

1. (a) (i) A – 4227;
B – 4665; 2
- (ii) mice from line A eat mainly food from grass borders /
mice from line B eat mainly wheat seeds; 1
- (b) only 2 mice from line A analysed after sowing / migration; 1
- (c) non-biodegradable;
concentrated to toxic levels in food chain; 2
- [6]**
2. (a) (i) mutualism is relationship where both organisms benefit;
Rhizobium gains ATP / organic compounds
named organic compound / photosynthetic product;
legume gains ammonia / ammonium; 3
- (ii) reaction requires large amounts of energy / 15 ATP;
obtained from respiration of products of photosynthesis; 2
- (b) saprophytic / putrefying (microorganisms) /
saprobiotic / ammonifiers / decomposers;
secrete enzymes which digest organic compounds;
releasing ammonia;
ammonia converted to nitrite;
then to nitrate;
processes are oxidation reactions;
by nitrifying bacteria / nitrification;
Allow credit for one correctly named example;
e.g. *Nitrosomas* / *Nitrobacter* in correct place max. 5
- [10]**
3. (a) Decomposers secrete enzymes / onto organic matter/ food/
extracellular breakdown;
Detritivores ingest / eat/ take in organic matter/food first; 2
- (b) Break down larger pieces of dead organic matter;
providing more surface for microbial activity;
Add products of excretion
More nutrients/nitrogen / higher nitrogen carbon ratio;
aeration by e.g. tunnelling;
increases oxygen content for respiration of microorganisms; max 4
- [6]**

4. (a) Identification of abiotic factor which would affect maize growth;
Method of measuring gives appropriate quantitative data/at intervals; 2
- (b) Reduce light;
Reduce water;
Reduce mineral ions;
Reduce wind;
Increase humidity;
Reduce temperature (by shading); max 2
- (c) Maize and beans have different niches / different nutritional requirements /
use different minerals;
Exploit environment more effectively;
As take water/mineral ions from different depths in soil; max 2
5. (a) Few planktonic organisms / algae (to intercept light);
Because few nutrients added; 2
- (b) (i) Mutualism / symbiosis; 1
(ii) Algae photosynthesise;
Take in carbon dioxide;
producing carbohydrates / named / carbohydrate which coral can utilise; 3
- (c) Increase in concentration of nitrates / phosphates;
From sewage / organic pollution / effluent (from increasing tourist industry);
Stimulation of seaweed / plant growth;
Seaweed covers coral preventing light reaching algae;
Seaweed prevents tentacles of coral setting up feeding current;
Increased number of (planktonic) algae (increases cloudiness);
Less light able to penetrate to algae in coral; max 6
6. (a) Leaching/washed out (by rain) and denitrification/conversion to nitrogen; 1
- (b) Some nitrates lost from soil;
Milk contains some nitrogen/protein;
Milk is being removed/nitrogen in milk not allowed to recycle; 2

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- (c) Saprophytic bacteria
Nitrogen in urine and faeces
- Nitrifying bacteria/named bacteria;
→ Ammonia (→Nitrite) → Nitrate;
- 2
- [5]
7. (a) (i) Fall in spring, rise in autumn/winter, or
High conc. in winter, low in spring / summer.
(Refs to timing should be accurate)
- 1
- (ii) Fertiliser run-off;
Nitrification/breakdown of dead organic matter;
Sewage effluent;
Nitrogen fixation.
- max2
- (b) (i) Absorption / uptake by algae (*not*: 'used' or 'used in growth');
Use in protein / amino acid synthesis.
- 2
- (ii) Breakdown to nitrogen;
by denitrifying bacteria / named example, e.g. *Pseudomonas*.
- 2
- [7]
8. (a) Phospholipid;
Part of cell membrane;
or
ATP/ADP;
ATP as source of energy for specific process;
ADP needed to produce ATP/needed in specific process;
or
Nucleic acids/DNA/RNA;
Carry genetic information/involved in protein synthesis;
- max 4
- Other valid examples may be accepted. Mark according to principles illustrated above.*
- (b) (i) Both rise to a peak then fall;
Peak is earlier in plants;
Fall in plants due to death of tissue/consumption by herbivores/dilution with non-radioactive phosphorus/rise in herbivores as they eat plants:
Fall in herbivores as they are eaten by carnivores:
Herbivore peaks later as takes time to pass through plants first;
- max 4
- (ii) Decompose organic compounds/phosphorus containing compounds/
Release phosphates;
- 1

