

- 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<sup>-1</sup>) 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 photosynthesis;  
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 to re-integrate with rest of population/eq.;  
collect second sample and count number marked;  
number in population estimated by:

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

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

4



(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 humidity
  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 if no *Rhizobium*;
- 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. more 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. Microorganisms 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 saprobially;  
2 bacteria/fungi/microorganisms 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  $NH_3/NH_4^+ \rightarrow NO_3^-$*   
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 active site;

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 day 8/9; 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 biphosphate/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 biphosphate;  
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/ $\text{NH}_3/\text{NH}_4^+$ ;

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/more 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]

