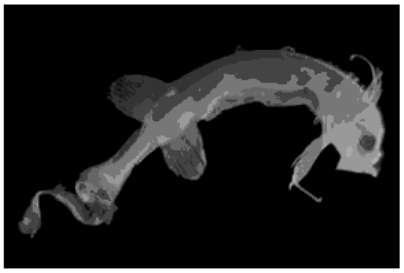
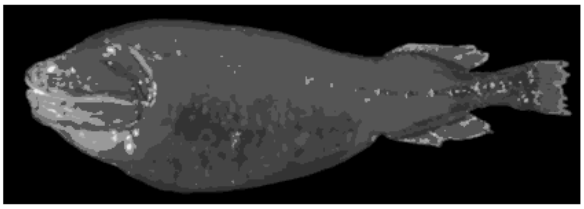
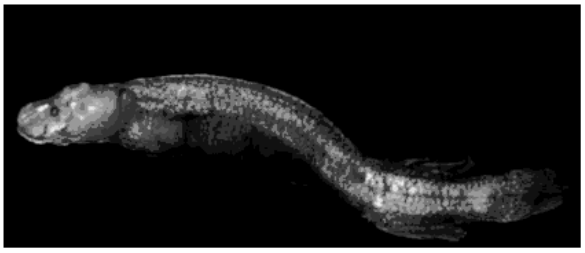
Extended Response (Component 2): Eduqas A Level Biology Exam Questions

11 questions · 99 marks · about 119 minutes. Answer in the spaces, then check the mark schemes at the end.

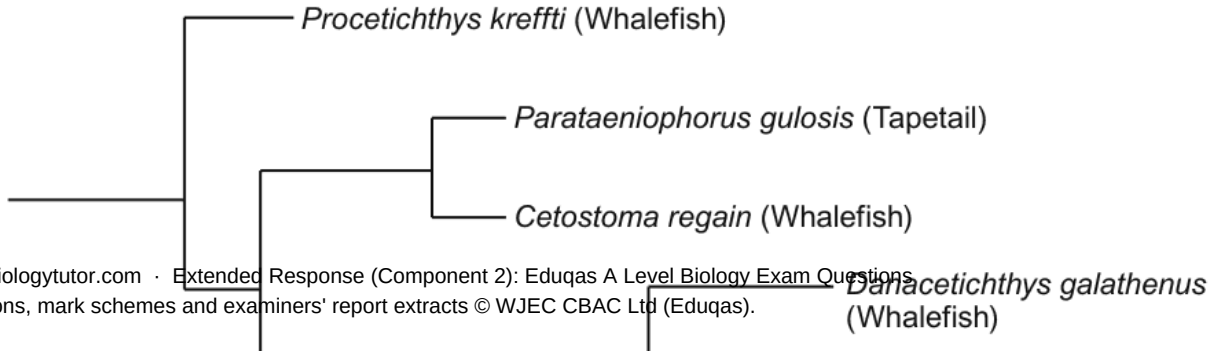
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7. The deep regions of the oceans (1000 – 4000 m) are nutrient-poor habitats. In order to survive, the fish that live there have evolved remarkable morphological and life-cycle strategies. The larvae of many deep-sea species develop in the nutrient-rich surface waters (0 – 200 m). Very few specimens of these fish have been caught, which makes them difficult to classify. This illustrates the tentative nature of classification. The table below provides information on specimens of three types of deep-sea fish.

Type of Fish	Example specimen	Evidence
Tapetail		**Depth Caught:** 0 – 200 m **Number caught:** 120 **Size:** 5 – 56 mm **Age:** juvenile **Gender:** unknown **Feeding:** large numbers of animal plankton; mouth is upturned, jaws are small
Whalefish		**Depth Caught:** below 1000 m **Number caught:** 600 **Size:** 26 – 408 mm **Age:** adult **Gender:** all female **Feeding:** eat large prey; jaws are long and can open very wide to swallow prey whole
Bignose Fish		**Depth Caught:** below 1000 m **Number caught:** 65 **Size:** 34 – 68 mm **Age:** adult **Gender:** all male **Feeding:** do not feed; have a very large liver which acts as a store of energy and nutrients

Analysis of ribosomal RNA from examples which have been caught has produced the following phylogenetic tree.

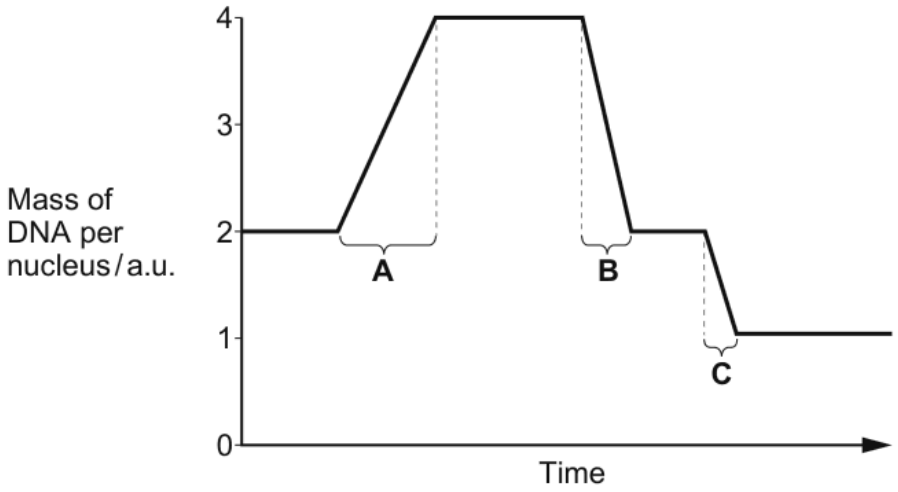
Phylogenetic evidence



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6. **Image 6.1** shows the changes which take place in the mass of DNA within the nucleus of a single cell during one type of cell division.

