OCR GCSE 21ST CENTURY BIOLOGY B · J257

BIOLOGY



MARK SCHEME

B1.1 WHAT IS A GENOME AND WHAT DOES IT DO? (HIGHER)

SCORE	PERCENTAGE
/67	%

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Question			Answer/Indicative content	Marks	Guidance
1	a		✓ DNA is made from four different nucleotides ✓ DNA is a polymer	2	If more than two boxes are ticked, do not award the mark even if the correct box is also ticked
	b		Correct sequence of amino acids – leu, glu, tyr, thr ✓	1	ALLOW leucine, glutamine, tyrosine, threonine
	c		Any four fromMutation is a substitution ✓Result could be no change / new tripletmight still code for same ami		
			Total	7	
2		i	Antigen is injected into the animal ✓ The antibody producing cells are taken from the animal ✓ The cells producing the correct antibody are then Selected and cultured ✓	3	All three stages needed for three marks
		ii	D B A C	1	
			Total	4	
3	a		A pairs with T or A pairs with C ✓ G pairs with T or G pairs with C ✓	2	DO NOT ALLOW A pairs with T or G pairs with C alone
	b		Triplet ✓ Order / sequence ✓	3	
			Classification ✓		
			Total	5	
4			*Similarity:* made from DNA / nucleic acid ✓ *Difference:* in the nucleus in the animal cell and in a loop in the bacteria ✓	2	
			Total	2	
5		i	Nucleus ✓	1	
		ii	10 ✓	1	

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Question			Answer/Indicative content	Marks	Guidance
		iii	Only need one egg cell / makes it easier for sperm to find egg cell ✓ RBC needs to move through small spaces / need lots of RBCs ✓	2 3	ALLOW idea of food storage in egg cell
			Total	4	
6	a		Any three fromB most similar to humans ✓D most different to humans ✓Idea of showing how closely relatedc		
	b		Longer sequence ✓ Repeat ✓	2	
			Total	5	

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Question			Answer/Indicative content	Marks	Guidance
7	a		40,037 / 40,000 + 37; 0.09;	2	 0.09 **must** be expressed to two decimal places. **Examiner's Comments** Given it was a calculation, this was answered relatively poorly with the majority of candidates gaining no marks. Of those who scored, many gave 0.09 as the answer, but with no working or the incorrect working. Many candidates got the answer 0.09 but often by carrying out the calculation (37/40000) × 100, which limited them to one mark. It is important to note that showing working here was essential to gain the second mark, and candidates should always be encouraged to show their working. Some candidates gave the answer to more than two decimal places, or to two significant figures. Many candidates calculated 40000/37.
	b		*any one from:* **majority of / most of / 99.91%** of their genes/chromosomes/genetic information/DNA from the mother and father/parents/sperm and egg/fertilised egg (not the donor); only small percentage of their genes/chromosomes/genetic information/DNA inherited from the donor; idea that most characteristics are coded for by DNA/genes/chromosomes/genetic material **found in the nucleus**;	1	 **ignore** reference to 50% from mother / 50% from father **Examiner's Comments** This question was answered poorly, with candidates not taking time to understand what was being asked. Many candidates focused on half of genes/23 chromosomes originating from each parent, without credit. Although some candidates had the correct idea that most genes come from the mother and father, they frequently forgot to say 'most', failing to understand what the question was actually asking. Some did say that characteristics are coded for by genes found in the nucleus. Very few made explicit the idea that few genes originated from the donor.

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Question			Answer/Indicative content	Marks	Guidance
	c		enzymes	1	ignore named proteins / enzymes accept structural/structure / functional/function (proteins) Examiner's Comments Most candidates did not score on this question, with a surprising number of no response answers. Of those who did score, enzymes was frequently given, with some candidates giving functional as a response and very rarely structural. Some did name specific enzymes or proteins, such as e.g. amylase/keratin and some candidates wrote 'hair', but these were not worthy of credit. Many also wrote 'amino acids', but again this was not worthy of credit. Given enzymes are a type of protein, the proportion of wrong answers was surprising.

