Advanced Subsidiary GCE Biology

Unit F214 - Communication, Homeostasis and Energy - High banded Candidate style answer

OCR has produced these candidate style answers to support teachers in interpreting the assessment criteria for the new GCE specifications and to bridge the gap between new specification release and availability of exemplar candidate work.

This content has been produced by senior OCR examiners, with the input of Chairs of Examiners, to illustrate how the sample assessment questions might be answered and provide some commentary on what factors contribute to an overall grading. The candidate style answers are not written in a way that is intended to replicate student work but to demonstrate what a “good” or “excellent” response might include, supported by examiner commentary and conclusions.

As these responses have not been through full moderation and do not replicate student work, they have not been graded and are instead, banded “medium” or “high” to give an indication of the level of each response.

Please note that this resource is provided for advice and guidance only and does not in any way constitute an indication of grade boundaries or endorsed answers.

1 The pancreas contains endocrine tissue. Fig. 1.1 shows an electron micrograph of a section of pancreatic endocrine tissue.

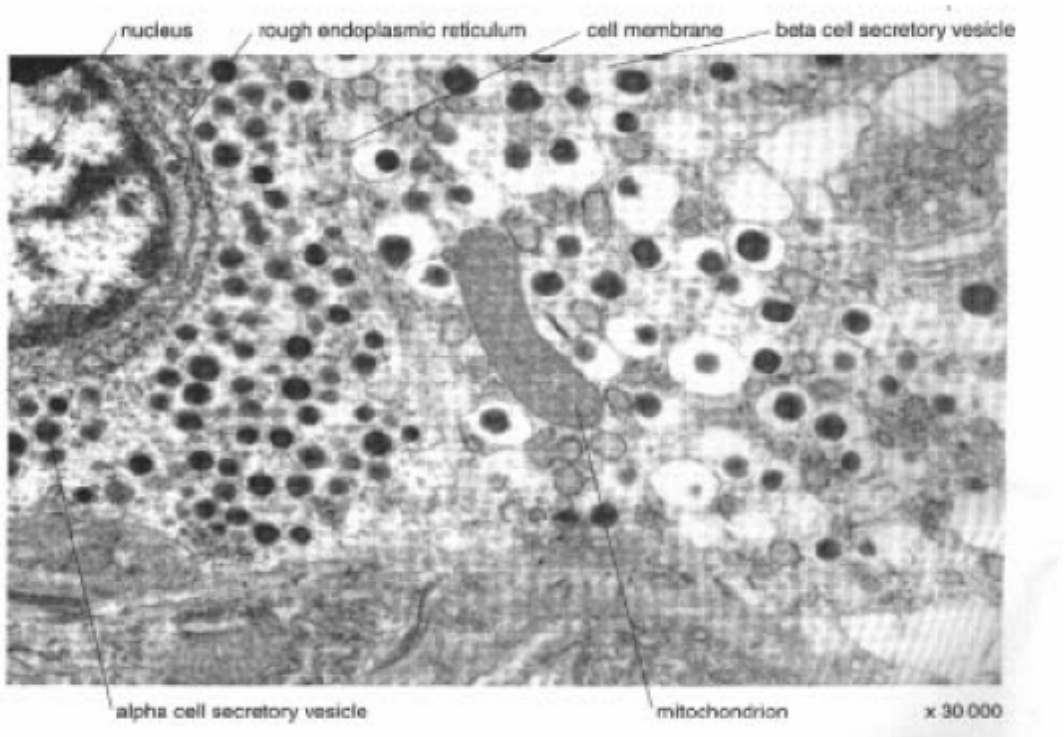


Fig. 1.1

(a) Name the endocrine tissue shown in Fig. 1.1. [1]

Candidate style answer	*Examiner's commentary*
Islets of Langerhans	A correct answer.

(b Name the hormone present in the secretory vesicles of alpha cells. [1]	
Candidate style answer	*Examiner's commentary*
Glucagon	A correct answer with correct spelling that is not ambiguous.

