Mark schemes

1

(a) 1. Contents of phloem vessel pushed into insect's mouth by high pressure;

2. (High pressure in phloem vessel) caused by loading of sugars into phloem in leaf;

3. And (resulting) entry of water by osmosis.

3

(b) 1. Polysaccharides are insoluble;

2. So do not affect water potential of gut.

2

(c) 1. (Only few bacteria passed from parent, so) only a few (copies of) genes passed on (inbacteria);

2. May not / does not include all alleles (of genes, so diversity reduced)
OR
Small number of bacteria transmitted means unrepresentative sample.

2

(d) 1. Number / mass / density of insects per plant;

2. Stage of development / size of plants / insects;
Ignore any abiotic factor

2

(e) Draw around leaf on graph paper **and** count squares;

1

[10]

2

(a) 1. Water potential becomes lower / becomes more negative (as sugar enters phloem);

2. Water enters phloem by osmosis;
3. Increased volume (of water) causes increased pressure.

3

(b) 1. Rate of photosynthesis related to rate of sucrose production;2. Rate of translocation higher when sucrose concentration is higher.

2

(c) 1. Rate of translocation does not fall to zero / translocation still occurs after 120 minutes;
2. But sucrose no longer able to enter cytoplasm of phloem cells.

2

[7]

3

(a) 1. Facilitated diffusion involves channel or carrier proteins whereas active transport only involves carrier proteins;

2. Facilitated diffusion does not use ATP / is passive whereas active transportuses ATP;
3. Facilitated diffusion takes place down a concentration gradient whereas activetransport can occur against a concentration gradient.

Since 'contrast', both sides of the differences needed

3

(b) 3.3:1.

Correct answer = 2 marks

If incorrect, allow 1 mark for 470–360 / 60 for rate in second hour

2

(c) 1. Group **A** – initial uptake slower because by diffusion (only);
2. Group **A** – levels off because same concentrations inside cells and outside cells / reached equilibrium;
3. Group **B** – uptake faster because by diffusion plus active transport;
4. Group **B** fails to level off because uptake against gradient / no equilibrium to be reached;
5. Group **B** – rate slows because few / fewer chloride ions in external solution / respiratory substrate used up.

4 max

[9] (a) Stomata per mm^2 or cm^2

4 OR

Number per mm^2 or cm^2;

Accept: mm^{-2} or cm^{-2}.

Reject: per μm^2 or μm^{-2}.

Reject: the use of a solidus / as being equivalent to per.

Ignore: 'amount'.

1

(b) 1. Single/few layer(s) of cells;

Accept: more/too many/overlapping.

*'Single layer' without reference to cells/tissue should **not** be credited.*

2. So light can pass through;

2

(c) 1. Distribution may not be uniform

OR

So it is a representative sample;

Accept: more/fewer stomata in different areas.

Ignore: anomalies/random/bias.

2. To obtain a (reliable) mean;

Accept: 'average'.

2

(d) 1. Hairs **so** 'trap' water vapour and water potential gradient decreased;
2. Stomata in pits/grooves **so** 'trap' water vapour and water potential gradient decreased;
3. Thick (cuticle/waxy) layer **so** increases diffusion distance;
4. Waxy layer/cuticle **so** reduces evaporation/transpiration.
5. Rolled/folded/curled leaves **so** 'trap' water vapour and water potential gradient decreased;
6. Spines/needles **so** reduces surface area to volume ratio;

*1, 2 and 5. Accept: humid/moist air as 'water vapour' but **not** water/moisture on its own.*

1, 2 and 5. Accept: diffusion gradient as equivalent to water potential gradient.

1, 2 and 5. Accept: less exposed to air as an alternative to water potential gradient.

