Mark schemes

1

(a) 1. To kill any fungus / bacteria on surface of seeds or in soil;

2. So only the added fungus has any effect.

2

(b) So that only nitrate or ammonia / type of fertiliser affects growth.

1

(c) 1. So that effects of nitrate or ammonium alone could be seen;2. So that effects of fungus can be seen.

2

(d) 1. Weigh samples at intervals during drying;2. To see if weighings became constant (by 3 days).

2

(e) With live fungus – showing effects of the fungus:
1. Fungus increases growth of roots and shoots in both;
2. Produces greater growth with nitrate.

With heat-treated fungus – showing effects of fertiliser:

3. Similar dry masses for roots and shoots;
4. (Probably) no significant difference because SDs overlap.

4

(f) 1. Dry mass measures / determines increase in biological / organic material;2. Water content varies.

2

(g) 1. Fungus with nitrate-containing fertiliser gave largest shoot: root ratio;
2. And largest dry mass of shoot;
3. 6.09:1 compared with ammonium-containing fertiliser 4.18:1

2 max

[15]

2

(a) 1. Respiration/metabolism/ammonification;

2. (Releases/produces) heat;

Reject: 'produces energy'.

2

(b) 1. SD is spread of data around the mean;

Accept: variation around the mean.

*Accept: range is difference between highest and lowest values/extremes **or** range includes anomalies/outliers.*

2. (SD) reduces effect of anomalies/ outliers;

Reject: (SD) removes anomalies/outliers.

3. (SD) can be used to determine if (difference in results is) significant/not significant/due to chance /not due to chance; *Ignore: reliability/accuracy/validity.*

2 max

(c) 1. Distributes heat / prevents 'hot' spots;
2. Distributes microorganisms;
3. More enzyme-substrate complexes;
4. Increases rate of decomposition;

Accept: increases nitrification/ammonification or 'breaks down waste faster'.

5. Aeration/provides oxygen;

2 max

(d) 1. Microorganisms change the abiotic conditions/temperature /organic waste /provide nutrients;

Must refer to microorganisms or bacteria/named bacteria causing the change.

Ignore: change the environment.

2. Less hostile conditions;
3. Decline in Cocci **and** increase in rods;

Accept: 'decrease in cocci, others are going up'.

Accept: decrease in cocci and increase in either rod type or increase in both types.

4. Gram positive outcompete / better competitors;

Accept: rods outcompete (cocci) / better competitors.

3 max

[9]

3

(a) 1. Excites electrons / electrons removed (from chlorophyll);

Accept: higher energy level as 'excites'.

2. Electrons move along carriers/electron transfer chain releasingenergy;

Accept: movement of H^+/protons across membrane releases energy.

Reject: 'produces energy' for either mark but not for both.

3. Energy used to join ADP and Pi to form ATP;

Reject: 'produces energy' for either mark but not for both.

Accept: energy used for phosphorylation of ADP to ATP

Do not accept P as Pi but accept phosphate.

4. Photolysis of water produces protons, electrons and oxygen;
5. NADP reduced by electrons / electrons and protons / hydrogen;

Accept: NADP to NADPH (or equivalent) by addition of electrons/hydrogen.

Do not accept NADP reduced by protons on its own.

5

(b) 1. Protein/amino acids/DNA into ammonium compounds /ammonia;

Accept: any named nitrogen containing compound e.g. urea.

2. By saprobionts;

Accept: saprophytes.

3. Ammonium/ammonia into nitrite;
4. Nitrite into nitrate;
5. By nitrifying bacteria/microorganisms;

Reject: nitrifying bacteria in root nodules.

1, 3 and 4. Accept: marks for conversion even if incorrect type of bacteria named as being involved.

2 and 5. Reject: marks for type of bacteria if linked to incorrectprocess e.g. nitrite converted to nitrate by saprobionts.

3 and 4. Accept: for one mark ammonia/ammonium into nitrate ifneither mark point 3 or 4 awarded.

Note: there are no marks for the role of nitrogen-fixing bacteria as the question refers to producing a source of nitrates from the remains of crops.

