Advanced Subsidiary GCE Biology

Unit F214 - Communication, Homeostasis and Energy - Medium 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.

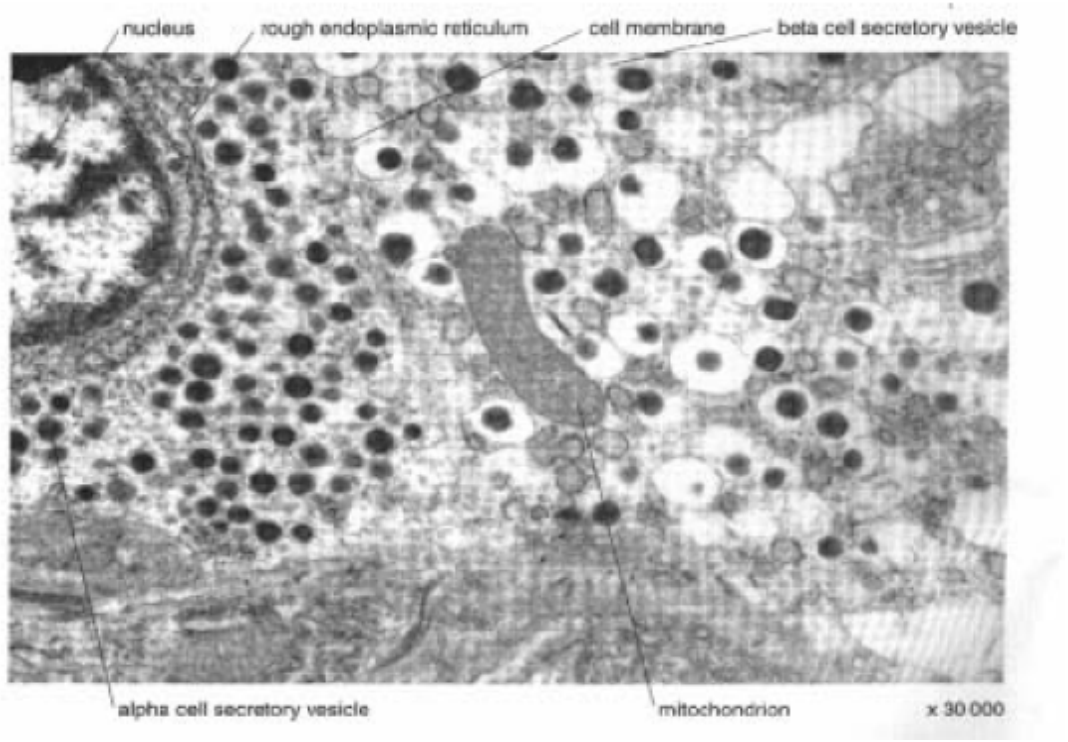


Fig. 1.1

(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*
Glucagen	While it is reasonably clear that the candidate understands the question, the spelling is ambiguous. Candidates should be aware that correct spelling is required if a word is likely to be confused with another term that has a distinctly different meaning. In this case, there could be some confusion with 'glycogen'.

(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*
As the blood concentration falls, this is detected by the brain. The alpha cells start producing glucagon and the beta cells stop producing insulin. This means that glucose is not converted into glycogen and some glycogen is converted into glucose. This increases the blood glucose concentration until it gets too high. Then the alpha cells stop producing glucagon and the beta cells produce insulin. This means that more excess glucose is converted into glycogen and is stored in the liver. Then as the blood glucose level falls again the whole thing starts all over again. This is called negative feedback.	An answer that shows knowledge and understanding of negative feedback but this is a standard answer that does not really address the question. The question only referred to ensuring that the blood glucose concentration does not fall too low, but this answer has continued the story. The answer could have been improved if further detail of the removal of glucose from the blood had been given.

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.