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Question			Answer/Indicative content	Marks	Guidance
	d		*any three from any category:* *Consideration of consequences. Examples include:* not enough known (about the impact); DNA in the mitochondria may affect the characteristics of the child / cause complications; may be unsafe / harmful / risky; may cause disability; idea of concerns about where it could lead; likely to be costly / could the money be put to better use; problems caused by having three parents; causes problems for DNA testing; psychological problems; consideration of other consequences; *Consideration of ethics. Examples include:* unethical/morally wrong; is it right to select based on disease/to get rid of genetic disease; child unable to give consent/decide; uncertainty over legal parents/ donor may wish to parent the child / donor is not fully the parent of the children; should only have two parents / people may believe that a child should not have three parents; destruction of an egg cell / nucleus / genetic information / DNA which could have created life; other ethical consideration; *Religious argument. Examples include:* religious reasons / against God's will; other religious argument;	3	**accept** alternative ideas to those on left **ignore** mutations **ignore** 'unnatural' **ignore** reference to embryos **ignore** 'playing God' **Examiner's Comments** Most marks were awarded for simple statements of ethical or religious reasons or problems associated with having three parents. Some candidates talked about the nucleus which could become a life being discarded, although some gave this in the context of an embryo, which gained no credit. 'Playing God' and unnatural were very frequent responses which gained no credit. Centres are advised that these responses do not gain credit, and candidates should be advised against them. Only a small number candidates considered costs, or considered consequences. The candidates that did identify consequences tended to be around the ideas of where it may lead. Very few considered the impact on the child themselves.

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Question			Answer/Indicative content	Marks	Guidance
	e		**any two from** (1 in 200 is a) **high** number of children affected; (so) less money will be spent treating children with diseases; (so) prevents faulty mitochondria being passed on to offspring/children; (but) **low number** (seriously) affected / **only** 1 in 6,500 / small chance of being (seriously) affected (so it may be) cheaper to treat those affected (than to develop the new technique); (however) idea that money used for the treatment only benefits few people / one disease / could benefit more patients/other diseases; it is worth it even to save one life / improve the quality of life / health;	2	**ignore** reference to religious and ethical arguments **accept** alternative idea that this is a high number in a whole population **Examiner's Comments** This question frequently scored 1 out of the 2 marks, with a significant number of candidates failing to use the information provided in the question. Many candidates gained credit for stating that the technique would improve quality of life, or save lives. Many candidates identified 1 in 6500 being a low number. Very few candidates discussed the idea of preventing faulty mitochondria being passed on. Some candidates did use both the 1 in 200 and the 1 in 6,500 figures thoughtfully in their answers to score 2 marks. Few candidates referred to it being cheaper to treat those affected than to develop the new technique.

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Question			Answer/Indicative content	Marks	Guidance
	f		any two from amino acid sequence will be different/ the amino acids coded for will be different; no/different/incorrect protein/enzyme produced; protein/enzyme may not function;	2	ignore changes to the production/formation of amino acids Examiner's Comments Generally the idea that a different or wrong protein would be produced was scored by many candidates. The concept of amino acid sequence being changed seemed not to be so well understood, and rarely scored. There were quite a few references to amino acid *production*, which on its own did not gain credit. Quite a lot of candidates seized on the mutation idea and described how a mutation could affect an individual ranging from various disabilities to cancer, occasionally also talking about incorrect base pairing. The link between a protein being different and a protein not functioning was not often seen, so relatively few candidates scored the final marking point.
			Total	11	
8	a			2	four correct = 2 marks two or three correct = 1 mark one correct = 0 marks
			proteins; DNA; genotype; phenotype		accept enzymes Examiner's Comments Many candidates were able to provide at least 2 correct responses for 1 mark.
	b		sex (chromosomes) / XX / XY / X AND Y	1	do not credit ‘sex cells / gametes’ / genes do not credit ‘X’ alone or ‘Y’ alone
					Examiner's Comments The majority of candidates were able to produce the correct response.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
9			Level 3 (5–6 marks) a good explanation of protein synthesis AND A good description of cell specialisation Quality of written communication does not impede communication of the science at this level Level 2 (3–4 marks) An explanation of protein synthesis AND a description of cell specialisation Quality of written communication partly impedes communication of the science at this level Level 1 (1–2 marks) an explanation of protein synthesis OR a description of cell specialisation Quality of written communication impedes communication of the science at this level Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit	6	This question is targeted at grades up to A* Indicative scientific points may include Protein synthesis • DNA / genetic material is located in the nucleus • the DNA cannot leave the nucleus • the DNA is unzipped / copied • mRNA is formed • mRNA can leave the nucleus • enters the cytoplasm • ribosome involved • gene has a sequence of bases • ref. to triplet code / codon • which corresponds to the order of amino acids • amino acids are joined to form the protein. Cell specialisation • all cells contain the same genes • genes / DNA / mRNA code for proteins • different genes are switched on / switched off • ciliated cells have the gene switched on • genes that are switched on in a cell will produce the protein / cilia • genes that are switched off in a cell will not produce the protein / cilia Accept higher level answers Examiner's Comments This question tended to be the lower scoring of three 6 mark questions. However, there were some excellent descriptions of protein synthesis, some responses included transcription and that although all cells have the same DNA only parts of it are read in specialised cells. Unfortunately, some of candidates only got 2 marks as there was no correct mention of cell specialisation. A few candidates got 2