5

[10] (a) (i) 1. Amino acid / protein / enzyme / urea / nucleic acid /

4

chlorophyll / DNA / RNA / / ATP / ADP / AMP / NAD / NADP;

2. DNA / RNA / nucleic acid / ATP / ADP / AMP / NADP / TP / GP / RuBP / phospholipids;

1. and 2. Accept any named equivalent examples e.g. nucleotides.

Neutral: ammonia / nitrite / nitrate / phosphate.

2

(ii) 1. Saprobiotic (microorganisms / bacteria) break down remains / dead material / protein / DNA into ammonia / ammonium;

Accept: saprobionts / saprophytes / saprotrophs

Neutral: decomposer

2. Ammonia / ammonium ions into nitrite and then into nitrate;*Allow correct chemical symbols.*

Accept: correct answers which use incorrect bacteria e.g. nitrogenfixing but then reject m.p. 3.

3. (By) Nitrifying bacteria / nitrification;

3

(b) 1. Nitrate / phosphate / named ion / nutrients for growth of / absorbed / used by plants / algae / producers;

2. More producers / consumers / food **so** more fish / fish reproduce more / fish grow more / fish move to area;

Must have idea of more plants related to some increase in fish.

2 [7]

(a) R.

5 **1**

(b) 1. Protein / amino acids broken down (to ammonium ions / ammonia);

Accept: nucleic acids / RNA / DNA / urea / any named nitrogen containing compound as an alternative to protein / amino acids
Accept: saprophytes / saprotrophs

2. By saprobionts / saprobiotic (microorganisms).

Neutral: decomposers

Reject: answers where incorrect type of bacteria given as saprobionts e.g. Nitrogen fixing bacteria

2

(c) 1. (Fertility increased as) more nitrate formed / less nitrate removed / brokendown;

Accept: Nitrate remains

2. Less / no denitrification / process P is decreased / fewer denitrifying bacteria.

Accept: more nitrification / more nitrifying bacteria / process R is increased

2

(d) 1. Grow crops / plants with nitrogen-fixing (bacteria);

Accept: grow legumes / named example e.g. peas, beans, clover

Accept: <u>fallow</u> year

Accept: use different amounts of ions / nutrients

2. (Different crops use) different minerals / salts / nutrients / ions (from the soil);3. (Different crops have) different pests / pathogens / diseases.

2 max

[7] 1. Carbon dioxide combines with ribulose bisphosphate / RuBP;

6

2. Produces two glycerate (3-)phosphate / GP;

Accept: any answer which indicates that 2 x as much GP produced from one RuBP.

3. GP reduced to triose phosphate / TP;

Must have idea of reduction. This may be conveyed by stating m.p. 4.

4. Using reduced NADP;

***Reject**: Any reference to reduced NAD for m.p.4 but allow reference to reduction for m.p. 3.*

5. Using <u>energy</u> from ATP;

Must be in context of GP to TP.

6. Triose phosphate converted to glucose / hexose / RuBP / ribulose bisphosphate /named organic substance;

[6]

7 (a)

Part of ecosystem	**Mean rate of carbon dioxide production / $cm^3\ m^{-2}\ s^{-1}$**	**Percentage of total carbon dioxide production measured by the scientists**
Leaves of plants	0.032	25.0
Stems and roots of plants	0.051	**39.8**
Nonphotosynthetic soil organisms	0.045	**35.2**

2 correct = 2 marks;;

Adding rates to get 0.128 = 1;

If rounded to 40 and 35 in table;

- *but working shows decimal points, then award 2 marks*
- *but no working shown, then 1 max*

2 max

(b) 1. Data only include (heterotrophic) soil organisms;

2. Doesn't include animals (above ground) / other (non-soil) organisms;

3. Doesn't take into account anaerobic respiration;

Award points in any combination

Accept for 1 mark idea that CO_2 for leaves doesn't take into account photosynthesis – not told in dark until part (d)

2 max

(c) **All three** of following = 2 marks;;

Two of them = 1 mark;

