

Biotechnology and Genetic Engineering

Mark Scheme 1

Level	IGCSE
Subject	Biology
Exam Board	CIE
Topic	Biotechnology and Genetic Engineering
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 1

Time Allowed: 68 minutes

Score: /56

Percentage: /100

<p>1 (a)</p>	<p>taking a, gene / DNA / allele, from one species ; inserting it into another organism ;</p> <p>OR</p> <p>changing the, genetic material / chromosome of, an organism / cell ; by removing / changing / inserting, <u>genes</u> / <u>DNA</u> / <u>alleles</u> ;</p>	<p>max [2]</p>																						
<p>(b)</p>	<table border="1"> <thead> <tr> <th data-bbox="376 488 537 555">Letter from fig</th> <th data-bbox="537 488 784 555">Name</th> <th data-bbox="784 488 1252 555">Descrip</th> </tr> </thead> <tbody> <tr> <td data-bbox="376 555 537 632">M</td> <td data-bbox="537 555 784 632">chromosomes</td> <td data-bbox="784 555 1252 632">threads of DNA found in the nucleus</td> </tr> <tr> <td data-bbox="376 632 537 708">N</td> <td data-bbox="537 632 784 708">gene / allele ;</td> <td data-bbox="784 632 1252 708">section of DNA removed from human cell</td> </tr> <tr> <td data-bbox="376 708 537 911">Q</td> <td data-bbox="537 708 784 911">plasmid</td> <td data-bbox="784 708 1252 911">vector / loop / circle, of DNA (that can carry a foreign section of DNA) / separate piece of DNA (from chromosome) ;</td> </tr> <tr> <td data-bbox="376 911 537 987">R</td> <td data-bbox="537 911 784 987">bacterial (cell) ; A yeast</td> <td data-bbox="784 911 1252 987">type of cell that is genetically engineered</td> </tr> <tr> <td data-bbox="376 987 537 1093">O</td> <td data-bbox="537 987 784 1093">insulin / protein ;</td> <td data-bbox="784 987 1252 1093">specific chain of amino acids coded by the section of DNA removed from the human cell</td> </tr> <tr> <td data-bbox="376 1093 537 1295">P</td> <td data-bbox="537 1093 784 1295">fermenter</td> <td data-bbox="784 1093 1252 1295">(container in which) bacteria / microorganisms / cells, reproduce / grow / produce insulin ;</td> </tr> </tbody> </table>	Letter from fig	Name	Descrip	M	chromosomes	threads of DNA found in the nucleus	N	gene / allele ;	section of DNA removed from human cell	Q	plasmid	vector / loop / circle, of DNA (that can carry a foreign section of DNA) / separate piece of DNA (from chromosome) ;	R	bacterial (cell) ; A yeast	type of cell that is genetically engineered	O	insulin / protein ;	specific chain of amino acids coded by the section of DNA removed from the human cell	P	fermenter	(container in which) bacteria / microorganisms / cells, reproduce / grow / produce insulin ;	<p>[5]</p>	
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<p>1 (c)</p>	<p>clone / (genetically) identical ; rapid / less energy to reproduce (asexually) / only one parent / no gametes ; large quantity of insulin produced ; all bacteria, have the insulin gene / produce insulin ; same insulin produced ; once cells are engineered does not have to be repeated ; AVP ; e.g. cheap / ethical <i>or</i> religious reasons / less allergic reaction / no immune rejection / more efficient / no risk of disease (transmission)</p>	<p>max [3]</p>	<p>A <u>no</u> variation</p> <p>only accept in context of comparisons with animal insulin extraction methods</p>
		<p>[Total: 10]</p>	

2 (a) (i)	all bacteria are, susceptible / sensitive to this antibiotic / not resistant ; (antibiotics) killed the bacteria / stopped bacteria growing / AW ;	[max 1]	R immune (as equivalent to resistance)
	(ii) (all) bacteria are, resistant / not affected (by the antibiotic) / ORA ;	[1]	R immune (as equivalent to resistance) ecf from 2(a)(i)
(iii) 1 2 3	only a few bacteria from the sample are resistant / ORA ; caused, by mutations / genes ; resistant bacteria, grew / reproduced ;	[max 2]	R immune (as equivalent to resistance) ecf from 2 (a)(i) and 2 (a)(ii) A susceptible bacteria did not grow
(b) 1 2 3 4	person may be infected with bacteria, that are resistant to, some / an, antibiotic(s) ; (test) to find the most effective antibiotic ; that kills all bacteria (in the person) ; prevents antibiotic resistance ;	[max 2]	R immune (as equivalent to resistance) No ecf from 2 (a)
(c) 1 2 3 4 5 6 7	prescribe / use antibiotics less often ; not for viral / fungal infections ; make sure people complete the course of antibiotics / AW ; develop new antibiotics ; do not use the same antibiotics for too long / rotate antibiotics / AW ; use combinations of antibiotics ; AVP ; e.g. isolation of patients with antibiotic-resistant infections / good hygiene to prevent spread of infection	[max 4]	

2 (d) (i)	S		V	R	T	Q	[1]	
(ii) 1 2 3 4 5 6 7	<p>easier/quicker, to supply the demand ; more cost effective ; no/less, rejection/allergies/side effects ; human insulin more effective (than animal insulin) ; because can be individually modified ; no risk of transmission of disease from animals ; ethical/religious/animal welfare consideration ;</p>						[max 3]	
							[Total:14]	

