

Tuesday 14 May 2019 – Afternoon

**GCSE (9–1) Biology B
(Twenty First Century Science)**

J257/03 Breadth in biology (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:

- a ruler (cm/mm)

You may use:

- a scientific or graphical calculator
- an HB pencil



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION

- The total mark for this paper is **90**.
- The marks for each question are shown in brackets [].
- This document consists of **28** pages.

Answer **all** the questions.

- 1 Reflexes help us to respond to stimuli. In a simple reflex, nerve impulses are passed along a pathway called a reflex arc.

The diagram in **Fig. 1.1** shows a reflex arc.

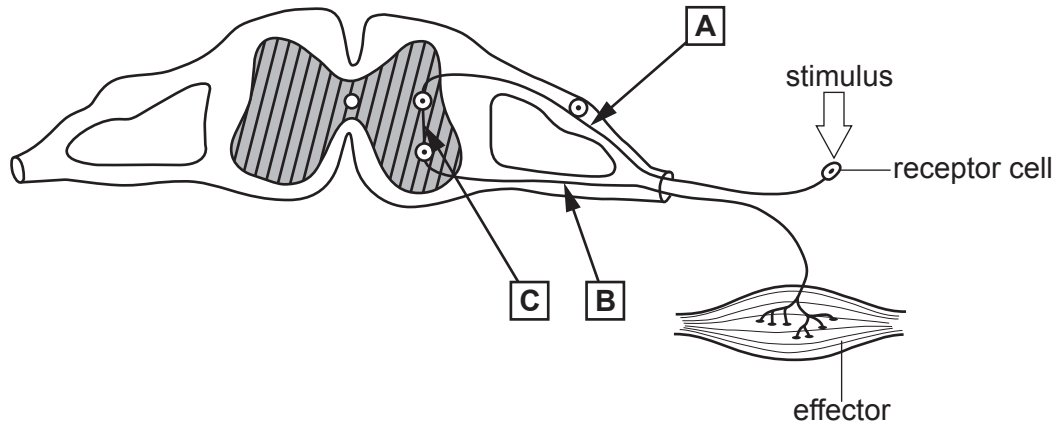


Fig. 1.1

- (a) Name the structures labelled **A**, **B** and **C**.

	Name of structure
A	
B	
C	

[3]

- (b) Write down **one** advantage of a reflex arc **not** involving the brain.

.....

..... [1]

(c) Two students want to investigate reflex actions.

They set up an experiment as shown in **Fig. 1.2**.

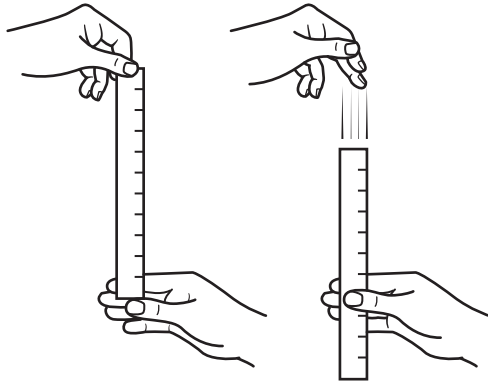


Fig. 1.2

Each student decides to use a different method.

- Using a stop clock, student **A** measures the time it takes for the participant to catch the ruler.
- Student **B** measures the distance the ruler falls through the participant's hand.

(i) Write down **one** reason why student **B's** method is better than student **A's**.

.....
 [1]

(ii) Write down **two** variables that both students would need to keep the same.

1
 2
 [2]

(iii) Both students decide to repeat their experiment.

Explain why.

.....
 [1]

(d) Some nerve impulses can travel at a speed of 119 m/s.

(i) Which of the following shows 119 written in standard form?

Tick (✓) **one** box.

$$1.19 \times 10^2$$

☐

$$1.19 \times 10^{-2}$$

☐

$$11.9 \times 10^1$$

☐

$$119 \times 10$$

☐

[1]

(ii) Which part of a neuron speeds up transmission of a nerve impulse?

Tick (✓) **one** box.

