OCR
Oxford Cambridge and RSA

GCE

Human Biology

Unit **F221:** Molecules, Blood and Gas Exchange

Advanced Subsidiary GCE

Mark Scheme for June 2016

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning of annotation
	Correct answer
	Incorrect response
BOD	Benefit of Doubt
NBOD	Not Benefit of Doubt
ECF	Error Carried Forward
GM	Given mark
	Underline (for ambiguous/contradictory wording)
^	Omission mark
I	Ignore
	Correct response (for a QWC question)
QWC+	QWC* mark awarded

Question			Answer	Mark	Guidance
1	(a)	(i)	neutrophil has, lobed / AW, nucleus **AND** monocyte has, bean-shaped / AW, nucleus **;** neutrophil , has granular cytoplasm / is a granulocyte **AND** monocyte has , no / much finer , granules in cytoplasm**;** monocyte may have vacuoles in cytoplasm but neutrophil does not **;** *idea that* nucleus occupies more of the cell in monocytes **;**	2 max	**CREDIT** responses on labelled diagrams **CREDIT** alternative descriptions of lobed **CREDIT** 'kidney shaped' **CREDIT** is an agranulocyte / agranular cytoplasm **CREDIT** ora
		(ii)	(monocytes) move into tissues / leave blood **;** differentiate / become macrophages **;**	2	**CREDIT** correct reference to a named tissue e.g. alveoli ,liver tissue **CREDIT** correct reference to a named macrophage e.g. Kuppfer cells
	(b)	**(i)**	30.4 (%) **;;**	2	If incorrect answer given allow 1 mark for: answer not given to 1 decimal place e.g. 30% or 30.37% **OR** incorrect rounding (30.3) **OR** a number divided by 7900 **ECF** if total cell number is incorrect

Question			Answer	Mark	Guidance
		(ii)	(so) patient may , have / be recovering from , an infection **OR** autoimmune disease **OR** blood cancer **;**	1	**CREDIT** a correct reference to pathogens or disease **DO NOT CREDIT** reference to patient being unwell **CREDIT** reference to an allergic response **CREDIT named** blood cancer e.g. leukaemia
		(iii)	Any **one** from: electrolytes or **named** dissolved ion(s) e.g. sodium ion **;** **named** dissolved nutrient(s) e.g. glucose, amino acids **;** water **;** AVP **;**	1 max	**IGNORE** oxygen (as this is mostly transported in combination with haemoglobin rather than in plasma) **CREDIT** correct symbol e.g. Na+ e.g. carbon dioxide, urea, antibodies, protein, fibrinogen, hormones

Question			Answer	Mark	Guidance
	(c)			3 max	
		1	(proteins processed by) modification **and** packaged (into vesicles) by **Golgi** (apparatus) **;**		**ACCEPT** 'golgi' with lower case letter for mark point 1 **CREDIT** a description of modification e.g. glycosylation for mp 1
		2	vesicles, transported to / fuse with, **cell surface membrane / plasma membrane ;**		**ACCEPT** alternative descriptions of fusing e.g. merge, join with
		3	(proteins / cytokines) released by **exocytosis ;**		
		4	(process requires) ATP produced by mitochondria **;**		
			QWC **;**	1	**Two** of the following terms, used in the appropriate context with correct spelling: **modified Golgi exocytosis** **cell surface membrane OR plasma membrane** **For QWC mark Golgi must have a capital letter**

Question			Answer	Mark	Guidance
	(d)		*idea that* air bubbles could increase cell count as they could be counted **;** *idea that* air bubbles could give lower cell count as reduce volume in chamber / AW **;** *idea that* overloading could give increase cell count (as there would be increased volume in chamber) / AW **;** AVP **;**	2 max	**LOOK FOR** how the count would change e.g. higher or lower **AND** a reason **CREDIT** reverse argument for underloading e.g. lower number as cells not seen clearly if slide flooded as some on top of others
			Total	**14**	

