

## Mark schemes

- 1** (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
- 2** (a) Oxygen production / concentration and time.  
*Accept: oxygen volume / concentration*  
*Reject: oxygen uptake*  
*Neutral: reference to carbon dioxide uptake* 1
- (b) 1. Intensity of light;  
*Accept: distance from light*
2. Amount / number / mass / species of algae / photosynthesising cells;
3. Carbon dioxide (concentration / partial pressure);
4. Time. 2 max

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- (c) 1. (pH) increases;  
*Neutral: becomes more alkaline / less acidic*
2. As (more) carbon dioxide removed (for photosynthesis). 2

- (d) 1. Less absorption / (more) reflection (of these wavelengths of light);  
*Reject: no absorption or cannot absorb unless in context of green light.*  
*Note: no green light absorbed or green light reflected = 2 marks.*
2. (Light required) for light dependent (reaction) / photolysis  
*Accept: for excitation / removal of electrons (from chlorophyll)*
3. (Represents) green light / colour of chlorophyll. 2 max

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- (a) 1. Oxidation of / hydrogen removed from pyruvate and carbon dioxide released;
2. Addition of coenzyme A.  
*Accept: NAD reduced for oxidation*

2

- (b) (i) 1. Change (in shape) of active site / active site moulds around the substrate;  
*Reject: reference to inhibitor*  
*Accept: change in tertiary structure affecting active site*
2. (Substrate / active site) now complementary.  
*Neutral: references to two active sites*

2

- (ii) 1. Is a competitive inhibitor / attaches to active site;  
*Neutral: reference to inhibitor forming an enzyme-substrate complex*
2. Reduces / prevents enzyme-substrate / E-S complex forming.  
*Accept: Reduces / prevents acetylcoenzyme A binding to enzyme / citrate synthase*

2

- (c) (i) 1. Regenerates / produces NAD / oxidises reduced NAD;
2. (NAD used) in glycolysis.  
*Accept: description of glycolysis*  
*Accept: glycolysis can continue / begin*

2

- (ii) (Pyruvate used) in aerobic respiration / (lactate / lactic acid) is toxic / harmful / causes cramp / (muscle) fatigue.

*Accept: (pyruvate) can enter link reaction*

*Accept: reduces cramp / (muscle) fatigue*

*Neutral: 'reduces muscle aches'*

1

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4

- (a) 1. Geographic(al) isolation;
2. Separate gene pools / no interbreeding / gene flow (between populations);  
*Accept: reproductive isolation*  
*This mark should only be awarded in context of during the process of speciation. Do not credit if context is after speciation has occurred.*
3. Variation due to mutation;
4. Different selection pressures / different abiotic / biotic conditions / environments / habitats;  
*Neutral: different conditions / climates if not qualified*  
*Accept: named abiotic / biotic conditions*
5. Different(ial) reproductive success / selected organisms (survive and) reproduce;  
*Accept: pass on alleles / genes to next generation as equivalent to reproduce*
6. Leads to change / increase in allele frequency.  
*Accept: increase in proportion / percentage as equivalent to frequency*

6

- (b) 1. Capture / collect sample, mark and release;
2. Method of marking does not harm lizard / make it more visible to predators;
3. Leave sufficient time for lizards to (randomly) distribute (on island) before collecting a second sample;
4. (Population =) number in first sample × number in second sample divided by number of marked lizards in second sample / number recaptured.

4

- (c) 1. High concentration of / increase in carbon dioxide linked with respiration at night / in darkness;
2. No photosynthesis in dark / night / photosynthesis only in light / day;  
*Neutral: less photosynthesis*
3. In light net uptake of carbon dioxide / use more carbon dioxide than produced / (rate of) photosynthesis greater than rate of respiration;
4. Decrease in carbon dioxide concentration with height;  
*More carbon dioxide absorbed higher up*  
*Accept: less carbon dioxide higher up / more carbon dioxide lower down*
5. (At ground level)  
less photosynthesis / less photosynthesising tissue / more respiration / more micro-organisms / micro-organisms produce carbon dioxide.  
*Neutral: less leaves unqualified or reference to animals*

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5

- (a) 1. No aerobic respiration / electron transfer / oxidative phosphorylation;  
*Reject reference to anaerobic respiration.*
2. (Because) no (respiratory) substrate / nothing to respire;  
*Reject idea of 'little' or 'less' – this would result in a change in oxygen concentration.*  
*Accept the idea of no residual respiratory substrate in the mitochondria.*

2

- (b) (i) (Oxygen concentration falls because)
1. Aerobic respiration (uses oxygen);  
*Accept 'oxidative phosphorylation / electron transfer takes place'.*
2. Oxygen is terminal / electron acceptor;
3. (oxygen combines with) protons / H<sup>+</sup> **and** electrons / e<sup>-</sup> **to form** water / H<sub>2</sub>O;  
*All aspects are required to gain mark.*

