

# Human Biology

## Unit: F221: Molecules, Blood and Gas Exchange: Medium banded candidate style answer.

### Introduction

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.

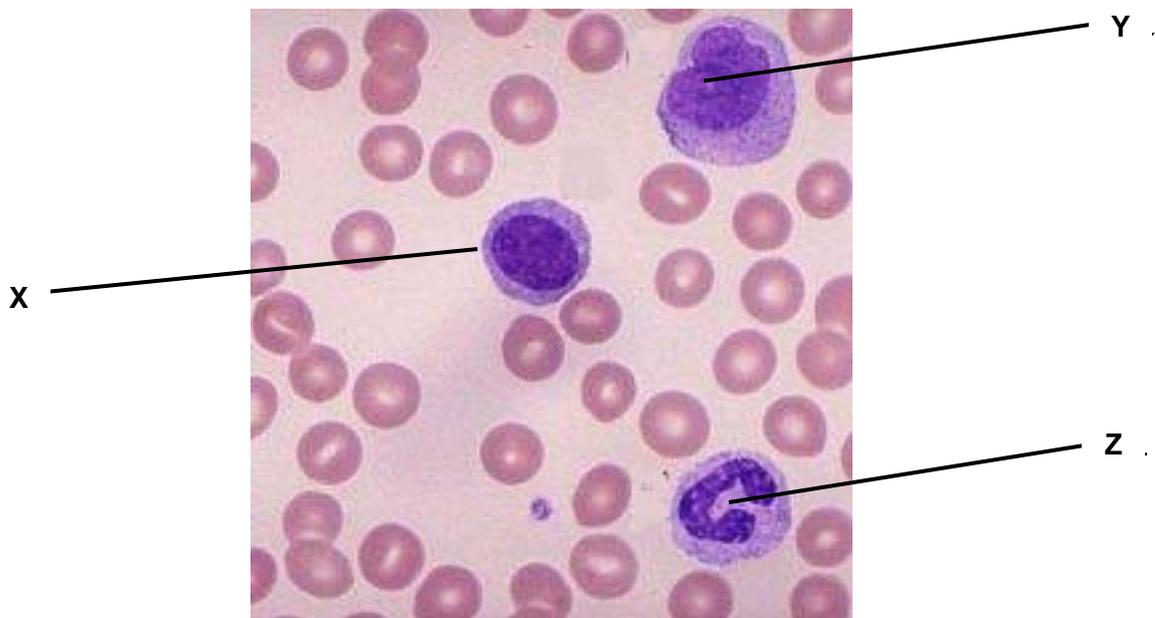
This content has been produced by senior OCR examiners, with the input of Chairs of Examiners, to illustrate how the sample assessment questions might be answered and provide some commentary on what factors contribute to an overall grading. The candidate style answers are not written in a way that is 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(a) Human blood contains erythrocytes and leucocytes. These cells are specialised to perform specific functions.**

**Fig. 1.1 shows a photomicrograph of blood cells.**



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Science Photo Library, 2007

**Fig. 1.1**

**Name the leucocytes X, Y and Z.**

**[3]**

*Candidate style answer*

*Examiner's commentary*

<p>X.....lymphocyte Y.....granulocyte Z.....neutrophil</p>	<p>The candidate would score some marks in this question. A specific name is required for cell Y.</p> <p>Teachers can print good quality electron micrographs from websites such as the following to use in class for identification purposes:</p> <p><a href="http://www.siumed.edu/~dking2/intro/bldcells.htm">http://www.siumed.edu/~dking2/intro/bldcells.htm</a></p> <p><a href="http://missinglink.ucsf.edu/lm/IDS_101_history_resource/blood_cells.htm">http://missinglink.ucsf.edu/lm/IDS_101_history_resource/blood_cells.htm</a></p> <p>Candidates should also be encouraged to practice using the magnifications provided to calculate actual sizes of cells and to practice the interconversion of appropriate units i.e. <math>\mu\text{m}</math> to mm.</p>
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**(b) The difference in composition between blood plasma and tissue fluid depends on the permeability of capillaries to different substances.**

**Table 1.1 shows the relative permeability of capillaries to substances found in blood plasma. Water is given a value of 1**