Axon

☐

Fatty sheath

☐

Neurotransmitter

☐

Synapse

☐

[1]

2 Read the newspaper article.

Scarlet fever cases increase

The number of scarlet fever cases is increasing. The number of confirmed cases in 2016 is reported to be > 19 000, the highest level in 50 years.

- (a) The article states that > 19 000 cases were reported in 2016.

What does the '>' in this statement mean?

..... [1]

- (b) Look at the data in the table showing the number of confirmed cases of scarlet fever.

Year	Number of confirmed cases of scarlet fever
2013	4700
2014	15637
2016	19206

Explain why doctors and scientists may be concerned by the data in the table.

.....

 [2]

- (c) Calculate the percentage increase in the number of cases from 2013 to 2014.

Put a ring around the correct answer.

23% **30%** **233%** **333%** [1]

(d) Scarlet fever is common in children under 10 years old.

(i) Scarlet fever is a bacterial infection. It is transmitted easily by close contact.

How could the spread of this infection be reduced?

.....

.....

..... [2]

(ii) Doctors could prescribe some medication to treat this infection.

Write down **one** factor that doctors will consider before prescribing this treatment.

.....

..... [1]

(iii) Which of the following diseases is also caused by bacteria?

Tick (✓) **one** box.

Athlete's foot

☐

HIV

☐

Malaria

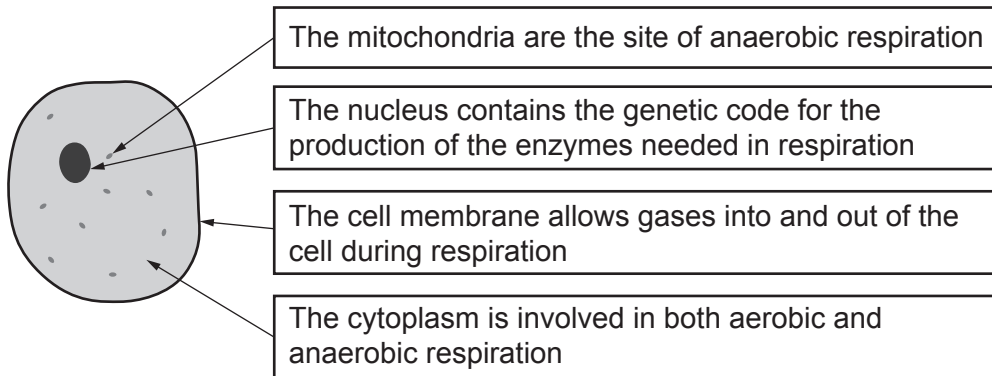
☐

Salmonella food poisoning

☐

[1]

- 3 (a) Cellular respiration takes place in all cells. A student annotated a diagram of a cell to describe how different parts of the cell are involved in respiration.



The student has made a mistake in their annotations.

- (i) Identify the mistake in the annotation by **drawing** a ring around it. [1]

- (ii) Write a correction for the student's mistake.

.....
 [1]

- (b) Describe the similarities **and** differences between **anaerobic** respiration in animal cells and yeast cells.

.....

 [3]

- (c) Write down **two** uses of the ATP produced during **aerobic** respiration in the human body.

1
 2 [2]

4 Deforestation is happening to rainforests in Malaysia and Indonesia.

The rainforests are being replaced with palm oil trees.

Palm oil is used in many products, such as soaps, body creams and food.

(a) (i) Some people talk about this.



Mia

I don't think it matters if rainforests are replaced with palm oil trees because there will still be the same amount of trees.

Alex

Palm oil trees will remove carbon dioxide out of the atmosphere.



Nina

Palm oil plantations are a monoculture. They reduce biodiversity.

Amir

Palm oil plantations do not provide a habitat for as many different species.



Which **two** people have the best arguments as to why we should conserve rainforests?