Volume of carbon dioxide given off

(From known) area / per m^2 / m^{-2}

In a known / set time

Ignore 'amount' / concentration of CO_2

Accept per second / per unit time

2

(d) 1. (In the light) photosynthesis / in the dark no photosynthesis;

2. (In light,) carbon dioxide (from respiration) being used / taken up (by photosynthesis);

2

(e) (i) (Rate of respiration)

Assume "it" means soil under trees

1. In soil under trees (always) higher;*Accept converse for soil not under trees*

Accept 'in the shade' means under the trees

2. In soil under trees does not rise between 06.00 and 12.00 / in the middleof the day / peaks at 20:00-21.00 / in the evening;

3. In soil **not** under trees, peaks at about 14:00-15:00 / in middle of day;

2. and 3. No mm grid, so accept 'between 18.00 and 24.00' or 'between 12.00 and 18.00'

2 max

(ii) <u>(Between 06.00 and 12.00</u>, (No Mark))

Respiration higher in soil under tree, (No mark)

Do not mix and match mark points

No list rule

1. Tree roots carry out (a lot of) respiration;

2. More / there are roots under tree;

Accept converse for soil not under trees

OR

3. More food under trees;

4. So more active / greater mass of / more organisms (carrying outrespiration);

Accept converse for soil not under trees

OR

Soil not under trees respiration increases (No mark)

5. Soil in sunlight gets warmer;

6. Enzymes (of respiration) work faster;

Accept converse for soil under trees

2 max

(f) (i) 1. Photosynthesis produces sugars;

2. Sugars moved to roots;
Do not penalise named sugars other than sucrose

3. (Sugars) are used / required for respiration;

2 max

(ii) Takes time to move sugars to roots;
Look for movement idea in (i) – can carry forward to (ii)

1

[15]

8 (a) Push – legume

Pull – grass;
Both needed for mark

1

(b) 1. Set up tape measures on two sides of the plot / make grid of plot;
Allow 'Number each plant'. With this approach mp3 cannot be awarded.

2. Use random number table / calculator / generator;*Allow 'Select from a hat' idea.*

3. To generate coordinates;

3

(c) 1. To prevent competition between the maize and the grass;2. For light / nutrients / water;

OR

3. Idea of limits movement of pest (between grass and maize);

4. Only eating / damaging grass;

2 max

(d) 1. Nitrogen-fixing bacteria convert nitrogen (in the air) into ammonium compounds (in the soil) which are converted into nitrates / nitrification occurs;
Accept 'ammonia' for 'ammonium compounds'.

2. Maize uses nitrates (in soil) for amino acid / protein / ATP / nucleotideproduction;
2. Must be in the context of maize.
Ignore ionic formulae unless only these are given.

2

(e) 1. Reduced % damage to maize plants / increased maize grain yield;

2. Calculation to justify mp 1;

3. Standard deviation shows no overlap but need stats to show significance of thisdifference;

4. More profit / net income / greater income than additional cost (with push-pull);

5. $322 extra / 408% more / $401 v $79 profit;

Accept '$350 extra income compared to $28 extra spend'.

Mp5 gains credit for both mp4 and 5

3 max

[11]

9

1. Growth of algae / surface plants / algal bloom blocks light;

2. Reduced / no photosynthesis so (submerged) plants die;

3. Saprobiotic (microorganisms / bacteria);

3. Accept: Saprobiont / saprophyte / saprotroph

3. Neutral: decomposer

4. Aerobically respire / use oxygen in respiration;

5. Less oxygen for fish to respire / aerobic organisms die;

[5]

10

1.P Pathogens and effects on host

2.T Taxonomy

2.C Classification and evolution.

