

Mark schemes

- 1**
- (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 $\mu\text{mol photons m}^{-2} \text{s}^{-1}$ 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]** (a) 1. To kill any fungus / bacteria on surface of seeds or in soil;
- 2**
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.

- (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]

3

- (a) 1. (Use) coordinates / number the rocks/sites/squares;

Ignore: references to grid, tape measures, metre rulers etc.

2. Method of generating/finding random numbers e.g. calculator/computer/random number generator/random numbers table;

Accept: numbers out of a hat / use of dice.

2

- (b) Difficult/too many to count / individual organisms not identifiable /too small to identify/count / grows in clumps;

Ignore: easier/quicker/representative/ more accurate, unless qualified.

1

- (c) Any suitable factor with valid explanation = 1 mark

1. Wave action - firmer grip on rock is necessary (at either site);
2. Wind/air movement/less humid - more evaporation at site A / more(physical) damage;
3. Light – (linked to) photosynthesis (at either site);
4. Temperature – (linked to) photosynthesis/respiration/enzymes/evaporation (at either site);
5. pH – (linked to) enzymes/proteins;

Note: other common factors include salt (salinity) linked to water potential / named nutrient e.g. nitrate linked to protein/DNA.

Ignore: carbon dioxide/oxygen/pollution/rainfall/food/nutrients.

Reject: biotic factors e.g. predation.

2 max

- (d) 1. Greater variety of food / more food sources;

Ignore: more food.

2. More/variety of habitats/niches; *Ignore: homes/shelters.*

Accept: different habitats.

2

- (e) (i) 1. (So they were) hungry/not full;

Accept: description of hunger e.g. appetite / 'empty stomach'/'so they eat'.

2. (Allows) comparison;

2

- (ii) 1. Alga without consumer/named consumer/animal;

Accept: repeat experiment without consumer.

Accept: in separate tank / in tank where not eaten.

2. (Find change in mass) in dark;
3. For 50 hours;

Accept: 'same time as in experiment'.

Accept: For lower time period then scaled up to 50.

3

- (iii)
1. For *Laurencia pacifica* **and** *Cystoseira osmondacea* (difference in results) significant / reject null hypothesis / not due to chance / less than 5%/0.05 probability due to chance;
Accept: for Laurencia pacifica 'less than 1%/0.01 probability'.
 2. For *Egregia leavigata* **and** *Microcystis pyrifera* no significant (difference in results)/accept null hypothesis / is due to chance/more than 5%/0.05 probability due to chance;
Accept: 'insignificant' for 'no significant difference'.
 3. (Difference in results) for *Laurencia pacifica* is the most significant;
Note: reference to probabilities on their own is not sufficient.
1, 2 and 3. Accept: abbreviations for all species.

3 [15]

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

4

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 / takeup carbon dioxide;
4. Source of medicines / chemicals / wood;
5. Reduces erosion / eutrophication.

Accept: tourism / aesthetics / named recreational activity

1 max

[9]

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

5

c
h
l
o
r
o
p
h
y
l
i
/
D
N
A
/
R
N
A
/
/
/
A
T
P
/
A
D
P
/
A
M
P
/
N
A
D
/
N
A

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. nitrogenfixing 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] (a) Succession;

6

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 CO₂ 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

[8] (a)

7

Part of ecosystem	Mean rate of carbon dioxide production / cm ³ m ⁻² 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	<u>39.8</u>
Nonphotosynthetic soil organisms	0.045	<u>35.2</u>

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 CO₂ 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 m² / m⁻²

In a known / set time

Ignore 'amount' / concentration of CO₂

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

[15]

8

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] 1.P Pathogens and effects on host

9

- 2.T Taxonomy
- 2.C Classification and evolution.
- 2.I Inheritance and evolution
- 2.Gc Genetic code, universal
- 2.B Behaviour