**Table 1.1**

substance	relative molecular mass	permeability
water	18	1
sodium ions	23	0.96
urea	60	0.8
glucose	180	0.6
albumin (a plasma protein)	69 000	0.000 01

**(i) describe the relationship between relative molecular mass and permeability.** **[1]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>the mass goes up as the permeability goes down</i>	The candidate would score marks in this question, gaining marks for each of the two sub-parts of the question. Candidates should be encouraged to use more specific key terms such as:

	<p><b>fenestrations/pores (instead of holes)</b>  <b>permeability (instead of the ability to get through)</b>  <b>specific blood vessels (rather than generic vessels)</b></p> <p>when discussing the movement of molecules from one area to another between fluids and blood vessels.</p>
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**(ii) predict with reasons which of the above substances you would not expect to be present in tissue fluid.** **[2]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>I think that there would be no large proteins like albumen in the tissue fluid as they are too big to get through the holes in the blood vessels. There will also not be any red blood cells as they are also too big to escape</i>	Correct response.

**(c) Saline is used medically in a variety of ways. Saline also contains sodium ions question**  
**(i) Give one common medical use of saline.** **[1]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>to wash dirt out of cuts after an accident</i>	This response gains the mark as alternative wording has been used for this mark point.

**(ii) Explain why the concentration of sodium ions in saline used medically is the same as that in plasma.** **[3]**  
**[Total:10]**

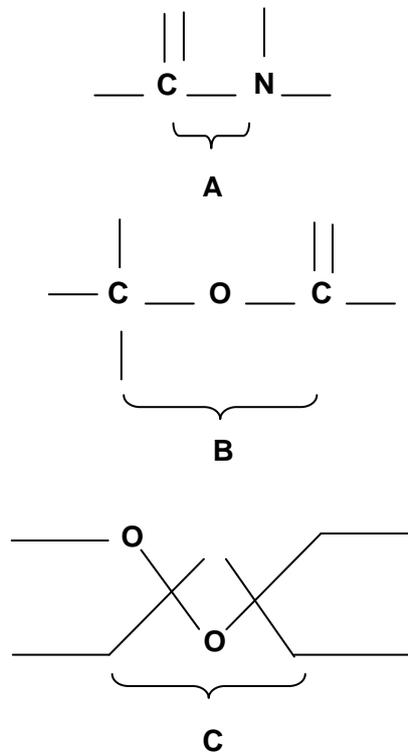
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>.It is important the concentration of sodium in saline is the same as plasma or else it will effect the osmosis of the blood. If there are too much sodium ions in the saline then water will leave the blood cells and they will shrivel up. This is because of osmosis.</i>	<p>This candidate has reiterated the stem of the question in the first line of the answer and gains no marks for doing so. Not only does this use up time but also means the candidate is more prone to not finishing their answer in the space provided and/or not giving sufficient information to gain maximum marks.</p> <p>To improve candidates should be trained to always use terms such as:</p> <ul style="list-style-type: none"> <li>▪ water potential</li> <li>▪ isotonic (in the context of animal cells only)</li> <li>▪ osmosis</li> <li>▪ water potential gradient</li> </ul>

A good teaching technique is to use homework time to set the following tasks to candidates to help reinforce key words to use in their answers:

- glossary of key terms
- simple flashcards of key terms with definitions on the reverse
- card sorts using 3 categories (term, definition and a sentence with the term used correctly)

**2 Proteins, polysaccharides and lipids are biological molecules present in the human body. These molecules all consist of smaller molecules that are joined together by different types of bond.**

**Fig. 2.1 shows three types of bond, labelled A to C, which occur in biological molecules.**



**Fig. 2.1**

- (a) Give the letter of the bond that,**  
**(i) joins together molecules of glucose in glycogen;**

**[1]**

*Candidate style answer*

*glucosidic*

*Examiner's commentary*

The candidate has made a common error in not reading the question correctly and not specifying the letter of the bond, and hence gains no marks. Candidates can be encouraged to underline key command words within a question to minimise such errors.

