01. 0610_s20_MS_42 Q: 6

<table>
<tr><td>(a)(i)</td><td>one mark per correct row
<table><tr><th>function</th><th>name of structure</th><th>letter from Fig. 6.1</th></tr><tr><td>provides support to the stem</td><td>xylem</td><td>L</td></tr><tr><td>protects flower bud</td><td>sepal</td><td>G</td></tr><tr><td>produces glucose</td><td>leaf</td><td>H</td></tr><tr><td>produces pollen</td><td>anther</td><td>B</td></tr><tr><td>delivers male nuclei to the site of fertilisation</td><td>pollen tube</td><td>D</td></tr></table>;;;;;</td><td>5</td></tr>
<tr><td>(a)(ii)</td><td>B / D / F ;</td><td>1</td></tr>
<tr><td>(a)(iii)</td><td>translocation ;</td><td>1</td></tr>
<tr><td>(a)(iv)</td><td>H ;</td><td>1</td></tr>
<tr><td>(b)(i)</td><td>nitrate (ions) ;</td><td>1</td></tr>
<tr><td>(b)(ii)</td><td>ribosomes / (rough) endoplasmic reticulum ;</td><td>1</td></tr>
<tr><td>(b)(iii)</td><td>enzymes ;</td><td>1</td></tr>
</table>

---

02. 0610_w18_MS_43 Q: 2

<table>
<tr><th></th><th>Answer</th><th>Mark</th><th>Partial Marks</th></tr>
<tr><td>(a)</td><td>6 ;</td><td>1</td><td>A 3 pairs</td></tr>
<tr><td>(b)</td><td>different lengths of (sex) chromosomes ;
different banding (patterns) of (sex) chromosome ;
different numbers of (sex) chromosomes ;
female has XX (chromosomes) and male has, XYY / AW (chromosomes) ;
female chromosomes are same as each other / male chromosomes differ from each other ;</td><td>2</td><td></td></tr>
<tr><td>(c)</td><td>(meiosis) produces gametes ;
(gametes) are haploid ;
gametes / AW, are genetically different (from each other) ;
fusion of gametes ;
at random ;
zygotes / offspring / AW, are genetically different (from parent) ;
sexual reproduction causes variation ;
AVP ;</td><td>4</td><td></td></tr>
<tr><td>(d)</td><td>an allele is a version of a gene ;
mutations (can cause new alleles to form) ;
change in the base / DNA, sequence ;
(ionising) radiation / (named) chemicals, cause mutations ;
AVP ;</td><td>3</td><td></td></tr>
</table>

	Answer	Mark	Partial Marks
(a)	a length of DNA ; that codes for a protein ;	2	**I** characteristics / traits **A** polypeptide for protein
(b)	**1** ribosomes make proteins ; **2** mRNA is copied, from gene / DNA ; **3** gene / DNA, remains in nucleus ; **4** mRNA moves, from nucleus to, cytoplasm / ribosome ; **5** mRNA passes through ribosome / AW ; **6** ribosome assembles amino acids (into a protein) / AW ; **7** (protein synthesis) uses energy ; **8** order of amino acids determined by base sequence of, mRNA / DNA / gene ;	4	**A** protein synthesis at, ribosomes / (rough) ER
(c)(i)(i)	active transport ;	1	
(c)(ii)	**1** protein uses, energy / ATP (from respiration) ; **2** *idea of* protein interaction with ions ; **3** (to) change shape of protein ; **4** ions move through the protein ; **5** against concentration gradient / lower concentration to high concentration (across a membrane) ; **6** AVP ;	3	e.g. ref to selective / specific shape
(d)	**1** plasma proteins ; **2** haemoglobin ; **3** (named) enzymes ; **4** antibodies ; **5** fibrinogen ; **6** (named) hormone ;	2	**A** fibrin **A** insulin / glucagon / ADH / oxytocin

