M1. (a) (i) **F**;

1

(ii) **B**;

1

(b) (i) Conversion of nitrate to nitrogen;
Use nitrate for respiration;

2

(ii) Denitrifying bacteria found in anaerobic conditions;
Sandy soils contain more oxygen;

Q *Accept converse argument for clay soils but answer must relate to denitrifying bacteria*

2

(c) (i) 253 (kg ha^{-1})

1

(ii) Suggests that less fertiliser might be applied/parts above ground not required could be ploughed in;

1

[8]

M2. (a) (i) nitrogen-fixing;

(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]

M3. (a) breakdown of organic matter/sewage by enzymes from bacteria;
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]

M4. (a) collect a sample (of insects in each area) and mark unobtrusively/in a way not harmful to insects;
release and allow time <u>to re-integrate</u> with rest of population/eq.;
collect second sample and count number marked;
number in population estimated by:

$$\frac{S1 \times S2}{\text{Number marked in } 2^{nd} \text{ sample}} \; / \; /$$

$$\frac{\text{Total marked}}{\text{Number marked in } 2^{nd} \text{ sample}} = \frac{\text{Population}}{\text{second sample}} ;$$

4

(b) (i) 1;

1

(ii) (p =) 0.05/ 5%;
(ignore 95%)

1

(iii) value for χ^2 exceeds critical value/ 125.8 > 10.8 ;
Results unlikely to be due to chance/ have a biological cause;
P < 0.1% / < 5% ;

2 max

(c) (i) biomass respired/ GPP – respiration = NPP;
biomass lost as CO_2;

2

(ii) more food for insects;

1

(iii) decomposers/ saprotrophs;
release enzymes and digest detritus/
substances found in detritus/ eq.;
absorb products of digestion/ suitable e.g. that relates to
candidates 2nd point;
respired and CO_2 released;
used by plants in photosynthesis/ enters leaves;

4 max

[15]

M5. Quality of Communication

The answers to all sections of this question require the use of continuous prose. Quality of language should be considered in crediting points in the scheme. In order to gain credit, answers should be expressed logically and unambiguously, using scientific terminology where appropriate.

(a) (Decomposers): Secretaion/release of enzymes; *[REJECT 'excrete]*

Digest/hydrolyse organic matter;
Absorption /'taken in' – by named process
e.g. diffusion/active transport; *(ALLOW 'endocytosis)*
Respiration
Release carbon dioxide;
Carbon dioxide used in photosynthesis;
Release ammonia/ammonium salts/ions/mineral salts / nutrients;
(ALLOW named small organic molecules)

(Nitrifying bacteria): Ammonia/ammonium to nitrate; / Nitrate to nitrate;] OR ammonia → nitrate = 1mk
Aerobic/use of oxygen/by oxidation;
[ALLOW correct symbols]

Nitrates/nitrites/ammonium used in synthesis of amino acids/protein
/nucleic acids/other correct organic –N;

max 7

(b) (Increase in carbon dioxide because) –

Burning releases carbon dioxide; *[IGNORE ref. to felling]*
Less carbon dioxide removed by trees/less removed in photosynthesis;

2

(c)
1. Cleared areas light/tree seeds germinate/grow in light;
2. Light for photosynthesis;
3. Softwoods compete for light;
4. Hardwoods can grow in low light;
5. Additional seeds from close/adjacent areas;
6. Less water evaporation (from hardwood seedlings) /maintains humididy
7. Less extremes of temperature; /maintains microclimate;
8. (canopy) reduces impact of rainfall (on hardwood seedlings)/ref. 'torrential;
9. roots stabilise soil / less soil erosion (by rainfall);
10. less leaching (of ions)(by rainfall);
11. litter fall → recycling of ions (for hardwood seedlings);
12. (Trees) provide food for animals;
13. (Trees) provide habitats/niches/cover/shelter/nest sites for animals;
14. Correct ref to succession / climax established;

max 6

[15]

M6. (a) 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

(b) leads to soil erosion;
increase in run off carries more fertilisers;
soil (+ fertilisers) blown into lake;
fewer nutrients taken up by the hedges;

2 max

[7]

M7. (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]

M8. (a) No - very little increase / no increase in yield of grass when *Rhizobium* 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]

M9. (i) excessive use of fertilisers;
run-off /leaching;

2 max

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

5 max

[7]

M10. (a) eggs / larvae /weeds left in soil;
lots of / plentiful supply of the same food source for pest;
rapid growth/reproduction of pest/more pests;
need to re-apply pesticides/use different pesticides / resistance to pesticides;
hence lower yield / more of crop affected;

3 max

(b) (i) resistant allele is recessive;
parents must both be heterozygous/carriers;
produce an offspring which is homozygous recessive;

(accept these points if clearly shown in a genetic diagram)

(accept mutation causes resistance to become dominant (in the gamete) for 1 mark)

3

(ii) bioaccumulation/biomagnification;
higher dose to have the same effect / develop tolerance;
kill natural enemies/predators of pest;
kill (beneficial) organisms (not a predator) / named;
hazard to user / enters water/food chain;
residue left on crop;

2 max

[8]

M11. (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 /light-dependent reaction;

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

3. (In dark) plants (and other organisms) respire;

Must be a reference to plants or all organisms

4. In light net uptake of carbon dioxide by plants/plants use more carbon dioxide than 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 photosynthesising tissue/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

(c) 1. Mcroorganisms are saprobionts/saprophytes;

Accept saprophytes although not strictly correct.

