PEARSON EDEXCEL IGCSE BIOLOGY · 4BI1

BIOLOGY



MARK SCHEME

SECTION 1: THE NATURE AND VARIETY OF LIVING ORGANISMS (PACK 2)

SCORE	PERCENTAGE
/186	%

STEMUP

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Mark Scheme

Q1.

Question Number	Answer	Mark
(a)(i)	The only correct answer is D nucleoid A is not correct as it is the flagellum B is not correct as it is the cell membrane C is not correct as it is the cell wall	**1**

Question Number	Answer	Mark
(a)(ii)	The only correct answer is B cell membrane A is not correct as it is a flagellum D is not correct as it is the nucleoid E is not correct as it is a plasmid	**1**

Question Number	Answer	additional guidance	Mark
(b)	An answer that makes reference to three of the following points: • bacterium has no chloroplasts (1) • bacterium has no nucleus (1) • bacterium has no (large) vacuole (1) • bacterium has plasmids (1) • bacterium has flagella (1) • bacterium has no mitochondria (1)	allow converse for plant cell ignore chlorophyll no credit for reference to structure A etc	**3**
			Total = 5 marks

Q2.

Question Number	Answer	Mark
(a)	A oesophagus / gullet (1) B stomach (1) C small intestine / ileum / duodenum / jejunum (1) D large intestine / colon / eq (1)	**4**

Question Number	Answer	additional guidance	Mark
(b)	An explanation that makes reference to three of the following: • (plants contain) cellulose (1) • digested by cellulase / enzyme (1) • into <u>glucose</u> (1) • energy released / respiration / eq (1)	 allow broken down by cellulase converse for no cellulase energy not released / energy lost in feaces / eq	**3**

Question Number	Answer	Mark
(c)(i)	• humans do not digest cellulose / do not eat only plant material / omnivores / eat fewer / less plants / vegetables / eq (1)	**1**

Question Number	Answer	additional guidance	Mark
(c)(ii)	An answer that makes reference to two the following: • removes <u>useful</u> bacteria / fewer / no useful bacteria / eq (1) • reduces competition / eq (1) • pathogenic bacteria increase / survive / multiply / grow / more harmful bacteria / eq (1)	 not just appendix contains useful bacteria as this is in stem allow toxic / bad / eq to harmful bacteria	**2**

Q3.

Question Number	Answer	Mark
(a)(i)	C cytoplasm *A is not correct as cellulose is not found in the bacterium* *B is not correct as chitin is not found in the bacterium* *D is not correct as a nucleus is not found in the bacterium*	**1 comp**

Question Number	Answer	Mark
(a)(ii)	C 7 *A is not correct because 1 is not neutral pH* *B is not correct because 2 is not neutral pH* *D is not correct because 12 is not neutral pH*	**1 comp**

Question Number	Answer	additional guidance	Mark
(a)(iii)	An explanation that makes reference the following points: • mutation (1) • variation (1) • survive (1) • reproduce / breed / offspring (1) • pass on allele / gene (1)		**4 exp**

Question Number	Answer	Mark
(b)	An answer that makes reference the following points: • probiotic / cranberry / both / treatments (better than control) reduce (bacteria) /eq(1) • more reduction if taken together / eq (1) • cranberry (alone) reduces more than probiotic (alone) / eq(1)	**2 grad**
		Total 8 marks

Q4.

Question number	Answer	Additional guidance	Mark
(a)(i)	A description that makes reference to the following two points: • release of energy (1) • within cells (1)	reject production of energy	2

Question number	Answer	Additional guidance	Mark
(a)(ii)	A description that makes reference to the following points: • keeping named characteristic, e.g. temperature (1) • constant within narrow range (1)	allow blood glucose/carbon dioxide/blood pressure/water content/equivalent	2

Question number	Answer	Mark
(b)	C	1

Question number	Answer	Mark
(c)	C	1

Q5.

Question number	Answer	Additional guidance	Mark
(a)(i)	A description that makes reference to the following two points: • release of energy (1) • within cells (1)	reject production of energy	2

Question number	Answer	Additional guidance	Mark
(a)(ii)	A description that makes reference to the following points: • keeping named characteristic, e.g. temperature (1) • constant within narrow range (1)	allow blood glucose/carbon dioxide/blood pressure/water content/equivalent	2

Question number	Answer	Mark
(b)	C	1

Question number	Answer	Mark
(c)	C	1

Q6.