*6. Accept: spines/needles **so** 'reduce area'.*

2 max

(e) 1. Water used for support/turgidity;
2. Water used in photosynthesis;
3. Water used in hydrolysis;
4. Water produced during respiration;

2 max

[9]

5

(a) 1. In source / leaf sugars actively transported into phloem;
2. By companion cells;
3. Lowers water potential of sieve cell / tube and water enters by osmosis;4. Increase in pressure causes mass movement (towards sink / root);
5. Sugars used / converted in root for respiration for storage.*Accept starch*

4 max

(b) Respiration.

1

(c) 1. (About) 30 hours;
2. Time between peak ^{14}C at top of trunk and bottom.

2

(d) Length of trunk (between top and bottom).

1

[8]

6

(a) <u>Starch (max 3)</u>

1. Helical/ spiral shape **so** compact;
2. Large (molecule)/insoluble **so** osmotically inactive;

Accept: does not affect water potential/ψ.

3. Branched **so** glucose is (easily) released for respiration;

Ignore: unbranched.

4. Large (molecule) **so** cannot leave cell/cross cell-surface membrane;

Cellulose (max 3)

5. Long, straight/unbranched chains of β glucose;
6. Joined by hydrogen bonding;

   Note: references to 'strong hydrogen bonds' disqualifies this mark point.
7. To form (micro/macro)fibrils;
8. Provides rigidity/strength;

5 max

(b) 1. (At source) sucrose is actively (transported) into the phloem/sieve element/tube;

   Accept: 'sugar/s' for sucrose but reject other named sugars e.g. glucose.

   Accept: co-transport (with H^+ ions).
2. By companion/transfer cells;
3. Lowers water potential in phloem/sieve element/tube **and** water enters by osmosis;
4. (Produces) high (hydrostatic) pressure;

   Accept: pressure gradient.
5. Mass flow/transport towards sink/roots/storage tissue;

   Accept: sieve element/tube.
6. At sink/roots sugars are removed/unloaded;

   Accept: at sink/roots sugars are used in respiration/stored.

5 max

[10] (a) (i) ***(Both)***

7

1. Are polymers / polysaccharides / are made of monomers / ofmonosaccharides;
2. Contain glucose / carbon, hydrogen and oxygen;
3. Contain glycosidic bonds;
4. Have 1−4 links;

   Neutral: references to 'unbranched', insoluble, formed by condensation, flexible and rigid

   Are made of the monomer glucose = MP 1 and 2 = 2 marks
5. Hydrogen bonding (within structure).

   Ignore reference to H bonds between cellulose molecules

2 max

(ii) (Starch)

1. Contains α / alpha glucose;

   Assume 'it' refers to starch

   Accept: converse arguments only if linked directly to cellulose

   Accept: forms α glycosidic bonds
2. Helical / coiled / compact / branched / not straight;
3. 1,6 bonds / 1,6 branching;
4. Glucoses / monomers same way up;
5. No H-bonds between molecules; 6. No (micro / macro) fibres / fibrils.

2 max

(b) (i) 1. No / few organelles / very little cytoplasm / cytoplasm at edge / more room / hollow / large vacuole / large space / thick walls;

Accept strong walls for thick walls

2. (So) easier / more flow / (thick / strong walls) resist pressure.

Easier flow may be expressed in other ways e.g. lower resistance to flow

2

(ii) 1. Mitochondria release energy / ATP / site of respiration;

***Q** Reject: 'produce energy' but accept produce energy in form of ATP*

2. For <u>active</u> transport / uptake against concentration gradient.

Note: no mark is awarded for simply naming an organelle

OR:

3. Ribosomes / rough endoplasmic reticulum produce(s) proteins;

Concept of making proteins needed

4. (Proteins) linked to transport e.g. carrier proteins / enzymes.

