser

Adaptation	What structures /cells in plants and animals has this adaptation?				
Large surface area					
Thin walls					
Lots of mitochondria					
Good blood supply					
Contains haemoglobin					
No nucleus					

Hints: red blood cell, sperm cell, muscle cell, alveoli, villi, palisade mesophyll cell

Lesson 7 – Transport system in plants

Reading

Plants make glucose by photosynthesis. This glucose is used for many things in plants for example it is combined with nitrates to make amino acids. Amino acids then make proteins which are needed for growth and repair of cells. This glucose needs to transported anywhere in the plant it is needed. Similarly water and mineral ions need to travel through the plant. The plant has two transport systems to help with this.

One transport system is called the phloem. The phloem transports glucose and other sugars made in photosynthesis to the rest of the plant. This includes transport to the growing areas of the stems and rots where they are used in the way mentioned above. The movement of these sugars around the rest of the plant is called translocation. The phloem is made up of living tissue. Scientists have used creatures called aphids to determine the function of the phloem. They stylet of the aphid is inserted into the phloem to feed. The aphids body is then removed leaving the stylet in the phloem, sap containing dissolved sugars would flow out of the phloem through the aphids stylet.

The other transport system in plants is called the xylem. The xylem carries water and mineral ions from the soil to the stems and leaves. Mature xylem cells are dead. In woody plants like trees the bulk of the bark is made up of the xylem with the phloem found in a ring just underneath the bark. Young trees have bark which is very thin, animals like deer would eat away this bark resulting in a prevention of translocation and the death of the plant.

These transport systems are vital in plants. Glucose is needed all over the plant for use in respiration and for growth. Water is needed for photosynthesis. Water is also needed to hold a plant upright. When water is plentiful the vacuole pushes against the cell wall making the cells turgid.

Comprehension

1. State the word equation for photosynthesis
2. State the symbol for glucose
3. List three uses of glucose
4. State two differences between the xylem and phloem
5. If you was to cut open the xylem, what would come out?
6. Why will plants without lots of glucose appear short and stunted?
7. State issues caused by young trees dying due to being eaten.
8. How have scientists used aphids to help them understand the phloem?
9. What is the function of the cell wall
10. Draw and label a plant cell

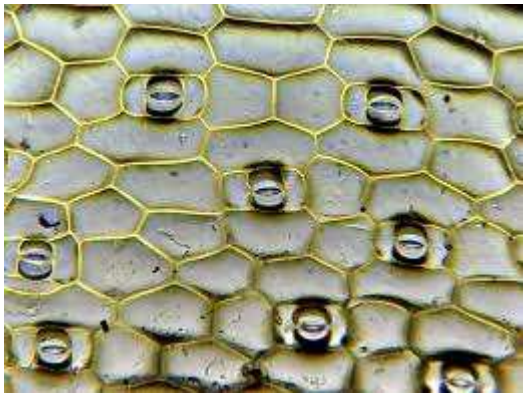
Extended writing

A local wood land trust has set up a scheme to put protective plastic covers around the trunks of young trees. Some local residents are complaining, saying it spoils the look of the woodlands. Evaluate the effect of this scheme. (6 marks)

Lesson 8: evaporation and transpiration

Reading

Water enters a plant in the roots and yet it must reach the highest leaves which in the world's tallest tree can be 87m away. The water travels up the plant in the xylem in a process known as transpiration. The leaves of plants are covered with small openings called stomata. These stomata can be open and closed based on environmental conditions. The opening and closing of stomata is controlled by guard cells. When the plant has a lot of water the vacuoles of the guard cells are full and the plant cells become turgid (opposite of flaccid). This forces the two guard cells apart and the stomata open. The converse happens when plants are low in water. The stomata can open when plants need to carry out gas exchange. Carbon dioxide from the atmosphere diffuses into the air spaces and then into the photosynthesising cells. Oxygen moves in the opposite direction, out of the photosynthesising cells into airs spaces then out into the atmosphere.



When stomata are open, it is not only oxygen and glucose that can move in and out. Water vapour can also be lost through the stomata by diffusion. This process of water moving up the xylem from the roots to the leaves where water diffuses out of the stomata is known as transpiration. The diagram below shows how transpiration occurs.

Due to water loss being a side effect of stomatal opening, it is important that plants can close their stomata to limit the loss of water vapour.

