Question Number	Acceptable answer	Additional Guidance	Mark
1(a)(i)	C 27%		(1)

Question Number	Acceptable answer	Additional Guidance	Mark
1(a)(ii)	C in general as carbon dioxide concentrations increase the temperature of the earth's surface increases		(1)

Question Number	Acceptable answer	Additional Guidance	Mark
1(a)(iii)	C future greenhouse gas emissions are obtained by extrapolating from current and past emissions		(1)

Question Number	Acceptable answer	Additional Guidance	Mark
1(b)	An explanation that makes reference to the following: • animals and plants are adapted to a particular habitat (1) • change in climate will change {biotic/abiotic} factors in a geographic region (1) • animals plants will no longer be adapted to local conditions so will migrate or become extinct in that area (1)	Allow suitable description of niche	(3)

Total for Question 1 = 6 marks

Question Number	Acceptable answer	Additional Guidance	Mark
2(a)	An explanation that makes reference to the following: • two pumps / sides (1) • right ventricle pumps (deoxygenated) blood to lungs (1) • left ventricle pumps (oxygenated) blood to muscles (1) • thicker muscle of left venticle provides high pressure (to ensure all tissues receive sufficient supply) (1)		**(4)**

Question Number	Acceptable answer	Additional Guidance	Mark
2(b)	An explanation that makes reference to three of the following: • the wall of the aorta contains elastic fibres (1) • that allow the wall of the aorta to stretch and recoil (1) • semilunar valves at entrance to aorta prevent the back flow into the ventricle (1) • contraction of muscle in the wall of the aorta (1)		**(3)**

Total for Question 2 = 7 marks

Question Number	Acceptable answer	Additional Guidance	Mark
3(a)(i)	A description that makes reference to two of the following: • carbohydrate (1) • disaccharide of (α)-glucose and fructose (1) • joined by a glyosidic link (1)	Accept made from carbon, hydrogen and oxygen $(CH_2O)_n$	**(2)**

Question Number	Acceptable answer	Additional Guidance	Mark
3(a)(ii)	• correct change in mass (1) • correct rate of change (1)	Example of calculation: 83.7 - 82.5 = 1.2 (kg) 1.2 ÷ 42 = 0.03 (kg day^{-1}) Accept 0.029 kg per day	**(2)**

Question Number	Acceptable answer	Additional Guidance	Mark
3(a)(iii)	An answer that makes reference to the following: • (this) artificial sweetener contains less energy than sucrose (1) • energy intake is below daily requirements (1) • fat stores are used to provide energy so body mass decreases (1)		**(3)**

Question Number	Acceptable answer	Additional Guidance	Mark
3(b)	An explanation that makes reference to the following: • Reducing body mass may reduce blood pressure (1) • Less risk of damage to endothelium (of arteries) (1) • Less inflammatory response (1) • Less risk of { accumulation of cholesterol / atheroma / plaque } developing (1)		**(4)**

Total for Question 3 = 11 marks

Question Number	Acceptable answer	Additional Guidance	Mark
4(a)(i)	D 86 982	50 060 + 36 922 = 86 982	(1)

Question Number	Acceptable answer	Additional Guidance	Mark
4(a)(ii)	A 16 %	(7 900 + 6 178) ÷ 86 982 x 100 = 16 %	(1)

Question Number	Acceptable answer	Additional Guidance	Mark
4(a)(iii)	B belong to different trophic levels		(1)

Question Number	Acceptable answer	Additional Guidance	Mark
4(b)(i)	• correct substitution of values into the equation (1) • correct answer (1)	Example of calculation: $t = \frac{-6.85 \times \sqrt{16}}{\sqrt{\frac{2273.89}{15}}}$ **= -2.23**	(2)

Question Number	Acceptable answer	Additional Guidance	Mark
4(b)(ii)	• t = 2.23 is greater than the critical value at 15 df (1) • reject the null hypothesis there is a significant difference at p = 0.05 (1)	**Allow for error carried forward if a different value has been calculated**	(2)

Question Number	Acceptable answer	Additional Guidance	Mark
4(c)(i)	C three fatty acids linked to a glycerol molecule by ester bonds		**(1)**

