

Mark Scheme (Results)

Summer 2024

Pearson Edexcel Advanced Level GCE In Biology B (9BI0) Paper 03: General and Practical Principles in Biology

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer V3	Additional Guidance	Mark
1(a)	An answer that includes the following		
	• meristem (1)		(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	 An answer that includes the following: to {break down middle lamella / break down pectins / separate layers of cells} (1) 	Accept calcium pectate separate cells	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An answer that includes the following:to make the {chromosomes / DNA} visible (1)	Accept to dye / colour the chromosomes / DNA	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(iii)	An answer that includes the following:to form a single layer of cells (1)	Accept to separate layers of cells / form a thin layer of cells	(1)

Question Number	Answer	Additional Guidance	Mark
1(c)	An answer that includes the following:		
	• number of actively dividing cells counted (1)	4	
	• mitotic index calculated to 1dp (1)	10.3	
		Correct answer with no working gains full marks	(2)

(Total for Question 1 = 6 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	 An explanation that includes the following: (urea moves) from {blood vessel / capillaries / glomerulus / blood} into capsule (1) 	Accept description of high blood pressure forcing {urea / small molecules} into capsule for mp1 and 2	
	• by ultrafiltration (1)	Accept due to high blood pressure / hydrostatic pressure	(2)

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An explanation that includes three of the following:		
	 concentration of ions is higher {outside nephron / in medulla} (than inside nephron) (1) 	Accept causes lower water potential outside / higher water potential in nephron Accept lowers the water potential in the medulla Accept correct ref to hypertonic / hypotonic Accept interstitial fluid for fluid in medulla Accept concentration of sodium ions is highest at the bottom of the loop	
	 water moves out of {descending limb / collecting duct} (1) 		
	• by osmosis (1)	Accept down a water potential gradient / from high to low water potential	
	• (loop of Henle acts as a) countercurrent multiplier (1)	Accept concentration (of urine) increases <u>along length of</u> <u>loop of Henle</u>	
			(3)

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	• correct ratio determined (1)	3.9 : 2 : 1 Accept 4 : 2 : 1 3.93 : 2 : 1 Accept numbers in any order if qualified	(1)

Question	Answer	Additional Guidance	Mark
Number			
2(b)(ii)	An explanation that includes two of the following:		
	• nephron has (relatively) long loop of Henle (1)	Accept large numbers of juxtamedullary nephrons / thin descending loop of Henle is relatively long	
	 so {long(er) distance for gradient to build up / (fluid in) medulla can become (more) concentrated / large(er) gradient can build up} / greater countercurrent multiplier effect (1) OR 	Accept many ions can be pumped out (due to long length)	
	 thick medula compared to cortex (1) as loops of Henle are longer (1) OR 		
	 highly folded cell membrane around (epithelial) cells lining nephron (1) 		
	 so large(er) surface area for absorption (1) 		
	OR	Accept mitochondria (in epithelial cells) have many	
	 high numbers of mitochondria in (epithelial) cells lining nephron (1) 	cristae	
	 so (more) ATP for active transport (1) 		
			(2)

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	{hide in burrows during the day / nocturnal / feed at night / leave burrows for a short time only} (1)		(1)

Total for Question 2 = 9 marks

Question Number	Answer	Additional Guidance	Mark
	An answer that includes the following		
3(a)(i)	 drawing of cell containing cell wall, vacuole and nucleus (1) 	Jonoplast Cell membrane	
		Shape of cell does not matter – can include other structures	
		Do not accept chloroplasts	
		eg tonoplast, cell (surface) membrane, nuclear membrane / envelope,	
	three membranes correctly	ignore mitochondriai / Golgi / chloroplast membrane	
	labelled (1)		(2)

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	An answer that includes the followingphospholipid bilayer (1)		
	 proteins embedded / protein channels (1) 	Accept integral / intrinsic / carrier proteins Accept correct detail of named organelle membrane	(2)

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	A description that contains two of the following:	Ignore permeability	
	 as temperature increases <u>absorbance</u> increases (until 50C) (1) 	Accept converse Accept positive correlation between absorbance and temperature increase	
	 increase is greatest between 40°C and 50°C (1) 	Accept increase is sigmoid / not linear	
	 (absorbance) {levels off / plateaus} {at / above} 50°C (1) 	Ignore mean is lower at 60°C	
			(2)

