Inheritance (H)

1. How can a mutation in non-coding DNA change the activity of a cell?

A It can change the amino acid sequence in a protein.
B The base sequence of mRNA may be altered.
C The shape of a protein may be changed.
D Transcription of mRNA may be stopped.

Your answer ☐ **[1]**

2. Why are the effects of most mutations **not** observed?

A Most mutations do not affect the genotype or phenotype.
B Most mutations do not affect the phenotype.
C Mutations mainly affect internal body processes.
D Mutations often kill the organism.

Your answer ☐ **[1]**

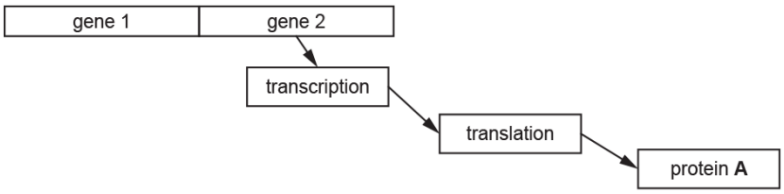
3. The table describes meiosis.

	Genetic description of cells made	Genetic variation introduced	Type of cells made
A	haploid	✓	body cells
B	diploid	*X*	body cells
C	haploid	✓	gametes
D	diploid	✓	gametes

Which row in the table is correct?

Your answer ☐ **[1]**

4. Gene **1** and gene **2** are both needed for the production of protein **A**.



What is the function of **gene 1** in this process?

A It codes for the amino acids in protein **A**.
B It codes for the mRNA needed to make protein **A**.
C It acts as the site for protein synthesis.
D It controls the expression of **gene 2.**

Your answer ☐ **[1]**

5. What was Mendel's contribution to modern genetics?

A He developed the theory of natural selection.
B He discovered that most characteristics are controlled by multiple genes.
C He worked out how sex determination occurs in mice.
D He found a pattern that shows how characteristics are passed on.

Your answer ☐ **[1]**

6. Why is the process of meiosis important in making gametes?

A The cells produced are diploid.
B The cells produced are genetically identical.
C The cells produced are much smaller in size.
D The cells produced have half the number of chromosomes.

Your answer ☐ **[1]**

7. What is a genome?

A A description of the number of chromosomes in an organism.
B All the proteins that one organism can produce.
C A store of seeds to preserve genetic variation.
D The entire genetic material of an organism.

Your answer ☐ **[1]**

8. A harmful protein can cause pain in the joints. A new treatment is being developed to stop the protein causing pain.

What effect would this treatment have on the person's phenotype and genotype?

A Changes both the phenotype and genotype
B Changes the genotype only
C Changes the phenotype only
D No change to their phenotype or genotype

Your answer ☐ **[1]**

9. Which of these processes can produce a **new** allele?

A A change in the environment
B Asexual reproduction
C Mutation
D Selective breeding

Your answer ☐ **[1]**

10. The data in the table shows the ratio of males to females in England and Wales.

	Ratio of males to females in England and Wales
At birth	105 males : 100 females
Average over the whole population	98 males : 100 females

There are more females than males living in England and Wales as an average over the whole population.

Suggest **one** reason why there are more females.

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[1]

11 (a). Hypercholesterolemia (HC) is the result of a mutation in the genome. It is caused by a dominant allele on chromosome 19. The mutation involved causes a change in the DNA nucleotides.

Write the words **allele, chromosome, genome** and **nucleotide** in the boxes to show their size from smallest feature to largest feature.

Smallest feature	
Largest feature	

[1]

(b). One in 500 people are heterozygous for HC.

There are 66 000 000 people in the UK.

Calculate how many people in the UK are heterozygous for HC.

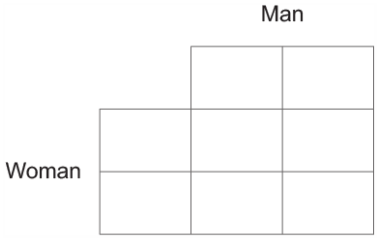
Number of people = ... **[1]**

(c). A woman who does not have HC and a man who is heterozygous are expecting a baby.

What is the probability of the baby having HC?

Complete the genetic diagram to explain your answer.

Use **D** for the dominant HC allele and **d** for the recessive allele.



Probability = ... **[2]**

12. Retinitis pigmentosa is a genetic condition that affects the eyes.

It is caused by a mutation to a gene. This mutation produces a recessive allele.

The condition causes rod cells in the retina to break down.

Explain the meaning of these terms.