It should also be noted that the incorrect

	<p>spelling of 'glucosidic' for <i>glycosidic</i> would also not be credited due to ambiguity in the meaning of the candidate's answer.</p> <p>A good website for non-chemists that looks at molecules and simple biochemistry is:</p> <p><a href="http://www.rsc.org/education/teachers/learnnet/cfb/contents.htm">http://www.rsc.org/education/teachers/learnnet/cfb/contents.htm</a></p> <p>This site provides accurate information, pitched at the correct level and also gives some online testing for use by students.</p> <p>Software packages such as Plato learning (11-18):</p> <p><a href="http://www.science-school.co.uk/view_product.php?prd_ref=MS1618">http://www.science-school.co.uk/view_product.php?prd_ref=MS1618</a></p> <p>can also provide good animations for the various biological processes.</p>
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<b>(ii) occurs in the primary structure of a protein such as insulin:</b>		<b>[1]</b>
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>peptide</i>	Correct answer.	

<b>(iii) occurs in a lipid or phospholipid.</b>		<b>[1]</b>
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>esher</i>	Correct answer.	

<b>(b) Name the chemical process involved in breaking the bonds <u>A</u>, <u>B</u> and <u>C</u>.</b>		<b>[1]</b>
 <b>In your answer, you should use an appropriate technical term spelled correctly.</b>		
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>condensation reactions</i>	<p>Again this is a common mistake to give the opposite answer to that required. Candidates should try to remember</p> <p>"<u>c</u>ondensation reactions <u>c</u>ombine molecules"</p>	

<b>(c) Glycogen is an insoluble polysaccharide and consists of branched chains of glucose molecules.</b>		<b>[3]</b>
<b>Explain how the properties and structure of glycogen adapt it to its function.</b>		<b>[Total: 7]</b>
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	

<p><i>Glycogen is a large carbohydrate made from many glucose molecules joined together by glucosidic bonds. It is used to store energy in cells. It has many branches which means it can fit into small spaces and can be broken down for energy when it is needed.</i></p>	<p>The candidate has again used time and space to in effect, rewrite the question. Candidates can be encouraged to use bullet points. In a question where there are two aspects to be considered, the candidates should aim to cover both aspects in <u>each</u> bullet point/statement, and as a guide, provide one more bullet point than there are number of marks. E.g.</p> <p>Glycogen is branched (<i>structure</i>) to enable it to be stored compactly (<i>property</i>).</p> <p>This candidate would score some marks for this answer,</p>
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**3 Airline passengers travelling on long haul flights are at risk of developing deep vein thrombosis (DVT).  
A thrombus is a clot that develops inside a blood vessel. If a thrombus breaks away from the wall of the vessel, it becomes an embolus and may lead to an embolism.**

