3 Reproduction and inheritance

3.1 understand the differences between sexual and asexual reproduction

(d)	1. same <u>colour</u> / no <u>colour</u> variation / same phenotype / look the same / all identical / same characteristics / eq; 2. n genetic variation / clones / alleles the same; 3. quic r production; 4. production all year roun	Ignore more produced / profit	2 max

3(c)	Any **two** from the following: • sexual reproduction involves two parents but asexual reproduction only involves one (organism / parent / cell) (1) • sexual reproduction needs gametes / sex cells but asexual reproduction does not (1) • sexual reproduction produces genetically different organisms but asexual reproduction produces genetically identical offspring / clones (1)	ignore any reference to meiosis or mitosis sexual reproduction results in variation but asexual reproduction does not	**(2)**

3.2 understand that fertilisation involves the fusion of a male and female gamete to produce a zygote that undergoes cell division and develops into an embryo

(c)	1. sperm; 2. .fertilisation / fusion; 3. .zygote; 4. . diploid; 5. .mitosis; 6. 40 / forty / 20 pairs;		6

3.3 describe the structures of an insect-pollinated and a wind-pollinated flower and explain how each is adapted for pollination

1 (a)	1. larger (petals); 2. lour; 3. enc sed anther / enclosed stamens / shorter stamen / shorter filament; 4. enc sed stigma / enclosed carpels / shorter style / stigma not feathery; 5. n tary;	ignore amount of pollen or nectar allow converse for wind-pollinated for all Mps ignore attractive / smell / sticky as not structures	3

(b)	A petal / petals / corolla;		1
	B anther;		1
	C filament;		1

3.4 understand that the growth of the pollen tube followed by fertilisation leads to seed and fruit formation

(c)	1. igma; 2. pollen tube grows (down style); 3. into ovule / ovary; 4. en rs via micropyle; 5. (male nucleus / (pollen grain) nucleus / male gamete; 6. rtilisation / fuse / join / eq; 7. o m / egg / (female) nucleus / female gamete; 8. ovule becomes seed; 9. o le wall becomes seed coat / testa; 10. ovary b mes fruit;	allow if shown on clearly labelled diagram	5

(c)	1. pollen tube; 2. st e; 3. ary; 4. (pollen tube / male gamete into) ovule; 5. m e nucleus / male gamete / male sex cell; 6. fertilisation / fertilised / fertilize / fuses / joins / eq; 7. femal nucleus / female gamete / female sex cell / ovum / egg; 8. ovary becomes fruit;	5. ignore pollen pollen fertilises the ovum = 2	Max 5

3.5 *practical: investigate the conditions needed for seed germination*

2(a)

tube	te erature	water	light	% seeds germinated	average height in cm
A	room)	no	(yes)	0	0.0
B	roo	(yes)	yes	90	2.3(1);
C	fridge	yes	no;	10;;	(0.3)

First three columns correct for one mark

One mark for two % germination correct

Two marks for all % germination being correct

One mark for both average height being correct

4

(b)

1. seeds split / seeds burst / sprouts / eq;
2. oot / radicle seen / grows / eq;
3. shoot / plumule / stem seen / grows / eq;

Ignore leaf/plant emerges / increase in height / become seedlings

2

(c)

temperature;

water / moisture;

light;

oxygen;

Allow one mark for two correctly named and two marks for three correctly named

Location = 0

2

(d)

1. they germinate/grow / eq;
2. reference to (room) temperature and water;

1. Ignore same result as tube B
2. Ign e light / oxygen

2

(e)

(no oxygen) no respiration;

1

3.6 understand how germinating seeds utilise food reserves until the seedling can carry out photosynthesis

1 (a)

root appears / shoot appears / sprout / seed coat splits / eq;

ignore growth alone

1

(b)

1. oxygen;
2. respiration;
3. water / moisture / rain;
4. (activate) enzymes / reactions / hydrolysis / digestion / eq;
5. warmth / suitable temperature / optimum temperature;
6. enzymes / reactions;
7. light;
8. activate plant growth regulators / eq;

ignore air / pH

3. ig re humid

5. ig re temperature alone / heat

four conditions and no explanations = 3 max

6

3.7 understand that plants can reproduce asexually by natural methods (illustrated by runners) and by artificial methods (illustrated by cuttings)

3 (a)(i)

mitosis

reasonable phonetic spelling provided there is a 't' ignore asexual reproduction

(1)

3 (a)(ii)	Any two from the following: • same characteristics in offspring as parent plant /best characteristics inherited / clones produced / identical (1) • easier to generate new plants/propagate (1) • quicker to produce new plants (1) • cheap /idea that the plants will not run out / no need to buy new plants / seeds (1)	Accept same as parent plant	**(2)**

