PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

BIOLOGY



MARK SCHEME

TOPIC 3: GENETICS (PAPER 1)

SCORE	PERCENTAGE
/81	%

STEMUP

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(Total for Question = 10 marks)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	<table><tr><td>T</td><td>T</td><td>G</td><td>A</td><td>T</td><td>T</td><td>G</td><td>C</td><td>G</td><td>T</td><td>A</td><td>A</td></tr><tr><td>A</td><td>A</td><td>C</td><td>T</td><td>A</td><td>A</td><td>C</td><td>G</td><td>C</td><td>A</td><td>T</td><td>T</td></tr></table> award 1 mark for all the As and Ts in the top line correctly paired (1) award 1 mark for all the Cs and Gs in the top line correctly paired (1)	accept lower case letters	**(2)** **AO2 1**

Question number	Answer	Mark
(ii)	B 4 **The only correct answer is B** ***A*** *is incorrect because each 3 amino acids would need 9 bases to be present* ***C*** *is incorrect 6 amino acids would need 18 bases* ***D*** *is incorrect because 12 amino acids would need 36 bases*	**(1)** **AO2 1**

Question number	Answer	Mark
(iii)	D double helix **The only correct answer is D** ***A*** *is incorrect because a DNA molecule is not three separate strands* ***B*** *is incorrect because the DNA molecule consists of two strands* ***C*** *is incorrect because a DNA molecule is a double helix not a single helix*	**(1)** **AO1 1**

Q2.

Question number	Answer	Mark
(i)	A they have membrane-bound organelles **The only correct answer is A** **B** *is not correct because they have a nucleus* ***C*** *is not correct because they do not have a cell wall* ***D*** *is not correct because this is not a specific feature of eukaryotic cells*	**(1)** **AO1 1**

Question number	Answer	Additional guidance	Mark
(ii)	genetic analysis / based on {DNA/genetics} / DNA of Archaea more similar to eukaryotes (1)	accept more knowledge because of better microscopes	**(1)** **AO1 1**

Q3.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking **two** from: • (protease) breaks down proteins (1) • in the {cell/nuclear} membrane (1) • destroys enzymes (that may break down the DNA) (1)	accept break down the {cell/nucleus/cell wall}	**(2)** **AO1 2**

Question number	Answer	Additional Guidance	Mark
(ii)	to precipitate the DNA / because DNA is insoluble in ethanol	accept to see the DNA	**(1)** **AO1 2**

Q4.

Question number	Answer	Mark
(i)	Total percentage for AT bases = 56.8 % (1) Remainder shared between 2 bases 43.2 ÷ 2 = 21.6 %	**(2)**

Question number	Answer	Mark
(ii)	An explanation that combines identification of knowledge (1 mark) and reasoning/justification – understanding (2 marks): • the percentage of each of the bases are different (1) • so bases cannot be complementary to one another (1) • so will not form a double helix / will form a single strand (1)	**(3)**

Q5.

Question number	Answer	Additional Guidance	Mark
	division 0.0062 ÷ 2 / 6.2 ÷ 2 (1) **OR** unit conversion 0.0031 x 1000 / 0.0062 x 1000 (1) 3.1 (picograms)	award full marks for correct answer with no working accept 6.2/ 0.0031 for 1 mark with no working	**(2)** AO2(1)

Q6.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	nucleus (1)		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	**C** In DNA, the bases A - T are complementary		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	A definition including two of the following: • a sperm fuses with egg / penetrates the egg (1) • nuclei/genetic information fuses /combines (1) • reference to haploid gametes /gametes have 23 chromosomes (1) • reference to cell made being diploid / has 23 pairs of chromosomes / zygote formed (1)	Ignore sperm meets egg	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	A description that includes the following: • (aerobic) respiration / using glucose / using oxygen (1) • energy released (for movement / swimming / metabolism)(1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	An explanation including **two** of the following: • a change in a base/base sequence/order of bases / a change in mRNA (1) • named change e.g. addition/deletion (1) • reference to change in an amino acid / order of amino acids (1)	Accept codon, triplet, genetic code for base. substitution/deletion/other named gene mutation.	**(2)**

Q7.

