Solutions

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

2.1

- genotype **TT**
- both alleles are the same, so every gamete carries T and all the offspring of a cross with another TT plant are TT – the feature never changes between generations

2.2

- state the parents: heterozygous short-haired is **Ss**, long-haired is **ss**
- gametes: S or s from the first parent, s or s from the second
- the grid gives **Ss, ss, Ss, ss**
- so **1 short-haired : 1 long-haired**, a **1:1** ratio

2.3

- cross the unknown cat with a **long-haired (ss)** cat
- if **any** kitten has long hair, that kitten is ss, so it received an s from the unknown parent, which must therefore be **Ss**
- if every kitten has short hair, the unknown parent is very probably **SS**

2.4

- genotype $\mathbf{I^AI^B}$
- codominance means **both** alleles are expressed in the phenotype
- neither allele masks the other, so this man's blood has **both** the A and the B features, rather than only one of them

2.5

- group O: $\mathbf{I^oI^o}$
- group A: $\mathbf{I^AI^A}$ or $\mathbf{I^AI^o}$

2.6

- the gene is on the **X chromosome**, and the allele for colour blindness is **recessive**
- a boy is $X^?Y$, with only **one** X, so a single copy of the recessive allele always shows
- a girl is $X^?X^?$ and needs **two** copies; with one copy she is a carrier with normal vision, and two copies are far less likely

3.1 B

- the child is group O, so its genotype is I^oI^o and it received an I^o from **each** parent
- so each parent carries an I^o as well as the allele for their own group: I^AI^o and I^BI^o
- **A** and **D** give no I^o to pass on; **C** gives the wrong blood groups for the parents themselves

3.2

(a)

- the allele is **recessive**
- individuals 1 and 2 do not have the condition, but their daughter 3 does, so the allele must have been carried without showing

(b)

- individual 3 is an **affected female**, so she has the recessive allele on **both** of her X chromosomes, one of them from her father, individual 1
- individual 1 has only one X, so he would then have the condition himself – and he does not, so the gene cannot be on the X chromosome

(c)

- individual 6 has the condition, so he is **aa**, with one a from each parent
- individuals 4 and 5 do not have the condition, so each also carries an A: both are **Aa**

(d)

- Aa × Aa gives AA, Aa, Aa, aa, so the probability is $\frac{1}{4}$, or **25%**

3.3

(a)

- her father is colour-blind, so his genotype is X^bY, and his only X carries X^b
- every daughter receives that X, so she has X^b; she has normal vision, so her other X must carry X^B, making her X^BX^b – a carrier

(b)

- parents: mother X^BX^b, father X^bY
- gametes: X^B or X^b from the mother, X^b or Y from the father
- the grid gives X^BX^b, X^bX^b, X^BY and X^bY
- phenotypes: a **carrier daughter** with normal vision, a **colour-blind daughter**, a **son with normal vision** and a **colour-blind son**

(c)

- a daughter: $\frac{1}{2}$, or **50%**
- a son: $\frac{1}{2}$, or **50%**

(d)

- **50%**, the same as for every other child
- each fertilisation is independent of the ones before it, so the three earlier children do not change the chance

(e)

- $\mathbf{X^BX^b}$, a carrier
- her father is X^bY, so his only X gave her X^b; she has normal vision, so her mother's X must have carried X^B – no other genotype is possible