

**QUESTIONSHEET 1**

- (a) (i) maize is a C<sub>4</sub> plant/uses specialized form of photosynthesis/uses a more efficient enzyme to fix CO<sub>2</sub>;  
can photosynthesise efficiently when CO<sub>2</sub> tension is low/stomata are closed;  
use water more efficiently in photosynthesis/use less water per carbon dioxide molecule fixed;  
more productive than a C<sub>3</sub> plant in the same environment;  
C<sub>3</sub> plants tend to lose mass by photorespiration in bright light/hot temperatures/low CO<sub>2</sub> tension/high O<sub>2</sub> tension;  
**max 3**
- (ii) repels water, maintains a layer of air on submerged leaf surface;  
allows efficient gas exchange with atmosphere; **2**
- (b) (i) a plant which is adapted to grow in arid/dry conditions/adapted to prevent water loss; **1**
- (ii) extensive or deep root system;  
stomata only on abaxial/under surface/stomata surrounded by hairs;  
sunken stomata;  
thick cuticle; **max 2**
- TOTAL 8**
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**QUESTIONSHEET 2**

- (a) plant adapted to growing in arid/dry conditions/adapted to preventing water loss; **1**
- (b) small leaf surface area : volume ratio/rolled up leaf reduces surface area so reducing water loss/area exposed to sun/wind;  
outer epidermis has no stomata;  
outer epidermis has thick cuticle;  
so reducing evaporation loss;  
hairs reduce air movement around stomata and so reduce water loss/hold moist air around stomata;  
hinge cells shrink if high transpiration rate occurs, causing leaf to roll up tighter/more thus reducing water loss; **max 5**
- TOTAL 6**
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**QUESTIONSHEET 3**

- (a) (i) guard cells; **1**
- (ii) chloroplasts; **1**
- (b) xerophytes are plants adapted to living on arid/dry conditions/have features which reduce water loss;  
chamber in front of stomatal pore will reduce air movement;  
thus increase immediate humidity/decrease diffusion gradient/water loss;  
thickened cuticle reduces evaporation loss; **max 3**
- TOTAL 5**

**QUESTIONSHEET 4**

- (a)  $X Y = \frac{105}{120} ; = 0.875 \text{ mm};$  2
- (b) (i) this creates a chamber of still/moist air above the stomatal pore;  
which is sheltered/protected from air currents;  
so transpiration/diffusion of water at the stomata is slowed/reduced;  
this is a xerophytic feature; max 3
- (ii) tracheids have narrow lumens/carry less water than vessels;  
reflects water conserving features/xerophytic adaptation of pine needle;  
transpiration losses from needles less than from leaves of deciduous species; max 2
- TOTAL 7**
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**QUESTIONSHEET 5**

- (a) leaf; 1
- (b) X = spongy mesophyll; 1  
Y = xylem/vessel; 1  
Z = palisade mesophyll; 1
- (c) minimises number of cross walls which light has to penetrate;  
cylindrical shape can house more chloroplasts than rounded shape;  
increases light absorption/phototsynthesis; max 2
- TOTAL 6**
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**QUESTIONSHEET 6**

- (a) less likely to suffer wind damage/able to support more grain;  
easier to harvest/plant uses less energy/nutrients in building straw; 2
- (b) (i) resembled A but was shorter; 1
- (ii) increase the chances that the gene for shortness was homozygous; 1
- (iii) contain potentially useful genes e.g. for disease resistance/frost resistance;  
may be useful if wheat is grown in new area or if growing environment changes; 2
- TOTAL 6**

**QUESTIONSHEET 7**

- (a) (i) wild strains would have dispersed their seeds widely;  
making it difficult for farmer to collect/harvest; 2
- (ii) allows young seedling to grow/seed to germinate when conditions are favourable;  
allows parents to die back before germination thus reduces reduces competition with parent;  
seeds may remain dormant for different lengths of time, extending germination period;  
increasing chance that some will survive;  
need cold period/vernalisation to stimulate gibberellin production; max 3
- (b) increases chance of exposing the plants to new selection pressures;  
changing genotype frequencies;  
may lead to interbreeding/formation of hybrids/speciation; max 2
- TOTAL 7**
- 

**QUESTIONSHEET 8**

- (a) (i) less likely to blow over/stems likely to break with heavy grain load; 1
- (ii) means that the variety can be planted at any time of year in period of longer days/allows multiple cropping; 1
- (b) (i) higher N allows increased protein/DNA synthesis;  
stem able to support heavier yield; 2
- (ii) beyond 30 kg ha<sup>-1</sup> weight of grain cannot be supported by the stem;  
plant falls over so yield declines; 2
- (iii) growth increment less because plant unable to obtain extra nitrogen/utilise extra nitrogen;  
reference to leaching of nitrates/anaerobic soils inhibiting uptake;  
reference to nitrogen depletion due to denitrification/activity of denitrifying bacteria; max 2
- TOTAL 8**
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**QUESTIONSHEET 9**

- (a) stomata may close during day when temperatures are high reducing water loss;  
stomata open at night/inverted stomatal rhythm;  
carbon dioxide may be taken in through stomata at night (when transpiration is less);  
carbon dioxide 'stored' for use during day/ref bundle sheath cells; max 3
- (b) water is a metabolite/used in photosynthesis;  
acts as solvent/allows mineral uptake;  
transport medium;  
provides turgidity which supports stem/shoot/increases leaf surface area and hence light absorption/photosynthesis;  
transpiration causes leaf cooling/ref latent heat loss; max 4
- TOTAL 7**

**QUESTIONSHEET 10**

(a) begining of May to end August/start of September;	1
(b) declines; water needed for photosynthesis; and for absorption of salts/transport/turgidity/support;	3
(c) leaves shade soil thus reducing evaporation (loss) from soil; reduces total water loss/evapotranspiration/since plants maintain a humid atmosphere around themselves; plants protect each other from wind, thus reducing transpiration;	3
	<b>TOTAL 7</b>

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**QUESTIONSHEET 11**

(a) adding lime will raise pH/make it alkaline; yield increases as pH increases/alfalfa prefers higher soil pH/basic or neutral soil;	2
(b) at high pH values, supply/availability of Mn/Fe declines; thus plant has stunted growth; fails to develop chlorophyll; fails to complete germination;	<b>max 3</b>
(c) 6.5 – 7.5;	1
	<b>TOTAL 6</b>

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**QUESTIONSHEET 12**

(a) Feature: large/many air spaces/aerenchyma;	1
Significance: provide buoyancy/helps leaf to float on/near surface; where light intensity is high/oxygen/CO <sub>2</sub> available;	2
Feature: thin epidermis/no cuticle;	1
Significance: helps/speeds up gas exchange; no problem with transpiration loss;	2
Feature: central vascular bundles;	1
Significance: peripheral 'cylinder' of vascular bundles found in terrestrial plants gives strength/rigidity to stems which is not needed (in an aquatic environment); holds flowers above water allowing pollination/seed dispersal;	<b>max 2</b>
	<b>TOTAL 9</b>