PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 7: MODERN GENETICS

FACTORS AFFECTING GENE EXPRESSION

SCORE	PERCENTAGE
/63	%

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Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	{methyl group / CH_3} added to a {base (cytosine or adenine) / cytosine / adenine / CpG site}	DO NOT ACCEPT between cytosine and guanine ACCEPT A for adenine, C for cytosine, G for guanine	

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following: • {zygote / morula} are totipotent stem cells as they give rise to all cell types (1) • {blastocyst / inner cell mass} contains pluripotent cells that give rise to the cells of the embryo (and not the extra embryonic tissue) / most cell types (1) • cells in the developing embryo are multipotent as they become only some cell types (1)	ACCEPT references to early and late stages of development if clear from description which stages are being referred to ACCEPT cleavage cells ACCEPT {trophoblastic cells / cells around the outside of the blastocyst} as they become extra embryonic tissue N.B. If correct description given for 2 or more types of stem cell but no reference to embryo, award 1 mark	

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following: • level of DNA methylation increases after the blastocyst stage} (1) • because genes {switched off / silenced / inactivated / cannot be transcribed / cannot be expressed} (1) • causing cells to become {specialised / differentiated} (1)		

Q2.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • changes that affect gene {expression / activation} **(1)** • credit an example of epigenetic modification **(1)** • involved in {differentiation / change in function / change in proteins synthesised } **(1)**	**Do not accept** altering the DNA / base sequence / genetic code e.g. DNA methylation, histone {modification / methylation / acetylation} / chromatin remodelling / non-coding RNA / transcription factors **Accept** when a B cell becomes a plasma cell	**(3)**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to two of the following: • because HIF can switch on gene (expression) (1) • bind to a promotor region / stimulate transcription / stimulate protein synthesis} (1) • for {enzymes / proteins} involved in glycolysis (1)	**ACCEPT** increased gene expression **ACCEPT** increase rate of transcription **IGNORE** enzymes **ACCEPT** named {enzyme / protein} involved in glycolysis e.g. enzyme that makes NAD **IGNORE** NAD otherwise	(2) EXP
Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • (because if conditions are hypoxic) there is not much oxygen available to act as a terminal electron acceptor (1) • therefore the electron transport chain will not operate (1) • therefore ATP production by oxidative phosphorylation will be reduced (1)	**ACCEPT** no oxygen **IGNORE** numbers of ATP molecules produced	(4) EXP

	• ATP is produced (directly / SLP) during glycolysis (during these anaerobic conditions) (1)		

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • both HIF-1 and HIF-2 increase (during hypoxia) (1) • levels of HIF-2 remain high (after a small decrease) but levels of HIF-1 fall (1)	**DO NOT PIECE TOGETHER** **IGNORE** any explanations given	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(iv)	An explanation that makes reference to two of the following: • HIF-1 and HIF-2 switch on different genes (1) • {products / transcription of genes} resulting from the presence of both HIF-1 and HIF-2 are needed in the early stages of hypoxia (1) • {products / transcription of gene} resulting from the presence of HIF-2 are needed {for longer periods of hypoxia / to sustain glycolysis} (1)	**ACCEPT** bind to different promotor regions **ACCEPT** converse for HIF-1	(2) EXP

Q4.

Question Number	Answer	Additional guidance	Mark
(a) (i)	(cut shoot) without IAA present / without agar blocks ;	ACCEPT - agar block with no IAA, empty agar block, agar block with water ACCEPT - auxin(s) as alternative to IAA	**(1)**

Question Number	Answer	Additional guidance	Mark
(a) (ii)	1. (both sides of) shoot taller / eq ; 2. than the control / eq ; 3. both IAA's diffuse {down / out of agar / to zone of elongation} / eq ; 4. reference to cell elongation / eq ; 5. details of cell elongation / eq ; 6. shoot bends to the right / eq ; 7. (due to) more growth on {left side of shoot / side with artificial IAA} / eq ;	ACCEPT - auxin as alternative to IAA throughout ACCEPT 1 – grow {taller/higher/up/ towards the light} ACCEPT 3 – away from the light/agar block ACCEPT 6 - bends away from side with artificial IAA	**(5)**

Question Number	Answer	Additional guidance	Mark
(b)	1. idea that IAA enters the cell ; 2. reference to movement within cell / IAA in cytoplasm to nucleus ; 3. effect when binds to transcription factor e.g. forms a transcription initiation complex or countering an inhibitor ; 4. reference to switching on gene ; 5. activity at promoter region / eq ; 6. allows formation of (m)RNA / eq ; 7. idea of translation produces protein ;	ACCEPT - auxin as alternative to IAA throughout ACCEPT 3 - joins to promoter region or activates transcription factor ACCEPT 5 – ref to RNA polymerase activity	**(4)**

Q5.

