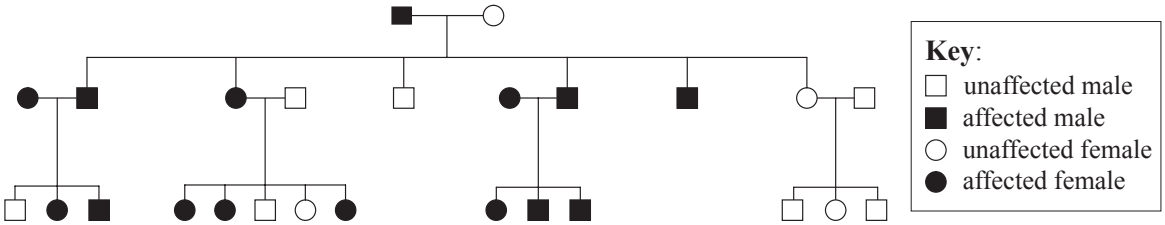
1. Red-green colour blindness is a sex-linked condition. Which of the following always shows normal vision? *(HL p1 May09 TZ1 q11)*

A. A homozygous male
B. A homozygous female
C. A heterozygous male
D. A heterozygous female

2. In a cross between red haired cattle and white haired cattle the offspring produced are always a colour called roan (light red). If the roan cattle are interbred they produce white, roan and red offspring. How many alleles are controlling this character? *(HL p1 May09 TZ1 q12)*

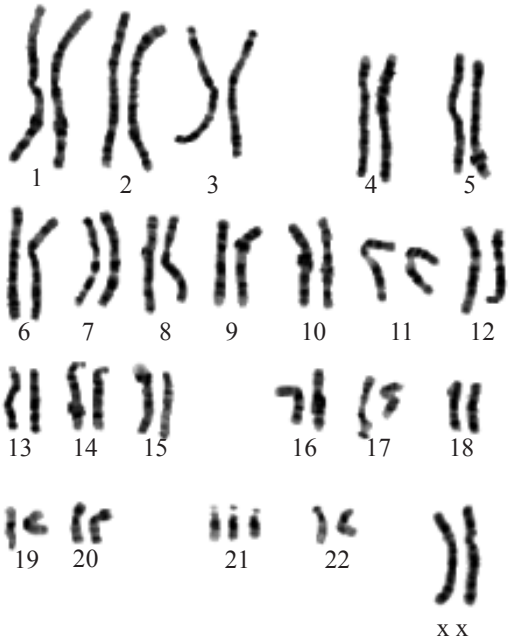
A. 1 B. 2 C. 3 D. 4

3. What evidence is given in the pedigree chart below to establish that the condition is caused by a dominant allele? *(HL p1 May09 TZ1 q13)*



A. Two unaffected parents have unaffected children.
B. Two affected parents have affected children.
C. An affected parent and an unaffected parent have affected children.
D. Two affected parents have an unaffected child.

4. What can be concluded on the basis of the following karyotype? (HL p1 May08 TZ1 q9)



A. Female with a normal set of chromosomes
B. Male with Down syndrome
C. Female with Down syndrome
D. Male with a normal set of chromosomes

5. What are homologous chromosomes? *(HL p1 May08 TZ1 q10)*

A. Two chromosomes with differing sets of genes, in the same sequence, with the same alleles
B. Two chromosomes with the same set of genes, in a different sequence, with the same alleles
C. Two chromosomes with a different set of genes, in the same sequence, with different alleles
D. Two chromosomes with the same set of genes, in the same sequence, sometimes with different alleles

6. Which feature of a genetic pedigree chart demonstrates that a characteristic is sex linked? *(HL p1 May08 TZ1 q12)*

A. Numbers of offspring carrying the characteristic decreased over several generations.
B. One gender is more commonly affected than the other.
C. Equal numbers of males and females inherit the characteristic.
D. Boys and girls only inherit the characteristic from their mothers.

