WJEC (Wales) Biology GCSE Topic 2.3 DNA and Inheritance Questions by Topic - Mark Scheme

1.

Question			Marking details	Marks Available
	(a)	(i)	Nucleus;	1
		(iii)	Gametes;	1

2.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(b)	(i)		1	Gametes;			
(c)	(ii)		2	1.34 (written on answer line) = 2 marks 1.34 m (not written on answer line) = 2 marks Allow 1 mark if answer expressed in cm (134) Allow 1 mark for (8.5x14) +15 but incorrect answer Allow 1 mark for 1.34 (not written on the answer line and without any units			

3.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	an allele which when present in the heterozygous condition expresses itself in the phenotype (OWTTE);	Allele which is always expressed if present		Stronger allele
(b)	(i)		1	Bb **X** Bb; both required for mark [1]			*if a letter other than **b** is chosen*
	(ii)		2	<table><tr><td>Gametes</td><td>**B**</td><td>**b**</td></tr><tr><td>**B**</td><td>**BB**</td><td>**Bb**</td></tr><tr><td>**b**</td><td>**Bb**</td><td>**bb**</td></tr></table> Gametes correct; [1] Mechanics of cross correct; [1]	ECF from (b)(i) If gametes are incorrect allow ECF for mechanics mark		X and Y
	(iii)		1	6	ECF from (b)(ii)		75%
(c)			2	**Phenotype** Manx/ (cat with)no tail **X** (cat with normal) tail/non manx; **Genotype** **Bb X bb;**	Possible ECF of letters from previous section	(Manx with) normal tail	
			7				

4.

Question			Marking details	Marks Available
4	*(a)*		There are {46 chromosomes/(23) pairs/has a diploid number/ not haploid/has both X and Y;	1
	(b)		No {corresponding/matching} part of chromosome (for paired allele)/only has one X chromosome/ only has one {copy of the gene/allele};	1
	(c)		Linearly/in a line/in a row;	1
			Question 4 total	**[3]**

5.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		1	10;	5 pairs		
	(ii)		1	Y (chromosome)/ has XY (chromosomes);	Only 1 X (chromosome)		
	(iii)		1	5; ECF from (i)			
(b)	(i)		1	nucleus;			
	(ii)		1	DNA;			
	(iii)		1	protein;			

6.

Question		Marking details	Marks Available

(a)

Gametes	A	A
a	Aa	Aa
a	Aa	Aa

[2]

Award 1 mark for all 4 gametes being correct (Must use **A** and **a**);
Award 1 mark for the mechanics of the cross; Award this mark even if the gametes are incorrect or the wrong letters are used.

(b) (i)

Gametes	A	a
A	AA	Aa
a	Aa	aa

[2]

Award 1 mark for all 4 gametes being correct;
Award 1 mark for the mechanics of the cross; Award this mark even if the gametes are incorrect
ECF- both these marks can be awarded if letters used in (a) are carried forward into (b). Also award the marks if **any** two F1 individuals are selfed.

(ii) 3 grey bodied: 1 black bodied (or correct ratio from given answer); [1]

7.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	i		1	Nn;	heterozygous		
	ii		2	He does not have cystic fibrosis therefore must have a {**N/dominant allele**} / He has to have a {**N /dominant allele**} to give to {the child without cystic fibrosis/ child **3**}; Has to have a {**n/recessive allele/ allele for cystic fibrosis** } to give to {child with cystic fibrosis/ child **4**} {child **4**/ child with cystic fibrosis} has to have a {**n/recessive allele**} from him;			
(b)	i		1	Nn;	heterozygous		
	ii		2	She does not have cystic fibrosis and therefore must have a{ **N** allele/dominant allele}/ person **3** gets { **N** allele/dominant allele} from person **2**; Her mother has {cystic fibrosis/ **nn**} and therefore must give one {**n** allele/recessive allele}/ person **3** gets {**n** allele/recessive allele} from person **1**;			
(c)			1	25%;			
Total Mark			7				

8.

Question		Marking details	Marks Available
(a)	(i)	B- 6 black and 2 white;	
	(ii)	Allow ECF from (a) (i)	
		Gametes correct; Must be B	1
		Must link to answer to a(i)	1
		Cross correct;	

Gametes	B	b
B	BB	Bb
b	Bb	bb

(b)	(i)	I	XY	both correct 1 mark 1
		II	XX;	
		Gametes correct; (ECF)		
		Cross correct;		1
				1

Gametes	X	Y
X	XX	XY
X	XX	XY

Question 8 Total **[6]**

9.

