

Question	Answers	Notes	Total	Crit
1	<p>a Any three functions and correct descriptions (max 6)</p> <ul style="list-style-type: none"> • Growth / differentiation increasing in size / becoming more complex • Respiration release of (useful) energy from nutrients • Reproduction replication of cells / propagation of species • Digestion breakdown of food to simpler molecules • Homeostasis regulation of internal environment • Excretion elimination of (metabolic) waste/CO₂ 	<p><i>Accept any equally valid response and correctly linked explanation.</i></p> <p>Not eat</p>	6	A, B
	<p>b</p> <p>Image A</p> <ul style="list-style-type: none"> • plant cell • cell wall or chloroplast or <u>large central</u> vacuole <p>Image B</p> <ul style="list-style-type: none"> • plant cell • cell wall or chloroplast or <u>large central</u> vacuole <p>Image C</p> <ul style="list-style-type: none"> • animal cell • absence of cell wall /absence of chloroplast/presence of lysosomes 	<p><i>Do not accept references to shape, complexity, organisation as these are not structures.</i></p>	6	
	<p>c</p> <p>any reasonable hypothesis, for example</p> <ul style="list-style-type: none"> • if the cell is exposed to light then it will produce oxygen • if the cell is given nutrients but is placed in the dark then it will not survive <p>a correct explanation, for example</p> <ul style="list-style-type: none"> • plant-like organisms photosynthesize to produce oxygen • plant-like organisms carry out photosynthesis, they do not survive without light 		2	

2	a	B – E – A – C – D three adjacent images in correct order all correct images in correct order	<i>Award 1 max</i> <i>Award 2</i>	2	A
	b	any of the points below in the correct order of movement (5 max) <ul style="list-style-type: none"> • <u>diffusion</u> of oxygen (molecule) across <u>membrane</u> (of alveolus) • into <u>capillary</u> • hemoglobin/<u>red blood cell</u> used to transport • transported to heart / to <u>pulmonary vein</u> • passes through heart / <u>left atrium / left ventricle</u> • leaves heart through the <u>aorta</u> • travels through <u>arteries</u> • travels (from arteries) through <u>capillaries</u> • <u>diffuses</u> into a muscle cell 	3 max for five points in incorrect order 2 max for three points in incorrect order 1 max for a correct use of any underlined term Ignore vein without pulmonary	5	
3	a	0.29 (cm ³ h ⁻¹)	<i>Accept 0.28, ignore incorrect units</i>	1	A, C
	b	negative/inverse relationship or (as the percentage of) affected gill increases, oxygen uptake decreases		1	
	c	one from features in common <ul style="list-style-type: none"> • thin membrane • large number of capillaries • large surface area • moist surfaces one from different features <ul style="list-style-type: none"> • oxygen absorbed from air in humans and from water in fish • fish have plate like structures, humans have globular alveoli • human lungs are internal, gills are external any third additional point	<i>Third additional point can come either from list of features in common or list of different features</i>	3	

	d	as the thickness of the gill increases, the oxygen cannot diffuse as quickly/efficiently/well (because) thickening reduces the surface area for diffusion	OWTTE	2	
	e	any of the points below (5 max) <ul style="list-style-type: none"> less oxygen/ lower oxygen take up so fish are less active easier for predators to kill/eat increased amounts of prey initial increase in predator population reduced population size of fish reduced growth of fish (as population decreases) reduced population of predators less food for fishing community community needs alternative supply workers need new occupation less money for community/economic impact) 	OWTTE	5	
4	a	any two reasonable variables, for example <ul style="list-style-type: none"> type of exercise temperature around person tested time of day tested 	OWTTE Accept any other variable that can reasonably be expected to have an impact on oxygen consumption not intensity, oxygen consumption (VO_2)	2	B, C
	b	(directly) proportional/positive correlation (up to point A, maximum) then the line levels off/plateaus	OWTTE	2	
	c	before point A, three from <ul style="list-style-type: none"> as exercise intensity increases oxygen consumption increases at a fixed rate oxygen consumption eventually reaches a maximum value (of $34-38 \text{ cm}^3\text{kg}^{-1}\text{min}^{-1}$) cells are using more oxygen (to meet energy needs) more cells involved for longer as intensity increases after point A, one from <ul style="list-style-type: none"> as exercise intensity increases above VO_2 max the oxygen consumption stabilizes eventually cells are using all of the available oxygen the cells are not able to consume more oxygen (than $34-38 \text{ cm}^3\text{kg}^{-1}\text{min}^{-1}$) even when the intensity of exercise increases aerobic respiration below VO_2 max/anaerobic respiration above VO_2 max any additional point	OWTTE Ignore incorrect values Additional point can come from either list	5	

