



EXAM PAPERS PRACTICE

Mark schemes

- 1** (a) (i) Temperature and light; 1
- (ii) Increase in temperature causes increase in rate of photosynthesis / uptake of carbon dioxide;
- Increase in light / more / medium / high light (intensity) causes increase in rate of photosynthesis / uptake of carbon dioxide; 2
- (b) 2.75 – 2.81 ($\text{mg g}^{-1} \text{hr}^{-1}$)
Accept answers in range 2.75 – 2.81 1
- (c) 1. Growth will decrease (at higher temperature);
2. Rate of respiration will increase at higher temperature;
3. Photosynthesis decreases as limited by light / as there is less light;
Ignore references to effect of temperature on rate of photosynthesis 3
- 2** (a) 1. High concentration of carbon dioxide linked with night / darkness;
Accept: converse of low in day
2. No photosynthesis in dark / night / light required for photosynthesis / light-dependent reaction;
Ignore references to rate of photosynthesis in day / night
Accept day = light
3. (In dark) plants (and other organisms) respire;
Must be a reference to plants or all organisms
4. In light net uptake of carbon dioxide by plants / plants use more carbon dioxide than they produce / rate of photosynthesis greater than rate of respiration;
Do not allow converse for this point
Accept description of compensation point
5. Decrease in carbon dioxide concentration with height;
Accept: converse of increase closer to ground
6. At ground level fewer leaves / less photosynthesising tissue / more animals / less light; [7]

5 max



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- (b)
1. Carbon dioxide combines with ribulose biphosphate / RuBP;
 2. To produce two molecules of glycerate 3-phosphate / GP;
 3. Reduced to triose phosphate / TP;
 4. Requires reduced NADP;
 5. Energy from ATP;

This mark scheme is based on specification content. Accept alternate names such as NADPH

Credit relevant diagrams

Accept: description of 'reduced'

5

[10]

3

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

4

- (a) (i) Yield increases by 0.6 kg m^{-2} (when extra carbon dioxide present);
- (ii) Temperature / light intensity so could be lower in these weeks (as temperature / light intensity not fully controlled / monitored) (over period 1998 – 2000);

1

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



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- (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]

5

1. Light (energy) excites / raises energy level of electrons in chlorophyll;
2. Electrons pass down electron transfer chain;
Q Accept any reasonable alternative for electron transfer chain.
3. (Electrons) reduce carriers / passage involves redox reactions;
4. Electron transfer chain / role of chain associated with chloroplast membranes / in thylakoids / grana;
Example such as chemiosmosis;
5. Energy released / carriers at decreasing energy levels;
6. ATP generated from ADP and phosphate / P_i / phosphorylation of ATP;

[5]

6

- (a) dry conditions - stomata partially closed;
due to less turgor in guard cells;
OR
watered conditions - stomata more open;
due to greater turgor in guard cells; 2
- (b) (i) *EITHER*
temperature [Allow heat] - higher causes more water evaporation /
diffusion [not just transpiration]
OR
light - causes stomatal opening
OR
soil texture - determines availability of water
OR
humidity - reduces evaporation / reduces gradient / wind
causes more (water) evaporation;



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- (ii) high CO_2 gives less variation AND watering gives less variation;
OR
insignificant difference in variability as small differences in SD;
reject 'no difference'

1

[4]

7

- (a) 1 5C / RuBP combines with CO_2 ;
2 to form 3C compound / TP / GP;
3 using ATP;
4 and reduced NADP / eq;
5 2 molecules of 3C compound / TP / GP form hexose;
6 all RuBP is regenerated;
7 10 molecules of 3C / TP / GP form 6 molecules of 5C / RuBP;

6 max

- (b) 1 electron transport chain accepts excited electrons;
2 from chlorophyll / photosystem;
3 electrons lose energy along chain;
4 ATP produced;
5 from ADP and P_i ;
6 reduced NADP formed;
7 when electrons (from transport chain) and H^+ combine with NADP;
8 H^+ from photolysis;

6 max

- (c) 1 some hexose / biomass / eq. used in respiration;
growth cancels this point
2 CO_2 produced (is lost to air);
3 some parts of the plant are eaten / some parts lost to decomposers
/ in leaf fall;

3

[15]