(c) During vigorous exercise, the blood glucose concentration falls. Describe the changes that take place to make sure that the blood glucose concentration does not fall to a dangerous level. *In your answer, you should use appropriate technical terms, spelled correctly.* [6]	
Candidate style answer	*Examiner's commentary*
The fall in blood glucose concentration is detected by the alpha and beta cells in the Islets of Langerhans in the pancreas. The alpha cells start producing glucagon and this is released into the bloodstream. The beta cells stop producing insulin. The glucagon stimulates the liver cells to convert glycogen into glucose. This is released into the blood and so increases the blood glucose concentration. Negative feedback keeps the concentration around the correct level.	This answer shows good understanding and has addressed the question. The answer could have been improved by referring to receptors for the hormone on the cell surface membrane and specific mention of gluconeogenesis.

2 The light-dependent stage of photosynthesis takes place on thylakoid membranes in chloroplasts. These membranes surround the thylakoid space (lumen) and are arranged into stacks known as grana. Fig. 2.1 is a diagram showing the arrangement of photosystems in the thylakoid membrane, and summarising the processes that take place there.

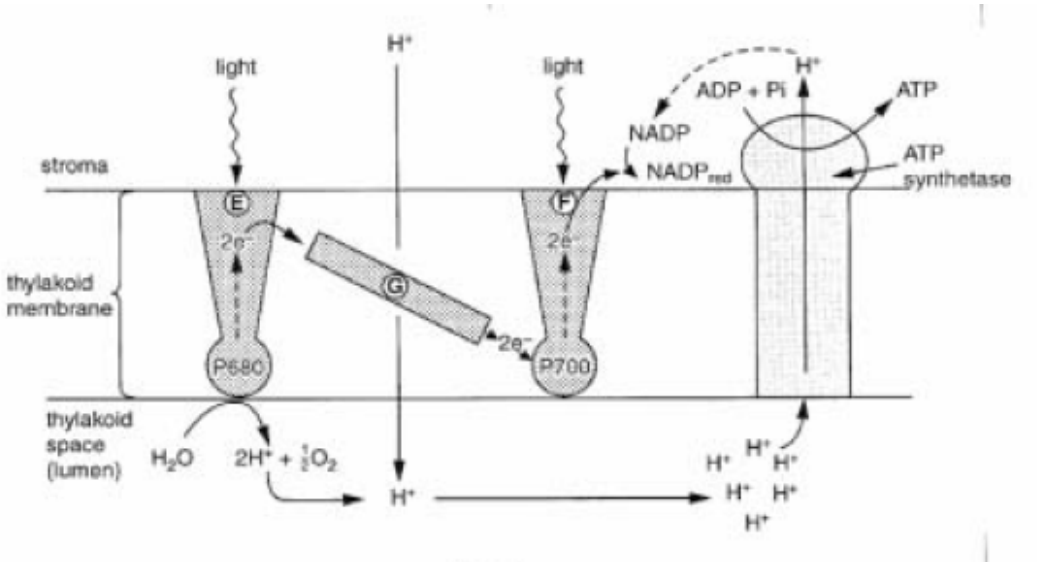


Fig. 2.1

(a)(i) Name the pigment represented by P680 and P700. [1]

Candidate style answer	*Examiner's commentary*
Chlorophyll a	The pigment was correctly identified.

(ii) Name the <u>type</u> of molecule represented by <u>G</u>. [1]	
Candidate style answer	*Examiner's commentary*
An electron carrier such as cytochrome.	Correct answer together with correct additional detail.

(b) Explain, <u>using the information in Fig. 2.1,</u> why the pH of the thylakoid space (lumen) is lower than that of the stroma <u>and</u> what significance this has for ATP production. [4]	
Candidate style answer	*Examiner's commentary*
The pH in the lumen is lower because there are more hydrogen ions there than in the stroma and pH is a measure of the concentration of hydrogen ions. They were pumped into the lumen using energy released as the electrons passed down the electron transport chain. The membrane is impermeable to hydrogen ions so the only place that they can go back into the stroma is through the stalked particles. As they diffuse back into the stroma, ADP joins with P to produce ATP using the ATP synthetase in the stalked particle.	This answer indicates that the candidate has carefully considered the question and has provided accurate facts in a clear and logical manner.