**(a) Suggest how an embolism may become life threatening.**

**[4]**

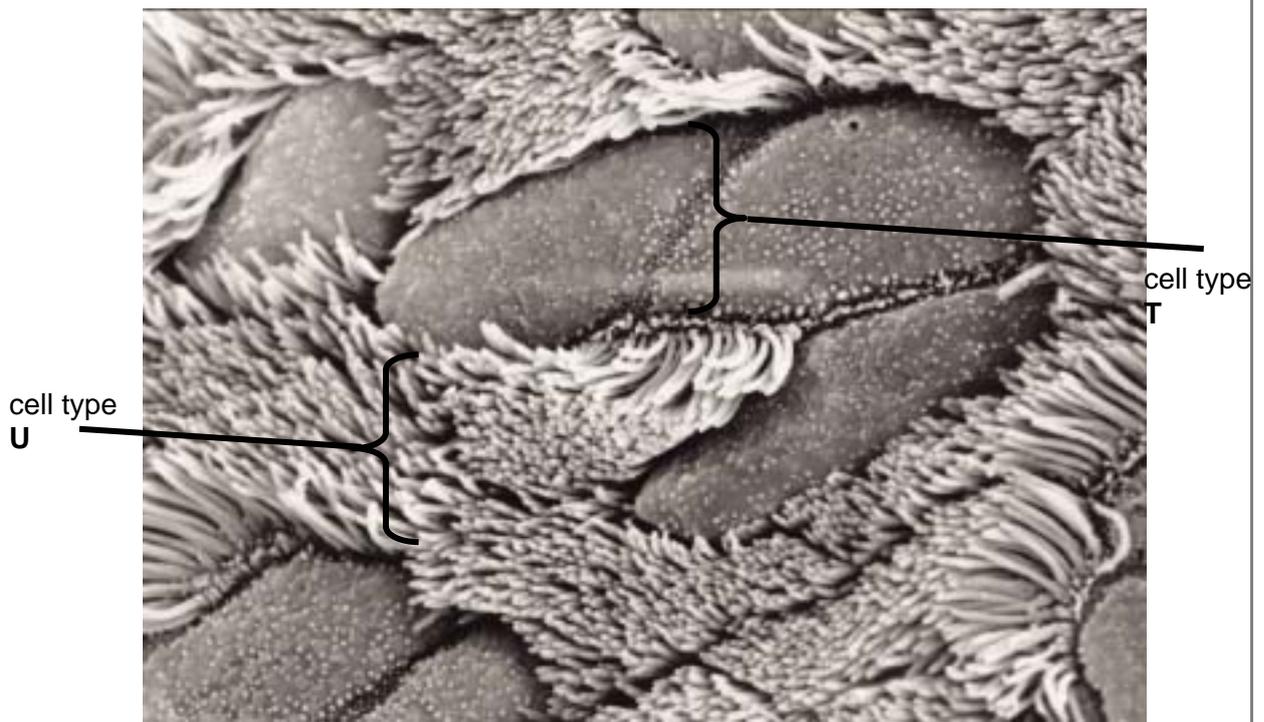
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>An embolism is a clot in the bloodstream which can travel around the body. This can cause a person to have a heart attack as the blood may not be able to reach the heart properly. Then the heart cells may die as they do not have enough oxygen. If the clot reaches the legs it can also cause a disease called DVT which means the person should wear special socks and try not to drink alcohol during their journey. Some old people should also try to take aspirin each day before they fly as this can stop the clots being made.</i></p>	<p>As per the glossary of command words in the specification, candidates are not expected to have been taught the content required to answer this question. The nature of a 'suggest' question is that the candidate has to provide a suitable and plausible idea based on their scientific knowledge and understanding. Commonly, less able candidates can leave these questions blank but teachers should encourage all candidates to tackle such questions using knowledge they have gained from that area of the specification.</p> <p>In this case the candidate would gain some marks. This candidate has tended to go off on a tangent in the latter half of their answer, giving details of prevention of DVT. Again the underlining of the key words in the questions i.e. 'how' and 'become life threatening' may have helped the candidate to focus on the question.</p>

**(b) Outline the mechanism of blood clotting.**

[5]  
[Total: 9]

Candidate style answer	Examiner's commentary
<p><i>Blood clotting is a special process which occurs very quickly in the body unless you have a disorder called haemophilia. The blood needs calcium ions to make the enzymes work and this cause the enzymes to make a mesh of protein which can trap the blood cells and make a clot form. This then forms a scab which seals the wound and stops diseases getting into the blood.</i></p>	<p>In the case of questions that ask candidates to 'outline' processes, candidates can be encouraged to draw flow diagrams as these help ensure that the key points in the process are stated e.g.</p> <p><a href="http://www.healthline.com/images/gale/big/gem_04_img0528.jpg">http://www.healthline.com/images/gale/big/gem_04_img0528.jpg</a>  <a href="http://www.octc.kctcs.edu/GCaplan/anat2/notes/Image337.gif">http://www.octc.kctcs.edu/GCaplan/anat2/notes/Image337.gif</a></p> <p>Some marks would be awarded for this answer.</p>

**4 The bronchioles of the human lung transport air to and from the alveoli. The wall of the bronchioles are lined with two types of specialised cells. Fig. 4.1 shows an electron micrograph of the surface of a bronchiole with the two types of cells labelled.**



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**Fig 4.1**

**(a) (i) Name the two types of cell labelled.**

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

[2]

Candidate style answer	Examiner's commentary
<p>cell type <b>T</b>.....<i>goblet cell</i>  cell type <b>U</b>.....<i>epithelium</i></p>	<p>Cell T is correctly identified but the type of epithelium is unspecified.</p>

**(ii) Describe how these cells work together to ensure that any particles present in the inspired air are trapped and transported out of the lungs.**

**[3]**

*Candidate style answer*

*Examiner's commentary*

*Dust and diseases get trapped in the mucus made by the goblet cells. The hairs then move in a mexican wave to move the trapped substances up to the mouth where they are then either swallowed or spat out as flem. The lungs are then clear of any bad things and are less likely to get any problems such as asma and broncitis.*

The incorrect reference to diseases getting trapped, though treated as neutral in this instance, is a common misunderstanding by candidates. This candidate would score only some marks due to the lack of detail in the role of the ciliated epithelium. There are several past questions on unit 2856 (available from the OCR website and publications department) that can be used to draw up topic tests in this are for revision purposes.