- (c) Form carbohydrates/sugars by photosynthesis;
Carbohydrate is respired;
Carbon dioxide is lost;
Some will form cellulose;
Is not digested/lost in faeces; max 3 [12]
9. (a) (i) Beechwood = 73.3% / 73%, Hedge = 34.7% / 35%;
(*Rounding to significant figures must be correct, e.g. not 34%*) 1
- (ii) To compare different numbers collected from the two sites;
and show whether differences significant/ not just due to chance /
to confirm or reject null hypothesis; 2
- (b) Random / not biased to one colour; 1
- (c) Predators find brown snails more easily in hedge than in beechwood; 1
- (d) Detritivores break leaves into small pieces / increase surface area;
Deposit faeces;
Increases rate of microbial action;
Bacterial fungi decompose / break down leaves or organic matter;
Secretion of enzymes for digestion;
Absorption of sugars;
Respiration by detritivores/ microorganisms;
Release of carbon dioxide;
Carbon dioxide used in photosynthesis; max 7 [12]
10. (a) (i) named factor and it action;
(rain water/erosion washes ions from rocks, temperature increases
solubility, oxidation forms salts) 1
- (ii) (larger detritivores/named example) break up larger pieces (by feeding);
excrete nitrogenous wastes/faeces/droppings;
increases surface area available to bacteria/microorganisms/
fungi/decomposers;
decomposition by microorganisms releases minerals/nutrients to soil; any 3

- (b) (i) grasses able to grow faster/more/better outcompete flowering plants in higher nutrient supply;
(higher nutrient) reduces diversity; 2
- (ii) reduced level of minerals/nutrients enables flowering plants to compete more effectively for nitrate/phosphate/ nutrient; 1
- [7]**
- 11.** (a) (i) conversion of ammonium or ammonia into nitrite/
ammonium or ammonia into nitrate/nitrite to nitrate 1
- (ii) conversion of organic nitrogen/nitrate into nitrogen 1
- (b) nitrate limiting factor for plant growth;
increased growth of plants/algae/protoctists;
nitrate needed by plants for protein synthesis;
competition for light/effect of competition (*e.g. plants underneath die*);
plants die, providing food supply for microorganisms/number of
microbes increases;
use of oxygen for respiration of microorganisms 5 max
- [7]**
- 12.** (a) (i) Conversion of nitrates/any nitrogen compound to nitrogen (gas);
by (denitrifying) bacteria; 2
- (ii) bisects contain proteins;
Digested to amino acids;
which can be absorbed/diffuse into leaf 2 max
- (b) High proportion of carbohydrate/starch in plant tissues;
Cellulose (in cell walls);
More protein in animal cells (such as muscle); 2 max
- (c) Proteins/amino acids broken down;
by saprophytes/decomposers;
deamination/ammonium compounds/ammonia formed;
Ammonia converted to nitrate;
by nitrifying bacteria;
Nitrite as intermediate;
Nitrate can be absorbed by roots; 6 max
- [12]**

13. (a) secrete/release enzymes/extracellular digestion;
starch is digested first and cellulose, lignin later / starch is 'easier' to digest;
different enzymes secreted / different fungi present; 3
- (b) starch/cellulose broken down;
maltose/glucose produced/source of glucose; 2
- (c) (carbon dioxide) enters/diffuses into plant leaves/ via stomata;
photosynthesis/fixes;
glucose produced;
sucrose;
actively loaded;
into phloem/ translocated/mass flow;
starch produced; 4 max
- (d) some decomposers have enzymes with low optimum pH;
caused by mutation;
survive (in peat bogs) to reproduce;
pass on favourable alleles; 3 max
14. (a) (*max 2 marks for each consequence of shortage and its effect on growth*)
reduced/lack of/unable to synthesise protein/amino acids; }
lack of enzymes for metabolism / named metabolic process; }
reduced/lack of/unable to synthesise DNA/nucleic acids/organic bases; }
mitosis/cell division reduced; }
reduced NADP/ less chlorophyll; }
reduced photosynthesis; }
reduced levels / less NAD; }
reduced respiration; } 4 max
- (b) (i) water potential of soil reduced/more negative/
reduced water potential gradient;
less water moves into roots/water moves out of roots by osmosis; 2
- (ii) nitrate washed/runs off /leached from fields;
algal bloom / increase in algal growth;
reduced light to other producers;
death of algae/producers;
increase in decomposers/decomposition;
aerobic respiration/requirement O₂ / increased BOD; 5 max

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- (c) uptake by active transport;
oxidative phosphorylation/electron transport chain stops/slows down /
glycolysis only occurs;
Krebs cycle provides reduced NAD/FAD produces ATP;
less ATP; 3 max
- [14]**
QWC 1
15. (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]**
16. (a) secondary consumer / trophic level 3;
second species to peak / in which phosphorus appears; 2
- (b) energy is lost at each level (so not enough left); 1
- (c) ATP;
DNA;
RNA / tRNA / mRNA;
nucleotides (*accept only if DNA/RNA not mentioned*);
phospholipids;
NADP;
RuBP; 2 max
- [5]**
17. hydrolysis/breakdown/digestion of carbon compounds;
respiration (by bacteria);
releasing carbon dioxide;
taken up by the plant during photosynthesis; 3 max
- [3]**
18. (a) (i) ammonia/ammonium ions/compound; 1

- (ii) glucose; 1
- (b) final acceptor for hydrogen;
to form water; 2
- (c) glycolysis;
can continue;
NAD can accept more hydrogen; 2 max
- (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 enzyme
at 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
- 19.** (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

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[12]

20. (a) (i) nitrogen-fixing;
(ii) nitrifying; 2
(names neutral, name only no mark)
- (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; 2
decomposed to release nitrates/ammonia/nitrites;
- (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
21. (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

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[8]