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Edexcel GCE

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Biology

Advanced Subsidiary

Unit 2: Development, Plants and the Environment

Tuesday 6 June 2017 – Afternoon

Time: 1 hour 30 minutes

Paper Reference

6BI02/01

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.
- 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.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

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

Turn over ►

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Pearson

Answer ALL questions.

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

1 Plant cell walls contain cellulose. Cellulose molecules are polymers.

(a) Put a cross in the box next to the correct word or words that completes each of the following statements.

(i) The monomers that make up cellulose are

(1)

- A α -glucose
- B amylopectin
- C amylose
- D β -glucose

(ii) The monomers that make up cellulose molecules are joined together by

(1)

- A glycosidic bonds in a branched chain
- B glycosidic bonds in an unbranched chain
- C hydrogen bonds in a branched chain
- D hydrogen bonds in an unbranched chain

(iii) In a plant cell wall, the cellulose molecules are held together in bundles called microfibrils embedded in a matrix containing

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- A calcium carbonate
- B calcium pectate
- C pectin carbonate
- D pectin nitrate

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(b) The cell walls in some plant tissues have secondary thickening.

These cell walls may contain a substance called lignin.

(i) Describe the function of lignin in the cell walls of xylem.

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(ii) Name **one** plant tissue, other than xylem, that has lignin in its cell walls.

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(iii) Explain how the structure of xylem is related to its function.

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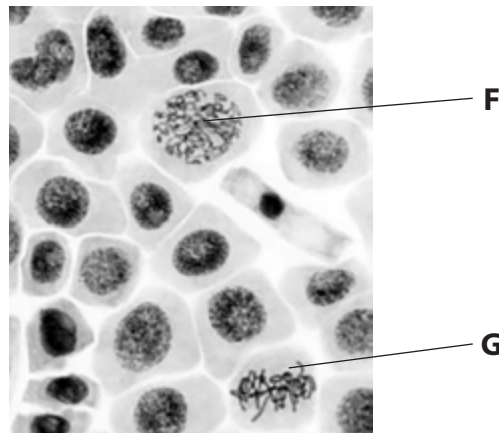
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(Total for Question 1 = 10 marks)



2 The stages of mitosis can be observed in cells from growing tissues.

(a) The photograph below shows cells from an onion root tip, as seen using a microscope.



Magnification $\times 600$

(i) Put a cross in the box next to the row that correctly identifies the stages of mitosis shown in cell F and cell G.

(1)

| | Cell F | Cell G |
|---------------------------------------|-----------|-----------|
| <input checked="" type="checkbox"/> A | Anaphase | Metaphase |
| <input checked="" type="checkbox"/> B | Metaphase | Prophase |
| <input checked="" type="checkbox"/> C | Prophase | Metaphase |
| <input checked="" type="checkbox"/> D | Telophase | Prophase |

(ii) The cells in the photograph are stained to make the chromosomes visible.

Name a stain that can be used to make chromosomes visible in a root tip.

(1)

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- (b) The table shows the number of cells, in a root tip, observed at different stages of the cell cycle.

| Stage of the cell cycle | Number of cells |
|-------------------------|-----------------|
| Interphase | 693 |
| Prophase | 35 |
| Metaphase | 37 |
| Anaphase | 6 |
| Telophase | 24 |

- (i) Put a cross in the box next to the stage of mitosis most likely to be observed in this root tip.

(1)

- A** anaphase
 B metaphase
 C prophase
 D telophase

- (ii) The mitotic index is the percentage of cells in a sample undergoing mitosis.

Calculate the mitotic index for the cells in the table.

Show your working.

(2)

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(c) Herbicides are chemicals used to kill weeds. Some herbicides work by disrupting the cell cycle.

An investigation was carried out to study the effect of different concentrations of the herbicide Agil on mitosis in onion root tips.

Agil concentrations of 0.5 ppm, 1.0 ppm and 1.5 ppm were used. The roots of the onions were exposed to these concentrations for 48 hours. A control was also used with no Agil present.