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	An explanation that contains one of the following :	Accept pigment for betalain	
	 increasing temperature causes increased permeability (1) 		
	 betalain (molecules) can pass through the {tonoplast / cell membrane} if it is {disrupted / gaps form} (1) 	Accept betalain (molecules) cannot pass through the {tonoplast / cell membrane} unless it is disrupted	
	and one from:		
		Accept as temperature increases membrane is disrupted	
	 as temperature increases membrane becomes more fluid (1) 	Accept at higher temperatures proteins in the membrane	
		are denatured	
	 above 40°C proteins in the membrane are 		
	denatured (1)	Ignore references to enzymes	
			(2)

Question Number	Answer	Additional Guidance	Mark
3(c)	An answer that includes four of the following:	Answers must be consistent with higher absorbance ie directional	
	 less than 20cm³ water in boiling tube (1) 		
	different beetroot used (1)		
	 beetroot pieces may be longer than 1cm (1) 	Accept ref to slanted ends / larger surface area	
	• beetroot pieces may not have been rinsed (1)	Ignore blotted dry	
	 beetroot pieces may have been left in tubes longer than 20 minutes (1) 	Accept left for in tubes for too long	
	 tubes may have been shaken (1) 	Accept cylinder may have been damaged / squeezed as it was removed from tube	
	• example of incorrect use of colorimeter (1)	Accept cuvettes scratched / have fingerprints incorrect filter used colorimeter not zeroed	(4)

(Total for Question 3 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	A description that includes five of the following:		
	• find mass of woodlice (1)	Allow same / stated mass	
	 {description / diagram} of respirometer (1) 	Accept description of basic respirometer or detail of method eg way of keeping woodlice away from soda lime	
	 with {sodium hydroxide / potassium hydroxide / soda lime} (to absorb carbon dioxide) (1) 		
	• measure distance moved by liquid in stated time (1)	Allow time to move fixed distance	
	• method of control of temperature (1)	Accept thermostatically controlled waterbath Accept control tube described (to compensate for changes in temperature / air pressure)	
	 method of finding volume of oxygen used (1) 	Accept volume of air needed to reset liquid to original position if syringe used / use of $\pi r^2 d$	
	• method of calculation of rate (1)	Accept volume of oxygen used divided by time divided by mass Accept units ie mm ³ min ⁻¹ g ⁻¹ Accept finding the gradient on a graph	(5)

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	An answer that includes the following:		
	One from		
	Safety		
	 soda lime is corrosive, so wear gloves / goggles (1) 	Accept harmful / toxic / irritant	
	 {allergy to woodlice / they may have bacteria on them} so wear 		
	gloves (1)		
	 glassware may break, so wear gloves (1) 		
	And one from		
	Ethics		
	 avoid harm to woodlice by {handling carefully / handling with a 	Accept avoid reducing population by	
	paintbrush / handling with a teaspoon / returning to garden} (1)	returning woodlice to garden (once	
	 woodlice may be harmed by soda lime, so make sure they are 	investigation is over) (1)	
	separated from it eg {gauze / small bag} (1)		
	 woodlice might use all the oxygen in the respirometer so 		
	refresh the air (1)		
			(2)

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	A explanation that includes the following:		
	Testchi squared (1)		
	 Reason {used to compare observed and expected frequencies / we are investigating the distribution of a single categoric variable} (1) 	Accept to compare observed and expected data / values	(2)

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	An explanation that includes the following:		
	 (woodlice prefer dark conditions as) more likely to be {humid / damp} so woodlice less likely to lose water (1) 	Accept less likely to be eaten by predators	
	 (woodlice prefer) damp so can absorb oxygen (more) effectively (when gills are damp) (1) 	Accept gas exchange for absorbing oxygen	(2)

Question Number	Answer	Additional Guidance	Mark
4(b)(iii)	A description that includes three of the following:		
	• set up choice chamber in advance (1)	Accept clean chamber between trials to remove scent trails	
	leave woodlice for longer than 5 minutes (1)		
	• ensure all woodlice are the same species (1)		
	• use more woodlice (than 5 / 20) (1)		
	 {take a photograph and analyse that to count numbers / statement of how to deal with woodlice on boundary} (1) 		
			(3)