(c) Herbicides (weedkillers) interfere with electron transport by accepting electrons. Suggest how this causes plants to die. [3]	
Candidate style answer	*Examiner's commentary*
If the electrons do not pass along the electron transport chain, then photophosphorylation will not take place and ATP won't be produced. The electron can't help to form reduced NADP so the two products of the light dependent reaction are not formed. This will have a knock-on effect for the Calvin cycle as without ATP and NADPH this cannot take place and TP is not formed and so glucose and amino acids and all the other possible products cannot be formed. As photosynthesis is effectively stopped, the plant dies.	A response that recognises the implications to photosynthesis of the interference with the electron transport chain. The answer given is clear and logical.

3(a) Define the term *excretion*. [2]

Candidate style answer	*Examiner's commentary*
The removal of waste products of the metabolism of the body, such as urea.	A correct answer that includes the fact that these compounds have been produced by the metabolism of the organism concerned.

(b) Table 3.1 shows the mass of different substances excreted by a volunteer during two 24 hour periods. During the first 24 hour period, the volunteer was fed a protein-deficient diet; during the second 24 hour period, the volunteer was fed a protein-rich diet. All other variables were kept constant.

Table 3.1

substance excreted	mass of substance excreted / g	
	protein-deficient diet	protein-rich diet
urea	2.20	14.70
uric acid	0.09	0.18
ammonium ions	0.04	0.49
creatinine	0.60	0.58

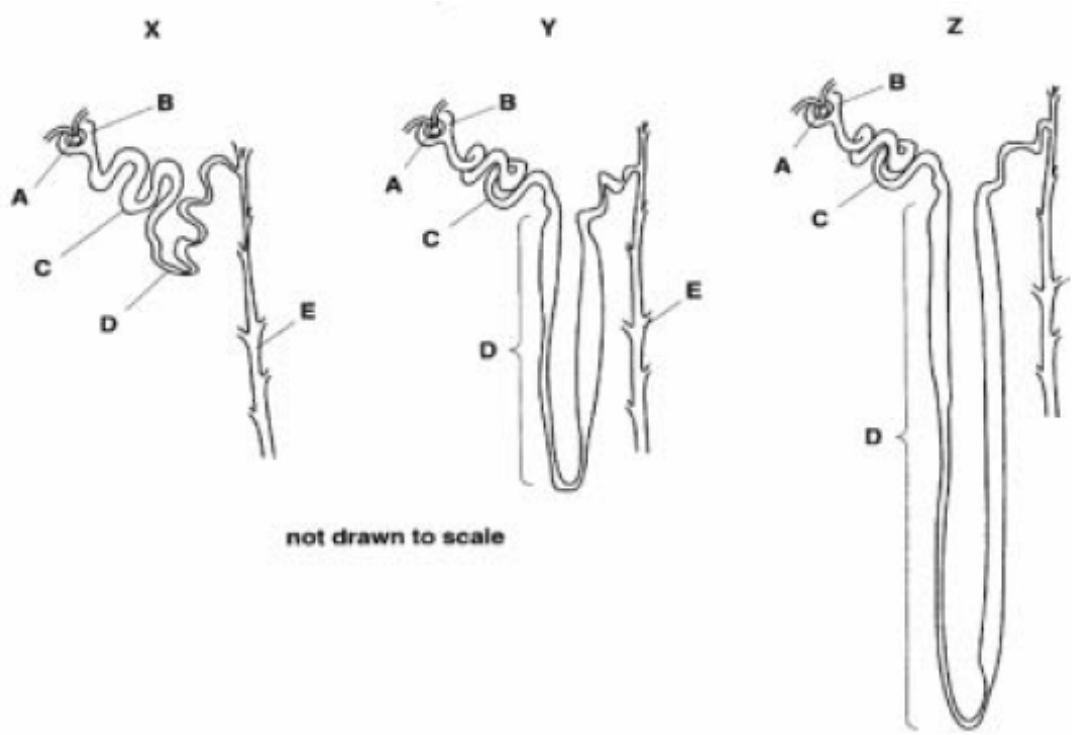
(i) Calculate the percentage increase in urea excreted when the volunteer switched from a protein-deficient to a protein-rich diet. Show your working. [2]

Candidate style answer	*Examiner's commentary*
14.7 – 2.2 = 12.5 *$\frac{12.5}{2.2}$ x 100 = 568.1818181* *Answer = ...568.....%*	A correct answer, given to an appropriate level of accuracy.

