Mark schemes

1

(a) Stroma (of chloroplasts);

Reject: stoma.

Reject: stroma of chlorophyll or any reference to chlorophyll.

Accept: stroma of chloroplasts.

1

(b) (i) (Less) RuBP combines with carbon dioxide;

Accept: binds/joins.

1

(ii) 1. Temperature is a limiting factor/below optimum;

2. Light is a limiting factor/below optimum;

Accept: limited by reduced NADP or ATP.

3. Limited by RuBP (available/produced);

Accept: RuBP will always give 2 GP (at high CO_2).

4. Limited by enzyme;

Accept: limited by Rubisco.

2 max

(c) 1. (Provides) hydrogen / protons/H^+ **and** electrons/e^-;

Ignore: if water is used as source of hydrogen.

2. For reduction;

Reject: reduction of NAD.

Reject: reduction by H^+ or protons on their own.

3. Source of electrons for chlorophyll/electron transfer chain;

Accept: electrons for photophosphorylation.

Ignore: photosystems.

1, 2 and 3. Reject: reference to respiration/mitochondria.

2 max

[6]

2

(a) (i) Stroma (of chloroplasts);

Reject: stoma

1

(ii) 2;

1

(b) 1. As oxygen (concentration) increases less Rubisco / RuBP reacts / binds with carbon dioxide;

1. Accept - as oxygen (concentration) increases more Rubisco / RuBP reacts / binds with oxygen

1. Accept – less GP / more phosphoglycolate formed as oxygen (concentration) increases

2. Competitive inhibition / competition between oxygen and carbon dioxide for rubisco / enzyme / active site (therefore) less RuBP formed / regenerated (to join with carbon dioxide);

2. Accept oxygen and carbon dioxide are complementary to active site

2

(c) 1. Less glycerate 3-phosphate / GP produced;

1. Accept one GP formed rather than two GP

2. (Less) triose phosphate to form sugars / protein / organic (product) / any named photosynthetic product;

3. Less RuBP formed / regenerated;

3. Accept RuBP takes longer to form

3

[7]

3 (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 Pi;

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]

4

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

1

(ii) CO_2 used / O_2 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]

5

(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 → 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]

6

(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]