(Total for Question 4 = 14 marks)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	A description that includes the following:		
	• correct ratio (3:1) (1)	Accept any correct eg 15 cm ³ and 5 cm ³	
	 {correct volume of stock solution and water / make up other volumes in correct ratio and use 10 cm³) (1) 	7.5 cm ³ stock and 2.5 cm ³ water	
	up other volumes in correct ratio and use form? (1)	Accept 7.5 cm ³ stock and make up to 10 cm ³ (using measuring cylinder / volumetric flask)	(2)

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	An answer that includes the following:		
	• axes correctly orientated and labelled with units (1)	Must be <u>Mean</u> % of plasmolysed cells	
	• all values accurately plotted on linear scale (1)	Allow tolerance of half a small square	
	• scattergraph with straight line joining points (1)		(3)

Question Number	Answer	Additional Guidance	Mark
5(a)(iii)	An answer that includes the following:		
	• correct value for 50% plasmolysis (1)	0.37 (mol dm ⁻³) Accept range of 0.36 – 0.38	(1)

Question Number	Answer	Additional Guidance	Mark
5(a)(iv)	An answer that includes the following:	- 980 (kPa)	
		(+ or – 20 of any value which matches their answer to 5aiii) Do not accept + values	(1)

Question Number	Answer	Additional Guidance	Mark
5(a)(v)	An answer that includes:		
	water potential = turgor pressure + osmotic potential (1)	Accept $\Psi = P + \pi$ $\Psi = \Psi_P + \Psi_s$	
		Accept solute potential for osmotic potential	(1)

Question Number	Answer	Additional Guidance	Mark
5(a)(vi)	An answer that includes the following:	Allow ecf from 5aiv	
	• correct value for water potential (1)	- 980 (kPa)	(1)

Question Number	Answer	Additional Guidance	Mark
5(b)	An explanation that includes the following:		
	 (tissue collected from same onion) as different onions may have (cell sap with a) different {osmotic / solute} potential (1) 	Accept different onions may have (cells with) different water potential	
	• (all tubes kept in waterbath) as temperature affects rate of osmosis (1)	Accept correct directional answer eg as temperature increases, rate of osmosis increases	
	 (count more than one field of view) as it may not be representative (1) 	Accept to increase sample size to calculate standard deviation to identify outliers / anomalous results	(3)

Total for Question 5 = 12 marks

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	 A explanation that includes two of the following: <u>rate</u> of photosynthesis is {high / higher / highest} 	Accept converse for red and blue filters Accept <u>rate</u> of photosynthesis is slower in red or blue	
	in {white light / with no filter} / (1)	light / with red or blue filters	
	 because the {chlorophyll / plant} is able to absorb more (wavelengths of) light when no filter is present (1) , 	Accept pigments / other named pigments Accept {red filter does not transmit {blue / green} light / blue filter does not transmit {red / green} light so less light for chlorophyll / plant to absorb	
	 so more {GP / GALP / glucose / amino acids / cellulose / ATP} is made OR more glucose allows faster respiration OR so mitosis occurs more rapidly producing 	Accept "products of light independent stage"	
	daughter plants (1)		(2)

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	An answer that includes two of the following		
	 higher light intensity (1) 	Accept move lamp closer	
	higher temperature (1)	Accept place heater in tank	
	• higher concentration of carbon dioxide (1)	Accept add sodium hydrogen carbonate / bubble carbon dioxide through water	
	 add {fertiliser / more mineral ions} (1) 		(2)

Question Number	Answer	Additional Guidance	Mark
6(a)(iii)	An answer including one of the following		
	• plants may overlap (so difficult to count) (1)	Ignore difficult to count unqualilfied	
	 {frond / plant} size may vary (so not comparable) (1) 		
	 (when budding is occurring it is) hard to tell when one plant becomes two (1) 		
			(1)

Question Number	Answer	Additional Guidance	Mark
6(a)(iv)	 A description including two of the following measure mass of plants (1) detail of technique eg blotting dry / use of replicates and dry mass (1) 		
	 measure surface area covered (1) detail of technique eg use of squared paper, or photograph (1) OR 	Accept estimate % cover Accept use of quadrat / grid	
	 measure root length (1) detail of technique eg use of calipers / straighten root (1) 	Accept plant length	(2)

Question Number	Answer	Additional Guidance	Mark
6(b)	 An explanation that includes three of the following as fertiliser concentration increases, {mitosis / cell division / growth} increases (1) because nitrate is needed to make {amino acids / proteins / enzymes / DNA / RNA / chlorophyll} (1) because phosphate is needed to make {nucleic acids / DNA / RNA / ATP / ADP / NADP / phospholipid} (1) because magnesium is needed to make chlorophyll (1) 	Accept positive correlation Accept more fertiliser / higher mass of fertiliser	
			(3)