Question Number	Answer	Mark
(a)	A nucleus (1) B mitochondrion / a (1)	2

Question Number	Answer	Mark
(b)(i)	An answer that includes two of the following points: • chloroplast (1) • cell wall (1) • starch grain (1)	**2**

Question Number	Answer	Mark
(b)(ii)	• not multicellular / are single-celled / can move from one place to another / has flagella (1)	**1**

Question Number	Answer	Mark
(c)	An explanation that makes reference to two of the following points • light captured / absorbed by chloroplast / chlorophyll (1) • in photosynthesis (1)	**2**

Question Number	Answer	Mark
(d)	• move / propel / swim /eq (1)	**1**

Question Number	Answer	Additional guidance	Mark
(e)	measure size of line on diagram (= 44 mm 43-45) (1) ×1000 convert mm into µm (1) Magnification = size of line in µm ÷15 µm 44000÷15 = 2933 allow 2 marks for any mag **between 2667 and 3000**	40-45mm 1mark for ×1000 if measured in cm allow 1 for × 10000	**2**
			total 10 marks

Q7.

Question Number	Answer	Mark
(a)	Carbon / C (1)	**1**

Question Number	Answer	Mark
(b)(i)	The only correct answer is **A** W is combustion **B** is not the answer as W is not decomposition **C** is not the answer as W is not feeding **D** is not the answer as W is not respiration	**1**

Question Number	Answer	Mark
(b)(ii)	The only correct answer is **D** X is respiration **A** is not the answer as X is not combustion **B** is not the answer as X is not decomposition **C** is not the answer as X is not feeding	**1**

Question Number	Answer	Mark
(c)	bacteria / fungi / allow correct genus and species names (1)	**1**

Question Number	Answer	additional guidance	Mark
(d)	A description that makes reference to six of the following points: • C different pH of organic material / add acid /alkali / add buffers/ eq (1) • O same organic material / plant / age / species / type / mass / volume of organic material(1) • R repeat (at each different pH) (1) • M1 measure change / loss in mass of organic material / initial mass – final mass /volume of carbon dioxide released / change in hydrogen-carbonate indicator / change in limewater /eq (1) • M2 after stated time period (1) • S1 same temperature / oxygen / eq (1) • S2 same water / same mineral ions / same humidity / same volume of each acid /alkali/ buffer / same bacteria / fungi / decomposer added / eq (1)	same state of decay or allow time taken M2 for same mass M1 to decompose 1 hour + allow same number of bacteria /decomposers / eq	**6**

Q8.

Question Number	Answer	Mark
(a)(i)	The only correct answer is C 11 A is not correct as it does not contain 1 B is not correct as it does not contain 6 D is not correct as it does not contain 12	**1**

Question Number	Answer	Mark
(a)(ii)	• mitochondrion / mitochondria	**1**

Question Number	Answer	Mark
(b)	The only correct answer is D ×600 A is not correct as it is not ×0.06 B is not correct as it is not ×0.6 C is not correct as it is not ×6	**1**

Question Number	Answer	Mark
(c)(i)	• chloroplast / (sap) vacuole	**1**

Question Number	Answer	Mark
(c)(ii)	An answer that makes reference to one of the following points: • nucleoid / circular chromosome / cytoplasm (1) • plasmid(s) (1)	**1**
		Total 5

Q9.

Question Number	Answer	Additional guidance	Mark
(a)	An answer that makes reference to three of the following: • have nucleus (1) • have organelles / mitochondria / chloroplasts eq (1) • have chromosome**s** / more than one chromosome (1) • lack plasmids (1)	**allow** converse for prokaryotes prokaryotes have a nucleoid prokaryotes have circular chromosome / loop of DNA	**3**

Question Number	Answer	Additional guidance	Mark
(b)	An answer that makes reference to suitable organism and matched disease: • plasmodium (1) • malaria (1)	**allow** other examples e.g. amoeba and dysentery Trypanosoma and sleeping sickness must be matched so amoeba with malaria scores 1 malaria plasmodium wrong way round scores 1	**2**

Q10.

