1. (a) reject lines to or from the same box, e.g. anther and petal to produce pollen grains
   A if lines do not touch box but meaning is clear

   - anther allows the passage of the pollen tube to the ovary
   - petal attracts insects for pollination
   - sepal produces pollen grains
   - style protects the flower when in bud
   - stigma the surface which receives pollen during pollination

   [4]

(b) assume answer is about stigma of wind-pollinated flower unless told otherwise, accept ora, 2 max for differences, 1 or 2 for significance

   wind-pollinated stigma, insect-pollinated stigma

   feathery / hairy ; R branched
   ignore not sticky
   large(r) ; A large surface area
   outside flower / AW ;
   A pendulous / exposed
   ignore long and short

   not, feathery / hairy ;
   ignore sticky
   small(er) ; A small surface area
   inside flower / AW ;

   [2 max]

   explanation
   to catch pollen / AW (in the wind) ; A for pollen to attach (to stigma)
   or make pollination more likely / easier
   increase chance of pollination :

   'more likely to catch pollen' = 2 marks

   [max 3]

(c) 1 little / less / AW / no, variation ; R cloning
  2 ref to becoming homozygous ; ignore ref to gene
  3 e.g. of consequence ‘good’ or ‘bad’ ;
     e.g. less chance of adapting to changing conditions / less ability to evolve
     may become extinct / adapted variety spreads / AW ;
  4 greater chance of pollination / ensures pollination occurs ;
     A reproduction / fertilisation
  5 useful if no other plants (of same species) nearby ;
  6 less wastage of pollen ; A gametes
  7 not dependent on (named) agent of pollination ;

   [max 3]

   [Total: 10]
(a) bars must be within potato square

bars plotted accurately at 2.6 and 5.6;
shading correct according to key; [2]

(b) (i) (sugar) beet;
(ii) wheat; [1]

(c) award three different main points as given below
or award two marks for the main points and max one for any detail of one point

use of named appropriate machinery; e.g. tractor / combine harvester
detail e.g. more efficient, sowing / harvesting / watering;
(artificial) fertilisers;
detail e.g. prevent mineral deficiencies / provide more nutrients;
pesticides / insecticides / fungicides / AW;
detail e.g. control, pests / diseases, feed / destroy / damage, crops;
A reduce losses to, pests / diseases
herbicides;
detail e.g. control / kill, weeds / competitors;
use of, hormones / named hormone(s);
detail e.g. reduce vegetative growth / promote fruiting / AW;
irrigation; R ‘put on (more) water’
detail e.g. prevent water becoming limiting factor / not relying on rain / AW;
glasshouses / greenhouses;
detail e.g. control, light intensity / carbon dioxide concentration / temperature
monoculture;
detail e.g. easier to harvest;

 genetic engineering / gene transfer / GM; ignore genetic technology
artificial selection / selective breeding;
detail e.g. improve, growth / aspect of yield / quality / disease resistance / pest resistance; [max 3]

(d) idea that water content of plants varies; [1]

(e) idea that energy is lost, along a food chain / between maize and cows;

energy loss by animals to max 2
food not eaten;
food not, digested / absorbed; A egested
(chemical energy) excreted;
heat loss;
movement;
respiration; [max 2]
(f) \( \text{6O}_2; \text{ R 6O}^2 / 6\text{O}_2 \)  

(ii) large surface area / broad / wide; \text{ R flat}
chloroplasts / chlorophyll;
leaf mosaic / leaves arranged to avoid shading;
leaves, grow at right angles to light / move to follow the sun;
cuticle / epidermis, thin / transparent;
leaf is thin;
palisade cells tightly packed;
movement of chloroplasts towards light source;
AVP;

(iii) root hair(s);
down water potential gradient / from high to low water potential / soil has
higher water potential / root has lower water potential;
osmosis / across partially permeable membrane;
A semi-permeable / selectively permeable \text{ R 'and active uptake' }

