Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Friday 22 May 2020

Morning (Time: 1 hour 30 minutes) | Paper Reference **8BN0/02**

Biology A (Salters Nuffield)

Advanced Subsidiary
Paper 2: Development, Plants and the Environment

You must have:
Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- You may use a scientific calculator.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over

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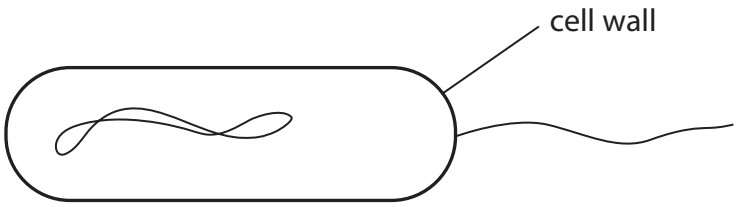
Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Bacteria contain structures that are characteristic of prokaryotic cells.

The diagram shows an incomplete bacterial cell.



(a) Complete the diagram by drawing and labelling the cell membrane, a mesosome and a plasmid.

(3)

(b) In prokaryotic cells, ribosomes are

(1)

☒ **A** absent

☒ **B** larger than ribosomes in eukaryotic cells

☒ **C** smaller than ribosomes in eukaryotic cells

☒ **D** the same size as ribosomes in eukaryotic cells

(c) Some bacteria have a capsule that is located

(1)

☒ **A** between the cell wall and the cell membrane

☒ **B** in the cytoplasm

☒ **C** inside the cell wall

☒ **D** outside the cell wall

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(d) Bacterial DNA is

(1)

☒ **A** circular and surrounded by a nuclear membrane

☒ **B** circular with no nuclear membrane

☒ **C** linear and surrounded by a nuclear membrane

☒ **D** linear with no nuclear membrane

(Total for Question 1 = 6 marks)

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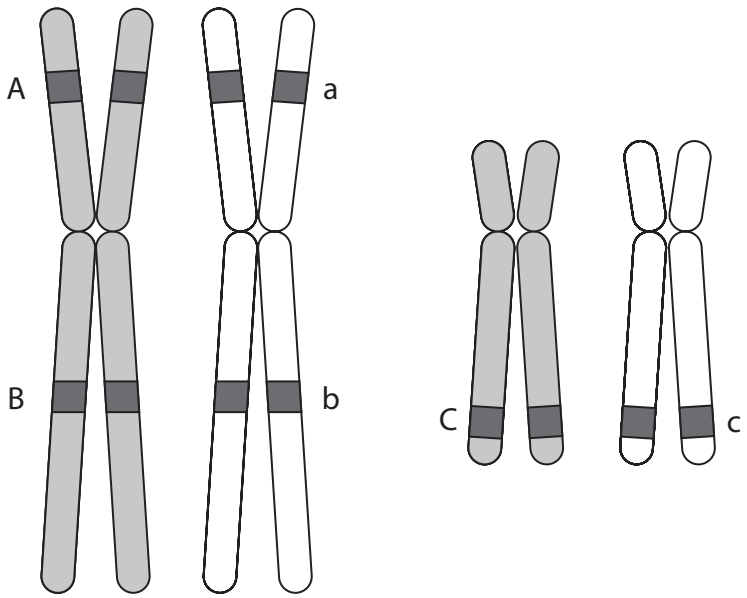
2 Homologous chromosomes pair up during meiosis.

The diagram shows the loci of three genes on two pairs of homologous chromosomes.



Chromosome 1 Chromosome 2

(a) (i) Draw a diagram to show a crossover for chromosome 1 during meiosis.

(2)

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(ii) Explain how crossing over and independent assortment can produce gametes with new combinations of the alleles shown on the diagram of the two pairs of chromosomes.

(4)

Crossing over

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Independent assortment

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(b) Explain how crossing over may differ in sex chromosomes.

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(Total for Question 2 = 8 marks)

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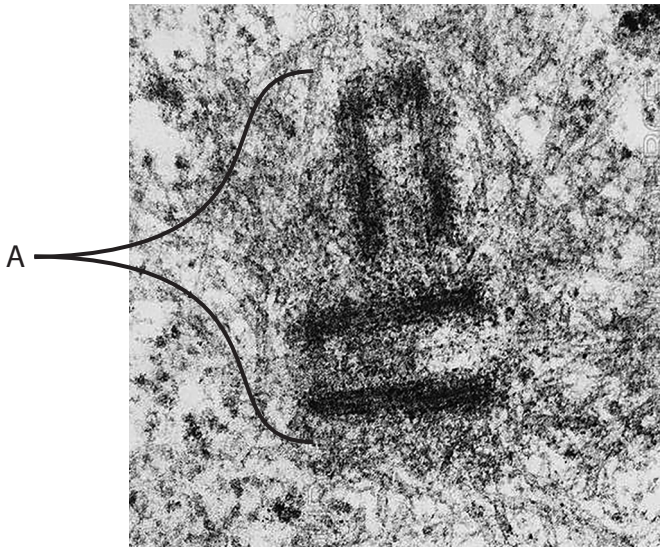
3 Cells can be observed using electron microscopes and light microscopes.

