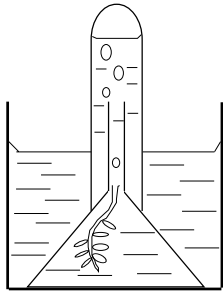


QUESTIONSHEET 1

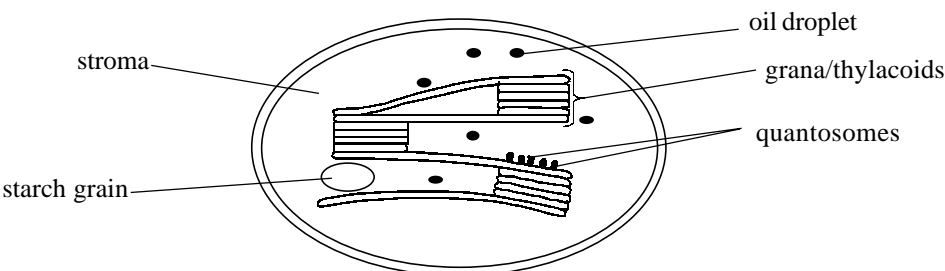
- (a) A - vascular bundle;
B - palisade mesophyll;
C - spongy mesophyll; 3
- (b) B/palisade mesophyll; 1
- (c) (i) 1 = double membrane/envelope; 2 = granum; 3 = quantosomes;
4 = stroma; 5 = lipid droplet; 6 = starch grain; 6
- (ii) 1. dark/Calvin/light independent reaction;
2. light/Hill/light dependent reaction; 2
- TOTAL 12**

QUESTIONSHEET 2

- (a) light intensity; 1
- (b) Y - some other factor is limiting reaction;
Z - light intensity is no longer limiting the reaction;
probably carbon dioxide concentration is now limiting; 3
- (c)  correct arrangement of beaker, funnel and test tube;
plant in correct position with end in stem of funnel;
water and oxygen bubbles correctly shown; 3

TOTAL 7

QUESTIONSHEET 3

- (a)  1
- (i) stack of grana/thylakoid/quantosome should be labelled; 1
- (ii) stroma should be labelled; 1
- (iii) starch grain/oil droplet should be labelled; 1
- (b) glycerate phosphate/phosphoglyceric acid/PGA; 1
- (c) chlorophyll a;
chlorophyll b;
carotene;
phaeophytin/xanthophyll; max 3

TOTAL 7

QUESTIONSHEET 4

- (a) A = 15 mmol CO₂ m⁻² sec⁻¹; (allow 15.1)
B = 25 mmol CO₂ m⁻² sec⁻¹; (allow only 1 mark if no units) 2
- (b) B; because it photosynthesises faster than A up to 20 °C/photosynthetic rate decreases/ lower than A after 20°C; 2
- (c) because the enzymes are denatured/description of denaturation;(No mark for saying “killed”). 1
- (d) Any two of: light intensity/carbon dioxide tension/lack of water;; (not just ‘light/CO₂/water’) 2
- TOTAL 7**
-

QUESTIONSHEET 5

- (a) correct labelled axes (distance on X-axis);
suitable scale (at least half the graph paper);
accurate plotting;
points joined with a ruler (according to IOB instructions for A-Level Biology);
curves labelled; 5
- (b) (i) from 2 to 0.5m, the rate of photosynthesis increases;
after this increasing the light intensity has no effect on the photosynthetic rate;
CO₂ tension probably limiting; 3
- (ii) lower rate of photosynthesis overall in A;
limiting effect in A starts at lower light intensity;
lower rate of photosynthesis in A when CO₂ is limiting; 3
- (c) $I_A = \frac{1}{0.75^2} ; = 1.778 ;$ (accept 1.78) $I_B = \frac{1}{0.50^2} ; = 4.0;$ 4
- TOTAL 15**
-

QUESTIONSHEET 6

- (a) A - carbon dioxide;
B - ADP;
C - NADP; (B and C could be the other way round) 3
- (b) stroma; 1
- (c) can be used to regenerate RuBP; 1
- (d) from the quantosomes/thylacoid membranes;
products of light dependent reaction/photophosphorylation; 2
- (e) polymerisation/condensation/removal of water;
joining glucose molecules by alpha-glycosidic links; 2
- TOTAL 9**