2

[8] (a) 1. Protein synthesis **and** cell wall synthesis **and** cell expansion

8 stop at −0.7 / at a *higher* water potential than other two;

If all 3 are correctly identified in marking point 1, accept 'the others / the other two' in marking point 2, and vice versa

2. Photosynthesis **and** stomatal opening stop at -1.5 / at a *lower* water potential than other three;

Correct processes must be named in at least one of marking point 1 or marking point 2

Where reference to water potential differences are made, they must be comparative, eg 'higher'

2

(b) 1. Stomata allow uptake of carbon dioxide;

2. Carbon dioxide used in / required for photosynthesis;

2

(c) 1. Growth involves cell division / cell expansion / increase in mass;*Marking point 1 is for the principle*

2. Protein synthesis stops **so** no enzymes / no membrane proteins / no <u>named</u> protein (for growth / division);

Marking points 2, 3 and 4 require appreciation of 'why' before credit can be awarded

'named' protein must relate to proteins involved in growth or cell division

3. Cell wall synthesis stops **so** no new cells can be made;

Full credit is possible without a statement of the principle (marking point 1)

4. No cell expansion / increase in mass **because** (cells) stop taking up water;

3 max [7]

9

(a) Any **three** from:

1. Light;
2. Carbon dioxide;
3. Type of soil;
4. Minerals / nutrients;

Accept named example

5. Water (in soil);
6. Humidity (of air);7. pH (of soil)
8. Planting density;

Idea of equally spaced

3 max

(b) Already levelled out (before 20 °C);

1

(c) Young leaves (may) have different number of stomata (per mm^2) / number of stomata (per mm^2) changes during development (of leaf);

Accept reference to density of stomata

1

(d) Any **two** from:

Points 1 and 2 need context of 'more'

1. Molecules have more kinetic energy; *Accept KE*
2. Faster diffusion of water / more evaporation of water (as temperature increasesin leaf);

For this point, diffusion must relate to movement of water

3. For this point, diffusion must relate to movement of water

2 max

[7] (a) Open / use tap / add water from reservoir;

10 **1**

(b) 1. Seal joints / ensure airtight / ensure watertight;

Answer must refer to precautions when setting up the apparatus

Ignore: references to keeping other factors constant

2. Cut shoot under water;

3. Cut shoot at a slant;

4. Dry off leaves;

5. Insert into apparatus under water;

6. Ensure no air bubbles are present;

7. Shut tap;

8. Note where bubble is at start / move bubble to the start position;

2 max

(c) 1. Water used for support / turgidity;

Accept: water used in (the cell's) hydrolysis or condensation (reactions) for one mark. Allow a named example of these reactions

2. Water used in photosynthesis;

3. Water produced in respiration;

4. Apparatus not sealed / 'leaks';

2 max

(d) As number of leaves are reduced (no mark),*Accept: converse arguments*

1. Less surface area / fewer stomata;

3. Less evaporation / transpiration;

4. Less cohesion / tension / pulling (force);

3

[8] (a) 1. The more recent the sample the greater the concentration;

11

Accept converse

This could be expressed by reference to time e.g. 'concentration has increased since 25 000 years ago

2. Increases most in last 5000 years / more or less constant / slight increase between 30 000 and 15 000 years ago;

2

(b) 1. Variation in data / spread of data;

Reject references to range e.g. 'range of data'

2. Around the mean;

Both marks are possible in the context of using the data

2

(c) 1. Yes as pine leaves not in organic matter of the same age;

2. No as organic matter would be the same age as the pine leaves;

Accept either approach

1 max

(d) Can get more CO_2 for photosynthesis;

More CO_2 enters leaf is insufficient.
Accept light-independent (reaction) as equivalent

1

(e) Any **three** from:

1. (Overall data show) negative correlation;

Do not allow description of correlation because in question stem

2. Little change in number of stomata in last 10 000 years;

3. Small sample size;

4. Only one species studied;

5. Other factors / named factor may have affected number of stomata;

6. Evidence does not support the conclusion between 30 000 and 25 000 yearsago / between 5000 years ago and present day;

Accept reference to either one of these age ranges

7. Appropriate reference to standard deviations (in comparing means);

E.g. no overlap between 15 000 and 10 000 years ago

3 max

(f) Any **three** from :

1. Thick cuticle;

2. Small leaves / low surface area;

Accept other ways of describing 'small', e.g. 'needle-like'

