You and your genes – 2021/20 GCSE 21st Biology Combined Science B

1. Nov 2021/Paper_J260/01/No.8

Cystic Fibrosis is a genetic condition. It is caused by a mutation in a gene.

(a) The alleles for the mutated gene are:
F = dominant allele
f = recessive allele.

The genotype of a person who has cystic fibrosis is **ff**.

Write down the **two** possible genotypes of people that do not have cystic fibrosis.

1 .....

2 .....

[2]

(b) Complete each sentence about mutations.

Use the words.

You can use each word once, more than once, or not at all.

caught **genotype** **inherited** **phenotype**

Genetic variants arising from mutations can be .....

Most mutations have no effect on .....

[2]

(c) **(i)** Using stem cells is a possible treatment for cystic fibrosis. Stem cells can be taken from embryos or adult humans.

Describe **one** similarity and **one** difference in **function** of embryonic and adult stem cells.

Similarity .....

.....

Difference .....

.....

[2]

(ii) Give **one** advantage and **one** disadvantage of using embryonic stem cells in treating cystic fibrosis.

Advantage .....

.....

Disadvantage .....

.....

[2]

(d) **(i)** Changes in cells can lead to uncontrolled growth and cell division causing disease.

What name do we use to describe this type of disease?

..... **[1]**

(ii) Leukaemia is a type of this disease which can cause a reduced amount of haemoglobin in red blood cells.

How will this affect the function of the blood?

.....

..... **[1]**

2. Nov 2020/Paper_J260/01/No.1

(a) Put a (ring) around the correct option to complete each sentence about the structure of DNA.

DNA is a long-chain molecule, which is made from smaller molecules called **amino acids / nucleotides / sugars**.

These smaller molecules join to form a **monomer / polymer / protein**.

Two strands of DNA form a **double / single / triple** helix.

[3]

(b) **(i)** The method for using a light microscope to see a sample of cells is shown below, but is **not** in the correct order.

A A higher power objective lens is selected and used to focus the image.

B A stain is added to the cells.

C The cells are squashed into a thin layer on the slide.

D The lowest objective lens is selected and used to focus the image.

E The prepared slide is placed on the microscope stage.

Write the letters in the boxes to give the correct order for the method.

The first one has been done for you.

C				

[3]

(ii) A student calculates the length of a plant and animal cell using a light microscope.

The length of the plant cell is 100 μm.
The length of the animal cell is 25 μm.

How many times **bigger** is the plant cell compared to the animal cell?

Put a (ring) around the correct answer.

2500 **40** **4** **0.25** **[1]**

(c) Animal cells are approximately 10 times bigger than bacterial cells.

Which statement about **order of magnitude** for animal cells and bacterial cells is **true**?

Tick (✓) **one** box.

Animal cells are the **same** order of magnitude as bacterial cells. ☐

Animal cells are **ten** orders of magnitude bigger than bacterial cells. ☐

Animal cells are **two** orders of magnitude bigger than bacterial cells. ☐

Animal cells are **one** order of magnitude bigger than bacterial cells. ☐

[1]

3. Nov 2020/Paper_J260/01/No.4

(a) (i) Shorthorn cattle were kept by 18th century farmers as they produced both meat and milk.

By the 20th century, farmers used selective breeding to produce two types of shorthorn cattle:

Type **A** – cattle that produced a large quantity of good quality meat, but produced little milk.

Type **B** – cattle that produced poor quality meat, but lots of milk.

Describe how farmers used **selective breeding** to produce type **A** shorthorn cattle.

.....

.....

.....

.....

.....

..... **[3]**

(ii) In the 18th century the human population of the world was approximately 1 billion. The human population of the world now is approximately 8 billion.

Suggest **two** ways in which selective breeding has helped humans.

1. .....

.....

2. .....

.....

[2]

(b) Coat colour in cattle is controlled by genes.

A red cow and a black bull reproduce. The coat colour of the offspring is black, as shown in **Fig. 4.1**.