- 2.Ev Populations and evolution, variation between individuals within a species
- 3.BP Relationships within ecosystems – eg predator / prey
- 3.E Energy transfer in ecosystems
- 3.N Nutrient cycles, the organisms involved
- 3.S Succession, biodiversity, species and individuals in a community
- 4.H Human impacts on the environment and its effect on relationships between organisms – including farming
- 4.Gt Gene technology and GMO and selective breeding
- 4.Ar Antibiotic resistance

Examiners are free to select other letters if they wish

The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves

Breadth, one mark for use of an example from each of the following approaches – 3 max:

1. *Pathogen and host*
2. *Evolution (related topics)*
3. *Ecological*
4. *Human intervention in relationships*

[25]

10

- (a) 1. Chlorophyll absorbs light energy;

Accept light energy 'hits' chlorophyll

Accept photon for light energy

2. Excites electrons / electrons removed (from chlorophyll); *Accept higher energy level as 'excites'*
3. Electrons move along carriers / electron transport chain releasing energy;
Accept movement of H^+ / protons across membrane releases energy
4. Energy used to join ADP and Pi to form ATP;
Negate 'produces energy' for either mark but not for both
Accept energy used for phosphorylation of ADP to ATP
Do not accept P as Pi
5. Photolysis of water produces protons, electrons and oxygen;
3. and 4.
6. NADP reduced by electrons / electrons and protons / hydrogen;

Accept NADP to NADPH (or equivalent) by addition of electrons / hydrogen

Do not accept NADP reduced by protons on their own

5 max

- (b) 1. Variation / variety;
2. Mutation;
Do not accept answers which suggest the mutation is caused by copper
3. Some plants have allele to survive / grow / live in high concentration of copper / polluted soils;
Reference to immunity disqualifies this mark
Do not disqualify mark for references to allele providing resistance to copper
4. (Differential) reproductive success / adapted organisms reproduce;
5. Increase in frequency of allele;
6. No interbreeding (with other populations) / separate gene pool / gene pool differs (from other populations);
Accept reproductive isolation

5 max

[10]

11

- (a) 1. Is widely / commonly used;
2. Provides a standard / benchmark / reference;
Allow a variety of descriptors for marking point 2 e.g. 'provides a base line',
'produces known amount of carbon dioxide'
Mark point 2, do not accept 'for comparison' on its own as 'comparison' is in stem of question
3. Produces large amount of carbon dioxide;
4. Is a decreasing resource / could be replaced by biofuel;
Ignore reference to a control

2 max

- (b) 1. Independent / no bias / trustworthy;
2. Non-profit making;
3. (Focused on) effect on environment / climate;

2 max

- (c) 1. CO₂ taken up in photosynthesis;

2. More taken up than produced (when it is used) with less CO₂ produced than petrol;

2

- (d) 1. (These microorganisms) don't have (cellulose-digesting) enzymes;
Accept 'don't make enough of these enzymes' for mark point 1
2. (Cellulose) is a polysaccharide / polymer / long (molecule / chain); *Accept 'large' for mark point 2*
3. (Cellulose) is insoluble / glucose / product of digestion is soluble;
4. Broken down into glucose / monomers / monosaccharides; *Ignore (alpha) glucose for mark point 4. Do not accept sugars for mark point 4*
5. Sugars / glucose used in glycolysis / glucose can be converted to pyruvate;
6. Produces more ethanol / fuel produces ethanol / fuel quicker;
Accept 'speeds up process' for mark point 6

3 max

- (e) 1. Removes species / fewer species / growth of single crop / single plant species / monoculture;
Deforestation or removal of hedges on its own should not be credited
2. Removes habitats / fewer habitats / niches / only one habitat;
3. Removes variety of food sources / fewer food sources / only one food source;

2 max

[11] (a) (i) Non-living / physical / chemical factor / non biological;

12

Do not accept named factor unless general answer given.

