

1. (a) Organic compounds of nitrogen / named example;
 converted to ammonium compounds / ammonia;
 by saprophytes / saprobionts / decomposers / equivalent;
 to nitrites;
 to nitrates;
 by nitrifying bacteria / named bacteria;
 uptake by roots; max 6
- (b) (i) Nitrogen fixing bacteria / named e.g.;
 in root nodules (of legumes);
 convert nitrogen to ammonium / organic compounds (in legume);
 released on decomposition;
 and converted to nitrates; less need for fertiliser; max 4
- (ii) Shorter food chain / less trophic levels;
 will produce a greater yield of fish;
 less energy lost between stages / more energy from producers;
 (energy loss) in respiration / as heat;
 fish prevent algal blooms / equivalent; max 3
- [13]**
2. (a) Release ammonia / ammonium / ammonification;
BY Decomposers / putrefying / saprotrophic / ammonifying bacteria;
 ammonia → nitrite → nitrate / nitrification;
BY nitrifying bacteria / named bacteria; max. 3
- (b) (Interspecific) competition;
 for nitrates / nitrites / ammonia / ammonium compounds; 2
- [5]**
- [Process is stand alone - bacteria only credited if in correct context.]
3. (a) Mark for principle of placing quadrats at random;
 marks for detail -
 (method of) marking area out with grid/using tapes;
 acceptable *method* of generating random numbers; e.g.
 table/calculator; 3
- (b) Any one correct change;
 reason for diversity level;
 explanation of how heather affects diversity; 3

- (c) (i) Award two marks for $0.5 \text{ g m}^{-2} \text{ yr}^{-1}$;;
award one mark for answer without units
or 2.4 – 2.5 %; 2
- (ii) Used for non photosynthesising/supporting organs;
eaten by grouse; 2
- (iii) Younger plants have more shoots/provide more food;
Younger plants provide more cover;
Getting rid of old (unproductive) plants; max. 2
- (d) (i) proteins/nucleic acids/amino acids/ATP/nucleotides;
- (ii) ammonium/nitrate/nitrite;
- NH_4^+ NO_3^- NO_2^- [Formula must correspond if given] 1
- (e) Organic material/proteins to ammonia/ammonium compounds; 1
by saprobiotic/putrefying bacteria;
ammonia to nitrite;
nitrite to nitrate;
by nitrifying bacteria/named bacteria; max. 4
- (f) In older stands, greater proportion of/more nitrogen in plants;
more lost when burnt: 2

[20]

4. (a) One mark for each correct column 2

	Animalia/animal
	Annelida/annelid
Class	
Order	
Family;	
	Lumbricus
	(L.) terrestris;

- (b) (i) Enzymes are proteins;
large molecules so not reabsorbed;
are not used up in reactions (which they catalyse);
enzymes are not themselves digested; max. 2

- (ii) Add starch to worm casts;
test for reducing sugars with Benedict's / test for disappearance
of starch with iodine;
need for control with boiled worm casts / soil; 3
- (c) Fungicide also killing earthworms;
earthworms break leaves down into smaller pieces;
making more surface for microbial action;
OR
soil fungi / fungal decomposers killed;
less decomposition of leaves; max 2
- (d) (i) Nitrogen as inorganic ions/nitrate/ammonia / nitrite; 1
(ii) Nitrogen in waste products of metabolism/urea/uric acid /ammonia;
(ignore references to egestion) 1
- (e) (i) Any **TWO** from:
Protein/amino acid/nucleic acid/ATP / urea; 1
(ii) Decomposers/saprophytic/putrifying bacteria release ammonia;
ammonia → (nitrite) → nitrate;
(named) nitrifying bacteria / nitrification; 3
- (f) (i) Reduces surface area minimising water loss; 1
(ii) Using food stores resulting in excretory nitrogen; 1
- (g) Addition of nitrogen;
from excretion / decay / enzymes;
removal of carbon;
when lost as carbon dioxide / during respiration; max. 3

[20]

5. (a) Energy losses due to radiation / evaporation / transpiration /
in photosynthesis / energy of wrong wavelength / some of
energy is heat;
Extras: cancel 1
- (b) 2920; 1

- (b) (Ammonium) → nitrite;
Nitrite → nitrate;

OR

Ammonium → nitrate; (1 mark only)

If symbols: correct symbols

e.g. ammonium (nitrate (NO_3) = NO MARKS

By nitrifying bacteria / *Nitrosomonas* / *Nitrobacter* / nitrification;

By oxidation / using oxygen / aerobic;

3 max

[5]

6. *Quality of language*

The answer to this question requires continuous prose. Quality of language should be considered in crediting points in the mark scheme. In order to gain credit, answers must be expressed logically in clear scientific terms.

