NOTES

DATE:

SEPTEMBER HOLIDAY REVISION

SEC 3 PURE BIOLOGY

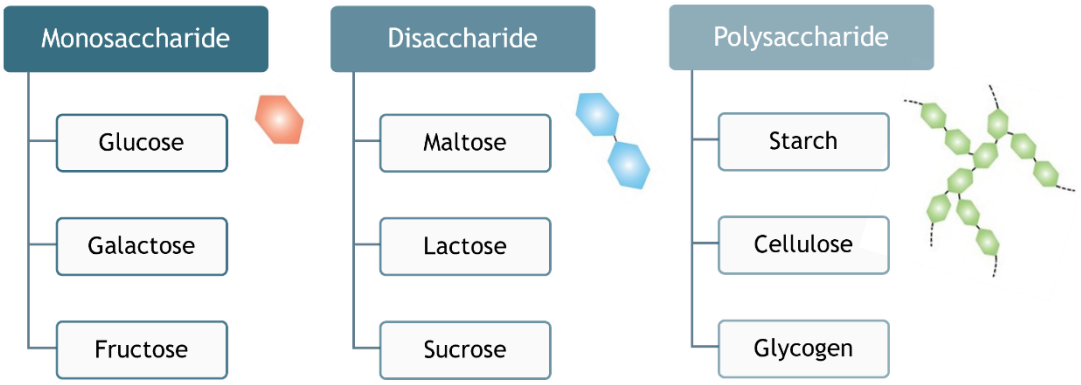
Instructions:
Please complete your Mock Exam Paper under timed conditions and bring it for class.

3. Biological Molecules

- Nutrients

- Enzymes

Carbohydrates

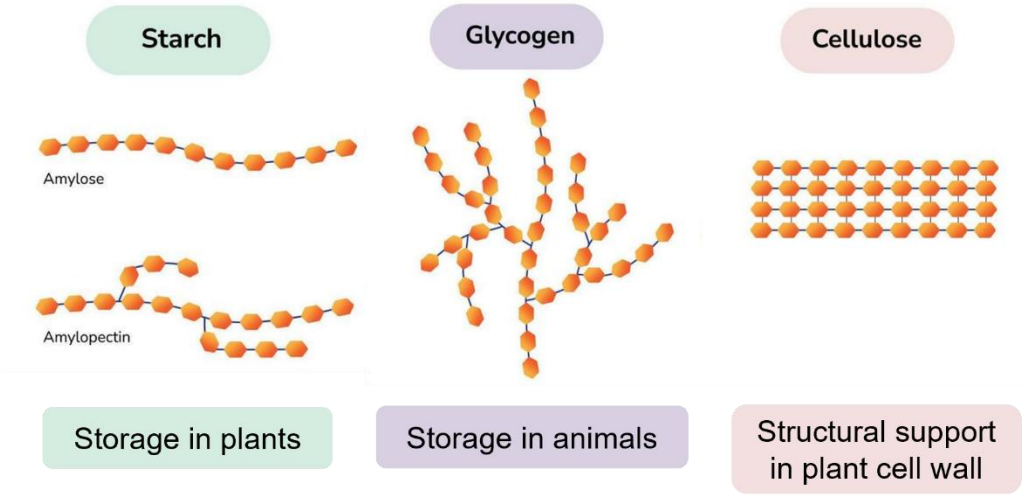


Element composition	Carbon, hydrogen, and oxygen only • Hydrogen and oxygen always 2:1
Basic unit	Monosaccharide ($C_6H_{12}O_6$) • Simplest carbohydrate molecule
Role in organism	All carbohydrates consumed are ultimately broken down into glucose • Substrate for cellular respiration • Substrate for lipid and amino acid synthesis

Benedict's test for reducing sugars

Reagent used:	Benedict's solution	
Procedure:	If presented with a solid sample, grind with a mortar and pestle then add distilled water. 1) Add 2 cm^3 of Benedict's solution to 2 cm^3 of the liquid/aqueous sample. 2) Heat the mixture for 5 minutes in a boiling water bath.	
Results:	<u>Remains clear blue</u> Reducing sugars absent	<u>Turns brick-red</u> Reducing sugars present

Polysaccharides



All polysaccharides are made of **many repeating subunits of glucose** chemically bound together.

Iodine test for starch

Reagent used:	Iodine solution	
Procedure:	Iodine test can be done on solid and liquid samples. - Add 3 to 5 drops of iodine solution to the sample	
Results:	Remains yellowish-brown Starch absent	Turns blue-black Starch present

Fats

Element composition	Carbon, hydrogen, and oxygen only No fixed ratio of hydrogen and oxygen
Basic unit	One glycerol backbone with three fatty acid tails
Role in organism	Long-term energy storage Insulation beneath the skin surface Cushion and protect internal organs from impact Major component of cell membrane Solvent for fat-soluble vitamins

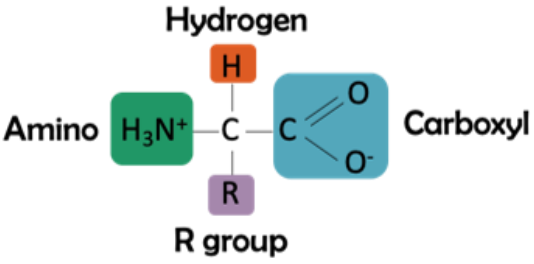
Ethanol-emulsion test for fats

Reagent used:	Ethanol	
Procedure:	1) Add the food sample to a beaker of ethanol and shake thoroughly to allow any fats present to dissolve 2) Filter the mixture and pour 2 cm^3 of the residue to 2 cm^3 of water	
Results:	<u>Remains clear and colourless</u> Fats absent	<u>Cloudy white emulsion forms</u> Fats present

Proteins

Proteins account for more than 50% of the dry mass of most cells and are crucial for the basic functioning of a cell. Proteins help to speed up chemical reactions, transport substances, and allow cells to move.

Element composition	Carbon, hydrogen, oxygen, and nitrogen - Some amino acids have sulfur and phosphorus
Basic unit	Amino acid
Role in organism	- Enzymes speed up chemical reactions - Antibodies and antigens protect cells from pathogens - Hormones regulate various processes - Contractile and motor proteins allow for movement



All amino acids consist of an amino group, a carboxyl group, and a hydrogen atom.

Biuret test for proteins

Reagent used:	Sodium hydroxide and copper (II) sulfate solution	
Procedure:	1) Add 2 cm^3 of sodium hydroxide solution to 2 cm^3 of the liquid/aqueous sample and shake thoroughly to mix 2) Add a 3 to 5 drops of copper (II) sulfate solution, shaking the mixture between drops	
Results:	Remains pale blue Proteins absent	Turns violet/purple Proteins present

Note that the Biuret test interacts with the bonds present between amino acids in a polypeptide/protein, and not the amino acids themselves. Hence, a solution of amino acids will result in a pale blue solution in the Biuret test.

Enzymes

Enzymes are biological catalysts that speed up the rate of chemical reactions and remain chemically unchanged at the end of each reaction.

How do enzymes work?

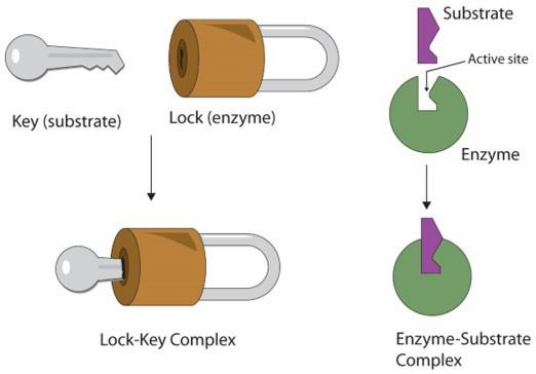
- All enzymes are proteins and function best at their optimal temperatures and pH
- Enzymes provide an alternative reaction pathway with a lower activation energy
- Only a small amount of enzymes are needed as they remain chemically unchanged at the end of each reaction and can therefore be reused.

What is activation energy?

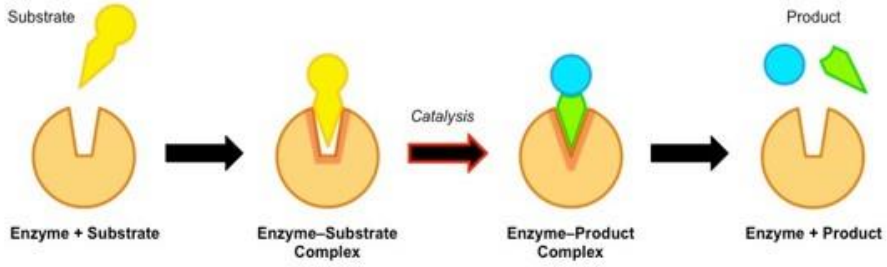
The minimum amount of energy reacting molecules need to have to undergo a reaction. The lower the activation energy, the more easily the reaction proceeds.

Mode of action – 'lock and key' hypothesis

Just like how a key fits perfectly into the keyhole of a lock, substrate molecules have a complementary shape to fit into the active site of an enzyme. Enzymes ensure specificity by having a unique active site that can only bind to a complementary substrate molecule.



Upon forming the enzyme-substrate complex (ESC), the substrate now requires a lower activation energy to undergo a reaction and can proceed to form new products by breaking or forming bonds.