f	<p>result both groups have similar heights or the heights are different but not significant</p> <p>conclusion GM maize has same growth as traditional maize with fertilizer or GM maize does not require fertilizer to give similar growth or traditional maize needs fertilizer to grow at the same rate as GM maize</p> <p>scientific explanation the new gene allowed the maize to obtain nutrients more efficiently</p>	<p><i>Can score marks if answers seen in any response box</i></p> <p><i>ECF from part d</i></p>	3	
---	--	---	---	--

g	<p>strength of the method, for example</p> <ul style="list-style-type: none"> • number of trials • number of controls • ignore outliers <p>features to change to improve the validity, for example</p> <ul style="list-style-type: none"> • poor control • poor experimental design • two variables altered at the same time <p>explanation of how the limitation stated above affected validity, for example</p> <ul style="list-style-type: none"> • poor experimental design meant that there was insufficient data to draw a conclusion <p>extension to the method, for example</p> <ul style="list-style-type: none"> • GM maize tested with fertilizer • consider other GM variants <p>correctly linked justification for how the suggested extension improves validity, for example</p> <ul style="list-style-type: none"> • confirmation that effects are not due to fertilizer use alone 	OWTTE	5	
h	<p>any reasonable answer, for example</p> <p>(bio)mass of maize number/yield of kernels, leaves etc</p>		1	

6	a	<table border="1"> <tr> <td> <ul style="list-style-type: none"> • incomplete or poorly stated hypothesis • independent or dependent variable stated • control variable stated </td> <td>1–2</td> </tr> <tr> <td> <ul style="list-style-type: none"> • clear statement of a hypothesis • independent and dependent variable stated • control variable is stated and partially justified • equipment linked to control variable is specified but is not always appropriate • attempt at a method but detail is insufficient for another student to follow </td> <td>3–6</td> </tr> <tr> <td> <ul style="list-style-type: none"> • a clear statement of a hypothesis with a correctly linked scientific explanation in general terms • independent and dependent variables stated with incomplete justification • control variable is stated and justified in general terms • equipment correctly linked to control variable is specified • method is described and could easily be followed by another student • appropriate number or range of data is stated </td> <td>7–11</td> </tr> <tr> <td> <ul style="list-style-type: none"> • a clear statement of a hypothesis with a correctly linked scientific explanation linked to the question • independent and dependent variables stated and fully justified using scientific reasoning • control variable is stated and fully justified using scientific reasoning • equipment correctly linked to control variable is specified and justified • complete method is described, fully explained and could easily be followed by another student • appropriate number or range of data and why this number / range is sufficient is explained • a relevant safety concern is explicitly stated </td> <td>12–17</td> </tr> </table>	<ul style="list-style-type: none"> • incomplete or poorly stated hypothesis • independent or dependent variable stated • control variable stated 	1–2	<ul style="list-style-type: none"> • clear statement of a hypothesis • independent and dependent variable stated • control variable is stated and partially justified • equipment linked to control variable is specified but is not always appropriate • attempt at a method but detail is insufficient for another student to follow 	3–6	<ul style="list-style-type: none"> • a clear statement of a hypothesis with a correctly linked scientific explanation in general terms • independent and dependent variables stated with incomplete justification • control variable is stated and justified in general terms • equipment correctly linked to control variable is specified • method is described and could easily be followed by another student • appropriate number or range of data is stated 	7–11	<ul style="list-style-type: none"> • a clear statement of a hypothesis with a correctly linked scientific explanation linked to the question • independent and dependent variables stated and fully justified using scientific reasoning • control variable is stated and fully justified using scientific reasoning • equipment correctly linked to control variable is specified and justified • complete method is described, fully explained and could easily be followed by another student • appropriate number or range of data and why this number / range is sufficient is explained • a relevant safety concern is explicitly stated 	12–17		17	B
<ul style="list-style-type: none"> • incomplete or poorly stated hypothesis • independent or dependent variable stated • control variable stated 	1–2												
<ul style="list-style-type: none"> • clear statement of a hypothesis • independent and dependent variable stated • control variable is stated and partially justified • equipment linked to control variable is specified but is not always appropriate • attempt at a method but detail is insufficient for another student to follow 	3–6												
<ul style="list-style-type: none"> • a clear statement of a hypothesis with a correctly linked scientific explanation in general terms • independent and dependent variables stated with incomplete justification • control variable is stated and justified in general terms • equipment correctly linked to control variable is specified • method is described and could easily be followed by another student • appropriate number or range of data is stated 	7–11												
<ul style="list-style-type: none"> • a clear statement of a hypothesis with a correctly linked scientific explanation linked to the question • independent and dependent variables stated and fully justified using scientific reasoning • control variable is stated and fully justified using scientific reasoning • equipment correctly linked to control variable is specified and justified • complete method is described, fully explained and could easily be followed by another student • appropriate number or range of data and why this number / range is sufficient is explained • a relevant safety concern is explicitly stated 	12–17												