3. Hairy leaves;

4. Sunken stomata;

5. Rolled leaves;

3 max

[12] (a) (i) 1. Stomata open;

12

Allow converse

2. Transpiration highest around mid-day as middle of day warmer / lighter;
2. Allow 'Sun is at its hottest'

3. (Increased) tension / water potential gradient;
Ignore 'pull, suck'

3

(ii) (Inside xylem) lower than atmospheric pressure / (water is under) tension;
Accept cohesion tension. Ignore vacuum

1

(b) (i) High pressure / smoothes out blood flow / artery wall contains more collagen /muscle / elastic (fibres) / connective tissue;
Accept converse for pulmonary vein
Incorrect function of artery disqualifies mark

1

(ii) 1. (Aorta wall) stretches because ventricle / heart contracts / systole /pressure increases;
1. Allow expand

2. (Aorta wall) recoils because ventricle relaxes / heart relaxes / diastole /pressure falls; *2. Allow spring back*
Reject any reference to contract / relax in MP1 and 2

3. Maintain smooth flow / pressure;

3

(iii) Aorta 1.2 / largest SD;
Allow pulmonary vein provided candidate relates standard deviation to mean

1

(c) Formation

1. High blood / hydrostatic pressure / pressure filtration;

2. Forces water / fluid out;
2. Reject plasma, ignore tissue

3. Large proteins remain in capillary;

Return

4. Low water potential in capillary / blood;

5. Due to (plasma) proteins;

6. Water enters capillary / blood;

7. (By) osmosis;

7. Osmosis must be in correct context

8. Correct reference to lymph;

6 max

[15] (i) 1. Increases then decreases;

13

Allow peak / maximum at any time between 13.00 - 14.00 or 7.8 - 8.0;

2. Peak / maximum at 13.00 / 14.00 (hours) / 7.8 - 8.0;

2

(ii) 1. Maximum / overall rate is higher (in branches);*Allow converse for all marking points.*

2. Reaches maximum / peak earlier (in the day) (in branches);

3. Starts higher / ends lower (in branches)

2

(iii) 1. Movement starts / peaks earlier in branches / higher up;

2. Creates tension / 'negative pressure' / 'pull'

2

[6] (a) Light;

14

Humidity / moisture in air;

Air movement / wind;

Temperature;

2 max

(b) Decreases chance of error / larger difference in mass / improvesaccuracy / precision;

Neutral: Reliability, references to anomalies.

1

(c) 1. Stomata open, (water) transpired / evaporates / diffuses out (via) water potentialgradient / leaf has higher water potential;

2. Water potential / diffusion gradient reduces (during investigation) as water notbeing replaced / no water supply;

3. Stomata close / closing;

Must clearly indicate that stomata are open for third marking point. However, allow correct descriptions of guard cells being turgid or

flaccid as being equivalent to stomata being open or closed. 'Loss through stomata' on its own is not sufficient.

Neutral: Any reference to 'loss by osmosis'.

3

(d) Stomata (on upper surface) covered / stomata close due to lack oflight / (grease provides) longer diffusion pathway;

Less evaporation / transpiration / diffusion out;

Accept: Evaporation / transpiration / diffusion 'stops' for second point as this could be referring to upper surface.

2

[8]

15

(a) (i) 1. Removes water vapour / moisture / saturated air;

2. Increases water potential gradient / more diffusion / more evaporation;

2

(ii) 1. Increases kinetic energy so water molecules move faster;

2. Increases diffusion / evaporation;

2

(b) (i) Positive correlation / as light intensity increases so does rate of water movement / follows same pattern / directly proportional;

1

(ii) 1. Stomata open and photosynthesis increases / transpiration increases;

2. More water pulled up due to cohesion between water molecules / bycohesion tension;

2

(iii) 1. Water pulled up trunk / moves up at fast rate under tension;

2. Sticking / adhesion (between water and) cells / walls / pulls xylem in;*Adhesion is not a specification requirement.*

Accept cohesion in this context

2

(c) **Elastic tissue**

1. Elastic tissue stretches under pressure / when heart beats then recoils / springsback;

2. Evens out pressure / flow;

Do not allow credit for expands / contracts / relaxes in this context.

