

- 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  $\mu\text{mol}$  Oxygen per mg chlorophyll.  
*Correct difference at 500  $\mu\text{mol photons m}^{-2} \text{s}^{-1}$  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]