(ii) Describe how excess protein is converted into urea. [3]

Candidate style answer	*Examiner's commentary*
The protein is first of all converted into amino acids. Then in the liver they are deaminated by removing the amine groups and forming ammonia. This is then converted into urea by the ornithine cycle.	This answer shows good understanding, giving the sequence of events clearly and concisely.

Fig. 3.1 shows diagrams of nephrons from the kidneys of three different mammals, *X*, *Y* and *Z*.



	X	Y	Z
name of mammal	beaver	house mouse	desert living gerbil
water potential of urine	high	low	very low

Fig. 3.1

(c) Explain the relationship between the length of the section *D* in the nephrons and the water potential of the urine each mammal produces. [3]

Candidate style answer	*Examiner's commentary*
D is the loop of Henle. This is the part of the kidney which sets up the conditions for the reabsorption of water. Sodium ions pass out of the loop of Henle into the medulla. This decreases the water potential in the medulla and the longer the loop the more ions can move into the surrounding tissue. When the urine passes through the collecting duct, water moves out into the medulla by osmosis. The longer the loop of Henle then the more water that moves out of the urine so the more concentrated it will be, with a lower water potential. The gerbil has the longest loop of Henle and has the urine with the lowest water potential.	This answer has identified the relationship and has given a clear explanation.

4 Fig. 4.1 shows the relationship between various metabolic processes in yeast.

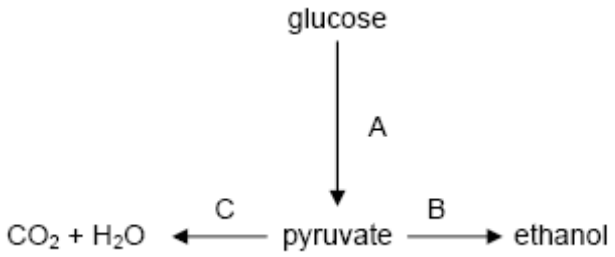


Fig. 4.1

(a)(i) Identify the three metabolic processes. [3]

Candidate style answer	*Examiner's commentary*
A *glycolysis* ***B*** *fermentation* ***C*** *aerobic respiration*	Three correct answers.

(ii) State the letter of the pathway in which acetyl coenzyme A is required. [1]

Candidate style answer	*Examiner's commentary*
C	This is correct, the candidate identifying its use in the conversion of pyruvate in Krebs cycle.

(iii) State the letter of the pathway in which ATP is utilised. [1]

Candidate style answer	*Examiner's commentary*
A	This answer correctly attributes the use of ATP in glycolysis.

(b) In an investigation, yeast cells were homogenised (broken up) and the resulting homogenate centrifuged. Portions containing only nuclei, ribosomes, mitochondria and cytosol (residual cytoplasm) were each isolated. Samples of each portion, and of the complete homogenate, were incubated in four ways:

1 With glucose.

2 With pyruvate.

3 With glucose and cyanide.

4 With pyruvate and cyanide.

Cyanide inhibits carriers in the electron transport chain, such as cytochromes.

After incubation, the presence or absence of carbon dioxide and ethanol in each sample was determined.

The results are summarised in Table 4.2.