Question number	Answer	Additional Guidance	Mark
	Any three from: • mitosis produces 2 cells and meiosis produces 4 cells (1) • mitosis produces **genetically** identical cells and meiosis produces **genetically** different cells (1) • mitosis produces diploid cells and meiosis produces haploid cells (1) • mitosis produces body cells and meiosis produces {gametes /sex cells} (1)	accept offspring for cells mitosis is involved in asexual reproduction and meiosis is involved in sexual reproduction (1)	**(3)** AO1 1

Q8.

Question number	Answer	Mark
(i)	B	**(1)**

Question number	Answer	Mark
(ii)	TACGTACATGGC	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	• 3.33×10^{-10} equals 0.33 nm (1) • $0.33 \times 250 = 82.5$ (nm) (1)	maximum one mark if no conversion to nm award full marks for correct numerical answer without working	**(2)**

Q9.

	Answer	Acceptable answers	Mark
a(i)	Genus – Geospiza Species -conirostris	**accept geospiza** **accept Conirostris**	**(2)**
a(ii)	A suggestion including two of the following: • (different beak sizes/adapted) enable different finches to feed on different food types (1) • less competition between species (1)	eat different foods accept comparison between 2 beaks and food source more species are able to co-exist (1)	**(2)**
a(iii)	**B** ☒ geographic isolation		**(1)**
b	A suggestion linking **three** of the following points: • variation between species/ beak sizes/ shapes (1) • due to mutation(1) • competition for resources (1) • survival of the fittest /those best adapted to the environment survived (1) • those who survive pass their genes/characteristics onto their offspring (1) • natural selection (1)		**(3)**

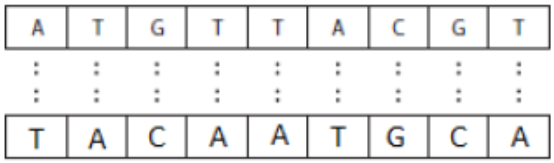
Total for Question = 8 marks

Q10.

	Answer	Acceptable answers	Mark

(i)	Genus – Geospiza Species -conirostris	**accept geospiza** **accept Conirostris**	**(2)**
(ii)	A suggestion including two of the following: • (different beak sizes/adapted) enable different finches to feed on different food types (1) • less competition between species (1)	eat different foods accept comparison between 2 beaks and food source more species are able to co-exist (1)	**(2)**
(iii)	**B** ☒ geographic isolation		**(1)**

Q11.

Question number	Answer	Mark
(i)	 accept lower case letters	**(1)** **AO1 1**

Question number	Answer	Mark
(ii)	C a double helix with strands joined by hydrogen bonds between bases **The only correct answer is C** **A** *is not correct because DNA strands are not held together with strong bonds* ***B*** *is not correct because complementary bases do not form the helix* ***D*** *is not correct because there are two complementary strands*	**(1)** **AO1 1**

Question number	Answer	Additional guidance	Mark
(iii)	Mutation	accept genetic modification / genetic engineering / insertion / deletion / substitution	**(1)** **AO1 1**

Q12.

Question number	Answer	Mark
	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • genetic variation means that some plants will be tolerant of drought conditions and these can be selected (1) • cross-pollinate these plants and grow the seeds under drought conditions (1) • select offspring and repeat over several generations (1)	**(3)**

Q13.

Question number	Answer	Additional guidance	Mark
	A description linking **two** from: • weak (1) • hydrogen bonds (1) • complementary bases (1) • A – T / C – G (1)	 accept H bonds reject hydro bonds accept the names of the base pair	**(2)** **AO1 1**

Q14.

Question Number	Answer	Acceptable answers	Mark
	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)**

Q15.