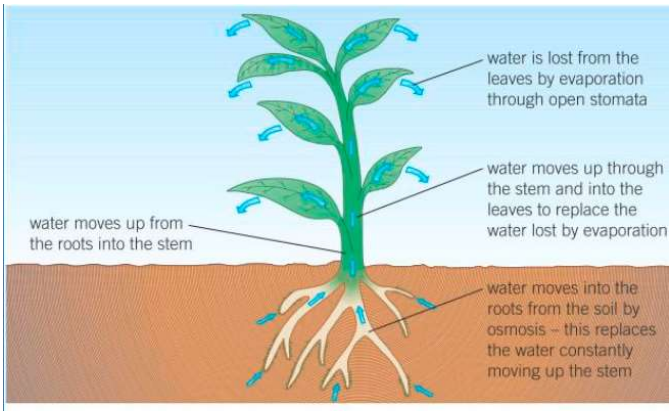


Figure 2 *The transpiration stream*

Comprehension

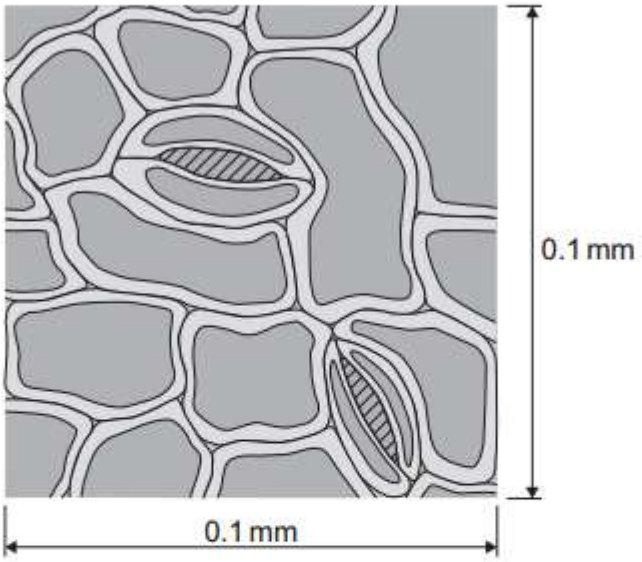
1. What are stomata
2. What is their role in the plant
3. What is the word equation for photosynthesis
4. How does water travel up the plant?
5. How does the plant ensure there is always an unbroken column of water In the xylem
6. How can the cells of the xylem be described?
7. What is the role of the guard cells?
8. What controls whether the guard cells are open and closed
9. Explain how guard cells open or close stomata
10. Suggest why cacti may have fewer stomata than other plants
11. Suggest why there are fewer stomata on the top of the leave than the bottom of the leave.

Experiment – investigating stomata

Exam questions

5 (b) **Figure 5** shows part of the surface of a leaf.

Figure 5



The length and width of this piece of leaf surface are both 0.1 mm.

5 (b) (i) Calculate the number of stomata per mm^2 of this leaf surface.

[2 marks]

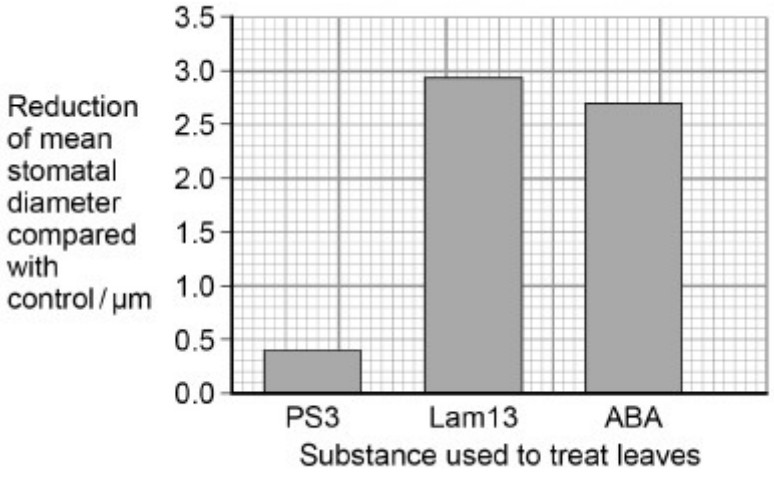
.....

.....

..... per mm^2

A scientist investigated the effect of treating the leaves of one species of plant with three different substances. These substances **reduce** the stomatal diameter. He compared the mean diameter of stomata after treating the leaves with these substances with the mean stomatal diameter on control leaves treated with distilled water.

The scientist's results are shown in the graph below.
The mean stomatal diameter of the control leaves was 7.5 µm.