..... and

[2]

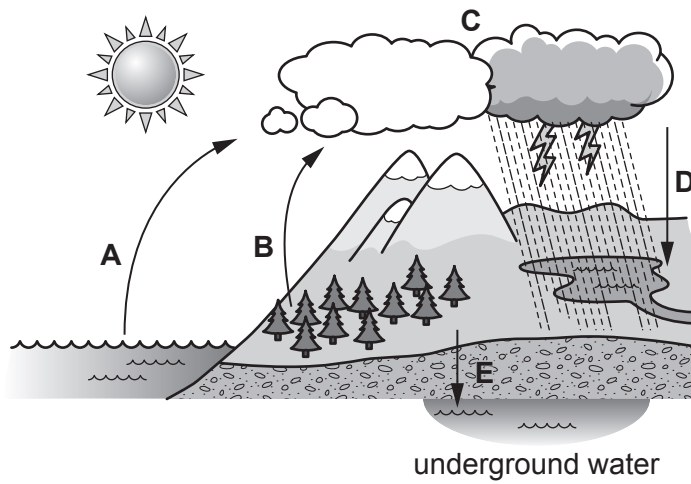
(ii) Describe the effect deforestation can have on climate change.

.....

 **[2]**

- (b) Deforestation can affect the water cycle.

The diagram below shows the water cycle.

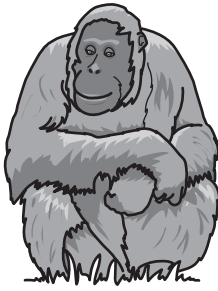


- (i) Put a ring around the letter, **A**, **B**, **C**, **D** or **E**, in the diagram which shows the process of transpiration. [1]
- (ii) Describe the effect deforestation will have on the amount of transpiration.

.....

..... [1]

- (c) Orangutans live in the rainforests of Malaysia.



Orangutan

A century ago there were 230 000 orangutans.

The table shows the estimated number of three species of orangutans which remain today.

Species of orangutan	Number
Bornean	104 700
Sumatran	7500
Tapanuli	800

- (i) Calculate the percentage (%) of orangutans which remain today.

Give your answer to **2** significant figures.

Percentage = ... % **[3]**

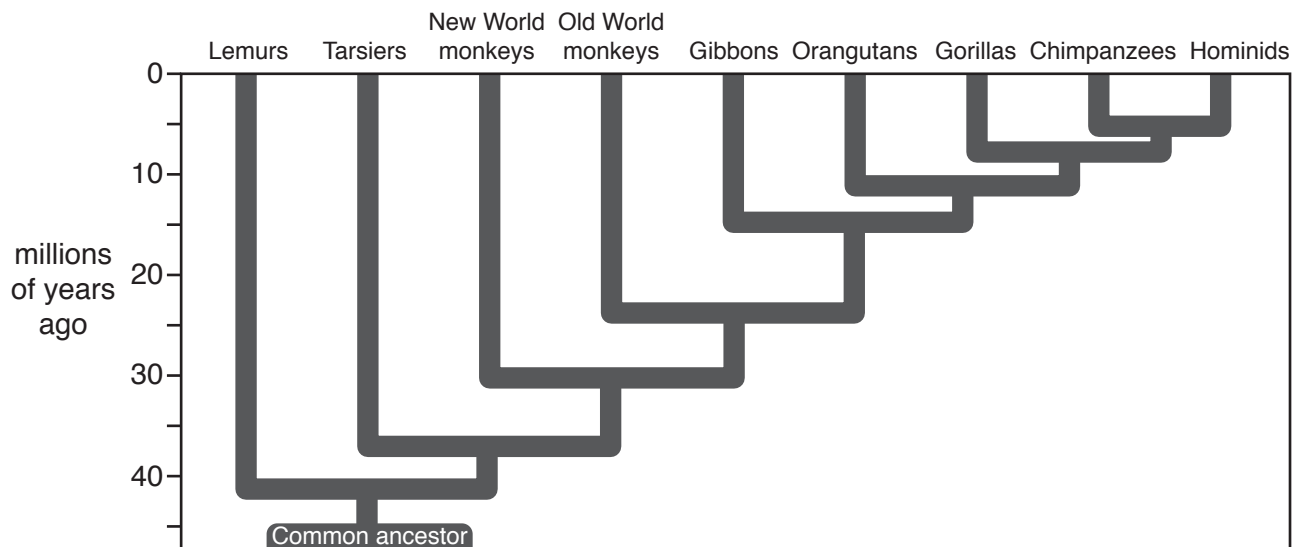
- (ii) The number of orangutans living in the rainforests of Malaysia is an estimate.