2.I Inheritance and evolution

2.Gc Genetic code, universal

2.B Behaviour

2.Ev Populations and evolution, variation between individuals within a species

3.BP Relationships within ecosystems − eg predator / prey

3.E Energy transfer in ecosystems

3.N Nutrient cycles, the organisms involved

3.S Succession, biodiversity, species and individuals in a community

4.H Human impacts on the environment and its effect on relationships between organisms − including farming

4.Gt Gene technology and GMO and selective breeding

4.Ar Antibiotic resistance

Examiners are free to select other letters if they wish

The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves

Breadth, one mark for use of an example from each of the following approaches − 3 max:

1. Pathogen and host

2. Evolution (related topics)

3. Ecological

4. Human intervention in relationships

[25]

11 (a) (i) Nitrification / oxidation;

Accept 'nitrifying'

1

(ii) Denitrification;

Accept 'denitrifying'

1

(b) 1. (Nitrogen) to ammonia / NH_3 / ammonium;

1. Do not disqualify mark for any references to ammonia beingconverted to nitrite, nitrate etc

2. Produce protein / amino acids / named protein / DNA / RNA;

2. Do not disqualify mark for any references to protein being formedfrom nitrogen, nitrite or nitrate

2

(c) 1. Soil has low(er) water potential / plant / roots have higher water potential;

1. Reference to water potential gradient is sufficient if correct direction of gradient or water movement is outlined

1. Accept WP or Ψ for water potential

2. Osmosis from plant / diffusion of water from plant;

2. Accept plant takes up less / not enough water by osmosis

2. Reference to movement of minerals by osmosis negates mark

2

[6]

(a) 1. Fertilisers / minerals / named ion (added to soil);

12

Accept any named examples of natural fertilisers for mark point 1 e.g. manure, bone meal etc. Ignore named elements

2. Role of named nutrient or element e.g. nitrate / nitrogen for proteins / phosphate / phosphorus for ATP / DNA;

Accept fertilisers / minerals / named nutrient / element removes limiting factor for mark point 2

3. Selective breeding / genetic modification (of crops);

Accept idea of choosing particular variety of crop for mark point 5

4. Ploughing / aeration allows nitrification / decreases denitrification;

5. Benefit of crop rotation in terms of soil nutrients / fertility / pest reduction;

5

(b) 1. Protein / amino acids / DNA into ammonium compounds / ammonia;

Accept any named nitrogen containing compound e.g. urea for mark point 1

2. By saprobionts;

Accept saprophytes for mark point 2

3. Ammonium / ammonia into nitrite;

Accept marks for conversion i.e. mark points 1, 3, 4 and 6 even if incorrect type of bacteria named as being involved

4. Nitrite into nitrate;

However, reject marks for type of bacteria i.e. mark points 2, 5 and 7 if linked to incorrect process e.g. nitrite converted to nitrate by saprobionts

5. By nitrifying bacteria / microorganisms;

6. Nitrogen to ammonia / ammonium;

Award one mark for ammonia / ammonium into nitrate if neither mark point 3 or 4 awarded

7. By nitrogen-fixing bacteria / microorganisms in soil;

Ignore reference to nitrogen-fixing bacteria in root nodules. If not specified, assume nitrogen-fixing bacteria are in the soil

5 max

[10]

13

(a) Nitrification;

Accept nitrifying.

Do not accept nitrogen fixing.

1

(b) 1. Uptake (by roots) involves active transport;*Reject all references to bacteria*

2. Requires ATP / aerobic respiration;

2

(c) (i) 1. Not enough time / fast flow washes bacteria away;

"Not enough time for bacteria to convert all the ammonia to nitrate" gains 2 marks

2. (Not all / less) ammonia converted to nitrate / less nitrification;

2

(ii) 1. Algal bloom / increase in algae blocks light / plants / algae die;

2. Decomposers / saprobionts / bacteria break down dead plant materials;

3. Bacteria / decomposers / saprobionts use up oxygen in respiration /increase BOD causing fish to die;

3. Accept alternatives such as microbes / saprophytes.

3

[8] (a) (i) 1. Gases / correct named gas not released;

14

2. Conditions (in digester) can be controlled;

3. Products / named product can be collected;

4. Open ponds associated with health risk / environmental damage /eutrophication;

Correct named gases include: methane, carbon dioxide, hydrogen sulphide, nitrogen oxides 1. Allow substance = product

4. Accept 'pond' in any context

2 max

(ii) 1. Respiration causes temperature increase / release of heat;

2. Enzymes would be denatured / microorganisms killed;

2

(b) (i) 1. Increase algae / algal bloom causes light to be blocked out;