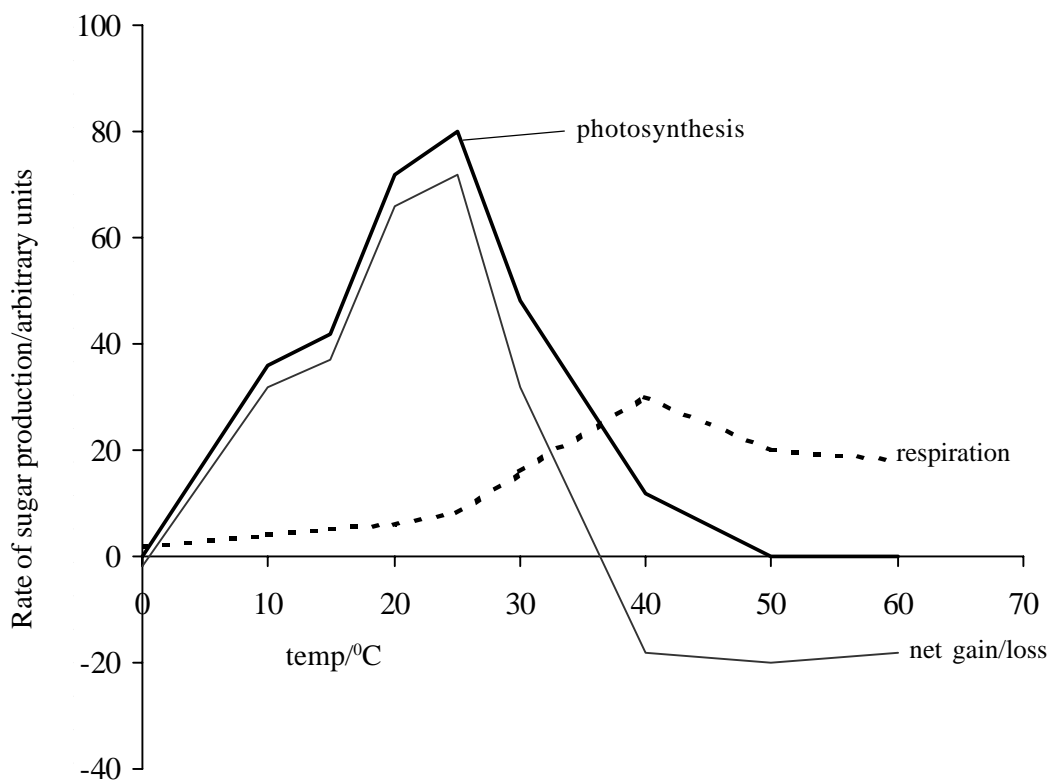
QUESTIONSHEET 7

(a) (i)

Temp °C	Net loss/gain
0	-2
10	32
15	37
20	66
25	72
30	32
40	-18
50	-20
60	-18

;; (2 marks if all correct, penalty of 1 mark per error)

2



(ii) axes labelled (temp. as X axis); suitable scale; accuracy of plotting; points joined with a ruler; curves labelled; 5

(b) (i) 25°C; 2
(ii) 40°C;

(c) (i) the light intensity; at which the rates of photosynthesis and respiration are the same; 2

(ii) 36.5°C; (accept 36.0 to 37.0) 1

TOTAL 12

QUESTIONSHEET 8

- (a) oxygen is an inhibitor of photosynthesis at higher concentrations;
little or no inhibition at atmospheric concentrations;
oxygen is a competitive inhibitor of RuBP carboxylase; 3
- (b) atmospheric levels of carbon dioxide are sub-optimal for photosynthesis;
rates of photosynthesis can be increased by increasing atmospheric concentration of carbon dioxide;
especially at high light intensity;
reference to principle of limiting factors; 4
- (c) (i) the light intensity;
at which the rates of photosynthesis and respiration are equal/no net gain or loss in weight; 2
- (ii) photosynthesis exceeds respiration;
thus plant gains sugar for storage; 2
- (iii) dim light in wood;
thus compensation point occurs at a low light intensity so plant starts to accumulate sugar sooner; 2
- TOTAL 13**
-