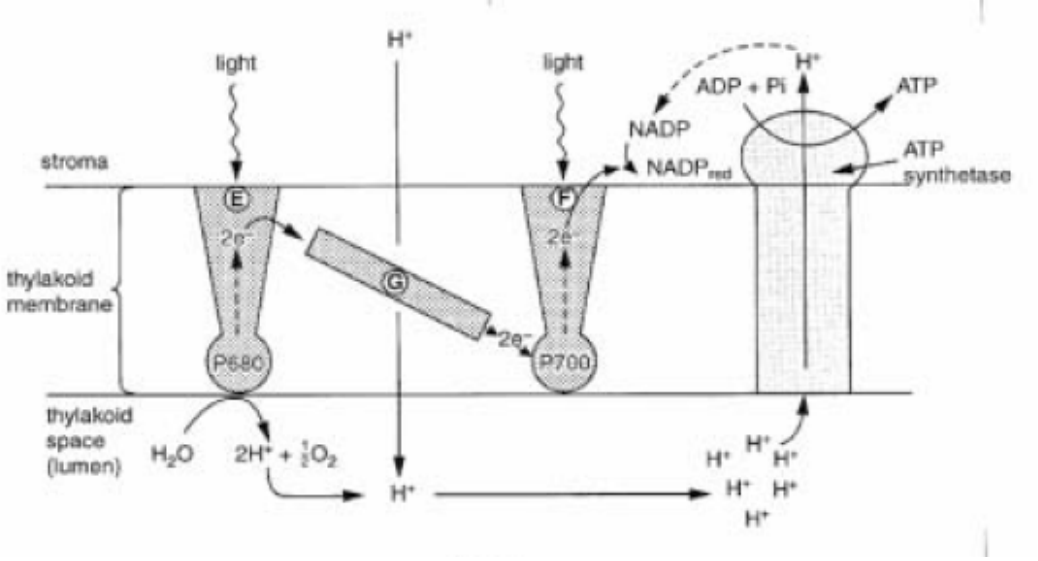


Fig. 2.1

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

Candidate style answer	*Examiner's commentary*
Chlorophyll	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*
Electron carrier	Correct answer that has not tried to complicate matters by attempting to give additional detail that could be incorrect.

(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*
Hydrogen ions are being pumped into the lumen and we can see that on the right of the diagram there are lots of hydrogen ions in the lumen and that they are flowing down to where there are none. As the hydrogen ions flow back into the stroma, ADP joins with P to produce ATP. The more hydrogen ions you have, the lower the pH.	This answer attempts to link the explanation with the information given in the diagram. Some of the information, however, lacks detail and the answer is a little disorganised. It would help, for example, if the pumping of the hydrogen ions had been linked with the activity in the electron transport chain. Similarly, reference to diffusion and the stalked particles would have clarified what was happening. The reference to pH seems to have been an afterthought, possibly having been included when the question was read a further time.

(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 herbicides accept electrons, then the plant cannot use the electron transport chain to release energy. So ATP can't be made and all the reactions of the cell that need energy will stop.	An adequate response that would have been improved by considering the full implications of the use of the herbicide. As this question has related to photosynthesis, candidates might be expected to consider the implications of the lack of ATP and reduced NADP in the Calvin cycle and hence the lack of production of carbohydrates and other compounds necessary for the survival of the plant.

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

Candidate style answer	*Examiner's commentary*
The removal of waste products like urea.	A correct but basic answer. Answers to this question should include some reference to 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

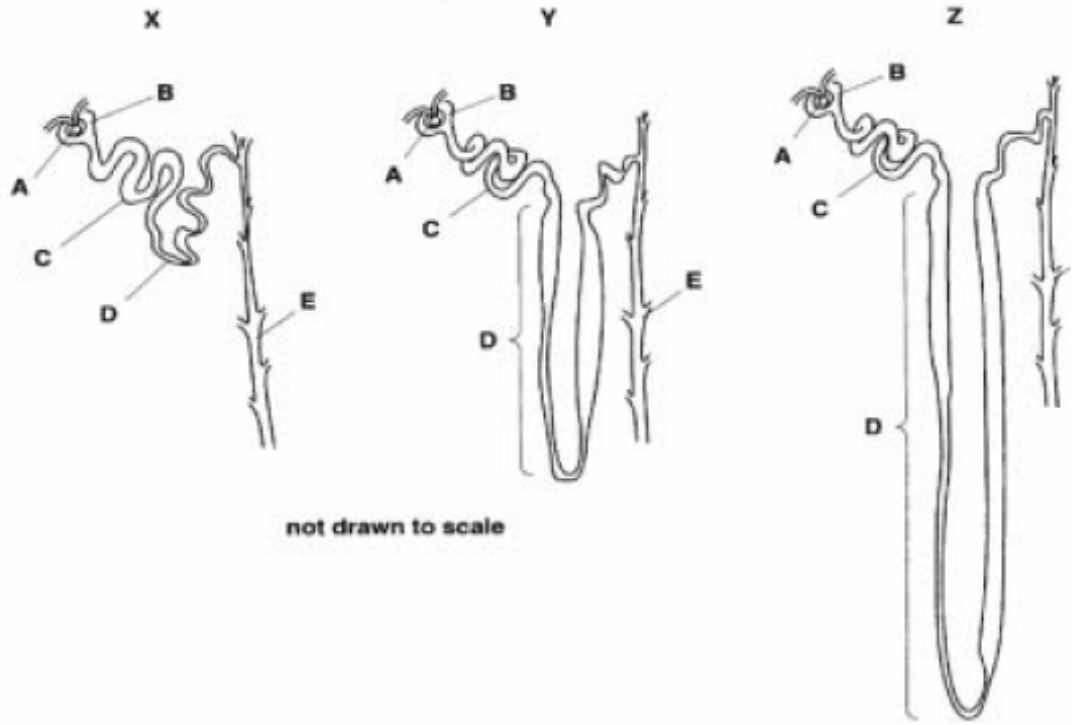
(i) Calculate the percentage increase in urea excreted when the volunteer switched from a protein-deficient to a protein-rich diet. Show your working. [2]