Question Number	Answer	Additional Comments	Mark
(a) (i)	As a comparison / to show that IAA required for growth ;		(1)

Question Number	Answer	Additional Comments	Mark
(a) (ii)	1. recorded {height / eq} of the shoots / eq ; 2. calculated difference in heights / eq ; 3. shoots with IAA are taller than control / eq ; 4. because IAA diffuse {down / out of agar / to zone of elongation} ; 5. causing cell elongation ; 6. details of cell elongation ; 7. idea of higher IAA concentration causes more growth ; 8. (due to) more cell elongation ;	**ACCEPT auxin as alternative to IAA throughout** **1. Accept** length **4. Accept** away from the light/agar block or goes into shoot **6. Accept** change in pH, H ions, H bonds, plasticity	(5)

Question Number	Answer	Additional Comments	Mark
(b)	1. Idea of IAA at cell surface membrane e.g. binds to receptors ; 2. idea of movement within cell e.g. secondary messengers, IAA moves to the nucleus ; 3. detail of interaction with transcription factor ; 4. idea of switching on gene ; 5. Activity at promoter region / eq ; 6. Allows formation of (m)RNA ; 7. Idea of translation produces protein ;	**Accept** auxin as alternative to IAA throughout **1. Accept** IAA enters the cell **3. Accept** e.g. binds to a TF, activates TF, forms transcription initiation complex, binds to or counters an inhibitor 4. **Accept** binds to promoter region **5. Accept** RNA polymerase activity **6. Accept** preRNA, rRNA **Ignore** ref to tRNA **7. Ignore** translation of protein	(4)

Q6.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • removal of the {shaded nucleotides / introns} (1) • attachment of ACC (and OH) (1) • joining with phosphodiester bonds (1)	**ACCEPT** shaded {parts / areas} **ACCEPT** adding {acceptor stem / amino acid binding site}	**(3)**

Q7.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: • by epigenetic modification (1) • for example by {DNA methylation / histone methylation / histone acetylation} (1) • {house-keeping genes / genes needed in both cell types} remain switched on (1) • genes needed in {common lymphoid progenitor / lymphoid} cells become (permanently) switched off (1) • causing {proteins / named protein} to be made that are specific to the {cell type / named cell} (1)	**ACCEPT** descriptions / post-transcriptional modification transcription of genes switched on / no transcription of genes switched off **ACCEPT** converse **ACCEPT** converse credit a named example of a gene which may be switched {on / off} e.g. gene coding for cytokines in T lymphocytes **NB** genes become switched on or off = 1 mark, if no other marks awarded	(4)

Q8.

Question Number	Correct Answer	Additional guidance	Mark
(a)	An explanation that makes reference to the following: • {Active site changes shape / not correctly formed} and no longer an efficient 'fit' to substrate (1) • because if one amino acid is changed then these bonds cannot form (1) • because only certain amino acids (e.g. cysteine needed for S –S bonding) can form disulphide bridges/hydrogen bonds/ionic bonds (1) • and these bonds are important in the formation of a tertiary/3D protein structure (1)		**(4)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(i)	An explanation that makes reference to the following: • (reduced activity of GA_{20} oxidase means) less active GA_{20} is produced (1) • therefore less GA_{20} means more DELLA proteins present (1) • hence more DELLA proteins means fewer transcription factors binding to growth regulator genes (1) • therefore resulting in growth regulator genes not expressed / growth less because transcription factors needed for expression of genes (1)	Less DELLA protein broken down	**(4)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(ii)	• equation $p^2 + 2pq + q^2 = 1$ (1) • $p^2 = 0.36$ so $p = 0.6$ (1) • $q = 0.4$ so $2pq = 2 \times 0.6 \times 0.4$ (1) • correct answer 48% (1)		**(4)**

Q9.

Question Number	Answer	Additional guidance	Mark
	1. reference to transcription factors ; 2. bind to promoter region / form a transcription initiation complex / eq ; 3. RNA polymerase can bind /eq ; 4. mRNA made ; 5. idea of translation occurring ; 6. at ribosomes / on the RER / in the cytoplasm ; 7. idea of function of product e.g. inhibits normal ant behaviour / stimulates abnormal ant behaviour / description of abnormal behaviour given ; 8. idea of product affecting nervous system ;	2. **ACCEPT** gene switched on 5. **ACCEPT** protein/poly peptide produced	**(5)**