Question Number	Answer	Mark
(a)(i)	The only correct answer is D S A is not correct as P does not contain chlorophyll B is not correct as Q does not contain chlorophyll C is not correct as R does not contain chlorophyll	**1**

Question Number	Answer	Mark
(a)(ii)	The only correct answer is C magnesium A is not correct as chlorophyll does not contain calcium B is not correct as chlorophyll does not contain iron D is not correct as chlorophyll does not contain water	**1**

Question Number	Answer	Mark
(a)(iii)	A description that makes reference to two of the following points: • absorb / trap / captures / eq, light (1) • photosynthesis (1) • make carbohydrate / make starch / make glucose / eq (1)	**2**

Question Number	Answer	Mark
(b)	The only correct answer is C a plant stem growing towards light A a plant root growing away from light is not correct B a plant root growing downwards due to gravity is not correct D a plant stem growing upwards due to gravity is not correct	**1**

Question Number	Answer	Mark
(c)		**3**

Role of substance	Name of substance
cause positive phototropism	**auxin**
digest fat	lipase (1)
diffuse across a synapse	neurotransmitter / acetylcholine / noradrenaline / correct named neurotransmitter (1)
prevent scurvy	vitamin C /ascorbic acid (1)

Total = 8 marks

Q11.

Question Number	Answer	Mark
(a)	**C** plasmid *A is incorrect because it is not the cell wall* *B is incorrect because it is not the nucleoid* *D is incorrect because it is not RNA*	**1 comp**

Question Number	Answer	Additional guidance	Mark
(b)	An answer that makes reference to three of the following points: • insulin / glucagon (1) • steam / hot water (1) • competition / contamination / eq (1) • mix / stir / agitate / distribute / eq (1) • oxygen / O_2 (1) • temperature (1)	**Allow** disinfectant / bleach / sterilising fluid / alcohol / ethanol **Allow** infection	**6 grad**
			Total 7 marks

Q12.

Question Number	Answer	additional guidance	Mark
(a)	A description that makes reference to the following points: • iodine (1) • blue black / blue / black /eq (1)	allow purple	**2**

Question Number	Answer	Mark
(b)(i)	The only correct answer is B fungus A is not correct because it is not a bacterium C is not correct because it is not a protoctist D is not correct because it is not a virus	**1**

Question Number	Answer	Mark
(b)(ii)	The only correct answer is A amylase B is not correct because it is not digested by ligase C is not correct because it is not digested by lipase D is not correct because it is not digested by protease	**1**
		Total 4 marks

Q13.

Question number	Answer	Mark
(a)(i)	Circle around dendrites/cell body and dendrites	**1**

Question number	Answer	Additional guidance	Mark
(a)(ii)	Multiplication • 1.20 × 102 = 120 (1) Multiplication • 1.3 ÷ 120 = 0.0108/1.08 × 10^{-2} (1)	award full marks for correct numerical answer without working	**2**

Question number	Answer	Mark
(a)(iii)	Mitochondria	**1**

Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that makes reference to the following points: • chromosome (1) • plasmid (1)	allow nucleoid	**2**

Question number	Answer	Mark
(b)(ii)	Stage Q	**1**

Question number	Answer	Mark
(b)(iii)	Stage R	**1**

(Total for question = 8 marks)

Q14.

Question Number	Answer	Mark
(a)	• hyphae (1) • chitin (1) • enzymes(1) • saprotrophic / saprophytic (1)	**4**

Question Number	Answer	Mark
(b)(i)	• carbon dioxide / CO_2 (1)	**1**

Question Number	Answer	Mark
(b)(ii)	An explanation that makes reference to the following: • increasing (kinetic) energy / molecules move more (1) • more collisions/ more enzyme substate complexes formed / eq (1) • above 37 / 40^{0}C /optimum / eventually / at higher temperature <u>enzyme</u> denatures / change in active site / substrate and enzyme can no longer bind /fit /eq (1)	**3**

Question Number	Answer	additional guidance	Mark
(b)(iii)	A description that makes reference to two of the following	no credit for counting bubbles or time for limewater as stem states in this experiment.	**2**
	• use (collect gas in) measuring cylinder / (gas) syringe / eq (1)	allow ref to capillary tube and scale ignore gas cylinder
	• measure <u>volume / cm^3</u> in <u>time</u> / or <u>time</u> to produce <u>volume</u> /eq (1)	must refer to volume **and** time for mp 2

Q15.

