1. (a) (i) Gg *accept 'she was heterozygous'* 1

(ii) any **one** from 1

- two of her children **or** (6) and (9) were normal **or** inherited a recessive gene **or** g from her

  accept 'some of her children were normal and some were affected' for both marks

- if she were GG, all her children would have the disease

(ii) any **one** from 1

- some of her children **or** (4) and (5) were affected **or** inherited a dominant gene **or** G from her
- she was affected so she had a dominant gene **or** G

  accept 'she was affected'

- if she were gg, none of her children would have the disease

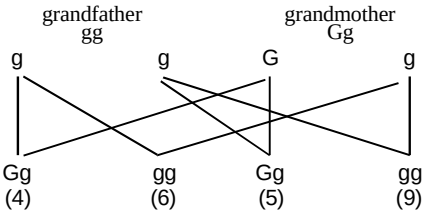
*accept a Punnett Square **or** a genetic diagram, for one mark, as part of the explanation:*

either

grandfather gg

grandmother Gg	g	g
G	(4) Gg	(5) Gg
g	(6) gg	(9) gg

or



(b) (i) Gg *accept 'he was heterozygous'* 1

(ii) he must have inherited a dominant gene 1
or G from his mother and a recessive gene **or** g from his father

accept 'he must have got g from his father 'a mark may be awarded for a Punnett square or a genetic diagram as above

(c) 50% **or** ½ **or** 0.5 *accept '1:1' **or** 'evens'* 1

(d) (i) any **one** from 1

- a change in a gene **or** chromosome

accept 'damage to a gene'

- a change in the base sequence of DNA

*accept 'a change in the DNA **or** the genetic information'*
***or** 'wrong base added to DNA'*
accept 'development of a new characteristic'

(ii) any **one** from 1

- X rays
- radiation
- UV light

accept 'sunlight'
*accept a named mutagenic chemical such as 'benzene' **or** 'cigarette tar'*
accept 'incorrect replication of DNA'

[8]

2. (a) mass √ *if more than one box is ticked, award no mark* 1

(b) (i) set 3 **or** Fred and Jack *consequential marking does **not** apply*
accept '3' 1

(ii) any **one** from 1

- they are similar apart from mass
- they have the same blood group, eye colour and sex

*consequential marking does **not** apply*
accept 'they have the same blood group and sex'
***both** blood group and sex must be mentioned for the mark*

- all the characteristics determined by genes are the same

*accept 'because set 1 **or** Sasha and Ninvata have different blood groups and set 2 **or** Lucy and Tom are different sexes'*

(c) As woman get older, they produce more of each hormone. ✓ 1

if more than one box is ticked, award no mark

(d) (i) any **one** from 1

- it halves the number of chromosomes

  accept 'it produces 23 chromosomes'
  or *'it halves the genetic material'*

- it maintains the number of chromosomes in the next generation

  accept 'so that the fertilised egg has 46 chromosomes'

- it leads to variation **or** it produces offspring with different characteristics

(ii) any **one** from 1

- so that all the cells have the same genotype

  accept 'so that the genetic information in all the cells is the same'

- so that all the cells have the same number of chromosomes

[6]

3. (a) (i) • genes **or** DNA **or** chromosomes 1 (L7)

• in gametes **or** sex cells **or** eggs or sperm 1

accept 'at fertilisation

'in the nucleus' is insufficient

(ii) • they have genes **or** DNA **or** chromosomes from both parents 1 (L7)

accept 'they have genetic information from both parents'

accept 'from eggs and sperm'

(b) • they have the same genetic information or the genes or DNA **or** chromosomes 1 (L7)

accept 'they are from the same egg and same sperm'

*accept 'the fertilised egg **or** zygote split in two'*

accept 'they are from the same fertilised egg

*'from the same egg' **or** 'from the same sperm' is insufficient*

accept references to the egg dividing if the answer makes clear that this is after fertilisation eg 'the egg divides after it has joined with a sperm

'the egg divides in the uterus' is insufficient

(c) any **one** from 1 (L7)

- eye colour is inherited or controlled by genes
- eye colour is not affected by environmental factors

any **one** from 1

- weight and skin colour are affected by environmental factors
- weight is affected by diet **or** exercise and skin colour by the Sun

accept 'weight and skin colour are not just controlled by genes'

answer must refer to both weight and skin colour

'weight and skin colour are3 not controlled by genes' is insufficient

[6]

4. (a) (i) Katie ✓ 1 (L3)
Becca ✓

***both** answers are required for the mark*

if more than two boxes are ticked, award no mark

(ii) any **one** from 1 (L4)

- their mother **or** Pam has freckles
- their father **or** David has freckles
- their parents have freckles
- their grandmother **or** Mary has freckles
- only family B has freckles

accept 'Rachel and Bill do not have freckles'
accept 'a grandparent has freckles'
*accept 'their family **or** the family on the right has freckles'*
accept 'freckles run in the family'
accept 'family A does not have freckles'

(iii) his parents **or** Bob and Emily do not have freckles 1 (L4)

accept 'his family does not have freckles'
accept 'his grandparents do not have freckles'
*accept 'he is not in family B' if the answer for **(ii)** is 'only family B has freckles'*

(b) (i) egg cell ✓ 1 (L4)
sperm cell ✓

***both** answers are required for the mark*
if more than two boxes are ticked, deduct one mark for each incorrect tick minimum mark zero

(ii) reproductive system ✓ *if more than one box is ticked, award no mark* 1 (L4)

[5]

5 (a) mitosis;
diploid;
meiosis;
haploid;
gametes; [5]
(b) use of correct symbols/X and Y;
parent genotypes shown;
gamete genotypes shown;
offspring genotypes shown;
phenotypes for both sexes identified.
parent genotype wrong – max 3
Any four – 1 mark each [4]
Total [9]

6. twenty-three/23;
forty-four/44;
haploid;
zygote;
Y; [5] Total [5]

7.

(a)

term
dominant;
allele;
heterozygous;
genotype;

[4]

(b) **(i)** white; **[1]**

(ii)

(parent genotypes)	Rr		Rr;	
(gametes)	R	r	R	r;
(offspring genotypes)	RR	Rr	Rr	rr;
(phenotypes)	red	red	red	white;

link to values with ratio 3 red: 1 white/OWTTE;
Mark Punnet's squares based on above points [5]