	b	<table border="1"> <tr> <td>Outline</td> <td> <ul style="list-style-type: none"> • an example of an ecosystem • a consequence of introducing GMOs to an ecosystem is suggested </td> <td>1–2</td> </tr> <tr> <td>describe</td> <td> <ul style="list-style-type: none"> • an incomplete definition of the term ecosystem • an advantage or a disadvantage of GMOs is suggested • a correct consequence of introducing GMOs to an ecosystem • a relevant ethical or economical responsibility that should be considered </td> <td>3–5</td> </tr> <tr> <td>discuss</td> <td> <ul style="list-style-type: none"> • a correct definition of the term ecosystem in general terms • a statement of an advantage and a disadvantage of GMOs • a correct consequence of introducing GMOs to an ecosystem supported by science • a relevant ethical responsibility and a relevant economical responsibility that should be considered (may be implicit) </td> <td>6–9</td> </tr> <tr> <td>discuss and evaluate</td> <td> <ul style="list-style-type: none"> • a correct definition of the term ecosystem linked to the question • a statement of a relevant advantage and a relevant disadvantage of GMOs • at least two correct and relevant consequences of introducing GMOs to an ecosystem supported by science • an explicit relevant ethical responsibility and an explicit relevant economical responsibility that should be considered • a concluding appraisal linking all the issues discussed previously </td> <td>10–13</td> </tr> </table>	Outline	<ul style="list-style-type: none"> • an example of an ecosystem • a consequence of introducing GMOs to an ecosystem is suggested 	1–2	describe	<ul style="list-style-type: none"> • an incomplete definition of the term ecosystem • an advantage or a disadvantage of GMOs is suggested • a correct consequence of introducing GMOs to an ecosystem • a relevant ethical or economical responsibility that should be considered 	3–5	discuss	<ul style="list-style-type: none"> • a correct definition of the term ecosystem in general terms • a statement of an advantage and a disadvantage of GMOs • a correct consequence of introducing GMOs to an ecosystem supported by science • a relevant ethical responsibility and a relevant economical responsibility that should be considered (may be implicit) 	6–9	discuss and evaluate	<ul style="list-style-type: none"> • a correct definition of the term ecosystem linked to the question • a statement of a relevant advantage and a relevant disadvantage of GMOs • at least two correct and relevant consequences of introducing GMOs to an ecosystem supported by science • an explicit relevant ethical responsibility and an explicit relevant economical responsibility that should be considered • a concluding appraisal linking all the issues discussed previously 	10–13		13	D
Outline	<ul style="list-style-type: none"> • an example of an ecosystem • a consequence of introducing GMOs to an ecosystem is suggested 	1–2															
describe	<ul style="list-style-type: none"> • an incomplete definition of the term ecosystem • an advantage or a disadvantage of GMOs is suggested • a correct consequence of introducing GMOs to an ecosystem • a relevant ethical or economical responsibility that should be considered 	3–5															
discuss	<ul style="list-style-type: none"> • a correct definition of the term ecosystem in general terms • a statement of an advantage and a disadvantage of GMOs • a correct consequence of introducing GMOs to an ecosystem supported by science • a relevant ethical responsibility and a relevant economical responsibility that should be considered (may be implicit) 	6–9															
discuss and evaluate	<ul style="list-style-type: none"> • a correct definition of the term ecosystem linked to the question • a statement of a relevant advantage and a relevant disadvantage of GMOs • at least two correct and relevant consequences of introducing GMOs to an ecosystem supported by science • an explicit relevant ethical responsibility and an explicit relevant economical responsibility that should be considered • a concluding appraisal linking all the issues discussed previously 	10–13															