(a) The electron micrograph shows an organelle in a eukaryotic cell.



(i) Name the organelle labelled A.

(1)

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(ii) The organelle labelled A is involved in

(1)

☒ **A** lipid synthesis

☒ **B** protein synthesis

☒ **C** ribosome production

☒ **D** spindle organisation

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(b) Cell division in a plant such as an onion can be observed using a light microscope.

Explain why the following techniques are used when producing a root tip squash to observe cell division.

(4)

Adding hydrochloric acid to the root tip

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Adding a stain to the root tip

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(c) Explain the role of the middle lamella when a plant cell completes mitosis.

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(Total for Question 3 = 8 marks)

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4 Sperm cells have adaptations for their function as male gametes.

(a) Describe how the acrosome is involved in the digestion of the zona pellucida.

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(b) A sperm cell must reach the egg cell membrane for fertilisation to occur.

The surface area of an egg cell with a diameter of 120 μm was calculated using the formula $4\pi r^2$.

Which of the following is the correct surface area of this egg cell to two significant figures?

(1)

☒ **A** 45 000 μm^2

☒ **B** 180 000 μm^2

☒ **C** 570 000 μm^2

☒ **D** 2 300 000 μm^2

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(c) Polyspermy occurs when more than one sperm cell enters the egg.

This is usually prevented by the hardening of the zona pellucida shortly after the arrival of the first sperm cell.

In an investigation, the effects of varying sperm cell concentrations on the fertilisation of eggs was measured. This was repeated using egg cells with the zona pellucida removed.

The table shows the results of these investigations.

Sperm cell concentration / $\times 10^3$ cm^{-3}	Zona pellucida intact		Zona pellucida removed	
	Percentage fertilisation (%)	Percentage polyspermy (%)	Percentage fertilisation (%)	Percentage polyspermy (%)
50	84	3	94	3
100	99	17	95	33
200	99	18	98	52

(i) In the investigation using egg cells without a zona pellucida, 15 egg cells were used for each sperm cell concentration.

Calculate how many of these egg cells were entered by more than one sperm cell when the sperm cell concentration was 100×10^3 cm^{-3}.

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Answer.....

(ii) Deduce the effect of sperm cell concentration on the chance of polyspermy when the zona pellucida is removed.

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*(iii) During IVF treatment, egg cells are extracted from the ovaries.

Large numbers of sperm cells can be added to these egg cells in a Petri dish to increase the chances of successful fertilisation.

In a study of 200 extracted egg cells, there was damage to the zona pellucida of 13 of these egg cells.

Comment on the frequency of polyspermy due to IVF procedures.

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(Total for Question 4 = 12 marks)

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5 There are currently three species of badger in the genus *Meles*: the Eurasian badger (*Meles meles*), the Asian badger (*Meles leucurus*) and the Japanese badger (*Meles anakuma*).

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The South Asian badger is currently classed as *Meles meles*.

(a) The pairing that would be expected to be able to mate and produce fertile offspring is **(1)**

☒ **A** Asian badger and South Asian badger

☒ **B** Eurasian badger and Asian badger

☒ **C** Eurasian badger and South Asian badger

☒ **D** Japanese badger and South Asian badger

(b) The Bosphorus Strait is a channel of water that separates populations of badgers.

Badgers found to the west of the Bosphorus Strait are *M. meles*. The badgers found to the east of the Bosphorus Strait are thought to be a new species.

(i) Explain how molecular phylogeny can be used to show that these two populations are reproductively isolated.

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(ii) Describe how mutations in badgers to the east of the Bosphorus Strait may lead to this population becoming a separate species.

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(c) Explain how the Hardy-Weinberg equation can be used to show that natural selection is occurring in a population.

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(Total for Question 5 = 10 marks)

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6 Monozygotic twins develop from a single fertilised egg cell.
Dizygotic twins develop from two separate fertilised egg cells.

(a) Describe the role of cell division in the production of monozygotic twins from a single fertilised egg cell.

(2)

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(b) Body mass in humans is a polygenic characteristic.