8

- (a) Temperature affects photosynthesis; Affects enzyme activity;
So that any change in photosynthesis rate is result of carbon dioxide / light intensity;

max 2



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- (b) Carbon dioxide increases rate of photosynthesis;
Up to max;
Something else / correct suggestion is a limiting factor; 3
- 9** (a) (i) **P** = 3;
Q = acetylcoenzyme A; 2
- (ii) 36 ATP, however derived = 2 marks
30 ATP, however derived = 1 mark 2
- (iii) *Correct statement in the context of aerobic respiration or anaerobic respiration concerning:*
Oxygen as terminal hydrogen / electron acceptor allowing operation of electron transport chain / oxidative phosphorylation;
Fate of pyruvate;
Significance of ATP formed in glycolysis; 3
- (b) (i) Thick walls exclude oxygen;
Produced by photosynthetic cells (of fern and *Anabaena*);
Contain no chlorophyll so do not photosynthesise;
Do not produce oxygen;
Oxygen would inhibit nitrogen fixation process; max. 3
- (ii) Decomposers / bacteria / fungi / saprobionts (in fields);
Convert protein / organic nitrogen (in cells of fern) into ammonium ions (*allow ammonia*);
Ammonium ions (ammonia) converted to nitrite, then converted to nitrate;
Allow 1 mark for $NH_3 / NH_4^+ \rightarrow NO_3^-$
By nitrifying bacteria / correctly named;
Nitrate used to form protein / amino acids in rice; 5
- [15]



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10

- (a) Excitation of chlorophyll molecule / electrons / energy of (pairs of) electrons raised to higher energy level;

Electron(s) emitted from chlorophyll molecule;

Electron(s) to electron transport chain;

Loss of energy by electron(s) along electron transport chain;

Energy lost by electron(s) is used to synthesise ATP;

From ADP + Pi;

"By electrons" need not be stated in each marking point if it can be reasonably inferred that the candidate is referring to electrons

max 5

- (b) Little green light reaches bottom as absorbed by surface dwellers / water;
Red and blue not absorbed and so penetrate;
Variation in pigments of sediment dwellers;
Bacteria with chlorophyll at an advantage as chlorophyll absorbs red and blue;
(Survive to) reproduce in greater numbers and pass on advantageous alleles / genes in greater numbers / increase in frequency of advantageous alleles in subsequent generations;
Increase in frequency / numbers of bacteria with chlorophyll;

6

[11]

11

- (a) (i) temperature also affects photosynthesis / rate of reaction; need to ensure the effect of only one variable is being observed;

1

- (ii) CO₂ used / O₂ produced / sugar produced / increase in mass;
per unit of time;

accept any volume or mass unit; per time unit;

(allow one mark for indicator of photosynthesis – second mark is for time element)

2

- (b) (i) as carbon dioxide increases, rate of photosynthesis increases;

1

- (ii) carbon dioxide not limiting photosynthesis / another factor / named factor limiting;
explanation for named factor;

2

[6]



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12

- (a) Grana / thylakoids / lamellae; 1
- (b) **A** = oxygen / O_2
B = ADP and phosphate / P_i / phosphoric acid / correct formula;
C = reduced NADP; ALLOW NADPH / $NADPH_2$ / $NADPH + H^+$ 3
- (c) (i) Absorbs light / energy;
Loses electrons / becomes positively charged / is oxidised;
Accepts electrons from water / from OH^- which causes more water to dissociate / pulls equilibrium to the right; 3
- (ii) Electrons raised to higher energy level / electrons excited;
Use of electron carriers / cytochromes / acceptors;
For production of ACT
[REJECT 'energy production'] 3
- (d) (i) GP formed from RuBP + CO_2 ;
GP \rightarrow TP / sugar-phosphate / sugar / to RuBP;
GP formed at same rate as it is used; 3
- (ii) No CO_2 to combine with / not enough CO_2 to combine with RuBP
RuBP not changed into GP / TP RuBP reformed from GP / TP; 2

[15]

13

- (a) On diagram, correctly labelled:
Light-dependent: granum / thylakoid membranes – labelled 'X'
AND
Light-independent: stroma – labelled 'Y'; 1
- (b) Any two from:
(Water) forms H^+ / hydrogen ions and electrons / e^- ;
 O_2 / oxygen formed; [*NOT O*, *NOT O*]
(Light) excites electrons / raises energy level of electrons / electrons to chlorophyll / to photosystem; max 2
- (c) (ATP) Provides energy for GP \rightarrow TP / provides P for RuP / TP \rightarrow RuBP;
(Reduced NADP) Provides H / electrons for GP \rightarrow TP / reduces GP to TP; 2

