PEARSON EDEXCEL GCSE BIOLOGY (HIGHER) · 1BI0

BIOLOGY



MARK SCHEME

TOPIC 4: NATURAL SELECTION AND GENETIC MODIFICATION (PACK 2)

SCORE	PERCENTAGE
/54	%

STEMUP

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Mark Scheme

Q1.

Question number	Answer	Mark
	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • genetic variation means that some plants will be tolerant of drought conditions and these can be selected (1) • cross-pollinate these plants and grow the seeds under drought conditions (1) • select offspring and repeat over several generations (1)	**(3)**

Q2.

Question Number	Answer	Additional Guidance	Mark
	An answer including: • breed two animals that can run fast (1) • selection of offspring that can run fast (1) • repeat the process over many generations (1)	accept beneficial characteristic for running fast	**(3)** **AO2 1**

Q3.

Question number	Answer	Additional guidance	Mark
	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • best characteristics/named characteristic chosen (1) • parents bred together (1) • offspring produced showing some of the best characteristics are selected(1) • selection and breeding process repeated (1)	accept reference to pollination / fertilisation	**(3)**

Q4.

Question number	Answer	Mark
	An answer that provides a description by making reference to: • an extra/new gene (1) • present in the DNA/chromosome (1)	**(2)**

Q5.

Question number	Answer	Additional guidance	Mark
	A description including **three** of the following: • overproduction of offspring (1) • organisms in a species have {variation / mutations} (1) • there is {a struggle for existence / selection pressure / competition} (1) • the adapted organisms survive (1) • (reproduction leads to) offspring inheriting {characteristics / gene / allele /adaptation / trait} (1) • this is repeated over many generations (1)	 accept there are differences within {species/organisms} accept named selection pressure /change in the environment accept survival of the fittest accept not adapted organisms die	**(3)** **AO2 1**

Q6.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	ligase	accept reasonable misspellings e.g. lygase reject lipase	**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	Two from the following • leaves single stranded ends /overhangs / sticky ends (1) • complementary / bases pair up (1) • hold gene in place while ligase joins the DNA / makes inserting gene into plasmid more successful (1)	 accept (single stranded DNA) matches up ignore join together easily	**(2)**

Question Number		Indicative Content	Mark
QWC	* **(b)**	A description to include some of the following points Sweets • made using invertase/sucrase • converts sucrose into glucose and fructose • reduces viscosity of sugar mixture • increases simple sugar content, increasing sweetness • production of soft centred sweets • production of lower calorie sweets Vegetarian Cheese • made using chymosin • produced by genetically modified organisms • Chymosin initiates clotting/protein coagulation • reduces the use of rennet extracted from animals Lactose free milk • made using lactase • using immobilised enzymes • lactose converted to galactose and glucose • beneficial to people with lactose intolerance	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description of the use of enzymes in the production of at least one food **or** naming an enzyme linked to its use • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description of at least two food products linked to their named enzyme **or** a detailed description of the production of one food including the name and role of the enzyme • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description of most stages of the production of two or more food products made using enzyme technology including the name and role of the enzymes • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Question Number	Answer	Acceptable answers	Mark
(c)	A description including two from the following **digestive** enzymes/named digestive enzyme (1) breakdown **named biological** stain (1) stains into soluble products (1)		**(2)**

Q7.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	ligase	accept reasonable misspellings e.g. lygase reject lipase	**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	Two from the following • leaves single stranded ends /overhangs / sticky ends (1) • complementary / bases pair up (1) • hold gene in place while ligase joins the DNA / makes inserting gene into plasmid more successful (1)	accept (single stranded DNA) matches up ignore join together easily	**(2)**