Question Number	Answer	Additional Guidance	Mark
6(c)	An answer that includes a maximum of three of the following : Positives • removes excess minerals from the water (1)	Accept duckweed removes pollutants	
	• <u>rapid growth rate</u> so large amounts of animal feed produced (1)	Accept large amounts of animal feed produced in <u>a short time</u>	
	• cheap (as it uses waste products) (1)	Accept idea of renewable / recycling / sustainable	
	 floats so not shaded by manure in water (1) 		
	• error bars do not overlap, so concentration affects growth (1)		
	 and a maximum of three of the following: Negatives need a large surface area to grow it (as it floats in a single layer) (1) 		
	 needs a warm temperature for rapid growth (1) 	Accept would have to be grown indoors in the winter	
	• very high levels of minerals may inhibit growth of duckweed (1)	Accept not all required minerals may be present / not right ratio	
	• duckweed may be killed by pollutant chemicals in water (1)	Ignore pH	
	• duckweed may have negative effects on other aquatic life (1)	Accept relevant example of effect	
	• error bars are large so good growth not certain (1)		
	 animal feed may be contaminated with bacteria (1) 	Accept causing disease	(4)

(Total for Question 6 = 14 marks)

Question Number	Answer	Additional Guidance	Mark
7(a)	An answer that includes six of the following:		
	• suitable method of making root extract (1)	eg grind / liquidise with sterile water and filter	
	 method of controlling concentration (1) 	eg known mass in known volume of water	
	• suitable method of growing bacteria (1)	eg on agar plates or in broth / liquid growth medium	
	• suitable method of applying extract (1)	eg on filter paper discs / in wells in agar or as liquid to nutrient broth / accept turmeric in agar	
	• carried out with and without turmeric (1)	accept compared with water / solvent used Ignore different concentrations as long as one is 0	
	• suitable {time / temp} for incubation (1)	Accept 24-72 hours / temperature at or below 30°C	
	 method of collecting results (1) 	eg diameter / area of clear area on agar eg liquid method eg haemocytometer / turbidity in colorimeter Accept counting colonies if turmeric in agar	
	 use of suitable stats test to test hypothesis (1) description of aseptic technique (1) 	eg t-test Accept use of replicates to calculate SD	
			(6)

Question Number	Answer	Additional Guidance	Mark
7(b)	An answer that includes a maximum of four of the following:		
	• small number of patients in trial (1)		
	• short duration of trial (1)		
	 limited range of ages involved in trial (1) 	Accept people with complex conditions excluded	
	 not a double-blind study (1) 	Accept patients knew which treatment they were	
	 measurement of pain is subjective (1) 	getting / patients may have been blased	
	and up to four of the following:		
	 relevant comment on pain reduction (1) 	eg very little difference between treatments	
	• relevant comment on side effects (1)	eg curcumin had fewer side effects	
	 relevant comment on overall outcome (rated by doctors) (1) 	eg very little difference between treatments	
	 relevant comment on weight loss (1) 	eg curcumin causes weight loss eg weight loss will improve symptoms / not good if person already underweight	
			(6)
		(Total for Ourstian 7 - 12 ma	

(Total for Question 7 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
8(a)	There is no correlation between the (mean) abundance of {celandine plants / <i>Ficaria verna</i> } and the distance from the path. (1)	Accept these plants	(1)

Question Number	Answer	Additional Guidance	Mark
8(b)(i)		example of calculation	
	• calculation of $\sum d^2$ (1)	$\Sigma d^2 = 236$	
	• calculation of intermediate step (1)	$\frac{6 \sum d^2}{n(n^2 - 1)} = 1.967$	
	 calculation of r₅ to 3 sf (1) 	$r_s = (-) 0.967$	
		correct answer with no working gains full marks	(3)

Question Number	Answer	Additional Guidance	Mark
8(b)(ii)	An answer that includes the following:		
	• critical value is 0.700 (1)	Accept correct value indicated in table Accept 0.833	
	 calculated value (0.967) is greater than the critical value, therefore reject the null hypothesis (1) 	Allow ecf from 8bi for wrong calculated value Do not allow minus 0.967< critical value	
	 there is a significant (negative) correlation between distance from the path and abundance of celandine plants. (1) 	Accept observed correlation between abundance of celandine plants and distance from path is not due to chance	
			(3)