Explain why.

.....

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

(d) The diagram shows the evolutionary relationship of the orangutan to some other primates.



(i) Which one of the other primates is the orangutan **least** closely related to?

..... [1]

(ii) Which biological molecule can provide scientists with evidence of how closely related two species are?

Tick (✓) **one** box.

Amino acid

DNA

Glucose

Lipid

☐
☐
☐
☐

[1]

5 John has cut his leg.

(a) What role will platelets play in the healing of the cut?

.....

.....

..... [2]

(b) The cut gets infected. John's doctor decides to take a sample from the wound and culture the microorganisms.

(i) The doctor must use aseptic techniques to do this.

Describe **three** aseptic techniques the doctor may use when culturing the microorganisms.

1

.....

2

.....

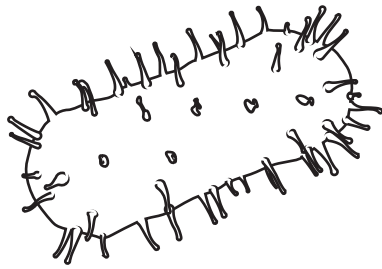
3

.....

[3]

- (ii) The doctor looks at some bacteria from the culture using a microscope.

Look at the image of one bacterium.



The actual length of this bacterium is $3.5\text{ }\mu\text{m}$.

$1\text{ }\mu\text{m} = 0.001\text{ mm}$

Calculate the magnification of the image of the bacteria.

Use the equation: magnification = measured size $\div$ actual size

Give your answer to **3** significant figures.

Magnification = $\times$ [3]

- 6** This question is about the genome and genetics.

Write down the best term to complete each sentence.

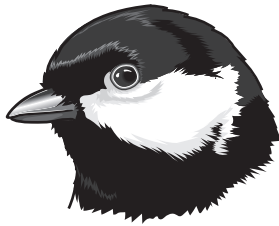
- (a) During protein synthesis, a copy of a gene is made from a molecule called
..... [1]
- (b) A characteristic of an organism that results from the interaction of the environment and the
genome is called its [1]
- (c) A is a monomer of DNA and is made from a sugar, a phosphate
group and a base. [1]
- (d) A mutation in a region of DNA can affect the phenotype by altering
gene expression. [1]

15
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PLEASE DO NOT WRITE ON THIS PAGE

- 7 Scientists studying birds called great tits think they may be evolving larger beaks.

They think this may be because of bird feeders.



- (a) (i) Place the following statements in the correct order to explain how scientists think this may have occurred.

- A The birds are more likely to survive and reproduce.
- B The offspring will be more likely to have larger beaks.
- C The birds get more food.
- D Birds that have longer beaks can feed more successfully on the bird feeders.
- E The birds will pass on the alleles for larger beaks to their offspring.

--	--	--	--	--

[1]

- (ii) What phrase describes the process occurring in part (a)(i)?

..... [1]

- (b) Great tits reproduce sexually.

Write down **one** reason why sexual reproduction is an advantage.

..... [1]

- (c) Scientists studied populations of great tits in the Netherlands to see if there were any differences between the genomes of birds there and in the UK.

What gene technology would scientists use to work this out?

..... [1]

- 8 Carbohydrates, lipids and proteins are large organic molecules.

