

Multiple choice questions

1. Red-green colour blindness is caused by an X-linked recessive allele. In the pedigree chart below which individuals must be carriers of the red-green colour blindness allele?
 - A. Grandparent 1, parent 1
 - B. Grandparent 4 and parent 2
 - C. Parent 1 and parent 2
 - D. Child 2 and child 3.
2. If the parents in the pedigree chart above had a fourth child who was female, what would be the probability that she was colour blind?
 - A. 50%
 - B. 25%
 - C. 0%
 - D. None of the above
3. Cystic fibrosis and Huntington's disease are inherited conditions in humans. Which row in the table correctly describes the disease causing allele in each case?

	Cystic fibrosis	Huntington's
A.	Recessive autosomal	Dominant autosomal
B.	Recessive sex-linked	Dominant sex-linked
C.	Dominant autosomal	Recessive autosomal
D.	Dominant sex-linked	Recessive sex-linked

4. Which of the following can cause new alleles to form and may lead to genetic diseases?
 - A. Mitosis
 - B. Meiosis
 - C. Radiation
 - D. Variation
5. What are the enzymes used in the process of gene transfer using plasmids in bacteria?
 - A. DNA ligase and DNA polymerase
 - B. DNA polymerase and Helicase
 - C. Restriction endonuclease and DNA ligase
 - D. Helicase and Restriction endonuclease.
6. Which of the following best defines the term, "gene"?
 - A. a heritable factor that consists of a length of DNA and influences many characteristics.
 - B. a heritable factor that consists of a length of mRNA and influences many characteristics.
 - C. a heritable factor that consists of a length of DNA and influences a specific characteristic

- D. a heritable factor that consists of a length of mRNA and influences a specific characteristic.
7. What is the main biological use of comparisons of the number of genes between species?
- A. It provides information about the size of the nucleus.
 - B. It provides information about how closely related different species are.
 - C. It gives information about the amount of DNA a species has.
 - D. It gives information about the number of genetic diseases in different species.
8. What is the difference between prokaryote and eukaryote chromosomes?
- A. Prokaryotes have a number of circular DNA molecules while eukaryotes have a single linear DNA molecule.
 - B. The prokaryote chromosome is a single circular DNA molecule while eukaryotes have a number of linear DNA molecules.
 - C. The prokaryote chromosome is made from plasmid molecules while eukaryotes have a number of linear DNA molecules.
 - D. Prokaryotes have a number of circular DNA molecules and eukaryotes have a single linear DNA molecule.
9. The roundworm (*Caenorhabditis elegans*) has a diploid chromosome number of 12. How many chromosomes would be in a haploid roundworm cell?
- A. 24
 - B. 12
 - C. 6
 - D. None of the above.
10. Which two processes are used in DNA profiling
- A. PCR and gel electrophoresis
 - B. Gene transfer and gel electrophoresis
 - C. PCR and a Karyogram
 - D. Gene transfer and PCR
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Structured answer questions

11. A student set up an experiment to clone some plants by growing cuttings of the plants in old drinks bottles. After two weeks the shoot on the left had grown the roots shown in the photo on the right.

Describe how you could use plants like this to investigate the effect of the concentration of a rooting hormone in the water in the bottle on the growth of roots. Include details of the number of plants, the control of variables and how you will measure the growth of the roots.

One mark for each of the points below;

Reliability: A large number of cuttings should be used / at least 3 cuttings in each bottle;

Independent variable: A range of different hormone concentrations should be used / 5 or more different concentrations;

Controlled variables could include,

- Time allowed for root growth;
- Size of cuttings / number of leaves;
- Species of cuttings;
- Light intensity / temperature;

Suggestion of a quantitative method for measuring growth / count the number of roots / measure the total lengths of root growth;

Suggestion of how the data will be used to answer the question, effect of concentration on root growth.

(6 marks)

12. DNA profiling is used in paternity investigations. The following diagram shows the results of an investigation of a paternity claim. Both male A and male B claim to be the father of the child.

Analyse the DNA profile and deduce which male is most likely to be the biological father. Explain reasons for your decision.