Question Number	Answer	Additional Guidance	Mark
8(c)(i)	• suitable abiotic factor chosen (1)	eg light intensity / humidity / temperature / soil pH / soil humus content / soil mineral content / soil water content	(1)

Question Number	Answer	Additional Guidance	Mark
8(c)(ii)	A description that includes the following points		
	 use of correct {equipment / method} (1) 	eg use of probe / meter if appropriate. eg collection of soil sample, weighing, heating and reweighing	
	• standardisation (1)	eg sample at known depth / meter at known / same height above soil surface Ignore time of day / year	
	 location of samples (1) 	eg sample at every position on the transect / at 1m intervals / smaller intervals	(3)

Question Number	Answer	Additional Guidance	Mark
8(c)(iii)	An explanation that includes the following:		
	 comment on how factor will vary <u>as distance from path</u> <u>increases (</u>1) 	{light intensity / temperature / pH} will decrease {humidity / soil humus content} will increase Accept {soil water / mineral content} will increase or decrease	
	• correct explanation for why this factor will vary (1)	eg {light / temperature / humidity} affected by shading from trees soil humus increased due to decomposing leaf litter soil minerals increase due to decomposing leaf litter or decrease as trees / (mycorrhizal) fungi take up more soil pH decreased by decomposing leaf litter soil water increased as less evaporation due to shading / more humus or decreased as trees take up more water.	
	 comment on how this affects plant physiology (1) 	eg light – reference to light dependent reactions of photosynthesis temperature / pH – reference to enzyme-controlled reactions humidity – reference to transpiration water - reference to photolysis / mineral uptake / turgor pressure minerals / humus – reference to uptake of nitrates etc	
	• explanation of how this affects growth (1)	eg less photosynthesis, so less glucose / amino acids for growth slower <u>named</u> enzyme-controlled reaction for growth more minerals, so more amino acids / chlorophyll etc for growth	(3)

(Total for Question 8 = 14 marks)

Question Number	Answer	Additional Guidance	Mark
9(a)	An explanation that includes four of the following:		
	• dark moths were a result of (random) mutation (1)	Accept (random) mutation causes variation	
	 (in industrial areas) {dark moths are less likely to be {seen / eaten} (by predators) / light moths are more likely to be {seen / eaten} (by predators) (1) 	Accept ref to camouflage / blending in for less likely to be seen Ignore dark moths being eaten in rural areas	
	• {dark moths have a selective advantage / light moths have a selective disadvantage} in industrial areas (1)	<u>Allele</u> for dark wing is advantageous in industrial areas	
	 dark moths are more likely to (survive and) breed, passing on (new) <u>allele</u> (1) 		
	• allele frequency (for dark wing) increases (1)	Accept allele frequency (for light wing) decreases	(4)

*9b

50		
Level	Marks	
0	0	No awardable content
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made.
		Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures.
		The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas_processes_techniques and procedures
		The discussion shows some linkages and lines of scientific reasoning with some structure.
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts.
		Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.
		The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

*9(b)	L 1: up to three comments from any area	Level 3 (com	ments from 3 areas)	
	L 2: up to 6 comments from at least two areas	7 marks	6 comments	
	L 3: minimum of 6 comments, must be from 3 areas	8 marks	7 comments, including 1 confounding	
		9 marks	8 comments, including 2 confounding	
	Indicative content			
	Investigation 1: predation by birds			
	 data supports natural selection because very visible moths v 	vere eaten		
	 better camouflaged moths not eaten 			
	Investigation 2: recapture of light and dark moths			
	• data supports natural selection because in the industrial are	a, twice as man	y dark moths survived.	
	• this matches the data from the bird predation investigation			
	• in the rural area, almost three times as many light moths su	rvived compare	d to dark moths	
	Investigation 3: map data			
	data supports natural selection because non-industrial area	s have mostly /	all light-coloured moths	
	example of non-industrial area fitting this pattern eg northe	rn Scotland, Cor	rnwall	
	data supports natural selection because industrial areas have	/e mainly / all da	ark-coloured moths	
	example of industrial area fitting this pattern eg named suita	able city / regior	n	
	 data supports NS as prevailing winds blow air pollution to rule 	iral areas and a	ffect numbers of moths + example	
	 relevant comment on change between 1950s and 1970s 			
	Confounding data:			
	Investigation 2 – light form survival % are the same in indust	rial and rural ar	reas, so does not support	
	if moths do not rest on tree trunks, camouflage against liche	ens is not releva	nt, so does not support	
	 bats are main predators + camouflage does not matter as l 	oats hunt at nigl	ht, so likely to eat equal numbers of both forms	
	 1970s – changes in proportions of moths without changes in 	lichen cover, so	o does not support	
	 suggests it may be the pollution itself causing the change, no 	ot the camouflag	ge	
	No idea of sample size / SD			
	Comment on mark recapture technique			
	Assumes those not recaptured are eaten, but % recapture m	nay not equal %	survival	
	 other factors may be involved eg not just due to pollution af 	fecting natural s	selection	

