

GENETICS ANSWERS

1. (a) A gene is a biological unit of genetic information which is located in a definite position (locus) on a particular chromosome.

1. (b) A chromosome is a filamentous or rod-shaped body in the nucleus, which contains the genes.

1. (c) Genetics is the study of heredity by genes on chromosomes.

2. (a) 23 (b) 46

3. No. The number of chromosomes varies with each species.

4. Human male has XY sex chromosomes, and the human female has XX.

5. No.

6. 'A' is the dominant allele or gene for a particular characteristic (e.g. normal skin pigment).

'a' is the recessive allele or gene for a particular characteristic (e.g. albinism).

'AA' is the genotype or pair of alleles or genes for a dominant characteristic (e.g. homozygous for normal skin pigment).

'aa' is the genotype or pair of alleles or genes for a recessive characteristic (e.g. homozygous for albinism).

'Aa' is the genotype or pair of alleles or genes for a dominant characteristic (e.g. heterozygous for normal skin pigment).

7. The terms 'alleles' and 'genes' are often used interchangeably. Alleles are the slightly different variations of a gene made of DNA. For example, in eye colour, there may be brown eye colour determined by the allele 'B', or there may be blue eye colour determined by the allele 'b'.

8. 'True-breeding' or homozygous means that the phenotype for a particular characteristic has both alleles or genes the same, e.g. BB, bb.

9. A genotype is the pair of alleles or genes for a particular characteristic e.g. BB.

A phenotype is the characteristic which is determined by the genotype e.g. brown eyes.

10. No. For example, the genotypes BB and Bb both determine the same phenotype of brown eye colour.

11. Yes.

12. Let Y = yellow and y = green

(a) All offspring would have genotype of Yy and phenotype of yellow pea colour.

(b) Half of the offspring would have the genotype Yy with phenotype of yellow colour, and the other half would be yy with green colour.

(c) Half would be YY with yellow colour, and the other half would be Yy also with yellow colour.

(d) This is called a monohybrid cross where each parent is hybrid or heterozygous for certain characteristic. The parents will both be Yy. The ratio of the offspring's genotypes will be 1 YY: 2 Yy: 1 yy. The ratio of the offspring's phenotype will be 3 yellow : 1 green.

13. Yes. If both parents were heterozygous or hybrid for brown eye colour (i.e. Bb), then 1 out of 4 possible children could inherit the genotype bb which determines blue eye colour.

14. No. The blue-eyed parents with genotypes bb and bb do not possess the allele B for brown eye colour.

15. Paternal grandfather - Bb ; paternal grandmother - Bb ; maternal grandfather - bb ; maternal grandmother - BB or Bb ; father - bb; mother - Bb ; child - bb.

16. The rough-coated guinea pig should be mated with a guinea pig whose genotype is homozygous recessive smooth-coated. If any offspring are smooth-coated, the rough-coated parent must be heterozygous. If not, the rough-coated parent is probably homozygous.

17. Homozygous recessive individuals are more likely to occur in offspring of closely-related individuals, and less likely to occur if the married couple was unrelated before marriage because they will have fewer common genes.

18. This is a monohybrid cross where the offspring genotype ratio is 3 dominant : 1 recessive. Hence about 150 offspring will have the dominant trait.

19. (a) The genotype ratio is about 3:1, so it is probably a monohybrid cross. The short-winged condition is probably recessive.

19. (b) Probably Ll and Ll where L = long-winged and l = short-winged.

20. (a) The parents are probably bbSS and BBss.

20. (b) This is probably a dihybrid cross where both parents are hybrid for both characteristic (BbSs). The appearance or phenotypes of the F₂ generation would be 9 black spotted: 3 brown spotted : 3 black solid: 1 brown solid.

21. Let RR =red , RW = roan and WW = white.

If the roan bull was mated to a white cow, the offspring would be half RW and half WW.

If the RW offspring were mated in a monohybrid cross, the F₂ offspring would be 1RR:2RW:1WW.

22. Where there is more than one allele for a certain characteristic, these are called multiple alleles, e.g. the ABO blood typing.

23. The parents' genotypes are probably I I and I I , with phenotypes A and B respectively.

24. A swap has probably occurred because neither Mr nor Mrs Smith had Sue's A allele, and and Mr and Mrs Jones could not have had a baby with blood type O.

25. A cross between the sex chromosomes XX and XY will result in half the offspring being male and half female.

26. Sex-linked inheritance occurs when the allele or gene for a particular occurs on the X chromosome. This means that a male possessing that characteristic only has to have one affected allele on his X chromosome, whereas a female must have two affected alleles on her two X chromosomes.

27. All daughters will be carriers for colour-blindness but will have normal vision. All sons will have normal vision.

28. Genotypes are X X , X X , X Y , X Y .

Phenotypes are 1 tortoise-shell female: 1 black female: 1 yellow male: 1 black male.

Note that it is not possible to have a tortoise-shell male cat.

29. Mutations of genes or chromosomes.