<table>
<tr><th colspan="2">Sub-section</th><th>Mark</th><th>Answer</th><th>Accept</th><th>Neutral answer</th><th>Do not accept</th></tr>
<tr><td>(a)</td><td>i</td><td>1</td><td>the mother Nn and
the father Nn ;
(both correct for 1 mark)</td><td></td><td></td><td></td></tr>
<tr><td></td><td>ii</td><td>1
1</td><td>gametes correct from ai;
mechanics of cross correct – this mark can be awarded even if the gametes are incorrect;
<table>
<tr><td></td><td>N</td><td>n</td></tr>
<tr><td>N</td><td>NN</td><td>Nn</td></tr>
<tr><td>n</td><td>Nn</td><td>nn</td></tr>
</table></td><td>ecf from ai

Use of wrong letters from ai (except X and Y)</td><td></td><td>Any reference to X and Y</td></tr>
<tr><td></td><td>iii</td><td>1</td><td>circle around nn;</td><td></td><td></td><td>any other letters</td></tr>
<tr><td></td><td>iv</td><td>1</td><td>¾/ 75%/ 0.75/ three out of four;
must relate to their Punnett square</td><td></td><td></td><td>ratio/ no credit if any letters other than Nn used</td></tr>
<tr><td>(b)</td><td></td><td>1</td><td><u>early</u> {treatment/ cure}/ treatment straight away/ {quicker/ sooner} treatment;</td><td>gene therapy as equivalent of treatment</td><td></td><td></td></tr>
<tr><td colspan="2">Total Mark</td><td>6</td><td></td><td></td><td></td><td></td></tr>
</table>

10.

Question		Marking details	Marks Available
(a)		{the genes/all the alleles} in {an organism/dog/it}/ the {set/pair/two/both} alleles that {determine/control} {a characteristic/colour} of the dog/ the genetic make-up of {an organism/dog};	1
(b)	(i)	{Cross/mate/breed} {the (black) Labrador/ it} with {a yellow Labrador/bb}/do a test cross; If all the {puppies/litter} are black then {the (black) Labrador/ it} is {homozygous/BB}; If there are yellow puppies in the litter then {the (black) Labrador/ it} is {heterozygous/Bb};	3
	(ii)	1 mark for each correct Punnett square;;	2

Gametes	B	B
b	B b	Bb
b	B b	Bb

Gametes	B	b
b	Bb	b b
b	Bb	b b

Alternative marking option

(b)	(i)	Cross/mate/breed} the black Labrador with another Black Labrador which is known to be {heterozygous/Bb}; If all the puppies are black then the black Labrador is {homozygous/BB}; If there are some yellow puppies in the litter then the black Labrador is {heterozygous/Bb};	3

Question		Marking details	Marks Available
	(ii)	1 mark for each correct Punnett square;	2

Gametes	B	B
B	BB	BB
b	Bb	Bb

Gametes	B	b
B	BB	BB
b	Bb	bb

If bi not completed then first marking option must be used for marking punnett squares

11.

Question		Marking details	Marks Available
(b)	(i)	C/from his father and his mother;	1
	(ii)	A/heterozygous for cystic fibrosis;	1
	(iii)	C/homozygous recessive for cystic fibrosis;	1
	(iv)	A/25%;	1
	(v)	C/males and females;	1
		Question 11 Total	**[8]**

12.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	{Both/ the two} alleles are different/ where one of the alleles is dominant and the other is recessive/ the alleles of a gene are different;			
(b)	(i)		1	3 (purple) : 1 (green)			
	(ii)	I	1	**both required for 1 mark** Must be upper case and lower case of the <u>same</u> letter. Letters should be carefully chosen, if the upper case and lowercase letters have the same form, eg P and p or C and c then it must be clear in the answer (and in the Punnett square below) that upper and lower case letters are being used. If this is unclear or ambiguous then do not award the mark/marks.			
		II	2	<table><tr><td></td><td>N</td><td>n</td></tr><tr><td>N</td><td>NN</td><td>Nn</td></tr><tr><td>n</td><td>Nn</td><td>nn</td></tr></table>gametes correct – according to chosen letters in (ii)(I) above; ECF allowed from (ii)(I) e.g. if two different letters chosen to represent the alleles mechanics of cross (possible to gain mark even if gametes are incorrect); NOT if more than two alleles are shown			
	(iii)		1	½ / 0.5 / 50%			
Total Mark			6				

13.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
(b)	(i)	I	DD		1		1		
		II	dd		1		1		
	(ii)		purple (flower)			1	1		
	(iii)		one dominant and one recessive (1) allele (1) reject gene different alleles of the same gene = 2 marks there are different alleles = 1 mark	2			2		
			Question 4 total	**4**	**2**	**1**	**7**	**0**	**0**

14.