QUESTIONSHEET 9

- (a) (i) absorption spectrum shows amount of light absorbed (by photosynthetic pigments) at different wavelengths;
action spectrum shows rate of photosynthesis at different wavelengths;
both have similar profiles/peaks in red and blue; 3
- (ii) cyclic involves photosystem 1 and non-cyclic involves both photosystems 1 and 2;
cyclic generates ATP and non-cyclic generates ATP and NADPH;
non-cyclic is coupled to photolysis of water but cyclic is independent of this; 3
- (iii) C₃ plants produce glyceraldehyde 3 phosphate (3C) from ribulose bisphosphate and CO₂;
C₄ plants produce malic acid (4C) from phospho-enol pyruvic acid and CO₂;
C₄ plants more efficient in high O₂ tensions; 3
- (b) (i) magnesium ions are a component of chlorophyll;
bound onto porphyrin ring of chlorophyll; 2
- (ii) large subunits on thylacoids house photosystem II;
small subunits on thylacoids house photosystem I; 2
- TOTAL 13**
-


QUESTIONSHEET 10

- (a) (i) to ensure no starch is present in the plant at the beginning of the experiment;
as this is what is being tested for; 2
- (ii) starch is broken down to sucrose/glucose;
and used for respiration/transported to roots/storage organ; 2
- (b) dip leaf in boiling water to kill cells;
place in boiling alcohol to remove chlorophyll;
wash in hot water to soften;
spread on a white tile and flood with iodine in potassium iodide;
blue/black indicates presence of starch; 5
- (c) A is completely blue black, B is only blue black where there was no cover;
covered part of B remains iodine colour;
thus starch only made in areas exposed to light; 3

QUESTIONSHEET 11

- (a) X- chloroplast;
Y- mitochondrion;
A- oxygen;
B- carbon dioxide; 4
- (b) oxidative phosphorylation uses energy from oxidation;
of reduced coenzymes/NADH;
to produce ATP;
photophosphorylation involves using light energy;
to produce ATP;
and reduced NADP/NADPH; 6
- (c) (i) ATP used as energy supply for CO₂ fixation in the dark/Calvin reaction;
NADPH used as reducing power when CO₂ is converted to carbohydrate in dark/Calvin reaction; 2
- (ii) ATP is needed for many synthetic chemical reactions;
and processes such as active transport; 2
- TOTAL 14**
-

QUESTIONSHEET 12

- (a) carotene;  red; blue; electron carriers; ATP; stroma; hydrogen; water; NADPH; Calvin; phosphoglyceric;
ribulose biphosphate; hydroxide; oxygen; 14
- (b) water absorbed by roots is a reactant/supplies electrons/H;
for uptake/transport of minerals/needed for turgidity; 2
- TOTAL 16**
-

QUESTIONSHEET 13

- (a) more light at top of tree than at bottom which is shaded;
thus more chloroplasts needed at top and so more palisade cells/fewer chloroplasts needed in shade
/comment on adaptation to microclimates;
possibly lower leaves cannot make enough food to enable growth of extra cells/lower leaves have less nutrition; 3
- (b) peas and beans contain Rhizobium/root nodules for nitrogen fixation;
thus can make more protein; 2
- (c) waste carbon dioxide produced by power station is bubbled through lake;
assimilated by Chlorella for growth and reproduction;
Chlorella is harvested for use as cattle food/reduces CO₂ emission and greenhouse effect; 3
- TOTAL 8**

QUESTIONSHEET 14

- (a) (i) stomatal width increases as concentration of starch decreases; 1
- (ii) stomatal width decreases as concentration of starch increases; 1
- (b) (i) light stimulates conversion of starch to sugars;
therefore as light intensity increases, starch decreases;
sugars reduce water potential of guard cells;
water enters osmotically;
as guard cells swell, stomatal pore opens;
ref uneven thickening of guard cell walls; max 4
- (ii) closed/reduced aperture;
deficit of water means guard cells cannot absorb any and so cannot swell; 2
- (c) peel off epidermis/make a varnish imprint;
use low power light microscope and eyepiece micrometer;
count number of stomata in a square mm; 3
- TOTAL 11**
-