2

[5]



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14

- (a) ✓ ✓ x;
x x ✓;
✓ ✓ ✓
✓ x x

4

(b) (i) pyruvate / succinate / any suitable Krebs cycle substrate;

1

(ii) ADP and phosphate forms ATP;
oxygen used to form water / as the terminal acceptor;

2

(iii) Y X W Z;
order of carriers linked to sequence of reduction / reduced
carriers cannot pass on electrons when inhibited;

2

[9]

15

(a) electrons;
from chlorophyll / photolysis;

2

(b) (i) RuBP combines with carbon dioxide to produce 2 x GP;

1

(ii) less used to combine with carbon dioxide /
less used to form glycerate 3-phosphate;

1

(c) (i) used in photosynthesis allows detection of products;

1

(ii) ATP and reduced NADP not formed;
GP is not being used to form RuBP / is being formed from RuBP;

2

(iii) used in respiration / formation of starch / cellulose;

1

[8]

16

(a) (i) pigment reflects / does not absorb green or yellow or orange;
pigment absorbs blue or violet;
pigment absorbs red;

(accept correct wavelengths instead of colours)
(any 2 for 1 mark)

1

(ii) light (energy) absorbed by chlorophyll;
raises energy level of electrons / electrons are excited / emitted;
ATP formed;

3



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- (b) more wavelengths / colours absorbed;
more (efficient) photosynthesis can occur at these depths / low light intensities
or
more (efficient) photosynthesis can occur when some wavelengths are not present;

2

[6]

17

- (a) (i) respiration;

1

- (ii) decomposers;
(*accept bacteria / fungi*)

1

- (b) $\frac{87402}{1.7 \times 10^6} \times 100 = 5.14 / 5.1\%$;

(*correct answer = 2 marks*)

(*principle: energy in producers \div energy of light absorbed = 1 mark*)

2

- (c) excites chlorophyll / electrons;
release electron(s);

2 max

- (d) reduced NADP;
reduces GP / to change GP to TP;
ATP;
provides the energy to reduce GP / convert GP to TP / TP to RuBP /
provides phosphate to convert TP to RuBP;

4

[10]

18

- (a) (i) RuBP – 5; GP – 3; TP – 3; Glucose – 6;
(*all correct = 2 marks; 3 or 2 correct = 1 mark*)

2

- (ii) stroma;

1

- (iii) light-dependent reaction / (photo)phosphorylation;
(*accept photolysis*)

1

- (iv) 5 out of 6 / 83% / equivalent;

1

- (b) enzymes involved / not a photochemical reaction;
slow rate of enzyme / chemical reaction at low temperature /
less kinetic energy / fewer collisions;

2

[7]



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19

- (a) adding CO₂ decreases pH / makes more acid
OR removing CO₂ increases pH / makes more alkaline;
(credit anywhere but do not credit this mark if stated that oxygen is an alkaline gas)

rate of photosynthesis > rate of respiration in **A**;
respiration only in **B**;
rate of photosynthesis = rate of respiration in **C**;

4

- (b) (i) shows that indicator alone does not change colour in light;

(ii) so that all tubes receive same amount of heat

1

1

[6]

20

- (a) the more light absorbed, the greater the rate of photosynthesis;
light provides the energy for light dependent reactions / photolysis /
light independent reactions / production of reduced NADP /
exciting electrons in chlorophyll;
(do not give credit if energy is used in photosynthesis)

2

- (b) count the number of bubbles / measure the volume of gas / measure the
change in pH / carbon dioxide / hydrogen carbonate ions;
(credit oxygen produced)

1

- (c) 530 – 630 nm;
(any values within this range)

limited absorption of light / (green) plants reflect green light /
limited photosynthesis at these wavelengths of light;
(allow references to no light absorbed or no photosynthesis)

2

- (d) (i) chlorophyll excited / reduced NADP formed;
electrons from chlorophyll / reduced NADP changes the dye colour;

2

(ii) ADP and phosphate needed to produce ATP / ATP is a product of
the light dependent reactions;
ADP levels are a limiting factor;
*(must explain the idea of limiting factors – do not credit answers like
more ADP causes more photosynthesis)*

2

[9]

21

- (a) rate of photosynthesis increased;
normal atmospheric concentration a limiting factor / more / faster
production of biomass or sugars / more products of photosynthesis
transported to fruits;

2