Mark schemes

Q1.

(a) 1. Low respiration;

Accept less energy lost in respiration

2. More growth/biomass/colonisation;

Allow examples of more carbon-containing molecules eg glucose

2

(b) 1. Less nitrification

OR

Fewer/less active nitrifying bacteria;

OR

Nitrification/nitrifying bacteria require oxygen/aerobic conditions;

2. (Less) oxidation/conversion of ammonium (ions) to nitrite (ions) and to nitrate (ions);

Order must be nitrite then nitrate

Accept ammonia for ammonium ions

Accept correct chemical formulae for ions, eg there will be little oxidation/conversion of $NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$

Ignore 'breakdown' for oxidation/conversion

3. More denitrification

OR

More/more active denitrifying bacteria

OR

Denitrification/denitrifying bacteria do not require oxygen

OR

Denitrification/denitrifying bacteria require anaerobic conditions;

4. (So more) nitrate (ions) reduced/converted to nitrogen (gas);

Accept correct chemical formulae eg So more NO_3^- *reduced/converted to* N_2*;*

2 max

(c) 1. Assumed that height is (directly) proportional to biomass;

Accept descriptions of 'is proportional to', eg

correlates to, is equivalent to

2. (Plants may put biomass into) other named aspect of growth (other than height)

OR

Height does not include the roots

OR

Some increase in height results from water gain;

Examples of other named aspects of growth could include root growth, flower/seed/fruit formation, lateral growth, wider leaves

2

(d) 1. Answer of 12 days = **2 marks**;;

2. 12.16 (12.15774433) **= 1 mark**

OR

4 days (used 387 and 268, ie not calculated starting length) **= 1 mark;**

2

[8]

Q2.

(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]

Q3.

(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]

Q4.

(a) Two suitable examples;
Examples
1. amino acid / protein / polypeptide / peptide;
2. nucleic acid / nucleotide / base;
3. DNA;
4. RNA;

5. ATP / ADP;
6. NAD / NADP (reduced or not);
7. Cyclic AMP / cAMP;
8. Chlorophyll;

List rule applies

Reject for either point nitrates / nitrites / ammonia / ammonium / urea

4. Accept pre-mRNA / mRNA / rRNA / tRNA

2 max

(b) Correct answer in the range 90 to 133.2 scores 2 marks;
1 mark for answers where yield calculated correctly for 1970 **OR** 2005;
(1970 in range) 170.8 to 176.4
OR
(2005 in range) 266.4 to 304.0;

Accept positive or negative values

2

(c) 1. Using more but getting less response over time;
2. The graph shows correlation but doesn't prove changes in yield due to fertiliser / but there could be other factors;
3. Becomes less cost effective with time;

Idea of over time is important

1. accept fertiliser becomes less effective over time

1. Accept use of figures from graph

1. Accept the idea of less grain / crop over time

2. Ignore whether correlation is positive or negative

2 max

[6]

Q5.

(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]