Question	E answers	Mark	Additional Guidance
1 (a) 1 2 3 4	**A** – **B** urea (concentration) decreases **;** water (content) increases / decreases **;** salt (concentration), decreases **;** ref to, glucose / sugar **;** *could be increase, decrease or stays the same*	[max 2]	**A** 'passes out of blood' / 'passes into blood' / removed / taken out / diffuses in / diffuses out **A** minerals / any named salt *or* ion
(b) 1 2 3 4 5 6	*advantages of transplants* long term solution / person no longer needs (regular) dialysis **;** an example of a disadvantage of dialysis **;** **A** pain / tiring / discomfort / takes a long time / fails eventually increased freedom / better quality of life / ora **;** better / more efficient, control of composition of blood **;** can have wider diet / ora **;** ref. to cost or economic benefit – to health service *or* to individual **;**	[max 3]	**A** 'doesn't need to go to clinic / hospital' **MP2** is medical issue **A** any appropriate blood borne disorder **MP3** is social issue **MP6 R** cost unqualified **A** 'dialysis machine available for others'
(c) (i)	I^AI^O x I^BI^O **;** *accept:* AO x BO **;** I^A , I^O + I^B , I^O **;** A , O + B , O **;** I^OI^O , (blood group) O **;** OO , (blood group) O **;** (allele) I^O recessive to I^A and I^B **;** (allele) O recessive to A and B **;** parents must both, have I^O / O / be heterozygous **;**	[max 4]	**R** one I for the genotypes, e.g. I^{AO} gametes must be derived correctly from the parental genotypes written explanation may be written in terms of parents pass on the allele I^O ***ignore*** gene for allele
(ii)	25% / 0.25 / ¼ / 1 in 4 **;**	[1]	**R** a ratio e.g. 1:3
		[Total: 10]	

Question	Answers		Marks	Additional Guidance
2 (a) (i)	**A** – pollen tube **;** **B** – ovule **;** **C** – egg cell / female gamete / female nucleus **;**		[3]	**R** egg / ovum
(ii)	**1**	(stigma) place where pollen grain, germinates / develops (to form a tube) **;**	[max 3]	**I** lands
	2	growth of pollen <u>tube</u> (down the style) **;**		MP2 **A** male gamete travels down **R** pollen grain moves
	3	pollen tube / **A**, enters, ovule / **B** **;**		
	4	ref to micropyle **;**		linked to pollen tube
	5	tip of, pollen tube / **A**, opens **;**		
	6	(male) nucleus / gamete fuses with, female gamete / nucleus / egg cell (nucleus) / **C** **;**		
	7	forms zygote **;**		**A** ovum as an *ecf*
	8	diploid **;**		
(iii)		**max 3 for advantages OR disadvantages**	[max 4]	
		advantages		
	1	*idea that* self-pollination perpetuates variety that is well adapted to habitat **;**		
	2	greater chance of pollination / ensures pollination occurs **;**		**I** faster
		A reproduction / fertilisation		
	3	less wastage of pollen / gametes / energy (in pollen production) **;**		
	4	*idea that* useful if no other plants (of same species) nearby **;**		
	5	no need for pollinating agent **;**		
		disadvantages		
	6	less, variation **;**		**R** ref. to clones / genetically identical
	7	ref. to genotype becoming homozygous **;**		
	8	ref. to harmful alleles (**A** genes) **;**		
	9	less chance of adapting to changing conditions / AW **;**		
	10	more susceptible to diseases **;**		
	11	may become extinct **;**		

Question	Answers	Marks	Additional Guidance
2 (b) (i)	*Glycine* ;	[1]	**R** *Glycine max*
(ii)	network / AW, of veins / one (large) central vein ; broad leaves ; two, cotyledons / seed leaves ; flower parts in multiples of, 4 / 5 ; central / main, root ; vascular bundles regularly arranged ; has (true) secondary growth ;	[max 2]	**A** reverse arguments **I** large leaves **R** parts **A** 'not in 3s' **A** vascular bundles **not** irregularly arranged
		[Total: 13]	

3 **(a** osmosis **;**
water, diffuses / moves, down water potential gradient **;** **A** high to low water potential
R high water potential gradient to a low water potential gradient
through partially permeable membrane **;** **A** selectively / semi-
salts / sugars / solutes, in root hair cell (to lower water potential) **;** **[max]**

(b) 20.0 **;** **A** 20 *accept if not in table* **[1]**

(c) (rate of water) uptake increases / AW **;**
positive correlation / exponential / not linear / AW **;** **R** directionally proportional
comparative use of figures <u>with units</u> **;**
e.g. 0.4 mm min^{1} at 0 m s^{1} / no wind, 20 mm min^{1} at 8 m s^{1} **A** increase by ×50 **[2 max]**