(b) Calculate the ratio of mean stomatal diameter of leaves treated with PS3 to those treated with ABA.

Answer = _____ : 1

(2)

(c) ABA is a substance that some plant species produce when little water is available.

Explain why producing ABA may help these species survive in dry conditions.

_____

_____

_____

_____

_____

_____

_____

(2)

(d) Many species of plants can be infected by powdery mildew which is spread by microscopic spores in the air.

Suggest how treatment with Lam13 might protect plants against powdery mildew infection.

_____

_____

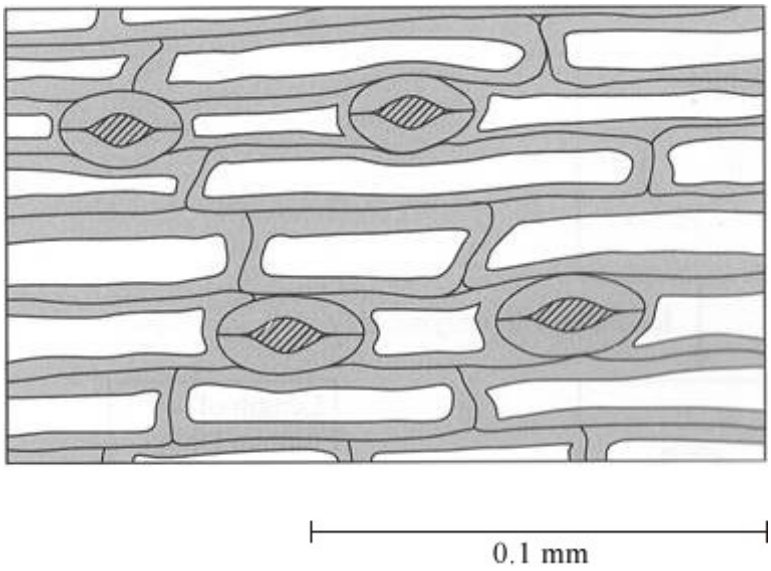
_____

_____

(1)

(Total 8 marks)

The drawing shows part of the lower leaf epidermis of sorghum.



(a) Calculate the number of stomata per mm^2 of the leaf surface. Show your working.

Answer _____ stomata per mm^2

(2)

(b) Sorghum has few stomata per mm^2 of leaf surface area. Explain how this is an adaptation to the conditions in which sorghum grows.

_____

_____

_____

_____

_____

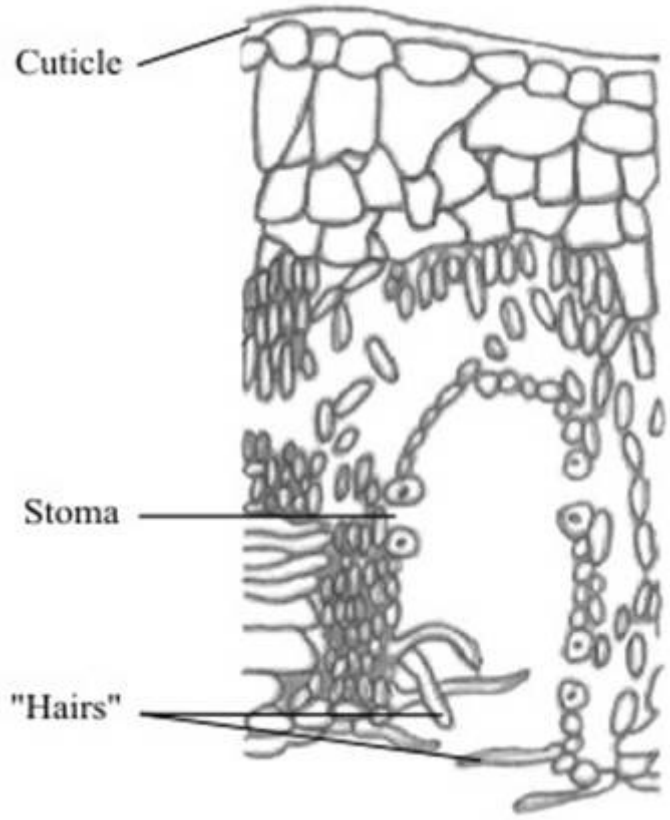
_____

(3)

(Total 5 marks)

Figure 1 shows a single stoma and surrounding cells from the leaf of a xerophytic plant.

Figure 1



(i) Explain how the cuticle reduces water loss.

_____

_____

(1)

(ii) Explain how **one** of the other labelled parts reduces water loss.