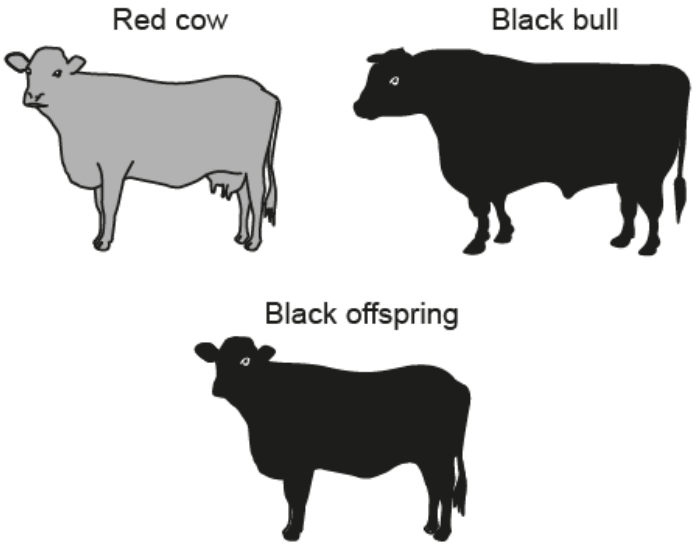


Fig. 4.1

(i) The dominant allele for coat colour is black.

Write down the genotype of a homozygous red cow and a homozygous black bull.

Use **B** to represent the black allele and **b** to represent the red allele.

Genotype of red cow .....

Genotype of black bull ..... **[1]**

(ii) When a homozygous red cow and a homozygous black bull (first generation) are mated **all** of the offspring (second generation) are black with the genotype **Bb**.

If the offspring of homozygous red cows and homozygous black bulls (second generation) breed, some of the offspring in the third generation are black **and** some are red.

Complete the Punnett square to show the expected percentage of black cattle and red cattle in the **third** generation.

Percentage of black cattle = ...%

Percentage of red cattle = ...% **[3]**

(iii) A cow has 60 chromosomes in each of its body cells.

Egg cells are produced by meiosis of body cells.

How many chromosomes are there in the egg cell of a cow?

Tick (✓) **one** box.

15 ☐

30 ☐

60 ☐

120 ☐

[1]

(c) Cows are used in conservation grazing to help prevent grassland turning into woodland. This helps maintain biodiversity.

Draw lines to connect each cow behaviour with how the behaviour helps maintain biodiversity.

Cow behaviour	How behaviour helps maintain biodiversity
Cow excretes faeces and urine, which are a form of organic fertiliser.	Allows new plants to start to grow.
Cows eat large fast-growing bracken plants.	Increases the amount of nitrates in the soil.
Grazing produces patches of bare earth.	Reduces competition, so smaller plants can grow.
Hooves tread seeds into the soil.	Seeds are less likely to be eaten by birds.

[3]

4. Nov 2021/Paper_J260/05/No.7

(a) Complete each sentence about how the genetic material of a eukaryotic cell relates to its function.

Use the words.

You can use each word once, more than once, or not at all.

allele **amino acids** **carbohydrates** **DNA** **enzymes** **FSH**

genome **genus** **lipid** **proteins**

The nucleus contains a copy of the entire genetic material. This is called the

..... . The genetic material is a molecule called ..... .

This is packaged into structures called chromosomes.

Genes in the nucleus tell the cell how to make chemicals called ..... .

Some of these chemicals are structural and some act as biological catalysts called

..... .

The structures and the catalysts allow the cell to carry out its function.

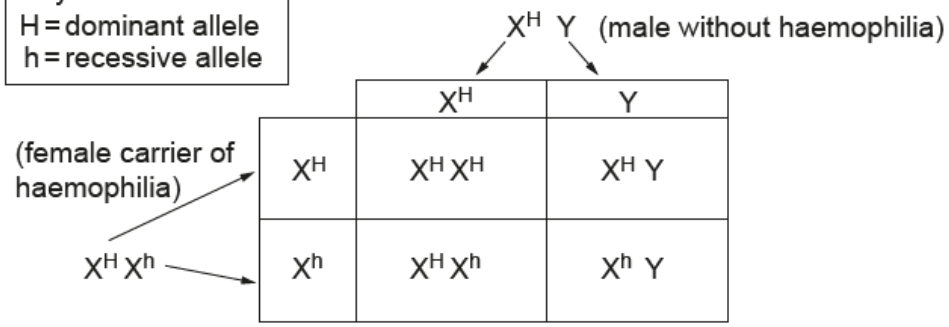
[4]

(b) Haemophilia is a rare condition that slows the process of blood clotting.