Question Number	Answer	Mark
(a)(i)	An explanation that makes reference to two of the following points: • no photosynthesis (1) • remove all starch / destarch / eq (1) • by respiration (1) • so any starch present is due to photosynthesis (in the experiment) (1)	**2**

Question Number	Answer	Mark
(a)(ii)	An explanation that makes reference to the following points: • act as a control / for a comparison (1) • show photosynthesis can occur with CO_2 present / show difference between X and Y is due to CO_2 (1) • show that when CO_2 is present light is required for photosynthesis / eq (1)	**2**

Question Number	Answer	Mark
(a)(iii)	An answer that makes reference to four of the following points: • place leaf in boiling water (1) • boil / heat in ethanol (1) • use water bath / switch off Bunsen / keep away from Bunsen / eq (1) • wear safety glasses / use tongs / forceps / eq (1) • add iodine solution (1) • if starch present goes blue/black / see if it goes blue / black (1)	**4**

Question Number	Answer	Additional guidance	Mark
(b)	An explanation that makes reference to the following points • on leaf Y (1) • no starch present under black paper strip (1) • so this part will be yellow/ orange / not blue black / eq (1)	Allow converse for rest of leaf	**3**

Question Number	Answer		Mark
(c)	An explanation that makes reference the following points: • starch is insoluble / eq (1) • does not have osmotic effect on plant cell does not diffuse / pass out of cells / eq (1)	Allow converse for glucose for both MPs	**2**
		Total = 13 marks	

Q16.

Question Number	Answer	Additional guidance	Mark
(a)(i)	D is the only correct answer A is incorrect as it is the vacuole B is incorrect as it is cytoplasm C is incorrect as it is the cell membrane		**1**

Question Number	Answer	Additional guidance	Mark
(a)(ii)	A is the only correct answer B is incorrect as animal cells have cytoplasm C is incorrect as animal cells have a cell membrane D is incorrect as animal cells have a nucleus		**1**

Question Number	Answer	Additional guidance	Mark
(a)(iii)	D (starch) is the only correct answer A is incorrect as glucose is not a storage molecule B is incorrect as glycerol is not a carbohydrate C is incorrect as plant cells do not have glycogen		**1**

Question Number	Answer	Additional guidance	Mark
(b)	These are calculation steps • correct measurement of line as 50 mm	**one** mark for correct measurement of line +/- 1 mm i.e. **one mark** for 50 (mm) or 5 cm	**3**
	• correct conversion of micrometres to millimetres or millimetres to micrometres	**one mark** for length × 1000 OR 0.125 (mm)	
	• correct division of 50 000 µm by 125 **or** correct division of 50 mm by 0.125	**one mark** for dividing by 125	
		two marks for 50 000 (µm) (measurement and conversion) OR **two marks** for (X) 0.4 or (x) 4 or (x) 40 or (x) 40 000	
	(×) 400 (3)	**Allow answer in the range of (x) 392 to (x) 408 for three marks** **Ignore** other units	

Q17.

Question Number	Answer	Mark
(a)(i)	Sickle shaped red blood cells stick to each other / caught / trapped /eq walls of blood vessels / eq (1)	**1**

Question Number	Answer	Mark
(a)(ii)	An explanation that makes reference to three of the following points • cold temperatures reduce blood flow / cause more sickling (1) • less oxygen (at high altitude) (1) • less respiration / (more) anaerobic respiration (1) • more lactic acid (1) • (less) energy / ATP (1)	**3**

Question Number	Answer	Mark
(b)(i)	only expressed when homozygous / two copies / no dominant allele present / not expressed in heterozygote /eq (1)	**1**

Question Number	Answer	Additional guidance	Mark
(b)(ii)	0.75 x 0.5 ¾ X ½ 0.375 or 3/8 or 37.5% (2)	Allow 1 mark for ¾ or 0.75 or 75% or one mark for ½ or 0.5 or 50%	**2**

Question Number	Answer	Mark
(c)	The only correct answer is D A is not correct as bacterium does not cause malaria B is not correct as fungus does not cause malaria C is not correct as plant does not cause malaria	**1**

Question Number	Answer	Mark
(d)	The only correct answer is B A is not correct as chlorophyll not found in red blood cells C is not correct as iron is not a pigment D C is not correct as magnesium not found in red blood cells	**1**

Question Number	Answer	Additional guidance	Mark
(e)	An answer that includes two of the following points • red cells smaller (1) • red cells have no nucleus (1) • red cells are biconcave /eq (1)	Allow converse for wbc allow (mature) RBC's lack mitochondria ign haemoglobin	**2**
			Total 11 marks

Q18.