Question			Marking details	Marks Available
	(a)	(i)	One {form/version/variant} of a gene/{two/different}{forms/ types/versions} of {the same/a} gene;	1
		(ii)	• In a {heterozygous organism/OWTTE} the allele that is not {expressed/shown}/ • only {expressed/shown} {when homozygous/when in a pair of recessive alleles}/	1
	(b)	(i)	Gametes correct (must use correct letter for this mark); Mechanics of cross correct; Allow ECF of incorrect gametes **but must use B/b**	2
		(ii)	75%/ 0.75/ ¾/ 3 in 4; NOT ratio	1
		(iii)	3 : 1 ;	1
			Question 14 Total	**[6]**

Gametes	**B**	**b**
B	**BB**	**Bb**
b	**Bb**	**bb**

15.

Question		Marking details	Marks Available
(a)		All correct 1 mark Mouse 1 **BB** - black Mouse 2 **Bb** - black Mouse 3 **bB** - black Mouse 4 **bb** - red	1
(b)	(i)	12;	1
	(ii)	All correct no errors	1

Gametes	**B**	**B**
b	**Bb**	**Bb**
b	**Bb**	**Bb**

(c)	(i)	25;	1
	(ii)	All correct no errors	1

Gametes	**B**	**b**
b	**Bb**	**bb**
b	**Bb**	**bb**

16.

Question		Marking details	Marks Available
(a)	(i)	Nn;	1
	(ii)	Nn;	1
(b)		50(%);	1

17.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
17	(a)	(i)		Offspring/results are obtained quickly/ does not take a long time to get results/ short life cycle		1		1		1
		(ii)		(Greater) confidence in result	1			1		1
	(b)	(i)		either of the 2 flies with dark end to abdomen		1		1		
				Gametes correct (1) Mechanics correct (1) Gametes / R / R r / Rr / Rr r / Rr / Rr		2		2		
	(c)	(i)		All ratios 3: 1		1		1	1	
		(ii)		{Flies/ embryos/ they} died/ one or both flies were {sterile/ infertile} flies did not mate/ flies diseased/ eggs did not hatch/ develop Reject no offspring unqualified			1	1		
		(iii)		Results for red eyed flies and white eyed flies have been inserted in wrong columns/ OWWTE Do not accept that the wrong flies were mated because no cross could produce this ratio. Do not accept a mutation occurred			1			1 1
		(iv)		Gametes / R / r R / RR / Rr r / Rr / rr Gametes correct 1 mark Mechanics correct 1 mark		2		2		
				Question 17 total	**1**	**7**	**2**	**10**	**1**	**4**

18.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	an allele which when present in the heterozygous condition expresses itself in the phenotype (OWTTE);	Allele which is always expressed if present		Stronger allele
(b)	(i)		1	Bb **X** Bb; both required for mark [1]			*if a letter other than **b** is chosen*
	(ii)		2	Gametes / **B** / **b** **B** / **BB** / **Bb** **b** / **Bb** / **bb** Gametes correct; [1] Mechanics of cross correct; [1]	ECF from (b)(i) If gametes are incorrect allow ECF for mechanics mark		X and Y
	(iii)		1	6	ECF from (b)(ii)		75%
(c)			2	**Phenotype** Manx/ (cat with)no tail **X (**cat with normal) tail/non manx; **Genotype** **Bb X bb;**	Possible ECF of letters from previous section	(Manx with) normal tail	
			7				