2. Plants can't photosynthesise / plants and / or algae die;

3. Bacteria / saprobionts / EW feed off / breakdown dead organisms usingup oxygen / bacteria respire / BOD rises;

3

(ii) 1. Acts as soil conditioner / improves drainage / aerates soil / increases organic content of soil;

2. Contains other elements / named element / wider range of elements;

3. Production of artificial fertiliser energy-consuming;

4. Less leaching / slow release (of nutrient);

Unspecified answers relate to natural fertiliser. Ignore references to cost / eutrophication

2. i.e. elements other than nitrogen, phosphorus and potassium

1 max

[8]

15

(a) 1. Saprobionts / saprophytes;

2. Digest / break down proteins / DNA / nitrogen-containing substances;

3. Extracellular digestion / release of enzymes;

4. Ammonia / ammonium produced;

5. Ammonia converted to nitrite to nitrate / ammonia to nitrate;

6. Nitrifying (bacteria) / nitrification;

7. Oxidation;

Ignore all references to other parts of the nitrogen cycle

1. Accept saprotrophs. Allow this mark if saprobionts linked to fungi.

2. Ignore"nitrogen in plants"

Ignore enzymes excreted

6. Accept Nitrosomonas / Nitrobacter

5 max

(b) 1. Carbon dioxide combines with ribulose bisphosphate / RuBP;

2. Produces two molecules of glycerate (3-)phosphate / GP;

3. Reduced to triose phosphate / TP;

4. Using reduced NADP;

5. Using energy from ATP;

6. Triose phosphate converted to other organic substances / named organicsubstances / ribulose bisphosphate;

7. In light independent reaction / Calvin cycle;

3. Accept add hydrogen for reduced

4. Accept alternatives such as NADPH for reduced NADP / GALPfor TP / ribulose biphosphate

6 max

[11] (a) Complementary to / fits / binds to <u>active site</u>;

16

Competitive / competes / 'prevents' enzyme-substrate complexes / 'prevents' urea attaching;

Max one mark if candidate suggests that active site / enzyme is damaged destroyed or useless.

Allow inhibitor 'prevents' or 'stops' urea / substrate attaching unless candidate clearly indicates this is permanent.

Ignore reference to inhibitor forming an enzyme / substrate complex.

2

(b) (i) Reduces loss of ammonia up to <u>day8 / 9</u>;

1

(ii) Increase in urease / temperature;

More enzyme-substrate complexes;

More bacteria;

2 max

(c) Less urea / ammonia lost (from soil) / less urea broken down;

Urea / ammonia converted to nitrite / nitrate;

Used to produce protein / amino acids / DNA / bases / nucleotides;

Reference to incorrect bacteria (e.g. denitrifying) producing nitrite / nitrate negates second marking point.

3

[8]

17 (a) Ammonia / ammonium / NH_3 / NH_4^+;

1

(b) Will have similar shape / tertiary structure (as substrate) / complementary shape (toactive site);

Neutral: same shape as substrate

Fit / bind with active site / forms enzyme-substrate complex;

Reject: same shape as active site

2

(c) (i) Provides ATP for the reaction / nitrogen fixation / reduction of nitrogen /formation of ammonia;

Accept: ATP or energy

Enzyme / nitrogenase produced quicker / <u>more</u> enzyme produced;

Ignore references to temperature

Uses / removes oxygen (so nitrogenase works);

Use of oxygen must be in the correct context

2 max

(ii) ATP used for / needed for nitrogen fixation / reduction of nitrogen / formation of ammonia / production of enzyme / nitrogenase; *Accept: ATP or energy*

(So less ATP) available for growth / protein synthesis / production of new cells / production of biomass;

Accept: converse for those without fertiliser

2

[7]

18

(a) 1. High concentration of carbon dioxide linked with night / darkness;

Accept: converse of low in day

2. No photosynthesis in dark / night / light required for photosynthesis / lightdependent reaction;

Ignore references to rate of photosynthesis in day / night
Accept day = light

3. (In dark) <u>plants</u> (and other organisms) respire;