✗ = absent ✓ = present ✓ = a little

Table 4.2

	samples of homogenate									
	complete		nuclei only		ribosomes only		mitochondria only		cytosol	
	carbon dioxide	ethanol	carbon dioxide	ethanol	carbon dioxide	ethanol	carbon dioxide	ethanol	carbon dioxide	ethanol
1 glucose	✓	✓	✗	✗	✗	✗	✗	✗	✓	✓
2 pyruvate	✓	✓	✗	✗	✗	✗	✓	✗	✓	✓
3 glucose and cyanide	✓	✓	✗	✗	✗	✗	✗	✗	✓	✓
4 pyruvate and cyanide	✓	✓	✗	✗	✗	✗	✗	✗	✓	✓

(i) Explain why more carbon dioxide is produced when the complete homogenate is incubated with just glucose or pyruvate than when cyanide is present. [3]

Candidate style answer	*Examiner's commentary*
Cyanide will stop the electron transport chain working. This means that pyruvate will not enter the mitochondria and the Krebs cycle cannot continue. If the Krebs cycle stops, decarboxylation will also stop and so no carbon dioxide will be produced. But glycolysis can still continue if pyruvate is converted to ethanol. Carbon dioxide is produced when pyruvate changes into ethanol, so there will be some carbon dioxide when cyanide is present even though the glucose hasn't been broken down completely. Without cyanide, the glucose is completely broken down to release carbon dioxide.	A good and logical answer.

(ii) Explain why carbon dioxide is produced when mitochondria are incubated with pyruvate but <u>not</u> when incubated with glucose. [3]

Candidate style answer	*Examiner's commentary*
Glucose is converted to pyruvate in the cytoplasm and the enzymes for those reactions are only found in the cytoplasm. But pyruvate can enter the mitochondria and the link reaction and Krebs can take place, producing carbon dioxide.	A correct and concise answer.

(iii) Explain why, in the presence of cyanide, ethanol production can still occur. [3]

Candidate style answer	*Examiner's commentary*
Pyruvate is converted into ethanal and this accepts the hydrogen and is converted into ethanol. So the electron transport chain is not used and the cyanide doesn't interfere with this reaction.	This answer uses the candidate's knowledge of anaerobic respiration to answer the specific question.

5(a) Fig. 5.1 is a diagram of a neurone.

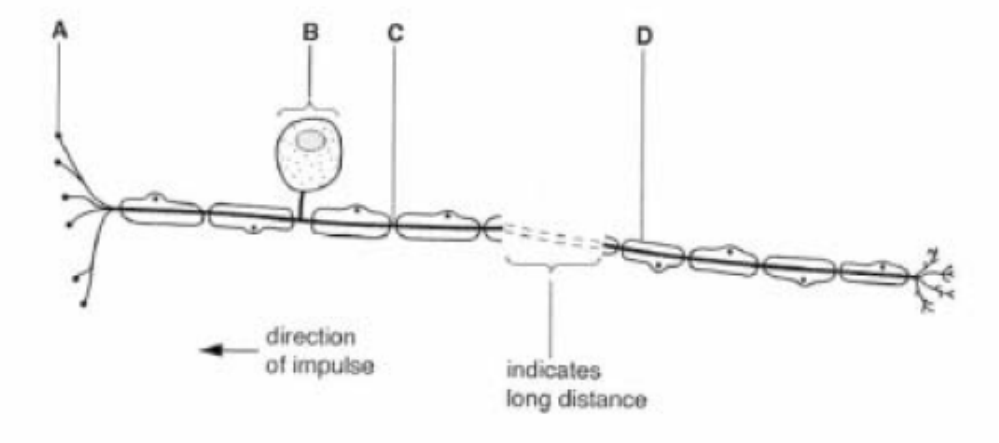


Fig. 5.1

Name the structures A and B. [2]

Candidate style answer	*Examiner's commentary*
A *synaptic knob* ***B*** *cell body*	Both structures have been correctly identified.

Fig. 5.2 shows a recording of the potential difference across the membrane of an axon as an action potential is transmitted.

