M1.(a) (i) Unit of energy / mass, per area, per year.

1

(ii) 1. Less light / more shading / more competition for light;
Neutral: references to animals

2. Reduced photosynthesis.
Accept: no photosynthesis

2

(b) 1. Pioneer species;
2. Change in abiotic conditions / less hostile / more habitats / niches;
Accept: named abiotic change or example of change e.g. formation of soil / humus / organic matter / increase in nutrients
Neutral: reference to change in environment unqualified
Neutral: more hospitable / habitable / homes / shelters

3. Increase in number / amount / diversity of species / plants / animals.
Accept: other / new species (colonise)

3

(c) 1. Net productivity = gross productivity minus respiratory loss;
2. Decrease in gross productivity / photosynthesis / increase in respiration.

2

(d) 1. Conserving / protecting habitats / niches;
2. Conserving / protecting (endangered) species / maintains / increases (bio) diversity;
3. Reduces global warming / greenhouse effect / climate change / remove / take up carbon dioxide;
4. Source of medicines / chemicals / wood;
5. Reduces erosion / eutrophication.
Accept: tourism / aesthetics / named recreational activity

1 max

[9]

M2.(a) 1. Oxygen produced in light-dependent reaction;
2. The faster (oxygen) is produced, the faster the light-dependent reaction.

2

(b) 35–36 µmol Oxygen per mg chlorophyll.

Correct difference at 500 µmol photons m^{-2} s^{-1} or incorrect difference but division by 4 shown = 1 mark.

2

(c) At all light intensities, chloroplasts from mutant plants:
1. Have faster production of ATP and reduced NADP;
2. (So) have faster / more light-independent reaction;
3. (So) produce more sugars that can be used in respiration;
4. (So) have more energy for growth;
5. Have faster / more synthesis of new organic materials.

Accept converse points if clear answer relates to non-mutant plants

4 max

[8]

M3.(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]

M4.(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]

M5.1. Growth of algae / surface plants / algal bloom blocks light;

2. Reduced / no photosynthesis so (submerged) plants die;

3. Saprobiotic (microorganisms / bacteria);

3. Accept: Saprobiont / saprophyte / saprotroph

3. Neutral: decomposer

4. Aerobically respire / use oxygen in respiration;

5. Less oxygen for fish to respire / aerobic organisms die;

[5]