(d) temperature **;** **R** heat
humidity **;**
light <u>intensity</u> **;** **R** amount / levels, of light **[2 max]**

(e)
1 (raw material for) photosynthesis / forming glucose *or* carbohydrate **;**
2 turgidity / support **;**
3 transport of, solutes / named solute / food substances **;**
4 forming vacuoles / growth / (cell) expansion **;**
5 taking part in chemical reaction(s) **;** e.g. hydrolysis / breaking down food substance
6 medium for chemical reactions / AW **;**
7 AVP **;** e.g. activating enzymes

R 'to keep hydrated' / solvent unqualified **[2 max]**

(f)
1 loss of water (vapour) through stomata (in leaves) **;**
2 evaporation, from surfaces of (mesophyll) cells / into air spaces (in leaf) **;**
3 loss of water from leaf (cells) lowers <u>water potential</u> **;**
4 water moves into leaf (from xylem) **;**
5 (this) pulls on / creates tension (in water column in xylem) **;**
6 cohesion of water molecules / AW **;** **A** 'stick together', ref to polar

R root pressure / adhesion / capillarity **[4 max]**

3 **(g)** *note question says **structural** adaptations*

leaves, small / reduced to spines / are needles **;** **A** small surface area
no leaves **;**
curled / rolled, leaves **;**
hairs on the, leaves / stems **;**
thick (waxy) cuticle **;** **R** 'skin' / waxy cuticle unqualified
sunken stomata / AW **;**
few stomata **;**
fleshy / succulent, leaves / stems **;** **A** described as reserves / stores of water
small surface area: volume ratio **;**
deep roots **;**
long / extensive, shallow roots **;** **A** long roots near the surface

AVP **;** e.g. photosynthesis i
AVP **;**

ignore stomata close during the day **[3 max]**

[Total: 17]

4 **(a)**	phenotype **;** gene **;** haploid **;** mitosis **;** [4]	
(b)	*if there is an error in the genetic diagram allow ecf even if final phenotypes are NOT all different as stated in the question* $I^A I^o \times I^B I^o$ **;** $I^A, I^o + I^B, I^o$ **;** $I^A I^o$, $I^A I^B$, $I^B I^o$, $I^o I^o$**;** A AB B O ; *blood types must match genotypes* [4]	**accept** IA, IB and IO for alleles A, B and O for alleles MP2 and 3 in Punnett square **ignore** spaces, commas or dots in diploid genotypes very little space between gamete genotypes **reject** I^{AB} etc as genotypes for parents or children I without A, B and o
(c)	1 two (or more) alleles **;** **R** two blood groups 2 two / both, are expressed / equally dominant / both dominant / give different phenotype **;** 3 in heterozygous / described (individual) **;** 4 AB, $I^A I^B$ (as example) **;** [3 max]	**A** two (or more) implied, e.g. 'neither' / 'each other' / 'both' **ignore** ref to genes 'neither is fully expressed' = 1 mark for MP1 'neither is dominant over the other' = 2 marks **R** ref. to recessive <u>and</u> dominant **A** *idea* 'when both alleles are present in the genotype' **A** refs. roan cattle, pink flowers as other correct examples

4 **(d)**	*accept converse statements* 1 used to treat diabetes (wherever in answer) **;** 2 insulin the same as human / uses human DNA / human gene / AW **;** 3 not rejected **;** **A** 'people not allergic' 4 no risk of, infection / disease (from animals) **;** 5 GE insulin can be, modified / improved / AW **;** 6 animals not killed / suitable for vegans **;** 7 cheaper / more readily available / produced quickly / constantly / large amounts / large scale **;** **R** 'easier' 8 ref. to bacteria reproduce quickly **;** 9 increasing numbers of people with diabetes / don't produce insulin **;** **A** don't respond to insulin [3 max]	MP2: e.g. animal insulin is 'foreign' / bovine insulin has three different amino acid residues from human insulin / porcine has only one different / insulin from dead animal, is not the same as human amino acid sequence can be modified **A** religious / ethical objections to using animals, but **not** to using GE insulin MP7 is related to production **A** animal insulin has to be obtained from animal soon after its death **R** refs. to side effects
(e) (i)	*note that this is 2 marks* plasmid **;** DNA / <u>genes</u> **;** [2]	**R** plasmic / plasma **R** nucleic acid unqualified by DNA
(ii)	(restriction) enzyme / endonuclease **;** **ignore** restrictive, etc human / insulin, gene / DNA **;** [1]	**R** incorrect enzyme, e.g. ligase **R** gene unqualified
	[Total: 17]	