Image 6.1



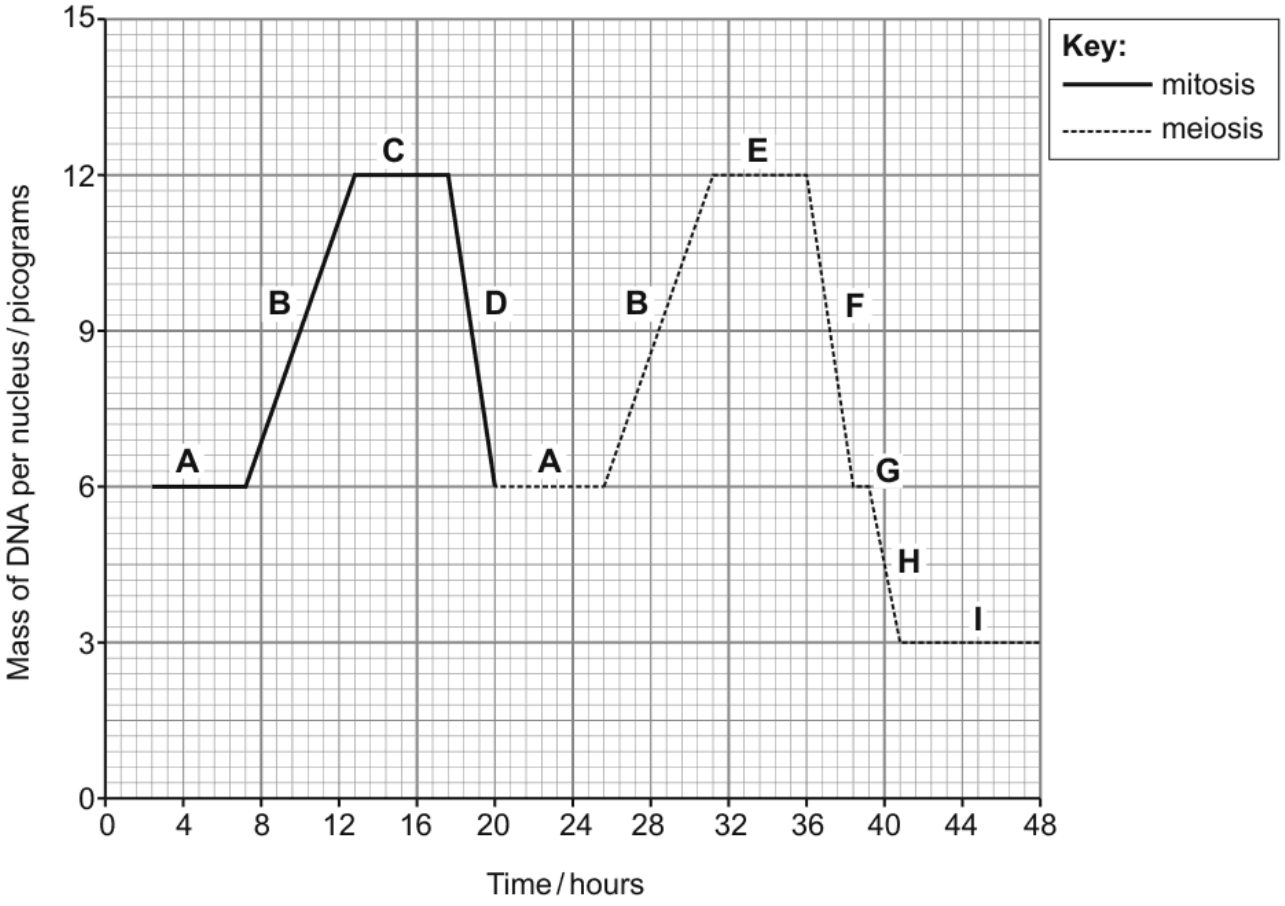
Identify, with an explanation, the type of cell division taking place.
Describe the changes in the mass of DNA that take place in stages **A**, **B** and **C**.
Explain the significance of this type of cell division to the survival of the species. [9 QER]

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5. Cells within the human male testes produce sperm through the processes of mitosis and meiosis.

Graph 5 shows the mass of DNA found in the nucleus of one of these cells as it undergoes mitosis and then meiosis to form a single sperm cell. The letters (**A–I**) indicate stages before and during cell division by mitosis and meiosis.

Graph 5

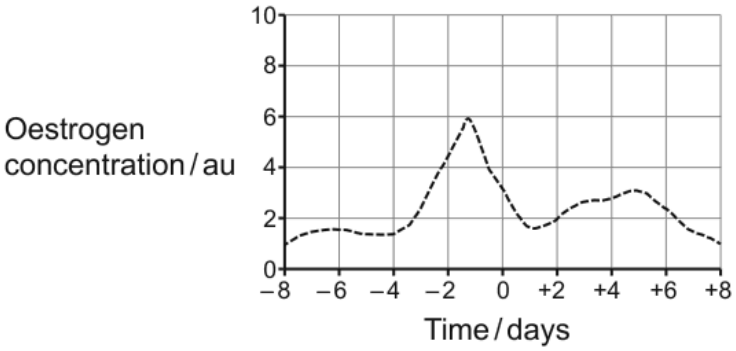


Use the information in **Graph 5** and your knowledge of cell division to explain the changes in the DNA mass of the nucleus for both mitosis and meiosis. Explain how meiosis increases the genetic variation of offspring. [9 QER]

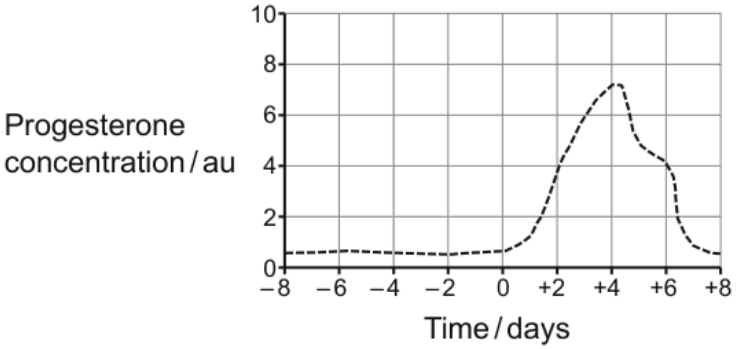
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8. **Graphs 8.1–8.4** show the concentrations of four hormones found in the plasma of a mature ewe (female sheep). The hormone concentrations are plotted over a time period of 16 days. The days are numbered either side of the peak concentration of LH secretion.