Root tip squashes were then prepared and the percentage of cells undergoing mitosis was recorded for 150 cells for each slide examined.

The table below shows the results of this investigation.

| Concentration of Agil / ppm | Percentage of cells undergoing mitosis (%) |
|-----------------------------|--|
| 0.0 | 39.5 |
| 0.5 | 24.7 |
| 1.0 | 22.7 |
| 1.5 | 20.0 |

(i) Using the information in the table, describe the effects of Agil concentration on mitosis in onion root tips.

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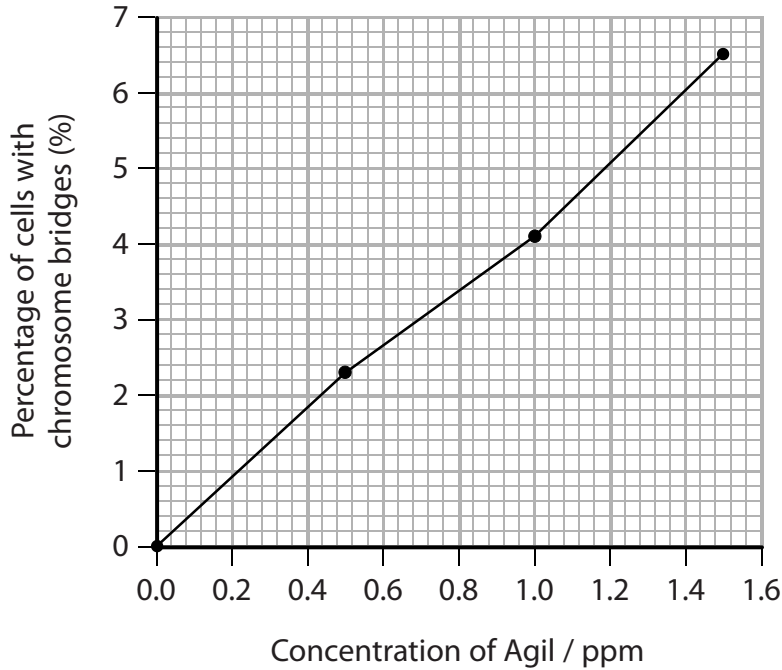
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- (ii) The herbicide Agil also increased the number of chromosome abnormalities. These include chromosome bridges, which prevent anaphase from completing normally.

The graph shows the effect of the concentration of Agil on the percentage of cells with chromosome bridges.



Suggest how chromosome bridge formation could affect the production of gametes.

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(Total for Question 2 = 9 marks)

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(b) The Millennium Seed Bank at Kew collects tree seeds to conserve the genetic diversity of ash trees.

(i) Put a cross ☒ in the box next to the correct definition of the term **genetic diversity**.

(1)

- A the number of different alleles in a gene pool
- B the number of different genes in a species
- C the number of different species in a gene pool
- D the number of different species in a habitat

(ii) Suggest how scientists could increase the probability of collecting seeds that will produce trees resistant to ash dieback disease.

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*(c) Explain how seed banks ensure that the seeds that are stored can remain viable for long periods of time.

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(Total for Question 3 = 11 marks)

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4 In mammals, reproduction involves the fertilisation of an egg cell by a sperm cell.

(a) (i) Explain how the structure of an egg cell is related to its function.

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(ii) Describe how the acrosome reaction allows fertilisation to take place.

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(b) Some cases of infertility in humans are due to low ovulation rates.

Ovulation can be triggered by hormone treatment. However, this can have serious side effects.

A new treatment is being tested using the hormone kisspeptin to stimulate ovulation.

Describe how clinical trials could be carried out to test the safety of kisspeptin.

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5 Plant fibres are used to produce textiles.

(a) Explain why the use of fibres from plants is more sustainable than using fibres made from oil-based sources.