04. 0610_s17_MS_43 Q:2

	Answer	Mark	Partial Marks
(a)	two cotyledons ; broad leaves ; leaves with branching veins ; petioles ; flower parts in multiples of four or five / flower parts not in threes ; pollen with three furrows or pores ; stem vascular bundles in a ring ; roots, develop from radicle ; AVP ;	1	**A** seed leaves **A** not adventitious e.g. secondary growth often present
(b)(i)	a length of DNA ; that codes for a protein ;	2	
(b)(ii)	different sequences of amino acids ; composed of different amino acids ; different shapes / folded differently / AW ;	2	
(c)	*mRNA to max 1* 1 mRNA carries copy of, gene / DNA / base pair sequence ; 2 goes from nucleus to, ribosome / cytoplasm ; 3 determines the specific, order / sequence, of amino acids ; *ribosome to max 1* 4 site of, protein synthesis ; ('protein synthesis' is in question) 5 ribosome assembles amino acids into proteins ; 6 passes through the ribosome / reads mRNA ;	2	
(d)(i)	1 temperature ; 2 surface area of substrate ; 3 concentration / volume / amount / number, of enzyme (solution) ; 4 concentration / volume / amount, of (named) substrate (solution) ; 5 type of enzyme ; 6 type of substrate ;	2	
(d)(ii)	1 increases and decreases ; 2 peaks at / optimum, at pH 4.0 / 0.55 (au) ; 3 no activity beyond pH 6.5 ; 4 curve is symmetrical / AW ; 5 any data quote, e.g. activity is 0.55 (au) at pH 4.0 ;	3	**A** works best / AW **I** denatured
(d)(iii)	1 pH 4 is the optimum (pH) ; 2 pH 7 enzyme is denatured ; 3 enzyme / protein / active site, has changed shape at pH 7; 4 shape of active site is complementary to substrate (4) / not (7) ; 5 enzyme-substrate complexes form (4) / not (7) ; 6 (most) effective collisions (between enzyme and substrate) (4) / none (7) ;	4	

05. 0610_m16_MS_42 Q:6

	Answer	Mark	Partial Marks
(a)	*Osteocephalus* ;	[1]	
(b) (i)	**1** two strands twisted to form helix ; **2** cross-links between the strands ; **3** A joins with T / C joins with G ; **4** all labels correct ;	[max 3]	**A** base / sugar / deoxyribose / phosphate / hydrogen bond / nucleotide / crosslinks / double helix
(ii)	the sequence of bases in DNA are used ; base sequences / DNA / genes, that are more similar mean that organisms are more closely related ; **ORA**	[2]	**I** genetic material
(c) (i)	gene ;	[1]	
(ii)	**1** mRNA carries a copy of the gene / DNA / base pair sequence ; **2** mRNA travel from the nucleus ; **3** to the ribosome / cytoplasm ; **4** order of amino acids depends on the sequence of bases in mRNA / AW ;	[max 3]	

06. 0610_w16_MS_43 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	double helix; (strands) contain, bases / A and T and C and G; A joins with T / C joins with G; strands / bases, join / pair up, by crosslinks / hydrogen bonds; AVP;	3	**A** labelled drawing or description
(a)(ii)	codes for a protein;	1	
(b)	respiration; aerobic (respiration); release energy / make ATP;	2	**R** produce energy
(c)	cytoplasm; cell membrane; single celled / unicellular; no (true) nucleus / no nuclear membrane; loop of DNA / chromosome / naked DNA; no, (membrane-bound) organelles / mitochondria / chloroplasts; (peptidoglycan / murein) cell wall; AVP; e.g. plasmids	2	**A** nucleoid **R** cellulose cell wall **I** flagella, pili, mesosomes, capsules
(d)	**B** and **D** in box 1 and 2 (any order); **C** in box 3; **A** and **F** in box 6 and box 7 (any order);	3	
(e)	it is (more) accurate (than traditional classification systems); easi(er) / cheap(er) / quick(er) / (more) efficient / to use (than other (named) identification methods); **ora** allows large-scale identification (of many species simultaneously); only trace samples are required; (DNA sequences) within a species are very similar;	1	**A** samples do not need to purified **A** early identification of (pathogenic bacteria) for infections
		Total: 12	