Gene

Allele

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[2]

13. Hypercholesterolemia (HC) is the result of a mutation in the genome. It is caused by a dominant allele on chromosome 19. The mutation involved causes a change in the DNA nucleotides.

The allele that is affected by HC codes for a protein called LDL receptor protein.
The faulty allele often has four extra nucleotides, making a total of 2521 nucleotides.

Calculate the number of **amino acids** found in the healthy, **unaffected** protein.

Number of amino acids = ... **[2]**

14. The data in the table shows the ratio of males to females in England and Wales.

	Ratio of males to females in England and Wales
At birth	105 males : 100 females
Average over the whole population	98 males : 100 females

Describe how sex is determined in humans.

You may use a genetic diagram in your answer.

---**[2]**

15. Huntington's disease is a genetic condition. It is caused by a **dominant allele**.

Explain what is meant by the term dominant allele.

---**[2]**

16 (a). Rats are a major pest in many areas of the world. They can reduce food security and spread diseases.

Warfarin is a chemical that is used as a rat poison. It stops the correct functioning of platelets in the blood.

Explain why warfarin can be used as a rat poison.

---**[2]**

(b). In 1958, some rats were found that were resistant to warfarin. They did not die, even when fed with large amounts of the poison. Scientists found that the resistance was due to dominant allele **R**.

Two resistant rats can mate and produce non-resistant rats.

Draw a genetic diagram below to show how these non-resistant rats can be produced.

[3]

(c). When scientists studied the resistant rats they found that there were two different types.

Homozygous rats are resistant to warfarin but need to eat 20 times more vitamin K.

Heterozygous rats are resistant to warfarin but only need slightly increased amounts of vitamin K.

The scientists found that the non-resistant rats never died out completely.

Explain why.

---**[2]**

17. The data in the table shows the ratio of males to females in England and Wales.

	Ratio of males to females in England and Wales
At birth	105 males : 100 females
Average over the whole population	98 males : 100 females

In 2015 there were approximately 698 000 babies born in England and Wales.

Calculate how many of these were male.

Answer = **[2]**

18 (a). Fanconi anaemia is a genetic disorder. It results in the bone marrow being destroyed. This causes a decrease in the numbers of red blood cells, white blood cells and platelets.

Explain **two** possible symptoms of Fanconi anaemia.

1

2

[2]

(b). Table 19.1 shows normal ranges for blood components in people **without** Fanconi anaemia.

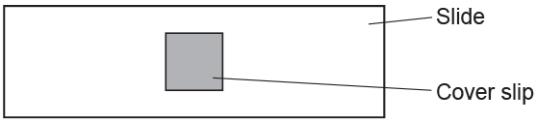
Blood component	Number per mm^3
red blood cell	$4.5 – 6.5 \times 10^6$
white blood cell	$6.0 – 16.0 \times 10^3$
platelet	$1.5 – 4.0 \times 10^5$

Table 19.1

i. Suggest why there is such a wide range of white blood cell numbers.

[2]

ii. The diagram shows a microscope slide containing blood from a patient.



The square cover slip is 10 mm wide and the thickness of the blood underneath is 0.001 mm.

Calculate the volume of blood under the cover slip.

Volume of blood = ... mm^3 **[1]**

iii. Under the cover slip are 1000 white blood cells.

Does the blood sample provide evidence that the patient has Fanconi anaemia?

Use **Table 19.1** and your answer to part **(ii)** to justify your answer.

[3]

(c). There are many different genetic disorders that can affect blood cells. Details of three of these are found in **Table 19.2**.

Name of disorder	Cause of disorder	Symptom
D-B anaemia	dominant allele	low red blood cell numbers
S-D syndrome	recessive allele	low white blood cell numbers
Fanconi anaemia	recessive allele	small numbers of all blood cells

Table 19.2

A blood smear from another patient shows that he has 3×10^6 red blood cells per mm^3 of blood. Neither of his parents have a blood disorder.

Use **Table 19.1** and **Table 19.2** to explain which blood disorder the patient could have.

Name of disorder

Explanation

[3]

19. Retinitis pigmentosa is a genetic condition that affects the eyes.

It is caused by a mutation to a gene. This mutation produces a recessive allele.

The condition causes rod cells in the retina to break down.

i. Two people who are heterozygous for retinitis pigmentosa are expecting a baby.

Draw a genetic diagram to calculate the probability that the baby will have the condition.

Use R for the normal allele and r for the allele for retinitis pigmentosa.

Answer = _____ **[3]**

ii. If the baby has retinitis pigmentosa, it will have normal colour vision but will not be able to see well in dim light.

Explain why.

_____

_____

_____

_____ **[3]**

END OF QUESTION PAPER