Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Biology A (Salters Nuffield)

Advanced Subsidiary

Paper 2: Development, Plants and the Environment

Tuesday 6 June 2017 – Afternoon

Time: 1 hour 30 minutes

Paper Reference

8BN0/02

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.*
- 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.

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.*

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 Plant cell walls contain cellulose. Cellulose molecules are polymers.

(a) (i) Name the monomer that makes up cellulose.

(1)

.....

(ii) Which of the following correctly describes how these monomers are held together in a cellulose molecule?

(1)

☒ **A** by glycosidic bonds in a branched chain

☒ **B** by glycosidic bonds in an unbranched chain

☒ **C** by hydrogen bonds in a branched chain

☒ **D** by hydrogen bonds in an unbranched chain

(iii) Cellulose molecules are held together in bundles called microfibrils.

These microfibrils are embedded in a matrix containing calcium pectate.

Calcium pectate can be found in the

(1)

☒ **A** amyloplast

☒ **B** chloroplast

☒ **C** middle lamella

☒ **D** tonoplast

(b) (i) The cell walls in some plant tissues have secondary thickening. This may contain a substance called lignin.

Which of the following properties can lignin give to cell walls in plants?

(1)

☒ **A** flexibility and permeability to water

☒ **B** flexibility and waterproofing

☒ **C** strength and permeability to water

☒ **D** strength and waterproofing

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(ii) Name a plant tissue that has lignin in its cell walls.

(1)

(c) Some plant cells also contain the polymer starch.

Explain how the structure and properties of starch are related to its function as a storage molecule.

(3)

(Total for Question 1 = 8 marks)

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2 Lupus is a genetic condition that has various symptoms.

There are several different genes involved in the development of the disease. The symptoms that develop vary depending on genetic and environmental factors.

Stress and exposure to chemicals in the environment can influence the development of lupus.

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

(1)

- ☒ **A** epigenetic
- ☒ **B** monogenic
- ☒ **C** polygenic
- ☒ **D** sex-linked

(ii) Which of the following is another environmental factor that could affect the development of lupus?

(1)

- ☒ **A** age
- ☒ **B** diet
- ☒ **C** gender
- ☒ **D** height

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(b) Alleles of a gene linked to the development of lupus have been located on the X chromosome.

Scientists tested 13 different alleles of the IRAK1 gene, which is located on the X chromosome. Five of these alleles were associated with lupus.

If these five alleles are recessive, explain how this could affect the ratio of males to females who develop lupus.

(3)

(Total for Question 2 = 5 marks)

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3 Conservation programmes are used to save endangered species.

The Scottish wildcat, shown in the photograph, is a subspecies of the European wildcat, *Felis silvestris silvestris*.



The Cairngorms Wildcat Project estimates that there are 150 breeding pairs left, but the Scottish Wildcat Association believes that only 35 cats remain.

A conservation group proposed that a captive breeding programme, and the relocation of Scottish wildcats, would be necessary to prevent extinction.

(a) (i) State why the Scottish wildcat has been described as **endemic**.

(1)

.....

.....

.....

(ii) The Scottish wildcat can interbreed successfully with domestic cats.

Explain the effect this could have on the genetic diversity of the Scottish wildcat.

(2)

.....

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(b) Explain how molecular phylogeny could be used to determine the relationships between the Scottish wildcat and other subspecies of European wildcat.

(2)

(c) Describe how the proposed conservation programme could prevent the Scottish wildcat from becoming extinct.

(4)

(Total for Question 3 = 9 marks)

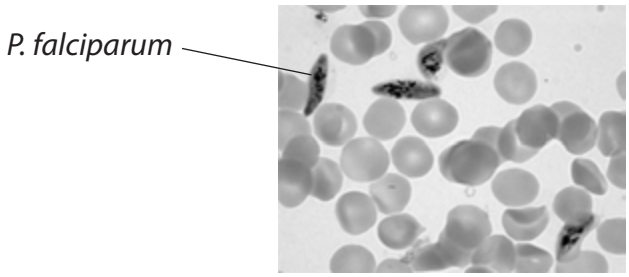
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4 *Plasmodium falciparum* is a single-celled eukaryotic organism. *P. falciparum* causes the disease malaria when it invades red blood cells.

