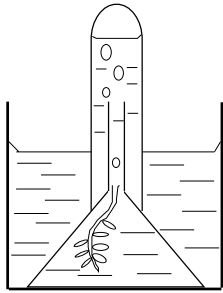


**QUESTIONSHEET 1**

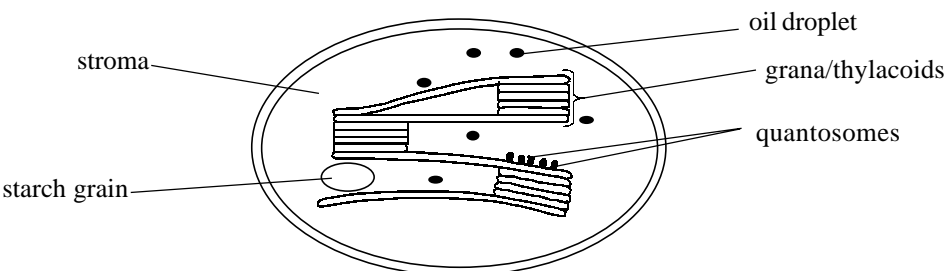
- (a) A - vascular bundle;  
B - palisade mesophyll;  
C - spongy mesophyll; 3
- (b) B/palisade mesophyll; 1
- (c) (i) 1 = double membrane/envelope; 2 = granum; 3 = quantosomes;  
4 = stroma; 5 = lipid droplet; 6 = starch grain; 6
- (ii) 1. dark/Calvin/light independent reaction;  
2. light/Hill/light 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 CO<sub>2</sub> m<sup>-2</sup> sec<sup>-1</sup>; (allow 15.1)  
B = 25 mmol CO<sub>2</sub> m<sup>-2</sup> sec<sup>-1</sup>; (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/CO<sub>2</sub>/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;  
CO<sub>2</sub> 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 CO<sub>2</sub> 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**

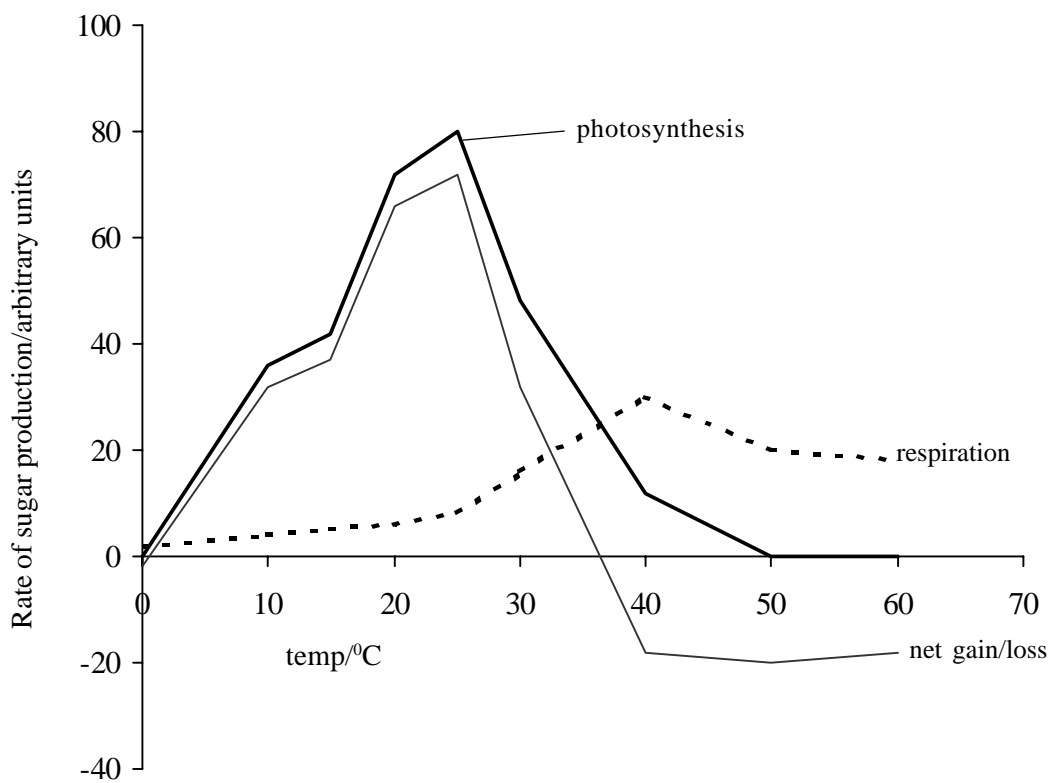
QUESTIONSHEET 7

(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) C<sub>3</sub> plants produce glyceraldehyde 3 phosphate (3C) from ribulose bisphosphate and CO<sub>2</sub>;  
C<sub>4</sub> plants produce malic acid (4C) from phospho-enol pyruvic acid and CO<sub>2</sub>;  
C<sub>4</sub> plants more efficient in high O<sub>2</sub> 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 CO<sub>2</sub> fixation in the dark/Calvin reaction;  
NADPH used as reducing power when CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> uptake = CO<sub>2</sub> 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 CO<sub>2</sub> 6hr<sup>-1</sup>; 2
- (b) Y;  
CO<sub>2</sub> absorbed in light;  
plus CO<sub>2</sub> 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 CO<sub>2</sub> to make biomass;  
this can be sold as cattle fodder/food/fertiliser; 2
- Chlorella absorbs CO<sub>2</sub> 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<sup>-1</sup>; 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**