_____

_____

_____

_____

(2)

(Total 3 marks)

Lesson 9 – factors affecting transpiration

In which of the three images are the clothes going to dry the fastest and why? The same conditions that affect evaporation affect transpiration. These factors are temperature, humidity, amount of air movement and light intensity. Anything that increases rate of photosynthesis will increase rate of transpiration because more stomata have to open to allow carbon dioxide to enter. Which then means more water is lost through the stomata by evaporation. Therefore, an increase in light intensity will increase rate of transpiration.

High humidity decreases the rate of transpiration as there is a smaller concentration gradient between the leaves and the atmosphere thus decrease rate of evaporation. Windy conditions with lots of air movement will increase rate of transpiration and help to maintain a steep concentration gradient. Temperature will increase rate of transpiration as the water molecules will move faster increasing rate of evaporation. Additional rate of photosynthesis also increases therefore more stomata will be open causing an increasing rate of transpiration.

Most leaves have a waxy, waterproof layer; the waxy cuticle; that is impermeable to water. Furthermore most of the stomata are found on the underside of the leaf where temperatures are lower. Xerophytes are plants adapted to live in dry environments. They can be adapted by having stomata that only open at night (known as CAM physiology) or having rolled leaves that trap air making the environment very humid. As previously mentioned, high humidity means lower rates of transpiration.

If plants don't have enough water they may wilt. This is actually a protective measure. The leaves all collapse and hang down. This greatly reduces the surface area available for water loss by evaporation.

The rate of transpiration can be measured using a photometer. A photometer can be used to show how the uptake of water by a plant changes in different conditions.

Comprehension

1. State four factors that affect transpiration
2. Suggest one other factors that might effect transpiration
3. Describe the effect each factor has on trasnpiration
4. Explain the effect each factor has on trasnpiration
5. What will lose more water: a plant in winter or a plant in summer ?
6. what are xerophytes
7. Give two ways xerophytes are adapted to prevent against water loss

8. Explain how wilting helps plants
9. Design an experiment to test the effect of amount of air movement on wind flow. Include a dependent variable, independent variable, control variable and any sources of error.