Must be a reference to plants or <u>all</u> organisms

4. In light net uptake of carbon dioxide by plants / plants use more carbon dioxidethan they produce / rate of photosynthesis greater than rate of respiration;

Do not allow converse for this point
Accept description of compensation point

5. Decrease in carbon dioxide concentration with height;*Accept: converse of increase closer to ground*

6. At ground level fewer leaves / less photosynthesisingtissue / more animals / less light;

5 max

(b) 1. Carbon dioxide combines with ribulose bisphosphate / RuBP;

2. To produce two molecules of glycerate 3-phosphate / GP;

3. Reduced to triose phosphate / TP;

4. Requires reduced NADP;

5. Energy from ATP;

This mark scheme is based on specification content. Accept alternate names such as NADPH Credit relevant diagrams

Accept: description of 'reduced'

5 **[10]**

19

(a) (i) dissolve (in soil water) / run-off / leaching; *reject nitrogen dissolving.*

1

(ii) insoluble / less soluble;
(molecules) require breaking down / slow release;

2

(b) increased growth / algal bloom; blocks light; less photosynthesis; plants die; increase in decomposers / bacteria; *ignore growth of bacteria* bacteria respire; less oxygen;

4 max

[7]

20

(a) **P** – denitrification;

Q – Nitrogen fixation;

2

(b) Ammonia formed by decay / decomposition / putrefying / ammonifying /by action of decomposers / saprobionts;
On nitrogenous waste / urea *or* nitrogenous compounds (e.g. proteins, amino acids, DNA, ATP);

2

(c) Oxygen added / hydrogen removed;
Ignore references to electron loss

1

[5]

21

(a) (i) mass produced increases then levels off at 17.1 kg m^{-2} / concentrations above 40 kg ha^{-1};

1

(ii) replaces nutrients removed;fertiliser provides nitrate needed for protein / amino acid production; as more fertiliser added, there is more growth / protein / amino acid / yield;

2

(iii) plants already have enough <u>nitrate</u> / <u>nitrate</u> no longer limiting;
another <u>named</u> factor / element is limiting growth;

2

(b) because cattle excreted / produced faeces / droppings / cowpats / manure; in field B crop used elements / minerals / nitrates / nutrients last year;

2

[7] (a) No - very little increase / no increase in yield of grass when *Rhizobium*

22 added / no difference between C and D;

1

(b) Yes: increased yield with nitrates;

Correct reference to result in graph **C** c.f. graph **A /** use of correct numbers (from C + A)
e.g. greater yield of soyabean in C than in A /
greater yield of soyabean with nitrate than without <u>if no *Rhizobium;*</u>

2

(c) Forms mutualistic / symbiotic union with soyabean / forms root nodules / mutual benefits (/ described);
makes ammonia / ammonium; (Nitrates – CANCEL)
Helps produce organic-N / amino acids / protein;

max 3

[6] (a) (i) nitrogen-fixing;

23

(ii) nitrifying;
(names neutral, name only no mark)

2

(b) (i) growing legumes / named legume; ploughed in / allowed to decompose / nitrogen-fixing (bacteria in nodules);

OR

allow cattle / named species / (farm) animals (to graze);
add dung / urine;

OR

spread / add manure / slurry;
decomposed to release nitrates / ammonia / nitrites;

2

(ii) bare soil / fallow in winter / hedge removal; leaching (of nitrates) / soil erosion;

OR

uptake of nitrates / ammonium compounds by crop;
harvesting crop / named crop which would be harvested;

OR

(farm) animals eat plants

(in field); (then) animals removed;

2

[6] (a) breakdown of organic matter / sewage by enzymes from bacteria;

24

nitrates / ammonia used by algae to make amino acids / proteins; algae photosynthesise; bacterial respiration uses O_2 / produces CO_2 for algae; (respiration) allows for reproduction / growth of bacteria;

4

(b) sufficient light penetration for photosynthesis (of algae); warm leads to faster enzyme activity; faster bacterial respiration / decomposition; faster photosynthesis;
increased growth / reproduction of bacteria / algae;