Candidate style answer	*Examiner's commentary*
14.7 – 2.2 = 12.5 $\frac{12.5}{14.7} \times 100 = 85.0340136$ *Answer = ...85.....%*	Candidates find percentage increase or percentage decrease calculations difficult. They can normally, as in this case, find the initial difference but then find it difficult to decide which number they should divide by. A rough estimate of the figures should show that it increases by just under 7 times, but few candidates seem to estimate or realise that you need to divide the difference by the original value.

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

Candidate style answer	*Examiner's commentary*
The protein is taken to the liver and is deaminated. Once the amine groups have been removed they are converted into urea by the orithrene cycle.	This answer shows basic understanding. It could be improved by specifically linking deamination to the amino acids rather than protein and by referring to ammonia as an intermediate in the reaction. The incorrect spelling of ornithine is not necessarily a problem, as it cannot be confused with another term, but correct spelling is desirable.

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*
The longer the part labelled D is, the lower the water potential of the urine.	This is a basic answer that has identified the relationship but has not given any explanation. Some reference to the processes taking place in the loop of Henle would have improved the answer.

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

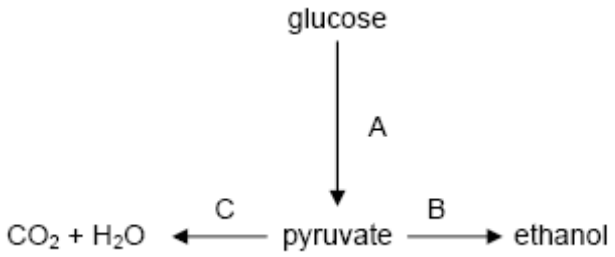


Fig. 4.1

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

Candidate style answer	*Examiner's commentary*
A *glycolysis* ***B*** *anaerobic respiration* ***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*
A	This is incorrect, the candidate possibly muddling its use in the conversion of pyruvate in Krebs cycle with the formation of pyruvate.

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

Candidate style answer	*Examiner's commentary*
C	This is also incorrect, the candidate possibly being unclear about the meaning of 'utilised'.

(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*
The cyanide will prevent the electron transport chain from working, so the glucose or pyruvate cannot be completely broken down. If the electron transport chain isn't working then Krebs cycle grinds to a halt and so no carbon dioxide is produced there.	This answer has shown that the candidate has grasped the essential points but it could be improved by indicating that a limited amount of carbon dioxide will also be produced when pyruvate is converted to ethanol.

(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*
The conversion of glucose to pyruvate takes place in the cytoplasm and not in the mitochondria. So the mitochondria cannot convert glucose to pyruvate and so carbon dioxide will not be produced because it is produced in the stages after glycolysis.	This answer is basically correct but a little repetitive. Some more detail of the stages involved would have improved the answer, as would the idea of specific enzymes for each stage of the process.

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

Candidate style answer	*Examiner's commentary*
Because it is the same as anaerobic respiration. In anaerobic respiration the electron transport chain stops working because there is no oxygen to be the final acceptor. To keep glycolysis going, the pyruvate acts as the hydrogen acceptor so that the NAD can be recycled and the pyruvate is then converted into ethanol.	Although the information given is correct, it does not really answer the question. The candidate has tried to use a rehearsed answer to this question, which is only partly relevant.