07. 0610_s19_MS_41 Q: 6

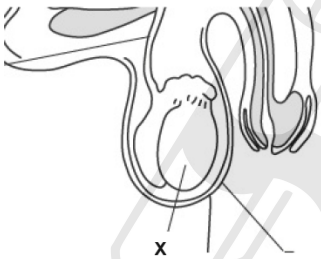
	Answer	Mark	Partial Marks
(a)(ii)	growth ; producing cells ; increase length of shoot / elongation of shoot ;	1	
(b)	dividing cell / cell division / mitosis, needs (lot of) energy ; carry out aerobic respiration ; provide / release, energy ; (for) a named function in dividing cells ; e.g. movement of chromosomes making cell wall making new (named) molecules (e.g. protein / DNA) making (named) organelle(s)	3	
(c)(i)	auxin ;	1	
(c)(ii)	*auxin / hormone:* made in the, shoot / stem, tip ; moves away from the tip ; moves to / collects on, lower side of stem ; stimulates cell elongation ; stem, bends / grows, upwards ; AVP ;	4	
(d)	plants have different, structures / parts / specialised cells ; *idea that* different parts / specialised cells, have different, functions / roles / features ; *idea that* specific proteins are required in, parts / specialised cells ; genes code for proteins ; therefore some genes, are required / are not required ; AVP ; e.g. *idea that* waste of (named) resource(s) if all genes expressed	3	

08. 0610_w19_MS_42 Q:3

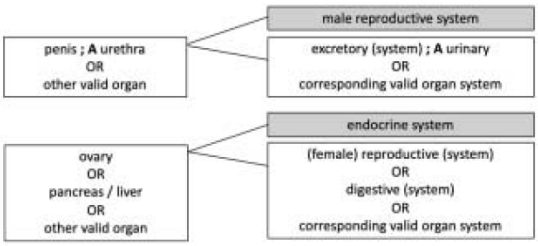
	Answer	Mark	Partial Marks
(a)(i)	provides, suitable / optimum, pH for (correct named) enzyme action ; activates, enzyme / pepsin ; kills / AW, bacteria / viruses / pathogens / microbes ; AVP ;	2	
(a)(ii)	(catalyses) breaks down / (chemically) digests, of protein ; to amino acids ;	2	
(b)	movement of digested food molecules into cells ; food molecules become part of cells ;	2	
(c)	(stem cells) divide by mitosis ; form (named) specialised cells (in stomach) ; to replace cells (in the lining of stomach) ; *idea that* cells are worn away from the surface of the stomach ; for repair of any damage to tissues ;	2	
(d)	increase / large, (surface) area ; for absorption (of named substances) / described; AVP ;	2	
(e)	54(%) ;;;	3	one mark for correct readings (78 minutes and 120 minutes) one mark for correct calculation one mark for whole number correctly rounded

09. 0610_m20_MS_42 Q:5

	Answer	Mark	Partial Marks
(a)(i)	doubles ;	1	**A** increases
(a)(ii)	34–39 minutes ;	1	**A** any value within this range
(b)	are genetically different (from each other and the parent cells) ; (produce) haploid (nuclei) ; ref. to reduction division / chromosome number being halved ;	3	
(c)	ref. to unspecialised cells ; that can become specialised ; ref. to expression of genes in specialised cells ; AVP ; e.g. continually divide	2	
(d)	breaking of the amniotic sac ; amniotic fluid is released ; contraction of (the muscles in the) uterus (wall) ; dilation of the cervix ; passage through the vagina ; (tying and) cutting the umbilical cord ; delivery of the afterbirth / placenta ; AVP ;	6	

<table>
<tr><th></th><th>Answer</th><th>Mark</th><th>Partial Marks</th></tr>
<tr><td>(a)</td><td>tissue ;
cell structure ;
cell ;
organ ;</td><td>4</td><td></td></tr>
<tr><td>(b)</td><td>
<table>
<tr><th>name of structure</th><th>function</th><th>letter on Fig. 4.1</th></tr>
<tr><td>testis</td><td>production of sperm / produces or releases testosterone</td><td>C ;</td></tr>
<tr><td>sperm duct</td><td>transports sperm but not urine</td><td>D ;</td></tr>
<tr><td><u>urethra</u></td><td>passage for urine and seminal fluid through the penis</td><td>A ;</td></tr>
<tr><td>prostate gland</td><td>secretes / produces, seminal fluid / nutrient-rich fluid / alkaline fluid / AW</td><td>E ;</td></tr>
<tr><td>scrotum / scrotal sac</td><td>contains testes</td><td>B ;</td></tr>
</table>
</td><td>5</td><td>one mark per row</td></tr>
<tr><td>(c)</td><td>X on testis / label line on testis with X ;
 