**(b) A spirometer was used to investigate lung volumes.. Measurements of tidal volume were taken from the student. The measurements were used to calculate**

- **the alveolar ventilation rate, which is the volume of air reaching the gaseous exchange surface per minute.**
- **The air in the lungs which is not in contact with the gaseous exchange surface is called dead space. The dead space in this student is 150 cm<sup>3</sup>.**

The results of this investigation are shown in Table 4.1.

**Table 4.1**

breathing rate / breaths min <sup>-1</sup>	tidal volume / cm <sup>3</sup>	alveolar ventilation rate / cm <sup>3</sup> min <sup>-1</sup>
30	200	
10	600	4500

The alveolar ventilation rate is calculated using the following formula:

$$\text{alveolar ventilation rate} = (\text{tidal volume} - \text{dead space}) \times \text{breathing rate}$$

**(i) Using this formula, calculate the alveolar ventilation rate at a breathing rate of 30 breaths min<sup>-1</sup>. Show your working.**

**[2]**

*Candidate style answer*

*Examiner's commentary*

*1500. cm<sup>3</sup> min<sup>-1</sup>*

This candidate gains marks for obtaining the correct answer. However, candidates should always be encouraged to show their working. If they demonstrate the correct method of working but write down the wrong answer in error, they would still be credited with a method mark.

(ii) Using a breathing tube such as a snorkel has the effect of increasing the dead space.

Predict what would happen to the breathing rate and tidal volume if the dead space is increased and explain the reason for the changes you have described.

[3]

[Total: 10]

Candidate style answer	Examiner's commentary
<p><i>I think it will go up as it will be harder to get the right amount of oxygen in for respiration and harder get rid of the carbon dioxide that has been made by the body.</i></p>	<p>The candidate has made the correct prediction and also made an accurate reference to the removal of carbon dioxide. However, due to a lack of reference to the specific type of respiration they cannot be awarded full marks. When discussing respiration and gas exchange candidates should be encouraged to always specify: the rate at which it is occurring i.e. faster/slower which type(s) of respiration are taking place i.e. aerobic/anaerobic</p>

5 Fig. 5.1 shows a diagrammatic view of the internal structure of a human heart.

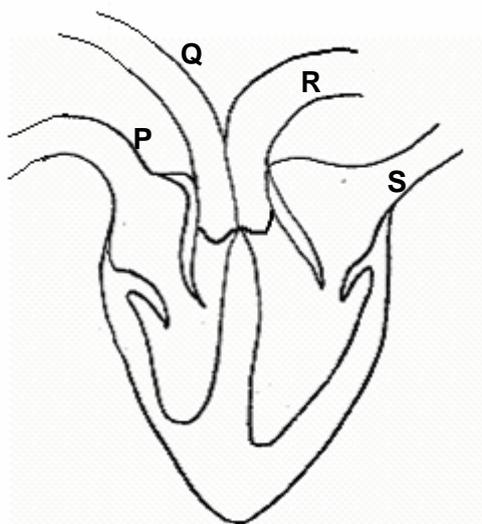


Fig 5.1

1(a) Which of the blood vessels labelled P to S carries blood under highest pressure?

[1]

Candidate style answer	Examiner's commentary
<p>R</p>	<p>Correct answer.</p>

(b) The ventricles shown in Fig. 5.1 are filling with blood. Use evidence from Fig. 5.1 to explain why the ventricles are filling with blood.

[2]

Candidate style answer	Examiner's commentary
<p><i>The valves in Q and R are open and the ones in between the atriums and</i></p>	<p>This answer contradicts itself and hence although mark point 2 has been stated it cannot be credited. The description of blood</p>

<i>ventricles are open. This means the blood can enter the bottom of the heart and move out to the lungs and body.</i>	flow through the heart is not relevant in this question.
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<b>(c) Describe the functions of the following in co-ordinating the cardiac cycle:</b> <b>(i) the SA node</b>	<b>[2]</b>
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<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>it acts as the pacemaker for the heart to tell it when to beat</i>	The candidate should be reminded to make at least the same number of statements/bullet points as there are marks to be awarded.