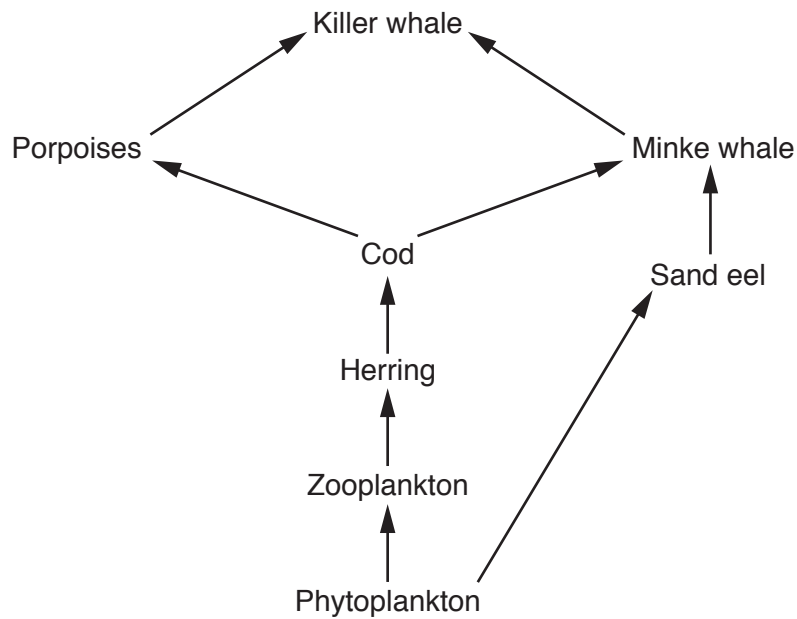
Complete the table to show which small organic molecules are used to make the large organic molecules.

Small organic molecules	Large organic molecules
	Carbohydrates
	Proteins
	Lipids

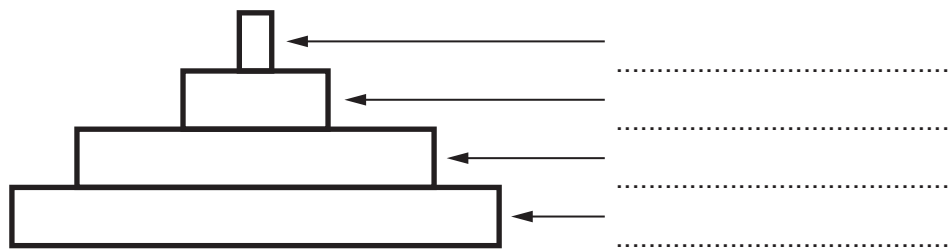
[3]

- 9 (a) Killer whales can be found off the coast of Scotland.

The diagram shows part of their food web.



- (i) Use the food web to label this pyramid of biomass correctly.



[2]

- (ii) Describe how biomass is lost at each stage of a food chain.

.....

.....

..... [2]

- (b) A killer whale was found dead off the coast of Scotland.

The post mortem found that chemicals called PCBs had bioaccumulated in the whale's body.

- (i) Use your knowledge of food chains to explain how the PCBs bioaccumulated.

.....

.....

.....

.....

..... [3]

- (ii) Scientists have worked out that the quantity of PCBs required to damage marine mammal health is 9 mg/kg.

The dead killer whale's blubber (fat) was analysed. They found 9×10^2 mg/kg in the blubber.

Do you think scientists would be concerned by this figure?

Explain your answer.

.....

..... [1]

- (iii) Whale calves feed on their mother's milk for 11 months. The milk is high in fat.

Suggest why scientists are concerned about the effect of PCBs on the whale population.

.....

.....

.....

..... [2]

- (c) Explain what would happen to the dead whale's body if it was left in the sea.

.....

.....

.....

..... [2]

10 Adult female cows have an oestrus cycle.

- (a) The hormones that control the oestrus cycle are the same as those that control the human menstrual cycle.

Which hormone is responsible for the release of an egg when a cow ovulates?

Tick (✓) **one** box.

FSH

☐

LH

☐

Oestrogen

☐

Progesterone

☐

[1]

- (b) The graph in **Fig. 10.1** shows the levels of some of the hormones during the oestrus cycle in one cow.