Question			Answer	Mark	Guidance
2	(a)	(i)	**B** glycerol **;** **C** saturated fatty acid **;** **D** unsaturated fatty acid **;**	3	 **ACCEPT** 'hydrocarbon (tail) for fatty acid
		(ii)	**A ;**	1	**CREDIT** phosphate (group)
	(b)		separates organelle contents from other parts of the cell **OR** separates the cell into compartments / AW **;** reference to a **named** example **;** AVP **;**	2 max	**CREDIT** 'controls what enters and leaves organelles' **or** 'to keep chemical reactions separate from other reactions within the cell' **CREDIT** reference to specific organelle plus contents being separated e.g. lysosome **AND** digestive enzymes **OR** mitochondria **AND** respiratory enzymes **OR** sarcoplasmic reticulum **AND** calcium ions **OR** vesicles **AND** proteins e.g. holds ETC components
			Total	**6**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>
<table>
<tr><th>enzyme</th><th>substrate</th><th>product</th><th></th></tr>
<tr><td>thromboplastin</td><td></td><td>thrombin</td><td>;</td></tr>
<tr><td></td><td><u>fibrinogen</u></td><td>fibrin</td><td>;</td></tr>
</table>
</td><td>2</td><td>1 mark for each row
BOTH answers in each row required for 1 mark

DO NOT CREDIT fibrogen</td></tr>
<tr><td></td><td>(b)</td><td>1
2

3
4

5</td><td>description
activation energy (peak) is lowered ;
substrate and product energy levels stay the same ;

explanation
enzymes have specific , 3D shape / tertiary structure ;
substrate fits into active site to
form enzyme-substrate complex (ESC) ;
force exerted on (bonds in) substrate
so lowers activation energy ;</td><td>4 max</td><td>CREDIT mp 1 from diagram / Fig.3.1

IGNORE references to rate or time as X axis label is progress of reaction</td></tr>
<tr><td></td><td></td><td></td><td>QWC ;</td><td>1</td><td>Two of the following terms, used in the appropriate context with correct spelling:
specific tertiary active site enzyme-substrate complex</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>idea that it is necessary for. enzyme substrate complexes to form / substrate to bind to active site ;</td><td>1</td><td>CREDIT (cofactor) must be present for enzyme to catalyse reaction

DO NOT CREDIT ‘to facilitate the reaction between the enzyme and substrate’</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>idea that it may prevent vitamin K from binding to enzyme
OR
bind to vitamin K ;

reduce the, concentration / AW of vitamin K ;</td><td>1 max</td><td></td></tr>
</table>

Question			Answer	Mark	Guidance
	(d)		amino acid(s) **;**	1	**IGNORE** peptide or dipeptide **ACCEPT** C, H, O, N, S (as question is asking for complete breakdown.
	(e)		*for evolved enzymes* *idea that* (because) active site has changed **;** (so) *idea that* active site is only complementary to / specific for, one substrate / A or C **;** *idea that* splitting the reaction into two allows for greater control **;** AVP **;**	2 max	**CREDIT** changes in protein structure changes active site **CREDIT** reverse argument for ancestral enzyme e.g. role of cofactors with evolved enzymes
			Total	**12**	

Question			Answer	Mark	Guidance
4	(a)	(i)	bicuspid **OR** left , atrioventricular / AV **;**	1	
		(ii)	systolic **AND** diastolic pressure is lower in heart **Z ;**	1	**CREDIT** ora for heart **Y** **ACCEPT** 'BP is lower in Z' if statement supported by correct figures for systolic and diastolic pressure e.g systolic has dropped by 5 and diastolic by 4 **OR** Z 115/6 and Y 120/10. **DO NOT CREDIT** reference to aortic pressure figures (120/80 and 115/80)

Question			Answer	Mark	Guidance
		(iii)	*idea that* needs to generate higher pressure or more force to overcome the resistance (caused by narrower opening) **;**	1	**e.g.** valve does not open so far so more pressure has to be applied to make sure the same volume of blood is moved into the ventricles needs to be stronger to push blood through the narrowed opening **IGNORE** reference to the atrium working harder
	(b)		electrocardiogram / ECG ; detail e.g. remove clothing **;** electrodes placed on arms, legs and chest **;** **OR** ultrasound / echocardiogram **;** detail e.g. remove clothing / application of gel **;** idea of placing transducer in several locations **;**	3 max	**e.g.** description of using an ECG trace **IGNORE** 'sphygmomanometer or taking a pulse' If sphygmomanometer or taking a pulse are given as techniques, allow up to **2 MARKS maximum for procedures**. e.g. (sphygmomanometer) cuff placed appropriately cuff inflated and deflated details of Korotkov sounds (pulse) fingers on suitable location count for appropriate time convert to bpm.
			Total	**6**	