Enzyme-catalysed reactions

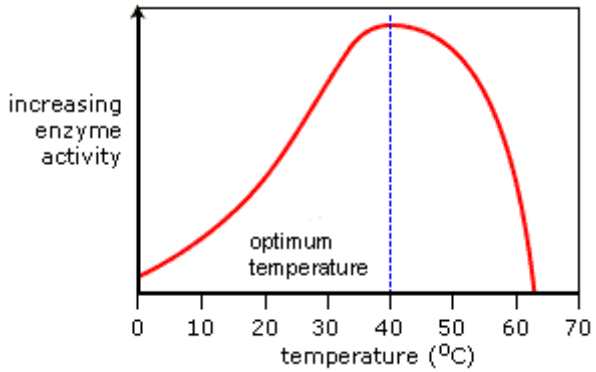
Enzymes are specific in action and can only catalyse reactions involving their complementary substrate molecules.

Enzyme	Substrate
Amylase	Starch
Sucrase	Sucrose
Protease	Proteins
Lipase	Lipids

All enzymes are named after their substrates by replacing the last few letters in the name of the substrate with "-ase".

Effect of temperature on enzyme-catalysed reactions

Being proteins, enzymes are sensitive to changes in temperature, and their ability to catalyse reactions will diminish when the conditions are too far from the optimal.



Graph is asymmetrical about the optimum temperature

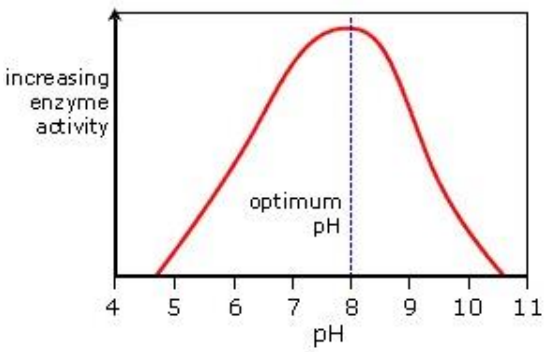
- Enzyme activity doubles with every 10°C increase towards the optimum
- Enzyme activity drastically decreases beyond the optimum

Different enzymes have their own optimal temperatures

- Enzymes found in the human body have an optimum temperature of around 37°C

Effect of pH on enzyme-catalysed reactions

Enzymes are also sensitive to changes in pH, and their ability to catalyse reactions will diminish when the conditions are too far from the optimal.



Graph is symmetrical about the optimum temperature

- Most enzymes have very narrow working pH ranges

Different enzymes have their own optimal pH

- Stomach enzymes – pH 2
- Pancreatic enzymes – pH 8

4. Nutrition in Humans

Mouth

<table>
<tr><td>Function</td><td colspan="2">Where food first enters the body / site of ingestion</td></tr>
<tr><td rowspan="2">Digestion</td><td>Physical (mechanical)</td><td>Chemical (enzymatic)</td></tr>
<tr><td>

Chewing: teeth cut (incisors) and grind (molars) food into smaller pieces

Increase surface area to volume ratio of food to digestive enzymes

Salivary glands secrete saliva which moistens and softens food

Lubricates food for easier swallowing

Tongue mixes food with saliva and rolls the mixture into a bolus

</td><td>

Saliva contains salivary amylase

$$starch \xrightarrow{amylase} \begin{matrix} maltose + \\ smaller\ polysaccharides \end{matrix}$$
</td></tr>
<tr><td>pH</td><td colspan="2">Usually 7 – sometimes slightly acidic depending on food consumed</td></tr>
</table>

Oesophagus

Function	Transport bolus from mouth to stomach via peristalsis	
Digestion	Physical (mechanical)	Chemical (enzymatic)
	-	-
Unique feature	Peristalsis is the rhythmic contraction of (circular and longitudinal) muscles along the alimentary canal that propels food in a wave-like, unidirectional motion that is independent of gravity	
pH	7 (no change from the pH in the mouth)	

Stomach

Function	Protein digestion begins here	
Digestion	Physical (mechanical)	Chemical (enzymatic)
	Muscular walls churn to thoroughly mix gastric juices with food to form chyme, a semi-solid mixture	Gastric secretions contain proteases and hydrochloric acid Protease breaks down proteins into polypeptides $protein \xrightarrow{pepsin} polypeptide$ Hydrochloric acid activates the protease and provides the acidic environment optimal for protease function Hydrochloric acid also kills pathogens present in food
pH	2	

Pancreas

Function	Secretes digestive enzymes into the duodenum	
Digestion	Physical (mechanical)	Chemical (enzymatic)
	-	Pancreatic lipase $triglyceride \xrightarrow{lipase} glycerol + fatty\ acids$ Pancreatic amylase $starch \xrightarrow{amylase} maltose + smaller\ polysaccharides$ Pancreatic protease $protein \xrightarrow{trypsin} smaller\ peptides$
pH	8.6	

Liver & Gallbladder

Function	Liver secretes bile which is stored and concentrated in the gallbladder	
Digestion	Physical (mechanical)	Chemical (enzymatic)
	Bile salts found in bile emulsify large fat globules into smaller fat droplets Increase surface area to volume ratio of fats to lipase Bile is released into the duodenum from the gall bladder via the bile duct Stimulated by the presence of lipids in food	-
pH	8	

Small intestine

<table>
<tr><td>Function</td><td colspan="2">Majority of digestion occurs in the duodenum (first ~25cm)
Absorption occurs in the jejunum and ileum (remaining ~5m)</td></tr>
<tr><td rowspan="2">Digestion</td><td>Physical (mechanical)</td><td>Chemical (enzymatic)</td></tr>
<tr><td>-</td><td>Intestinal epithelial cells of the duodenum secrete a variety of digestive enzymes
Intestinal lipase
$triglyceride \xrightarrow{lipase} glycerol + fatty\ acids$
Intestinal disaccharidase
$maltose \xrightarrow{maltase} glucose$
Intestinal protease
$protein \xrightarrow{peptidase} amino\ acids$</td></tr>
<tr><td>pH</td><td colspan="2">8 – due to alkaline secretions from pancreas and gallbladder</td></tr>
</table>

Large intestine

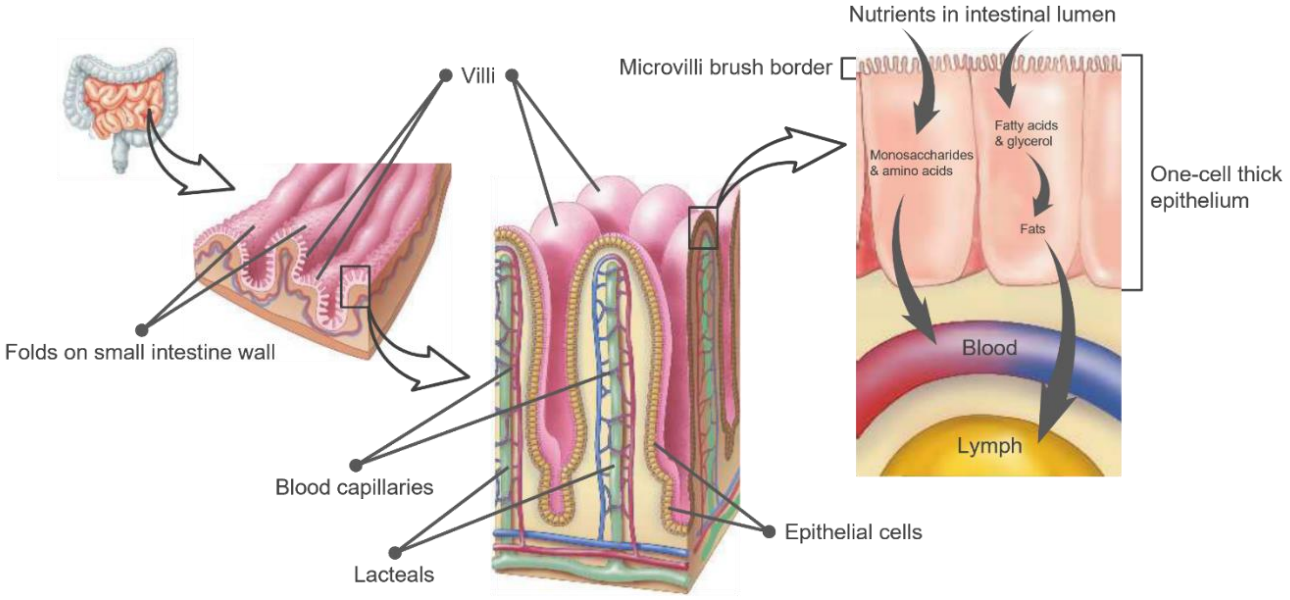
<table>
<tr><td>Function</td><td colspan="2">Absorbs excess water from undigested food</td></tr>
<tr><td rowspan="2">Digestion</td><td>Physical (mechanical)</td><td>Chemical (enzymatic)</td></tr>
<tr><td>-</td><td>-</td></tr>
</table>

Absorption in the small intestine

Monosaccharides and amino acids are absorbed into the bloodstream while glycerol and fatty acids enter the lymphatic system.

The lining of the small intestine is highly adapted to increase the efficiency of absorption:

- Large surface area to volume ratio
- Steep concentration gradient
- Barrier thickness



The winding nature of the small intestine inside the abdominal cavity also maximises the time available for more absorption to occur.

Feature	Function
Highly folded intestinal wall	Increase surface area to volume ratio of intestinal epithelium to nutrients in intestinal lumen
Finger-like projections called villi	
Microscopic projections on epithelial cells called microvilli	
Dense network of capillaries	Quickly transport blood that had absorbed nutrients away to maintain steep concentration gradient
One-cell thick epithelium	Decrease barrier thickness for more efficient absorption of nutrients

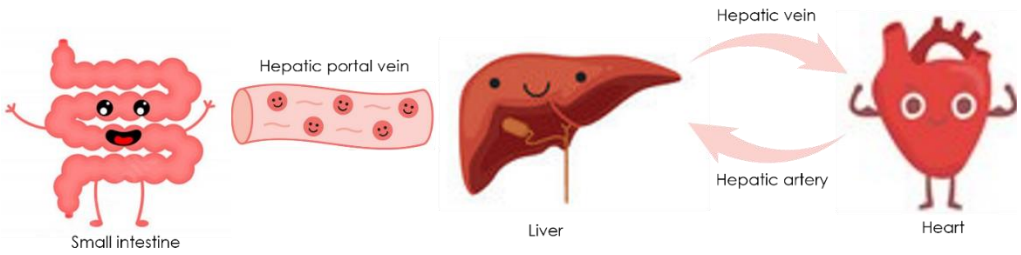
Functions of the liver

The many functions of the liver not only ensure the optimal and healthy functioning of the various organs in the body, but also allows the body to respond to changes in and around itself.