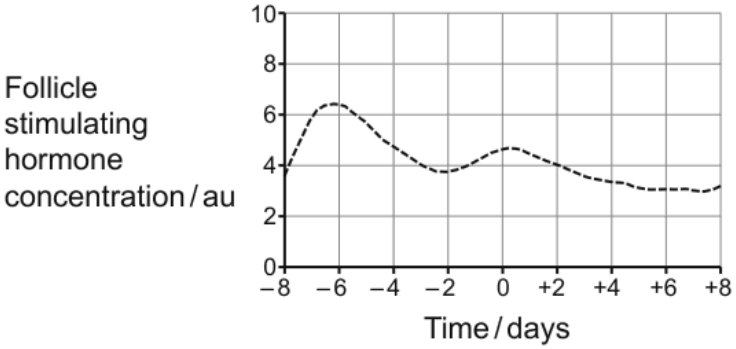
Graph 8.1



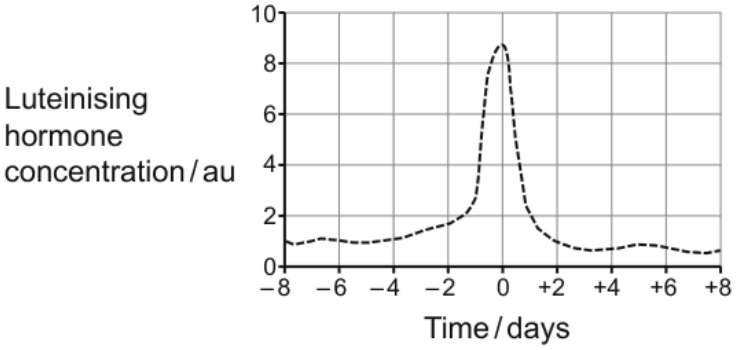
Graph 8.2



Graph 8.3



Graph 8.4



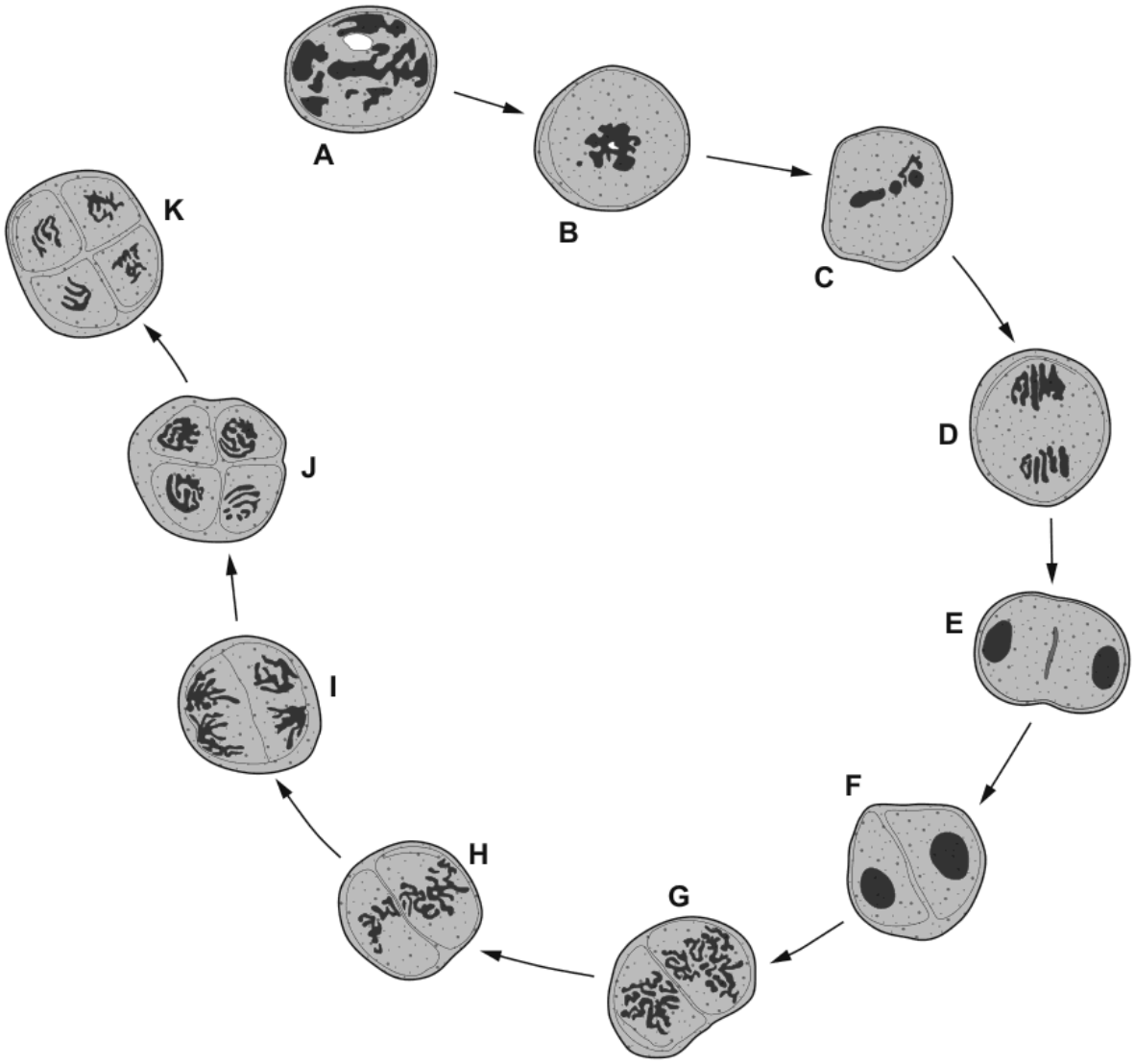
If sheep are given progesterone for eight days and then the treatment is stopped, they will ovulate eight to twelve days later. In this way, the oestrus cycle of a flock of sheep can be synchronised.

Use **Graphs 8.1**, **8.2**, **8.3** and **8.4** to explain the role of oestrogen in the control of the timing of ovulation in the sheep.

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7. Pollen grain formation in flowering plants involves both mitosis and meiosis.
Image 7 shows the stages of meiosis in the formation of pollen grains in an anther of a species of lily (*Lilium sp.*).

