A-Level Biology

Nutrient Cycles

Mark Scheme

Time available: 68 minutes
Marks available: 48 marks

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1.

(a) 1. (They use enzymes to) decompose proteins/DNA/RNA/urea;

Accept any named molecule containing nitrogen eg enzymes, NAD, ATP, amino acids

Accept digest/breakdown/hydrolyse for decompose

Ignore 'nitrogen -containing compounds' unqualified

2. Producing/releasing ammonia/ammonium compounds/ammonium ions;

Accept (they) perform ammonification

Accept named ammonium compound

2

(b)

Principle is

1. *Named apparatus*
2. *What is measured*
3. *Standardisation of method*

Accept **any** valid method, for example

1. Use of colorimeter;

Reject calorimeter

2. Measure the absorbance/transmission (of light);

Reject if samples are filtered unless filtering to remove debris

Accept descriptions

3. Example of how method can be standardised eg same volume of water, zeroing colorimeter, same wavelength of light, shaking the sample;

Ignore references to calibration curves

3

[5]

2.

(a) 1. (µg because) very little ammonia (in soil);

2. (µg because) avoids use of (lots of) decimal places (in their results) / avoids the use of powers of 10 / avoids the use of standard form;

Accept makes numbers more manageable

Accept makes easier to plot graph

3. (g^{-1}) to allow comparisons (between samples);

2 max

(b) Answer between 4.5 and 4.6 µg g^{-1} day^{-1};;

Award 1 mark for correct number but wrong / no units

Ignore plus or minus signs

Accept 'per gram' ***AND / OR*** *'per day'*

2

(c) 1. pH 4.3 / B has fastest rate of breakdown (of ammonia);

2. A + B / mixture at pH 6.9 slowest / slower (than A or B);

Not just ref. to A and then B on their own

3. Suggests (community / bacteria at) pH 4.3 / B doesn't work (well) at pH 6.9 / pH of mixture;

Accept converse that only (community / bacteria at) pH 6.9 / A is working in the mixture

3

(d) (Species **S** because) no mark

1. Species **S** change of 990,000 (per gram of soil);

Award MP1 and 2 OR MP3 and 4

Accept standard forms 9.9×10^5 and 9.9×10^3 for either

Accept for 1 mark for 100 times greater in correct context with no other calculations shown

2. Species **T** change of 9,900 (per gram of soil);

Accept standard forms 9.9×10^5 and 9.9×10^3 for either

OR

(Species **T** because) no mark

3. Species **S** has 99% change;

4. Species **T** has 9900% change;

2

(e) 1. They didn't count bacteria / cells / population(s);

Ignore ref. to other factors / other named factors affecting growth

2. Copies / number of mRNA related to amount of enzyme / amoA produced / translated;

3. Don't know how much mRNA / amoA produced by each cell;

Accept some bacteria produce more mRNA / amoA than others

4. Don't know if amoA (mRNA / enzyme) is linked to cell division / growth (of population);

Amount of amoA does not show cell division / growth

Reject references to mitosis / meiosis

4

(f) 1. Suitable method;
eg in boiling water / steam / autoclave / wash in disinfectant / wash in alcohol

Ignore heat unqualified

Ignore flaming of bottle

Accept radiation

2. (Reason) to remove / kill other bacteria / organisms that might break down ammonia;

Ignore ref to removing bacteria that 'affect the result'

Accept other bacteria producing amoA

Accept other bacteria compete with / kill bacteria that produce amoA

Ignore contamination unqualified

2

[15]

3.

(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]

4.

(a) (i) 1. Amino acid / protein / enzyme / urea / nucleic acid / 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. nitrogen-fixing 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]

5.

(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 being converted to nitrite, nitrate etc

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

2. Do not disqualify mark for any references to protein being formed from 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]