The best definition of a polygenic characteristic is one that involves

(1)

☒ **A** a single allele at a single locus

☒ **B** a single allele at multiple loci

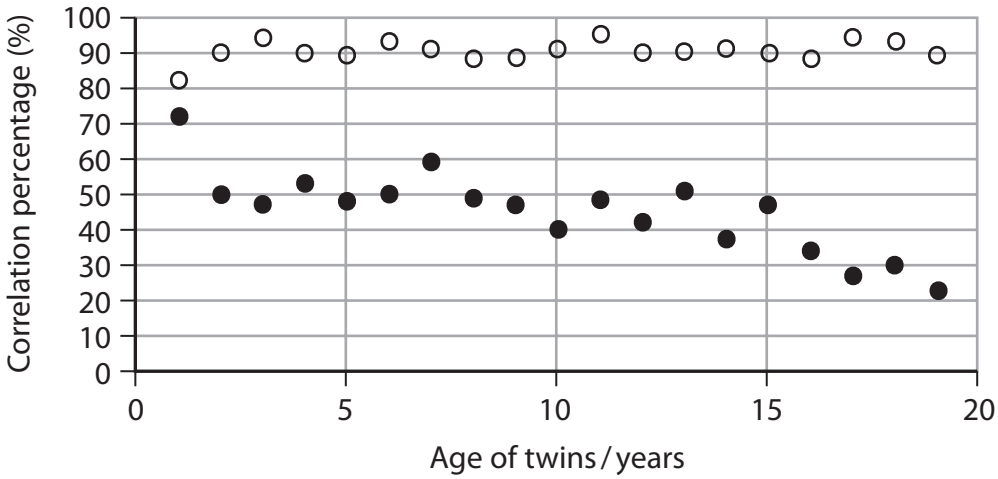
☒ **C** multiple alleles at a single locus

☒ **D** multiple alleles at multiple loci

(c) The body mass of a group of monozygotic (MZ) twins was studied for 19 years.
The correlation between the body masses of each set of twins was calculated.
This was repeated for a group of dizygotic (DZ) twins.

If a set of twins had the same body mass, they would have a correlation of 100%.

The results are shown in the graph.



Key ○ MZ twins ● DZ twins

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Comment on the effect of genetic and environmental factors in determining the body mass of the twins shown in the graph.

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(d) Epigenetic changes can cause monozygotic twins to have different body masses.

Explain how epigenetic changes can cause differences in a characteristic.

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(Total for Question 6 = 10 marks)

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7 In 1988, the Kariega Game Reserve in South Africa was farmland.

In 1989, the following species of antelope were reintroduced: impala, blesbok, cape grysbok, bushbuck, duiker, reedbuck and springbok.

The reintroduction of springbok was unsuccessful.

(a) The percentage of species reintroduced successfully to this area was

(1)

☒ **A** 14%

☒ **B** 15%

☒ **C** 85%

☒ **D** 86%

(b) In May 2004, two male and two female lions were released into this game reserve.

Explain why these lions were not released into this game reserve until 2004.

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(c) The two male lions were relocated from one region of South Africa. The females were relocated from a different region of South Africa.

Explain why choosing lions from different regions increased the genetic diversity of the lion population.

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(d) Many areas of South Africa have been converted to game reserves where native species have been reintroduced.

Within each game reserve, populations of carnivores are controlled.

The table shows data for four game reserves.

Game reserve	Area / ha	Ideal population size				
		Lion	Leopard	Cheetah	Wild dog	Spotted hyena
Schotia	1 600	6	6	0	6	0
Pumba	6 500	11	4	5	0	11
Kwandwe	19 978	10	4	15	12	0
Kariega	50 000	8	0	0	0	0

(i) Calculate the difference in the number of hectares (ha) per lion in Kwandwe compared with Kariega.

(3)

Answer.....

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(ii) Evaluate the statement that Pumba Game Reserve has a more successful reintroduction programme than the one at Schotia Game Reserve.

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(Total for Question 7 = 12 marks)

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8 The fibres from different species of plants have different properties.
Therefore, plant fibres can be used in the manufacture of a variety of materials.

(a) Describe the importance of magnesium ions in the production of plant fibres.

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(b) Sisal fibres are extracted from the stems of the plant *Agave sisalana*.

The tensile strength of sisal fibres was investigated and calculated using two methods:

- calculation using the mean diameter of a number of fibres
- calculation using the actual diameter of each fibre

Both methods calculated a relative standard deviation by comparing the standard deviation to the mean tensile strength.

Calculation using	Mean tensile strength / MPa	Standard deviation / MPa	Relative standard deviation (%)
Mean diameter	308.9		58.5
Actual diameter	329.5	180.9	54.9

(i) Calculate the standard deviation when using the mean diameter.

(2)

Answer.....

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(ii) Explain why the standard deviations were calculated for these data.

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(c) Kapok (*Ceiba pentandra*) is a tree.
Kapok produces seed pods containing waxy fibres made of cellulose covered in lignin.
These fibres are used as fillings for cushions.

(i) Describe the arrangement of glucose monomers in a cellulose molecule.

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(ii) Devise a method to find the relationship between the actual diameter and the tensile strength of kapok fibres.

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(Total for Question 8 = 14 marks)

TOTAL FOR PAPER = 80 MARKS

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