19.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)			**F1** Gametes: **D** **D** **d**: **Dd** **Dd** **d**: **Dd** **Dd**			
			1 1	Gametes correct 1 mark Mechanics of cross correct 1 mark If use different letters cannot award gametes mark but can award mechanics mark			
(a)	(ii)			**F2** Gametes: **D** **d** **D**: **DD** **Dd** **d**: **Dd** **dd**			
			1 *1*	Gametes correct 1 mark **Must use any two of their F_1 offspring from (i)** Mechanics of cross correct (**must generate a 3:1 ratio)** [If incorrect letters are used in (a)(i) allow ECF for (a)(ii) to access both marks] If different letters used in second punnett square to first = 0 marks			
(b)			1	repeatability/increased confidence in results	Identify anomalies		Reliability/ accuracy/ validity/ reproducibility
(c)			1	So that the {work/results/experiments} can be {verified/confirmed}/ to see if they get the {same/ similar/different} results/ reproducibility;		To see if Mendels work was right/ correct/ true	Repeatability/ validity/ accuracy/ reliability
Total Mark			6				

20.

Question		Marking details	Marks Available
(a)	(i)	23;	2
	(ii)	46;	
(b)		50%;	1

21.

Question		Marking details	Marks Available
(a)		Nucleus; Gene; Protein;	3
(b)	(i)	I 8;	1
		II Kangaroo;	2
		(8 is/ gametes have) {half the body cell number/ half the diploid number}/ 8 is the haploid number/ {reference to fertilisation restoring the body cell chromosome number/OWTTE}; NOT half the number of chromosome 2nd mark only accessed if 1st mark credited	

22.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		1	10;	5 pairs		
(b)	(i)		1	nucleus;			
	(ii)		1	DNA;			
	(iii)		1	protein;			

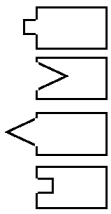
23.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(a)	(i)		chromosomes	1			1		
		(ii)		DNA	1			1		

24.

Question		Marking details	Marks Available
(a)		Nucleus;	1
(b)	(i)	Sugar and phosphate;	1
	(ii)	A with T **and** G with C;	1
	(iii)	Double helix;	1
(c)		Amino acids **+** Proteins;	1
		Question 24 Total	**[5]**

25.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	i		2	 Each shape needs an oblong + an indentation or a protrusion. *4 shapes correct = 2 marks* *3 shapes correct = 1 mark* *0/1/2 shapes correct = 0 marks*			
	ii		2	Cytosine Adenine Thymine Guanine **Spelling must be correct** *4 names correct = 2 marks* *3 names correct = 1 mark* *0/1/2 names correct = 0 marks*			
(b)			2	Three bases form a code/ a triplet code; (Code) determines the {order/ sequence} of the amino acids;			
Total Mark			6				

26.

Question			Marking details	Marks Available
	(b)		TAGACATGTC	1
	(c)		3	1
			Question 6 Total	**[4]**

27.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	i		1	Double helix;			
	ii		2	T,G,C *3 correct = 2 marks* *2 correct = 1 mark* *0/1 correct = 0 marks*			
(b)			1	Proteins **and** amino acids;			
Total Mark			4				

28.

Question		Marking details	Marks Available
(a)	(i)	Bases;	1
	(ii)	T and C in correct positions;	1
(b)	(i)	Nucleus; Accept chromosome	1
	(ii)	Twisted/ helix; NOT coil	1
		Question 28 Total	**[4]**

29.

Question	Marking details	Marks Available
(a)	B;	1
(b)	Phosphate **and** sugar; (either order)	3
	Bases;	
	Helix;	
(c)	Code (for amino acids);	1
	NOT 'code for life'	
	Question 29 Total	**[5]**

30.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		2	ACAAT;; 5 correct = 2 marks 4 correct = 1 mark 0/1/2/3 correct = 0 marks			
	(ii)		1	Phosphate;			
(b)	(i)		1	Amino acid;			
	(ii)		2	(form a) code; (determining){order/sequence} of amino acid/ decides which amino acid (goes where)/ decides the type of amino acid;			
Total Mark			6				

31.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	Nucleus/ mitochondria;			
(b)			1	A always matches to T **and** C always matches to G;	Pairs with/ bonds with/ complementary base pairs with	Incorrect spelling of bases	Goes with/
(c)	(i)		1	Mitosis (correct spelling)			

32.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	28.6 = thymine **and** 21.4 = cytosine for 1 mark			
(b)			2	A = 200 = 2 marks 400 = 2 marks			
Total Mark			3				

33.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
33				***Indicative content:*** • Two long chains • alternating sugar and phosphate • connected by bases • (twisted to form) double helix • four types of bases/ Adenine, thymine, cytosine, guanine • complementary base pairing/ A -T; C - G • order of bases forms a code for making proteins • each triplet code identifies a particular amino acid • amino acids are linked together to form proteins. **5-6 marks** At least 7 points from indicative content *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3-4 marks** At least 4 points from indicative content *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.*	6			6		
				1-2 marks • Two long chains • connected by bases • double helix • four types of bases At least 1 points from indicative content *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks:** *No attempt made or no response worthy of credit.*						
				Question 33 total	**6**	**0**	**0**	**6**	**0**	**0**

34.

