Heredity - answers

1 The allele for red-coloured flowers must be dominant if no white flowers appear in the first generation (assuming a very large sample).

2 The recessive allele corresponding to **D** is **d**.

3 (a) A true-breeding, long-furred cat has the genotype **ss**.
(b) The **Ss** genotype will produce a short-furred phenotype.
(c) In an **Ss** genotype, the dominant allele (**S**) will be expressed.
(d) (i) **Ss** is heterozygous. (ii) **SS** is homozygous dominant.

4 (a) Rabbit 1 (**BB**) will be black; Rabbits 2 and 3 (**Bb** or **bB**) will be black; Rabbit 4 (**bb**) will be white.
(b) Rabbits 1 (**BB**) and 4 (**bb**) will breed true.
(c) Rabbits 1 (**BB**) and 4 (**bb**) are homozygous for coat colour.
(d) All 12 babies should be black as rabbit 1 contributes dominant alleles to all the offspring.
(e) If the heterozygous rabbits (**Bb**) are mated, you would expect a ratio approximating to 3 black to 1white baby; e.g. 36 black and 12 white.
(f) Rabbit 4 contributes only recessive alleles so approximately 50% of the babies should be black and 50% should be white; e.g. 25 of each.

5 Group A - $\mathbf{I^AI^A}$ or $\mathbf{I^Ai}$,
Group B - $\mathbf{I^BI^B}$ or $\mathbf{I^Bi}$.
Group AB - $\mathbf{I^AI^B}$; Group O - **ii**.

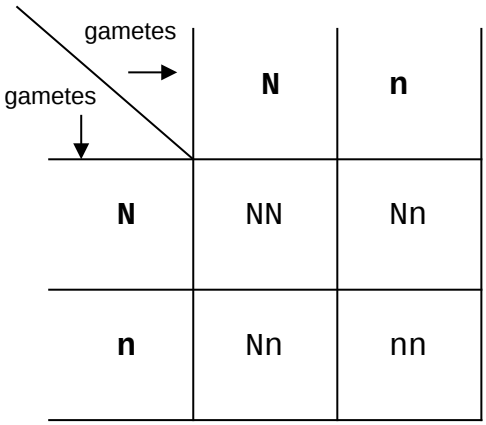
6 (a) The roan calf exhibits codominance of the two alleles.
(b) Each allele is fully expressed, i.e. neither allele is dominant.
(c) (i) the ABO blood groups are examples of the codominance of the $\mathbf{I^A}$ and the $\mathbf{I^B}$ alleles.
(ii) Sickle-cell anaemia .is an example of incomplete dominance. The recessive allele is partially expressed in the heterozygote.

7 Haemophilia (recessive), albinism (recessive), phenylketonuria (recessive), red-green colour blindness (recessive), sickle-cell anaemia (partially recessive) (any three).

8 (a) The male genotype is **XY**. (b) The female genotype is **XX**.

9 (a) The sperm determines the sex of the offspring.
(b) All the ova contain an **X** chromosome. Half the sperms carry an **X** chromosome and half carry a **Y** chromosome.

10 (a)



(b) The expected ratio of phenotypes would be approximately three normal to one ebony.
(c) On average, one-third of the normal phenotypes would be true-breeding (**NN**).

11 A sex-linked gene is usually carried on the **X** chromosome and is absent from the **Y** chromosome.

12 (a) Both grandparents must be heterozygous (**Nn**).
(b) If either grandparent was homozygous (**NN**) the **N** allele would be dominant in the offspring, the PKU allele would not be expressed and none of their children would be affected.
(c) Jane's husband must be heterozygous (**Nn**).
(d) If he were homozygous (**NN**) all his children would receive a dominant allele and none could exhibit PKU.
(e) There is a 50% chance that Peter has inherited the recessive PKU allele from his parents. This would make him a carrier.
(f) If Jane had been normal, the grandparents' genotypes could be (i) both **Nn** or (ii) one **NN** and one **Nn**. They could not both have been **NN** or Jane would also have been **NN** and could not have had an affected child.
(g) If the allele for PKU was sex-linked, the grandparents could not have had an affected daughter.

13 (a) **XN Y**, (b) **Xn Y**, (c) **XN XN**, (d) **Xn Xn** (e) **XN Xn**.

14 See diagram below
(a) The chances are 1:1 that a boy from this marriage will be colour-blind,
(b) The chances of a carrier daughter are also 1:l.

	Normal man		*Carrier woman*	
Genotypes	**XN Y**		**XX Nn**	
Gametes	**XN**	**Y**	**XN**	**Xn**
Possible combinations	**XX NN**	**XN Xn**	**XN Y**	**Xn Y**
	normal girl	carrier girl	normal boy	colour blind boy