Image 7

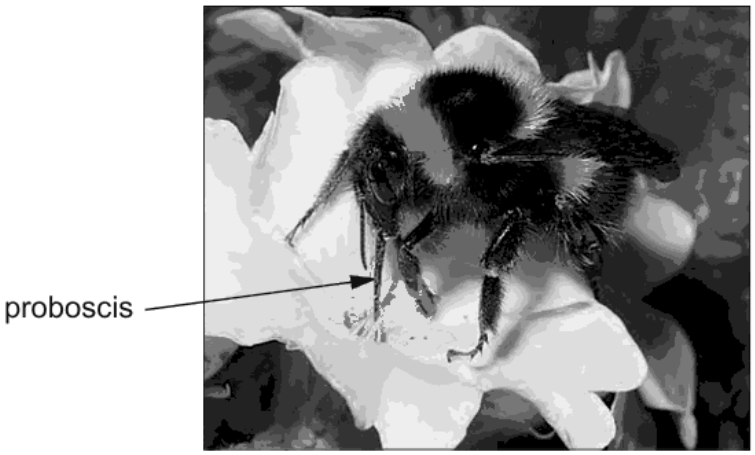


Describe the role of mitosis and meiosis in the development of fully mature pollen grains in an anther.
Describe the events taking place at stages **B** and **C** in **Image 7**.
Explain the importance of meiosis to this plant species. [9 QER]

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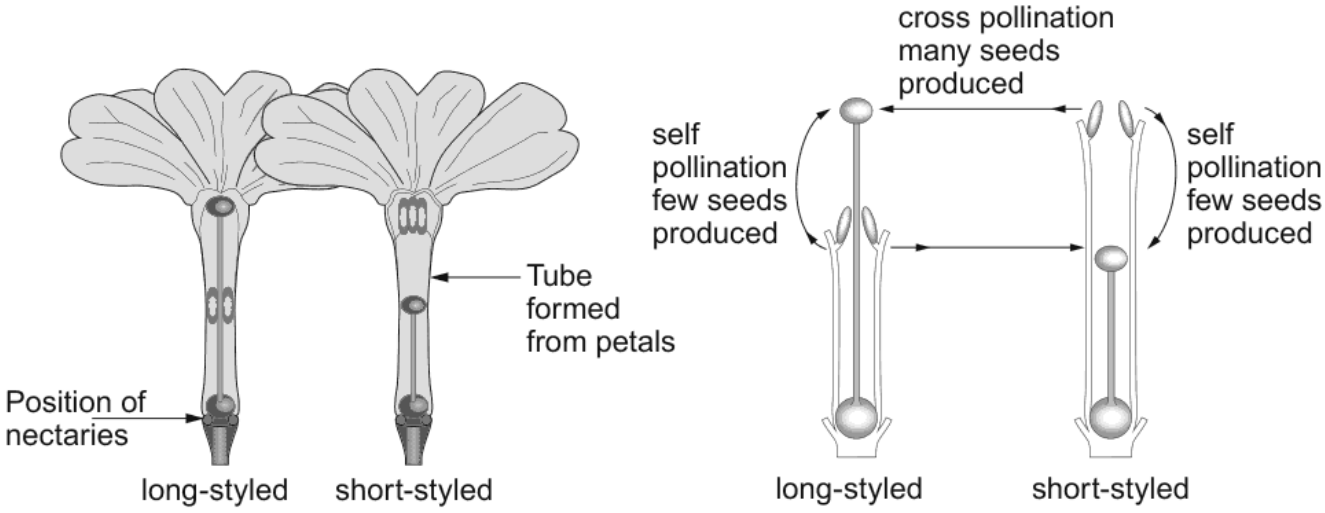
8. Figure 8.1 shows a bumble bee collecting nectar from a flower of *Primula vulgaris*.

Figure 8.1



There are two different forms of these flowers. Each plant only has one of the two forms.

Figure 8.2



Apart from the length of the style, there are other differences between the two types:

- the stigma is rougher in the long-styled flowers;
- the pollen-grains are smaller in the long-styled flowers;
- the pollen-grains of the long-styled flowers are more triangular.

Experiments have been carried out where some flowers have been protected from insects (to force self-pollination) and others were allowed to cross pollinate. The number of viable seeds produced was counted as a measure of fertility. The structure of the flowers and the results are shown above.

Describe the structural differences visible between the drawings of the long-styled and short-styled flowers in Figure 8.2. Explain how the anatomy of these flowers promotes cross-pollination. Use the observations about the stigma and pollen to explain why self-pollination produces fewer seeds than cross-pollination. [9 QER]

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7. The dandelion *(Taraxacum officinale)* is a common plant in the UK. It is classified as a weed as it can spread easily and quickly and is very difficult to eradicate.

The passage below describes the reproductive strategies of the dandelion.

1 The flowers are bright yellow and open fully during the day and close at night. They contain both male and female reproductive organs. In each flowerhead, the stigmas mature before the anthers and degenerate before the anthers begin to produce pollen. However, in spring and autumn when insect numbers are low, the anthers mature
5 earlier, the filaments grow longer and push the anthers against the stigma.

Each dandelion flowerhead produces between 125 and 300 seeds and this can happen from March to November. Once formed, the lightweight seeds are attached to white fibres and are easily detached by the wind. They can be carried for long distances before landing.

10 If conditions are suitable, the seeds germinate and quickly grow a taproot that penetrates deep into the soil. Dandelions can regrow the whole plant from the taproot; as little as 2 mm^3 of taproot tissue is needed to form a new plant.