From a marking viewpoint ignore all specific references to arteries and arterioles. Consider all points as applying to both.

2 Do accept controls

Muscle

3. Muscle contracts to reduce diameter of lumen / vasoconstriction / constrictsvessel;

4. Changes flow / pressure;

Epithelium

5. Epithelium smooth;

6. Reduces friction / blood clots / less resistance;

6

[15]

16

(a) Single layer of cells / few layers of cells;

So that light that can pass through / cells absorb light;

2

(b) Method of determining area of field of view / area seen using microscope;

Count number of stomata in field of view;

Repeats and calculation of mean;

3

(c) Water <u>vapour</u> accumulates / increased humidity / reduced air movement (around stomata);

Water potential / diffusion gradient reduced;

2

[7] (a) 235–240;;

17

(one mark for an answer between 200-300
based on 2 - 3 stomata in 0.01mm^2
Alternatively, one mark for calculating the area of the
rectangle correctly as 0.016 – 0.017mm^2)

2

(b) grows in arid / dry conditions;
less surface area;
(rate of) transpiration / water loss would be reduced;

3

[5] (a) 1. (when light intensity is increased) tension in the xylem becomes greater / more

18

negative / stronger;

2. (this increase) takes place over ≈100 second;
3. then levels out;

4. stomata open (more);
5. increased evaporation / transpiration;
6. therefore the water potential of leaf cells becomes more negative / lower;
7. therefore more water moves from xylem to surrounding cells;
8. down a water potential gradient;
9. correct ref. to hydrogen bonds / cohesion;

5 max

(b) humidity will affect (the rate of) evaporation / transpiration;
increased humidity / humid conditions decreases rate of water loss;

2

[7]

19

(a) Light (intensity) / temperature / air movement / humidity;

1

(b) Prevent air entering / continuous water column;

Allow answer in context of shoot, xylem or potometer.

1

(c) Distance and time;

Reject 'amount bubble moves'

1

Radius / diameter / area (of capillary tube);

1

(d) (used to provide) turgidity / support / description of;

(used in) photosynthesis / (produced in) respiration;

Apparatus not sealed / 'leaks';

2 max

(e) (i) Returns bubble (to start);

1

(ii) Increases reliability (of results) / anomalous result can be identified;

Q *Ignore references to validity / precision / accuracy etc.*

1

[8] (a) increased humidity leads to decreased transpiration;

20

high humidity means more water in the air / increased saturation / increased water potential; reduced diffusion gradient / water potential gradient; slower rate of water loss / less evaporation;

3 max

(b) thick cuticle; impermeable to water / waterproof;

sunken stomata; reduces water
diffusion gradient;

shape of leaf / rounded / small surface area;
small surface area : volume ratio;

(explanation must be linked to feature)

4 max

[7]

21

(a) 1. water <u>evaporates / transpires</u> from leaves;

2. reduces water potential in cell / water potential / osmotic gradient across cells *(ignore reference to air space)*;
3. water is drawn out of xylem;
4. creates tension *(accept negative pressure, not reduced pressure)*;
5. cohesive forces between water molecules;
6. water pulled up as a column;

4 max

(b) (i) same surface area of leaf / number of leaves / age / thickness ofcuticle;

1

(ii) (environmental conditions) affect rate of transpiration / evaporation;

1

(iii) presence of grease reduces water loss;

1

(c) (i) 1.2 / 1.3g;

1

(ii) more stomata on the lower surface;
(thicker) waxy cuticle on the upper surface;

2

22 **[10]** (a) (i) unrestricted / free / quick / easy water flow / continuous column / maintains transpiration stream;

1

(ii) resists tension in water (column) / provides support / strength / maintains column of water / adhesion / prevents water loss

