Mark schemes

1

(a) 1. Time taken to reach maximum blood flow varied widely/significantly;

Must be emphasis on idea of 'widely'. Mention only of 'vary' is insufficient. Ignore use of numbers unless a comparison is given

Ignore any mention of a correlation between maximum percentage increase in blood flow and time taken to reach maximum increase in blood flow

2. Quickest after a carbohydrate-only meal;
OR
Slowest after a protein-only meal;

2

(b) 1. More blood flows to (skeletal) muscles (during exercise);

2. (supplying) more oxygen / glucose / removing more carbon dioxide/ lactic acid/ heat;

1 and 2. Idea of 'more' is needed

More blood to muscles delivering oxygen = 2 marks

3. For high (rate of) respiration / to meet increased demand for energy/ATP;
OR
Prevents anaerobic respiration/lactic acid build up;

Accept: reduces/delays for prevent

3

(c) **Immediate effect of exercise after meal**

1. Meal increases blood flow in (mesenteric) artery AND exercise decreases blood flow in (mesenteric) artery;

1. Will relate to information given in the tables

Overall effect on blood circulation

2. Insufficient blood (flow to small intestines / muscles);

2. Accept: blood diverted away/shunted

Ignore references to 'strain on heart', 'heart disease', 'cardiovascular diseases'

Ignore references to controlling variables and reliability

Effect on blood flow of type of meal

3. Carbohydrate meal quick(er) / during exercise;
OR
Protein/fat meal slow(er) / after exercise;

Effect of reduced blood flow on cells

4. (More) anaerobic (respiration) / lactic acid produced;
OR
less aerobic respiration;

Consequence for person of changed blood flow

5. Less absorption (of digested food) / faeces contains digested food;
6. Cramp / indigestion / discomfort / fatigue;

*Look for **ideas** in each of 5 areas*

MP1 might be spread throughout the answer

6. Ignore references to digestion

Max 4

(c) 1. (blood flows from kidney along) renal vein to vena cava;
2. (along) vena cava to <u>right</u> atrium/side of heart;
3. (along) pulmonary artery to lungs;
4. (along) capillaries to pulmonary vein;
5. (along) pulmonary vein to <u>left</u> atrium/side of heart;
6. (along) aorta to renal artery (to kidney);
7. Blood may pass through several complete circuits before returning to kidney;

Reject: 'blood vessel pumps' only once

Ignore references to valves

Ignore references to heart action/cardiac cycle

Accept labelled diagram must include directional arrows

Max 6

[15]

2

(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]

3

(a) 1. Respiration/metabolism/ammonification;
2. (Releases/produces) heat;

Reject: 'produces energy'.

2

(b) 1. SD is spread of data around the mean;

Accept: variation around the mean.

*Accept: range is difference between highest and lowest values/extremes **or** range includes anomalies/outliers.*

2. (SD) reduces effect of anomalies/ outliers;

Reject: (SD) removes anomalies/outliers.

3. (SD) can be used to determine if (difference in results is) significant/not significant/due to chance /not due to chance;

Ignore: reliability/accuracy/validity.

2 max

(c) 1. Distributes heat / prevents 'hot' spots;
2. Distributes microorganisms;
3. More enzyme-substrate complexes;
4. Increases rate of decomposition;

Accept: increases nitrification/ammonification or 'breaks down waste faster'.

5. Aeration/provides oxygen;

2 max

(d) 1. Microorganisms change the abiotic conditions/temperature /organic waste /provide nutrients;

Must refer to microorganisms or bacteria/named bacteria causing the change.

Ignore: change the environment.

2. Less hostile conditions;
3. Decline in Cocci **and** increase in rods;

Accept: 'decrease in cocci, others are going up'.

Accept: decrease in cocci and increase in either rod type or increase in both types.

4. Gram positive outcompete / better competitors;

Accept: rods outcompete (cocci) / better competitors.