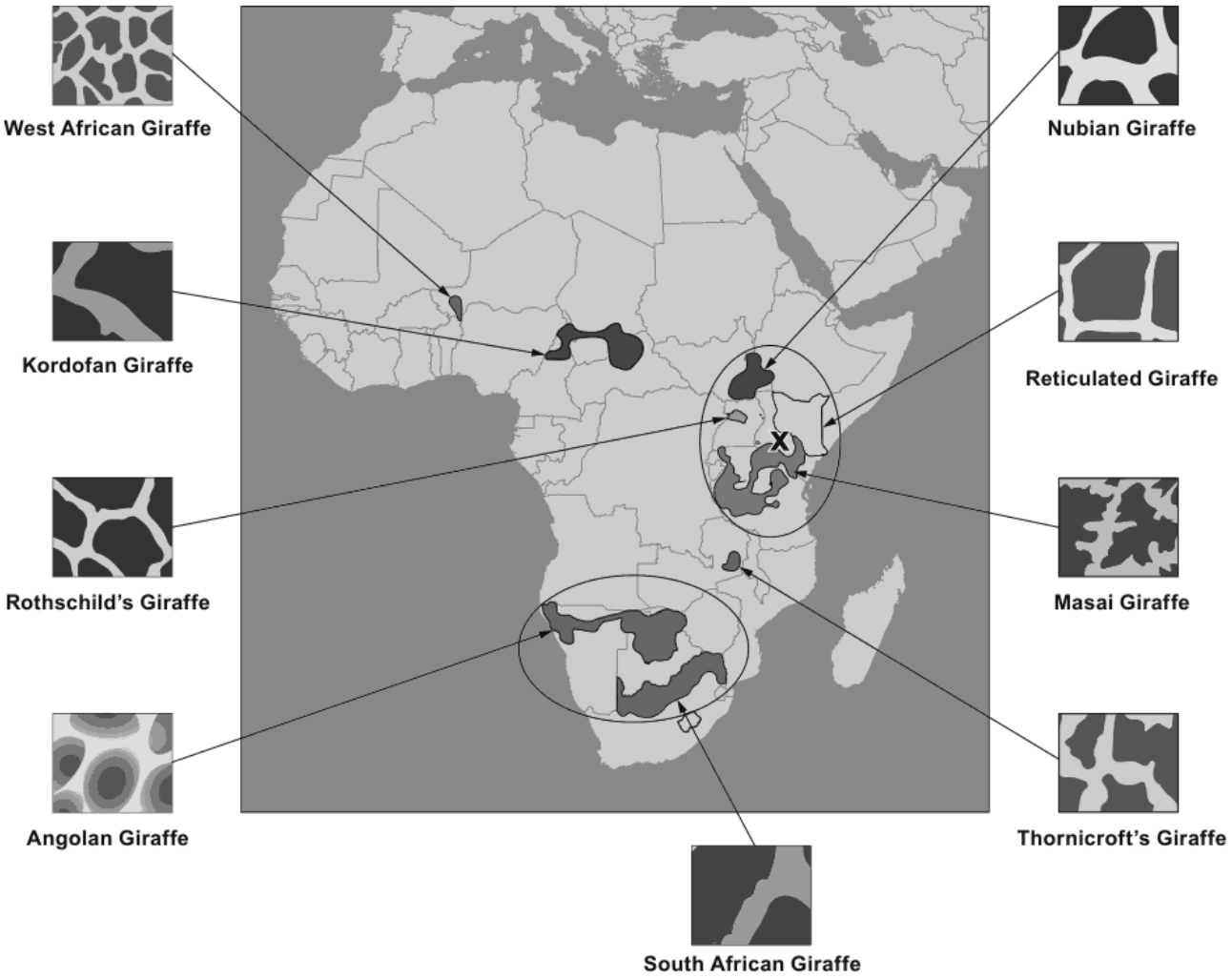
Using your knowledge of plant reproduction and the information from the passage above, identify the types of pollination found in dandelions and explain the advantages of each. Describe and explain how the flowers are adapted for each type of pollination. Identify and explain the other reproductive strategies that make dandelions such effective weeds. [9 QER]

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7. Today, there are an estimated 1 500 giraffes held in captivity and approximately 90 000 in the wild. There are several different coat patterns that are similar to each other but are different in colouration and size of coloured areas in different populations. Giraffes live in a range of habitats ranging from sandy scrubland to dense forest.

Currently, only a single species of giraffe, *G. camelopardalis*, is recognised, but studies suggest that there may be up to nine species of giraffe. **Image 7.1** shows the current distribution of the proposed different species of giraffe together with their typical coat patterns.

Image 7.1



Giraffe populations are found in many parts of Africa. Some are now separated from other populations while others co-exist in the same parts of the continent (indicated by the oval shapes).

It has been suggested that different coat patterns evolved from a single ancestral form found in East Africa (marked **X** on the map). A number of different factors are believed to be responsible for the formation of the proposed different species of giraffe during the last million years.

Use the information provided and your own knowledge to explain how evolution could have resulted in the appearance of different coat patterns. Explain how **two** different forms of speciation may have resulted in the development of different species of this animal. [9 QER]

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8. Read the passage below and then answer the questions that follow.

The purpose of the original Human Genome Project was to improve our knowledge and understanding of genetic disorders. The original study was based on the analysis of DNA from a small number of anonymous donors from Europe.

Since then, 100 K projects have been set up in 10 areas around the world, as shown in **image 8.1**. These projects aim to sequence the genomes of 100 000 people with rare genetic disease or cancers.

Image 8.1



Projects have also been set up to sequence the genomes of the mosquito, *Anopheles gambiae* and the *Plasmodium* parasite that it transmits. Malaria is responsible for over a million deaths each year.

Describe how the findings of the Human Genome Project could improve the treatment of human disease and suggest why the findings of the original project may be of limited use.

Explain why the 100 K projects will eventually provide more valuable information and suggest why more projects need to be set up to improve treatment of humans on a worldwide basis.

Suggest why some countries may have invested more money into sequencing the genomes of both the malaria parasite and its vector rather than funding 100 K projects. [9 QER]

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Question 10 · A level Component 2 · June 2018 · Q6 · 9 marks

6. In April 2003 one of the most significant scientific breakthroughs of modern times was announced. After years of painstaking research carried out by thousands of dedicated scientists across the world, the complete genetic code of a human being – their genome – could now be made freely available on-line.

The Human Genome Project, as this work was known, was the largest international collaboration ever undertaken in biology with British scientists leading the global race to read the human genome using a technique called sequencing.

To bring the predicted benefits of genomics to NHS patients the 100 000 Genomes Project was launched in late 2012 and by 2017 had sequenced the genomes of 100 000 NHS patients. The project focussed on patients with a rare disease and their families, and on patients with cancer.

