Solutions

Each answer shows the steps, then the **result**.

2.1

- homozygous — the two alleles of a gene are the same; heterozygous — the two alleles are different

2.2

- the homozygous recessive

2.3

- In codominance both alleles are fully expressed, so the heterozygote shows both phenotypes together, such as roan; in incomplete dominance the heterozygote shows an intermediate blend, such as pink

2.4

- The gene is on the X chromosome and a male has only one X, so a single recessive allele is expressed with no second allele to mask it, whereas a female would need two

2.5

- There is no significant difference between the observed and the expected numbers, and any difference is due to chance

3.1 C

- Tt × tt
- Tt, Tt, tt, tt
- half show the recessive phenotype

3.2 B

- RW × RW
- RR (red) : RW (pink) : RW (pink) : WW (white) = 1 : 2 : 1

3.3

(a)

- parents $X^B X^b \times X^B Y$; gametes X^B, X^b and X^B, Y; offspring $X^B X^B, X^B X^b, X^B Y, X^b Y$ — normal daughter, carrier daughter, normal son, colour-blind son

(b)

- 1/2 (of the sons)

3.4

- the faulty *TYR* allele codes for a non-functional tyrosinase enzyme; so no melanin pigment is made, giving albinism

3.5

(a)

- Orange male X^OY; black female X^BX^B; tortoiseshell female X^OX^B

(b)

- Parents $X^OX^B \times X^OY$; gametes X^O, X^B and X^O, Y; offspring X^OX^O, X^OX^B, X^OY, X^BY; phenotypes orange female, tortoiseshell female, orange male, black male; ratio $1:1:1:1$

(c)

- A tortoiseshell cat needs both X^O and X^B, so it needs two X chromosomes; a male is normally XY, so only an individual with an abnormal XXY karyotype can be a tortoiseshell male

(d)

- Expected is 48 of each; $\chi^2 = \dfrac{(54-48)^2}{48} + \dfrac{(42-48)^2}{48} = \dfrac{36}{48} + \dfrac{36}{48} = 1.5$

(e)

- 1.5 is less than the critical value of 3.84; so the null hypothesis is retained; there is no significant difference between the observed and expected numbers, and the difference is due to chance