3 max

[9]

4

(a) (i) Cytoplasm/cytosol;

1

(ii) 1. Regenerates/produces NAD / oxidises reduced NAD;
2. NAD reduced in stage 1/glycolysis / NAD accepts hydrogen in stage 1/glycolysis;

Note: penalise use of NADP for first marking point obtained.

Do not accept NAD accepts only protons but allow accepts protons and electrons.

2

(b) (i) 1/one/1.0;

1

(ii) 1. Aerobic and anaerobic respiration occurring;

Accept: some/mainly anaerobic respiration occurring.

2. More carbon dioxide produced than oxygen uptake;

2

(c) 1. Oxygen is final/terminal (electron) acceptor / oxygen combines with electrons and protons;
2. (Aerobic respiration) oxidative phosphorylation / electron transfer chain;
3. Anaerobic (respiration) only glycolysis occurs / no Krebs / no link reaction;

Ignore: number of ATP produced.

3. Accept: without oxygen.

3. Ignore: converse.

2 max

[8]

5

(a) 1. (Use) coordinates / number the rocks/sites/squares;

Ignore: references to grid, tape measures, metre rulers etc.

2. Method of generating/finding random numbers e.g. calculator/computer/random number generator/random numbers table;

Accept: numbers out of a hat / use of dice.

2

(b) Difficult/too many to count / individual organisms not identifiable / too small to identify/count / grows in clumps;

Ignore: easier/quicker/representative/ more accurate, unless qualified.

1

(c) Any suitable factor with valid explanation = 1 mark

1. Wave action - firmer grip on rock is necessary (at either site);
2. Wind/air movement/less humid - more evaporation at site A / more (physical) damage;
3. Light – (linked to) photosynthesis (at either site);
4. Temperature – (linked to) photosynthesis/respiration/enzymes/ evaporation (at either site);
5. pH – (linked to) enzymes/proteins;

Note: other common factors include salt (salinity) linked to water potential / named nutrient e.g. nitrate linked to protein/DNA.

Ignore: carbon dioxide/oxygen/pollution/rainfall/food/nutrients.

Reject: biotic factors e.g. predation.

2 max

(d) 1. Greater variety of food / more food sources;

Ignore: more food.

2. More/variety of habitats/niches;

Ignore: homes/shelters.

Accept: different habitats.

2

(e) (i) 1. (So they were) hungry/not full;

Accept: description of hunger e.g. appetite / 'empty stomach'/'so they eat'.

2. (Allows) comparison;

2

(ii) 1. Alga without consumer/named consumer/animal;

Accept: repeat experiment without consumer.

Accept: in separate tank / in tank where not eaten.

2. (Find change in mass) in dark;
3. For 50 hours;

Accept: 'same time as in experiment'.

Accept: For lower time period then scaled up to 50.

3

(iii) 1. For *Laurencia pacifica* **and** *Cystoseira osmondacea*

(difference in results) significant /reject null hypothesis / not due to chance / less than 5%/0.05 probability due to chance;

Accept: for Laurencia pacifica 'less than 1%/0.01 probability'.

2. For *Egregia leavigata* **and** *Microcystis pyrifera* no significant (difference in results)/accept null hypothesis / is due to chance/more than 5%/0.05 probability due to chance;

Accept: 'insignificant' for 'no significant difference'.

3. (Difference in results) for *Laurencia pacifica* is the most significant;

Note: reference to probabilities on their own is not sufficient.

1, 2 and 3. Accept: abbreviations for all species.

3

[15]

6

(a) 1. Excites electrons / electrons removed (from chlorophyll);

Accept: higher energy level as 'excites'.

2. Electrons move along carriers/electron transfer chain releasing energy;

Accept: movement of H^+/protons across membrane releases energy.

Reject: 'produces energy' for either mark but not for both.

3. Energy used to join ADP and Pi to form ATP;

Reject: 'produces energy' for either mark but not for both.

Accept: energy used for phosphorylation of ADP to ATP

Do not accept P as Pi but accept phosphate.