3.8 understand how the structure of the male and female reproductive systems are adapted for their functions

4 (a) (i)	P oviduct / fallopian tube; Q ovary; R uterus / womb; S vagina;	 allow ovaries allow uterine wall / uterine lining	4

10	penis; sperm / eq; egg / ovum / ova; fallopian (tube) / oviduct; zygote; mitosis; embryo; uterus / womb; twice / double / two times; diploid;		10

3.9 understand the roles of oestrogen and progesterone in the menstrual cycle

(b) (i)	O from oestrogen peak to trough;		1
(ii)	M from start until oestrogen line levels at start of cycle / from where progesterone peaks to end of cycle		1
(iii)	1. grows / thickens / build up / repaired / eq; 2. maintained / remains / eq; 3. breakdown / loss / shedding / eq; 4. not broken down if pregnant / egg fertilised / egg implanted / eq;	allow vascularisation	Max 3

2(b)(i)	An answer that combines points of interpretation/evaluation to provide a logical description: • levels remain low up until day 14 then rise (1) • they continue to rise to day 23 and drop at day 24 (1)	**(2)**

2(b)(ii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • as ovulation occurs (1) • the levels of progesterone released from the corpus luteum increases to maintain the lining of the uterus (1)	**(2)**
2(b) (iii)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • progesterone levels fall after day 23 to 17.11 (1) • so uterus wall thickness is not maintained and therefore pregnancy has not occurred (1)	**(2)**

3.10B understand the roles of FSH and LH in the menstrual cycle

1 (a)(i)	**A** ☒ FSH		**(1)**

3.11 describe the role of the placenta in the nutrition of the developing embryo

(c)	placenta; from mother's blood; diffusion / high conc. to low conc.; large surface area / thin / eq; umbilical cord;	ignore gas exchange / ignore carried	3

(b)	1. diffusion; 2. glucose / oxygen; 3. respiration / energy / ATP; 4. amino acids; 5. protein synthesis; 6. vitamins / named vitamin / minerals / named mineral / fatty acids / glycerol; 7. remove carbon dioxide / remove urea;	6. Ign e nutrients	Max 4

3.12 understand how the developing embryo is protected by amniotic fluid

6(a)	1. protects fetus; 2. cushions / shock absorber / supports / eq;		2

3.13 understand the roles of oestrogen and testosterone in the development of secondary sexual characteristics

(d)	1. secondary sexual characteristics; 2. start menstruation / ovulation / periods / eq; 3. hips widen; 4. growth of breasts; 5. growth of pubic hair / body hair; 6. change distribution of fat;	5. ignore ref to hair alone	Max 3

3.14 understand that the genome is the entire DNA of an organism and that a gene is a section of a molecule of DNA that codes for a specific protein

1 (a)	1. (section of) DNA; 2. (co s) for a protein / polypeptide;	Ignore codes for characteristic	2

3.15 understand that the nucleus of a cell contains chromosomes on which genes are located

5(a)(i)	23 (chromosomes)	**(1)**

3.16B describe a DNA molecule as two strands coiled to form a double helix, the strands being linked by a series of paired bases: adenine (A) with thymine (T), and cytosine (C) with guanine (G)

6(a)(i)	B	**(1)**
6(a)(ii)	TACGTACATGGC	**(1)**

1 (b)	A description linking three of the following (DNA is a) double helix (1) the sides of DNA are made from (alternating) sugars and phosphate (molecules) / sugar phosphate backbone (1) {paired / complementary} bases / A (joins to) T and C (joins to) G (1) (bases joined by/strands held together by) hydrogen bonds (1)	Accept H bonds Ignore h or H_2 bonds	**(3)**

(b) (i)	guanine;	Allow phonetic spelling eg gwanine = 1	1
(ii)	420;		1

3.17B understand that an RNA molecule is single stranded and contains uracil (U) instead of thymine (T)

2(c)(i)

G	G	C	T	A	G	T	T	G

C	**C**	**G**	**A**		**C**	**A**	**A**	**C**

[all correct = 2 marks and 1 mistake = 1 mark] **(2)**

3.18B describe the stages of protein synthesis including transcription and translation, including the role of mRNA, ribosomes, tRNA, codons and anticodons