Scenario:

It is 2025 and Sharon has a painful skin infection that she just can't get rid of. Her doctor would like to prescribe an antibiotic called phenyloxacillin, since it is especially effective against the bacteria *(Staphylococcus aureus)* that are causing the infection. However, her doctor knows that in a small number of cases phenyloxacillin can cause serious liver damage so suggests a genome test. She tells Sharon that there is a law giving people the right not to disclose the results of genetic tests to insurers.

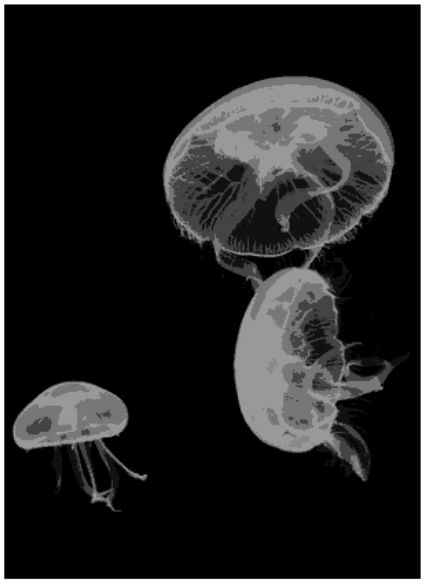
Explain what is meant by 'sequencing' the human genome and describe the type of data that might be made available on-line.
Explain how the extra information provided by the '100 000 Genomes Project' might be used in medicine, and describe how the scenario above illustrates one possible beneficial application and an ethical dilemma of genome sequencing. [9 QER]

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7. Bioluminescence is the natural ability to produce light through a chemical reaction. This property is possessed by certain marine animals, such as jellyfish. *Aequorea victoria* is a jellyfish that produces a protein called green fluorescent protein (GFP) that confers the ability to glow. These are shown in **Image 7.1A**.

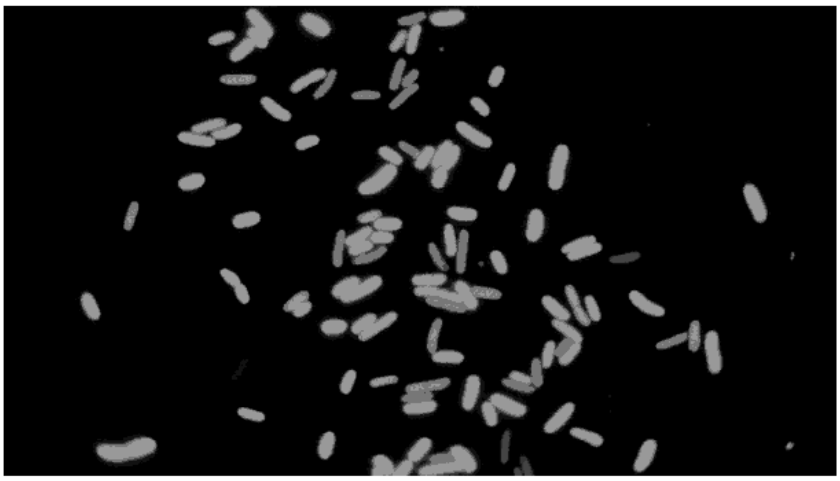
The gene for GFP was taken from the jellyfish and introduced into different organisms leading to the development of genetically engineered glow-in-the-dark organisms such as bacteria. These are shown in **Image 7.1B**.

Image 7.1A



Jellyfish

Image 7.1B



Bacteria

Bacteria can be genetically modified to contain functioning human genes. Previously, genetic modification of bacteria has relied on the introduction of antibiotic resistance marker genes. These identify genetically modified cells that contain a functioning human gene. The use of the GFP gene has been trialled as an alternative marker gene in human gene therapy.

Describe how scientists can use mRNA from the jellyfish to synthesise a DNA molecule coding for GFP.

Explain how this method overcomes the problems of removing the GFP gene directly from the jellyfish chromosomes.

Suggest how the GFP marker could be used in gene therapy and why it is more useful than the antibiotic resistance marker. [9 QER]

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Mark schemes

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7	**Indicative content** **Use of table** • **Feeding evidence:** supports hypothesis 1, • {feeding / jaw} is different in each fish type suggesting three separate families/ if same family would expect same {feeding / jaw}. • **Gender evidence:** supports hypothesis 2, • the whalefish are all females, the bignoses are all males, the tapetails are all immature. • **Depth evidence** supports hypothesis 2 • the tapetails are all caught above 200 m whalefish and bignoses are caught below 1000m **Use of tree** • **Phylogenetic tree:** supports hypothesis 2, • the ends of the branches of the phylogenetic tree have different types of fish grouped together/ Whalefish are on more than one branch - E.g. Tapetails and whalefish at the end of the same branch in the top half of the tree. - E.g. Bignose and whalefish at the end of the same branch in the lower half. • If they belonged to 3 separate families the ends of the branches would have only whalefish, bignoses or tapetails together at the ends of the last branch. **Conclusion and future change:** • Hypothesis 2 more likely because it is supported by both table and phylogenetic {evidence/ tree}. • The feeding evidence does not rule out hypothesis 2 because different developmental stages could have different feeding mechanism. It might change in future if a larger number of specimens became available.	2			2		
	7-9 marks Indicative content of this level must include Detailed evidence from table Detailed evidence from tree Conclusion *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately* **4-6 marks** Indicative content of this level Any two from Evidence from table Evidence from tree Conclusion *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.* **1-3 marks** Indicative content Either basic evidence from table Or basic evidence from tree						

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Question 2 · AS Component 1 · Autumn 2021 · Q6 · 9 marks

6	• Meiosis • Mass of DNA in nucleus has halved • There are two stages of division • A: DNA is replicated during interphase • Mass of DNA doubles • B: First meiotic division. • Mass of DNA halved • Homologues separate • C: Second meiotic division • DNA mass halves again • Chromatids separate • Daughter cells are haploid • Genetic variation • Crossing over during prophase I • Random assortment (of homologues) during metaphase I • Random assortment (of non-identical sister chromatids) in metaphase II • Variation promotes species survival	6	2	1	9	0	0
	7-9 marks Indicative content of this level is detailed content from all three sections To award 9 marks a comment linking relevant data from graph to the process of meiosis is required. *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.* **4-6 marks** Indicative content of this level is detail from any two sections or less detail from three. *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.* **1-3 marks** Indicative content of this level is any statement from the indicative content. *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.* **0 marks** *The candidate does not make any attempt or give a relevant answer worthy of credit.*								