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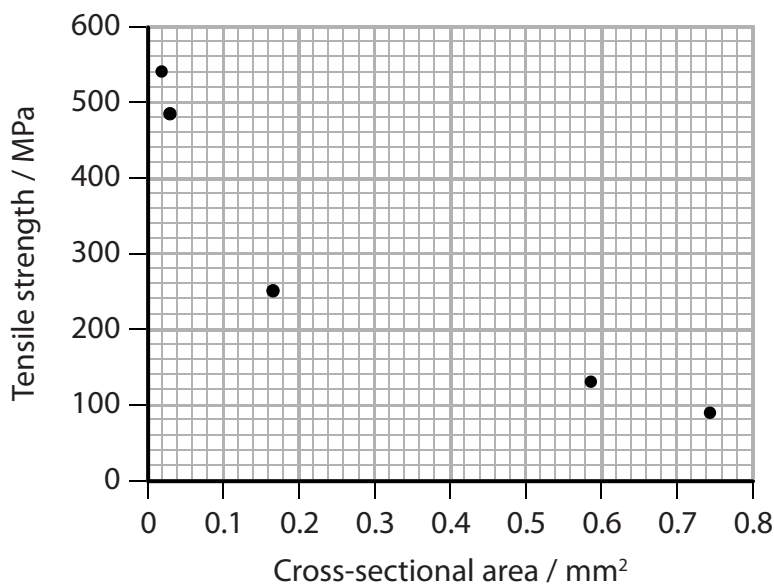
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(b) An investigation was carried out to measure the tensile strength of plant fibres with different cross-sectional areas.

The results of this investigation are shown in the graph below.



(i) Describe how the tensile strength of these fibres was measured in this investigation.

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(ii) Use the information in the graph to describe the relationship between the cross-sectional area of fibres and their tensile strength.

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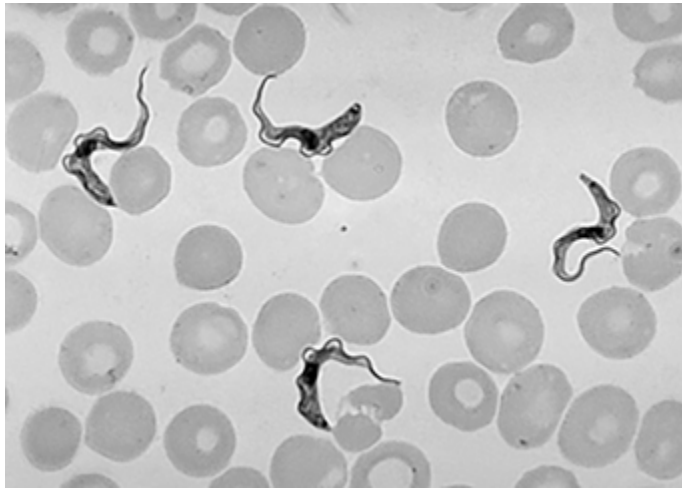
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6 Sleeping sickness is caused by an organism called *Trypanosoma*.

The photograph below shows *Trypanosoma*, a single-celled eukaryotic organism. It has a streamlined shape and a flagellum for movement.



Magnification $\times 1000$

(a) (i) Explain how scientists identified *Trypanosoma* as a eukaryotic organism and not a prokaryotic organism, such as a bacterium.

(4)

Handwriting practice area consisting of 15 horizontal dotted lines for student response.

(ii) Name the type of adaptation shown by the flagellum of *Trypanosoma*.

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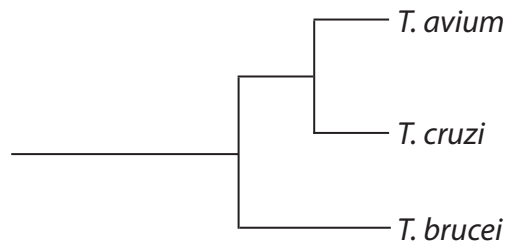


- (b) There are many species of *Trypanosoma* and these are responsible for different diseases in different organisms.