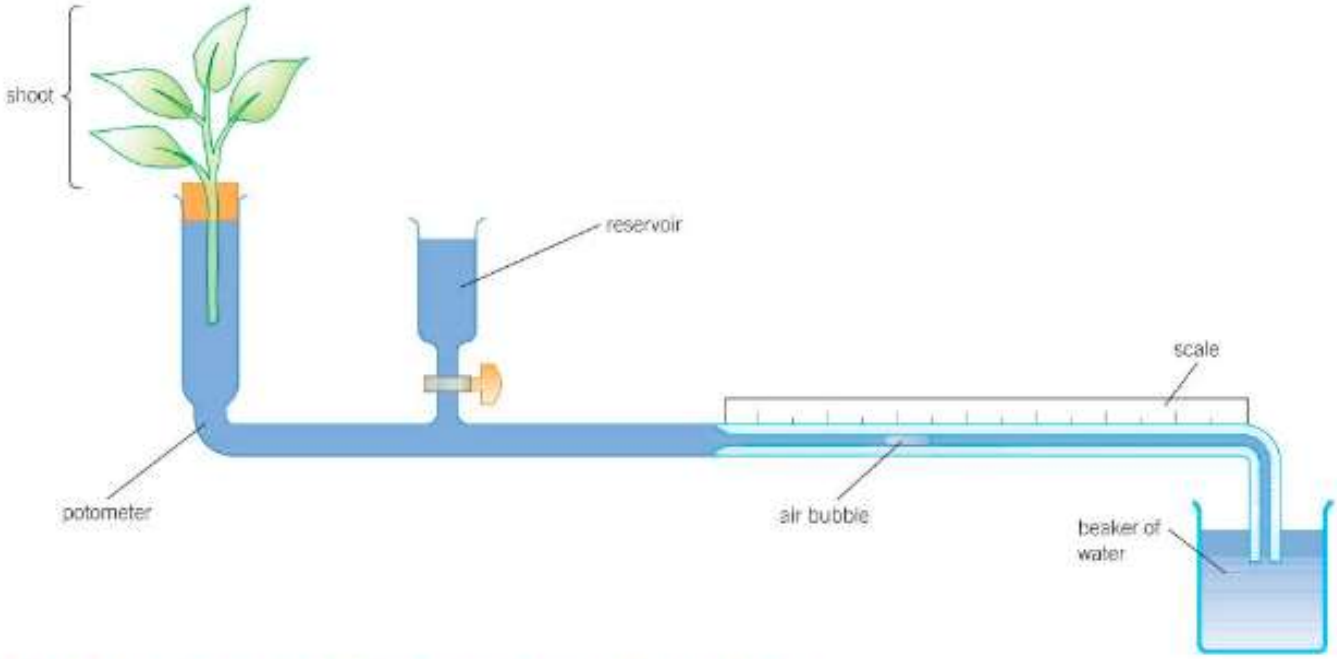
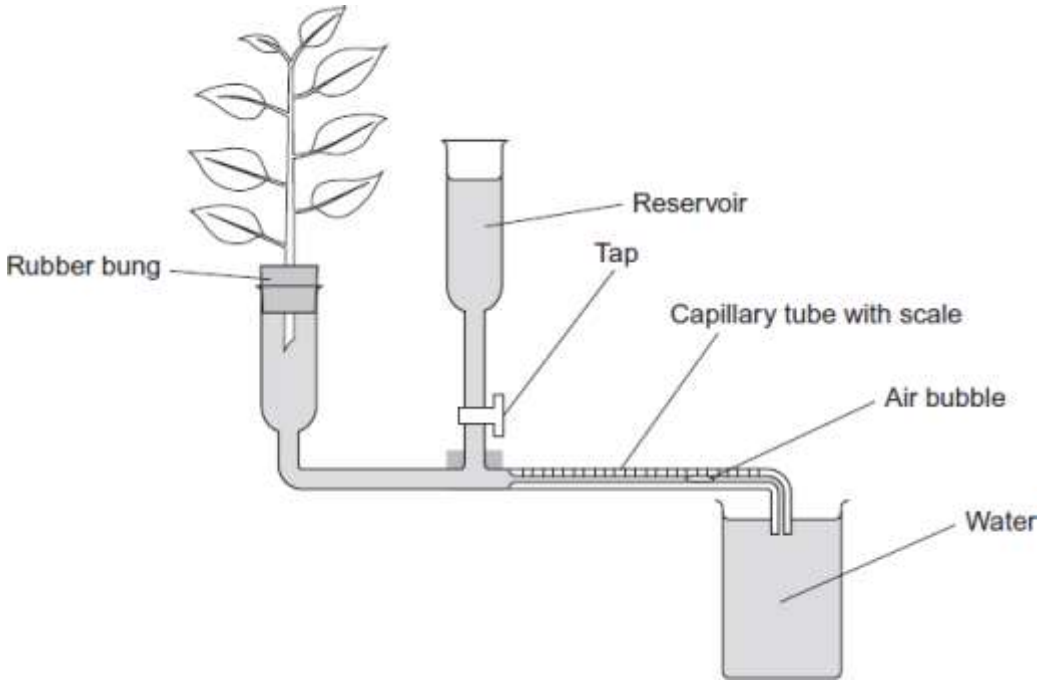


Figure 2 *A potometer is used to show the water uptake of a plant under different conditions*

Exam questions

Q1.

Students investigated the effect of removing leaves from a plant shoot on the rate of water uptake. Each student set up a potometer with a shoot that had eight leaves. All the shoots came from the same plant. The potometer they used is shown in the diagram.



(a) Describe how the students would have returned the air bubble to the start of the capillary tube in this investigation.

_____

_____

_____

(1)

(b) Give **two** precautions the students should have taken when setting up the potometer to obtain reliable measurements of water uptake by the plant shoot.

1. _____

2. _____

(2)

(c) A potometer measures the rate of water uptake rather than the rate of transpiration. Give **two** reasons why the potometer does **not** truly measure the rate of transpiration.

1. _____

2. _____

(2)

(d) The students' results are shown in the table.

Number of leaves removed from the plant shoot	**Mean rate of water uptake / cm^3 per minute**
0	0.10
2	0.08
4	0.04
6	0.02
8	0.01

Explain the relationship between the number of leaves removed from the plant shoot and the mean rate of water uptake.