	Answer	**Acceptable answers**	**Mark**
(a)	A description including the following linked points • ref to a gene (coding for protein)(1) • sequence of bases determines sequence of amino acids (1) • idea of one code / triplet / codon / 3 bases (for one amino acid) (1) • several amino acids make up a protein / (poly)peptide (1) • transcription / detail of transcription (1) • translation / detail of translation (1)	 Accept on either DNA or RNA base pairs Accept a chain of amino acids eg mRNA made eg mRNA attached to ribosome	**(4)**

		Indicative Content	
QWC	***(b)**	A description including some of the following points in sequence Points relating to DNA structural features: • two strands • double helix • (contains) bases • A, T, C, G • adenine / A paired with thymine / T • guanine / G paired with cytosine / C • hydrogen / H bonds joining bases Contributions from Scientists: • X-ray (crystallography) being used • to show helical structure • to show diameter of molecule • how base pairs are arranged was shown • how strands are arranged was shown • modelling • reference to using other people's ideas	

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description that includes either: at least **three** DNA features **OR one** contribution • 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 that includes at least **three** features of DNA and at least **one** contribution **OR two** features of DNA and **two** contributions. • 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 description of the structure of DNA that includes at least **three** features and **two** contributions. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

	Answer	**Acceptable answers**	**Mark**
(c)	An explanation to include two of the following points linked together • genes / base sequence (on human chromosome) identified (1) • identification of faulty /	Accept base pair sequence gene map Accept idea that genes can be linked to disease Accept diagnosis of cancer	**(2)**

	mutated genes (1) • people can be tested for a genetic disorder (1) • ref to development of gene therapy (1) • idea that appropriate /early /personalised / genomic medication / counselling can be given (1)	Accept a description of gene therapy	

Q16.

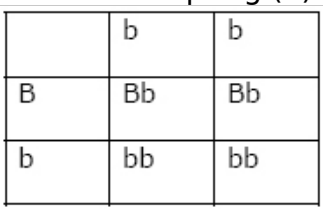
Question number	Answer	Mark
	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • both parents must be heterozygous for the recessive allele (1) • so the offspring must inherit the recessive allele from each parent (1)	**(2)**

Q17.

	Answer	Acceptable answers	Mark
(a)(i)	**D** ☒ homozygous recessive		**(1)**
(a)(ii)	**A description to include three of the following points:** tired / lethargic (1) short of breath / reduced oxygen carrying capacity / problems exercising (1) swelling of hands and feet (1) painful / weak joints (1)	**Accept weak/fatigued/** Accept difficulty breathing Accept reference to pain or painful episodes/sickle cell crisis	**(3)**

	blocked blood vessels / blood clots(1)	Ignore references to the shape of the red blood cell Ignore references to mucus	
(b)(i)	 correct gametes (1) correct offspring genotypes (1)	**Allow ECF for incorrect gametes**	**(2)**
(b)(ii)	50(%) (1) 0(%) (1)	**Answers must be in this order** **Possible ecf from the candidates Punnett square** **Clip together with 1bi**	**(2)**

Q18.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	75%		**(1)**
(a)(ii)	An explanation linking **two**of the following: • Punnett square would predict 50% normal 50% carrier (1) • actual offspring are not 50% carrier (1) • the probability is applied to each child not the overall offspring (1)	accept ratios or probabilities instead of percentages actual offspring are 75% accept references to random assortment	**(2)**
(a)(iii)	 Probability = 50% Ratio 2/4, 2:2, can be given for probability	Accept reverse order for gametes Accept letters other than B/b (but alleles must be the same letter) 50% mark can only be given if 50% of the offspring are	**(2)**

	1 mark for correct gametes 1 mark for completed Punnett square with correct probability	homozygous recessive	
(a)(iv)	**A** ☒ homozygous dominant (BB)		**(1)**

		Indicative Content	
QWC	***(b)**	A explanation to include some of the following points: Pedigree analysis would show the likelihood of their o inheriting the disorder Pedigree analysis should also be carried out on the pa third generation. • X is not a carrier • X is homozygous dominant • and does not have sickle cell disease • The parents of X are heterozygous / his sister • so will not pass on the allele for the disease to • if his partner is a carrier • there will be a 50% chance of the child being a • Y and Z are carriers of the sickle cell allele • Y and Z are heterozygous • The mother of Y has sickle cell / Y will inherit t allele • The parents of Z do not have sickle cell / moth carrier/heterozygous • They have a 50% chance of passing the sickle onto their potential offspring • If their partners were also carriers • There would be a 25% chance that the offsprin the sickle cell disease • There would be a 50% chance that the offsprin carry the allele for sickle cell disease Example Punnett square:	