Question Number	Answer	Mark
(a)(i)	A mitochondrion *B is incorrect because the nucleus does not carry out photosynthesis* *C is incorrect because ribosomes carry out protein synthesis* *D is incorrect because the vacuole sores sap*	**1**

Question Number	Answer	Mark
(a)(ii)	B chitin A is incorrect because fungal cell walls are not made of cellulose C is incorrect because fungal cell walls are not made of glycogen D is incorrect because fungal cell walls are not made of starch	**1**

Question Number	Answer	Mark
(a)(iii)	A cell membrane B is incorrect because prokaryotes do not contain mitochondria C is incorrect because prokaryotes do not contain nuclei D is incorrect because prokaryotes do not have vacuoles	**1**

Question Number	Answer	Additional guidance	Mark
(b)(i)	80 % (2)	one mark for 20 **Award full marks for correct answer**	**2**

Question Number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that makes reference to two of the following: • (yeast) respires / fermentation / respiration (1) • producing / carbon dioxide (1) • (carbon dioxide) bubbles become trapped / stuck / inflate in dough (1)	**Reject** oxygen produced	**2**

Question Number	Answer	Additional guidance	Mark
(b)(iii)	An explanation that makes reference to two of the following: at 25 °C: • (kinetic) energy lower / molecules move slower / eq (1) • fewer collisions / fewer enzyme substrate complexes / further away from **enzyme** optimum / eq (1) • less carbon dioxide / gas released / eq (1)	**Accept** converse for 35 °C for all MPs	**2**

Question Number	Answer	Additional guidance	Mark
(b)(iv)	An explanation that makes reference to two of the following: at 35 °C • enzymes not denatured (1) • substrate fits into active site / active site shape not changed / eq (1) • so respiration continues / more carbon dioxide produced / yeast cells are alive / eq (1)	**Accept** converse for 65 °C for all MPs	**2**

Q19.

Question Number	Answer	Mark
(a)(i)	An answer that makes reference to the following points: • cornea / C bends / refracts light (1) • lens / A becomes (more) curved / rounder / convex / thicker / eq (1) • as ciliary muscles / D contract (1) • (ciliary muscles / D) cause suspensory ligaments to relax become less taut / slacken / loosen / eq (1)	**4** allow ciliary body

Question Number	Answer	Mark
(a)(ii)	An explanation that makes reference to three of the following points: • circular muscles contract (1) • radial muscles relax (1) • pupil constricts / becomes smaller / eq (1) • less light enters eye (1)	**3**

Question Number	Answer	additional guidance	Mark
(b)(i)	An answer that makes reference to the following points: • (breaks down / digests cell walls of / kill / prevent growth of / remove / protect from) <u>bacteria</u> / <u>fungi</u> / <u>pathogens / microorganisms</u> / eq (1) • prevent infection / disease (1)	prevent bacterial infection = 2 marks	**2**

Question Number	Answer	additional guidance	Mark
(b)(ii)	An answer that makes reference to two of the following points: • optimum pH (for lysozyme) (1) • prevent enzyme being denatured / change in active site /eq (1) • break down cell walls / kill bacteria / work at fastest / fast rate / eq (1) • (too) acidic / (too) alkaline may damage eye / eq (1)	neutral won't damage eye	**2**
		Total = 11 marks	

Q20.

Question Number	Answer	Additional guidance	Mark
(a)	An answer that makes reference to the following points: • no chloroplast / no chlorophyll (1) • wall made of chitin (1)	allow plant cell has chlorophyll/ chloroplast cellulose cell wall ignore references to shape	**2 grad**

Question Number	Answer	Mark
(b)(i)	An explanation that makes reference to two of the following points: • aerobic respiration (1) • more energy / ATP (1) • anaerobic respiration produces alcohol (1) • kills yeast cells / eq (1)	**2 exp**

Question Number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that makes reference to two of the following points: • affects growth / kills yeast cells (1) • compete for / use up glucose (1) • remove pathogens (1)	Ignore 'competition' unqualified	**2 grad**

Question Number	Answer	Additional guidance	Mark
(b)(iii)	An answer that makes reference to three of the following points: • species of yeast / type of yeast / yeast from same batch (1) • temperature (1) • pH (of solution) (1) • concentration of glucose (1) • depth of sample (1) • view at same magnification / same area of field of view (1)	Allow same source of yeast Ignore light intensity Ignore volume of sample Ignore volumes of gases/named gases	**3 exp**

Question Number	Answer		Mark
(b)(iv)	An answer that makes reference to the following point: • reliable because results are similar / concordant / eq OR • not reliable because insufficient repeats / only three repeats done / eq		**1 grad**
		Total 10 marks	

Q21.