Question Number	Acceptable answer	Additional Guidance	Mark
4(c)(ii)	An explanation that makes reference to the following: • lambs obtain energy from sheep milk (1) • more grazing to provide energy for production of milk (1)		**(2)**

Total for Question 4 = 10 marks

Question Number	Acceptable answer	Additional Guidance	Mark
5(a)	37°C (1) AND An answer that makes reference to two of the following: • this is the optimum temperature for enterobacterial growth (1) • because Enterobacter enzymes adapted to work best at 37°C (1) • susceptibility to antibiotics may be different at other temperatures (1)		**(3)**

Question Number	Acceptable answer	Additional Guidance	Mark
5(b)	An explanation that makes reference to three of the following: • weakened cell wall (1) • osmotic lysis (1) • failure to synthesis new cell wall (1) • prevents cell replication (1)		**(3)**

Question Number	Acceptable answer	Additional Guidance	Mark
5(c)(i)	An explanation that makes reference to three of the following: • Penicillin acts as a selection pressure (1) • therefore Enterobacteria with a gene for beta lactamase will survive and reproduce (1) • the frequency of the gene for beta lactamase will increase within the population (1) • Enterobacteria can transfer plasmids to other bacteria (1)		**(3)**

Question Number	Acceptable answer	Additional Guidance	Mark
5(c)(ii)	An explanation that makes reference to the following: • plasmids contain genes (1) • information to make beta-lactamase is carried by a gene (1) • which is a sequence of nucleotides (1)		**(3)**

Total for Question 5 = 12 marks

Question Number	Acceptable answer	Additional Guidance	Mark
6(a)	A description that makes reference to the following: • combines CO_2 with { ribulose bisphosphate / RuBP } (1) • two molecules of { glycerate 3-phosphate / GP } (1)		**(2)**

Question Number	Acceptable answer	Additional Guidance	Mark
6(b)(i)	An explanation that makes reference to the following: • incorporation of CO_2 into the leaves of plants OR production of glycerate 3-phosphate (1) • within a set period of time (1)		**(2)**

Question Number	Acceptable answer	Additional Guidance	Mark
6(b)(ii)	An explanation that makes reference to the following: • increase in temperature increases the kinetic energy (1) • increasing the frequency of collisions of the enzyme and substrate (1) • therefore increasing the rate of reaction (1)		**(3)**

Question Number	Indicative content	
***6(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • Zinc ions inhibit increase in dry mass • Zinc ions inhibit CO2 uptake • Suggesting that photosynthesis is inhibited • Isolated chloroplasts produce electrons / reduce / decolorise DCPIP • Zinc ions do not inhibit the reduction of DCPIP by isolated chloroplasts • Suggesting that zinc ions do not inhibit light dependent stage of photosynthesis • So must be inhibiting the light independent stage	
Level	**Mark**	**Descriptor**
Level 0	Marks	No awardable content
Level 1	1-2	An answer may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The answer will contain basic information with some attempt made to link knowledge and understanding to the given context.
Level 2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The answer shows some linkages and lines of scientific reasoning with some structure.
Level 3	5-6	An answer is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The answer shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

Total for Question 6 = 13 marks

Question Number	Acceptable answer	Additional Guidance	Mark
7(a)	An explanation that makes reference to the following: • the receptor has a unique { primary / tertiary } structure (1) • that gives the receptor molecule a { specific shape / binding site } (1) • that is complementary to the insulin molecule (1)		**(3)**

Question Number	Acceptable answer	Additional Guidance	Mark
7(b)(i)	An explanation that makes reference to the following: • different cells will have different proteins in their cell membrane (1) • proteins present on these cells { recognised as foreign / trigger immune response } (1) • T killer cells recognise specific cell as foreign (1) • T cells help B cells produce antibodies that bind to a specific cell (1)		**(4)**

Question Number	Indicative content	
*7(b)(ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • Probability of having type II diabetes is higher for an individual with an identical twin than with a non-identical twin suggesting genetic aspect • Probability of having type II diabetes is higher for an individual with a non-identical twin than with a non-twin sibling suggesting role for environmental factors • Inbred mice genetically identical so any changes observed are due to environment / epigenetics • The more obese the mice the less DNA methylation observed • The less methylation the greater the insulin responsiveness of the adipocytes • A high fat diet appears to cause epigenetic changes / DNA methylation that correlates with reduced insulin responsiveness • Both genetic and environmental factors / epigenetic factors contribute to type II diabetes	
Level	**Mark**	**Descriptor**
Level 0	Marks	No awardable content
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.
Level 3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.