Male A is most likely the father;

Band B matches a band in Male A (but doesn't match male B);

The mother Male A and Male B both have bands which are not found in the child – missing bands in the child's DNA profile are not proof of paternity / maternity;

Band A and band C seem to match the bands in the mothers DNA profile so can't help identify the father;

(2 marks)

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13. State two properties of the DNA fragments in the DNA profile which allow them to be separated by the process of gel electrophoresis

(1 mark)

The size of fragment, and the electrical charge on the fragment;

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14. Some genetic conditions are said to be sex-linked.

1. Define sex linkage

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Gene linkage occurs when the gene is located on a sex chromosome / X-chromosome

(1 mark)

2. State one example of a sex linked genetic condition in humans

Red-green colour blindness / haemophilia / muscular dystrophy

(1 mark)

15. In a genetic cross by Gregor Mendel. Pure breeding pea plants with yellow seeds were crossed with pure breeding plants with green seeds. All of the offspring had green seeds.

1. Identify which of the alleles is dominant

...The allele for green seeds is dominant ...

(1 mark)

2. Deduce the genotype of the offspring

Offspring genotype is Gg (accept other letters so long as one is upper case, the other lower)

(1 mark)

3. Construct a Punnet grid to show the cross between two offspring plants

	G	g
G	GG	Gg
g	Gg	gg

1 mark for the gamete alleles; 1 mark for correct genotypes

(2 marks)

4. Deduce ratio of the different phenotypes for the offspring of this second cross

... 3 green : 1 yellow

(1 mark)

16. Explain one use of the enzyme DNA ligase in biotechnology

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DNA ligase general function – to join together pieces of DNA;

Biotech function - to join/integrate the new gene to the plasmid vector;

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(2 marks)

Extended answer questions

17. Describe the movement of chromosomes in the process of meiosis. Marks will be awarded for correctly labelled diagrams.

There are two cell divisions / meiosis I and meiosis II (in meiosis);

Meiosis produces four (haploid) cells;

homologous chromosomes pair up;

homologous chromosomes line-up on equator;

(spindle fibres) pull homologous chromosomes to opposite poles;

two haploid cells are formed;

second division / like mitosis, separates chromatids to opposite poles;

Chromosomes line up on equator;

(spindle fibres) pull chromatids to opposite poles;

Four haploid cells are formed;

Accept any of the above points if clearly explained in a clearly labelled diagram - 6 max

(6 marks)

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18. Explain how karyograms can be used to find out information about the genetics of unborn babies.

To make a Karyogram cells are taken from an unborn fetus / amniocentesis / CVS;

Cells are grown in the lab until they divide;

Chromosomes in the dividing cells are photographed

Chromosomes are arranged in homologous pairs;

Chromosomes are arranged in order of size / largest first;

The chart / karyograms is analysed to identify chromosome anomalies / mutations / gender;

Examples are Down's syndrome / trisomy 21 / gender / other examples eg Turner's syndrome

(6 marks)

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Total 40 marks

Extension Questions

19. Discuss the potential risks and benefits of two named examples of GMO crops?

named example of two GMO crops; *[2 max]*

Possible benefits: [4 max]

selective breeding cannot produce desired phenotype;

GMO crops lead to increased productivity of food production / less land required for production;

GMO crops require less use of chemicals (*eg* pesticides);

GMO food crop could grow in extreme environments;

GMO crops can provide less expensive drug preparation;

eg vaccine in bananas;

Possible harmful effects: [4 max]

There is (some) evidence that eating GM crops could be harmful;

There is a risk releasing genetically engineered plants into the environment;

the GM crop can spread and compete with the naturally occurring varieties;

GMO is a technological solution and traditional agriculture could give similar benefits;

producing crops using GMO methods reduces genetic variation / biodiversity;

(6 marks)

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20. Describe the method of cloning using somatic cell nuclear transfer, using the example of Dolly the sheep, or another example.

Take egg cells from donor sheep / use hormones to promote ovulation;

Remove the nucleus from a (sheep) egg cell;

Take a body (somatic) cell from the animal being cloned / Dolly;

Insert the (somatic cell) nucleus into the (enucleated) egg cell;

Stimulate the egg & donor nucleus with electricity;

A new one-celled embryo is formed;

Implant the new embryo into a surrogate (sheep's) uterus;

(6 marks)

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