- Produces bile to aid in fat digestion
- Stores glycogen to help regulate blood glucose concentration
- Deaminates excess amino acids for excretion
- Breaks down alcohol into harmless soluble substances
- Breaks down hormones that have completed their functions

Assimilation

Nutrient-rich blood leaving the small intestine is first transported to the liver via the **hepatic portal vein**. This allows the liver to regulate the concentration of nutrients in blood prior to distribution, as well as remove any potential toxins absorbed before they can circulate broadly in the body.



Protein metabolism

After all the amino acids absorbed from the small intestine have been transported throughout the body to be used, excess amino acids will be deaminated in the liver then converted to urea before being excreted in urine.

Alcohol metabolism

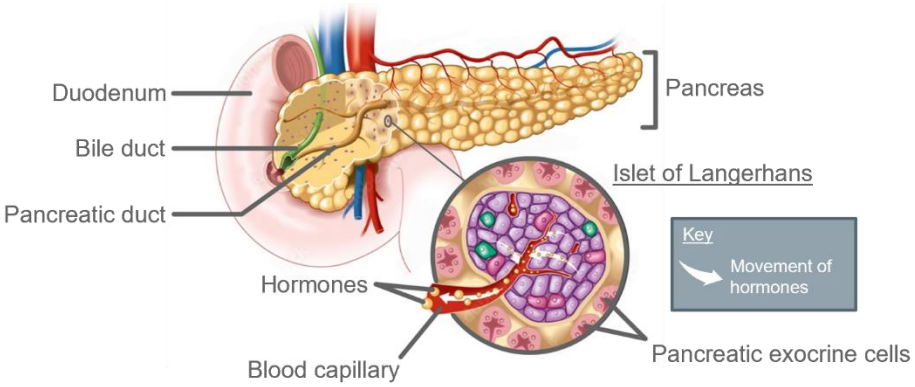
The liver can break down blood alcohol into less harmful substances.

$$\boldsymbol{alcohol} \xrightarrow{\boldsymbol{alcohol\ dehydrogenase}} \boldsymbol{carbon\ dioxide + water}$$

Blood glucose concentration regulation

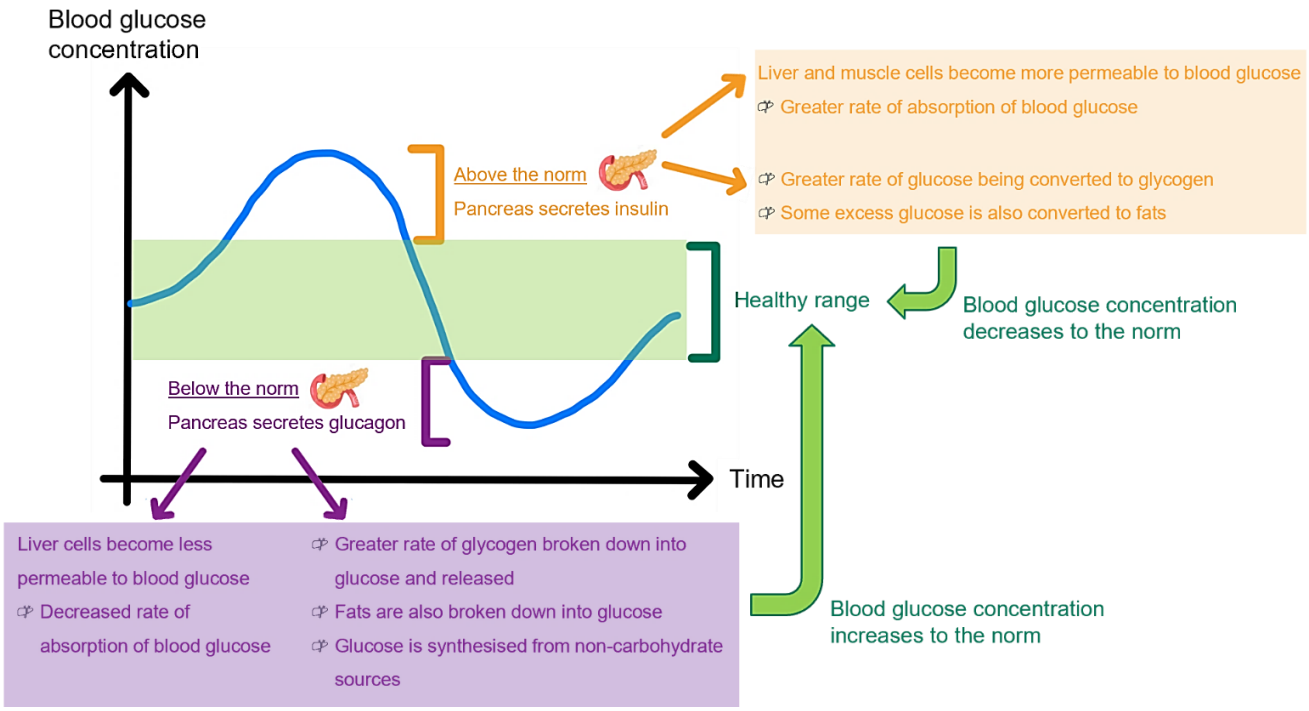
After a meal rich in carbohydrates, the amount of glucose present and absorbed at the small intestine will cause blood glucose levels to rise above the normal range. This triggers a series of events led by the liver and pancreas to bring blood glucose back down to healthy levels.

Conversely, should blood glucose levels fall below the acceptable range due to vigorous physical activities or periods of fasting, the liver and pancreas also work together to bring blood glucose levels back up to the norm.



The pancreas, liver, and muscles are all involved in maintaining healthy levels of glucose in the bloodstream. Cells would be deprived of energy if they do not receive sufficient glucose to undergo respiration, resulting in tissue death and organ failure. On the other hand, having too much glucose affects the normal functioning of cells, which may also result in tissue death and organ failure.

Role of insulin and glucagon



Upon detecting a drop in blood glucose concentration below the norm, the islets of Langerhans of the pancreas increase glucagon secretion into the bloodstream. When blood glucose concentration decreases back to the norm, the pancreas decreases its rate of glucagon secretion, and any existing blood glucagon is brought to the liver to be destroyed and excreted.

When blood glucose concentration increases above the norm, the islets of Langerhans of the pancreas increase insulin secretion into the bloodstream. Once blood glucose concentration increases back to the norm, the pancreas decreases its rate of insulin secretion, and any existing blood insulin is brought to the liver to be destroyed and excreted.

An unfortunately common consequence of not being able to respond to and correct fluctuating blood glucose concentration is known as diabetes mellitus.

Diabetes mellitus

Chronically elevated blood glucose concentration is an indication of diabetes where the pancreas cannot produce sufficient insulin (Type I), or target cells no longer respond adequately to insulin (Type II). Left untreated, diabetes could cause liver and kidney failure, and even the loss of limbs due to cells not receiving enough glucose for respiration.

Comparing Type I and Type II diabetes

	Type I	Type II
Problem	White blood cells attack and damage the islets of Langerhans in the pancreas 💉 Insufficient insulin	Overstimulation of insulin receptors on muscle and liver cells 💉 Insulin resistance
Cause	Genetic (can be inherited)	Frequent and excessive consumption of carbohydrates
Detection	Early onset	Late onset

People suffering from diabetes need to manage their diet (consume carbohydrates in moderation), have daily insulin injections (specifically for Type I diabetes), and lead healthier lives (exercise increases metabolic rate) to reduce the impact of the disease.

5. Transport in Humans

Blood

Red blood cells

Primary function	Unique structure or feature	How structure aids function
Transport oxygen from lungs to respiring cells	Biconcave shape	Greater surface area to volume ratio for an increased rate of diffusion of oxygen into and out of the cell
	Contains haemoglobin	Haemoglobin binds reversibly to oxygen
	Lacking most organelles: e.g. nucleus and mitochondria	More space to pack more haemoglobin in the cell
		No mitochondria to use up oxygen

White blood cells

Primary function	Unique structure or feature	How structure aids function
Protect body from diseases and infections	Irregularly shaped	Allows the cell to squeeze through gaps in the capillary endothelium
	Less numerous than red blood cells	Increase in numbers when fighting pathogens
Phagocytes: Ingest/engulf foreign matter (phagocytosis) like bacteria and viruses		
Lymphocytes: Produce antibodies that bind to and neutralise toxins		

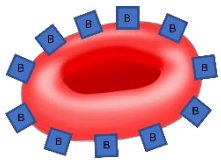
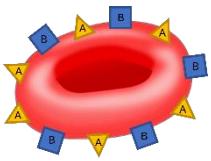
Platelets

Primary function	Unique structure or feature	Steps in the blood clotting process
Initiate the blood clotting process - Prevent excessive blood loss - Prevent entry of foreign pathogens	Small fragments of cytoplasm	1. Platelets and damaged tissues release enzymes 2. Enzymes convert soluble fibrinogen into insoluble fibrin strands 3. Fibrin strands form a mesh over the wound to trap red blood cells and form a clot

Plasma

Primary function	Unique structure or feature	Substances transported
Medium for transport	Pale yellow fluid that is 95% water	Useful: - Nutrients (glucose, amino acids) - Vitamins (A-E, K) - Hormones (insulin, oestrogen, testosterone) - Proteins (albumin, antibodies, enzymes) - Ions (calcium, iron, sodium) Not useful: - Urea - Carbon dioxide

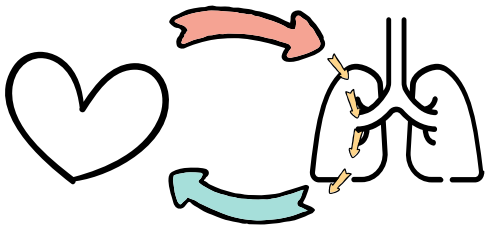
The human ABO blood group system

Blood group	A	B	AB	O
Antigens on red blood cells				
Antibodies in blood plasma			None	
Can receive from	A and O	B and O	A, B, AB, and O	O only
Can donate to	A and AB	B and AB	AB only	A, B, AB, and O

If an antibody binds to its complementary antigen on the red blood cell, the red blood cells clump up and form a mass in the blood vessel, potentially blocking off the blood supply to various organs. This is known as agglutination and is a fatal consequence of incorrectly matching blood donors to recipients.