If untreated, malaria can result in a shorter than normal life span.

The high mortality rate of people with malaria has been claimed to be one of the greatest selection pressures on the human genome in recent history.

(a) The photograph shows *P. falciparum* in a sample of human blood.



Describe how scientists could have determined that *P. falciparum* is a eukaryotic organism and not a prokaryotic organism.

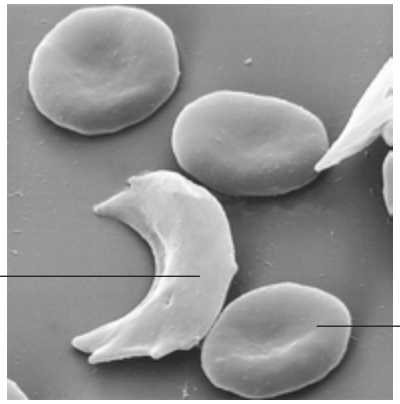
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(b) Sickle cell anaemia is a genetic condition.

People who are homozygous for the sickle cell allele have red blood cells that become deformed in shape when they are deoxygenated.

The electron micrograph shows these deformed sickle cells alongside normal red blood cells.



Magnification ×3000

(i) The image of the normal red blood cell labelled in the electron micrograph has a diameter of 2 cm.

Which of the following is the actual diameter of this red blood cell?

(1)

☒ **A** 0.67 μm

☒ **B** 6.7 μm

☒ **C** 67 μm

☒ **D** 670 μm

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(ii) People with a heterozygous genotype for this condition do not develop severe sickle cell anaemia.

The Yoruba are a group of people who live in West Africa.

In a population of 600 Yoruba individuals, 24 were found to have severe sickle cell anaemia.

Calculate the number of heterozygous individuals in this population.

Use the Hardy Weinberg equation, $p^2 + 2pq + q^2 = 1$.

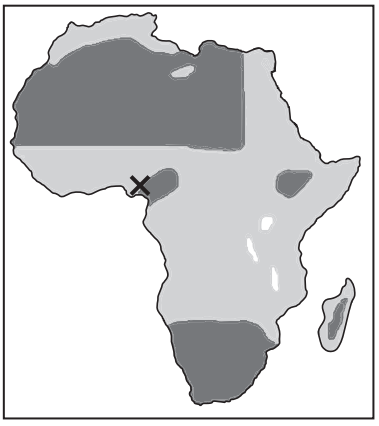
(3)

Answer .....

*(iii) Individuals who are heterozygous for this condition are resistant to a severe form of malaria, called cerebral malaria, that affects the brain. Individuals who are homozygous for the sickle cell allele are more likely to develop severe sickle cell anaemia.

The maps show the percentage of the population with the allele for sickle cell anaemia and the distribution of *P. falciparum* in Africa. The location of the Yoruba people is indicated with a cross (✕).





per cent of population with the sickle cell allele (Haemoglobin S)

- 13 +
- 9 to 12
- 5 to 8
- 0 to 4

endemic *P. falciparum*

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Analyse the data to explain how malaria has affected the percentage of individuals in the Yoruba population with the allele for sickle cell anaemia.

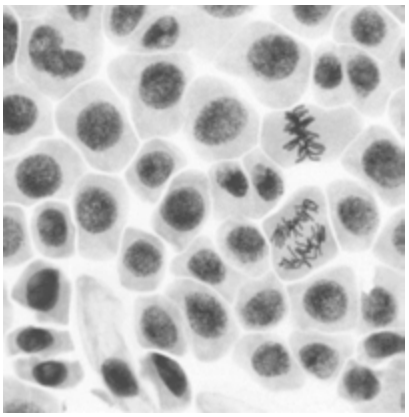
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(Total for Question 4 = 14 marks)

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5 Cell division can be affected by various chemicals. The effects of these chemicals can be studied by observing tissues.