Question			Answer	Mark	Guidance
5	(a)		(gases move) by diffusion down a concentration gradient **;** oxygen (from alveoli) into capillary / blood / AW **AND** carbon dioxide from capillary / blood / AW (into alveoli) **;**	2	**BOTH NEEDED FOR ONE MARK** **ACCEPT** correct terms for detail of location of respiratory gases in blood.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Similarity
1. As volume increases, surface area increases / surface area to volume ratio decreases ;

Differences

2. idea that the spherical cell always has a lower surface area than the cuboidal cell ;

3. SA:V greater in cuboidal cell ;

4. idea of difference between surface areas gets bigger
4. / SA:V difference gets bigger , as volume increases ;

5. correct comparative figures ;</td><td>3</td><td>CREDIT reverse argument throughout

as volume increases the surface area of the cuboidal cell increases more than the spherical cell’ – gets mp 1 and 4

<table>
<tr><th rowspan="2">VOL (a.u)</th><th colspan="2">Surface area (au)</th><th rowspan="2">Difference ± 2</th></tr>
<tr><th>Spherical cell ± 1</th><th>Cuboidal cell ± 1</th></tr>
<tr><td>10</td><td>23</td><td>27</td><td>4</td></tr>
<tr><td>20</td><td>35</td><td>45</td><td>10</td></tr>
<tr><td>30</td><td>46</td><td>59</td><td>13</td></tr>
<tr><td>40</td><td>56</td><td>70</td><td>14</td></tr>
<tr><td>50</td><td>65</td><td>82</td><td>17</td></tr>
<tr><td>60</td><td>73</td><td>93</td><td>20</td></tr>
<tr><td>70</td><td>82</td><td>103</td><td>21</td></tr>
<tr><td>80</td><td>90</td><td>112</td><td>22</td></tr>
<tr><td>90</td><td>97</td><td>120</td><td>23</td></tr>
<tr><td>100</td><td>105</td><td>130</td><td>25</td></tr>
</table></td></tr>
</table>

Question			Answer	Mark	Guidance
		(ii)	*curve drawn on Fig.5.1* to be above **both** that of cuboidal and spherical cells **;** to start at 0 for both SA and V **AND** be a smooth curve of similar shape to other two curves **AND** (if going off scale) terminates after 50 a.u. volume **;**	2	
	(c)		*reason for mucus retention* cilia not functioning correctly / AW **OR** goblet cells producing too much mucus **;** *reason for recurrent infections of respiratory system* bacteria / pathogens / viruses / microorganisms are not removed **;**	2	e.g. ciliated cells damaged / cilia missing / fewer cilia / fewer or no ciliated cells
	(d)	(i)	FEV_1 for normal person is 3.5 **AND** FEV_1 for person with a respiratory disorder is 2.0 **;** *idea that* blocked / damaged , airways reduce flow of air out of lungs **;**	2	**BOTH** FEV_1 values needed for 1 mark
	(d)	(ii)	to check if medication is working **;** to monitor the condition / AW **;** AVP **;**	1 max	e.g. to see if it is getting any worse e.g. this is the NICE recommendations for this condition
			Total	**12**	

Question			Answer	Mark	Guidance
6	(a)		*idea that* everything is moving in one direction **;**	1	
	(b)	(i)	made of different types of tissue **;**	1	**CREDIT** named tissues
		(ii)	has four polypeptide chains **AND** (4) haem / iron-containing (prosthetic) groups **;** each haem group can carry, one oxygen <u>molecule</u> / O_2 **OR** each haemoglobin molecule can carry four oxygen <u>molecules</u> **;** *idea of* reversible binding / AW **OR** cooperative binding / AW **;**	3	**ACCEPT** Fe^{2+} for 'iron' **LOOK FOR** descriptions of reversible binding e.g. 'binds ….released' OR descriptions of cooperative binding.
		(iii)	*idea of* further , folding / twisting , of secondary structure / polypeptide **;** into (specific) 3D shape **;** held by**, named** bond(s) / bonds between R groups **;**	2 max	e.g. ionic, disulfide, hydrophobic / hydrophilic interactions **IGNORE** hydrogen unless it is bonding between R groups as hydrogen bonds appears in different levels of structure.

Question			Answer	Mark	Guidance
	(c)	(i)	polysaccharide / carbohydrate / polymer / macromolecule **;**	1	
	(c)	(ii)	compact **;** so lots of , glucose / glycogen , can be stored in a small space **;** **OR** branched molecule **;** so lots of end points for, quick / AW, release of glucose **;**	2 max	*feature must be linked to correct property* Allow 1 mark max for correct feature **or** correct property if not linked
			Total	**10**	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553