7	a	<p>Vaccines immunize against pathogens or vaccines stop pathogens causing disease</p> <p>contains killed/weakened pathogens (to be administered to humans) or to stimulate specific antibodies against that pathogen or to stimulate an immune response</p>	<p>OWTTE Answer must specifically relate to immunization, "solution" is not sufficient.</p>	2	A, B, D
	b	<p>Apply scientific language effectively term <u>antibody</u> used correctly anywhere in the response</p> <p>Any four from below or any other reasonable responses (4 max)</p> <ul style="list-style-type: none"> • pathogens cause disease • pathogens have antigens / foreign material • vaccine is administered to a human body • the body produces antibodies specific for those antigens/pathogens • antibodies are produced by white blood cells / (B) lymphocytes • antibodies combine with antigens to neutralize pathogens/ prevent their action / target them for destruction • memory cells/ (B) lymphocytes maintain the ability (to produce specific antibodies) for many years • memory cells/ (B) lymphocytes give immunity against the pathogen 	<p>OWTTE</p>	5	
8	a	<p>dependent variable statement of variable correct justification for variable stated</p> <p>independent variable type of vaccine correct justification for variable stated</p> <p>control variable statement of variable correct justification for variable stated</p>	<p>Check order of variables in response corresponds to order in markscheme.</p> <p>2nd mark in each pair can be awarded if it is correct for the variable stated even in the variable is incorrectly identified.</p>	6	

b	Outline	<ul style="list-style-type: none"> • a statement comparing the use of GM bananas with traditional vaccines • an effect on an individual or a community 	1-2	15	D
	describe	<ul style="list-style-type: none"> • a statement of an advantage or a disadvantage of using GM bananas compared to traditional vaccines • an incomplete supporting scientific statement • an effect on an individual and a community(may be incomplete) • mention of an ecosystem 	3-6		
	discuss	<ul style="list-style-type: none"> • a statement of a relevant advantage and a relevant disadvantage of using GM bananas compared to traditional vaccines • a complete scientific supporting statement in general terms • an effect on an individual and a community • a clearly explained, reasonable impact on an ecosystem 	7-10		
	discuss and evaluate	<ul style="list-style-type: none"> • clear statements of a relevant advantage and a relevant disadvantage of using GM bananas compared to traditional vaccines • a complete scientific supporting statement linked to the question • a fully described effect on an individual and a community • a correct impact on an ecosystem supported by science • discussion of an ethical issue or consideration • a concluding appraisal linking all the issues discussed previously 	11-15		
				120	