Question			E Answers	Marks	Additional Guidance
3	(a)	(i)	amino acids ;	[1]	A (di/oligo/poly)peptide
		(ii)	(permanent) increase in, size/length/AW ; increase in <u>dry</u> mass ; increase in <u>cell</u> number ;	[max 2]	Note: increase in dry mass = 2 marks A ref to cell division/mitosis/reproduction of cells R reproduction unqualified ignore development
	(b)	1 2 3 4 5 6 7 8	identify/locate, the (position of) gene (in bovine genome) ; cutting, chromosome/DNA/plasmid ; insert gene into a, plasmid/vector ; plasmid/vector, enters the bacterium ; reproduction/growth, of (GM) bacteria (in fermenters) ; bacteria, synthesise/produce, the protein/BST ; protein/BST, harvested/purified ; correct reference to (named) enzyme ;	[max 3]	<i>answers referring to insulin can be credited with marking points 2,3,4,5,8</i> e.g. restriction enzyme/ligase/endonuclea

3	(c)	<p>(i) <i>mean milk yield to max 4</i></p> <p>1 immediate increase (from treatment/week 10) ; 2 peaks/increases and decreases ; 3 (general) decrease after 20 weeks/43.3 – 43.7 kg per day ; 4 (mean) BST/A, yield always higher than, B/no BST (from 10 week/treatment) ; 5 any suitable data quote giving mean milk yield with units and week ;</p> <p><i>mean food energy intake to max 4</i></p> <p>6 peaks/increase and decreases ; 7 (then) levels off ; 8 (mean) BST/A, energy always higher than, B/no BST (from 10 week/treatment) ; 9 any suitable data quote giving mean food energy intake with units and week ;</p>	<p>Note: All units (kg per day) must be stated for mean milk yield but <i>ignored</i> for food energy intake</p> <p>A optimum/maximum for peak</p> <p>MP 5 39 kg per day at, 10 weeks/start of treatment 43.3–43.7 kg per day at <i>either</i> 19/20 weeks <i>or</i> 9/10 weeks, after treatment 29 kg per day at <i>either</i> 36–37 weeks <i>or</i> 26 - 27 weeks, after treatment approx 10 kg per day difference between A and B</p> <p>MP 9 158 MJ per day at, 10 weeks/start of treatment 164 MJ per day from <i>either</i> week 29 – 34 <i>or</i> after 19–24 weeks of treatment 165 MJ per day at <i>either</i> week 36–37 <i>or</i> 26–27 weeks, after treatment 172 MJ per day at 19.5–20 weeks</p> <p>[max 6]</p>
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Question		E	Answers	Marks	Additional Guidance
3 (c)	(ii)	1	milk yield does not increase much (from initial yield) ;	[max 3]	<p>MP 6 after, 30 weeks/20 weeks treatment, differences in milk yield 10±2 kg (per day), differences in food energy 26–52 MJ (per day) milk yield shows a 20± 2% increase, food intake shows a 15 – 32 % increase after, 30 weeks/20 weeks treatment</p>
		2	increase only for, 10 weeks/short period ;		
		3	increase in food (energy) intake ;		
		4	cattle feed adds extra costs ;		
		5	<i>idea of</i> milk yield decreases but food (energy) intake remains high (from 20 week) ;		
		6	use of comparative data in support ;		
		7	cost of, using/producing, BST ;		
	(d)	1	labelling, provides information/allows consumer choice ;	[max 3]	<p>ignore unethical unqualified</p> <p><i>examples for MP5</i> confusion in consumer minds about GM food loss in sales there is no difference in the milk this is not a GM food, but GM technology is used in the production of BST ignore 'milk is safe'</p>
		2	concerns about hormones 'in the milk' ;		
		3	possible effects on human health ; e.g. allergies/side effec		
		4	ref to, animal welfare/health of cattle expected to produce more milk ;		
		5	there is no reason to label the milk/described example ;		
				[Total: 18]	

Question		E Answers	Marks	Additional Guidance
4	(a)	ref. to limiting factor(s) ; nutrients used up ; no space ; oxygen used up ; build up of waste ; waste is toxic ; pH could change to be unsuitable ;	[max 3]	A (fungus) reached carrying capacity A food R any references to temperature
	(b)	<i>general</i> mixes nutrients with fungus ; increases contact between fungus and nutrients ; <i>air</i> (provides oxygen) for <u>aerobic</u> respiration ; releases energy for, growth / reproduction ; <i>ammonia</i> provide <u>nitrogen</u> for making, amino acids / proteins ; provide alkaline conditions / helps maintain pH ;	[max 3]	R 'produce' energy A mycoprotein / nucleic acids
	(c)	<u>optimum</u> ; reactions occur at a constant rate ; if higher, enzymes <u>denature</u> ; therefore, no growth / fungus dies / reaction stops; if lower, rate of reactions is (too) slow / enzyme activity slows ; ref. to collisions ; therefore slow growth ; heat is generated during respiration ;	[max 4]	ignore reference to economic consequences / productivity
	(d)	glucose / air / ammonia, continually supplied ; fungus continually removed ; remove, waste product(s) / carbon dioxide ; optimum / AW, temperature, ref. to heat exchanger / cold water ;	[2]	A nutrients / raw materials R food here A unlimited supply R mycoprotein removed

4	(e)	improve / give, taste / flavour; preservation / lengthen shelf life / AW ; give colour ; give texture / shape ; AVP ; e.g. improve appearance	[max 2]	R add nutrients / named nutrients R keep fresh
			[Total: 14]	