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Question 3 · AS Component 1 · June 2023 · Q5 · 9 marks

5	Changes in DNA content: Mitosis • {Doubles due to replication / increases to 12pg} during {B/ interphase} • Returns to normal (6pg) at D when chromatids separated • Genetically identical / clones produced • Daughter cells have same mass of DNA as initial cells Meiosis • Doubles due to replication (12pg during B) • Homologous chromosomes are separated at {F/ anaphase I} • Drops to 6pg/DNA mass is half of the original mass • Chromatids are separated at {G /anaphase II} • Drops to 3pg/ Halves again • Original cell is diploid and daughter cells produced are haploid Significance of meiosis • Chromosome number remains constant in each generation • Genetic variation introduced • Independent assortment • Crossing over in prophase I • Allows survival in a changing environment	5 4	9
	7-9 marks Indicative content of this level is detailed statements from all three areas of the indicative content. *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.* **4-6 marks** Indicative content of this level is detailed statements from two areas of the indicative content. *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.* **1-3 marks** Indicative content of this level is any correct statement from the indicative content. *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.* **0 marks** *The candidate does not make any attempt or give a relevant answer worthy of credit.*		

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8	**Indicative content** OESTROGEN A1 Developing follicles secrete oestrogen; A2 {Increased/high levels} of oestrogen A3 (Oestrogen) {inhibits/ reduces} FSH (release)/ ref to negative feedback on FSH; A4 (Oestrogen) stimulates LH (release)/ ref to positive feedback on LH A5 LH causes ovulation. PROGESTERONE B1 When progesterone is stopped, {FSH/LH} inhibition is removed /progesterone inhibits {FSH/LH} B2 FSH released/ increased B3 so follicles {develop/ mature} B4 LH released B5 So ovulation occurs CONTROL and PROBLEMS C1 know when it is best to introduce the male/ artificially inseminate/ to increase chance of fertilisation C2 To increase the stock of lambs/ more meat C3 lambs all born around the same time/ ready for market at the same time C4 Hormone may be present in meat (that may be eaten by Humans) C5 Hormones may be toxic / have an unknown effect in humans/ may affect human female menstrual cycle/ alter fertility C6 Stress/ injury to sheep during injection	4	3	2	9
	7-9 marks Indicative content of this level is detailed statements from all three areas of the indicative content. *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.* **4-6 marks** Indicative content of this level is detailed statements from two areas of the indicative content. *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.* **1-3 marks** Indicative content of this level is any correct statement from the indicative content. *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer*				

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7

Pollen formation

A1 Mitosis to produce pollen mother cells
Accept microspores mother cells / microsporocytes

A2 (Followed by) meiosis to produce a {tetrad / four {cells / grains / gametes / microspores}}

A3 That are haploid

A4 then {mitotic divisions of the / mitosis of the} nucleus

A5 to produce {two male nuclei / generative nucleus}

A6 (and) a (pollen) tube nucleus

Stages This must be clearly referring to B and C

B1 (B) Condensation of {chromosomes / chromatin}

B2 (B) (Formation of) bivalents / pairing of homologous chromosomes

B3 (B/C) {Chiasmata / chiasma formation / crossing over}

B4 (C) {bivalents / homologous pairs / chromosomes} arranged across {equator / or description of}

B5 (C) spindle fibres attach to centromeres

B6 (C) {Independent assortment / random assortment / or description of}

The importance of meiosis

C1 (Meiosis is important because it) produces genetically {different / variation in}

C2 cells / gametes / offspring / plants / grains
can only be awarded with C1

C3 Any ref to {evolution/ natural selection/ selective advantage}

C4 Comment on advantage in event of {environmental change / or example e.g. new disease}

C5 Maintains chromosome number (down generations) / haploid cells fertilise giving diploid cells

7-9 marks

Indicative content of this level is detailed statements from all three areas of the indicative content.

The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.

4-6 marks

Indicative content of this level is detailed statements from two areas of the indicative content or less detail from three

The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and

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8

Indicative content

Differences

- Long-styled has stigma protruding from corolla/petal tube/ flower + Short-styled have stigma near the middle of the corolla/petal tube/ flower
- Long-styled has anthers near the middle of the corolla/petal tube/ flower + Short-styled have anthers near the mouth of corolla/petal tube/ flower
- Long-styled has stigma above anthers + Short-styled form has anthers above stigma

Promoting Cross pollination

- In long-styled flowers stigma above anthers so pollen less likely to fall onto stigma
- Ref to position of nectaries at base of flower
- Ref to relative positions of anthers and stigmas for transfer of pollen
- Position of pollen on bee/ proboscis with regard to transfer

Fertility experiments

- More seeds with cross pollination because more pollen germinates
- pollen might not germinate on own stigma
- Reference to {size/ texture} of {stigma / pollen}
- so pollen might not attach to own stigma/ be compatible

7-9 marks

Indicative content of this level is…
Detailed account from all three sections

The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.

4-6 marks

Indicative content of this level is…
Detail from two sections/ some detail from three sections

The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.

1-3 marks

Indicative content of this level is…
Any clear point from any section

The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.

0 marks

The candidate does not make any attempt or give a relevant answer

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Question 7 · A level Component 2 · June 2022 · Q7 · 9 marks

7 **Pollination types + Advantages**

- Insect + cross + self
- (Insect) to increase chance of pollination
- (Cross) to increase genetic variation
- (Self) to ensure pollination if no insects available / preserves alleles

Adaptations for pollination types

Types of Pollination	Adaptations
(insect-pollinated)	• {Brightly coloured/ owtte} to attract insects • Open during day more insects around
(cross-pollinated)	• Stigmas mature before anthers so can't be self-pollinated at that time • Anthers mature after stigma so only produce pollen after stigmas have degenerated
(self-pollinated)	• (Low insect levels) anthers mature earlier • Anthers pushed against stigma {for pollination/ transfer of pollen}

Other reproductive strategies

- Seeds produced over long period of time / can colonise most of the year
- Large numbers of seeds increased chance of survival
- Germinate quickly / established quickly from seeds
- Wind dispersal + colonise other habitats/ be dispersed over greater distances
- {Lightweight / feathery} seeds + carried by the wind/ stay in air for longer
- Regrow from taproot (as well as seeds)

			7	2	9		

7-9 marks
Indicative content of this level is… detailed description of all three areas of indicative content
The candidate constructs an articulate, integrated account, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.