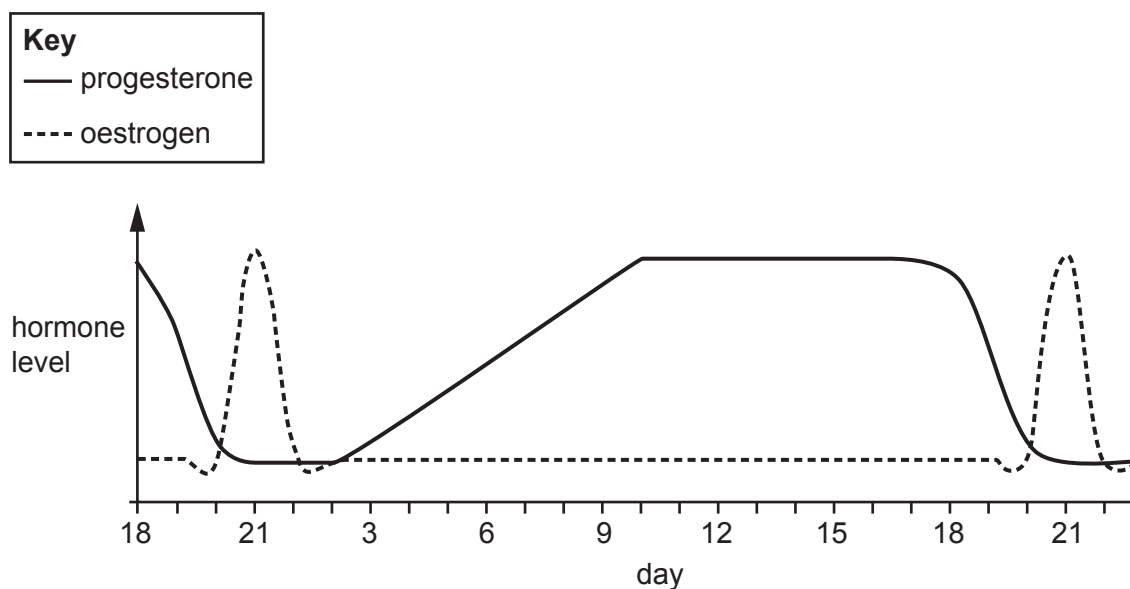


Fig. 10.1

- (i) Use the graph in **Fig. 10.1** to work out the length of one cycle.

Length of one cycle = ... days [1]

- (ii) The cow is **not** pregnant.

What evidence from the graph in **Fig. 10.1** supports this statement?

Tick (✓) **one** box.

The oestrogen levels rise and fall.

☐

The progesterone levels are high for a period of time.

☐

The progesterone levels fall.

☐

There is no FSH shown on the graph.

☐

[1]

- (c) Cows are farmed to produce milk.

Each cow produces a different amount of milk.

- (i) How could a farmer use selective breeding to try to make sure the cows in the next generation make a lot of milk?

.....

.....

.....

..... [2]

- (ii) Farmers can carry out selective breeding artificially. To do this they need to manipulate a cow's oestrus cycle by injecting hormones.

Which hormone would a farmer inject to cause a large number of follicles to be produced?

Tick (✓) **one** box.

FSH

☐

LH

☐

Oestrogen

☐

Progesterone

☐

[1]

- (iii) The farmers will collect the eggs from the cow and fertilise them with sperm from a bull.

A fertilised egg (zygote) divides to form an embryo.

What name is given to this type of cell division?

.....

[1]

(d) The embryos continue to develop.

When the embryo has 8 cells the cells are separated and allowed to develop into several embryos.

Each embryo is then transferred into a surrogate cow as shown in **Fig. 10.2**.

