Question	E Answers	Marks	Guidance
1 (a)	*general marks* roots absorb water ; idea of <u>both</u> gaining water over a large, volume / area, of soil ; AVP ; **A** has deep roots / go a long way down ; to gain water that drains through soil / reach water table / AW ; **B** has shallow roots / wide spreading roots / AW ; absorbs water, before it drains *or* evaporates / immediately after rainfall ;	[max 4]	NB water absorption and area marks given once only **R** long roots unqualified
(b)	thick cuticle ; longer distance for diffusion / not easy for water to pass through / ref to impermeable ; rolled leaves ; air trapped inside rolled leaf has high<u>er</u> humidity AW / stomata protected from wind *or* moving air (reduces transpiration) ; sunken stomata / stomata in pits *or* grooves *or* depressions ; chamber has high<u>er</u> humidity AW / stomata protected from wind *or* moving air (so reducing transpiration) ; hairs on leaf ; reduce air flow over the surface (so reducing transpiration) / increase humidity by 'trapping' water (molecules) ; small leaves / leaves reduced to spines / leaves are needles / no leaves / leaves shed in very dry periods ; small(er) / no surface area (for transpiration) ; fewer stomata / stomata closed during hot parts of day ; stomata are pores through which water can pass (so reducing transpiration) ;	[2 + 2]	**R** cuticle unqualified or ref to 'waxy' without description of thickness Must be **TWO** descriptions (max) with appropriate linked explanations **explanations alone cannot be accepted** **A** correct references to water potential / concentration gradient for rolled leaves or sunken stomata IGNORE references to succulent leaves and storage (not water loss) 'sharp' leaves also need to be small

<table>
<tr><th>Question</th><th>E Answers</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1 (c)</td><td>
<table>
<tr><th>tissue</th><th>substances transported</th><th>source</th><th>sink</th></tr>
<tr><td>xylem</td><td>water, ions / named ion / mineral / salts ;</td><td>roots ;</td><td>stem / growing points / buds / leaf / flower / fruit / seed / storage organ ;</td></tr>
<tr><td rowspan="4">phloem</td><td rowspan="4">Sucrose / sugar, amino acids ;</td><td colspan="2">either</td></tr>
<tr><td>leaf ;</td><td>stem / growing points / buds / root / flower / fruit / seed / storage organ ;</td></tr>
<tr><td colspan="2">or</td></tr>
<tr><td>storage organ ;</td><td><u>young AW</u> leaf / stem / growing points / buds / root ;</td></tr>
</table>
</td><td>[6]</td><td>NB substances transported score:-

ONE mark for TWO correct responses

R references to single cells as sources or sinks e.g. root hairs

R glucose

mark each box independently</td></tr>
<tr><td colspan="2"></td><td>[Total: 14]</td><td></td></tr>
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Question	E Answers	Marks	Additional Guidance
2 (a)	pollen transferred from, anther / stamen, to stigma **;** within same flower / between flowers on same plant **; R** if only 'same plant'	[2]	**R** complete answers given in context of fertilisation **R** 'single parent'
(b)	*cross 1* $I^RI^R \times I^WI^W$ $I^R + {}^W$ I^RI^W **;** *cross 2* $I^RI^W \times I^RI^W$ $I^R, I^W + I^R, I^W$ **;** $I^RI^R, I^RI^W, (I^RI^W), I^WI^W$ **;** 1 red : 2 pink : 1 white **;** **A** 25% red : 50% pink : 25% white **A** multiples, e.g. 2 red: 4 pink : 2 white **R** if two different ratios given	[4]	**A** other notation, e.g. R and r or mixture, e.g. I^R and W. **R** I^{RR}, etc. *cross 1* 1 mark for parental genotypes, gametes and offspring all correct. Any mistake and no mark awarded. *cross 2* 1 mark for cross genotypes and gametes all correct. Any mistake and no mark awarded. 1 mark for giving all three genotypes (on answer line or in the white space e.g. in Punnett square). If correct on answer line ignore any errors in working. 1 mark for ratio of offspring phenotypes **and** colours **R** if no colours given
(c)	$I^RI^W \times I^WI^W$ $I^R, I^W + I^W$ **;** I^RI^W, I^WI^W **;** 1 (pink) : 1 (white) **;** **R** if two different ratios given	[3]	1 mark for parental genotypes and gametes all correct. Any mistake and no mark awarded. 1 mark for offspring genotypes 1 mark for ratio (colours not necessary) **A** if no colours given