</td><td>1</td><td></td></tr>
<tr><td>(d)(i)</td><td>one set of chromosomes ;</td><td>1</td><td></td></tr>
<tr><td>(d)(ii)</td><td>23 ;</td><td>1</td><td></td></tr>
</table>

11. 0610_s19_MS_42 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	testosterone ;	1	
(a)(ii)	one mark per box but organ system must match organ ;;;;  	4	
(b)	to produce, gametes / sperm ; for sexual reproduction ; to halve the number of chromosomes / produce haploid cells ; so that when fertilisation occurs the number of chromosomes return to the, same / diploid, number / AW ; creates (genetic) variation / AW ;	3	
(c)(i)	<table><tr><th>letter</th><th>name</th><th>function</th></tr><tr><td>P</td><td>acrosome</td><td>contain enzymes / digests jelly coat ;</td></tr><tr><td>Q</td><td>haploid nucleus</td><td>contains / AW, DNA / half number / unpaired, single set of / chromosomes / genes ;</td></tr><tr><td>R</td><td>mitochondrion ;</td><td>releases energy</td></tr><tr><td>S</td><td>flagellum</td><td>swimming / AW ;</td></tr></table>	4	one mark per row
(d)	drawing detail ; additional drawing detail / any drawn and labelled common cell structure e.g. nucleus, cytoplasm, cell membrane, mitochondria / DNA / ribosome / (r)ER ; drawn and labelled unique cell structure ; e.g. jelly (coat) / energy store / protein-rich layer / yolk / large volume of cytoplasm	3	
(e)	jelly coat (of fertilised egg) hardens ; *reference to* zygote ; mitosis / cell division ; embryo forms ; moves down oviduct ; AVP ; e.g. use of nutrients in cytoplasm	3	

(a) **R and Y**;
RY;
orange; [3]

(b)

	genotypes of offspring
cross 2	**RR**, **YY**, **RY**
cross 3	**RR**, **RY**
cross 4	**YY**, **RY**

allow: ecf from **4(a)** [3]

(c) Any three from:
phenotype of **RY** (offspring of **cross 1**) is different from either parent or the homozygous genotypes / owtte;
the phenotype was intermediate / mixture of two colours;
offspring of **cross 2** gives three phenotypes not two;
offspring of **crosses 3** and **4** both give two phenotypes;
if dominance **cross 3** or **4** would give one phenotype only;
allow: incomplete dominance
allow: both alleles are expressed [max 3]

(d) Any two from:
transfer of pollen from anthers or stamen to stigma;
self = within same flower (or flower on same plant);
cross = between flowers on different plants (of same species); [max 2]

(e) Any four from:
limited variation;
offspring become homozygous (over time) / owtte;
allow: reference to inbreeding / limited gene pool
variation is due to mutation;
low chance that mutations will be expressed / owtte;
offspring will be well adapted to conditions near parent;
if environment does not change;
limited opportunity for evolution if environment changes / will not be able to adapt to change in the environment;
allow: reference to disease in context (as a change)
avp; e.g. some variation due to reassortment of chromosomes and crossing over during meiosis / reduced variation leads to intraspecific competition locally; [max 4]