<b>(ii) the AV node</b>	<b>[2]</b>
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<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>it passes the message to the bottom of the heart</i>	This is colloquial and incorrect and gain no marks.

<b>(iii) the purkyne tissue</b>	<b>[2]</b>
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<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>these are fibres that go from the top to the bottom of the heart and pass the message to the apex of the heart.</i>	The transmission (of the impulse) to the apex of the heart can be credited but no further marks can be supported. A good revision activity is to complete the following task: On an A4 piece of paper print a large diagram of the heart and ask pupils to: <ul style="list-style-type: none"> <li>• label key structures</li> <li>• identify the role of each</li> <li>• annotate in 8 steps, the pathway of electrical impulse during the cardiac cycle.</li> </ul>

<b>(d) The pressure of blood in an artery varies during the cardiac cycle. Explain what happens to the wall of the artery at different points during the cardiac cycle and the effect this has on blood flow.</b>	<b>[3]</b>
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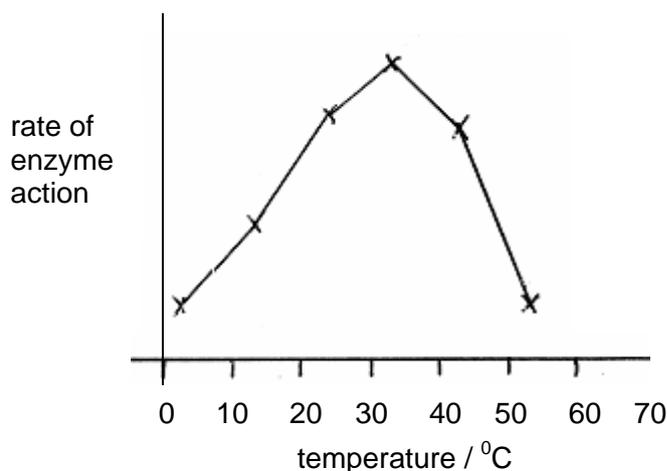
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>At the beginning of the cardiac cycle the wall of the artery is relaxed. When the heart beats the artery wall has to get wider to cope with the extra blood that is passing through it. It also has to be able to not burst with the extra pressure. At the end of the cycle the volume and pressure falls again so the walls of the artery relax</i>	This is a higher demand question and the candidate has found it hard to score any marks. As in this case, candidates often misunderstand the role of elastin and smooth muscle within artery walls. The respective role should be reinforced with respect to blood pressure and maintenance of blood flow.

**(e) How reliable blood pressure measurements may be taken.** **[4]**  
**[Total 15]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Blood pressure can be measured by the doctor or nurse using a sphygmomanometer or a digital meter. The special balloon called a cuff is put around the left arm and then pumped up. The doctor then listens to the blood flow using a stethoscope and when he can hear the 'lub-dub' of the blood he takes the measurements. It is measured in mm Hg. A good doctor will do it again to make sure he got it right the first time and the person was not too stressed out.</i></p>	<p>The nature of the specification is to be based on 'real-world' Biology means that procedures and techniques form learning outcomes and as such will be examined in all units. Candidates can be encouraged to have a separate notebook to make notes for such procedures. Candidates should be encouraged to make bullet point methods of ~15 steps which can be followed by another student. If this is collated during the course of the GCE it will not only become a useful revision resource but an invaluable reference book for general use.</p>

**6 Enzymes are globular protein molecules that are able to catalyse chemical reactions. Maintaining the body temperature at 37 °C optimises the activity of enzymes within the human body.**