Question	E	Answers	Marks	Additional Guidance
2 (d)	**1**	ref. to meiosis **;**		
	2	mutation can occur <u>in meiosis</u> **;**		**R** sexual reproduction allows mutations to occur
	3	(gives) variation / diversity **; R** 'varied species (plural)'		
	4	ref. to, alleles / genes / DNA, from different, plants / parents **;**		
	5	allows mutations to be, expressed / AW **;**		
	6	allows adaptation to, new conditions / changed environment / AW **;**		**A** may allow resistance to disease **A** 'suited to' / survive / AW for adapted
	7	(new species) can evolve / allows natural selection to occur **;**		**R** 'passed on by natural selection' **R** 'new species are made'
	8	seeds are dispersed **; R** dispersed unqualified, **R** pollen dispersal		
	9	can colonise new areas / AW **;**		**A** 'go to new areas' or 'spread to new areas'
	10	less competition (with parent plant / among offspring) **;**		*competition is in context of seed dispersal not pollen dispersal*
			[max 4]	**R** 'multiply quicker'
			[Total: 13]	

3 **(a** (length of) DNA / part of chromosome / on a chromosome ,
that codes for a <u>protein</u> *or* <u>polypeptide</u> *or* <u>enzyme</u> / controls a characteristic **;** **[1]**

(b) H^NH^S x H^NH^S **;** *accept N and S*

H^N, H^S + H^N, H^S **;** gametes must be clear *accept on dotted line or in Punnett square*

H^SH^S **;** *ecf from correct gametes if wrong parental genotype* **[3]**

(c) *check http://www.sicklecellsociety.org/education/healthpr.htm for AVPs*

1 red (blood) cells become, sickle shaped / distorted / AW **;** **R** abnormal unqualified
2 in areas of low oxygen concentrations / in tissues **;**
3 fewer / less elastic / less flexible / short-lived, red blood cells **;** *ora*
4 less haemoglobin **;**
5 <u>blood</u> / <u>haemoglobin</u>, less efficient at transporting oxygen **;** **R** no oxygen
6 less respiration **;** **R** no respiration
7 less energy / fatigued / exhaustion / less active / feeling faint *or* tired / breathless **;**
8 <u>capillaries</u> are blocked **;**
9 pain **;**
10 death of tissues linked to blood supply **;**
11 'sickle cell crisis' **;** **A** 'attacks needing oxygen'
12 slow / poor, growth **;**
13 susceptible to infections **;**
14 reduced life span **;**
15 AVP **;**
16 AVP **;** **[4 max]**

3 **(d)** **1** *idea that* areas with high percentage of sickle cell (allele) are places with malaria **;**

2 H^SH^S / homozygous recessive, reduced life span because of <u>sickle cell anaemia</u> **;**

3 H^NH^N / homozygous dominant / without H^S , susceptible to malaria / AW **;**

4 H^NH^S / heterozygous / carrier/ with H^S, resistant / not affected / less susceptible **;**

A H^SH^S **R** immune / immunity

5 H^NH^S (carrier) survive <u>and</u> have children / H^NH^N *or* H^SH^S do not **;**

6 H^NH^S / carrier, pass on the allele / H^S **;**

7 (if H^NH^S x H^NH^S) 1 in 4 chance of, H^SH^S / homozygous recessive **;**

8 2 in 4 / 50% / ½ , have advantage of resistance to malaria **;** **[5 max]**

(e) **1** *idea that* distinct groups / categories **;** ref to bar chart

2 *either* sickle cell anaemia (H^SH^S), sickle cell trait (H^NH^S), normal (H^NH^N) / *or* normal, anaemic **;** **A** 'some people have disease, some do not'

A 'some people have the <u>allele</u>, some do not'

3 no intermediates / no continuous scale of anaemia / AW **;**

4 genetic condition / environment has no effect (or its expression) **;**

A ref to small number of, genes / alleles, involved **[3 max]**

[Total: 16]

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4 (a (i)

process	materials moved	source of materials in the plant	sink for materials in the plant
transpiration	water + (mineral) salts / AW ; **A** ions / minerals / named ion **R** nutrients	roots / root hairs ;	leaves / shoot / stem ; **A** flowers / fruits named, cell(s) / tissue(s)
translocation	*two from* sugars / sucrose amino acids ions / minerals / AW hormones / named hormone; **R** glucose **R** nutrients	leaves / (named) storage organ / seed(s) / cotyledon ;	roots / stem / shoot / named growing region / (named) storage organ ; **A** buds / flowers / fruits / tubers **A** named cell(s) / tissue(s)

[6]

(ii) *answer needs to make clear which structures are source and sink*

during germination / AW, (source is) seed / cotyledon ;
idea that leaves grow and start to photosynthesise (so become source) ;

leaves may, be shed / die / be shaded / AW ;
leaves may stop photosynthesising (so become sink) / AW ; **A** 'slow down'

(in early growth) root (is sink) ;
(later) flowers / fruits / seeds / tubers / AW (become sinks) ; [max. 2]

[Total: 8]

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