(a) The photograph shows onion root cells undergoing mitosis.



(i) Draw a line labelled **M** to one cell at metaphase and a line labelled **A** to one cell at anaphase.

(2)

(ii) The rate at which cells are dividing can be determined by calculating the mitotic index.

The mitotic index is the percentage of cells in a sample undergoing mitosis.

The table shows the number of cells at different stages of the cell cycle in one sample.

Stage	Number of cells
Interphase	462
Prophase	23
Metaphase	24
Anaphase	4
Telophase	16

Calculate the mitotic index for the sample of cells shown in the table.

(2)

Answer ..... %

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(b) 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.

The roots of onions were exposed to different concentrations of Agil for 24 hours.

Root tip squashes were then prepared and the mean mitotic index was calculated for each Agil concentration.

The results are shown in the table.

Agil concentration / ppm	Mean mitotic index (% ± SE)
0.0	40.7 ± 0.22
0.5	33.7 ± 0.32
1.0	31.1 ± 0.15
1.5	30.8 ± 0.19

(i) Describe the effects of Agil concentration on mitosis in onion root tips.

(2)

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(ii) Devise an investigation to determine the effect of exposure time to Agil on the rate of mitosis in onion root tips.

(6)

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(c) Chemotherapy is used to treat cancer. Cancer involves uncontrolled cell division. Some chemotherapy treatments have an effect on mitosis.

Paclitaxel is a chemical used in chemotherapy to treat various types of cancer. It works by preventing the shortening of spindle fibres.

Explain how preventing the shortening of spindle fibres affects mitosis.

(2)

(Total for Question 5 = 14 marks)

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6 Textiles are often made from plant fibres. The use of plant fibres is more sustainable than the use of synthetic fibres made from fossil fuels.

(a) Give reasons why the use of fibres from plants is sustainable.

(2)

(b) The tensile strength of plant fibres from different plant species can be measured.

(i) Which of the following are variables that would need to be controlled when testing the tensile strength of these fibres?

(1)

- ☒ **A** humidity and light intensity
- ☒ **B** light intensity and temperature
- ☒ **C** temperature and humidity
- ☒ **D** temperature and pH

(ii) Describe how the tensile strength of these fibres can be measured.

(3)

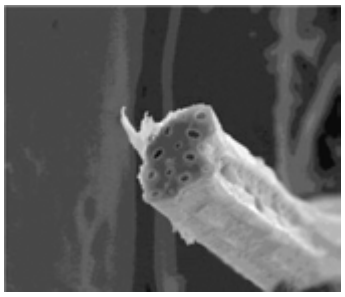
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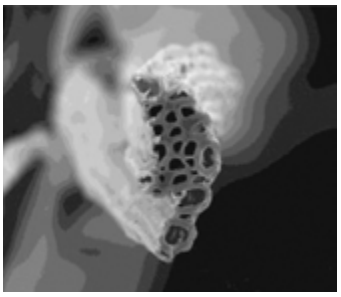
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(c) Fibres of curaua, jute and sisal were examined using an electron microscope.

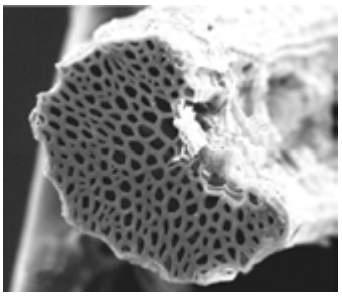
These electron micrographs were examined and the physical features of the fibres were measured.



Curaua



Jute



Sisal

Type of fibre	Cell wall thickness / μm	Diameter of lumen / μm	Mean tensile strength / MPa
Curaua	3.5	4.0	543
Jute	2.5	6.7	249
Sisal	2.6	8.2	484

Analyse these data to evaluate the relationship between the structure of these plant fibres and their tensile strength.

