Mark schemes

Q1.

(a) 1. (Percentage of light absorbed at each wavelength) correlates (with rate of photosynthesis);

Accept description of correlates e.g. as % light absorbed increases so does photosynthesis or converse.

Ignore directly proportional.

2. High(er)/increases (rate of photosynthesis) with blue **and** red light **and** low(er) /decreases (rate of photosynthesis) with green light;

Ignore wavelength.

*Reject '**no** photosynthesis with green light'.*

Accept other words which are equivalent to 'high(er)' and 'low(er)'.

2

(b) 1. Intensity/brightness of light (at each wavelength)

Accept 'distance of/from light source'.

Reject sunlight.

2. Carbon dioxide concentration

Accept conc. for concentration.

3. Temperature

4. Water

OR

Humidity;;

Accept water potential/Ψ (of soil).

Ignore pH and nutrients.

*3 correct = **2 marks***

*2 correct = **1 mark***

*0–1 correct = **0 marks***

2 max

(c) 1. ATP and reduced NADP;

Accept NADPH or $NADPH_2$ or NADP + H for reduced NADP.

2. ATP provides energy;

3. GP reduced to triose phosphate;

Must have idea of reduction. This may be conveyed by stating GP converted to triose phosphate using reduced NADP.

Accept TP for triose phosphate as triose phosphate is named in the question.

If GP named it must be correct.

3

[7]

Q2.

(a) 1. Draw line/origin on (chromatography) paper (using ruler and pencil);

2. (Use pipette/tubing/dropper to) add chlorophyll/solution to origin/line;

3. Add solvent/**A** below line/origin;

Accept 'so solvent is not above line' for 'solvent below line'.

4. Remove/stop (from glassware) before solvent reaches end (of chromatography paper)
OR

Mark (position) where solvent reaches/front;

Accept all marks on a labelled diagram.

Allow filter paper for chromatography paper.

Accept remove/stop (immediately) when solvent reaches end/top.

Accept ensure solvent does not reach top/end.

Ignore Rf values.

4

(b) For **2 marks** = two pigments have same solubility in (solvent) **A** but different solubility in (solvent) **B**
OR

For **2 marks** = one pigment is soluble in (solvent) **B** but not in (solvent) **A**
OR

For **2 marks** = pigments have different solubilities in the solvents/**A** and **B**
OR

For **2 marks** = one pigment is only soluble in (solvent) **B**
OR

For **2 marks** = one pigment is insoluble (only) in (solvent) **A**;;

For **1 mark** = response as for 2 marks but refers to solution rather than solvent;

Accept 'dissolves' for solubility.

Accept correct reference to 'affinity' for solubility e.g., 'greater affinity' (to solvent) indicates more soluble.

Accept correct reference to 'polarity' for solubility' e.g. pigments have different polarities.

Accept 'Rf value' for solubility.

Ignore 'solvent stronger'.

2

[6]

Q3.

(a) 1. Organic

2. Respiration

Ignore aerobic/anaerobic

3. Carbon

Accept cells/tissue(s)/plant(s)/animal(s)/organism(s)/ NPP/ living material/biological molecules.

Ignore biomass/biological materials/organic matter and reference to 'dry'.

4. Calorimetry;;

Accept calorimeter but reject colorimeter.

Accept phonetic spellings.

*4 correct = **2 marks***

*2–3 correct = **1 mark***

*0–1correct = **0 marks***

2

(b) 1. Carbon dioxide combines/reacts with ribulose bisphosphate/RuBP;

Accept idea of fixation for 'reacts'.

2. Produces two glycerate (3-)phosphate/GP using (enzyme) Rubisco;

Accept: any answer which indicates that 2 × as much GP produced from one RuBP catalysed by Rubisco.

Reject GP once if incorrectly named e.g., glucose 3- phosphate.

3. GP reduced to triose phosphate;

Reject GP once if incorrectly named e.g., glucose 3- phosphate.

Must have idea of reduction. This may be conveyed by stating mp4.