4-6 marks
Indicative content of this level is… description of at least two areas of indicative content or less detail of three
The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately

1-3 marks
Indicative content of this level is… description of at least one area of indicative content
The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.

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Question 8 · A level Component 2 · Autumn 2020 · Q7 · 9 marks

Indicative content

natural selection

- coat colour variation
- due to mutation
- different patterns give competitive advantage in different habitats
- providing camouflage/ survival of the fittest
- those best adapted survived and reproduced passing advantageous allele(s) to offspring

sympatric speciation

- animals living in same area diverged through reproductive isolation / sympatric speciation, eg., ref to those in areas marked with ovals or named species from those areas
- suitable example of reproductive isolation eg., behaviour / morphological
- more likely to breed with animals of same coat colour
- genetic drift and speciation

allopatric speciation

- geographical / physical isolation of some groups of giraffe diverged / allopatric speciation eg., West African Giraffe, Thornicroft's Giraffe
- gene pool not representative of whole gene pool / founder effect
- alleles that did not confer advantage lost from gene pool
- different environmental / selection pressures favoured survival of those with advantageous alleles
- genetic drift and speciation

9 | 9

7-9 marks

Identifies and explains all THREE of

- natural selection as the cause of the evolution of coat patterns;
- sympatric speciation;
- allopatric speciation.

with no irrelevancies or errors

The candidate constructs an articulate, integrated account, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.

4-6 marks

Identifies and explains TWO of

- natural selection as the cause of the evolution of coat patterns;
- sympatric speciation;
- allopatric speciation

The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.

1-3 marks

Identifies and explains ONE of

- natural selection as the cause of the evolution of coat patterns;
- sympatric speciation;
- allopatric speciation.

The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.

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Question 9 · A level Component 2 · Autumn 2021 · Q8 · 9 marks

8	**HUMAN GENOME PROJECT** • Identify genetic cause of disease / more accurate diagnosis • better prediction of the effect of drugs / improved design of drugs /develop new and improved treatments for disease. • sample size too small • all European origin / do not represent different ethnicities • anonymous so don't know details of health of individuals / cannot relate findings to {genetic disorders / cancer} **100 K PROJECTS** • people in sample selected based on their genetic disorders / cancer status • large samples so can identify variation • more ethnicities / not just Europe • include male / female / different ages • projects do not include eg., Africa, South America, Indian sub-continent • so not wholly representative of whole human population **MALARIA / ANOPHELES** • malaria still killing 1 000 000+ people per year/ • more people dying from malaria than genetic conditions • need to improve drug / insecticide development to control malaria more effectively • need to sequence genomes to find ways to combat high mutation rate in *Plasmodium* and *Anopheles*		4 5 9	
	7-9 marks Detailed coverage of all three areas with no irrelevancies or errors *The candidate constructs an articulate, integrated account, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.* **4-6 marks** Detailed coverage of two areas or some coverage of three areas *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately* **1-3 marks** Detailed coverage of any one area; basic coverage of two or three areas *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.*			

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6	**Indicative content** **Sequence and data:** • the order of nucleotides/bases in the DNA • Sanger sequencing • descriptions of methods used • data/information would give {loci/sequences} of individual genes • coding for specific amino acid/proteins • descriptions of introns and exons (correct context) **100 000 Genomes Project:** • Next Generation Sequencing/NGS • locate genes responsible for {rare genetic disorder/cancers}/mutated sequences • by comparing genomes of sufferers with {normal genome/large number of individuals} • Predisposition to disease/{diagnosis/ understanding causes} of diseases • developing treatments/gene therapy. • Use in prenatal diagnosis **Benefits and ethics:** • Sharon would find out if the drug would give her liver damage/benefit is matching drugs to genetic make up of patient/personalised medication • ethical dilemma is over rights of access to genomic information • {Misuse of genetic information} by Employers/insurers • Wider implications on family health • {Anxiety/distress} caused by knowledge • Social discrimination/OWTTE
	7-9 marks Indicative content of this level must address all three parts: *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.* **4-6 marks** Indicative content of this level addresses at least two parts. *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.* **1-3 marks** Indicative content addresses at least one part.

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Question 11 · A level Component 2 · June 2024 · Q7 · 9 marks

7	mRNA: A1 take mRNA from a cell producing GFP A2 reverse transcriptase A3 used to produce {cDNA strand / cDNA fragment / complementary single stranded DNA} A4 DNA polymerase A5 used to produce double stranded DNA Problems overcome: B1 No need to locate gene (on jellyfish chromosome) B2 Restriction enzymes / endonucleases (not used) B3 which could cut GFP gene {making it useless / into non-functional fragments} B4 Removes the problem of introns B5 Removes the problem of post-transcriptional {processing / splicing / modification} (to produce functioning mRNA) Gene therapy C1 (GFP) {gene / marker} can be combined with {desired / functioning human / owtte} gene C2 {Cells / bacteria} containing the {functioning gene / recombinant / owtte} can be identified C3 these {Cells / bacteria} are allowed to replicate C4 Cells without gene discarded C5 Stops the problem of antibiotic resistance (genes) being passed to other organisms / ORA / antibiotic resistance (genes) cannot be used in human cells / C6 Faster (than using antibiotic resistance markers)	7	2	0 9	0 0
	7-9 marks Indicative content of this level is detailed content from all three areas. *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.* **4-6 marks** Indicative content of this level is detailed content from two areas. *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.* **1-3 marks** Indicative content of this level is any correct statement from the indicative content. *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.* **0 marks** *The candidate does not make any attempt or give a relevant answer worthy of credit.*				

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