1 **(a)** MUST USE LABEL LINES
ACCEPT NAMES AS WELL AS LETTERS
S. – any point in the vagina
D. – the cervix
M. – the ovary
F. – the oviduct
E. – any point on the surface of the uterus or in cavity
R if line is in muscular wall **5**

(b) (ovum)
i. ref. to fallopian tube / oviduct ;
ii. ref. to presence of ciliated cells / cilia (in wall) ;
iii. ref. to (ovum) wafted down / propelled / moved / conveyed AW / sweep ; **R** passed unqual. **R** transport
iv. ref. to peristaltic movement AW of oviduct ; **max 2**

(ii) (sperm)
i. ref. to presence of tail + to swim / move AW ;
ii. ref. to mitochondria + to provide energy / power ;
iii. ref. to sperm streamlined / light / very small ; **2**

(iii) (zygote)
i. ref. to a fertilised egg / fused egg and sperm (nucleus) ;
ii. contains chromosomes of egg and sperm ;
iii. egg and sperm / gametes / sex cells + are both haploid / have half normal number of chromosomes / have 23 chromosomes / (both) formed by meiosis ; **max 2**

(iv) ref. to progesterone ;
secreted / produced by + placenta ; **2**

total max. 13

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2 **(a)(i** meiosis; Ⓐ reduction division **[1]**

(ii) ref. to half the number of chromosomes/haploid; Ⓐ v.v
has 23 chromosomes;
Ⓐ only contains one sex chromosome AW
ref. to presence of tail/ability to move; Ⓡ refs to shape
Ⓐ less cytoplasm/less food stores AW **max. [1]**

(iii) zygote; Ⓐ diploid Ⓡ **[1]**

(iv) ref. to sperm cell that fertilises it must be carrying an X (chromosome);
ref. to fertilised egg cell contains XX;
Ⓐ egg cell had not been fertilised by a Y sperm AW **[1]**

(b)(i) ovary; Ⓐ follicle **[1]**

(ii) oviduct/fallopian tube; **[1]**

(iii) uterus; Ⓐ womb **[1]**

(c) (amniotic fluid)

- protects fetus from physical damage/cushions; Ⓡ protects unqual.
- acts as shock absorber AW ; Ⓡ prevents shock unqual.
  Ⓡ supports unqual.
- prevents unequal pressures from acting on fetus/maintains constant environment/allows free movement;
- protects fetus from temperature fluctuations AW; Ⓡ insulates unqual.
- protects fetus from drying out AW;
- ref. to absorbs + excretory material/urine from fetus; **max. [1]**

(amniotic sac)

- secretes/produces + amniotic fluid;
- encloses/contains + amniotic fluid AW; **max. [1]**

(d)(i) IGNORE REFS TO NUTRIENTS/FOOD

- ref. to exchange of up to **two** named materials e.g. oxygen/glucose/ water/amino acids/antibodies/urea/carbon dioxide; ;
  Ⓐ other correct materials ◯
- ref. to physical attachment between fetus and uterus/mother;
- ref. to prevention of blood mixing/allows blood systems to be close AW;
- ref. to protection from mother's (high) blood pressure;
- ref. to protective role in preventing the entry of some pathogens AW;
  Ⓡ germs/disease **max. [4]**

(ii) ref. to secretion of progesterone; (ignore oestrogen refs.)
to keep lining of uterus thick/prevents menstruation/to prevent breakdown of uterus lining;
Ⓐ prevents uterine muscle contracting **[2]**

Total 15

3 **(a)** column drawn and shaded correctly ;
Y axis labelled ;
X axis labelled + units ; **[3]**

(b) continuous ; **[1]**

(ii) ref. to different amounts of light ; ® environmental differences unqual.
ref. to different amounts of minerals ;
ref. to exposure to different temperatures ;
ref. to disease / fungal or viral infection ;
ref. to competition for water ;
ref. to genetic differences ;
ref. to trampling ;
ref. to grazing ; **[max. 3]**