The table below gives information about three species of *Trypanosoma*.

| Species of <i>Trypanosoma</i> | Organisms infected | Diseases caused |
|-------------------------------|--------------------|-------------------|
| <i>Trypanosoma avium</i> | birds | trypanosomiasis |
| <i>Trypanosoma brucei</i> | humans | sleeping sickness |
| | cattle | nagana |
| <i>Trypanosoma cruzi</i> | humans | Chagas disease |

These three species are related as shown in the phylogenetic diagram below.



- (i) Using the phylogenetic diagram, explain which two species of *Trypanosoma* are most closely related.

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- (ii) Name the process that resulted in different species of *Trypanosoma* developing as parasites in different groups of animals over time.

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(iii) Suggest how molecular phylogeny was used to determine the evolutionary relationships between these different species of *Trypanosoma*.

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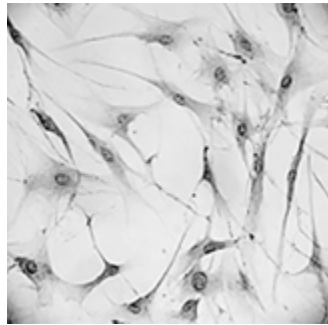
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7 In mammals, different types of stem cell are found in bone marrow.

The photograph below shows mesenchymal stem cells, a type of stem cell found in bone marrow, as seen using a microscope.



Magnification $\times 500$

Mesenchymal stem cells can differentiate into a variety of cell types, including bone cells and muscle cells.

*(a) Suggest how mesenchymal stem cells can give rise to specialised cells in tissues, such as muscle and bone.

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- (b) The number of mesenchymal stem cells in human bone marrow changes with age as shown in the table below.

| Age / years | Mesenchymal stem cells as a percentage of all cells in the bone marrow (%) |
|-------------|--|
| 0 | 0.01 |
| 14 | 0.001 |
| 30 | 0.0004 |
| 50 | 0.00025 |
| 80 | 0.00005 |

- (i) Calculate how many times more mesenchymal stem cells there are in a population of one million bone marrow cells in a person aged 14 compared with a person aged 50.

Show your working.

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- (ii) Using the information in the table, explain how ageing affects the time taken for broken bones to mend.

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(c) Veterinary medicine is developing techniques to use mesenchymal stem cells from adult animals, such as dogs and cats. These cells will be used to treat damage to tissues, including bone and cartilage.

There are two sources of mesenchymal stem cells:

- allogenic stem cells collected from a genetically different donor within the same species
- autologous cells collected from the patient before being used in their treatment.

Suggest **two** advantages of using autologous stem cells instead of allogenic stem cells.

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(d) Stem cell therapy is also used to treat humans.

State **one** ethical issue concerning the use of embryonic stem cells instead of stem cells collected from adults.

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(Total for Question 7 = 13 marks)



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8 Crohn's disease is an irritable bowel disease (IBD). It is a medical condition that affects the digestive system.

Approximately 15% of people with Crohn's disease have a close relative who also has this disease.

If one identical twin has Crohn's disease, there is a 70% probability that the other twin will also have this disease.

(a) Explain how this information demonstrates that the causes of Crohn's disease are only partially genetic.

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(b) In some people, several genes at different locations in the genome contribute to Crohn's disease.

Put a cross in the box next to the correct word to complete each of the following statements.

(i) The term that refers to the pattern of inheritance where a single characteristic is determined by more than one gene is

(1)

- A monogenic
- B monohybrid
- C polygenic
- D polyhybrid



(ii) The location of a gene on a chromosome is called the

(1)

- A allele
- B centriole
- C centromere
- D locus

(c) Some people adopt a vegetarian diet to reduce the symptoms of the disease.

Smoking cigarettes is known to make the symptoms of Crohn's disease worse.

Suggest how environmental and genetic factors interact to affect the development of Crohn's disease.

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(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 80 MARKS



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