Question		Marking details	Marks Available
(a)	(i)	Adenine Thymine Cytosine Guanine -1 for each error	2
	(ii)	Amino acids;	1

35.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			2	Ratio of A:T approximately equal; Ratio of G:C approximately equal;	Similar masses/ similar ratio		Similar results/ numbers/ amount

36.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
36	(a)	(i)		sugar and phosphate	1			1		
		(ii)		A,C (1) T and A (1)		2		2		
		(iii)		(The order of the bases) form a code (1) For the amino acids (1)	2			2		
	(b)	(i)		Suspect 3 has same {bands as profile/ DNA profile/ profile/ DNA}			1	1		
		(ii)		Establishing paternity/ family relationships/ classification	1			1		
		(iii)		Issues of privacy/ ownership		1		1		
				Question 36 total	**4**	**3**	**1**	**8**	**0**	**0**

37.

Marking details	Marks Available

Indicative content

Two chains of alternating sugar and phosphate molecules connected by bases. The chains are twisted to form a double helix. There are 4 bases: adenine, thymine, cytosine and guanine. Base pairing occurs between A and T; C and G. Triplet codes determine types of amino acids. The order of amino acids will determine the particular protein produced.

5-6 marks
The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.

3-4 marks
The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.

1-2 marks
The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.

0 marks
The candidate does not make any attempt or give a relevant answer worthy of credit.

Question 37 Total **[6]**

38.

<table>
<tr><th colspan="3">Question</th><th>Marking details</th><th>Marks Available</th></tr>
<tr><td>38</td><td>(a)</td><td>(i)</td><td>One {form/version/variant} of <u>a</u> gene/{two/different}{forms/ types/versions} of {the <u>same/a</u>} gene;</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Gametes correct (must use correct letter for this mark);

Mechanics of cross correct;
Allow ECF of incorrect gametes but must use B/b

<table>
<tr><td>Gametes</td><td>B</td><td>b</td></tr>
<tr><td>B</td><td>BB</td><td>Bb</td></tr>
<tr><td>b</td><td>Bb</td><td>bb</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>75%/ 0.75/ ¾/ 3 in 4;
NOT ratio</td><td>1</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>3 : 1 ;</td><td>1</td></tr>
<tr><td></td><td></td><td></td><td>Question 38 Total</td><td>[6]</td></tr>
</table>

39.

Question	Marking details	Marks Available
(a)	The analysis of the DNA of an organism/ looking at the {patterns/ bands} in DNA;	[1]
(b)	Any 2 from : {Identifying/ finding out who is} the {culprit/ suspect} from evidence at a crime scene/ or example; NOT solving crimes/ catching criminals {Paternity/ maternity} testing/ finding out who the {father/ mother} is/ identify relatives; Comparison between species for classification purposes; Identification of genes associated with an {inherited disease/ named inherited disease}/ to find out if parents may have children with cystic fibrotic disease/ determine risk of developing breast cancer; Identification of dead bodies;	[2]
	Question Total	**[3]**

40.

Question		Marking details	Marks Available
(b)		50(%);	1
(c)	(i)	{Genetic/ DNA} {profile/ profiling}; NOT genetic fingerprinting	1
	(ii)	DNA {has coded information/ codes for protein}; Baby's DNA is different to Mike's/ In the {DNA profiles/ genetic analysis} above, the baby {does not have any (base) A/ has one less G};	2

41.

Question		Marking details	Marks Available
(a)	(i)	DNA;	1
	(ii)	Genes/ alleles;	1

42.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	ii		1	genetic profile /DNA profiling;			Fingerprinting

43.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(b)			1	{Genetic/ DNA/ gene} profiling;			Genetic analysis/ DNA testing/ chromosome profiling/ genetic fingerprinting
(c)			1	Species; (correct spelling)			

44.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	i		1	DNA;			
	ii		1	chloroquine killed (most) non-resistant Plasmodium ;			