(c) ref. to large + petals ;
ref. to coloured + petals ;
ref. to scent ;
ref. to presence of nectar ; **[max. 2]**

(ii) ref. to pollination AW ; **[1]**

(d) ref. to self-pollination / ref. to other agents of pollination ;
so fertilization occurs using pollen from same flower AW ; **[2]**

[max.12]

Question		Mark	Additional Guidance
4 (a)	feathers ;	max [1]	
(b)	<table><tr><td>go to 2</td><td></td></tr><tr><td>go to 4</td><td></td></tr><tr><td>*Spinus tristris*</td><td>**D**</td></tr><tr><td>go to 3</td><td></td></tr><tr><td>*Ara ararauna*</td><td>A</td></tr><tr><td>*Aquila chrysaetos*</td><td>**F**</td></tr><tr><td>*Platalea regia*</td><td>**C**</td></tr><tr><td>go to 5</td><td></td></tr><tr><td>*Trochilus polytmus*</td><td>**E**</td></tr><tr><td>go to 6</td><td></td></tr><tr><td>*Recurvirostra americana*</td><td>**G**</td></tr><tr><td>*Phoenicopterus minor*</td><td>**B**</td></tr></table>	[3]	5 or 6 correct = 3 3 or 4 correct = 2 1 or 2 correct = 1

Question		Mark	Additional Guidance
4 (c) (i)	**A –** meiosis ; **B** – zygote ;	[2]	
(ii)	(cell / nucleus) has <u>two</u> sets of chromosomes ; has pairs of chromosomes ; has chromosomes from <u>two</u>, haploid cells / sperm and egg / two gametes ; has chromosomes from male and female (parents) ; has twice the number of chromosomes as the gametes ;	max [1]	**ignore** has 80 chromosomes **ignore** 2n unqualified
(iii)	increase in complexity ; (named) cells / tissue(s) / organ(s) / organ system(s), become specialised / differentiate / AW ;	max [1]	**R** ref to increase in cell number and cell size
(iv)	ref adaptation to, new / changed, environment / habitat / ecosystem ; any example ; e.g. ref to (new) disease / camouflage / escaping from (new) predators allows, selection / evolution ; ref to reduces competition ; increases chances of survival of the species / reduces chance of extinction ; AVP ; e.g. increase in gene pool	max [2]	**A** ref to selective advantage
		[Total: 10]	

5 **(a)**	taking a, gene / DNA / allele, from one species ; inserting it into another organism ; OR changing the, genetic material / chromosome of, an organism / cell ; by removing / changing / inserting, genes / DNA / alleles ;	max [2]	
(b)	<table><tr><th>Letter from fig</th><th>Name</th><th>Descrip</th></tr><tr><td>**M**</td><td>chromosomes</td><td>threads of DNA found in the nucleus</td></tr><tr><td>**N**</td><td>gene / allele ;</td><td>section of DNA removed from human cell</td></tr><tr><td>**Q**</td><td>plasmid</td><td>vector / loop / circle, of DNA (that can carry a foreign section of DNA) / separate piece of DNA (from chromosome) ;</td></tr><tr><td>**R**</td><td>bacterial (cell) ; **A** yeast</td><td>type of cell that is genetically engineered</td></tr><tr><td>**O**</td><td>insulin / protein ;</td><td>specific chain of amino acids coded by the section of DNA removed from the human cell</td></tr><tr><td>**P**</td><td>fermenter</td><td>(container in which) bacteria / microorganisms / cells, reproduce / grow / produce insulin ;</td></tr></table>	[5]	

5 **(c)**	clone / (genetically) identical ; rapid / less energy to reproduce (asexually) / only one parent / no gametes ; large quantity of insulin produced ; all bacteria, have the insulin gene / produce insulin ; same insulin produced ; once cells are engineered does not have to be repeated ; AVP ; e.g. cheap / ethical *or* religious reasons / less allergic reaction / no immune rejection / more efficient / no risk of disease (transmission)	max [3]	**A** no variation only accept in context of comparisons with animal insulin extraction methods
		[Total: 10]	

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