2 max

- (ii) Phosphate (ions) / inorganic phosphate / P<sub>i</sub>;  
*Reject 'phosphorus' or 'P'.*  
*Accept 'PO<sub>4</sub>'*

1

- (c) 1. Oxygen concentration continues to fall in plants but stays constant in animals;  
*For 'plants' accept 'line R to T', for 'animals' accept 'line R to S'.  
 MP1 and MP2. Accept answers in terms of 'use' of oxygen rather than change in concentration.*
2. (Oxygen concentration) falls more slowly in plants than before cyanide added;
3. (Because aerobic) respiration continues in plant (mitochondria);  
*Accept (because aerobic) respiration stops in animal (mitochondria).*
4. (Because) electron transfer / oxidative phosphorylation continues in plant (mitochondria);  
*Accept (because) electron transfer stops in animal (mitochondria).  
 Accept for **one additional mark**  
 (up to 4 max) use of Resource A i.e: idea that plant cytochrome oxidase is (more) resistant to cyanide  
 OR  
 idea that animal cytochrome oxidase not resistant to cyanide.*

4

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- (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.*
- (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;

2

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

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- (a) Succession;

*Ignore any word in front of succession e.g. secondary / ecological succession.*

*Neutral 'forestation'.*

1

- (b) 1. Greater variety / diversity of plants / insects / more plant / insect species;  
*Neutral: more plants.*

2. More food sources / more varieties of food;

*Neutral: more food / more / greater food source (singular).*

3. Greater variety / more habitats / niches;

*Accept: more nesting sites.*

*Q Neutral: more homes / shelters.*

3

- (c) (i) Temperature and carbon dioxide;

*Neutral: water, chlorophyll.*

1

- (ii) Shows (gross) photosynthesis / productivity minus respiration / more carbon dioxide used in photosynthesis than produced in respiration;

*Correct answers are often shown as: net productivity = (gross) photosynthesis – (minus) respiration.*

1

- (iii) 1. (Shade plant) has lower (rate of) respiration / respiratory losses / less CO<sub>2</sub> released at 0 light intensity / in dark;

*Accept use of figures.*

*Accept: lower compensation point.*

2. Greater (net) productivity / less sugars / glucose used / more sugars / glucose available;

*Neutral: any references to rate of photosynthesis.*

2

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(a) Prevents oxygen being taken up / entering / being absorbed;

*Accept: any idea of no contact with oxygen.*

*Neutral: for anaerobic respiration / anaerobic conditions.*

*Neutral: prevents entry of air.*

*Reject: prevents entry of oxygen and another named gas.*

1

(b) (i) 0.0155 / 0.016 = 2 marks;;

0.0775 / 0.077 / 0.078 / 0.08 = 1 mark

/ 0.62 = 1 mark

2

(ii) Glucose decreases / is a limiting factor / increase in ethanol / yeast / cells die / toxins build up;

*Accept: glucose is used up.*

1

(iii) 1. (Stays the) same / level / (relatively) constant;

2. Same volume / amount of oxygen uptake and carbon dioxide release;

*Note: if m.p. 1 is awarded m.p 2 can be obtained without referring to 'same volume / amount'.*

2

(c) 1. Oxygen is final / terminal (electron) acceptor / oxygen combines with electrons and protons;

2. Oxidative phosphorylation / electron transport chain provides (most) ATP / only glycolysis occurs without oxygen / no Krebs / no link reaction;

2

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1. Carbon dioxide combines with ribulose bisphosphate / RuBP;
2. Produces two glycerate (3-)phosphate / GP;  
*Accept: any answer which indicates that 2 x as much GP produced from one RuBP.*
3. GP reduced to triose phosphate / TP;  
*Must have idea of reduction. This may be conveyed by stating m.p. 4.*
4. Using reduced NADP;  
*Reject: Any reference to reduced NAD for m.p.4 but allow reference to reduction for m.p. 3.*
5. Using energy from ATP;  
*Must be in context of GP to TP.*
6. Triose phosphate converted to glucose / hexose / RuBP / ribulose bisphosphate / named organic substance;

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- (a)
  1. (Protein / molecule) that moves from cytoplasm to DNA;  
*Accept 'it' as TF.*  
*Accept moves into nucleus*
  2. (TF) binds to specific gene / genes / to specific part of / site on DNA / binds to promoter / RNA polymerase;  
*Accept regulator / enhancer region*
  3. Leads to / blocks (pre)mRNA production / allows / blocks binding of RNA polymerase (to DNA) / allows RNA polymerase to work;  
*Ignore translation unless context wrong*  
*Max 1 if refer to oestrogen as a transcription factor*
- (b)
  1. (Binding to CREB) prevents transcription / mRNA formation;  
*Accept that lack of protein leaves NAD reduced*
  2. (Binding of huntingtin) prevents production / translation of protein (that removes electrons / protons from NAD);
  3. Fewer electrons to electron transport chain / electron transport chain slows / stops / stops / slower oxidative phosphorylation;
  4. Fewer protons for proton gradient;
  5. Not enough ATP produced / energy supplied to keep cells alive / anaerobic respiration not enough to keep cell alive;  
*Accept neurones require ATP for active transport of ions*  
*Ignore references to resting potential*