Blood vessels

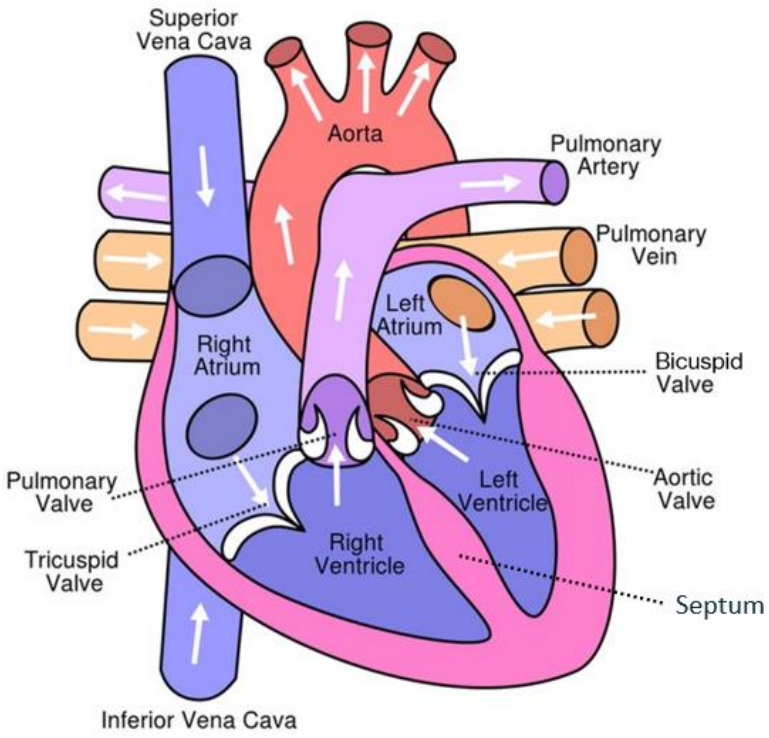
- Arteries transport blood away from the heart
- Veins transport blood towards the heart
- Capillaries allow substances to be exchanged between blood and body cells



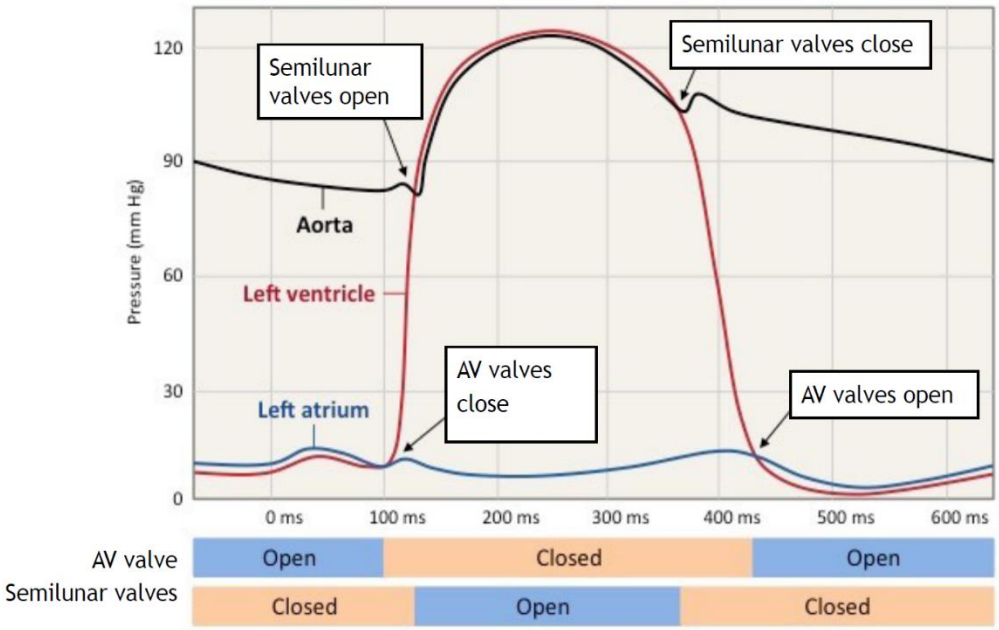
Structure of blood vessels

Structure	Artery	Vein	Capillary
Vessel wall	Thick and elastic muscular wall	Thin muscular wall	One-cell thick endothelium
Lumen diameter	Narrow	Wide	Very narrow
Vessel diameter	Large	Large	Very small
Presence of valves	Absent	Present	Absent

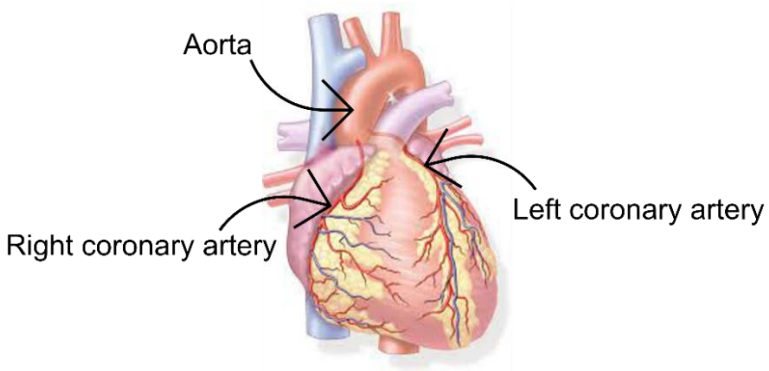
Structures of the human heart



Cardiac cycle graph



Coronary Heart Diseases



When the coronary arteries narrow or become blocked, the heart muscles receive less oxygenated blood and may die, resulting in a heart attack. Factors that increase the chances of a person suffering from coronary heart diseases include:

1. Unhealthy/unbalanced diet
2. Excessive stress
3. Smoking

Frequent consumption of foods high in fat and cholesterol is a rising cause of coronary heart disease. The excess fat and cholesterol accumulate in the bloodstream and may deposit on the inner walls of coronary arteries.

The lumen of the arteries narrows and eventually become entirely blocked, cutting off blood supply to the heart muscles.

6. Respiration in Humans

The respiratory system

Nose/nasal cavity

Structure	Function
• Lined with mucous membrane • Filled with tiny hairs	• Allows air to enter the body • Warms and moistens inhaled air • Nose hairs filter inhaled air by trapping dust and small particles

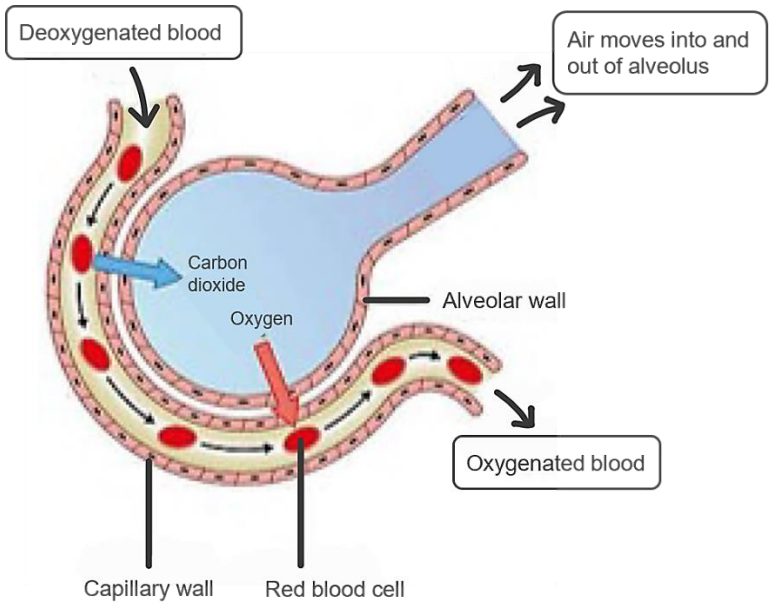
Larynx

Structure	Function
• Cartilaginous • Contains the vocal cords	Allows air to pass from the throat and enter the trachea

Trachea, bronchus, bronchiole

Structure	Function
Cartilaginous C-shaped rings	• Keeps the airway open as air passes between the nose and lungs • Membrane encloses the tracheal boundary facing the oesophagus to allow the bolus in the oesophagus to move smoothly via peristalsis
Contain mucus-producing cells	• Mucus traps dust and small particles (which may include pathogens) in inhaled air • Mucus also warms and moistens inhaled air
Lined with ciliated epithelial cells	• Sweeping motion of cilia pushes mucus away from the lungs • Towards the throat for mucus to be swallowed or expelled

Gaseous exchange at the alveoli



Structure	Function
Numerous in lungs	Increases surface area to volume ratio of lungs to increase the rate of diffusion - Human lungs contain millions of alveoli, which together have a surface area of about 100 m^2, 50 times that of the skin.
Elastic with one-cell thick epithelium	- Allow alveoli to inflate and deflate easily - Decreases diffusion distance for more efficient diffusion
Thin film of moisture on alveolar wall	- Allows oxygen to dissolve into aqueous state for more efficient diffusion - Prevent alveoli from collapsing
Surrounded by a dense capillary network	- Increases the amount of blood in contact with alveolar surfaces for exchange to occur more efficiently - Maintain steep concentration gradient of oxygen and carbon dioxide between air in the alveoli and the bloodstream - One-cell thick epithelium also decreases diffusion distance for more efficient diffusion

Breathing and respiration

Breathing (or ventilation) is how the body moves air into and out of the lungs, while gaseous exchange describes the exchange of oxygen and carbon dioxide between inhaled air and the bloodstream. These physical processes then allow cells to undergo cellular respiration, a chemical process which releases energy.