Question Number		Indicative Content	Mark
QWC	* **(b)**	A description to include some of the following points Sweets • made using invertase/sucrase • converts sucrose into glucose and fructose • reduces viscosity of sugar mixture • increases simple sugar content, increasing sweetness • production of soft centred sweets • production of lower calorie sweets Vegetarian Cheese • made using chymosin • produced by genetically modified organisms • Chymosin initiates clotting/protein coagulation • reduces the use of rennet extracted from animals Lactose free milk • made using lactase • using immobilised enzymes • lactose converted to galactose and glucose • beneficial to people with lactose intolerance	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description of the use of enzymes in the production of at least one food **or** naming an enzyme linked to its use • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description of at least two food products linked to their named enzyme **or** a detailed description of the production of one food including the name and role of the enzyme • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description of most stages of the production of two or more food products made using enzyme technology including the name and role of the enzymes • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Question Number	Answer	Acceptable answers	Mark
(c)	A description including two from the following **digestive** enzymes/named digestive enzyme (1) breakdown **named biological** stain (1) stains into soluble products (1)		**(2)**

Q8.

	Answer	Acceptable answers	Mark
(a)	A description including **three** of the		

	following points: • all have digits/fingers (1) • all have { similar bones /radius / ulna / carpals}(1) • all have a humerus bone (1) • <u>pentadactyl</u> limb (1)	accept: phalanges for fingers accept: same bone structure	**(3)**
(b)	An explanation including two of the following points: • soft tissue of organisms does not form fossils (1) • some fossils are yet to be found (1) • fossils may be damaged (1) • conditions not correct for fossil formation (1) • fossils may only be fragments / not whole organisms (1)	accept: references to plant or animal tissue accept: reasons why they may not be found accept: reasons for damage e.g. earthquakes accept: named conditions e.g. pH	**(2)**
(c) (i)	D 9.0%		**(1)**
(c) (ii)	• lowered the level of carbon dioxide / carbon dioxide {removed / taken in} (1) • increased the level of oxygen / oxygen {produced / made}(1)	accept: percentage for level If CO_2 written must be correct, do not accept CO^2	**(2)**
(c) (iii)	Any **two** from: • large organisms {more complex/carry out greater number of functions / more cells} • for (more aerobic) respiration • for (more) energy		**(2)**

Q9.

	Answer	Acceptable answers	Mark
	A suggestion linking **three** of the following points: • variation between species/ beak sizes/ shapes (1) • due to mutation(1) • competition for resources (1) • survival of the fittest /those best adapted to the environment survived (1) • those who survive pass their genes/characteristics onto their offspring (1) • natural selection (1)		**(3)**

Q10.

	Answer	Acceptable answers	Mark
	A suggestion linking **three** of the following points: • variation between species/ beak sizes/ shapes (1) • due to mutation(1) • competition for resources (1) • survival of the fittest /those best adapted to the environment survived (1) • those who survive pass their genes/characteristics onto their offspring (1) • natural selection (1)		**(3)**

Q11.

Question Number		Indicative Content	Mark
QWC	*	A explanation to include some of the following points Basic structure All have: • similar bone structure • humerus / femur / has one upper limb bone • radius and ulna / tibia and fibula / two lower limb bones • carpels / wrist bones • pentadactyl limb • have 5 digits Specific examples • some (eg horse) have digits reduced / missing • different shapes reflect different uses • suitable example, eg bat has extended first digit to support wing • different features caused by mutations • different environments have selected different features / mutations • idea of different features being beneficial / survival of the fittest • idea of adaptive radiation / selection of features / genes • suggests similar ancestors for all mammals /birds / reptiles / and (many) amphibians • can show how one species is related to another	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited explanation of at least one idea from the basic structure section or the specific examples • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• a simple explanation from the basic structure linked to at least one specific example OR a detailed explanation of the basic structure • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed explanation that includes linking some of the areas of basic structure to specific examples related to evolution • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q12.

Question number	Answer	Mark
	An explanation that combines application of knowledge (2 marks) and reasoning/justification – application of understanding (2 marks) • The phosphorescent gene needs to be isolated from the DNA of the phosphorescent organism using enzymes to expose sticky ends(1) • The plasmid is removed from the bacterial cell and cut open using the same enzymes to expose complementary sticky ends (1) • The phosphorescent gene is inserted into the bacterial cell matching the sticky ends using the enzyme ligase (1) • The plasmid is inserted back into the bacterial cell and is grown on a petri dish each bacterial cell will express the phosphorescent gene and glow in the dark (1)	**(4)**

Q13.