Question Number	Answer	Mark
(a)(i)	**The only correct answer is C chitin glycogen** A is not correct as it is not cellulose and glycogen B is not correct as it is not cellulose and starch D is not correct as it is not chitin and starch	**1**

Question Number	Answer	Mark
(a)(ii)	**The only correct answer is B fungus** A is not correct as it is not a bacterium C is not correct as it is not a plant D is not correct as it is not a protoctist	**1**

Question Number	Answer	Mark
(b)(i)	**Only correct answer is B** **glucose → ethanol + carbon dioxide** A is not correct as it is not the correct equation C is not correct as it is not the correct equation D is not correct as it is not the correct equation	**1**

Question Number	Answer	additional guidance	Mark
(b)(ii)	• restriction / endonuclease / ligase (1)	allow correctly named endonuclease	**1**

Question Number	Answer		Mark
(b)(iii)	• contains new DNA / new gene / foreign DNA / foreign gene / altered genes / DNA from other organism/ DNA from other species / gene from other organism / gene form other species / contains gene for digesting cell walls / contains gene for digesting cellulose / gene for cellulase / eq /		**1**

Question Number	Answer		Mark
(b)(iv)	An answer that makes reference to two of the following points: • less burning of fossil fuels / eq (1) • less carbon dioxide in air / carbon neutral / plants use CO_2 (in photosynthesis) / eq (1) • less trapping of heat / less greenhouse effect / eq (1) • uses renewable resource (1)	allow named fossil fuel	**2**

Question Number	Answer	Additional guidance	Mark
(c)(i)	• 2.2 – 1.25 = • 0.95 ÷ 1.25 = 0.76 • × 100 = 76% (2)	award full marks for correct numerical answer without working allow 2.2 -1.3 =0.9 0.9÷1.3 = 0.69 ×100 = 69% allow 2.2 – 1.2 =1 1÷ 1.2= 0.8 0.8×100 = 80% allow 1 mark for dividing by mass of normal yeast / 1.2 to 1.3 percentage between 69 and 80 (2)	**2**

Question Number	Answer	additional guidance	Mark
(c)(ii)	An answer that makes reference to two of the following points: • running out of glucose / food / eq (1) • (build-up of) ethanol (1) • yeast cells die (1)	allow one mark for oxygen becomes available ethanol kills the yeast = mp2 and mp3	**2**
			Total 11 marks

Q22.

Question Number	Answer	Additional guidance	Mark
(a)(i)	B (fungi) is the only correct answer A is incorrect as animals are not single celled C is incorrect as plants do not have chitin or are single celled D is incorrect as protoctists do not have chitin		**1**

Question Number	Answer	Additional guidance	Mark
(a)(ii)	An answer that makes reference to one of the following: • (viruses) do not grow (1) • (viruses) do not respire (1) • (viruses) are not sensitive / have internal control / eq (1) • (viruses) do not move (1) • (viruses) do not excrete (1) • (viruses) do not reproduce (independently) / need a host to reproduce / eq (1) • (viruses) do not feed / have a nutritional need / eq (1)	**Allow** do not carry out life processes / do not have all the characteristics of life /do not have MRSGREN(C) **Ignore** need another living organisms / host to live / survive **Ignore** need to live inside another cell	**1**

Question Number	Answer	Additional guidance	Mark
(b)	An answer that makes reference to the following: • restriction (enzymes) cut DNA /gene / plasmid / open plasmid / remove gene / eq (1) • ligase joins DNA to plasmid / joins DNA / joins sticky ends / inserts DNA / attaches DNA / eq (1)	**Allow** endonuclease **Reject** lipase	**2**

Question Number	Answer	Additional guidance	Mark
(c)(i)	An explanation that makes reference to three of the following: • respiration / fermentation / (chemical) reactions, releases heat (energy) (1) • checks / monitor, temperature **and** lets (cooling) water in / open valve / water is pumped around / eq (1) • lowers temperature / removes heat / prevents over heating / stops temperature getting too high (1) • maintain optimal temperature / optimum temperature (1) • stop enzymes denaturing / stops enzyme shape changing / eq (1)	**Ignore** cools it down alone	**3**

Question Number	Answer	Additional guidance	Mark
(c)(ii)	An explanation that makes reference to two of the following: • (provides) oxygen (1) • for respiration / prevent anaerobic respiration (1)	**Reject** for anaerobic respiration	**2**

Question Number	Answer	Additional guidance	Mark
(c)(iii)	An explanation that makes reference to two of the following: • prevent other microbes / bacteria / fungi / pathogens / eq (1) • prevents contamination / contaminate (of product) / toxins (being released) / competition (for nutrients) / eq (1)	**Allow** remove bacteria / keep sterile **Ignore** germs / keep clean	**2**