

QUESTIONSHEET 1

- (a) (i) maize is a C₄ plant/uses specialized form of photosynthesis/uses a more efficient enzyme to fix CO₂;
can photosynthesise efficiently when CO₂ tension is low/stomata are closed;
use water more efficiently in photosynthesis/use less water per carbon dioxide molecule fixed;
more productive than a C₃ plant in the same environment;
C₃ plants tend to lose mass by photorespiration in bright light/hot temperatures/low CO₂ tension/high O₂ 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**
-

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/phototynthesis; max 2
- TOTAL 6**
-

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⁻¹ 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**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
	TOTAL 7

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;	max 3
(c) 6.5 – 7.5;	1
	TOTAL 6

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 ₂ 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;	max 2
	TOTAL 9