Question		E Answers	Marks	Additional Guidance
1	(a)	self-pollination, occurs within same flower / between flowers of same plant ; cross-pollination, occurs between flowers on different plants ;	2	
	(b)	wastage of pollen ; wastage of energy ; explanation ; depends on presence of pollinator ; need a pollinating / other, plant (nearby) ; long time for next generation to develop ; seeds scattered to places where they cannot grow ; variation leads to plants that are not adapted to place where parents grow / seeds end up ;	max 4	**A** idea of pollen does not reach a stigma
	(c)	*round* **RR** *wrinkled* **rr** ;	1	

1	**(d)**				

cross		phenotype of seeds in the seed pods		ratio of round to wrinkled seeds
		round seeds	wrinkled seeds	
1	pure bred for round seeds x pure bred for wrinkled seeds	✓	×	1:0
2	offspring of cross 1 self pollinated	✓	✓	**3:1** ;
3	offspring of cross 1 x pure bred for round seeds	✓	×	**1:0** ;
4	offspring of cross 1 x pure bred for wrinkled seeds	✓	✓	**1:1** ;

			3	
	(e)	controlled by (a) gene alone ; limited number / two, (pheno)types ; no intermediates ;	max 1	**A** (just) two types / round & wrinkled
	(f)	**1** colonisation / spread to new areas ; **2** where might be able to grow better ; **3** better (named) condition(s) ; **4** less competition ; **5** less (chance of) disease ; **6** *idea that* allows breeding with wider variety of plants; **7** AVP ;	max 3	light / water / minerals / CO_2 / space e.g. bigger gene pool / more alleles / e.g. Some survive a localized disaster /
			[Total: 14]	

Question		E Answers	Marks	Additional Guidance
2	**(a)**	loss of water <u>vapour</u> **;** from, leaves / stems / aerial parts / through stomata **;**	[2]	**accept** evaporation **accept** diffusion through stomata
	(b)	water moves from high(er) water potential to low(er) water potential **;** by osmosis **;** through partially permeable membrane **;** ref to protein pores **;**	[max 3]	
	(c)	*feature plus explanation* no leaves **;** less surface for / reduce, transpiration / loss of water **;** swollen / AW, stem **;** stores water **;** spines **;** protect against, herbivores / being eaten **;** ridged stem **;** allows stem to swell when water available **;** upright shape **;** reduce surface area for absorption of heat (at mid day)	[2 + 2]	*a mark can be awarded if the feature is not linked to an explanation or the explanation is incomplete or incorrect* *each explanation must be linked to a feature, no mark for an explanation alone*

2	**(d)**	*allowing to survive* no / less, water (vapour) lost **;** by transpiration / diffusion **;** can survive, in dry areas / with shortage of water from the soil / with little rainfall **;** open at night when cool without much loss of water **;** *limits growth* cannot absorb carbon dioxide during the day **;** carbon dioxide diffuses through stomata **;** needed / raw material, for photosynthesis **;** only happens when light available **;** therefore little food (for growth) **;** transpiration cools plants **;** may overheat (during the day) **;** ref to denaturation of, proteins / enzymes **;** slower, reactions / metabolism / AW **;** AVP **;**	[max 4]	
			[Total: 13]	

Question		E Answers	Marks	Additional Guidance
3	**(a)**	(gives) variation / diversity **;** **R** 'varied species' (plural) ref to, alleles / genes / DNA, from different, plants / *idea that* increased chance for mutations to be expressed **;** allows adaptation to, new conditions / changed environment / AW **;** allows evolution to occur **;** prevents inbreeding **;** ref to disease resistance **;**	[max 3]	
	(b)	**(i)** **A** – ovary / ovary wall **;** **R** pod **B** – pollen tube **;** **C** – zygote **;** **D** – radicle / embryonic root **;** **E** – cotyledon / seed leaf **;**	[5]	**accept** embryo once only for **D** or **E**
		(ii) <u>mitosis</u> **;**	[1]	
	(c)	(male / female) gametes are not all identical **;** female gametes are not fertilised by identical male nuclei **;** gametes are produced by meiosis **;** meiosis gives rise to variation **;** pollen grains come from different plants **;**	[max 2]	

3	**(d)**	some seeds not, viable / AW ; some remain dormant ; no water available ; no soil ; no minerals / no nutrients ; too cold / too hot ; **A** extremes of temperature not enough light ; ref to competition with other plants ; eaten by animals ;	[max 3]	
			[Total: 14]	

4	**(a)**	**(i)**	transport of oxygen	[1]	
		(ii)	amino acids	[1]	**A** polypeptides, haem
		(iii)	iron / Fe / Fe^{2+}	[1]	

	(b)		fewer red blood cells		**Ig** ref to malaria
		2	less elastic / less flexible / sickle-shaped, red blood cells		
		3	haemoglobin is abnormal shape		
		4	haemoglobin / blood, less efficient at transporting oxygen		
		5	less respiration		
		6	less energy / fatigues / exhaustion / less active / feeling faint / breathlessness		
		7	death of tissues linked to oxygen supply		
		8	capillaries are blocked		
		9	pain		
		10	'sickle cell crisis'		
		11	slow / poor, growth		
		12	susceptible to infections		
		13	reduced life span		
		14	AVP e.g. problems in pregnancy, kidney disease	[max 3]	
	(c)	**1**	malaria is common in Africa		
		2	people who are, heterozygous / $\mathbf{Hb^AHb^S}$		
		3	have, sickle cell trait / mild sickle cell		Mpt 4 **R** immune
		4	protected / AW, against malaria		
		5	description of sickle cells are less prone to infection		
		6	$\mathbf{Hb^S}$ continues to appear due to selective advantage / AW	[max 3]	**A** description of selection

4	(d)		**Hb^A** is dominant / **Hb^S** is recessive / (both) parents are, carriers / heterozygous Hb^AHb^S x Hb^AHb^S Hb^A, Hb^S + Hb^A , Hb^S (Hb^AHb^A , Hb^AHb^S, Hb^AHb^S) Hb^SHb^S	[max 3]	**Note:** **Ig** incorrect text if genetic diagram is correct **ECF** for Mpt 2 and 3 in diagram key. Mpt 3 linked to correct derivation in Mpt 2 *do not allow genotypes for parents or children that are single alleles*
	(e)	**1** **2** **3**	ref to (ionising) radiation causes / increased risk, mutation change to DNA / genes	[max 2]	**A** e.g. of radiation e.g. gamma rays
			[Total: 14]		