13. 0610_s20_MS_41 Q:6

(a)	transmission of genetic information from generation to generation ;	1
(b)(i)	1 correct use of X and Y in responses for individual 5 and individual 8 ; 2 correct X allele given for individual 5: X^bY / **b** ; 3 correct X allele given for individual 8: X^BY / **B** ;	3
(b)(ii)	*any three from:* colour blindness is a sex-linked characteristic ; she is, heterozygous for the gene / **Bb** ; she has, normal allele / **B**, so has normal colour vision ; but has passed on the, recessive allele / **b,** to her sons / 5 and 7 ; she has two **X** chromosomes which have the gene for colour vision ; father / 4, passes on his **Y** chromosome ;	3
(b)(iii)	*any two from:* mutation ; to give, recessive allele / **b** ; occurred in 3 *or* in one of her parents / 1 or 2 *or* her grandparents ; AVP ; e.g. other reason such as donated gamete	2

---

14. 0610_m19_MS_42 Q:2

	Answer	Mark	Partial Marks
(a)(i)	(large) petals ;	1	
(a)(ii)	self-pollination is within the same, plant / flower ; OR cross-pollination is between different plants (of the same species) ;	1	
(a)(iii)	prevents extinction / enables survival of species ; more chances of fertilisation ; more chances of pollination ; no need for (named) pollinators ; useful if plants are (geographically) isolated / on their own / AW ; parent plants adapted to the environment, pass alleles to offspring / AW ; *idea of* sexual reproduction better than asexual reproduction for variation ;	3	
(b)(i)	both alleles are, expressed / neither allele is, dominant / recessive to the other ; the phenotype (of heterozygote is), intermediate / new / different / AW ; presence of multiple alleles, for one trait ;	2	
(b)(ii)	*gametes:* C^R , C^W + C^R , C^W ; *offspring genotypes:* C^RC^R, C^RC^W, C^RC^W, C^WC^W ; *offspring phenotypes:* red pink white ; *ratio:* 1 : 2 : 1 ;	4	
(b)(iii)	(parents phenotypes must be) red and white ; offspring must, inherit a C^R and a C^W allele / be heterozygous ;	2	

---

15. 0610_w19_MS_43 Q: 6

	Answer	Mark	Partial Marks
(a)	*ref. to* platelets ; fibrinogen is converted to fibrin / **L** ; fibrinogen is soluble / fibrin is insoluble ; (**L** / fibrin) forms a, mesh / AW ; (**L** / fibrin) traps / AW, blood cells / **J** / **M** ; **J** is a red (blood) cell ; **L** is fibrin ; **M** is a, white (blood) cell / lymphocyte / phagocyte ;	5	
(b)	prevents blood loss / AW ; prevent (named) pathogens entering a wound ;	2	
(c)(i)	observable features (of an organism) ;	1	
(c)(ii)	co-dominance ;	1	
(c)(iii)	I^AI^A ; I^Ai ;	2	

16. 0610_w18_MS_41 Q: 4

	Answer	Mark	Partial Marks
(a)	<table><tr><th>function</th><th>name of part</th><th>letter on Fig. 4.1</th></tr><tr><td>carries impulses to the brain</td><td>optic nerve</td><td>**Y** ;</td></tr><tr><td>focuses light onto the back of the eye</td><td>lens</td><td>**S** ;</td></tr><tr><td>controls the tension of the suspensory ligaments</td><td>ciliary, muscles / body</td><td>**Q** ;</td></tr><tr><td>tissue the detects light and colour</td><td>retina</td><td>**W** ;</td></tr><tr><td>location of most cone cells</td><td>fovea</td><td>**X** ;</td></tr></table>	5	one mark for each correct row
(b)(i)	antagonistic ;	1	
(b)(ii)	accommodation ;	1	
(c)	cones are less sensitive in low light ; cones detect colour ; rods work in low light but can't detect colour / AW ;	2	
(d)(i)	X^BX^b ;	1	
(d)(ii)	X^bY ;	1	
(d)(iii)	solid shaded square on Fig. 4.2 ;	1	
(d)(iv)	one X chromosome from each parent / an X from father ; mother does not have any colour-blind alleles / father passes on one colour-blind allele ; (all female offspring are) heterozygous / X^BX^b ;	2	