QUESTIONSHEET 15

- (a) most bacteria in red light and blue light/400-450 nm and 650-700 nm/few in yellow-green areas/equivalent; 1
- (b) bacteria congregate where oxygen concentration is greatest;
oxygen released in photosynthesis;
these are the most effective (wavelengths) in photosynthesis; 3
- (c) each pigment absorbs different wavelengths/parts of visible spectrum/has different absorption maxima;
accessory pigments/carotene/xanthophyll become excited/energised;
and pass excited electrons onto chlorophylls;
therefore leaves/plants are able to absorb more/a lot of light; max 3
- TOTAL 7**
-

QUESTIONSHEET 16

- (a) compensation point;
light intensity at which CO₂ uptake = CO₂ output/rate of photosynthesis equals rate of respiration;
plant can only gain mass/grow when X is exceeded; max 2
- (b) increasing light intensity stimulates light dependent stage/stimulates cyclic/non-cyclic photophosphorylation;
some other factor becoming limiting/slowing rate of reaction;
such as carbon dioxide concentration; max 2
- (c) (i) oxygen;
NADPH;
ATP; 3
- (ii) ATP provides energy for conversion of PGA to TP;
NADPH provides hydrogen/H atoms/reducing power for conversion of PGA to TP; 2
- TOTAL 9**

QUESTIONSHEET 17

- (a) $\frac{190 + 180 + 185}{3}$; = 185 mg CO₂ 6hr⁻¹; 2
- (b) Y;
CO₂ absorbed in light;
plus CO₂ released in respiration (in light); (Reject respiration in dark -it is not photosynthesising in the dark) 3
- (c) $\frac{180}{200} \times 100$; = 90% ; 2
- (d) Chlorella absorbs CO₂ to make biomass;
this can be sold as cattle fodder/food/fertiliser; 2
- Chlorella absorbs CO₂ and so reduces greenhouse effect;
reduces global warming/eq. ; 4
- TOTAL 11**
-

QUESTIONSHEET 18

- (a) (i) amino acid/protein/DNA/RNA/nucleotide synthesis; 1
- (ii) carries energy in form of ATP/ref. to photophosphorylation; 1
- (iii) component of chlorophyll molecules/component of middle lamella (of cell wall); 1
- (b) factor which limits/restricts the rate of a process/named metabolic process;
that factor which is closest to its minimum value; 2
- (c) (i) higher phosphate increases yield; 1
- (ii) 60 (59-61) kg ha⁻¹; 1
- (d) (i) leaching out into water contributing to eutrophication/blue baby syndrome/may increase risk of stomach cancer if
converted to nitrosamines; 1
- TOTAL 8**

QUESTIONSHEET 19

- (a) cut up leaves and macerate/grind up;
suitable solvent/acetone/acetone ether mixture;
micropipette on to paper repeatedly;
allow to dry each time/use of hair dryer; 4
- (b) Any two of: use pencil line, not ink/pen/
do not allow solvent to touch line/
seal/allow time to achieve saturated atmosphere in tube/
do not allow paper to touch sides/avoid contamination by substances on fingers/
keep cold/in dark;; 2
- (c) different pigments absorb different wavelengths/parts of visible spectrum;
greater amount of light absorbed/faster photosynthesis; 2
- TOTAL 8**
-

QUESTIONSHEET 20

- (a) ensure pigment spot is above solvent/ensure atmosphere in container was saturated with solvent before running; 1
- (b) solutes/pigments dissolve in solvent;
solvent moves up paper;
distance moved by solutes/pigments depends on their relative solubility/molecular size; 2
- (c) (i) relative flow (Rf) is a physical constant;
for a specific solute in a specific solvent;
it is the distance moved by the solute divided by the distance moved by the solvent (front); **max 2**
- (ii) $B = \frac{35}{93} = 0.38; (0.376)$ $C = \frac{36}{93} = 0.39; (0.387)$ 2
- (ii) 2-way chromatography/run with a different solvent; 1
- TOTAL 8**