Aerobic respiration in humans

All living cells undergo aerobic respiration all the time and the chemical reactions involved occur in the mitochondria.

Glucose is broken down in the presence of oxygen to release energy, with carbon dioxide and water as the by-products.

Anaerobic respiration in humans

When engaging in vigorous physical activities that require rapid muscular contractions, the huge increase in energy demand becomes greater than what the maximum rate of respiration can supply. This forces muscle cells to also undergo anaerobic respiration to supplement the energy production.

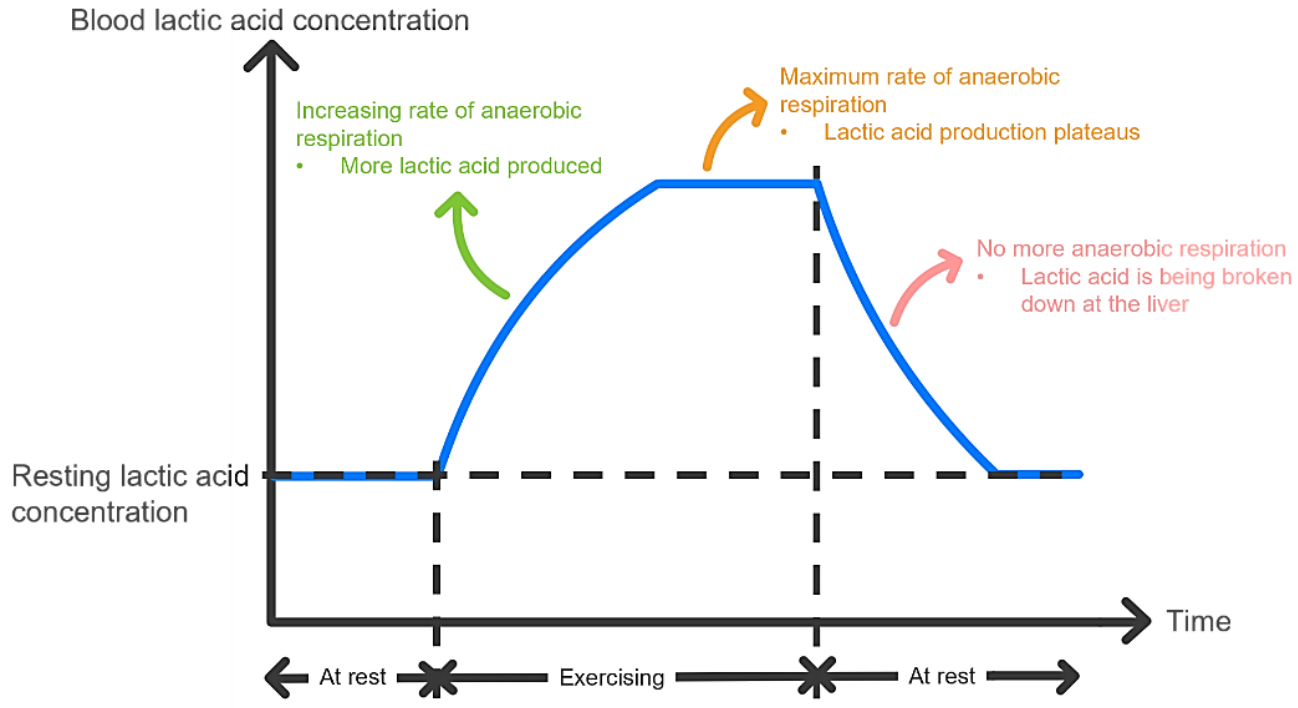
It is important to note that anaerobic respiration in humans only occur in the muscle cells, and releases very little energy compared to what aerobic respiration does.

Lactic acid is also toxic at higher concentrations and must be removed and broken down as quickly as possible. If not removed from muscle cells quickly, the accumulation of lactic acid may result in fatigue, cramps, and a burning sensation in the muscles.

Lactic acid and the oxygen debt

When the person is done exercising, breathing rate does not immediately return to resting levels due to the development of the oxygen debt. Rapid, deep breathing after exercise is used to remove or repay the oxygen debt.

1. The oxygen debt describes the amount of oxygen required, on top of the resting oxygen requirement, to break down the lactic acid produced during anaerobic respiration.
2. Lactic acid is transported in the bloodstream to the liver where it is broken down into less harmful substances to be expelled or excreted.



The harmful effects of tobacco smoke

Nicotine

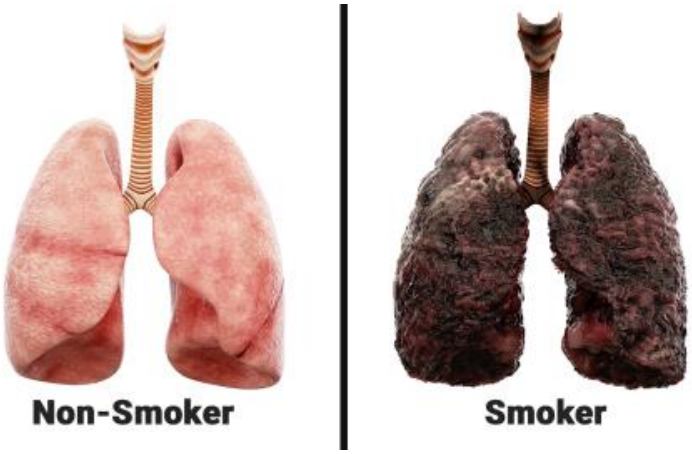
Nicotine is the addictive chemical in tobacco. It stimulates the nervous system and causes the heart rate and blood pressure to increase. Small blood vessels under the skin constrict more easily and nicotine also causes wrinkles to form prematurely.

Tar

Tar is highly carcinogenic and is a sticky substance that deposits on the walls of the airways. This paralyses cilia and irritates the epithelium, causing more mucus to be produced which remains trapped in the airways because the paralysed cilia are no longer functioning.

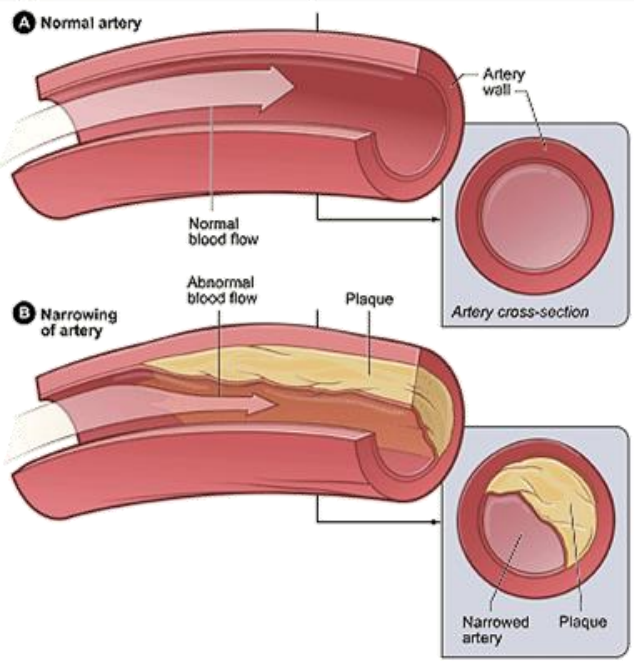
Tar coats the inner wall of the alveoli, reducing the surface area available for gaseous exchange to occur.

This decreases the amount of oxygen the red blood cells can absorb and the amount of carbon dioxide that can be removed from the bloodstream.



Carbon monoxide

Carbon monoxide binds more readily and more strongly to haemoglobin than oxygen does, and this reduces the amount of oxygen that each volume of blood can transport.



Plaque also forms more readily in blood with more carbon monoxide, increasing the risk of atherosclerosis.

Narrowed blood vessel face increased blood pressure, and the vessel walls also lose their elasticity.

END OF YEAR MOCK EXAMINATION
SECONDARY THREE
BASED ON 2024 SEAB SYLLABUS

BIOLOGY **6093/01**

Paper 1

September 2024
30 minutes

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

There are **twenty** questions on this paper. Answer **all** questions. For each question, there are four possible answers A, B, C and D.
Choose the **one** you consider correct and record your choice in **soft pencil** on the Optical Answer Sheet.

Fill in the Optical Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question paper.
The use of an approved scientific calculator is expected, where appropriate.

Shade the corresponding lozenge.