1(c)	A description including four of the following: (the process is) translation (1) (mRNA) leaves the nucleus / enters the cytoplasm (1) (mRNA joins to) ribosomes(1) tRNA carries amino acids (1) tRNA joins to mRNA / bases on tRNA matches bases on mRNA (1) (bases read as) {sets of three / triplets / idea of codons} (1) (ribosome / mRNA holds tRNA so) amino acids are joined together / to make polypeptides (1)		**(4)**

2(c)(ii)	three / 3	**Reject** any other numbers given	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(d)	ribosome(s) / polysome(s)	**Ignore** cytoplasm **Reject** any other structure given	**(1)**

3 (c)(i)	**C** 4		**(1)**

3.19 understand how genes exist in alternative forms called alleles which give rise to differences in inherited characteristics

1(c)(ii)	Any one from: • mutation in the base sequence (1) • different base sequence (1) • different sequence length (1)	different amino acid sequence	**(1)**

3.20 understand the meaning of the terms: dominant, recessive, homozygous, heterozygous, phenotype, and genotype

2 (c)	T / always expressed / expressed in heterozygote / expressed in homozygote and heterozygote / always shown in phenotype / eq;	reject dominates over recessive	1

4 (a) (i)	same alleles / DD / dd / both dominant / both recessive / only one type of allele / eq;	ignore only one allele present allow other letters eg AA or aa. reject genes	1

6(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • both parents must be heterozygous for the recessive allele (1) • so the offspring must inherit the recessive allele from each parent (1)	**(2)**

3.21B understand the meaning of the term codominance

(d)	both / two alleles / equal / eq; reject if reference to genes expressed / contribute / shown / eq; in heterozygote / phenotype / characteristic; example described / intermediate phenotype described / eq;	reject weaker and stronger ignore dominant and recessive	max 2	

(c) (i)

Chicken	Genotype
parent with all black feathers	C^BC^B / BB
parent with all white feathers	C^WC^W / WW
offspring with a mixture of black and white feathers	C^BC^W / BW;

1

(ii) 0.5 / ½ / 50% / 2 in 4 / eq; 1

3.22 understand that most phenotypic features are the result of polygenic inheritance rather than single genes

3.23 describe patterns of monohybrid inheritance using a genetic diagram

1 (a)	1. . parents are BB and bb; 2. . first generation is Bb;	no TE	2
(b)	1. . gametes B and b; 2. second generation BB, Bb, Bb and bb;	allow TE for 1 mark for correct offspring from incorrect gametes	2

1a(i)	answers must be in this order. dominant HH		**(2)**

1a(ii)	<table><tr><td></td><td>H</td><td>h</td></tr><tr><td>H</td><td>HH</td><td>Hh</td></tr><tr><td>h</td><td>Hh</td><td>hh</td></tr></table>	1 mark for correct gametes 1 mark for correct offspring If incorrect gametes allow 1 mark for correct Punnett square based on selected gametes	**(2)**
1a(iii)	75% / ¾ / 0.75	accept error carried forward from their Punnett square **accept:** 3 : 1	**(1)**
1b(i)	An explanation linking **two** of the following: Huntington's disease is caused by a dominant allele / CF is caused by a recessive allele (1) only one allele for Huntington's disease needs to be inherited to have the disease / would have the disease if heterozygous (or homozygous dominant)(1) two alleles (recessive) need to be inherited to have CF / be homozygous recessive for CF (1)	 Ignore refs to gene for allele against this marking point Ignore refs to gene for allele against this marking point	**(2)**

3.24 understand how to interpret family pedigrees

(c)	1. condition present in offspring but not in parents; 2. it skips generations / eq; 3. carriers (present);		3

2(a)(i)	XX	ignore any superscript or subscript letters/symbols reject XY	**(1)**

2(a)(ii)	An explanation linking two of the following they did not inherit the (haemophilia) allele (1) (allele is) located on X chromosome (1) males receive X chromosome from their mother/Y chromosome from father (1) B is homozygous dominant/ neither X chromosome from B has the allele for haemophilia (1)	ignore gene throughout accept have the dominant/normal allele accept disorder is located on the X chromosome ignore mother is unaffected accept mother neither affected **nor** a carrier accept mother for B and father for A	**(2)**

3.25 predict probabilities of outcomes from monohybrid crosses

(b)

Parent genotypes	Probability of child with polydactyly
(Dd x DD)	1.0;
(Dd x dd)	(0.5)
(Dd x Dd)	0.75;

2

4 (a)	50% are heterozygous = 3; show a phenotype ratio of 1:1 = 1; have a genotype ratio of 1:1 = 2;		3

3.26 understand how the sex of a person is controlled by one pair of chromosomes, XX in a female and XY in a male