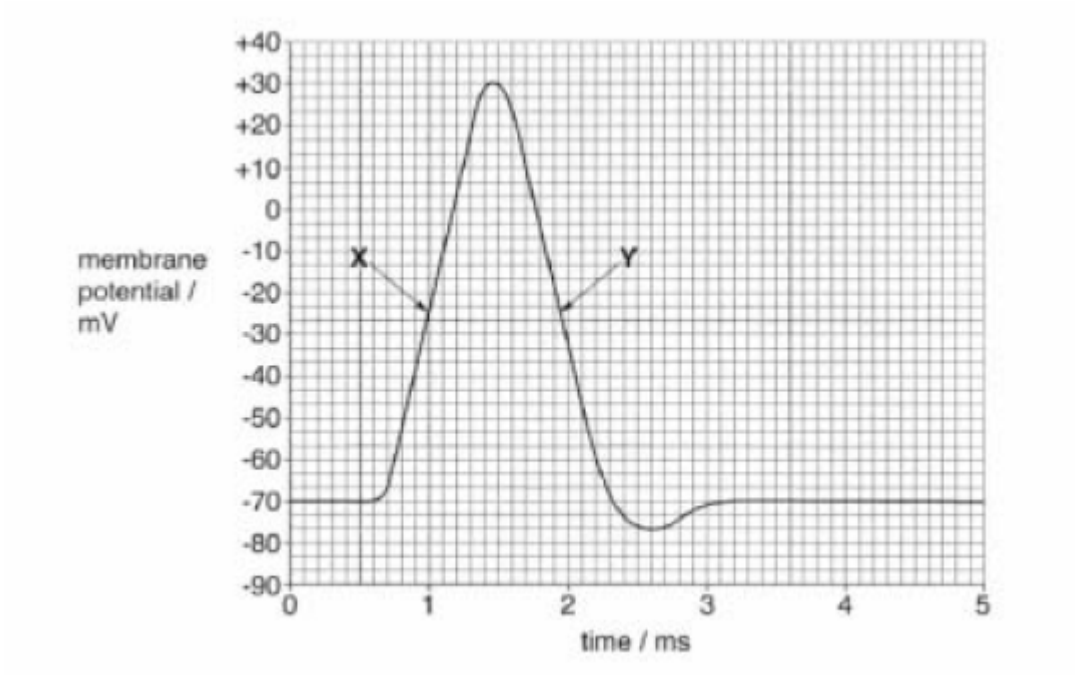


Fig. 5.2

(b) Describe the events taking place in the neurone during stages X and Y. [4]

Candidate style answer	*Examiner's commentary*
During X the potential increases from -70mV to +30mV. The sodium gates have opened and so sodium ions have diffused through the membrane and into the cell. During Y the potential decreases to -76.67mV. This is because potassium ion gates are opening and potassium ions flood out of the cell.	This answer is clear and concise, with accurate data quotes.

Table 5.3 shows how the speed of conduction of an action potential varies with the diameter of myelinated and non-myelinated axons in different organisms.

Table 5.3

organism	type of axon	axon diameter / μm	speed of conduction / ms^{-1}
crab	non-myelinated	30	5
squid	non-myelinated	500	25
cat	myelinated	20	100
frog	myelinated	16	32

(c) Describe the effect of myelination on the rate of conduction of an action potential and explain how this effect is achieved.

In your answer, you should use appropriate technical terms, spelled correctly. **[5]**

Candidate style answer	*Examiner's commentary*
The speed of conduction in a myelinated axon is faster than in a non-myelinated axon. A diameter of a squid axon is 25 times bigger than that of a cat but the speed of conduction in the smaller myelinated axon is 4 times faster. This is because the myelin sheath acts as an insulator. It stops ions travelling into and out of the cell. The only place that this can happen is at the nodes of Ranvier, where there is no myelin, so there are far fewer local circuits set up and each one is much longer. The action potential jumps from node to node and this is faster and is called saltatory conduction.	This answer clearly sets out the relationship between speed of conduction and myelination, with good use of data from the table in support. The explanation is clear and well expressed.

6(a)(i) State what is meant by the term respiratory substrate. **[1]**

Candidate style answer	*Examiner's commentary*
It is a compound that can be broken down during respiration to release the energy contained in the bonds.	This is a good and full answer.

The equation below shows aerobic respiration of compound A.

$$C_{55}H_{100}O_6 + 77O_2 \rightarrow 55CO_2 + 50H_2O$$

compound A

The respiratory quotient (RQ) is defined as:

$$RQ = \frac{\text{volume of } CO_2 \text{ released}}{\text{volume of } O_2 \text{ absorbed}}$$

(ii) Calculate the RQ for this reaction. Show your working. [2]

Candidate style answer	*Examiner's commentary*
55 ÷ 77 = 0.7124857 *Answer = ...0.7.....*	This answer is correct, RQ values normally being given to 1dp.