2 max

3 max



- (c) 1. Mitochondrion has two membranes / inner and outer membranes;  
*Accept cristae for inner membrane*
2. For each (different) membrane a (different) carrier required;  
*Ignore reference to channel proteins*

2

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(a)

Part of ecosystem	Mean rate of carbon dioxide production / $\text{cm}^3 \text{m}^{-2} \text{s}^{-1}$	Percentage of total carbon dioxide production measured by the scientists
Leaves of plants	0.032	25.0
Stems and roots of plants	0.051	<b><u>39.8</u></b>
Non-photosynthetic soil organisms	0.045	<b><u>35.2</u></b>

2 correct = 2 marks;;

Adding rates to get 0.128 = 1;

*If rounded to 40 and 35 in table;*

- *but working shows decimal points, then award 2 marks*
- *but no working shown, then 1 max*

2 max

- (b) 1. Data only include (heterotrophic) soil organisms;
2. Doesn't include animals (above ground) / other (non-soil) organisms;
3. Doesn't take into account anaerobic respiration;  
*Award points in any combination*  
*Accept for 1 mark idea that CO<sub>2</sub> for leaves doesn't take into account photosynthesis – not told in dark until part (d)*

2 max

(c) **All three** of following = 2 marks;;

**Two** of them = 1 mark;

Volume of carbon dioxide given off

(From known) area / per  $m^2$  /  $m^{-2}$

In a known / set time

*Ignore 'amount' / concentration of  $CO_2$*

*Accept per second / per unit time*

2

(d) 1. (In the light) photosynthesis / in the dark no photosynthesis;

2. (In light,) carbon dioxide (from respiration) being used / taken up (by photosynthesis);

2

(e) (i) (Rate of respiration)

*Assume "it" means soil under trees*

1. In soil under trees (always) higher;

*Accept converse for soil not under trees*

*Accept 'in the shade' means under the trees*

2. In soil under trees does not rise between 06.00 and 12.00 / in the middle of the day / peaks at 20:00-21.00 / in the evening;

3. In soil **not** under trees, peaks at about 14:00-15:00 / in middle of day;

*2. and 3. No mm grid, so accept 'between 18.00 and 24.00' or 'between 12.00 and 18.00'*

2 max

(ii) (Between 06.00 and 12.00, (No Mark))

Respiration higher in soil under tree, (No mark)

*Do not mix and match mark points*

*No list rule*

1. Tree roots carry out (a lot of) respiration;

2. More / there are roots under tree;

*Accept converse for soil not under trees*

**OR**

3. More food under trees;

4. So more active / greater mass of / more organisms (carrying out respiration);

*Accept converse for soil not under trees*

**OR**

Soil not under trees respiration increases (No mark)

5. Soil in sunlight gets warmer;

6. Enzymes (of respiration) work faster;

*Accept converse for soil under trees*

2 max

(f) (i) 1. Photosynthesis produces sugars;

2. Sugars moved to roots;

*Do not penalise named sugars other than sucrose*

3. (Sugars) are used / required for respiration;

2 max

(ii) Takes time to move sugars to roots;

*Look for movement idea in (i) – can carry forward to (ii)*

1

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12

(a) Push – legume

Pull – grass;

*Both needed for mark*

1

- (b) 1. Set up tape measures on two sides of the plot / make grid of plot;  
*Allow 'Number each plant'. With this approach mp3 cannot be awarded.*
2. Use random number table / calculator / generator;  
*Allow 'Select from a hat' idea.*

3. To generate coordinates;

3

- (c) 1. To prevent competition between the maize and the grass;
2. For light / nutrients / water;

**OR**

3. Idea of limits movement of pest (between grass and maize);
4. Only eating / damaging grass;

2 max

- (d) 1. Nitrogen-fixing bacteria convert nitrogen (in the air) into ammonium compounds (in the soil) which are converted into nitrates / nitrification occurs;  
*Accept 'ammonia' for 'ammonium compounds'.*

2. Maize uses nitrates (in soil) for amino acid / protein / ATP / nucleotide production;  
 2. *Must be in the context of maize.*  
*Ignore ionic formulae unless only these are given.*

2

- (e) 1. Reduced % damage to maize plants / increased maize grain yield;
2. Calculation to justify mp 1;
3. Standard deviation shows no overlap but need stats to show significance of this difference;
4. More profit / net income / greater income than additional cost (with push-pull);
5. \$322 extra / 408% more / \$401 v \$79 profit;  
*Accept '\$350 extra income compared to \$28 extra spend'.*  
*Mp5 gains credit for both mp4 and 5*

3 max

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