2. Secrete enzymes (onto dead tissue)/extracellular digestion;

3. Absorb products of digestion/smaller molecules/named relevant substance;

Accept: description of absorption

4. Respiration (by microorganisms) produces carbon dioxide;

5. Carbon dioxide taken into leaves;

6. Through stomata;

5 max

[15]

M12. (a) deforestation removes many habitats/niches
fewer species/ fewer types of organisms;

(do not credit just fewer organisms);

2

(b) 1. ammonium nitrate contains more nitrogen per molecule than potassium nitrate;
2. nitrate ions in fertiliser available/ absorbed immediately;
3. ammonium converted to nitrate;
4. by nitrifying bacteria/Nitrosomonas and Nitrobacter;
5. fertiliser would provide only the initial release of nitrate/ potassium nitrate;

3 max

[5]

M13. (a) more proteins/amino acids;
more DNA/nucleotides/nucleotide derivative;
increased cell division/number of cells formed;

2 max

(b) reduced light/shading;
less photosynthesis;

2

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

6 max

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

2

[12]

M14. (a) greenflies take in (small mass of) insecticide from roses/leaves;
ladybirds eat large numbers of/more/many greenflies;
bioaccumulation idea / insecticide cannot be excreted/remains in body/stored in fat/not broken down;

3

(b) (i) chemical: numbers fluctuate throughout year;
biological: numbers fairly constant throughout year /
accurate description;

2

(ii) number of plants drops because of spraying/reapplication, then rises because insecticide washed away/new plants grow;

1

(c) (i) chemical: some plants/parts of plants are not sprayed / spray washes off before it has effect;
plant may be resistant to spray;
(Reject 'immune')

2

(ii) biological: because biological control never eats all plants;
as weeds diminish so do control agents and/or *vice versa* /
is balance between food and consumer;

2

[10]

M15. (a) (i) **P** = 3;
Q = acetylcoenzyme A;

2

(ii) 36 ATP, however derived = 2 marks
30 ATP, however derived = 1 mark

2

(iii) *Correct statement in the context of aerobic respiration or anaerobic respiration concerning*:
Oxygen as terminal hydrogen/electron acceptor;
Operation of electron transport chain/ oxidative phosphorylation;
Fate of pyruvate;
Krebs cycle;
Significance of ATP formed in glycolysis;

max. 3

(b) (i) Thick walls exclude oxygen;
Produced by photosynthetic cells (of fern and *Anabaena*);
Contain no chlorophyll so do not photosynthesise;
Do not produce oxygen;
Oxygen would inhibit nitrogen fixation process;

max. 3

(ii) Decomposers/ bacteria/fungi/saprobionts (in fields);

Convert protein/organic nitrogen (in cells of fern) into ammonium ions (*allow ammonia*);
Ammonium ions (ammonia) converted to nitrite;
Nitrite converted to nitrate;

Allow 1 mark for $NH_3/NH_4^+ \rightarrow NO3_3^-$

By nitrifying bacteria / correctly named;
Nitrate used to form protein / amino acids in rice;
Link between application of fern and protein/cells of rice;
Decomposers respire (suitable substrate) and release CO_2;

Used in photosynthesis by rice;

max. 5

[15]

M16. (a) Complementary to/fits/binds to <u>active site</u>;

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 day8/9;

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]

M17. (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 concentration increases;

Clearing

2. No/Less vegetation so no/less photosynthesis / photosynthetic organisms;

3. No/Less carbon dioxide removed (from the atmosphere);

Burning

4. Burning/combustion releases / produces carbon dioxide;

Ignore correct references to respiration or animals

For mark points 2 and 3 idea of 'no/less' must be stated not just implied.

3. Must not include 'by respiration'

4. Do not credit references to burning fossil fuels. Only give credit for combustion increases carbon dioxide if mark point 1 has not been given.

4

(c) 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 organic substances/ribulose bisphosphate;

7. In light independent reaction/Calvin cycle;

3. Accept add hydrogen for reduced

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

6 max

[15]

M18. (a) Ammonia/ammonium/NH_3/NH_4^+;

1

(b) Will have similar shape/tertiary structure (as substrate)/complementary shape (to active 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]