(iii) Compound A is a fat.
Suggest what the RQ of a carbohydrate, such as glucose, might be. [1]

Candidate style answer	*Examiner's commentary*
As the equation is $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ the same amount of oxygen is used as carbon dioxide produced. So the RQ will be 1.0	This answer is correct. Although no explanation was required, the candidate has clearly shown the reasoning for the answer.

(b) Fig. 6.1 is a diagram of a respirometer. A respirometer can be used to measure the oxygen uptake of living organisms.

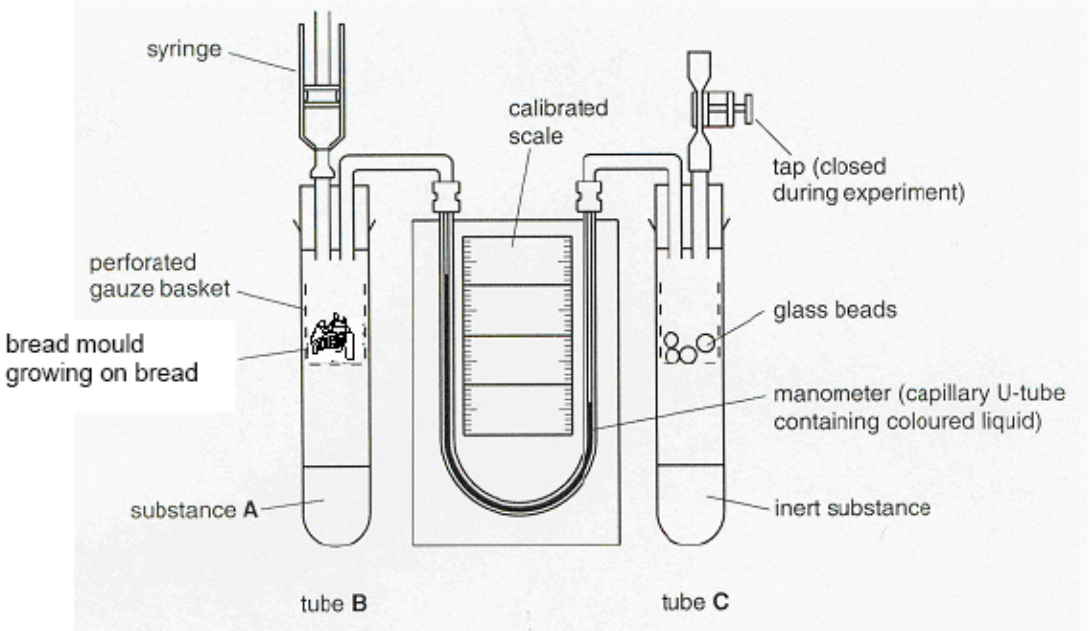


Fig. 6.1

Describe how the apparatus shown in Fig. 6.1 could be used to determine the <u>rate</u> of respiration of the bread mould, *Mucor*. [4]

Candidate style answer	*Examiner's commentary*
As Mucor respires, it takes in oxygen and gives out carbon dioxide. The carbon dioxide produced is absorbed by the substance in the bottom of tube B (possibly soda lime). This reduces the volume in tube B and so the liquid moves in the manometer towards the tube. So to measure the rate you first of all need to make sure that the apparatus is equilibrated. Then you adjust the position of the fluid in the manometer by using the syringe. Record the position of the fluid, leave the apparatus for a certain length of time (e.g. 10 minutes) and then record the new position of the liquid. Repeat and take a mean. If you know the diameter of the capillary tube you can work out the actual volume taken up to give the rate.	This answer is probably too detailed in clearly setting out the principle of how the respirometer works and also clearly shows how the rate may be determined.

Overall banding: High

The answers to these questions indicate thorough understanding of the principles being tested. The information is presented in an orderly and succinct fashion.