Question Number	Answer	Acceptable answers	Mark
1(a)(i)	A description including **two** of the following: as pH decreases so do the number of species in the lake (1) all the organisms /species in the lake are found at 6.0/6.5 (1) comment on specific reading from the graph e.g. (only) {frogs / 1 organism} remain at lowest pH. eq. (1)	accept: the more acidic the lake is the lower the number of species {more species / types of organisms} live in more neutral conditions /less organisms live where {low pH /more acidic}	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	**D** ☒ sulfur dioxide		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)	An explanation linking **three** of the following: eutrophication (1) causes an algal bloom (1) plants {at the bottom of the lake / underneath the algae} cannot get light to photosynthesise (1) plants at the bottom of the lake die and microorganisms break them down (1) microorganisms respire removing oxygen from the water (1) reduction in biodiversity (1)	accept: **increase**d growth of algae accept: decomposers for microorganisms Ignore references to fish suffocating / dying this is insufficient for this marking point	**(3)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>Q1(c)</td><td>
<table>
<tr><th>condition</th><th>indicator species</th></tr>
<tr><td>clean water</td><td>stonefly (larvae / nymph)/
(freshwater) shrimp /
mayfly larvae/nymph/
caddis fly larvae /
dragonfly nymph /
damselfly nymph /
riffle beetle /
water penny larvae /</td></tr>
<tr><td>polluted water</td><td>bloodworm /
sludgeworm /
algae /
rat tailed maggot /
water louse/
leeches/
planarian worms /
aquatic worms /</td></tr>
</table>

Ignore general references to organisms such as frogs / snails/ squid the answers need to be specific indicator species.

If unsure of an organism then please put into review</td><td>(1)

(1)</td></tr>
</table>

Total for Question 1 = 8 marks

Question Number	Answer	Acceptable answers	Mark
2(a)	**A description to include three of the following** selection of individuals with {favourable characteristics/largest cobs}/collect seeds from plants with large cobs (1) cross breeding (of selected individuals)/plant seeds together (from maize with large cobs) (1) selection of offspring (1) repeat process over time (1)	 accept selective breeding	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(b)	**An explanation including two of the following** reduce number of pests (1) reduced damage to crop/maize (1) increased yield (1) OR kills weeds (1) reduces competition for {light/space/named resource}(1) increased yield (1)	 accept kill pests/insects/named pest/deters animals **reject** predators	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)	**A discussion to include a maximum of two from Advantages:** removes CO_2 when growing (1) less use of {fossil fuels/named fuel} (1) reduced SO_2 emissions (1) renewable / can be regrown quickly /sustainable (1) **A discussion to include a maximum of two from Disadvantages:** reduced food production (1) takes up land (1) reduced biodiversity (1) crop growth is weather dependent (1)	 accept carbon neutral **reject** CO^2 **reject** SO^2 accept deforestation ignore references to cost and energy content	**(4)**

Question Number	Answer	Acceptable answers	Mark
2(d)	**A** ☒ *Agrobacterium tumefaciens*		**(1)**

Total for Question 2 = 10 marks

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	photosynthesis		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	A description of the processes that return carbon dioxide to the atmosphere including • respiration in animals / respiration from arrow 2 (1) • respiration in plants / respiration from arrow 5 (1) • decomposition /respiration by microorganisms / decomposition /respiration arrow 3 (1)	accept trees combusting/burning releasing CO_2 **ignore -** references to arrow 1 returning carbon dioxide to the atmosphere / photosynthesis / references to arrow 4	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(b)	An explanation linking the first bullet point with an explanation including • increase in carbon dioxide levels (1) Plus **one** of the following • respiration/ burning of **fossil** fuels/ waste decaying (1) • deforestation leading to reduced photosynthesis (1)	maximum 1 mark for reason accept named fossil fuel	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 (c)	lichen / blackspot fungus	other air quality indicator species eg. canaries / algae / moss / peppered moths	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(d)	An explanation linking **three** of the following including points • algal bloom/ **increased** algae / **more** algae (1) • blocks sunlight (from plants growing on the bottom of the lake/river) (1) • so stops photosynthesis (1) • (plants die) so decomposers break them down • which use oxygen for respiration /oxygen depletion (1)	Ignore encourages algae to grow Accept bacteria/microorganisms for decomposers No mark for 'plants die' Do not give mark for just low oxygen this must be linked to microorganisms (respiring)	**(3)**

(Total for question 3 = 10 marks)

Question Number	Answer	Acceptable answers	Mark
4(a)	C (1) least amount of freshwater shrimps found at C (1)	Reference to freshwater shrimps as indicator species freshwater shrimps can only survive in clean water / cannot survive in polluted water more shrimps die in polluted water	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)	D		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(c)	C		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(d)	A description of the process linking **four** of the following points: • algae (on the surface) of the stream show rapid growth (1) • (they) block light to the photosynthesising plants below (1) • (causing) plants on the stream bed to die (1) • decomposers use up oxygen to break down these dead plants (1) • other organisms die due to lack of oxygen (1)	algal bloom occurs / large increase in growth of algae /other plants grow quickly **Accept** microorganisms / microbes / bacteria **Accept** reference to anaerobic bacteria can function in anoxic conditions - not against a current marking point	**(4)**

(Total for question 4 = 8 marks)

Question number	Answer	Additional guidance	Mark
5(a)(i)	• $2.1 \times 10^4 = 21\,000 \times 0.1 = 2\,100$ in the water beetle (1) • 210 J in the bird (1)	award full marks for correct numerical answer without working	(2)

Question number	Answer	Mark
5(a)(ii)	it limits the length of the food chain	(1)

Question number	Answer	Additional guidance	Mark
5(b)(i)	• 107 ÷ 153 (1) • 0.699 3464 × 100 = 70% (1) Answer to 2 significant figures	award full marks for correct numerical answer without working	(2)

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • stream B is more polluted that stream A (1) Plus one from: • (because) stream A contains stonefly larvae/mayfly larvae/caddis fly larvae (which are indicators of clean water) (1) • (because) stream B contains larger numbers of blood worm and sludge worm (which are indicators of polluted water) (1)	accept other correct indicators from the table. accept higher oxygen levels in place of clean water accept lower oxygen levels in place of polluted water	(2)

Question number	Answer	Mark
5(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): • plants growing on the bottom of the stream will be unable to receive sunlight due to the thick layer of algae (1) • these plants will not be able to photosynthesise and will die and start to decompose (1) • the microorganisms decomposing the plants will respire, removing oxygen from the water (1) • the stream will become anoxic/oxygen depleted and other respiring organisms (plants and animals) will not be able to survive so biodiversity will be reduced (1)	(4)

(Total for question 5 = 11 marks)