17. 0610_w18_MS_42 Q:5

	Answer	Mark	Partial Marks
(a)	***red blood cell:*** *feature:* red blood cells smaller than (named) white blood cell(s) / ora ; biconcave (disc / shape) / no nucleus ; *role:* contains haemoglobin / transports oxygen / transports carbon dioxide ; ***lymphocyte:*** *feature:* little cytoplasm / large(r) nucleus / nucleus fills most of the cell ; *role:* *ref. to* active immunity / responds to, antigen(s) or vaccine(s) / produce, antibodies or antitoxins / *ref. to* memory cells ; ***phagocyte:*** *feature:* lobed / irregular-shaped / C-shaped / AW, nucleus ; *role:* engulf pathogens / phagocytosis / AW ;	6	
(b)(i)	fibrinogen ⟶ fibrin ;	1	
(b)(ii)	prevent blood loss ; prevent entry of (named), pathogens / microbes ; *ref. to* wound healing / tissue repair ;	2	
(c)(i)	(**P**) X^HX^h ; (**Q**) X^hY ; (**R**) X^HY ;	3	
(c)(ii)	0.25 / 25% / 1 in 4 / ¼ ;	1	
(c)(iii)	gene is located on, a sex chromosome / X or Y / X / Y ; characteristic is more common in, males / one sex (than the other) ;	2	

18. 0610_m17_MS_42 Q:3

	Answer	Mark	Partial Marks
(a)	part of the eye: function rod cells: night vision / detects low light ; cone cells: colour vision ; sensory neurone: transmits nerve impulses to brain ;	3	1 mark for each correct row
(b)	**1** more rod cells than cone cells in the retina ; **2** ref to uneven distribution of rod cells either side of fovea ; **3** no rod cells and no cone cells at blind spot ; **4** optic nerve enters / leaves retina at blind spot ; **5** only cone cells at the fovea / no rod cells at the fovea ; **6** maximum number of cone cells are at the, fovea / 0 degrees ; **7** maximum number of rod cells at 20–21 degrees ; **8** data quote include units ; **9** AVP ; **10** AVP ;	5	
(c)	more males affected than females / **ora** ; only females are carriers / males are affected or not ;	2	
(d)	correct gametes ; X^B,Y +X^b, X^b ; correct offspring genotypes ; X^BX^b, X^BX^b, X^bY, X^bY; correct offspring phenotypes ; carrier female, carrier female, colour-blind male, colour-blind male ; correct percentage ; 50 % ;	4	offspring phenotype must be linked to the correct offspring genotype

19. 0610_w17_MS_41 Q:3

	Answer	Mark	Partial Marks
(a)	scent ; nectar ; 'honey' guides ; colourful petals ; large petals ; pollen (as source of food) ;	3	**I** sticky pollen / stigma **I** stigma / anther, inside flower **A** mimicry
(b)	pollen lands on stigma ; pollen tube grows ; through style ; to ovary ; *(pollen nucleus / male gamete)* enters ovule ; through micropyle ; pollen and ovule / egg, nuclei fuse ;	5	
(c)(i)	a version / type, of a gene ;	1	***A*** alternative form *of a gene*
(c)(ii)	test cross ;	1	
(c)(iii)	*parental phenotypes* tall x dwarf *parental genotypes* **TT** ; x **tt** ; *gametes* **T T** x **t t** ; *offspring genotype* **Tt** ; *offspring phenotype* (100%) tall		**A** ecf from parental genotypes.
(c)(iv)	**tt** ; so that no dominant allele is present / all alleles are recessive / AW ; recessive alleles only expressed if no dominant allele present ;	2	**A** homozygous recessive