4 (a)	1. sperm/ male gametes have X or Y / sperm are X and Y; 2. eggs / female gametes are X / eq; 3. XX is female / mother is XX / X sperm meets X egg produces female; AND XY is male / father is XY / Y sperm meets X egg produces male;	Ignore gene allow MP1 and MP2 from a Punnett square	max 2

3.27 describe the determination of the sex of offspring at fertilisation, using a genetic diagram

3.28 understand how division of a diploid cell by mitosis produces two cells that contain identical sets of chromosomes

(d)	mitosis;		1

3.29 understand that mitosis occurs during growth, repair, cloning and asexual reproduction

QWC	**1(d)**	A comparison between mitosis and meiosis including **Mitosis** • (genetically) identical cells produced • two daughter cells • one division • diploid daughter cells • identical set of chromosomes • occurs in the formation of body cells • for growth and repair (of body tissues) **Meiosis** • (genetically) non-identical cells • four daughter cells • 2 divisions • haploid daughter cells • half the number of chromosomes • occurs in the formation of gametes • for sexual reproduction • results in genetic variation	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description including two points on either meiosis or mitosis there maybe confusion between the two but this does not negate the level • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description including one comparison of meiosis and mitosis or a detailed description of either mitosis or meiosis • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed comparison of both meiosis and mitosis – at least two correct comparisons made • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

3.30 understand how division of a cell by meiosis produces four cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes

2 (c)	1. u d in growth / used in repair / used in asexual reproduction / eq; 2. n genetic variation / clones / genetically identical cells produced / exact genetic copies of cells / eq; 3. chromosome number stays the same / eq; 4. o round of division / 2 cells produced; 5. d loid cells produced / not used to make gametes;	Allow converse answers for meiosis	3 max

3(a)	A description including four of the following points • ref to meiosis (1) • 4 cells produced (from one parent cell) (1) • haploid (cells) / cells have half the number of chromosomes (1) • cells are genetically different (1)	do not accept if there is a 't' cells have one set of chromosomes / 23 chromosomes	**(4)**

3.31 understand how random fertilisation produces genetic variation of offspring

3.32 know that in human cells the diploid number of chromosomes is 46 and the haploid number is 23

3.33 understand that variation within a species can be genetic, environmental, or a combination of both

3.34 understand that mutation is a rare, random change in genetic material that can be inherited

3.35B understand how a change in DNA can affect the phenotype by altering the sequence of amino acids in a protein

5 (c)	An explanation linking: • (the mutation results in) a change in the shape of the enzyme / active site (1) with any **one** of: • mutation is a change in the DNA (base sequence) (1) • enzyme - substrate complex can't form / {amino acids / substrate} will not fit into / bind to the {active site / enzyme} (as well) (1)	(2)

3.36B understand how most genetic mutations have no effect on the phenotype, some have a small effect and rarely do they have a significant effect

3.37B understand that the incidence of mutations can be increased by exposure to ionising radiation (for example, gamma rays, x-rays and ultraviolet rays) and some chemical mutagens (for example, chemicals in tobacco)

3.38 explain Darwin's theory of evolution by natural selection

(b)	humans not involved / animals choose / eq; 'fittest' survive / best adapted / competition / eq; more generations involved / slower process; role of chance / random / mutation / eq; speciation / evolution / eq;	Max 2

2	mutation; competition; tail attractive (to female) / selected (by female) / chosen (by female); reproduce / mate / eq; offspring have larger/more colourful tails / pass on characteristic; gene/allele (passed on / inherited); process continues / tail changes over time / evolution / eq; survival / fittest / extinction;	ignore camouflage allow points if predation discussed allow converse	max 5

3.39 understand how resistance to antibiotics can increase in bacterial populations, and appreciate how such an increase can lead to infections being difficult to control

5 (a) (i)	fungi / bacteria / ***Penicillium***;	allow named correct organism	1
(ii)	bacteria;		1
			5
(b)	1. mutation; 2. variation; 3. gene / allele / DNA; 4. survive / not killed / eq; 5. resistant; 6. reproduce / multiply / replicate / breed / produce offspring / eq; 7. ass on gene / allele / DNA;	 allow resist pass on resistance = 1 for resistance MP 5 only pass on gene = 2 = Mp3 and Mp7	

6	1 variation / variety; 2 rare / random; 3 mutation / mutant; 4 gene / allele / DNA / eq; 5 survive / not killed / live / eq; 6 reproduce / breed / have offspring / eq; 7 pass on (gene) / eq; 8 many generations / repeated over time / eq;	 allow converse for non-resistant ignore pass on phenotype / characteristic	Max 5