(Total for Question 9 = 13 marks)

Question Number	Answer	Additional Guidance	Mark
10(a)(i)	 An answer that includes the following correct rate of respiration (1) 	$0.03 (\mathrm{cm}^3 \mathrm{min}^{-1})$ accept $0.028 - 0.032$	
			(1)

Question Number	Answer	Additional Guidance	Mark
10(a)(ii)	An explanation that includes the following:		
	 (yeast) can use sucrose to produce carbon dioxide (1) 	Accept (yeast) can use sucrose to respire	
	• (yeast) cannot use lactose, so no respiration (1)		
	• because lactose cannot be broken down (1)		
	 {respiration stops / volume of carbon dioxide remains constant} because all {sucrose / substrate} has been used up (1) 	Accept line levels off because all {sucrose / substrate} {has been used up / is a limiting factor}	
			(3)

Question Number	Answer	Additional Guidance	Mark
10(a)(iii)	An explanation that includes the following:		
	 lactase breaks down lactose to give glucose and galactose (1) 		
	 yeast can use one of these (sugars) as a respiratory substrate (1) 	Accept yeast can respire using glucose /one of these sugars Accept yeast cannot use one of them / galactose to respire	
	 because volume of CO₂ is approx. half of that {expected / produced by sucrose} (1) 	Accept because the volume of CO ₂ has levelled out as all the {glucose / substrate} has been used up	
	• rate of respiration at 400 minutes is close to zero		(2)
	as all {glucose / substrate} has been used up (1)		(3)

Number		Additional Guidance	Mark
10(b)	An explanation that includes three of the following:		
	 at lower temperature, there will be less kinetic energy, so respiration rate is lower (1) 	Accept at lower temperature, there will be less kinetic energy, so less CO ₂ produced per unit time	
	 because fewer enzyme-substrate collisions <u>per unit</u> <u>time</u> (1) 	Accept less ES complexes per unit time Accept less frequent / likely collisions Do not accept no ES collisions Do not accept in context of enzyme denatured	
	 respiration will continue until all of the {sucrose / substrate} is used up (1) 		
	 so that {the same volume (of CO₂) is produced / (eventually) rate of respiration will reach zero} (1) 	(at a lower temperature) it will take longer for the {rate of respiration to reach zero / same volume of CO_2 to be produced}	(3)

Question	Answer	Additional Guidance	Mark
Number			
10(c)(i)	 An answer that includes the following: line drawn to the right of existing line ie slower initial rate and reaching same final value (1) 	Total volume of carbon dioxide produced / cm ¹	(1)

Question	Answer	Additional Guidance	Mark
10(c)(ii)	An explanation that includes three of the following:	All marking points must be comparative Accept converse for 3.5g yeast for all points	
	 (7g yeast / high concentration) more yeast cells present, so {carbon dioxide is produced faster / more carbon dioxide produced (at start) (1) 	Accept more enzymes (for more yeast) Accept more yeast cells so higher respiration rate	
	 (more yeast cells present), so more enzymes to {hydrolyse sucrose / carry out respiration} (1) 		
	 final volume of CO₂ produced is the same for 7g and 3.5g yeast (1) 		
	 because {mass / concentration} of {sucrose / substrate} is the same for both (1) 	Accept line levels off sooner for 7.0g because rate	
	 line levels off sooner for 7.0g because sucrose is used up more quickly} (1) 	of respiration is faster	
	• 3.5g yeast will produce half the rate of reaction compared to 7.0g yeast (1)	Accept it takes twice as long for the line to plateau (with 3.5g yeast)	(3)

(Total for Question 10 = 14 marks

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