4

[8] (a) contain nitrogen-fixing bacteria in roots / nodules (so don't need fertiliser);

25

nitrogen containing compounds added to the soil
<u>when plant dies / after harvest of crop;</u>

2

(b) low(er) / more negative water potential in soil (than in the plant); prevents roots from taking up water (from the soil) / plants still lose water by transpiration; plants lose water to soil by <u>osmosis</u>;

2

(a) more proteins / amino acids / more DNA / nucleotides / nucleotide derivative;

26 increased cell division / number of cells formed;

2

(b) reduced light / shading;less photosynthesis;

2

(c) 1 bacteria / fungi feed on dead matter saprobiotically;
2 respiration uses up oxygen;
3 converts proteins to amino acids;
4 then to ammonium compounds;
5 nitrifying bacteria convert ammonium compounds;6 via nitrates;

6

(d) lower species diversity / number of species;species tolerant to low oxygen thrive / species requiring high oxygen die out;

2

[12] (a) (i) ammonia / ammonium ions / compound;

27

1

(ii) glucose;

1

(b) final acceptor for hydrogen:
to form water;

2

(c) glycolysis can continue;
NAD can accept more hydrogen;

2

(d) secondary / tertiary structure;produces particular shape of active site; *or*
(shape of) active site;
complementary to shape of substrate;

2

(e) sodium ions / non-competitive inhibitor binds to enzymeat a site other than active site; resulting in change of shape of active site / no longer complementary; substrate can no longer bind with the enzyme / enzyme-substrate complexes no longer formed;

3

[11] (i) excessive use of fertilisers;

28 run-off / leaching;

2 max

(ii) 1. growth of algae / plants stimulated / increased;
2. death of algae / plants;
3. more bacteria / decomposers / decomposition;
4. respiration;
5. decomposers / bacteria remove oxygen;
6. animals die (because of lack of oxygen);

5 max

[7]

(b) very long / deep roots, to reach water deep in the soil / nitrogen-fixing bacteria, to provide a

29 source of nitrogen for growth in poor soil;

1

interspecific;

1

(b) (mesquite) proteins / amino acids (ploughed) into soil / nodules ploughed in and
(decomposers) bacteria / fungi feed on these;
excrete ammonia;

nitrifying bacteria convert these to nitrites / nitrates; absorbed by roots of grasses and increase their growth; *accept increases recycling of other ions / phosphate / potassium;*

3

(c) control organism a parasite / predator;specific to pest; population varies with population of pest; controls size of pest population but does not kill all;
keeps pest population low enough to prevent significant (economic) damage;

3 max

[8]

30

(a) proteins / amino acids broken down;

deamination / ammonification / release of ammonium compounds; conversion to nitrates; by nitrifying bacteria / named bacterium; nitrates absorbed into roots;

5

(b) fewer nitrates in the soil for the next crop / plants grow less wellbecause of lack of nitrates; requiring application of more fertiliser / economic reason for using less fertiliser / valid environmental reason explained e.g. nitrates leaching into water / eutrophication / explanation / health related e.g drinking water;

2

(c) production of phospholipids;in cell membranes; synthesis of ATP; production of DNA; production of RNA; production of NADP;

4 max

[11] (a) (i) presence of grass causes less nutrients / minerals / nitrates /

31

ammonium ions to be leached;

(do not allow references to less nitrogen)

1

(ii) clover contains nitrogen-fixing bacteria;

(do not allow references to nitrifying bacteria)

decomposition (of ploughed clover) introduces nitrates / ammonium ions into soil;

2

(b) (i) minimal effect / no significant effect on yield / small increase up to 25 kg ha^{-1};
increase in protein content of grain with all fertiliser applications;

2

(ii) (37 ÷ 44 =) 0.84 : 1.0

(allow 0.8 : 1);

1 **[6]**

32

run off / leaching of nutrients / nitrates;

leads to increased growth of algae / plants; competition for light / effect of competition; death of algae / plants; increases food supply / increases microorganisms / decomposers; respiration (of microorganisms) uses up oxygen / increases BOD; fish / animals die due to lack of oxygen;

[5]