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Question			Answer/Indicative content	Marks	Guidance
					marks for a description of cell specialisation without mention of protein synthesis, but these were in the minority. Many candidates defined what specialised and unspecialised cells are e.g. cells may be specialised for a particular function, their structure will allow them to carry this function out, rather than stating whether genes are switched on or off. The most common misconception was to discuss the cell, rather than the gene being switched on/off.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
10			**[Level 3]** A good description of coding AND enzyme being made. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Incomplete description of coding AND enzyme being made. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Simple description of DNA code OR how enzyme is made Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Indicative scientific points for coding may include: • DNA contains bases • bases are A T C G • the order of bases (in a gene) is the code for building up amino acids in the correct order • 3 bases needed to code for 1 amino acid • triplet code • DNA unzips • mRNA / codon / a copy (of the gene) is made Indicative scientific points for making an enzyme may include: • mRNA / codon / a copy leaves the nucleus • mRNA / codon / a copy goes to cytoplasm / ribosome • cytoplasm / ribosome where enzyme / protein is made • amino acids are added in the correct sequence • proteins / enzymes are made from amino acids Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments The question was well answered by a significant proportion of the candidates i.e. they were awarded 5 or 6 marks and there were remarkably few no responses. A few candidates gave excellent responses which were restricted to just coding or making points and were therefore limited to Level 1 but these were very much in the minority. Most responses awarded Level 1 marks were simply because of lack of knowledge. Similarly a few candidates gave good answers with several coding or making points but only a single point for

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Question			Answer/Indicative content	Marks	Guidance
					the other aspect and were limited to level 2 because of this. One common 'error' seen was the occasional protein/enzyme being formed in the chloroplast. Not many except the very best candidates utilised the '3 bases needed to code for one amino acid' point although several did recognise that proteins/enzymes were made out of amino acids and that this involved a triplet code and some idea of a sequence or order. Some candidates completely misunderstood the question and gave details about how enzymes work (lock-and-key, etc.) but nothing creditworthy. Other common mistakes referred to the triplet code of amino acids or that at the ribosome the amino acids were made or that the bases are amino acids.
			Total	6	
11	a		1, 5, (2), 15, 11	2	4 correct responses = 2 marks 3 correct responses = 1 mark 2 or fewer correct responses = 0 marks Examiner's Comments The vast majority of candidates scored two marks here and seemed confident about interpreting the triplet code. Where marks were lost, it was usually for careless errors.
	b		messenger RNA / mRNA (1)	1	**allow** upper or lower case letters Examiner's Comments A pleasing number of candidates got this answer correct and so many scored a mark here. The most common incorrect response was 'clone'.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
12		i	glucose (1) nitrate (1)	2	**deduct** one mark for each additional tick
		ii	Protein	1	**deduct** one mark for each additional tick
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
13	a		gene ✓ mRNA ✓ ribosome ✓ amino acids ✓ genetic variant ✓	4 (AO 1.1 x 4)	2 correct = 1 mark 3 correct = 2 marks 4 correct = 3 marks Examiner's Comments Few candidates gained full marks on this question. The most common errors were seen in the first sentence. Very few candidates realised that it was a copy of the gene which was made from mRNA, many thought it was a copy of the DNA.
	b		(mutation) changes the base sequence in the DNA / order of bases/ triplet codes ✓ this would give rise to a different sequence of amino acids/ a different amino acid is coded for (in the receptor protein made from the gene) ✓	2 (AO 1.1 x 2)	DO NOT ALLOW the idea that triplet bases make different amino acids Examiner's Comments This question was aimed at a high level and was designed to test candidates understanding as to why mutations were problematic to protein structure. It was clear from the answers seen that many candidates did have an idea of how mutations affect structure, but their explanations were a little confused and lacked precision when using key terminology. It was pleasing to see that candidates had been taught how the base sequence could change as a result of a substitution, deletion or addition, unfortunately some candidates did not continue with the explanation to discuss the impact this would then have on the base sequence and consequently lost the first marking point. Many candidates incorrectly referred to the change in base sequence resulting in different amino acids being made.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
14			(nitrate ions are the plant's only source of) nitrogen ✓ to make amino acids/proteins/nitrogenous compounds ✓	2 (AO 1.1 × 2)	ALLOW examples e.g. enzymes / DNA Examiner's Comments This question required candidates to recognise that nitrates were the plant's source of nitrogen and that nitrogen was needed to make amino acids or other nitrogenous compounds.
			Total	2	

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