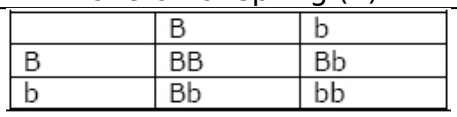
	B	b
B	BB	Bb
b	Bb	bb

Level	**0**	No rewardable content
1	**1 - 2**	• a limited explanation the genetic profile of X,Y and Z or an explanation of the use of pedigree analysis • 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 explanation of the genetic profile of X, Y and Z and an explanation of the use of pedigree analysis

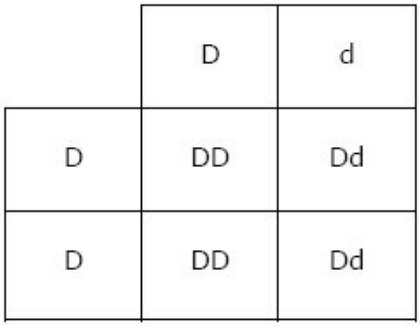
		• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed explanation of the genetic profile of X, Y and Z and explanation of the use of pedigree analysis plus either an explanation of one genotype or a prediction of one of the offspring outcomes • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Total for question = 12 marks

Q19.

	Answer	**Acceptable answers**	**Mark**
(i)	75%		**(1)**
(ii)	An explanation linking **two** of the following: • Punnett square would predict 50% normal 50% carrier (1) • actual offspring are not 50% carrier (1) • the probability is applied to each child not the overall offspring (1)	accept ratios or probabilities instead of percentages actual offspring are 75% accept references to random assortment	**(2)**
(iii)	 Probability = 50% Ratio 2/4, 2:2, can be given for probability 1 mark for correct gametes 1 mark for completed Punnett square with correct probability	Accept reverse order for gametes Accept letters other than B/b (but alleles must be the same letter) 50% mark can only be given if 50% of the offspring are homozygous recessive	**(2)**
(iv)	**A** ☒ homozygous dominant (BB)		**(1)**

Q20.

	Answer	Acceptable answers	Mark
(i)	 correct gametes (1) correct offspring genotypes (1)	**Allow ECF for incorrect gametes**	**(2)**
(ii)	50(%) (1) 0(%) (1)	**Answers must be in this order** **Possible ecf from the candidates Punnett square** **Clip together with 1bi**	**(2)**

Q21.

	Answer	Acceptable answers	Mark
	An explanation to include two of the following points linked together • genes / base sequence (on human chromosome) identified (1) • identification of faulty / mutated genes (1) • people can be tested for a genetic disorder (1) • ref to development of gene therapy (1) • idea that appropriate /early /personalised / genomic medication / counselling can be given (1)	Accept base pair sequence gene map Accept idea that genes can be linked to disease Accept diagnosis of cancer Accept a description of gene therapy	**(2)**

Q22.

	Answer	Acceptable answers	Mark
(a)	Gametes correctly labelled (1) X X X Y Female zygote X X Male zygote X Y (1)	X X Y X	**(2)**
(b)	**A** ☒ enzymes to help get through the membrane of the egg cell		**(1)**
(c)	to supply / contain (a large amount of) nutrients / energy (for the zygote / embryo)	food /named nutrient Ignore references to foetus Reject baby	**(1)**
(d)	An explanation linking **two** of the following: • rising oestrogen levels (1) • (stimulate production of) LH (1) • (LH) levels increase / when it reaches a set level / peaks (which causes ovulation) (1)	accept high oestrogen levels / oestrogen peaks / oestrogen released	**(2)**
(e)	An explanation linking: • Uterus lining maintained/ thickened (more) (1) With one of: • Because progesterone levels maintained / progesterone is still produced • So that the embryo can embed on it / So that the uterus lining can supply the embryo with nutrients	Reject: repairs	**(2)**

Q23.