Total for Question 7 = 6 marks

Question Number	Acceptable answer	Additional Guidance	Mark
8(a)(i)	D		(1)

Question Number	Acceptable answer	Additional Guidance	Mark
8(a)(ii)	B 0.25		(1)

Question Number	Acceptable answer	Additional Guidance	Mark
8(b)(i)	An answer that makes reference to the following: • version of a gene (1) • that is only expressed in individuals homozygous for that allele (1)		(2)

Question Number	Acceptable answer	Additional Guidance	Mark
8(b)(ii)	• correctly proportion of homozygous recessive (q) • correct proportion of heterozygotes (2pq) • correct number of heterozygotes	<u>Example of calculation:</u> q = √(9 ÷ 324) = 1/6 OR 0.167 2pq = 2 x 0.167 x 0.833 = 0.278 number of heterozygotes = 2pq x 324 = 90	(3)

Total for Question 8 = 7 marks

Question Number	Acceptable answer	Additional Guidance	Mark
9(a)	A description that makes reference to four of the following: • random sampling in grazed and non-grazed sand dune hollows (1) • measure { percentage cover / number of plants } (1) • at least 10 quadrats in each area to calculate mean values (1) • record abiotic data at each site (1) • use of an appropriate statistical test to compare distribution (1)	e.g. student t test or Mann Whitney U test	**(4)**

Question Number	Acceptable answer	Additional Guidance	Mark
9(b)(i)	B metaphase		**(1)**

Question Number	Acceptable answer	Additional Guidance	Mark
9(b)(ii)	A description that makes reference to four of the following: • fix root tips in ethanoic alcohol (1) • heat root tip in hydrochloric acid (1) • select the end of the growing tip (1) • add a drop of a correctly named stain (1) • break up the tissue on a glass slide and squash beneath a coverslip (1)	Accept description of ethanoic alcohol or common name "Farmer's fluid" e.g. orcein or Toluidine blue	**(4)**

Total for Question 9 = 9 marks

Question Number	Acceptable answer	Additional Guidance	Mark
10(a)	An answer that makes reference to the following: • yeast cells are eukaryotic because they have membrane bound organelles (1) • yeast cells are similar to plants in having cell walls containing a polysaccharide of β-glucose (1) • yeast is different from plants as it { is not photosynthetic / does not possess chloroplasts }(1) • yeast is different from plants as it has a cell wall of glucans and not cellulose (1)	Allow a named organelle	**(3)**

Question Number	Acceptable answer	Additional Guidance	Mark
10(b)(i)	A description that makes reference to the following: • cell membrane folds around bacteria to form a vesicle inside the cell (1) • lysosomes containing { enzymes / lysozyme } fuse with the vesicle (1) • contents of lysosomes digest bacteria (1)	Allow reference to endocytosis	**(3)**

Question Number	Acceptable answer	Additional Guidance	Mark
10(b)(iii)	An answer that makes reference to the following: • ranges do not overlap for phagocytic activity (1) • the effect of Macrogard is probably significant (1)		**(2)**

Question Number	Acceptable answer	Additional Guidance	Mark
10(c)(i)	An answer that makes reference to two of the following: • stimulates phagocytic activity (1) • part of the non-specific response (1) • protecting trout from bacterial infection (1)		**(2)**

Question Number	Acceptable answer	Additional Guidance	Mark
10(b)(ii)	Trout would be protected	Accept trout would have enhanced natural immunity to the pathogen	**(1)**

Question Number	Acceptable answer	Additional Guidance	Mark
10(b)(iii)	protection would be reduced	Accept trout would have less natural immunity to infection	**(1)**

Total for Question 10 = 9 marks