Haemophilia A is caused by a fault in a single gene. The haemophilia A gene is located on the X chromosome but not the Y chromosome.

A male without haemophilia and a female carrier of haemophilia have a child. The Punnett square shows the possible alleles of the offspring.

Key:
H = dominant allele
h = recessive allele



(i) Calculate the probabilities of having:

- a child with haemophilia .....
- a female child with haemophilia .....
- a male child with haemophilia .....

[2]

(ii) Write down an example of a homozygous and heterozygous offspring from the Punnet square.

Explain your answers.

Homozygous offspring: .....

Heterozygous offspring: .....

.....

.....

.....

.....

[4]

(iii) How is a gamete represented in the Punnett square?

Put a (ring) around the correct answer.

X^H X^HX^h X^HY XY

Give **one** reason for your answer.

.....

..... **[2]**

(iv) Haemophiliacs lack a protein which helps to make blood platelets active.

Which statement about the adaptations of platelets is correct?

Tick (✓) **one** box.

Platelets are cell fragments which trap red blood cells forming a clot. ☐

Platelets are large cells which block wounds. ☐

Platelets can stick to the edges of damaged blood vessels and start clot formation. ☐

Platelets kill pathogens which enter wounds. ☐

[1]

(c) Eye colour, like haemophilia, is only determined by genes.

Suggest **two** reasons why there are so many different eye colours.

1 .....

.....

2 .....

.....

[2]

5. Nov 2020/Paper_J260/05/No.3

(a) Chromosomes are made from DNA.

Describe the structure of DNA.

.....

.....

.....

..... **[2]**

(b) Chromosomes **cannot** be seen using a light microscope if a specimen is too thick.

Why should a **thin** layer of a specimen be placed on a microscope slide to see the chromosomes?

.....

..... **[1]**

(c) (i) A microscope slide prepared with a specimen is placed on the stage of a light microscope.

The first step is to locate the cells and focus the image.

Which combination of objective lens and focus knob should be used for the **first** step?

Tick (✓) **one** box.

Objective lens	Focus knob	
×10	Coarse	
×4	Coarse	
×10	Fine	
×4	Fine	

[1]

(ii) Which combination of objective lens and focus knob will allow the cells to be seen in the **greatest** detail?

Tick (✓) **one** box.

Objective lens	Focus knob	
×10	Coarse	
×4	Coarse	
×10	Fine	
×4	Fine	

[1]

6. Nov 2020/Paper_J260/05/No.6

(a) James makes a summary table of what he has been taught about communicable diseases.

Complete James's table to identify the pathogen for each communicable disease, and how the communicable disease is spread.

Tick (✓) **at least two** boxes in each column.

One has been done for you.

		Athlete's foot	HIV/Aids	Influenza	Malaria	*Salmonella*
Pathogen	**Bacterium**					✓
	Fungus					
	Protist					
	Virus					
Spread	**Coughing**					
	Food					✓
	Mosquito bite					
	Sexual contact					
	Surfaces					

[4]

(b) *Salmonella* bacteria can cause food poisoning.

When *Salmonella* bacteria is swallowed, it must pass through the stomach to get to the small intestine where the *Salmonella* bacteria reproduce.

Millions of other bacteria live in the small intestine.

Give **two** reasons why **large** numbers of *Salmonella* bacteria have to be swallowed for an individual to become ill.

1 .....

.....

2 .....

.....

[2]

(c) **(i)** James eats a meal containing 1×10^6 *Salmonella* bacteria.

Salmonella reproduce approximately every 30 minutes.

After four hours James starts to feel ill.

How many bacteria were present to make James ill?

Assume no bacteria died.

Number of bacteria = ... **[2]**

(ii) Suggest **two** reasons why doctors do not usually give antibiotics to people with *Salmonella*.

1 .....

.....

2 .....

.....

[2]

(d) Give **two** advantages of treating communicable diseases with medicines.

1 .....

.....

2 .....

.....