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

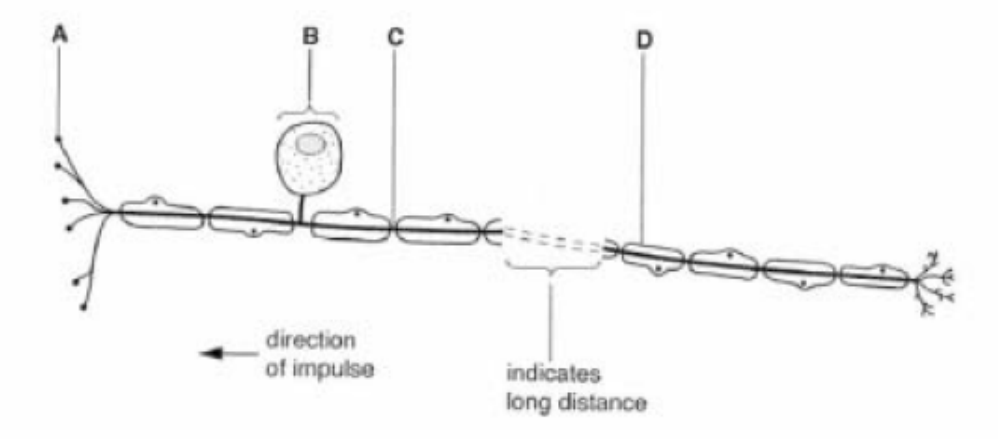


Fig. 5.1

Name the structures A and B. [2]

Candidate style answer	*Examiner's commentary*
A *synaptic knob* ***B*** *cell*	Structure A has been correctly identified, but structure B is the cell *body* as the whole neurone is the cell.

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

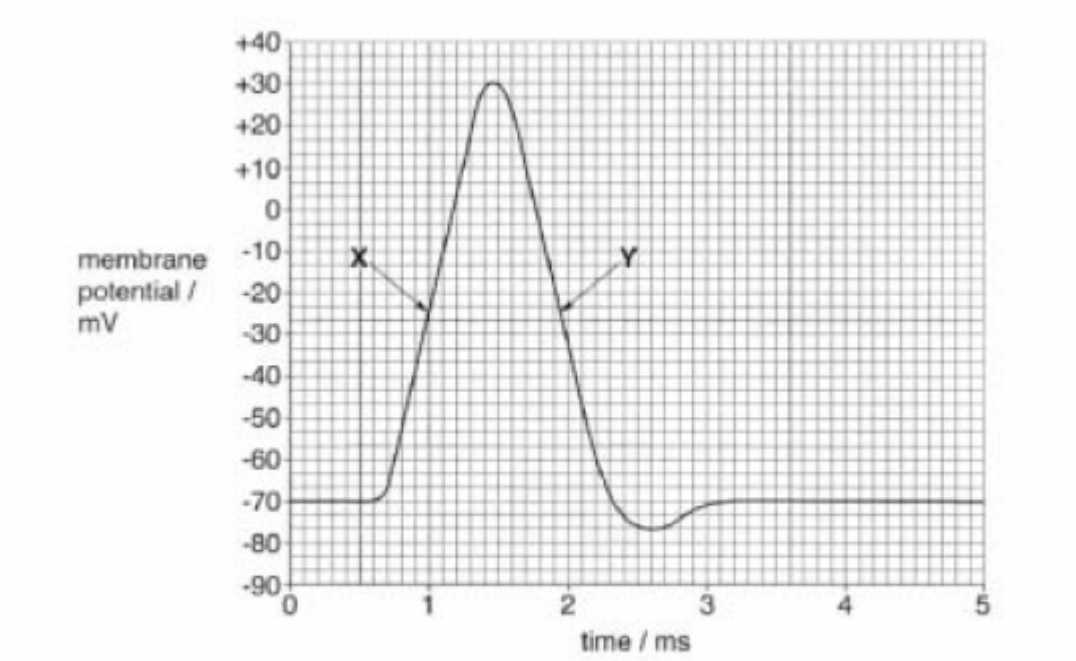


Fig. 5.2

(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 changes from -70mV to +30mV and then during Y it goes back to -75mV. This is because ion gates are opening and closing. As the potential goes from negative to positive the sodium gates open and sodium floods into the membrane. Once the voltage reaches 30mV, the potassium gates open and potassium ions flood out.	This answer is basically correct but there are some errors and the whole answer could be organised more logically. It might have been better to have dealt with stage X and then stage Y. The data quote for the end of stage Y was incorrect and care needs to be taken in accurate data quoting if the marks are to be awarded. Care also needs to be taken to distinguish between sodium atoms and sodium ions and in expressing how chemicals enter cells (i.e. across the membrane rather than into the membrane).