Question Number	Answer	Mark
(i)	C sugar **1. The only correct answer is C** ***A*** *is not correct because the base is the rectangle* ***B*** *is not correct because the phosphate is the circle* ***D*** *is not correct because a polymer is composed of repeated subunits*	**(1)** AO 1 1

Question Number	Indicative content	Mark
* (ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are therefore not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **DNA sequences** • DNA has 4 different bases • changes in the DNA are mutations • results in different alleles for these genes • affects the phenotype / produces variation **Outcome of DNA sequencing for the individual** • identify genetic diseases • identify the risk of developing diseases • impact of knowing that a disease could develop • allow the individual to modify their lifestyle to reduce risk **Impact on medical treatment** • HGP has determined the location of genes/determined the function of proteins • we have a better understanding of some diseases • take preventative medicine • provide tailor-made medical treatments/personalised medicines	**(6)** AO 1 1

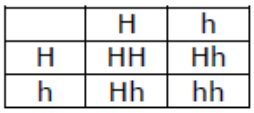
Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates elements of biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q24.

Question number	Answer	Mark
	C	**(1)**

Q25.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	answers must be in this order. dominant HH		**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)		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)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	75% / ¾ / 0.75	accept error carried forward from their Punnett square **accept:** 3 : 1	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(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)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	**A** ☒ mucus		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(iii)	An explanation linking **two** of the following: (thick / sticky / more) mucus (1) builds up in the tubes (of the reproductive system) (1) (the mucus) blocks the flow of sperm (1)	 **Reject: mucus in lungs/intestine** accept sperm duct / vas deferens	**(2)**

Q26.

	Answer	Acceptable answers	Mark
(i)	A description including **three** of the following points: • cell divides / cell division / cell splits(1) • two cells produced (1) • (both) diploid (1) • (both) cells are genetically identical (1)	credit correct reference to stages of mitosis: DNA replication / chromosomes duplicate (1) Chromosomes line up along the equator / middle of the cell (1) chromosomes pulled to either end of cell (1) cytokinesis / cytoplasm splits (1)	**(3)**
(ii)	A description including three of the following points: • ref (to many) cell divisions / eq (1) • growth (1) • ref to differentiation / specialisation (1) • ref to stem cells (1)	accept: gets bigger / larger accept: become specific cells	**(3)**

Q27.

Question Number	Answer	Additional Guidance	Mark
(i)	Any **two** from: • wear gloves (1) • clean the area of skin where blood being removed (1) • cover the wound after (1) • use a sterile needle (1)	 accept wash hands / wear a mask accept disinfect / clean the wound ignore clean accept sit the person down (1) ignore references to removing the correct volume of blood	**(2)** **AO2 2**

Question Number	Answer	Additional Guidance	Mark
(ii)	• heterozygous An explanation linking: • affected offspring must have inherited the recessive allele (1) • unaffected offspring must have inherited dominant allele (1)	accept carrier / dominant and recessive allele / Hh accept one offspring is homozygous recessive accept one / two offspring are homozygous dominant accept a **labelled** Punnett square for any mark point	**(3)** **AO3**

Q28.

		Indicative Content	
QWC	*	A explanation to include some of the following points:	

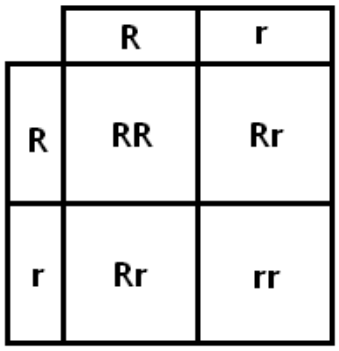
		Pedigree analysis would show the likelihood of their o inheriting the disorder Pedigree analysis should also be carried out on the pa third generation. • X is not a carrier • X is homozygous dominant • and does not have sickle cell disease • The parents of X are heterozygous / his sister • so will not pass on the allele for the disease to • if his partner is a carrier • there will be a 50% chance of the child being a • Y and Z are carriers of the sickle cell allele • Y and Z are heterozygous • The mother of Y has sickle cell / Y will inherit t allele • The parents of Z do not have sickle cell / moth carrier/heterozygous • They have a 50% chance of passing the sickle onto their potential offspring • If their partners were also carriers • There would be a 25% chance that the offsprin the sickle cell disease • There would be a 50% chance that the offsprin carry the allele for sickle cell disease Example Punnett square: | | B | b | | B | BB | Bb | | b | Bb | bb |

Level	**0**	No rewardable content
1	**1 - 2**	• a limited explanation the genetic profile of X,Y and Z or an explanation of the use of pedigree analysis • 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 explanation of the genetic profile of X, Y and Z and an explanation of the use of pedigree analysis • 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 explanation of the genetic profile of X, Y and Z and explanation of the use of pedigree analysis plus either an explanation of one genotype or a prediction of one of the offspring outcomes • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q29.

