

Mark schemes

Q1.

- (a) NADP, ADP, Pi and water; 1
- (b) 1. Chlorophyll absorbs light
OR
Light excites/moves electrons in chlorophyll;
Ignore photosystems.
2. Electron/s are lost
OR
 (Chlorophyll) becomes positively charged;
Ignore site/molecule from where electrons are lost.
Accept electrons go to electron transport/carrier chain for 'electrons lost'. 2
- (c) Ink and (leaf) pigments would mix
OR
 (With ink) origin/line in different position
OR
 (With pencil) origin/line in same position
OR
 (With pencil) origin/line still visible; 1
- (d) 1. Level of solvent below origin/line;
Reject water or any named aqueous solution.
Accept named organic solvent.
2. Remove/stop before (solvent) reaches top/end; 2
- (e) Accept any answer in range of 0.58 to 0.62;
Accept 0.58 or 0.62.
Ignore any numbers which follow numbers in range. 1
- (f) (Absorb) different/more wavelengths (of light) for photosynthesis;
Accept wider/larger range of wavelengths.
Accept frequency for wavelength.
Accept light-dependent reaction /photophosphorylation /photoionisation for photosynthesis. 1

Q2.

- (a) 1. (Less/no) ATP;
 2. (Less/no) reduced NADP;
Accept NADPH, NADPH + H, NADPH₂ NADPH + H⁺
Reject reduced NAD, NADH etc, 2
- (b) 1. (Less/no) carbon dioxide (reacts) with RuBP;
 2. (Less/no) GP; 2
- (c) 1. Stroma (of/in chloroplast);
Reject: stoma
Reject stroma of cytoplasm/chlorophyll
Reject stroma of mitochondrion
Ignore references to Calvin cycle or the light-independent reaction 1
- (d) 1. Rubisco activity increases with temperature
OR
 Rubisco optimum temperature is above (**rubisco activase**);
 2. (Rubisco) **activase** activity decreases at high temperatures (allow any temperature above 25 °C.)
OR
 (Rubisco) **activase** optimum (allow in range) 25 to 30 °C.;
Accept denatures at high temperature (allow any temperature above 25 °C)
 3. (Results/graphs suggest) **activase** cannot/does not affect activity of rubisco;
 4. (Results are) only for cotton;
Accept may not be the same in other species/types of plant
Ignore: only one study
 5. (Results are) for isolated enzymes;
 6. No stats test;

4 max

[9]

Q3.

- (a) 1. Oxygen produced in light-dependent reaction;
2. The faster (oxygen) is produced, the faster the light-dependent reaction.

2

- (b) 35–36 μmol Oxygen per mg chlorophyll.

*Correct difference at 500 $\mu\text{mol photons m}^{-2} \text{s}^{-1}$ or
incorrect difference but division by 4 shown = 1
mark.*

2

- (c) At all light intensities, chloroplasts from mutant plants:
1. Have faster production of ATP and reduced NADP;
2. (So) have faster / more light-independent reaction;
3. (So) produce more sugars that can be used in respiration;
4. (So) have more energy for growth;
5. Have faster / more synthesis of new organic materials.

*Accept converse points if clear answer relates to
non-mutant plants*

4 max

[8]**Q4.**

- (a) 1. Stirrer distributes heat (energy);
*Accept stirrer ensures equal/even temperature or
prevents build up of 'hot spots'.*
2. Insulation/space/air reduces loss/gain of heat

OR

Insulation/space/air reduces conduction/convection;
Reject vacuum.

3. Water has high (specific) heat capacity;

2 max

- (b) $3.28 / 3.3 \text{ (kJ g}^{-1}\text{)} = \mathbf{2 \text{ marks;;}}$

Incorrect answer but shows $328 / 33$ (ignore any subsequent numbers and decimal point) = **1 mark**

OR

Incorrect answer of $6.56 / 6.6 \text{ (kJ g}^{-1}\text{)}$ (ignore any subsequent numbers) = **1 mark;**

2

- (c) 1. (Light is) reflected;
Light is not absorbed on its own is not enough.
2. (Light is) wrong wavelength;

*Accept frequency for wavelength.
Accept reference to absorbing specified
wavelengths/frequencies.*

3. (Light) misses chlorophyll/ chloroplasts/photosynthetic tissue;
4. CO₂ concentration or temperature is a limiting factor.

2 max

- (d) 1. ATP;
2. Reduced NADP;
*Accept 1 and 2 in either order.
Reject Reduced NAD.
Accept NADPH/NADPH₂.*

2

- (e) Correct answer of $1.31/1.3 \times 10^8$ (ignoring any subsequent numbers after 1.31) = **2 marks**;;

Incorrect answer but shows 2^{16} = **1 mark**

OR

65536 in any correct numerical form = **1 mark OR**

Incorrect answer but shows 131 ignoring any subsequent numbers and ignoring any decimal point = **1 mark**;

2

[10]

Q5.

- (a) 7.7(%);

1

- (b) 1. No error bars / SD;
2. To show if overlap occurs so difference (in means) is not significant / due to chance
OR
To show if no overlap occurs so difference (in means) is significant / is not due to chance.

Do not accept 'no statistical test performed' as Chi squared / Spearman's rank would be inappropriate.

Ignore references to sample size as it can be assumed that scientists completed the study using appropriate methodology.

2

- (c) 1. Reduced transfer of protons across thylakoid membrane
OR
Reduced chemiosmotic gradient / proton gradient across thylakoid membrane;

2. (So) less ATP produced;
3. (So) less reduced NADP produced;
Accept NADPH / NADPH₂ / NADPH⁺
Reject reduced NAD
4. (So) light-independent reaction slows / stops;
OR
Less reduction of GP to triose phosphate.

4

- (d) Idea that energy is released from high energy / excited electron/s (that were lost from chlorophyll)

1

[8]