_____

_____

_____

_____

_____

_____

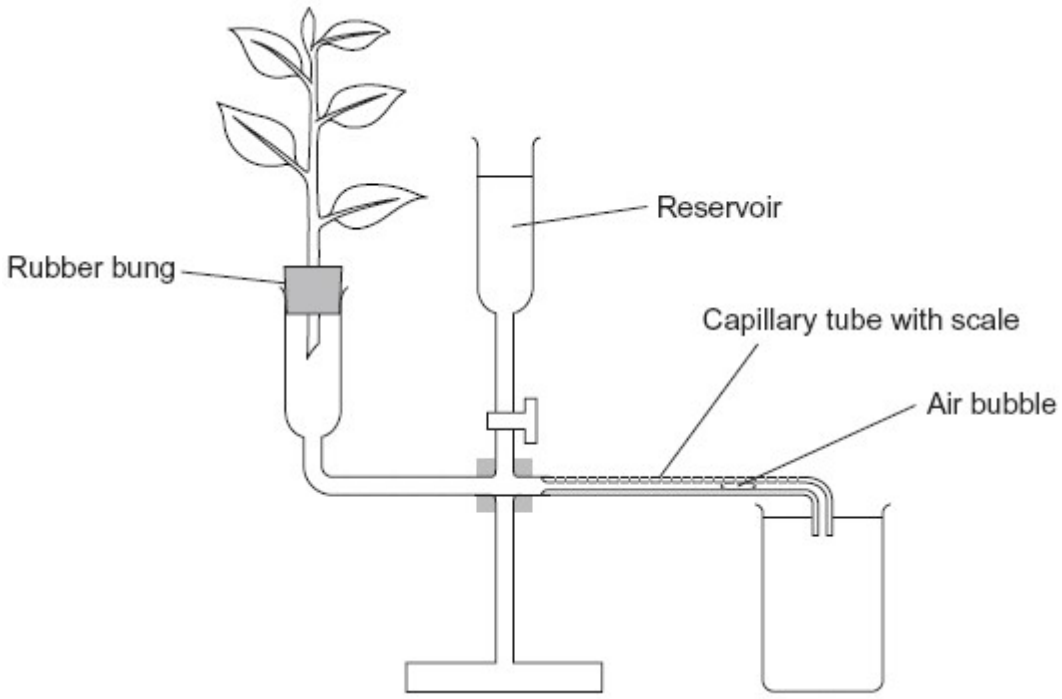
*(Extra space)*_____

(3)

(Total 8 marks)

Q2.

A student investigated the rate of transpiration from a leafy shoot. She used a potometer to measure the rate of water uptake by the shoot. The diagram shows the potometer used by the student.



(a) Give **one** environmental factor that the student should have kept constant during this investigation.

(1)

(b) The student cut the shoot and put it into the potometer under water. Explain why.

(1)

(c) The student wanted to calculate the rate of water uptake by the shoot in cm^3 per minute. What measurements did she need to make?

_____

(2)

(d) The student assumed that water uptake was equivalent to the rate of transpiration.

Give **two** reasons why this might **not** be a valid assumption.

1. _____

_____

2. _____

_____

(2)

(e) The student measured the rate of water uptake three times.

(i) Suggest how the reservoir allows repeat measurements to be made.

_____

_____

(1)

(ii) Suggest why she made repeat measurements.

_____

_____

(1)

(Total 8 marks)

Q1.

(a) Open / use tap / add water from reservoir;

1

(b) 1. Seal joints / ensure airtight / ensure watertight;

Answer must refer to precautions when setting up the apparatus

Ignore: references to keeping other factors constant

2. Cut shoot under water;

3. Cut shoot at a slant;

4. Dry off leaves;

5. Insert into apparatus under water;

6. Ensure no air bubbles are present;

7. Shut tap;

8. Note where bubble is at start / move bubble to the start position;

2 max

(c) 1. Water used for support / turgidity;

Accept: water used in (the cell's) hydrolysis or condensation (reactions) for one mark. Allow a named example of these reactions

2. Water used in photosynthesis;

3. Water produced in respiration;

4. Apparatus not sealed / 'leaks';

2 max

(d) As number of leaves are reduced (no mark),

Accept: converse arguments

1. Less surface area / fewer stomata;

3. Less evaporation / transpiration;

4. Less cohesion / tension / pulling (force);

3

[8]

Q2.

(a) Light (intensity) / temperature / air movement / humidity;

1

(b) Prevent air entering / continuous water column;

Allow answer in context of shoot, xylem or potometer.

1

(c) Distance and time;

Reject 'amount bubble moves'

1

Radius / diameter / area (of capillary tube);

1

(d) (used to provide) turgidity / support / description of;

(used in) photosynthesis / (produced in) respiration;

Apparatus not sealed / 'leaks';

2 max

(e) (i) Returns bubble (to start);

1

(ii) Increases reliability (of results) / anomalous result can be identified;

Q *Ignore references to validity / precision / accuracy etc.*

1

[8]