Question Number	Answer	Acceptable answers	Mark
(a)	Genus; Species;	Must be in the correct order	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	A suggestion including the following points: • rats with the mutation survive to reproduce (1) • pass on the allele which makes the offspring resistant to warfarin (1)	accept breed / produce offspring etc for reproduce accept gene / mutation for allele	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	 Correct gametes (1) Correct offspring (1)	If incorrect gametes are entered into the Punnett square but the offspring for those gametes are correct 1 mark can be awarded as an error carried forward	**(2)**

Question Number		Indicative Content	Mark
QWC	* **(d)**	A explanation to include some of the following points • MRSA is a bacterial infection • number of cases increased from 1995 to 2006 • MRSA is resistant to antibiotics • so MRSA infection not easy to treat • number of cases were similar between 2005 and 2007 • antiseptics killed the bacteria • less bacteria were transferred from person to person • number of cases decreased from 2007 • antiseptics kill bacteria on surfaces • causing less infections from MRSA	**(6)**
Level	**0**	No rewardable content	
1	**1 – 2**	• a limited explanation of the graph including correct data reading or the use of antiseptics or antibiotics to kill bacteria/treat MRSA • 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 explanation of one trend of the graph including correct data reading and the effect of the use of antiseptics or antibiotics to kill bacteria/treat MRSA • 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 explanation of at least two trends of the graph linking it to antibiotic resistance and antiseptic programme • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q30.

	Answer	**Acceptable answers**	**Mark**
	Gametes correctly labelled (1) X X X Y Female zygote X X Male zygote X Y (1)	X X Y X	**(2)**

Q31.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	XX	ignore any superscript or subscript letters/symbols reject XY	**(1)**

Question Number	Answer	Acceptable answers	Mark
(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)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	<table><tr><td></td><td>X^H</td><td>Y</td></tr><tr><td>X^H</td><td>X^HX^H</td><td>X^HY</td></tr><tr><td>X^h</td><td>X^HX^h</td><td>X^hY</td></tr></table> a Punnett square showing the gametes of individuals C and D (1) a Punnett square showing the genotypes of the offspring (1) 25% / 0.25 / 1 in 4 probability of a child having haemophilia (1)	<table><tr><td></td><td>X^H</td><td>X^h</td></tr><tr><td>X^H</td><td>X^HX^H</td><td>X^HX^h</td></tr><tr><td>Y</td><td>X^HY</td><td>X^hY</td></tr></table> reject if allele shown on Y chromosome 50% of males have haemophilia Punnett square must be interpreted correctly	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking the following aseptic conditions (1) prevent growth of **unwanted** organisms/prevent contamination (1) OR temperature /pH (1) provide optimal conditions for growth /prevent enzymes denaturing (1) OR nutrient levels (1) provide optimal conditions for growth (1) OR aeration/oxygen (1) for aerobic respiration/ provide optimal conditions for growth / prevent anaerobic respiration (1)	ignore sterile provide optimal conditions for enzymes/prevent micro-organisms being killed	**(2)**

Q32.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	0.5 / 0.5 picogram	Accept: 0.5 picograms accept: the same (mass) as the sperm cell	**(1)**
(a)(ii)	**C** haploid		**(1)**
(a)(iii)	**A** thymine with adenine, cytosine with guanine		**(1)**
(a)(iv)	weak hydrogen bonds / hydrogen bonds / hydrogen (1)	H (bond)	**(1)**
(b)(i)	A description including **three** of the following points: • cell divides / cell division / cell splits(1) • two cells produced (1) • (both) diploid (1)		**(3)**

	• (both) cells are genetically identical (1)	credit correct reference to stages of mitosis: DNA replication / chromosomes duplicate (1) Chromosomes line up along the equator / middle of the cell (1) chromosomes pulled to either end of cell (1) cytokinesis / cytoplasm splits (1)	
(b)(ii)	A description including three of the following points: • ref (to many) cell divisions / eq (1) • growth (1) • ref to differentiation / specialisation (1) • ref to stem cells (1)	accept: gets bigger / larger accept: become specific cells	**(3)**

Q33.