Total score: _____

1	A ▭	B ▭	C ▭	D ▭
2	A ▭	B ▭	C ▭	D ▭
3	A ▭	B ▭	C ▭	D ▭
4	A ▭	B ▭	C ▭	D ▭
5	A ▭	B ▭	C ▭	D ▭
6	A ▭	B ▭	C ▭	D ▭
7	A ▭	B ▭	C ▭	D ▭
8	A ▭	B ▭	C ▭	D ▭
9	A ▭	B ▭	C ▭	D ▭
10	A ▭	B ▭	C ▭	D ▭
11	A ▭	B ▭	C ▭	D ▭
12	A ▭	B ▭	C ▭	D ▭
13	A ▭	B ▭	C ▭	D ▭
14	A ▭	B ▭	C ▭	D ▭
15	A ▭	B ▭	C ▭	D ▭
16	A ▭	B ▭	C ▭	D ▭
17	A ▭	B ▭	C ▭	D ▭
18	A ▭	B ▭	C ▭	D ▭
19	A ▭	B ▭	C ▭	D ▭
20	A ▭	B ▭	C ▭	D ▭

Question 1

A drawing of an animal cell is shown below.

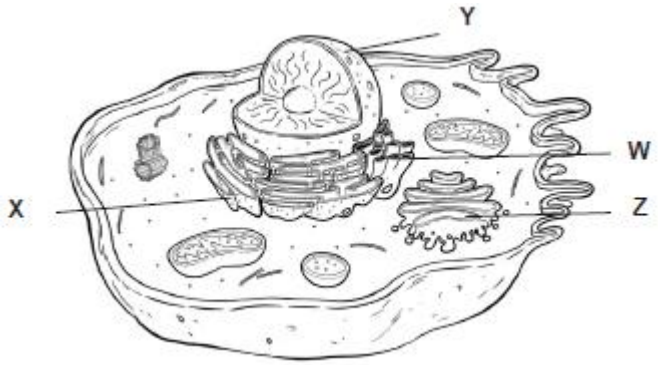


Figure 1.1

Which statements are true of structures W, X, Y, and Z?

I. X is the site where polysaccharides are synthesised.

II. Y controls all cellular activities in the cell.

III. Z modifies the substances made in Y.

IV. W carries out detoxification.

(A) I and III
(B) II and III
(C) II and IV
(D) I and II

Question 2

Live pancreatic cells were extracted from a mouse and kept in an isotonic buffer solution maintained at 37°C. Radioactive amino acids were added to the solution to study the protein synthesis processes in the cells. In which order would radioactivity be detected?

(A) Golgi body → rough endoplasmic reticulum → secretory vesicles

(B) Golgi body → rough endoplasmic reticulum → smooth endoplasmic reticulum

(C) rough endoplasmic reticulum → Golgi body → secretory vesicles

(D) rough endoplasmic reticulum → smooth endoplasmic reticulum → Golgi body

Question 3

The diagram shows a plant cell after it has been submerged in solution P for 20 minutes.

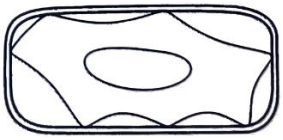


Figure 3.1

Which row describes the water potential of solution P at the start of the experiment and the condition of the cell after 20 minutes?

	Water potential of solution P at the start of the experiment	Condition of the cell after 20 minutes
(A)	Higher than the inside of the cell	Plasmolysed and turgid
(B)	Higher than the inside of the cell	Under high turgor pressure
(C)	Lower than the inside of the cell	Plasmolysed and flaccid
(D)	The same as the inside of the cell	Under low turgor pressure

Question 4

A partially permeable membrane is filled with starch suspension and placed in a beaker containing iodine in potassium iodide solution.

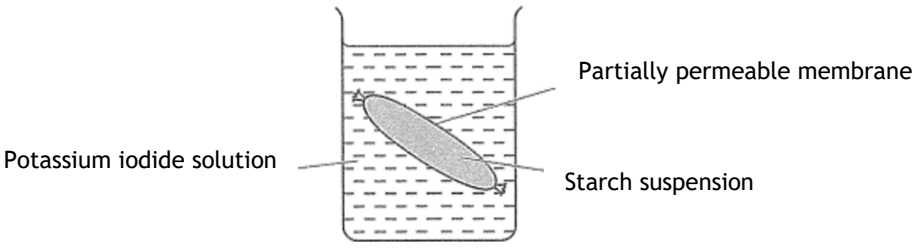


Figure 4.1

After 10 minutes, the colour of that liquid inside the partially permeable membrane turned blue-black while the liquid in the beaker remained yellowish-brown.

Which statement best explains the result of this experiment?

(A) Iodine diffused through the membrane.

(B) Iodine entered the membrane via osmosis.

(C) Starch diffused through the membrane.

(D) Starch entered the membrane via osmosis.

Question 5

Sheryl was eating a piece of unsweetened bread then realised it tasted sweeter after chewing on it for 5 minutes. What is the reason for her observation?

(A) Bacteria in her mouth fed on starch and produced sugar.

(B) Enzymes in her saliva digested the starch into maltose.

(C) Sugar in the bread diffused into her mouth.

(D) Saliva was converted to sugar when chewing.

Question 6

Food tests were conducted on an extract of saliva taken directly from the salivary glands. Which of the following correctly shows the final observations of the food tests?

	Benedict's test	**Biuret test**	**Ethanol emulsion test**
(A)	Blue mixture	Blue mixture	Cloudy white emulsion
(B)	Blue mixture	Violet mixture	Clear colourless solution
(C)	Orange mixture	Blue mixture	Cloudy white emulsion
(D)	Orange mixture	Violet mixture	Clear colourless solution

Question 7

William did an experiment in school using egg whites and gastric secretions.

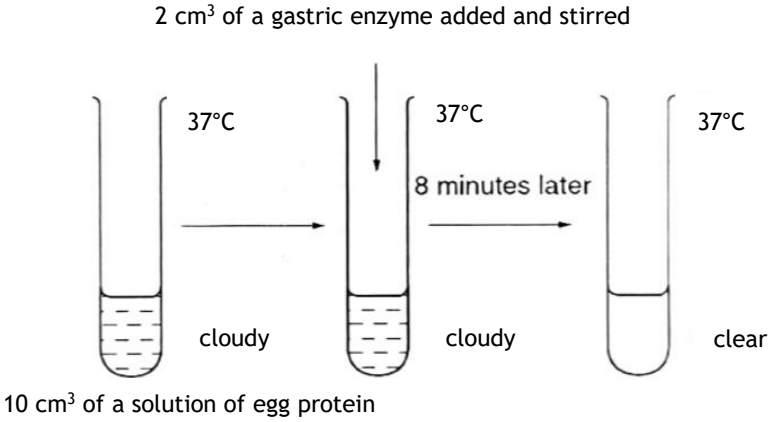


Figure 7.1

What could he have done to observe a clear solution more quickly?

(A) Add more egg whites.

(B) Leave the mixture alone without stirring.

(C) Lowered the pH of the mixture.

(D) Raised the temperature to 65°C.

Question 8

Six green beans were collected from the same plant and soaked in water for 6 hours. Three were placed in a boiling water bath kept at 100°C while the other three were kept at room temperature water. After 24 hours, all the beans were chopped up and placed on the surface of a starch-infused agar jelly.

All the seeds were removed after 2 days, and the jelly was flooded with iodine solution. The diagram shows the result of the experiment.

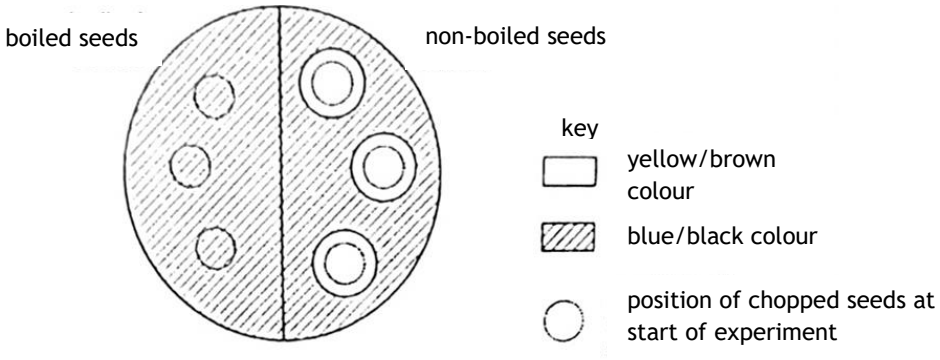


Figure 8.1

What caused the colours observed with the non-boiled seeds?

(A) The seeds naturally caused the colour of the agar to fade.

(B) The seeds reacted with the iodine to produce a yellowish-brown colour.

(C) The seeds secreted amylase which caused the iodine to break down

(D) The seeds secreted amylase which caused starch to break down.

Question 9

Cholecystectomy is the surgical removal of the gallbladder to treat gallstones and its related complications. Which of the following are expected after the surgery?

I. Decreased glycerol secretion

II. Lowered amino acid absorption

III. Less bile is produced

IV. Decreased rate of fat digestion

(A) I and III
(B) II and IV
(C) III
(D) IV

Question 10

A certain disease in cows causes their small intestines to become completely smooth.

Which of the following is a likely consequence of this disease?

(A) Constipation
(B) Increased absorption of digested food
(C) Increased fat digestion
(D) Malnutrition

Question 11

The following diagram shows part of the human digestive system.

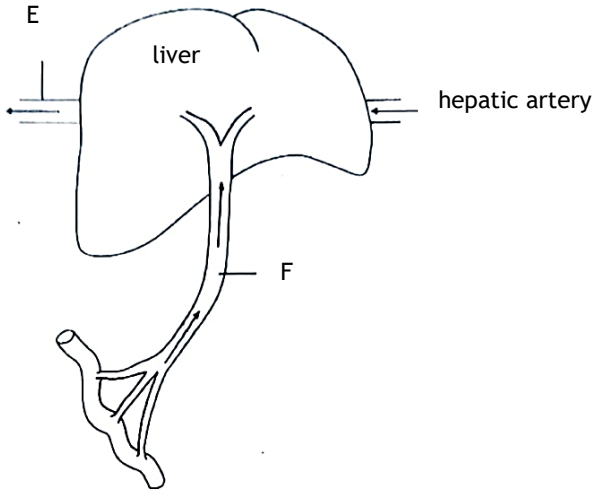


Figure 11.1

How would blood in vessels E and F differ after a heavy meal of rice and potatoes?