(iv) (carbon dioxide) diffuses (from air) / ref to down diffusion gradient;
through stoma(ta);

air spaces, between (mesophyll) cells / in leaf;
dissolves in water, on / in, cell wall;
(diffuses) through, cell wall / membrane;

carbon dioxide from, respiration / mitochondria;

[Total: 19]
3  

(a)  (i) boil the leaf in water

boil the leaf in ethanol (alcohol)

soak the leaf in water

add iodine solution to the leaf

to test for starch

to break down cell membranes

to remove chlorophyll

to soften the leaf

(ii) chlorophyll masks the colour change (shown with iodine) / AW ;

(b) light ; water ; A moisture

suitable temperature ; R heat

chlorophyll ;

(max 2)

(c) to show that the factor under test is responsible for the change observed / AW ;
e.g. to show carbon dioxide is need
to show plants can photosynthesis under the glass cover
A so there is only one variable

(d) to be sure that starch is produced during the experiment ;

(e) correct result for starch test and reason needed for each mark

reject crossed ticks

<table>
<thead>
<tr>
<th>stage</th>
<th>leaf from plant</th>
<th>starch test</th>
<th>reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>A and B</td>
<td>✗</td>
<td>plants have had no light for photosynthesis / destarched / AW ;</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td>✗</td>
<td>plant has had no carbon dioxide for photosynthesis ;</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>✓</td>
<td>plant has had, carbon dioxide / all conditions, for photosynthesis ;</td>
</tr>
</tbody>
</table>

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3  (f)  no photosynthesis;
    plant respires;  R  ‘plant begins to respire’ / ‘instead it respires’
carbon dioxide produced;  A correct equation for aerobic respiration
carbon dioxide, released / diffuses, from plant;  

[max 3]

[Total: 15]
4 (a) order needs to be correct for one mark; TICK TO LEFT OF TABLE
All numbers correct for two marks; * NUMBER TO MATCH TISSUE
Three correct for one mark

<table>
<thead>
<tr>
<th>tissue</th>
<th>number of chloroplasts</th>
</tr>
</thead>
<tbody>
<tr>
<td>upper epidermal cells</td>
<td>none +</td>
</tr>
<tr>
<td>palisade mesophyll</td>
<td>many +</td>
</tr>
<tr>
<td>spongy mesophyll</td>
<td>some / many ✓</td>
</tr>
<tr>
<td>guard cells</td>
<td>✓</td>
</tr>
</tbody>
</table>

(b) ONE MARK FOR SYMBOLS CORRECT R energy
ONE MARK FOR CORRECT BALANCING

\[6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2\]

(ii)
   i. internal factor / external factor / environmental variable / named factor (CO\textsubscript{2} / H\textsubscript{2}O / light / temp);
   ii. which restricts the effects of others AW / limits rate of reaction;
   A converse answer R photosynthesis / growth
   iii. it is the one in short(est) supply; max. 2

(iii) carbon dioxide / CO\textsubscript{2};

(c) (i)
   i. ref. to long / tubular / formed as a vessel AW / lumen present / hollow;
   ii. ref. to absence of end walls;
   iii. ref. to dead cells / lack of cell contents / named part(s) (cytoplasm / nucleus);
   iv. ref. to lignified walls;
   v. ref. to tracheids; max 3

(ii) MAX. 3 IN EITHER SECTION
   (xylem)
   i. ref. to transport / carry; AWARD ONCE
   ii. ref. to water;
   iii. ref. to mineral salts / named salts / ions; R nutrients unqual.
   iv. from roots to leaves:
   v. provides structural support AW;
   vi. ref. to transpiration;
   (phloem)
   vii. ref. to transport; (IF NOT ALREADY GIVEN)
   viii. ref. to amino acids;
   ix. ref. to sugars / sucrose / organic materials; R glucose, food, nutrients
   x. from leaves to storage area or place of use AW; R up the plant
   xi. ref. to translocation; max 4

(d) ref. to reduce (less / no) + water loss / wilting / transpiration;

total max. 16