2021 ASSESSMENT MATERIALS

GCSE
BIOLOGY

Biology Test 4: Inheritance, variation and evolution (Higher)

Total number of marks: 34

0 5 **Table 2** gives the classification of four plant species.

Table 2

Group	Species 1	Species 2	Species 3	Species 4
Kingdom	*Plantae*	*Plantae*	*Plantae*	*Plantae*
Phylum	*Spermatophyta*	*Spermatophyta*	*Spermatophyta*	*Spermatophyta*
Class	*Monocotyledonae*	*Dicotyledonae*	*Monocotyledonae*	*Dicotyledonae*
Order	*Poales*	*Fabales*	*Poales*	*Scrophulariales*
Family	*Cyperaceae*	*Fabaceae*	*Poaceae*	*Scrophulariaceae*
Genus	*Eriophorum*	*Pisum*	*Poa*	*Antirrhinum*
Species	*angustifolium*	*sativum*	*annua*	*majus*

0 5 . 1 Species **1** and **3** are the most closely related.

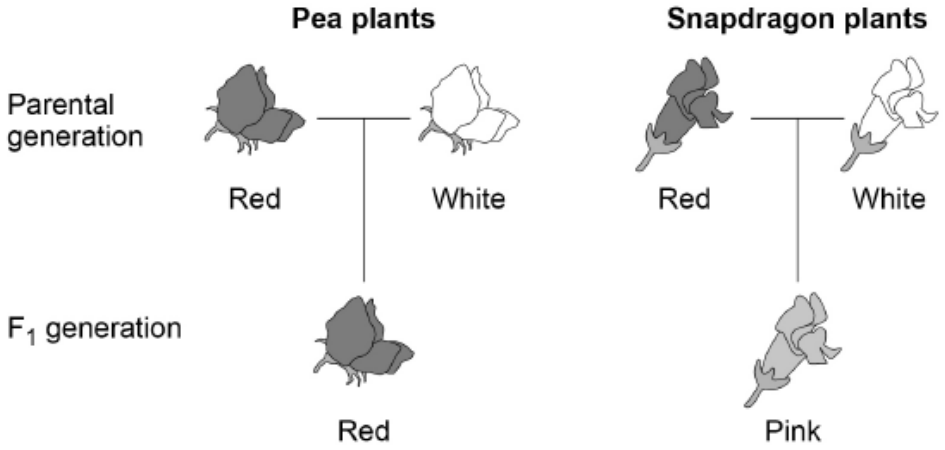
What information in **Table 2** gives evidence for this?

[1 mark]

Species 1 and 3 are in the same kingdom, phylum, class and order and only start to differ at the family stage.

Figure 6 shows the inheritance of flower colour in two species of plant.

Figure 6



- In pea plants and in snapdragon plants, flower colour is controlled by one pair of alleles.
- In **Figure 6** the parental generation plants are homozygous for flower colour.
- In heterozygous **pea** plants, the allele for red flower colour is dominant.
- In heterozygous **snapdragon** plants, the alleles for flower colour are both expressed.

Use the following symbols for alleles in your answers to Questions **05.2** to **05.4**:

Pea plants	**Snapdragon plants**
R = allele for red flowers	$\mathbf{C^R}$ = allele for red flowers
r = allele for white flowers	$\mathbf{C^W}$ = allele for white flowers

0 5 . 2 What is the genotype of the red-flowered pea plants in the F_1 generation?

Rr

[1 mark]

0 5 . 3 What is the genotype of a white-flowered snapdragon plant?