(A) There would be an equal concentration of glucose in E and F.

(B) F would have a greater concentration of glucose than E.

(C) E would have a greater concentration of starch than F.

(D) Both regions will not have any glucose.

Question 12

The diagram below shows the flow of blood through the systemic circuit. The arrows show the direction of blood flow.

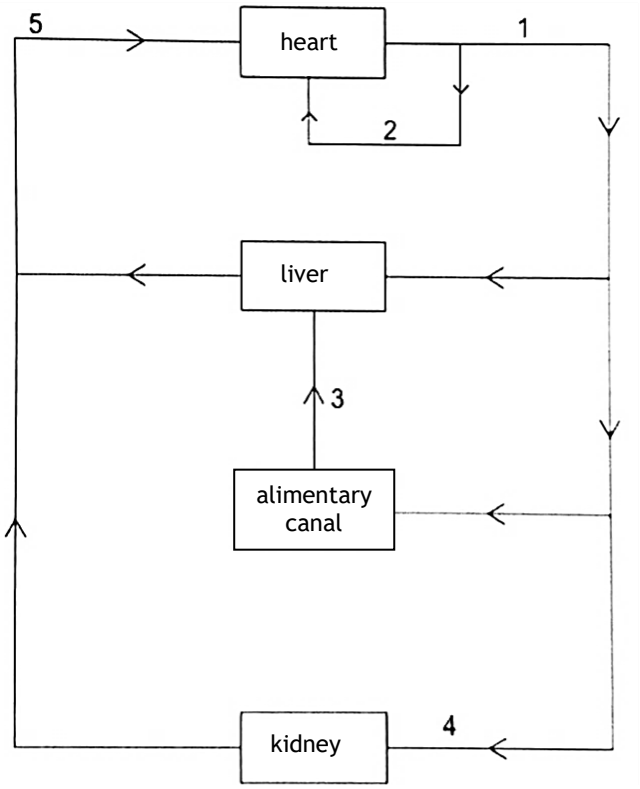


Figure 12.1

If blood vessel 1 is the aorta, which row correctly identifies the other blood vessels?

	2	3	4	5
(A)	aortic arch	hepatic artery	renal artery	vena cava
(B)	aortic arch	hepatic portal vein	renal artery	pulmonary vein
(C)	coronary artery	hepatic portal vein	renal artery	vena cava
(D)	coronary artery	hepatic artery	renal vein	aorta

Question 13

Three valves inside a human heart are labelled in the diagram below.

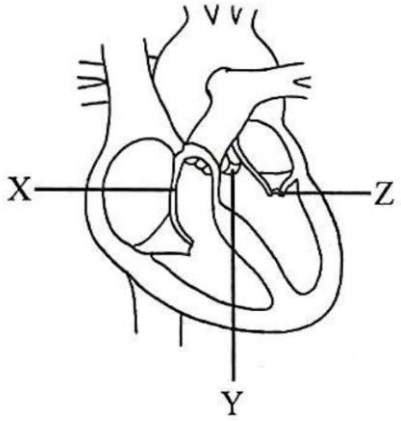


Figure 13.1

Which of following correctly shows the action of valves X, Y, and Z when the atria contract?

	X	Y	Z
(A)	Open	Close	Open
(B)	Open	Open	Open
(C)	Close	Open	Close
(D)	Close	Close	Close

Question 14

A person exhales, and the air from their lungs is collected and placed in a gas jar. A second gas jar contains normal atmospheric air.

A candle is set alight and is placed inside each gas jar as shown. The time taken for each flame to go out is measured with a stopwatch.

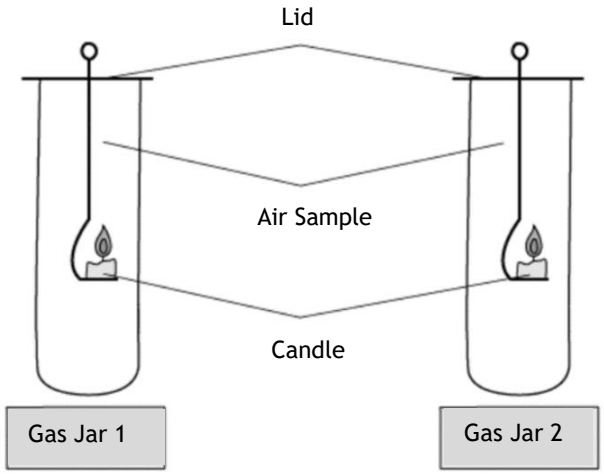


Figure 14.1

The table shows the results of this experiment.

Gas jar	Time for candle to go out / s
1	7
2	12

Table 14.1

Which of the following is the best explanation for the difference between the results in gas jars 1 and 2?

(A) Jar 1 contains atmospheric air which has less oxygen than exhaled air.

(B) Jar 1 contains exhaled air which has less oxygen than atmospheric air.

(C) Jar 2 contains atmospheric air which has more carbon dioxide than exhaled air.

(D) Jar 2 contains exhaled air which has more carbon dioxide than atmospheric air.

Question 15

The diagram shows the oxygen uptake of a man before, during, and after strenuous exercise. Which region represents the repayment of oxygen debt.

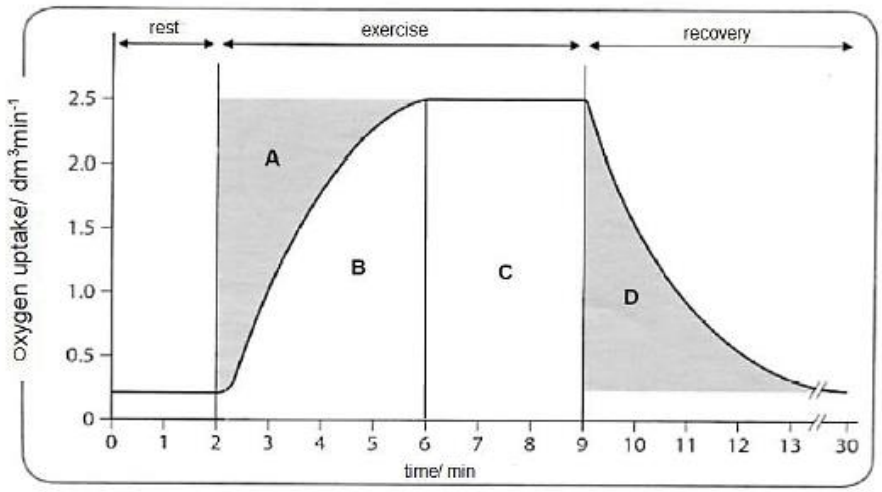


Figure 15.1

(A) A
(B) B
(C) C
(D) D

Question 16

Drinks that contain alcohol reduce the production of anti-diuretic hormone (ADH).

Which row shows the effect of such drinks on the kidney tubule and the urine produced?

	Amount of water reabsorbed by kidney tubule	Effect on urine produced	
		Quantity	Concentration
(A)	decreased	decreased	concentrated
(B)	decreased	increased	diluted
(C)	increased	decreased	concentrated
(D)	increased	increased	diluted

Question 17

The diagram shows a human kidney and its blood vessels.

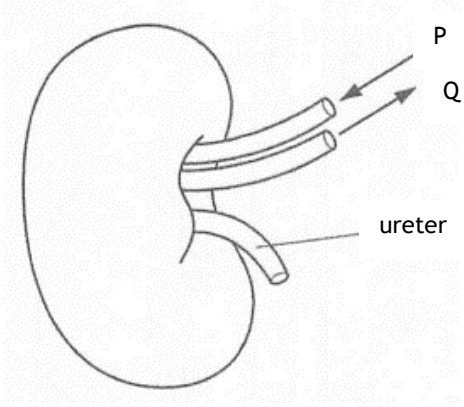


Figure 17.1

Which row correctly compares the blood in vessel Q with the blood in vessel P?

	Blood in vessel Q has		
	Percentage carbon dioxide	Percentage water	Percentage glucose
(A)	less	more	less
(B)	less	more	more
(C)	more	less	less
(D)	more	less	more

Question 18

A swimmer stays too long in very cold water and his body temperature falls below 37°C. After he comes out of the water, what will help his body temperature return to normal?

1. blood rushing to the skin surface
2. drying the skin quickly with a towel
3. hair erector muscles relaxing
4. shivering
5. running around

(A) 1, 2 and 3
(B) 1, 3 and 4
(C) 2, 4 and 5
(D) 3, 4 and 5

Question 19

Which factors are controlled by homeostasis?

	Glucose concentration in the blood	Water content in the urine	Temperature in the liver
(A)	✓	✓	✓
(B)	✓	✓	X
(C)	✓	X	✓
(D)	X	✓	✓

Question 20

The sentences describe the homeostatic function of the skin when the body temperature rises above normal.

The blood vessels near the skin surface ..... 1 .....
Glands in the skin release ..... 2 .....
These actions are controlled by the ..... 3 .....
The body cools when water ..... 4 .....

	1	2	3	4
(A)	narrow	oils	pancreas	is absorbed
(B)	narrow	sweat	hypothalamus	is absorbed
(C)	widen	oils	pancreas	evaporates
(D)	widen	sweat	hypothalamus	evaporates

END OF YEAR MOCK EXAMINATION
SECONDARY THREE
BASED ON 2024 SEAB SYLLABUS

BIOLOGY **6093/02**

Paper 2 September 2024

40 minutes

READ THESE INSTRUCTIONS FIRST

Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in the spaces provided.