20. 0610_w17_MS_42 Q: 4

	Answer	Mark	Partial Marks
(a)	little / less / AW / no, variation / (genetic) diversity ; ref to becoming homozygous ; less chance of, surviving / adapting / evolving, to, changing conditions / new environments / (new) disease ; risk of extinction ; increase chance of genetic disease ; adapted variety spreads / AW ; only one plant needed / no mate required ; **R** if 'asexual reproduction' is given greater chance of pollination / ensures pollination occurs ; *idea that* reproduction / fertilisation, successful if no other plants (of same species) nearby ; less wastage of pollen ; not dependent on (named) agent of pollination ; AVP ; no hybrid vigour / smaller gene pool	4	**A** fewer alleles **I** ref to gene(s) **R** cloning / uniform(ity) **A** increased risk of abnormalities / genetic 'weakness' / AW **A** gametes **I** no wastage
(b)(i)	term: example in *P. sativum* dominant trait: purple flowers recessive allele: **b** ; phenotype: (flower) colour / purple (flowers) / white (flowers) ; homozygous genotype: **BB** and / or **bb** ; heterozygous genotype: **Bb** ;	4	
(b)(ii)	*parental phenotype* purple flowers x white flowers purple flowers x white flowers *parental genotype* Bb x bb BB x bb ; *genotypes of gametes* B b + b (b) B B + b (b) ; *offspring genotypes* Bb bb Bb (Bb); *offspring phenotypes* purple flowers, white flowers ; purple flowers ;	5	
(c)(i)	*test cross 1* **GG** x **GG** / **GG** x **Gg** **A GG** on its own **R GG** x **gg** ; *test cross 2* **Gg** x **Gg** ;	2	 **A Gg** on its own
(c)(ii)	white plants are, homozygous recessive / **gg** ; (white plants / no chlorophyll) cannot, photosynthesise / produce own food ; (therefore white plants) do not grow into mature plants / do not produce flowers / die before reproducing / AW ;	2	 **I** cannot survive unqualified

(a) **R and Y**;
RY;
orange; [3]

(b)

	genotypes of offspring
cross 2	**RR**, **YY**, **RY**
cross 3	**RR**, **RY**
cross 4	**YY**, **RY**

allow: ecf from **4(a)** [3]

(c) Any three from:
phenotype of **RY** (offspring of **cross 1**) is different from either parent or the homozygous genotypes / owtte;
the phenotype was intermediate / mixture of two colours;
offspring of **cross 2** gives three phenotypes not two;
offspring of **crosses 3** and **4** both give two phenotypes;
if dominance **cross 3** or **4** would give one phenotype only;
allow: incomplete dominance
allow: both alleles are expressed [max 3]

(d) Any two from:
transfer of pollen from anthers or stamen to stigma;
self = within same flower (or flower on same plant);
cross = between flowers on different plants (of same species); [max 2]

(e) Any four from:
limited variation;
offspring become homozygous (over time) / owtte;
allow: reference to inbreeding / limited gene pool
variation is due to mutation;
low chance that mutations will be expressed / owtte;
offspring will be well adapted to conditions near parent;
if environment does not change;
limited opportunity for evolution if environment changes / will not be able to adapt to change in the environment;
allow: reference to disease in context (as a change)
avp; e.g. some variation due to reassortment of chromosomes and crossing over during meiosis / reduced variation leads to intraspecific competition locally; [max 4]

22. 0610_s16_MS_42 Q: 3

	Answer	Mark	Partial Marks
(a) (i)	1 cross / breed, (parent) plants with desired feature ; 2 (grow seeds and) chose offspring for (desired) feature(s) ; 3 cross (offspring) plants showing features with, original variety / self / each other ; 4 keep / many generations of, crossing and selecting ; 5 any detail ; e.g. bagging flowers / transfer of pollen (with paintbrush) / detail of seed collection	[max 3]	
(ii)	1 two parents / gametes, are required ; 2 variation in offspring / offspring might not all be red ; 3 time consuming ; 4 AVP ; e.g. harvesting seeds / finding pollinators, can be difficult / limited number of seeds / wasteful in context of unused pollen	[max 2]	I cost / energy
(b)	1 reduction / nuclear, division ; 2 chromosome number is halved ; 3 (diploid to) haploid ; 4 results in genetically different, cells / gametes / AW ;	[max 2]	
(c) (i)	$F^A F^N$;	[1]	
(ii)	pink (flowers) ;	[1]	ecf from (c)(i)
(iii)	*gametes:* F^A , F^N , F^A , F^A ; *offspring genotype:* F^AF^A, F^AF^N ; *offspring phenotype:* red, pink ; *proportion of pure breeding carnation plants*: 50% / 1:1 / 0.5 / half ;	[4]	
		[Total:13]	