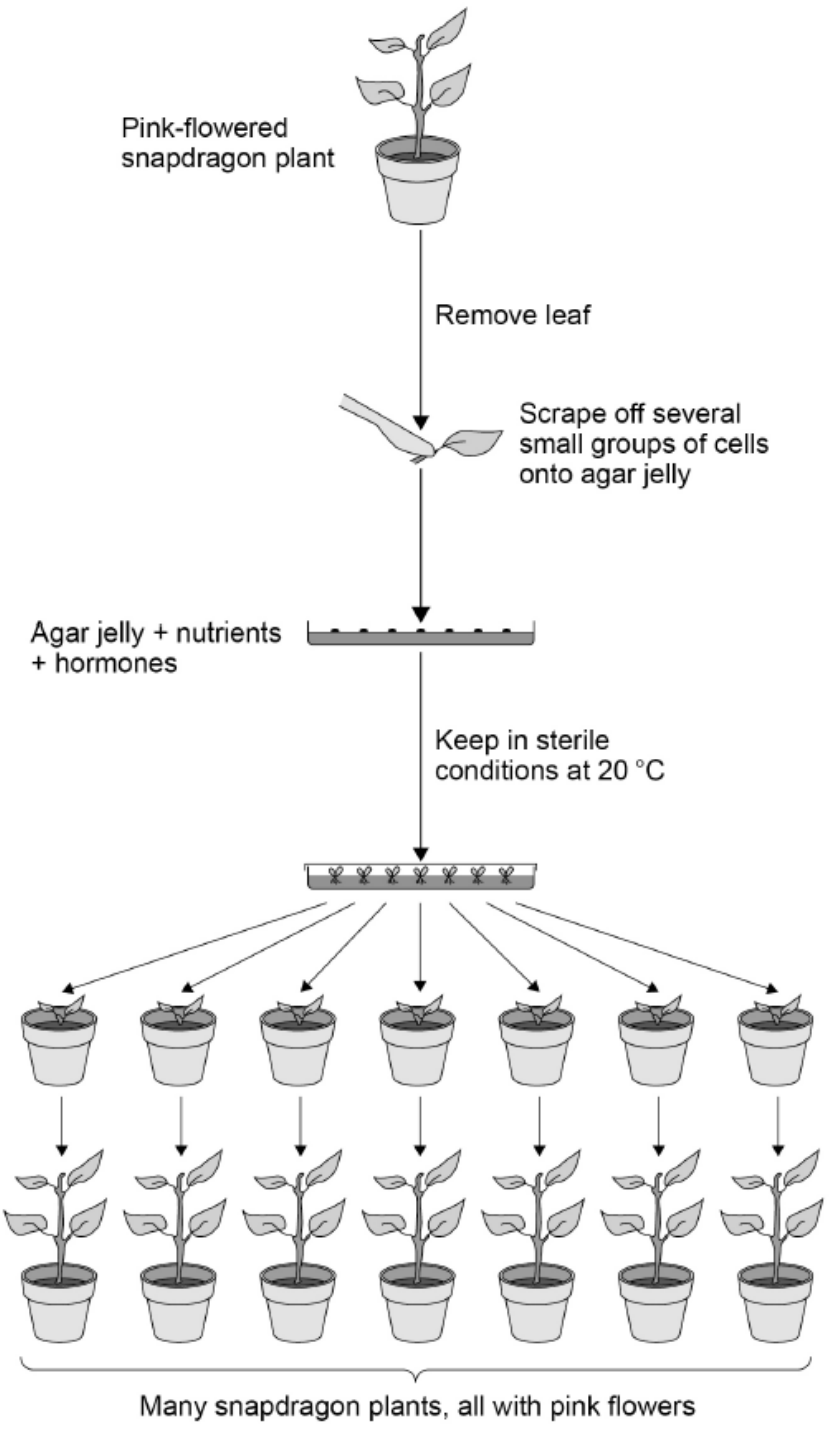
$C^W C^W$

[1 mark]

Commercially, hundreds of pink-flowered snapdragon plants can be produced from one pink-flowered plant.

Figure 7 shows a tissue culture technique used for producing many plants from one plant.

Figure 7



0 5 . 6 Give a reason for each of the following steps shown in **Figure 7**.

[5 marks]

Several groups of cells are scraped off the leaf: to increase the chances that the cells will grow into plants

Nutrients are added to the agar jelly: plants need nutrients e.g. amino acids, glucose, nitrogen, magnesium and phosphorus to grow and produce proteins and cellulose.

Hormones are added to the agar jelly: hormones such as auxin stimulate plant growth to speed up the process

The plant cells are kept in **sterile** conditions: to prevent unwanted microorganisms (e.g. pathogens) contaminating the culture and the plants catching diseases

The plant cells are kept at **20 °C**: this is the optimum temperature for plant growth.

0 5 . 7 Explain why the method shown in **Figure 7** produces **only** pink-flowered plants.

[2 marks]

all of the cells scraped off onto the agar jelly are identical and so have the exact same genetic information i.e. the genotype C^RC^W, where the alleles mix together. The plant cells divide by mitosis so there's no mixing or recombination of genetic material.

0 4 DNA is a polymer of nucleotides.

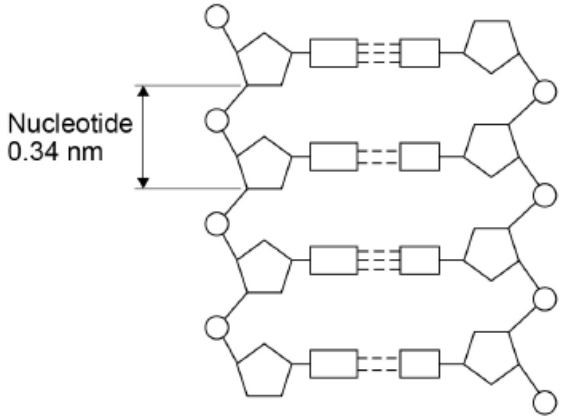
0 4 . 1 Why is DNA described as a polymer?