The number of marks is given in brackets [ ] at the end of each question or part question.

The use of an approved scientific calculator is expected, where appropriate.

SCORE

Paper 1		20
Paper 2		30
TOTAL		50

Write your answers in the spaces below.

Question 21

The table below shows how four mixtures were prepared for an experiment.

Flask	Content	Temperature of water bath (°C)
P	20 cm^3 starch solution + 5 cm^3 saliva	35
Q	20 cm^3 starch solution + 2 cm^3 saliva	35
R	20 cm^3 starch solution + 5 cm^3 boiled saliva	35
S	20 cm^3 starch solution + 2 cm^3 saliva	10

Table 21.1

Samples from each flask were obtained at 5-minute intervals and the iodine test was carried out. The experiment was stopped 25 minutes later when starch breakdown was completed in two of the flasks. The results of the experiment are shown below.

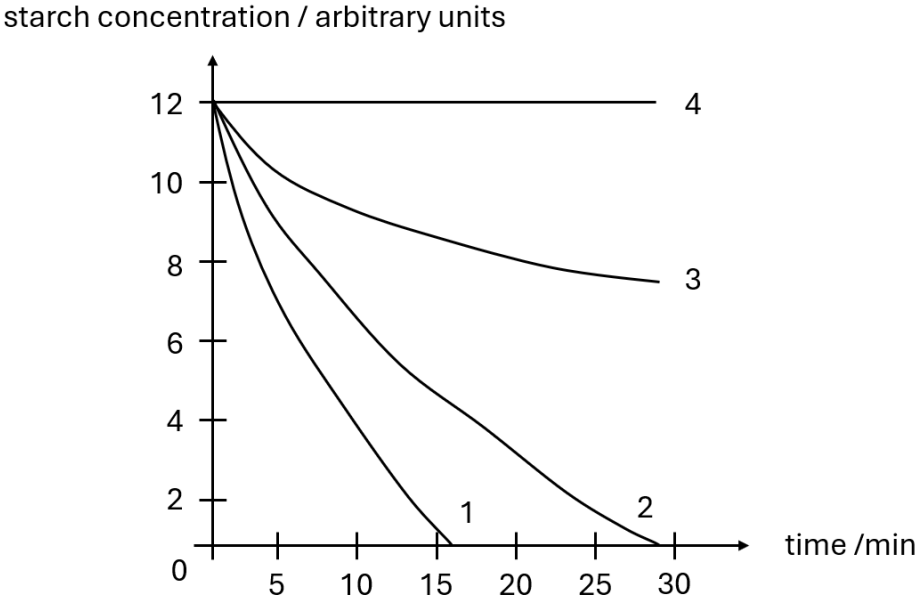


Figure 21.1

(a) Match the curves to the correct flasks. [2]

Flask P: Curve _____ Flask R: Curve _____

Flask Q: Curve _____ Flask S: Curve _____

(b) Another flask T containing 20 cm^3 starch solution + 5 cm^3 saliva was acidified with dilute hydrochloric acid and set up for 25 minutes at 35 ºC. When the results were plotted on the graph above, a curve that exactly matched one of the existing curves was obtained.

(i) Identify the curve that exactly matched the results for flask T. [1]

(ii) Explain your answer in part (b)(i). [3]

Question 22

The diagram below shows three white towels with identical oil stains. They were washed with biological washing powder at three different temperatures, 15 °C, 40 °C, and 75 °C.

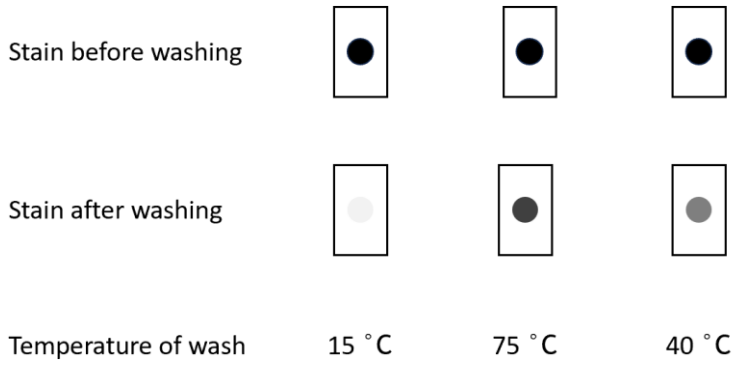


Figure 22.1

(a) (i) Identify the main component of the biological washing powder that removed the oil stain. [1]

(ii) Eunice recalled that increasing the temperature would increase the rate of a reaction and told her mum to use hot water at 90 °C for a more effective wash.

Do you agree with her statement? Explain why. [3]

(b) Describe the test for the substance in part (a)(i) in a sample of biological washing powder. [3]

Question 23

A diagram of the human digestive system is shown below.

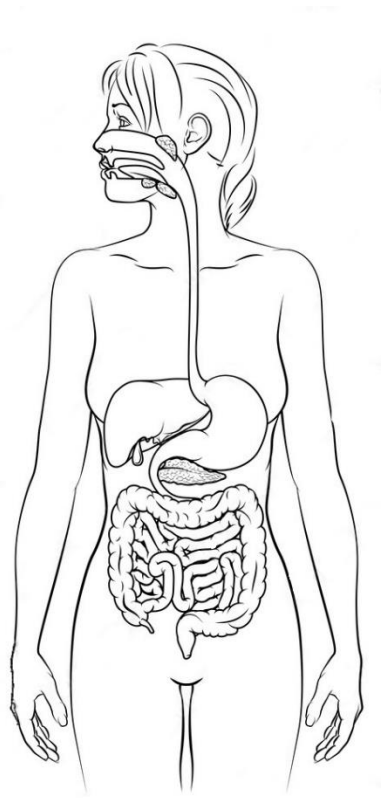


Figure 23.1

(a) Label on the diagram above the pancreas. [1]

(b) Suggest and explain how a person's diet has to change if the pancreas was removed. [3]

Question 24

The diagram below shows a longitudinal cut of the human heart.

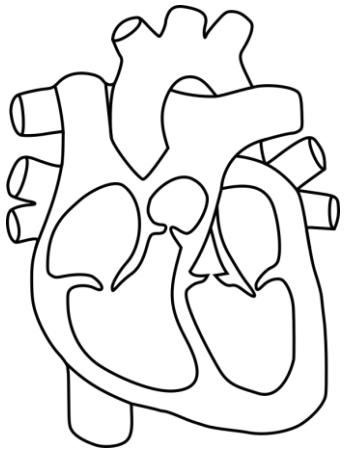


Figure 24.1

(a) Identify and label on the diagram the following parts of the heart:

(i) Right ventricle [1]

(ii) Bicuspid valve [1]

(iii) Aorta [1]

(b) Aortic regurgitation occurs when the aortic valve weakens and cannot function properly. Describe the effect of a weaken aortic valve on the volume of blood flowing through the aorta and how it affects the body. [2]

(c) Describe how one-way arteries are adapted for their function. [1]

Question 25

The graph below shows how pressure in the left side of the heart changes in a single heartbeat.

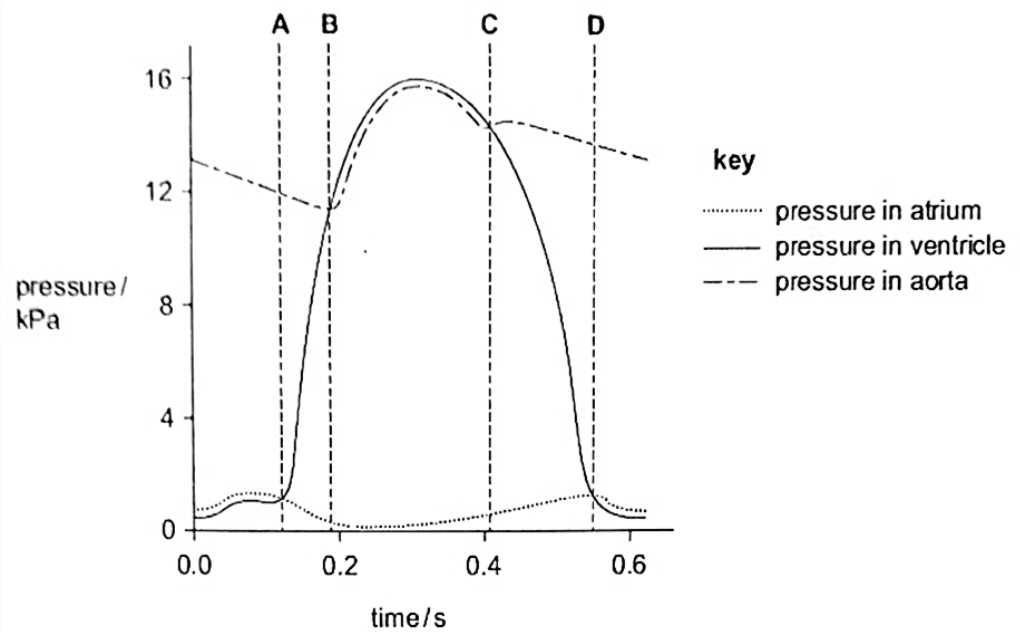


Figure 25.1

(a) At which point, A, B, C, or D, do the semilunar valves first close? Explain why. [3]

(b) With reference to a patient with blood type B, describe the importance of donor-recipient matching in blood transfusions. [4]

~ End of Paper ~

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Marine Parade	Tuesday	5PM - 7PM
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Bukit Timah	Saturday	2PM-4PM

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Bukit Timah	Saturday	5PM-7PM