- (a) *Any three from:*

Loss of habitat / nest sites / shelter / niche; ignore 'homes'

Loss of food;

Exposure of soil leads to erosion / leaching of ions;

Change in (micro)climate / levels of light / temperature / humidity;

Animals move away / higher death rate / extinction;

3 max

- (b) *Any three from:*

Absorb carbon dioxide; (*extra carbon-sources CANCEL*)

In photosynthesis;

Carbon (dioxide) is used in forming permanent plant tissues / biomass / plant structures;

Carbon is incorporated in organic molecules / named e.g.;

3 max

- (c) (i) *Any four from:*

Less oxygen can enter the soil (from the air);

For saprobionts / soil microorganisms / bacteria / fungi / decomposers / correctly named soil organisms;

For use in aerobic respiration;

Less breakdown of organic matter / humus / dead plants / dead animals / other e.g.;

Less carbon dioxide released / formed;

4 max

(ii) Any five from:

Oxygen enters the soil / use of oxygen;

Nitrifying bacteria are aerobic;

Ammonia / ammonium ions → nitrite;

Nitrite → nitrate;

(Ammonia → nitrate = 1 mark)

(If formulae used, worth 1 mark only if correct)

Nitrate is absorbed / used by plants;

To make named organic-N – e.g. protein / amino acids / DNA /

ATP / NAD(P) / chlorophyll;

Increased yield / growth;

5 max

[15]

7. (a) ‘Slash’ / cutting down trees reduces photosynthesis;
Reduces removal of carbon dioxide from atmosphere;

‘Burn’ combustion releases carbon dioxide;

OR ‘Slash’ cutting down trees removes respiring organisms;

Reduces removal of carbon dioxide into atmosphere;

‘Burn’ / combustion releases carbon dioxide;

max 2

(b) (Before clearing) soil exists / already produced;

(After clearing) recolonisation by new plants / seeds;

(Brings about) change in environment / soil;

(Allows) succession;

(Leading to) climax (community);

max 3

(c) 1 Ammonium compounds from proteins / amino acids urea / N-containing;

2 Converted into nitrite;

3 Into nitrate; [*Reject: Incorrect sequence once*]

4 By nitrifying bacteria / correctly named;

5 Nitrogen-fixing bacteria;

6 Fix nitrogen from atmosphere / air;

7 Nitrate taken up by plants;

8 Nitrogen needed for protein synthesis / plant growth;

max 6

- (d) Trees available as a sustainable resource;
 Maintain habitats / niches / shelter;
 Maintain diversity / avoid loss of species / protect endangered species.
 Maintain stability (of ecosystem);
 Maintain food chains / webs / supply of food;
 Reduced loss of soil / erosion;
 Reduced flooding;
 Act as carbon sink / maintain O_2 and CO_2 balance reduce greenhouse effect
 Reduce global warming;
 Source of medicines;
[Ignore: eutrophication]

max 4

[15]

8. (a) (i) CO_2 combines with RuBP/with ribulose bisphosphate;
 (Product) splits in two/production of two molecules of GP/use
 of RubisCo; 2
- (ii) Amount formed = amount broken down/used/reference to Equilibrium; 1
- (b) Any three from:
 No ATP made (in dark);
 No reduced NADP / NADPH (in dark); [*Note: NOT "NADH"*]
 GP not converted (in dark);
 TP not formed (in dark); max 3
- (c) (i) During day/light photosynthesis occurs;
 (Photosynthesis) uses/takes in CO_2 ;
[Accept: converse explanation during darkness] 2
- (ii) Higher;
 Less light/cooler/fewer leaves/ CO_2 formed from soil organisms/decay
 in soil/respiration in soil; 2
- (d) Wind mixes air (with surrounding air)/removes CO_2 /supplies CO_2 ;
 Introduces another variable/makes data unreliable/takes account of wind; 2
- (e) Any three from:
 Detritivores/worms/woodlice/other e.g./decomposers/microorganisms/
 bacteria/fungi;
 Digestion/hydrolysis (of organic matter/of leaves)/decay/decomposition/
 rotting;
 Respiration;
 Releases CO_2 ; max3

[15]