Question number	Indicative content	Mark
	AO1 • the gene that codes for human insulin is identified • in the human DNA • this is removed using a restriction enzyme • the plasmid of a bacterial cell is removed • using lysosomes/lysozyme • the plasmid is cut open • using (the same) restriction enzyme • leaving complementary sticky ends • the human gene is inserted into the bacterial plasmid • using the enzyme ligase • the plasmid is returned to the bacterial cell • the bacterial cell multiplies	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or underdeveloped. (AO1) • Presents and explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of scientific ideas is detailed and fully developed. (AO1) • Presents and explanation that has a well developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• A brief understanding of the removal of the human gene or how the bacterial cell is altered • The process described links to the next or a key aspect of the process
Level 2	3–4	• A brief understanding of both the removal of the human gene and the use of a plasmid / bacterial DNA / vector • Linked to the use of at least one correct enzyme
Level 3	5–6	• A clear understanding of the removal of the human gene, the use of the bacterial plasmid including one correct enzyme, and insertion of the (recombinant) plasmid into a bacterium • Linked to the correct enzymes for removal of the gene and the insertion into the plasmid AND the role of sticky ends

Level	Mark	Examples of answers
	0	No rewardable material.
Level 1	1–2	• The human insulin gene is inserted into the bacterial DNA - 1 • Cut the human insulin gene from a cell and insert it into the bacteria -2 • Cut the human insulin gene leaving sticky ends - 2
Level 2	3–4	• Cut the human insulin gene and cut a plasmid. Insert the gene into the plasmid DNA - 3 • Cut the human insulin gene and cut a plasmid with restriction enzymes. Insert the gene into the plasmid DNA - 4 • Remove the insulin gene using restriction enzymes and cut the plasmid with the same restriction enzyme, Use ligase to insert the gene into the plasmid - 4
Level 3	5–6	• Cut the insulin gene using a restriction enzyme that leaves sticky ends. Cut the plasmid DNA with the same restriction enzyme and insert the gene into the plasmid. Insert the recombinant plasmid back into the bacteria - 5 (no ligase) • Cut the insulin gene using a restriction enzyme. Cut the plasmid DNA with the same restriction enzyme and insert the gene into the plasmid. Insert the recombinant plasmid back into the bacteria – 5 (no sticky ends) • Cut the insulin gene using a restriction enzyme that leaves sticky ends. Cut the plasmid DNA with the same restriction enzyme to leave complementary sticky ends. Join the gene and the plasmid using ligase. Insert the recombinant plasmid back into the bacteria – 6

Q14.

Question number	Answer	Mark
	An explanation that combines identification - knowledge (3) • a {plasmid/bacterial DNA} is cut using the restriction enzymes and the (insulin) gene is cut using restriction enzymes (1) • these enzymes produce **complementary** {sticky ends / base pairs} (1) • the gene (for insulin) is inserted into the plasmid using ligase (to join the gene to the plasmid) (1)	**(3)**

Q15.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation linking two of the following: • cut the {plasmid/gene/DNA} with a **restriction enzyme** (1) • insert the gene into the plasmid using **ligase** (1) • gene and plasmid have the same sticky ends / complementary sticky ends (1)	accept vector for plasmid	**(2)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	An evaluation that combines three of the following points: At least one from benefits • (yeast grows rapidly) increasing yield (1) • it can be produced in a shorter time period (1) • production is cheaper/easier to extract (1) • takes up less space than growing plants (1) • yeast growth is not weather dependent (1) At least one from risks • concerns over the genetically modified yeast being manufactured illegally (1) • the painkillers may not be identical/as effective (1) • concerns over GM organisms entering environment (1)	Max of 2 marks for benefits. Max of 2 marks for risks. accept possible health risks of painkillers from GM yeast	**(3)** AO 2 1