

1. Rhesus factor is an antigen present on the surface of red blood cells of Rhesus positive individuals.

Rhesus positive (Rh^+) is dominant to Rhesus negative (Rh^-). A mother with Rhesus negative blood gives birth to a baby with Rhesus positive blood and there are concerns that subsequent pregnancies will trigger an immune response.

What are the genotypes of the mother and her first baby?

	Genotype of mother	Genotype of first baby
A.	$Rh^- Rh^-$	$Rh^- Rh^-$
B.	$Rh^- Rh^-$	$Rh^+ Rh^-$
C.	$Rh^- Rh^-$	$Rh^+ Rh^+$
D.	$Rh^+ Rh^-$	$Rh^+ Rh^+$

(Total 1 mark)

2. A parent organism of unknown genotype is mated in a test cross. Half of the offspring have the same phenotype as the parent. What can be concluded from this result?

- A. The parent of unknown genotype is heterozygous.
- B. The parent of unknown genotype is homozygous dominant.
- C. The parent of unknown genotype is homozygous recessive.
- D. The parent of known genotype is heterozygous.

(Total 1 mark)

3. A woman who is a carrier for hemophilia and a man who does not have hemophilia have a child.

What is the probability that the child will have hemophilia?

	If it is a girl	If it is a boy
A.	0%	50%
B.	0%	0%
C.	50%	50%
D.	50%	0%

(Total 1 mark)

4. What does the karyotype below correspond to?



- A. A normal male
- B. A normal female
- C. A female with Down syndrome
- D. A male with Down syndrome

(Total 1 mark)

5. The pedigree chart below shows the blood types of three members of a family.

Which could be the blood types of individuals 1 and 2?

	Individual 1	Individual 2
A.	A	AB
B.	AB	B
C.	O	B
D.	B	A

(Total 1 mark)

6. Boys can inherit the recessive allele (*c*) that causes red-green colour blindness from their mother, not from their father. The allele for normal red and green vision is *C*. Which of the following genotypes are possible in men?
- A. *c* only
- B. *C* or *c* only
- C. *CC* or *cc* only
- D. *CC*, *Cc* or *cc* only

(Total 1 mark)

7. What is chorionic villus sampling?
- A. Sampling cells from the placenta
 - B. Sampling cells from the fetal digestive system
 - C. Sampling fetal cells from the amniotic fluid
 - D. Sampling stem cells from the umbilical cord

(Total 1 mark)

8. Which of the following statements about homologous chromosomes is correct?
- A. Each gene is at the same locus on both chromosomes.
 - B. They are two identical copies of a parent chromosome which are attached to one another at the centromere.
 - C. They always produce identical phenotypes.
 - D. They are chromosomes that have identical genes and alleles.

(Total 1 mark)

9. The blood groups of a mother and four children are indicated on the pedigree chart below.

What are the possible blood groups of the father?

- A. Group A only
- B. Group A or B only
- C. Group AB only
- D. Group A, B or AB only

(Total 1 mark)

10. The following sequence of pictures, made using an electronic imaging technique, shows a cell undergoing division.

[Adapted by permission from Macmillan Publishers Ltd, Fuller, B G et al. 2008. "Midzone activation of aurora B in anaphase produces an intracellular phosphorylation gradient". *Nature*. Vol 453.]

- (a) State the stage of mitosis typified by image II.

.....

(1)

- (b) List **two** processes that involve mitosis.

.....

.....

(2)

- (c) State the process that results in tumour (cancer) formation or development.

.....

(1)

- (d) Explain, using **one** example, how non-disjunction in meiosis can lead to changes in chromosome number.

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.....

.....

(2)
(Total 6 marks)

11. Which of the following types of information are needed to construct a karyotype?

- I. Size of the chromosomes
- II. Gene mutations of the chromosomes
- III. Age of the individual

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

(Total 1 mark)

12. The diagram below shows a pair of chromosomes during meiosis in a cell in the human testis. The position of the alleles of some genes is indicated.

(a) Deduce, with reasons for your answer, whether the chromosomes are

(i) autosomes or sex chromosomes.

.....
.....

(1)

(ii) homologous or non-homologous.

.....
.....

(1)

(b) State the stage of meiosis of a cell if it contains pairs of chromosomes as shown in the diagram.

.....

(1)

(c) At the end of meiosis, each of the chromatids shown in the diagram will be in a different haploid cell. The diagrams below represent the chromatids inside the haploid cells. Determine the combinations of alleles that would be present on each chromatid. Use the diagrams to indicate your answer.

(2)

(d) State the pattern of inheritance shown by the three genes.

.....

(1)

(Total 6 marks)

13. (a) Define the term *allele* as used in genetics.

.....

(1)

(b) List the possible genotypes for blood group B.

.....

(1)

(c) Label the diagram below which shows a basic gene transfer.

I.

II.

III.

IV.

(2)

(d) State **two** general types of enzymes used in gene transfer.

.....
.....

(1)
(Total 5 marks)

14. The karyotype below shows the chromosomes from a person with Down syndrome.

[Source: U.S. Department of Energy Human Genome Program (genomics.energy.gov, genomicscience.energy.gov)]

(a) State the evidence provided by the karyotype that shows this person has Down syndrome.

.....

(1)

(b) Outline how Down syndrome occurs due to meiosis.

.....
.....
.....

(2)

(c) Determine, giving a reason, the sex of the person in the karyotype.

.....
.....

(1)

(d) Explain briefly why males are more likely to inherit colour blindness than females.

.....
.....
.....
.....

(2)

(Total 6 marks)

15. What is the difference between the alleles of a gene?

- A. Their position on the chromosome
- B. Their amino acid sequence
- C. Their pentose sugars
- D. Their base sequence

(Total 1 mark)

16. *Up to two additional marks are available for the construction of your answers.*

(2)

(a) Embryos that are produced by *in vitro* fertilization can be screened for genetic disease. Outline the process of *in vitro* fertilization, including **one** example of a situation when it is used.

(9)

(b) Explain, using an example, how females but not males can be carriers of some recessive alleles.

(4)

(c) Explain the causes and consequences of sickle-cell anemia.

(5)

(Total 20 marks)

17. *Up to two additional marks are available for the construction of your answers.*

(2)

(a) Describe the causes of Down syndrome.

(5)

(b) Describe how human skin colour is determined genetically.

(5)

(c) Explain the causes of sickle-cell anemia.

(8)

(Total 20 marks)