7. In *Drosophila* the allele for normal wings (W) is dominant over the allele for vestigal wings (w) and the allele for normal body (G) is dominant over the allele for ebony body (g). If two *Drosophila* with the genotypes Wwgg and wwGg are crossed together, what ratio of phenotypes is expected in the offspring? *(HL p1 May08 TZ1 q29)*

A. 9 × normal wings, normal body : 3 × normal wings, ebony body : 3 × vestigal wings, normal body : 1 × vestigal wings, ebony body

B. 3 × normal wings, normal body : 3 × normal wings, ebony body : 3 × vestigal wings, normal body : 1 × vestigal wings, ebony body

C. 3 × normal wings, normal body : 1 × normal wings, ebony body : 3 × vestigal wings, normal body : 1 × vestigal wings, ebony body

D. 1 × normal wings, normal body : 1 × normal wings, ebony body : 1 × vestigal wings, normal body : 1 × vestigal wings, ebony body

8. What constitutes a linkage group? *(HL p1 May08 TZ1 q30)*

A. Genes whose loci are on different chromosomes
B. Genes carried on the same chromosome
C. Genes controlling a polygenic characteristic
D. Genes for the inheritance of ABO blood groups

9. What are the possible outcomes of recombination? *(HL p1 May08 TZ1 q31)*

I. A different combination of unlinked genes not seen in the parents
II. A different combination of linked genes not seen in the parents
III. The same combination of genes seen in the parents

A. I and II only B. I and III only C. II and III only D. I, II, and III

10. When do chiasmata form in meiosis? *(HL p1 May09 TZ1 q34)*

A. During prophase I
B. During metaphase I
C. During anaphase I
D. During prophase II

11. Which of the following processes result in the production of recombinants? *(HL p1 May09 TZ1 q35)*

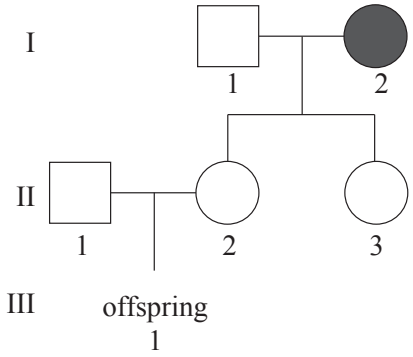
I. Crossing over between linked genes
II. Reassortment of non-linked genes
III. Mutation

A. I only B. I and II only C. I and III only D. I, II and III

12. What feature demonstrates codominance in the inheritance of ABO blood groups? *(HL p1 May07 TZ1 q10)*

A. When A antigens and B antigens are present on red blood cells.
B. When A antibodies and B antibodies are present in blood serum.
C. When I^A and i alleles are expressed in homozygotes.
D. When I^A and i alleles are expressed in heterozygotes.

13. In the pedigree shown below, the female, labelled I-2, is a carrier for colour blindness, however neither male (I-1 or II-1) is colour blind.



What is the probability that offspring III-1 will be colour blind? *(HL p1 May07 TZ1 q11)*

A. 50% B. 25% C. 12.5 % D. 0%

14. Allele S and T are both dominant. In the theoretical cross ttSs x Ttss, which of the following offspring would show recombination? *(HL p1 May07 TZ1 q30)*

A. TS, tS B. TS, Ts C. tS, Ts D. TS, ts

15. (a) (i) Define *allele* *[1]* *(HL p2 May08 TZ1 q3)*

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(ii) Outline the consequences of a base substitution mutation. *[2]*

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(b) (i) Mendel crossed tall, round-seeded plants with short, wrinkled-seeded plants. All F_1 produced were tall, round-seeded plants. When F_1 plants were crossed with other F_1 plants, the F_2 generation produced many more than 1/16 short, wrinkled-seeded plants. Deduce, with reasons, the inheritance of these genes. *[2]*