[1 mark]

it is made up of many nucleotide monomer units

Figure 5 shows part of a DNA molecule.

Figure 5



0 4 . 2 Describe the structure of a nucleotide.

[4 marks]

A nucleotide is made up of three parts - a pentose sugar (deoxyribose), a phosphate group and a nitrogenous base (adenine, guanine, cytosine or tyrosine). The three parts are joined together by covalent bonds formed in condensation reactions.

0 4 . 3 The length of a DNA double helix increases by 0.34 nm for every pair of nucleotides.

The total number of nucleotides in a human body cell is 1.2×10^{10}.

Calculate the total length of double helix in a human body cell.

Give your answer in metres. Use information from **Figure 5**.

[5 marks]

m → ÷100
cm → ÷10
mm → ÷1000
µm → ÷1000
nm

$(1.2 \times 10^{10}) \div 2 = 6 \times 10^{9}$

$(6 \times 10^{9}) \times 0.34 = 2.04 \times 10^{9}$ nm

nm → m = $\div 10^{9}$

$2.04 \times 10^{9} \div 10^{9} = 2.04$ m

Total length = 2.04 m

0 4 . 4 Some parts of DNA do **not** code for proteins.

Describe how non-coding parts of DNA can affect the expression of genes.

[1 mark]

Non-coding parts of DNA can switch genes on and off.

0 5 There are two types of cell division: mitosis and meiosis.

0 5 . 1 Describe **three** differences between the processes of mitosis and meiosis.

[3 marks]

1 mitosis produces 2 daughter cells whereas meiosis produces 4 daughter cells.

2 mitosis results in genetically identical cells whereas meiosis results in genetically different cells.

3 mitosis has one round of division whereas meiosis has two

0 5 . 2 Describe **one** similarity between the processes of mitosis and meiosis.

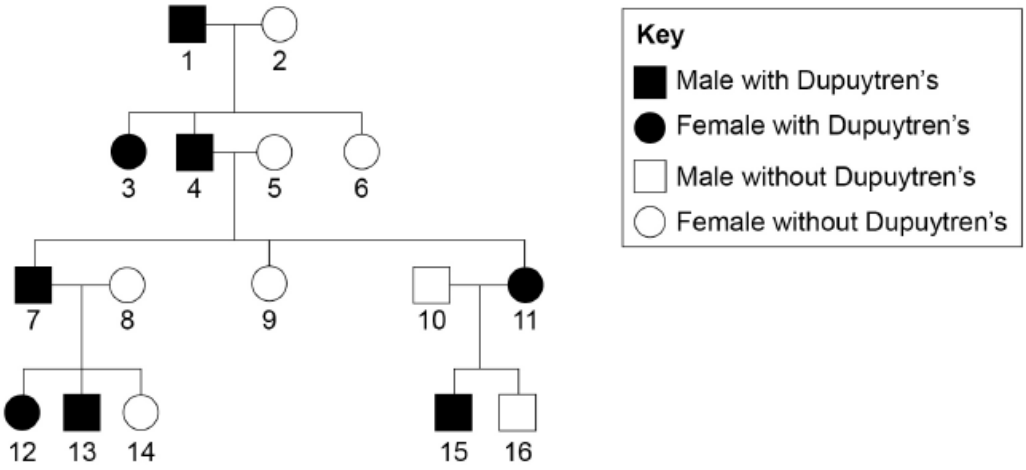
[1 mark]

they both involve the division of the cytoplasm

Dupuytren's is a disorder that affects the hands.

Figure 6 shows the inheritance of Dupuytren's in one family.

Figure 6



Dupuytren's is caused by a dominant allele in this family.

D = dominant allele

d = recessive allele

0 5 . 3 Give the genotype of person **1**.

Explain your answer.

[2 marks]

Genotype Dd

Person one must be heterozygous (or contain at least 1 dominant allele) as they have the disorder but cannot be homozygous dominant otherwise all of the offspring would have the disorder (which they don't).

0 5 . 4 Person **7** and person **8** in **Figure 6** are expecting a fourth child.

What is the probability of the child having Dupuytren's?

You should:

- draw a Punnett square diagram
- identify which offspring have Dupuytren's

[5 marks]

		Person 7	
		D	d
Person 8	d	Dd	dd
	d	Dd	dd

Dd = affected = 50%

dd = unaffected = 50%

Probability = 50%

0 5 . 5 Explain how **Figure 6** shows the allele for Dupuytren's is **not** on the Y chromosome.

[2 marks]

Male 10 does not have the disorder and so doesn't carry the dominant allele, but his child, child 15, does have the disorder, meaning the momer must have passed on the dominant allele and females do not carry the Y chromosome.