4. Photolysis of water produces protons, electrons and oxygen;

5. NADP reduced by electrons / electrons and protons / hydrogen;

Accept: NADP to NADPH (or equivalent) by addition of electrons/hydrogen.

Do not accept NADP reduced by protons on its own.

5

(b) 1. Protein/amino acids/DNA into ammonium compounds / ammonia;

Accept: any named nitrogen containing compound e.g. urea.

2. By saprobionts;

Accept: saprophytes.

3. Ammonium/ammonia into nitrite;

4. Nitrite into nitrate;

5. By nitrifying bacteria/microorganisms;

Reject: nitrifying bacteria in root nodules.

1, 3 and 4. Accept: marks for conversion even if incorrect type of bacteria named as being involved.

2 and 5. Reject: marks for type of bacteria if linked to incorrect process e.g. nitrite converted to nitrate by saprobionts.

3 and 4. Accept: for one mark ammonia/ammonium into nitrate if neither mark point 3 or 4 awarded.

Note: there are no marks for the role of nitrogen-fixing bacteria as the question refers to producing a source of nitrates from the remains of crops.

5

[10]

7

(a) 1. Antigen stimulates immune response / activates B/T cells;

2. B/T cells divide OR antibodies produced;

3. Antibodies/T cells attack myelin sheaths;

Ignore references to antigen binding to myelin

3

(b) 1. Fewer cristae/smaller surface area (of cristae);
2. So less electron transport/oxidative phosphorylation;
3. (So) not enough ATP produced

OR

Not enough energy to keep neurones alive;

1. Accept 'inner membrane' as 'cristae'

2. Accept fewer ATP synthase enzymes

2. Accept lower rate of electron transfer/oxidative phosphorylation

3. Accept less use/stimulation of neurone leads to death of cell

3. Accept no/less ATP produced/no energy to keep neurones alive

3. Ignore references to glycolysis/ Krebs cycle

3

(c) (i) (Transmission) electron (microscope) – **no mark**

Need high resolution (to see structure of mitochondria)

Accept 'scanning electron microscope' /TEM/SEM

Accept – optical microscope not high enough resolution

1

(ii) 1. Took photographs/areas at random;
2. Counted total number (of normal) and number of unusual mitochondria;
3. Divided number of unusual mitochondria by total number and multiplied by 100;

1. Accept (very) large number of areas/photos/samples

MP 3 = 2 marks (includes MP2)

3

[10]

8

(a) 1. Equilibrium reached.

Accept equilibrate

2. Allow for expansion / pressure change in apparatus;
3. Allow respiration rate of seeds to stabilise.

Ignore seeds acclimatise

3

(b) 1. Optimum temperature / temperature for normal growth of seeds;
2. (Optimum temperature) for enzymes involved in respiration.

2

(c) 1. Oxygen taken up / used by seeds;
2. CO_2 given out is absorbed by KOH (solution);
3. Volume / pressure (in **B**) decreases.

3

(d) 0.975 / 0.98.

If incorrect,

0.26 × 6 / or incorrect numbers divided by 1.6 for 1 mark

2

[10]

9

(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 µmol photons m^{-2} 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]

10

(a) 1. Reduction in ATP production by aerobic respiration;
2. Less force generated because fewer actin and myosin interactions in muscle;
3. Fatigue caused by lactate from anaerobic respiration.

3

(b) Couple **A**,
1. Mutation in mitochondrial DNA / DNA of mitochondrion affected;
2. All children got affected mitochondria from mother;
3. (Probably mutation) during formation of mother's ovary / eggs;

Couple **B**,
4. Mutation in nuclear gene / DNA in nucleus affected;
5. Parents heterozygous;
6. Expect 1 in 4 homozygous affected.

4 max

(c) 1. Change to tRNA leads to wrong amino acid being incorporated into protein;
2. Tertiary structure (of protein) changed;
3. Protein required for oxidative phosphorylation / the Krebs cycle, so less / no ATP made.

3

(d) 1. Mitochondria / aerobic respiration not producing much / any ATP;
2. (With MD) increased use of ATP supplied by increase in anaerobic respiration;
3. More lactate produced and leaves muscle by (facilitated) diffusion.