1

- (ii) Accept an abiotic factor that may limit photosynthesis / growth;
Reject altitude / height
Water
Named soil factor
Not "soil" / "weather"
Light
Carbon dioxide
Accept Oxygen
Incline / aspect
Wind / wind speed

1

- (b) 1. Correct explanation for differences between day and night e.g. photosynthesis only during the daytime / no photosynthesis / only respiration at night;
2. Net carbon dioxide uptake during the day / in light

OR

No carbon dioxide taken up at night / in dark / carbon dioxide released at night / in dark;

3. At ground level more respiration / in leaves more photosynthesis;
4. Carbon dioxide produced at ground level / carbon dioxide taken up in leaves;

Principles

Comparing day and night / light and dark

1. Explanation in terms of photosynthesis / respiration
2. Effect on carbon dioxide production / uptake

Comparing leaves with ground level

3. Explanation in terms of photosynthesis / respiration
4. Effect on carbon dioxide production / uptake
2 and 4 must relate to why the change occurs

4

- (c) 1. Variation in original colonisers / mutations took place;
2. Some better (adapted for) survival (in mountains);
2. Allow "advantage so able to survive"
3. Greater reproductive success;
4. Allele frequencies change;
4. Reject gene / genotype

3 max

[9] (a) (i) 1. Same breed so similar alleles;

13

1. Allow different alleles have different effects
2. Controls / removes variable / so genes not a factor / only temperature affects results / rate of growth affected by genes; 2. Accept idea worded in such terms as inherited.

2

- (ii) 1. Different growth rates / gained different biomass / grew different amount;
Allow "more food for growth"
Ignore references to efficiency of conversion.
2. Not due to temperature / the independent variable;

- (b) (i) Rise then fall with peak at 20 °C;

Do not accept 0.85 as alternative to 20.

1

- (ii) 1. Temperature may be between 10 and 30 / 10 and 20 / 20 and 30;

No mark for yes or no.

2. Intervals are 10°C / large / not small / should be smaller / should be intermediates;

2

- (c) (i) 1. Growth rate decreasing / conversion staying same / decreasing;

2. (Scientists would be) looking for high growth rate / conversion / datashows unlikely to improve growth / yield;

3. Wastes time / resources / would not relate to farming conditions; 3.
Ignore cruelty to pigs

2 max

- (ii) 1. Will lose more heat / not as much energy used to maintain body temperature;

1. *Must be a comparative statement*

Accept energy as equivalent to heat in the context of this question

2. Heat resulting from respiration / more respiration;

2. *Do not credit answers relating to energy made in respiration*

3. More food used in respiration;

2 max

- (d) **In support**

Read standard deviation as standard error

1. Food **B** produces greater mass than control / greater than 100%;

1. *Must refer to control*

But

2. Error bars for **B** mean **B** could be no better / not different from control;

3. Overlap of error bars for **B** and **A**;

4. A no better than / not different from **B**;

4. *Neutral: "Results not significant". Mark must compare **A** to **B***

Experimental limitations

5. Experiment only ran for 10 days;

6. Experimental conditions / breed of pig may not be the same as on the farm;
7. No information about cost;

4 max

[15]

- (a) 1. High temperature allows enzymes to work faster / allows more collisions / allows

14

more e-s complexes to be formed

OR

A lot of light so light not limiting;

2. Photosynthesis reactions are faster / more photosynthesis;

*Accept enzymes more effective. Ignore references to respiration.
Ignore references to optimum (temperature or light).*

2

- (b) (i) Gross productivity = net productivity + respiratory loss / respiration;

Accept any correct rearrangement of this equation

Accept recognisable abbreviations

Reject respiratory rate.

1

- (ii) 1. Respiration slower / less respiration;

Unspecified references refer to August. Allow converse of respiration faster but must specify July / higher temperature

2. Light-dependent reaction / photosynthesis less affected by temperature increase;

3. Lower (energy) loss;

Unspecified references refer to August. Allow converse of higher loss but must specify July

"Lower respiratory losses (in August)" can meet both points 1 and 3 and gain 2 marks.