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*
Myelination always increases the speed that an action potential will travel. Even very large diameter non-myelinated axons will conduct slower than much smaller diameter myelinated axons. If you look at the figures for the crab and the cat, the diameter is about the same but the speed is 20 times faster for the myelinated. This is because the myelin acts like an electrical insulator and so stops the impulse from 'escaping'. It jumps from gap to gap in the insulation.	This answer is a little rambling and lacking in some substance. More concise statements relating to the effect of myelination would have improved the answer, as would more accurate quoting of figures. The explanation of how myelination increases the speed of conduction is weak. The candidate should have referred to the nodes of Ranvier, the idea that movement of ions across the membrane can only occur at the nodes and the concept of local currents.

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 to release energy.	This is an adequate answer but could be improved with the inclusion of the term 'respiration'.

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 =.....0.71.....*	This answer is correct, although care needs to be taken with the number of decimal places used in the answer.

(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*
This would be less than compound A.	This answer is incorrect and also fails to recognise that a figure was expected.

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

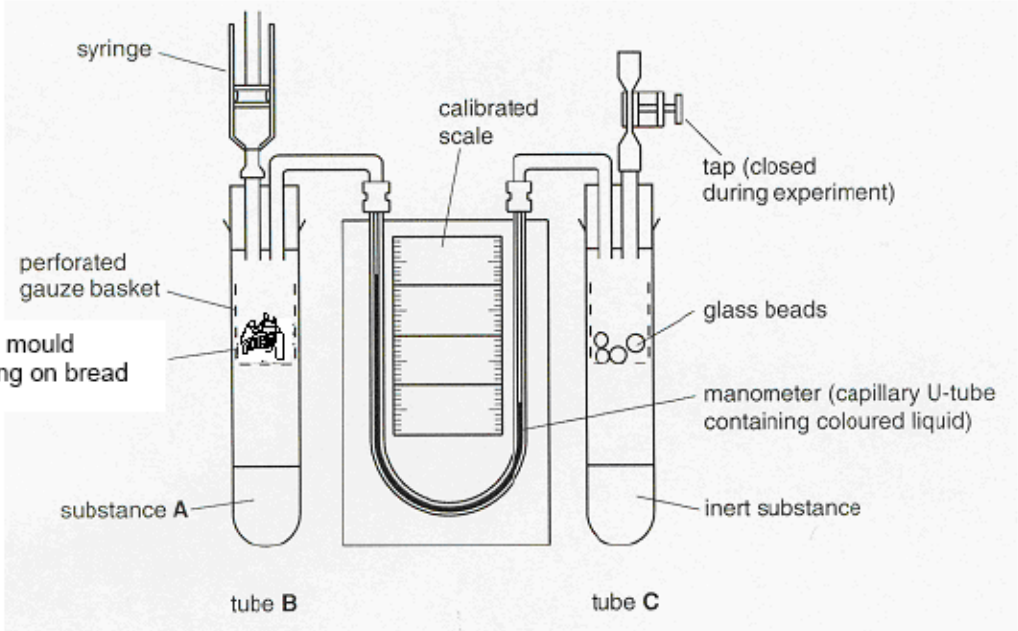


Fig. 6.1

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

Candidate style answer	*Examiner's commentary*
Substance A could be limewater and it is there to absorb the carbon dioxide produced by the mould in respiration. So as the mould takes in the oxygen it pulls up the liquid in the tubing. If you measure the position of the liquid at the beginning and then at the end, you can work out the rate.	This answer is lacking in detail. As in previous questions, the basic concept is understood but is not explained clearly or in detail. The answer could be improved by indicating a suitable time period over which to make the measurements and taking a number of repeats to calculate the mean.

Overall banding: Medium

The answers to these questions indicate good basic understanding of many of the principles being tested. There are some gaps in knowledge and some misconceptions. Some marks have been lost because of carelessness in expressing ideas or not reading the questions carefully enough.