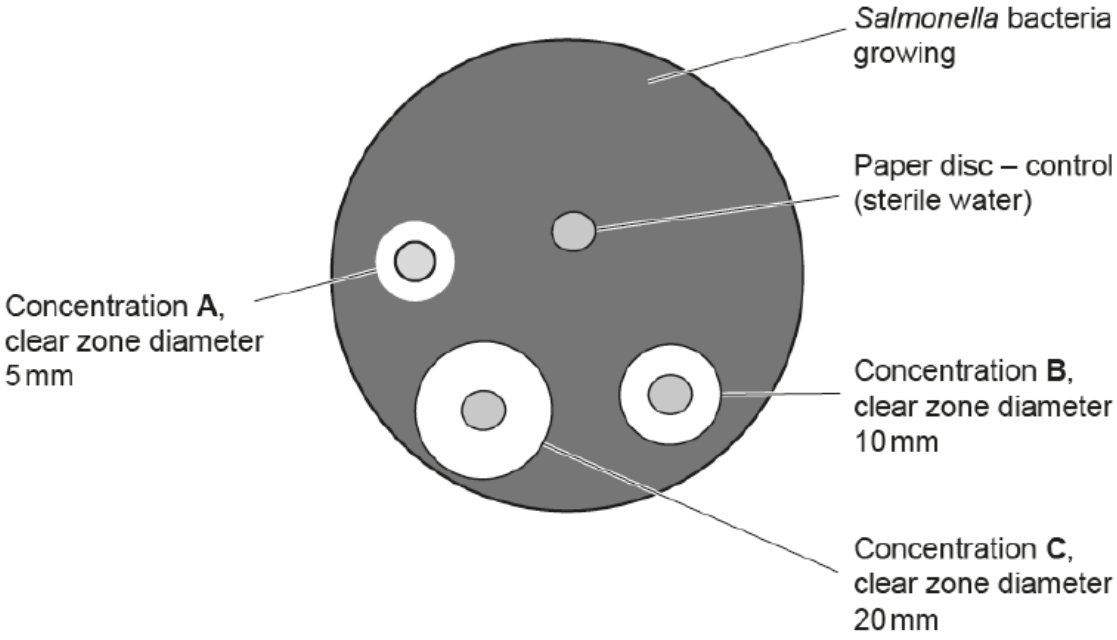
[2]

(e) (i) A researcher tested the effectiveness of **three** different concentrations of antibiotic on the growth of *Salmonella* bacteria.

Paper discs were soaked in each antibiotic and then placed on an agar plate, which was covered in the *Salmonella* bacteria. One other paper disc was soaked in sterile water as a control disc.

The clear zones are where the bacteria did not grow.

The results are shown in the diagram.



Calculate the cross-sectional area of the clear zone (including the area of the disc) for the most effective concentration of antibiotic.

Use a clear zone diameter given in the diagram.

Use the formula: πr^2

$\pi = 3.14$

Cross-sectional area = ... mm^2

[3]

(ii) Why does the scientist put a control paper disc on the agar plate?

.....

..... **[1]**

(f) Drug companies regularly develop new medicines.

Each new medicine must pass **four** stages of testing before doctors can prescribe them to patients.

Complete the table to show if each stage of testing is clinical or preclinical, and if each stage assesses safety, effectiveness, or both.

Tick (✓) **at least two** boxes in each row.

Stage	Preclinical	Clinical		Safety	Effectiveness
Animal cells					
Cultured cells					
Healthy volunteers					
Humans with the disease					

[4]

(g) The typical size of a *Salmonella* bacterium is 4 μm.

The typical size of a virus is 100 nm.

Explain why bacteria and viruses are not the same order of magnitude.

1 μm = 1000 nm

.....

.....

.....

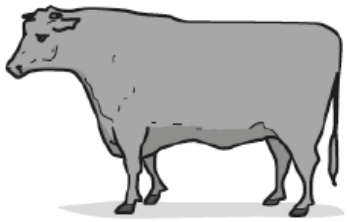
..... **[2]**

7. Nov 2020/Paper_J260/05/No.7

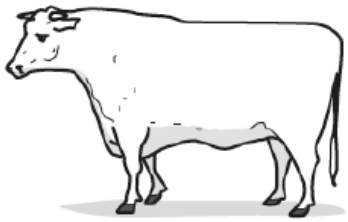
Coat colour in shorthorn cattle (bulls and cows) is controlled by two alleles, red, R, and white, W.

The alleles that control coat colour are codominant. This means that cattle with both alleles express **both** colours in their phenotype, as shown in the diagram.