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(ii) The same cross was later repeated but gave fewer F_2 short, wrinkled-seeded plants although still more than 1/16. Outline a **named** statistical test that could indicate if your deduction about the inheritance of these two genes is likely to be correct. *[2]*

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16. Describe how meiosis results in an enormous genetic variety in the production of pollen. *[5]*
(HL p2 May08 TZ1 q4b)

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17. A gene in humans called APC is located on chromosome 5. This gene controls cell division and is known as a tumour suppressor gene. Mutations of APC cause a genetic disease called FAP (Familial Adenomatous Polyposis). *(HL p2 May07 TZ1 q3a-c)*

(a) State, with a reason, whether FAP is a sex-linked genetic disease or not. *[1]*

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50 % of the gametes produced by a person with FAP have an APC gene with the mutation.

(b) Identify, with a reason, whether FAP follows a dominant or recessive pattern of inheritance. *[2]*

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In a person with FAP, each cell contains a copy of the APC gene with the mutation. If a mutation occurs on the cell's other copy of the APC gene, the cell becomes a tumour cell. Almost everyone with FAP develops cancer before the age of 50.

(c) Explain why almost everyone with FAP eventually develops cancer. *[2]*

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18. Explain the events in meiosis that lead to the genetic diversity of sperm. *[8]*

(HL p2 May07 TZ1 q7b)

KEY

1. D 2. B 3. D 4. C 5. D 6. B 7. D 8. B 9. A 10. A

11. B 12.A 13. C 14. D

15.

(a) (i) one specific/variant/alternative form of a gene on the same locus/position on a chromosome (differing from other alleles);

(ii) changes triplet code/codon;
different amino acid (may be) coded for/inserted;
(may) change protein/polypeptide/primary structure/sequence of amino acids / may code for a different protein;
may cause sickle cell anemia/other correctly named disease / form stop codon;

(b) (i) dihybrid cross would give 9 : 3 : 3 :1 ratio in this F_2 if genes not
(*give credit for punnett grid showing this*)
therefore the genes are linked;
more homozygous recessive offspring / 3:1 ratio expected if linked;

(ii) chi-squared (test);
(*accept symbol)* compare observed and expected values/results;
(chi-squared) value is obtained; statistical table used to determine probability;
No marks if t-test given. ***[1]*** *max if test not named.*

16.

homologous chromosomes pair/form bivalents/undergo synapsis;
crossing over / gene exchange / chiasma formation;
in prophase I;
produces new combinations / recombination of alleles/genes;
random orientation of homologous (chromosome) pairs/bivalents in metaphase I;
random orientation of (sister) chromatids in metaphase II;
or accept clear annotated diagram of above.
2^n possibilities/combinations of chromosomes (n = haploid number);
non-disjunction changes chromosome number;

17.

(a) not sex-linked because the gene is not on a sex chromosome/X chromosome / is on an autosome
Reject "gene is located on chromosome 5".

(b) dominant;
person with FAP has one mutant and one normal allele of the gene / is heterozygous / if recessive 100 % of gametes have the mutated APC gene;
Award ***[0]*** *if alleles are identified as "recessive".*

(c) mutation only has to occur once / only one cell needs to have the mutation (to its normal APC gene);
a tumour develops from one cell; all/huge numbers of cells in the body could become tumour cells;
tumour formation not suppressed if both copies of the APC gene in a cell are mutant;

18.
pairing of homologous chromosomes / formation of bivalents / synapsis;
during prophase I;
crossing over;
exchange of parts of non-sister chromatids / homologous chromosomes;
genes on the same chromosome are linked;
crossing over allows recombination of (linked) genes;
random orientation of (pairs of) chromosomes / bivalents;
in metaphase I;
independent assortment of genes on different chromosome types;
2^n / 2^{23} (in humans) possible combinations of chromosomes;
effectively infinite number of combinations if effects of crossing over are included;
X or Y chromosome in each sperm;