9. (a) (i) **Any four from:**
- 1 Several/> 1 traps in each of the two habitats;
 - 2 Place traps at random;
 - 3 Details of method of achieving random layout/random coordinates generated e.g. tables/calculators; [Reject: "throwing"]
 - 4 Named factor held constant – e.g. same size traps/same length of time/same time of day;
 - 5 Count number of insects of each kind/type/species/count number of kinds/ types/species present;
 - 6 Calculate index of diversity (for forest and for field);
e.g. $d = \frac{N(N-1)}{\sum n(n-1)}$ = 1 mk + key to symbols = 2 mks max 4
- (ii) **Any four from:**
- In forest: Greater diversity of insects;
Greater number of plant species/higher diversity of plants;
Greater number/variety of (ecological) niches/habitats;
Greater variety of food;
Less competition for resources/more food available;
Less harsh environment (abiotic) in forest; max 4
- [Accept: converse for cultivated field]
- (b) (i) **Any two from:**
- Harvesting/crops are removed;
Less material available for decomposition;
Nitrates/ammonium/soluble compounds/ions leached;
Low initial N-content due to burning; max 2
- (ii) **Any five from:**
- 1 Nitrogen (gas) converted to NO_x/nitrates;
 - 2 By lightning/atmospheric nitrogen fixation;
 - 3 Nitrogen (gas) converted to ammonia/ammonium compounds/amino acids;
 - 4 By nitrogen-fixing bacteria;
 - 5 Organic material/leaves from plants (fall onto soil)/animal droppings/dead animals;
 - 6 Broken down by saprotrophs/decomposition;
 - 7 Release of ammonia/ammonium ions (from organic matter/from decay);
 - 8 Ammonia/ammonium converted to nitrite;
 - 9 Nitrite converted to nitrate;
- [Accept: Ammonium → nitrate for 1 mark]
- 10 By nitrifying bacteria/correct named example; max 5
- [Note: Formulae, if used on their own, must be correct]

[15]

- (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]

12. (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]

13. (a) deforestation removes many habitats/niches
fewer species/ fewer types of organisms;
- 2

(do not credit just fewer organisms);

- (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]

14. (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:

$$\frac{S1 \times S2}{\text{Number marked in 2}^{\text{nd}} \text{ sample}} = \frac{\text{Total marked}}{\text{Number marked in 2}^{\text{nd}} \text{ sample}} = \frac{\text{Population}}{\text{second sample}} ; \quad 4$$

- (b) (i) 1; 1
 (ii) (p =) 0.05/ 5%; 1
(ignore 95%)
 (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 CO₂; 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 CO₂ released;
 used by plants in photosynthesis/ enters leaves; 4 max

[15]

15. (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 CO₂;
 Used in photosynthesis by rice; max. 5

[15]

16. (a) (i) pyramid correctly drawn and labelled;
ignore organic matter 1

(ii) energy lost/not transferred between trophic levels;
 in respiration /as heat / in excretory products / movement;
ignore in urea / in faeces. 'Growth' cancels 2nd marking point only 2

(b) (i) decomposers convert (nitrogen in organic compounds) into ammonia/ammonium;
 suitable example of "organic nitrogen" - protein/urea/amino acid etc. (e.g. linked to process);
 nitrifying bacteria / correctly named convert ammonium to nitrate; via nitrite; 3 max

(ii) convert nitrogen (gas) into ammonium / ammonia / amino acids;
 add usable/available nitrogen to an ecosystem / eq.; 2

- (c) (i) 1. numbers of dispersed bacteria increase as they feed on organic matter;
 2. numbers of free-swimming protoctistans increase because number of bacteria increase;
 3. dispersed bacteria decrease as amount of dispersed organic matter decreases / due to lack of food / as organic matter is converted to flocs;
 4. decrease as are preyed on by free-swimming protoctistans;
 5. decrease in free-swimming protoctistans due to lack of dispersed bacteria; 3 max
- (ii) 1. (in a succession) organisms (enter an area and) change the environment/conditions;
 2. creating new niches / habitats;
 3. allows different species / different types of organisms to enter / be successful;
 4. dispersed bacteria change dispersed organic matter to flocs;
 5. presence of flocs allows crawling protoctistans to enter / to increase / to be successful; 4 max

[15]

17. (a) (i) Amino acid / protein / DNA / ATP; 1
 (ii) Dead animal / dead plant ; 1
- (b) (i) Putrefying / saprobic / nitrifying bacteria / correct named bacteria; 1
 (ii) Denitrifying bacteria / correct named bacteria; 1
- (c) (Marks awarded for the two principles:
 Some inorganic nitrogen is lost (to leaching, atmosphere, clover)
 Some nitrogen in clover comes from fixation;
 this may be shown by the correct calculation -
 Inorganic nitrogen (514) - nitrogen lost via leaching (13) and to atmosphere (52)
 and to clover(110 - 96 = 14) / 514 - (13 + 52 + 14) / 514 - 79 = 435 kg/ha)
 435;
 (Correct working but incorrect answer or answer of 339 -1 mark) 2
- (d) Clover contain bacteria which can fix nitrogen;
 clover decays/ dies and adds nitrogen compounds to soil;
 no / less fertiliser needed; max. 2

[8]

18. (a) (i) 32.7; 1
 (ii) that all N not lost in urine and dung is converted into beef; 1

- (b) putrefying bacteria;
convert nitrogen compounds into ammonium ions;
nitrifying bacteria;
convert ammonium into nitrate; 4 [6]
19. (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; 3
(accept these points if clearly shown in a genetic diagram)
(accept mutation causes resistance to become dominant
(in the gamete) for 1 mark)
- (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]
20. (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]
21. (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; | 2 |
| | | <i>Q Accept converse argument for clay soils but answer must relate to denitrifying bacteria</i> | |
| (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]