3

(e) 1. Enough DNA using PCR;
2. Compare DNA sequence with 'normal' DNA.

2

[15]

11

(a) 1. To kill any fungus / bacteria on surface of seeds or in soil;
2. So only the added fungus has any effect.

2

(b) So that only nitrate or ammonia / type of fertiliser affects growth.

1

(c) 1. So that effects of nitrate or ammonium alone could be seen;
2. So that effects of fungus can be seen.

2

(d) 1. Weigh samples at intervals during drying;
2. To see if weighings became constant (by 3 days).

2

(e) With live fungus – showing effects of the fungus:
1. Fungus increases growth of roots and shoots in both;
2. Produces greater growth with nitrate.

With heat-treated fungus – showing effects of fertiliser:

3. Similar dry masses for roots and shoots;
4. (Probably) no significant difference because SDs overlap.

4

(f) 1. Dry mass measures / determines increase in biological / organic material;
2. Water content varies.

2

(g) 1. Fungus with nitrate-containing fertiliser gave largest shoot: root ratio;
2. And largest dry mass of shoot;
3. 6.09:1 compared with ammonium-containing fertiliser 4.18:1

2 max

[15]

12

(a) 1. (No grease)
means stomata are open
OR
allows normal CO_2 uptake;

Allow 'gas exchange' for CO_2 uptake.

'As a control' is insufficient on its own.

2. (Grease on lower surface)
seals stomata
OR
stops CO_2 uptake through stomata
OR
to find CO_2 uptake through stomata
OR
shows CO_2 uptake through cuticle / upper surface;

3. (Grease on both surfaces) shows sealing is effective
OR
stops all CO_2 uptake.

3

(b) (i) 1. (Mean rate of) carbon dioxide uptake was constant *and* fell after the light turned off;

Ignore absence of arbitrary units in both marking points.

Both ideas needed for mark.

Accept 'stayed at 4.5' as equivalent to 'was constant'.

2. Uptake fell from 4.5 to 0 / uptake started to fall at 60 minutes and reached lowest at 80 minutes / uptake fell over period of 20 minutes;

One correct use of figures required.

Accept fell to nothing / no uptake for 0.

2

(ii) 1. (Because) water is lost through stomata;
2. (Closure) prevents / reduces water loss;
3. Maintain water content of cells.

This marking point rewards an understanding of reducing water loss e.g. reduce wilting, maintain turgor, and is not related to photosynthesis.

2 max

(c) (i) (Carbon dioxide uptake) through the upper surface of the leaf / through cuticle.

1

(ii) 1. No use of carbon dioxide in photosynthesis (in the dark);
2. No diffusion gradient (maintained) for carbon dioxide into leaf / there is now a diffusion gradient for carbon dioxide out of leaf (due to respiration).

2

[10]

13 (a) R.

1

(b) 1. Protein / amino acids broken down (to ammonium ions / ammonia);

Accept: nucleic acids / RNA / DNA / urea / any named nitrogen containing compound as an alternative to protein / amino acids

Accept: saprophytes / saprotrophs

2. By saprobionts / saprobiotic (microorganisms).

Neutral: decomposers

Reject: answers where incorrect type of bacteria given as saprobionts e.g. Nitrogen fixing bacteria

2

(c) 1. (Fertility increased as) more nitrate formed / less nitrate removed / broken down;

Accept: Nitrate remains

2. Less / no denitrification / process P is decreased / fewer denitrifying bacteria.

Accept: more nitrification / more nitrifying bacteria / process R is increased

2

(d) 1. Grow crops / plants with nitrogen-fixing (bacteria);

Accept: grow legumes / named example e.g. peas, beans, clover

Accept: <u>fallow</u> year

Accept: use different amounts of ions / nutrients

2. (Different crops use) different minerals / salts / nutrients / ions (from the soil);
3. (Different crops have) different pests / pathogens / diseases.

2 max

[7]