(allow waterproofing in correct context i.e. not absorbing);

1

(b) (i) as total area of stomata decreases the rate of water flow decreases /<u>decrease</u> is proportional;

(reject proportional, 'as one goes up the other goes up' and 'same shape')

1

(ii) <u>increasing / higher</u> temperature causes <u>increasing / higher</u> rate of evaporation / transpiration;

(*not water loss*)

1

(iii) lower plateau (start and finish at same point);
(allow *if curve sketched on original graph, reject 'curve is lower'*)

1

(c) conserves water / reduces water loss / reduces transpiration / reduces evaporation;high humidity (in pit) / reduced water potential gradient / less water blown away / increased diffusion pathway;

2

[7] (a) (i) rate of flow increases to max at 1200 and then decreases;

23

increasing transpiration / evaporation from leaves;
transpiration creates tension / increases transpirational pull; water molecules are cohesive / stick together;
produces a water column;

3 max

(ii) (increase transpiration) produce a higher tension / reduces the pressure in the xylem reducing the diameter / adhesive forces between xylem and water;

1

(b) water moves in dead cells / xylem is non-living tissue;
the process is passive / no energy is needed;

2

[6] (a) shallow roots enable rapid uptake of rainfall (in **X** and / or **Z**);

24

widespread / shallow roots allow collection of larger volume water / over a larger area / rapid uptake of water (in **Z**);
swollen stem for water storage (in **X**); deep roots for accessing deep groundwater (in **Y**); small / no leaves so little transpiration;

3

(b) **Z**; wide spread of roots for rapid water absorption;
(accept **X**; if linked to leaves channelling water to roots)
(ignore references to water storage abilities)
(accept other responses if justified)

2

[5]

(i) (waxy so) impermeable to water / waterproof / stops water

25 passing through;

1

(ii) reference to hairs / position of stomata (sunken stomata / stomata in pits)
LINKED to reduced air movement / trap layer of air / trap water vapour (*reject water)* / maintains humidity;

reduces diffusion gradient / concentration gradient of water / water potential gradient;

OR

stoma can close;
reduces area for evaporation or transpiration;

2

[3]

26

(a) long cells / tubes with no end walls;

continuous water columns; no cytoplasm / no organelles / named organelle; to impede / obstruct flow / allows easier water flow; thickening / lignin; support / withstand tension / waterproof / keeps water in cells; pits in walls;
allow lateral movement / get round blocked vessels;

4 max

(b) (i) increase in transpiration rate / evaporation due to increase in temperature ;
increased (kinetic) energy of water molecules;

OR

increase in light (intensity) increases transpiration rate / evaporation;

greater stomatal aperture / more stomata open so increase in flow rate due to cohesion / attraction of water molecules;

2 max

(ii) adhesion / attraction of water molecules to walls of xylem; results in tension as water pulled up stem; pulling in walls;

2

[8]

27

(a) 1. Diameter of trunk minimal at warmest / brightest time of day / midday = warmest / brightest;
2. Stomata open in light → more water loss;
3. Water evaporates more when warm / more heat energy for water evaporation;
4. Hydrogen-bonding between water molecules / cohesion (/ described) betweenwater molecules;
5. Adhesion (described) between water molecules and walls of xylem vessels;
6. (Xylem) pulled inwards by faster flow of water / pulled in by tension;

6

(b)

Feature	Explanation
Think cuticle / wax layer	waterproof / impermeable;
Sunken stomata	saturated layer of still air outside;
Hairy	saturated layer of still air outside;
Leaves small / reduced to spines / needles	reduced S.A. for water loss;
Leaves roll up in dry weather	less S.A. for water loss / stomata covered / saturated region of still air;
Reduced number of stomata	reduced S.A. for water loss;
CAM (/ Crassulacean Acid Metabolism)	stomata closed in light / in warm / only open in dark / when cool;

3 features but no explanations – max 1 mark

max 3

[9]