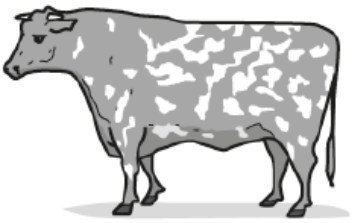
Pure red – genotype RR



Pure white – genotype WW



Roan – genotype RW



(a) When a **roan** shorthorn cow and a **roan** shorthorn bull are mated a mixture of white, red and roan offspring are produced.

The farmer counts 23 white, 28 red and 52 roan offspring, in one year.

The farmer thinks these numbers show that **roan** cattle are heterozygous.

Is the farmer correct?

Use the Punnett square to explain your answer.

.....

.....

.....

..... **[4]**

(b)* Modern shorthorn cattle have been produced by selective breeding for over 200 years.

Describe how farmers have used selective breeding to produce shorthorn cattle that produce more beef per animal, and explain how selective breeding is different to natural selection.

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.....

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.....

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.....

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.....

.....

..... **[6]**

8. Nov 2020/Paper_J260/05/No.8

(a) Complete the sentences to describe how the genome affects the phenotype in euka organisms.

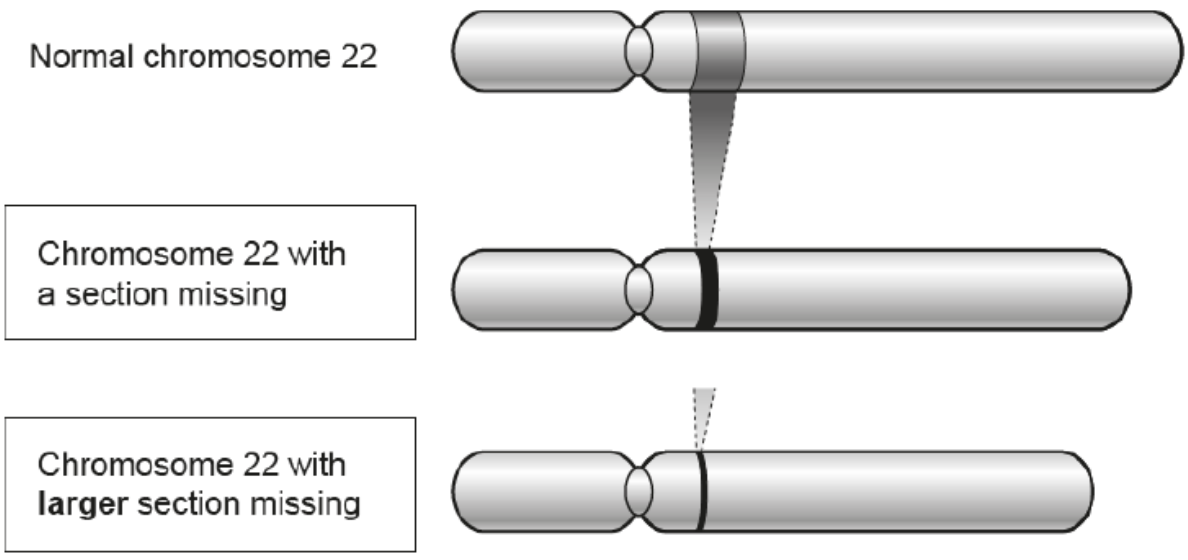
Use words from the list.

You can use each word once, more than once, or not at all.

alleles	**amino acids**	**chromosomes**	**environment**
gene	**genome**	**genotype**	**mutation**
nucleus	**phenotype**	**proteins**	**recessive**

In eukaryotic organisms the ..... is packaged into long molecules of called ..... . Genes are sections of the DNA. Each gene codes particular sequence of ..... , which are synthesised into ..... . The ..... is the characteristic that results the combination of ..... and the interaction with the .....

(b) DiGeorge syndrome is a genetic disorder caused by the deletion of a small pa chromosome 22. The size of the missing section of chromosome 22 varies, as shown i diagram.



(iv) The article on DiGeorge syndrome is from a newspaper.

Scientists report their work to other scientists in peer-reviewed journals.

Why is it important that science is reported in both **peer-reviewed journals** and **newspapers**?

Peer-reviewed journals .....

.....

Newspapers .....

..... **[2]**