	Answer	Acceptable answers	Mark
(i)	**D** ☒ homozygous recessive		**(1)**
(ii)	**A description to include three of the following points:** tired / lethargic (1) short of breath / reduced oxygen carrying capacity / problems exercising (1) swelling of hands and feet (1) painful / weak joints (1) blocked blood vessels / blood clots(1)	**Accept weak/fatigued/** Accept difficulty breathing Accept reference to pain or painful episodes/sickle cell crisis Ignore references to the shape of the red blood cell Ignore references to mucus	**(3)**

Q34.

		Indicative Content	
QWC	*	A description including some of the following points in sequence Points relating to DNA structural features: • two strands • double helix • (contains) bases • A, T, C, G • adenine / A paired with thymine / T • guanine / G paired with cytosine / C • hydrogen / H bonds joining bases Contributions from Scientists: • X-ray (crystallography) being used • to show helical structure • to show diameter of molecule • how base pairs are arranged was shown • how strands are arranged was shown • modelling • reference to using other people's ideas	

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description that includes either: at least **three**DNA features **OR one**contribution • 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 that includes at least **three**features of DNA and at least **one**contribution **OR two**features of DNA and **two** contributions. • 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 description of the structure of DNA that includes at least **three**features and **two**contributions. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q35.

Question number	Answer	Additional guidance	Mark
(i)	• heterozygous	accept alleles showing heterozygous genotype	(1)

Question number	Answer	Mark
(ii)	• correct Punnett square (1) • 75% normal fur pigmentation (1)	(2)

	A	a
A	AA	Aa
a	Aa	aa

Q36.

Question number	Answer	Additional Guidance	Mark
(i)	to precipitate the DNA	accept so the DNA is visible / so the DNA is not soluble (in ethanol)	(1) AO1 (2)

Question number	Answer	Additional Guidance	Mark
(ii)	Any two from: • mass of fruit (1) • volume of buffer (1) • crushing method /crushing time / crushed evenly (1) • volume of ethanol (1) • temperature (1) • pH /same buffer solution (1)	accept amount of fruit / number of fruit cells /size of fruit ignore amount of buffer accept idea of incubation time ignore amount of ethanol accept fully filtered (1) accept same concentration of ethanol (1)	**(2)** A02 (2)

Question number	Answer	Additional Guidance	Mark
(iii)	Any one from: • to obtain more data (1) • to identify anomalies (1) • see if the results are {the same /reliable/correct} (1) • to calculate a {mean/average} (1)	accept to be sure their {results are valid / conclusion is valid} (1) ignore accuracy/precision	**(1)** AO2(2)

Q37.

	Answer	Acceptable answers	Mark
(a)(I)	An explanation including **two** of the following: the dodo was multicellular (1) the dodo fed on other organisms /fed heterotrophically (1) the dodo did not have chlorophyll / cell walls (1)	Accept animals can't make food for themselves by photosynthesis Accept chloroplasts for chlorophyll Ignore references to legs /backbone etc	**(2)**
(a)(ii)	has a (supporting) rod / spinal cord	**Accept** backbone / spine / vertebrate	**(1)**
(a)(iii)	**B** ☒ genus		**(1)**
(b)	A suggestion including 3 of the following: • Predation / disease (1) • change in environmental conditions (1) • loss of food source / reduced food source (1) • increased competition (1) • limited adaptations / survival of the fittest (1) • unable to reproduce / reproduce less (1)	Accept named environmental change / climate change Accept food source eaten by other animals / humans Accept unable to fly so cannot escape	**(3)**
(c)	**D** ☒ speciation		**(1)**
(d)	A description to include two of the following: genetic (variation) (1) due to mutation (1) due to sexual reproduction / interbreeding /	Accept references to different genes/DNA Accept named environmental change e.g.change in climate	**(2)**

	hybridisation (1) environmental (variation) (1)			