**(a) Fig. 6.1 shows how the activity of an enzyme varies with temperature.**



**Fig. 6.1**

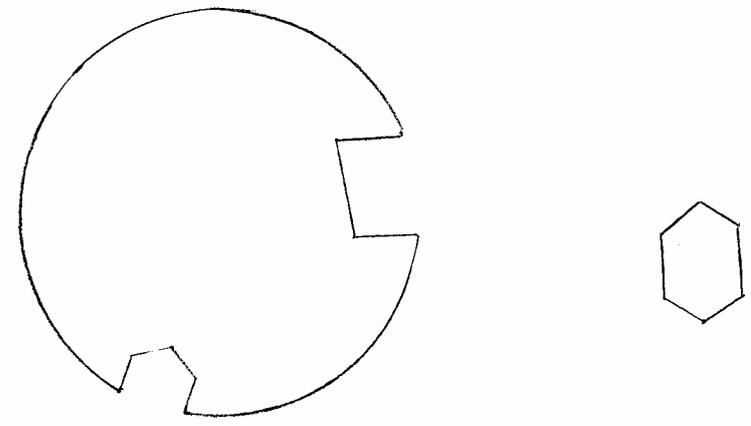
**Explain the reasons for the change in enzyme activity**

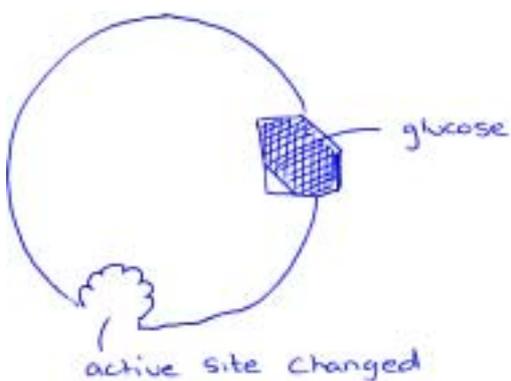
**(i) between 0 °C and 30 °C**

**[2]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>At low temperatures the enzymes are denatured and can not work properly. As they get heated up they gain energy and all the molecules move around more. More enzymes bump into more substrate molecules and form more ESCs</i></p>	<p>The candidate has made a good attempt at the question but incorrectly muddles the terms inactive and denatured; in this case the sentence is treated as neutral. The remaining answer gains some marks.</p>

<b>(ii) between 30 °C and 50 °C.</b>		<b>[2]</b>
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>The enzyme gets to its best temperature at 30°C and works at its fastest rate. When it gets heated up even more it becomes denatured. This changes the shape of the active site and then the substrate cannot fit into it properly so the reactions stop.</i>	<p>This answer shows understanding but lacks the use of key terms such as optimum temperature. There is also no explanation of why the change in rate occurs.</p> <p>A good revision exercise is to draw a graph of a typical enzyme controlled reaction and ask students to annotate what is happening (and why) at each of the 3 stages of the graph, and be able to describe the trend line accordingly.</p>	

<p><b>(b) Glycogen phosphorylase is an enzyme that breaks down glycogen in muscle cells. Glucose acts as a non-competitive inhibitor to glycogen phosphorylase. Fig.6.2 shows representations of a glycogen phosphorylase and a glucose molecule.</b></p>	
 <p style="text-align: center;">glycogen      phosphorylase                      glucose</p> <p style="text-align: center;"><b>Fig. 6.2</b></p>	
<p><b>(i) Draw a diagram based on the molecules in Fig. 6.2 to show how glucose acts as a non-competitive inhibitor to glycogen phosphorylase.</b></p>	
<b>[2]</b>	

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
	<p>This has been accurately and clearly answered.</p>

**(ii) Suggest why the action of glucose as a non-competitive inhibitor is an advantage to muscle cells.**

**[2]**

**[Total: 8]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>Muscle cells will not use up all there glucose as they will not work. This will give the muscles more glucose for respiration and they will be able to work for longer.</i>	The candidate has made a fair attempt at the question but has missed the main aspect. The ability to apply knowledge and understanding to new situations will naturally be more challenging for the middle ability candidate. Practising past questions from previous papers e.g. past 2856 papers from OCR can help.

**Overall Banding :** Medium.

**Overall Comments:** This candidate has demonstrated ability typical of a middle ability candidate. The main area for improvement is to encourage the use of more specific scientific terms. Whilst in several questions the candidate has shown ability and good understanding, it is their lack of clarity of expression and use of colloquial language that has limited their overall mark. The production of glossaries at the end of each module, which can then be assembled into a unit revision pack, will help identify the key terms needed in each topic. This will also aid candidates with dyslexia as they will be better able to identify the terms that may be used to assess QWC.