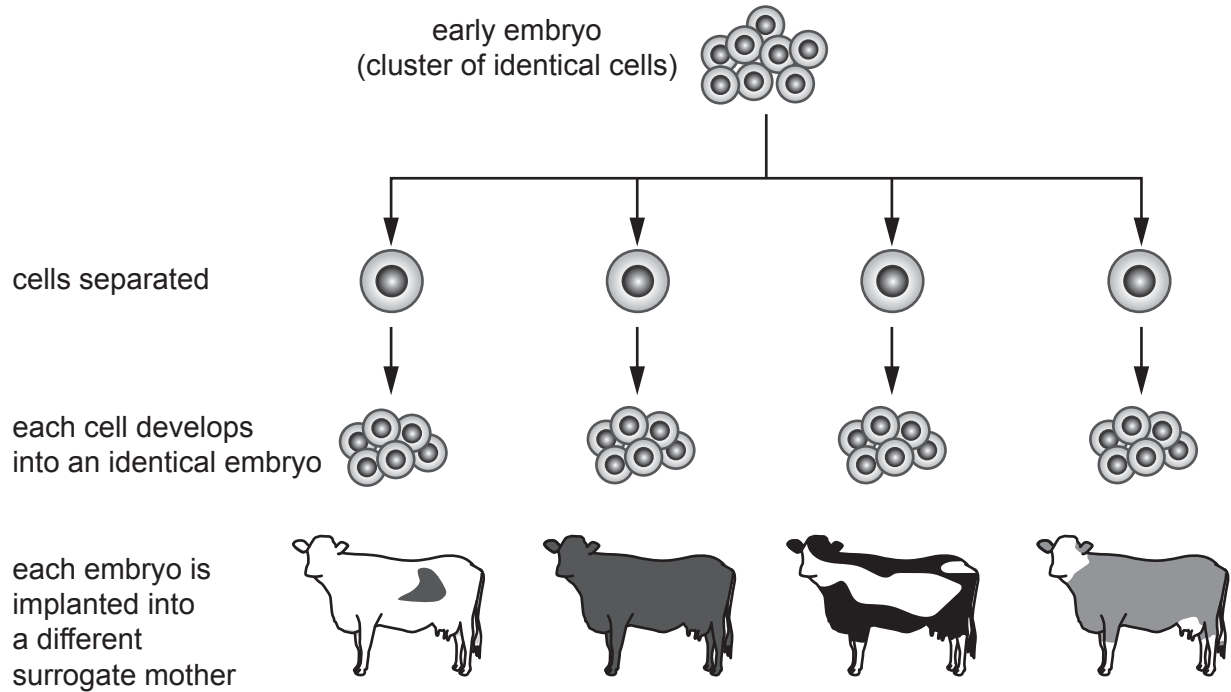


Fig. 10.2

(i) Suggest why a farmer may use this technique rather than allowing the cows to reproduce naturally.

.....

.....

.....

..... [2]

- (ii) Why are the embryos split at this early stage rather than at a later stage?

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

- (iii) Before the embryo is implanted into a surrogate cow, the cow will need to be given a hormone to allow the pregnancy to continue.

Name this hormone **and** explain why this hormone is required.

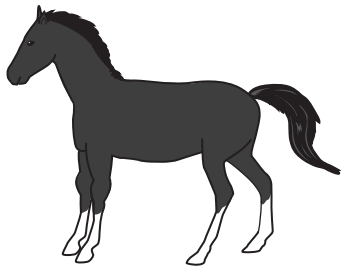
Name of hormone

Explanation

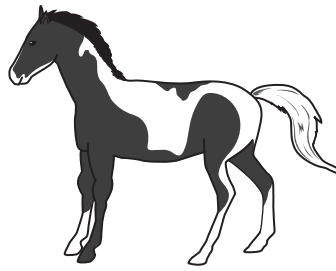
.....
..... [2]

11 Coat colour is inherited in a breed of horse called the American Paint horse.

Horses can either be a solid colour or frame patterned.



solid colour



frame patterned

(a) Coat colour is determined by two alleles of a single gene.

The table describes the allele combinations that result in each coat colour.

Allele combination	Coat colour
Homozygous dominant	Solid colour
Heterozygous	Frame patterned

(i) Use the letter F to write down the genotypes for a horse with the following coat colours.

Solid coloured

Frame patterned

[2]

- (ii) Lethal white syndrome (**LWS**) is a genetic disorder found in these horses.

Foals born to these horses have all white or nearly white coats and blue eyes and appear normal.

Horses with this syndrome are homozygous recessive.

Complete the Punnett square to show how two horses **without** lethal white syndrome can have a foal with the syndrome.

Write down the probability of this happening.

Probability of foal having LWS = ... [4]

- (b) Foals with LWS do not survive. Producing a LWS foal is now avoidable.

What technology is now available to assist breeders to prevent foals being born with LWS?

..... [1]

- (c) Explain how genetic variants arise **and** how they can influence the phenotype of an individual.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

END OF QUESTION PAPER

This image shows a blank sheet of white paper designed for handwriting practice. It features a solid vertical line on the left side, creating a narrow margin. The rest of the page is filled with evenly spaced horizontal dashed lines, providing guides for letter height and placement. There are no other markings, text, or illustrations on the page.

Oxford Cambridge and RSA

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