Only accept TP if triose phosphate is also in the answer. However only penalise once.

4. Using reduced NADP;

Accept NADPH or $NADPH_2$ or NADPH + H for reduced NADP.

Reject: Any reference to reduced NAD for mp4 but allow reference to reduction for mp3.

Must be in context of GP to triose phosphate.

5. Using <u>energy</u> from ATP;

Must be in context of GP to triose phosphate.

6. Triose phosphate converted to glucose/hexose/RuBP/ribulose bisphosphate/named organic substance;

Only accept TP if triose phosphate is also in the answer. However only penalise once.

Accept marks in suitable diagram.

6

[8]

Q4.

(a) Correct answer of 6.0×10^8/6.02×10^8/6.0192×10^8 = **3 marks**;;;

601920000 = **2 marks**;;

8.8 × any **two** of 12000 **OR** 95 **OR** 60 = **1 mark**

1.0032×10^7 / 6.336×10^6 / 5.0160×10^4 = **1 mark**

*Correct answer but not in correct standard form = **2 marks**, eg 60.192×10^7*

Accept 10032000 / 6336000 / 50160 for 1 mark

3

(b) 1. (This difference) is **not** significant;

2. There is greater than a 0.5 probability that this difference is due to chance
OR
There is greater than a 0.05 probability that this difference is due to chance

Accept 50%/1 in 2 for 0.5

Accept 5%/1 in 20 for 0.05

Reject 'results' for 'difference' once

2

(c) 1. Less ATP **and** reduced NADP produced;

Accept NADPH/$NADPH_2$ for reduced NADP

Reject less reduced NAD/NADH for reduced NADP

2. Less GP/glycerate 3-phosphate reduced/converted to triose phosphate;

*If triose phosphate is not mentioned, **reject TP once***

3. Less triose phosphate to regenerate/make RuBP
OR
Less RuBP is regenerated/made;

*If triose phosphate is not mentioned, **reject TP once***

4. Less RuBP to react with carbon dioxide

Need idea of less at least once

*Reject **no** once*

*If mark points 2, 3 and 4 are not present, allow 1 mark for less light independent reactions **OR** fewer Calvin cycles.*

4

(d) 1. 3.5875×10^{-3};
Accept any correct rounding eg 4×10^{-3}

2. kg m^{-2} h^{-1};
Accept per m^2 ***and/or*** *per hour*
Accept kg/m^2/h
Accept kg h^{-1} m^{-2}
Reject kg^{-1}
Reject m^{-2} h^{-1} kg ***OR*** *h^{-1} m^{-2} kg*

2

(e) 1. (In the shade, so) **less/slower rate of** photosynthesis;
Accept any named aspect of photosynthesis that uses light, eg LDR, photoionisation

2. (Slow-growing, so) would take a long time to replace (mature leaves)
OR
Leaves more likely to reach maturity
OR
Leaves take a long time to mature;
Accept would take a long time to make cellulose or any other correct named compound

3. Plants can maintain (a large enough) surface area for photosynthesis
OR
Plants can absorb enough light;

2 max

(f) Yes (no mark)

1. The most recently evolved species/asterids produce more than the mean concentration;

2. The least recently evolved species/ferns produce less than the mean concentration;

No (no mark)

3. The highest concentration was **not** in the most recently evolved species/asterids
OR
The highest concentration was in magnoliids
OR
Magnoliids produce more than more recently evolved species/basal angiosperms/rosids/ asterids;

4. The lowest concentration was **not** in the least recently evolved species/ferns
OR
The lowest concentration was in monocots
OR
Monocots evolved more recently but produce a lower concentration than ferns;

5. The least recently evolved species/ferns have the same concentration as more recently evolved species/basal angiosperms/rosids;

6. Basal angiosperms and rosids have the same concentration but evolved at different times;

Ignore answers relating to no statistical testing

Accept 'newest species' for most recently evolved species/asterids

Accept 'oldest species' for least recently evolved species/ferns

2 max

[15]