2 max

- (c) 1. Stored as fat / glycogen / biomass;

Reject stored energy. Ignore respiration

2. Used for growth / movement / reproduction / process involved in growth / movement / reproduction;

2 max

- (d) 1. More heat / energy is lost (in March) / colder (in March);

2. Maintain / regulate body temperature / more heat generated; *Accept keep warm.*

3. By respiration / metabolism;

2 max

[8] (a) (i) Reduced cost;

15

Less feed / less land use / more growth rate with same amount of food;

Allow is 'cost effective'

2

(ii) Amount of food taken in less than expected.

Allow 'expected food intake is higher,

Allow 'food intake is lower than it should be'

1

(b) Type of food (not a mark)

1. May vary in protein / fat / carbohydrate / fibre / roughage / vitamins / minerals;

2. May affect absorption / digestibility / energy value / tastiness / growth / overall food intake;

For mark point 1 allow appropriately named food compound e.g. cellulose, glucose

For mark point 2 it must be clear that these factors are affected by the type of food.

Temperature (not a mark)

3. Will affect heat loss / gain / respiration / metabolism;

4. More food / energy can be used for growth;

Note: two maximum marks for effect of temperature.

4

(c) RFI does not affect methane production /

There is no difference in the rate of methane production for low and high RFI values /

The difference between the rates of methane production is due to chance /

No correlation / relationship / link between RFI and methane production;

Any clear statement that there is no link between RFI and methane production should be credited.

1

(d) (i) Sulfate without straw;

1

(ii) 1. May affect yield / damages rice crop;

2. Substance / treatment may affect other organisms / environment;

3. Cost of substance / application / labour;

4. Method / frequency / timing of application / amount of substance required;

2 max

(iii) Not flooded aerobic conditions / more oxygen / with flooding anaerobic conditions / less oxygen;

Not flooded fewer / less active anaerobic microorganisms / respiration / not flooded more / more active aerobic microorganisms / respiration;

2

[13] (a) Heat at 100°C / heat to temp to evaporate water;

16

Value which would not burn material

Weigh and heat until no further change in mass;

2

(b) Amount of water present will vary;

This will affect fresh mass / will not affect dry mass;

2

[4]

(a) To see if a difference in hours of sunshine was present / because it is necessary to monitor

17 factors which cannot be controlled;

So that they could eliminate this factor from affecting the yield (with /without extra carbon dioxide);

OR

Duration of light influences length of time for photosynthesis / temperature in glasshouse;

Higher photosynthesis results in higher yield / more carbohydrates / sugars / proteins produced;

2 max

(b) Named factor;

Explanation of why the factor is important;

E.g.

Density of planting;

Competition for named resource;

or

Same variety of tomato;

Yield will vary with different varieties / with different genotypes;

or

Water (application);

Water needed for expansion of fruit / maintain leaf turgidity / maintain stomatal opening / replace water lost in transpiration / water used in photosynthesis;

For named resource accept 'nutrient' but not 'food'

2

[4]

- 18** (a) (i) Yield increases by 0.6 kg m^{-2} (when extra carbon dioxide present); 1
- (ii) Temperature / light intensity so could be lower in these weeks (as temperature / light intensity not fully controlled / monitored) (over period 1998 – 2000); 1
- (b) Two marks for correct answer of 50.6%;
One mark for incorrect answer in which candidate has shown clearly that calculation based on an increase / 0.42 and original mass / 0.83 2
- (c) Cost of supplying carbon dioxide;
Price of (very early) tomatoes; 2
- (d) Lowest price paid for tomatoes;
Some carbon dioxide lost as windows open in summer;
Little / no mean increase in yield in summer; 2 max
- (e) Grow with extra carbon dioxide in one glasshouse and without carbon dioxide in other glasshouse at same time;
So all environmental conditions / light and temperature same for experiment and control; 2

[10]