(4)

(Total for Question 6 = 10 marks)

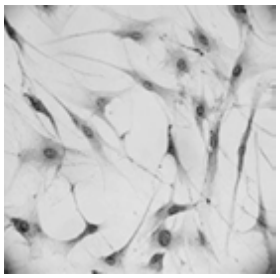
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7 In humans, different types of stem cell are found in the bone marrow.

The photograph shows some mesenchymal stem cells from bone marrow.



Mesenchymal stem cells can differentiate to give rise to a variety of cell types, including bone cells, cartilage cells, muscle cells and fat cells.

The skeletal system consists of bone tissue, muscle tissue and cartilage tissue.

(a) (i) Describe how a tissue differs in structure from a system.

(2)

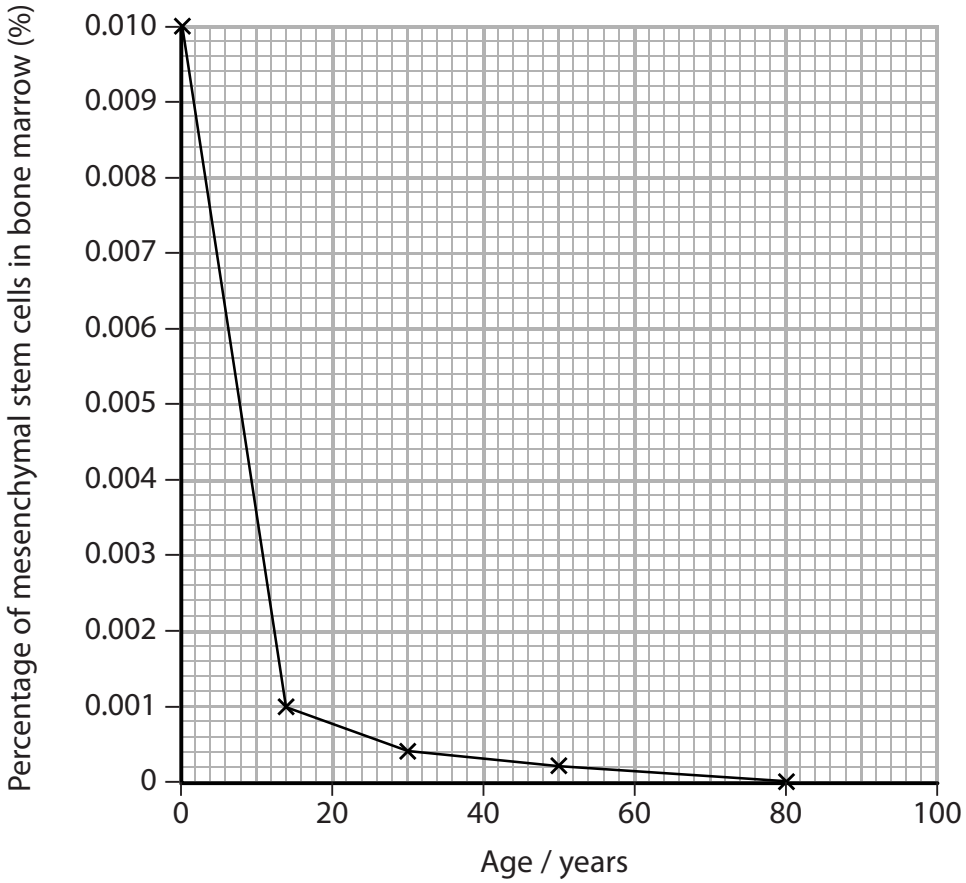
(ii) Describe how mesenchymal stem cells can give rise to different types of cell.

(4)

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(b) The proportion of mesenchymal stem cells to other cells in the bone marrow changes with age.

The graph shows the relationship between age and the percentage of mesenchymal stem cells in bone marrow.



Calculate the rate at which the percentage of mesenchymal stem cells in the bone marrow changes between the ages of 14 and 30.

(2)

Answer ..... % y^{-1}

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(c) Deduce why age affects the time taken to recover from injuries.

(3)

(Total for Question 7 = 11 marks)

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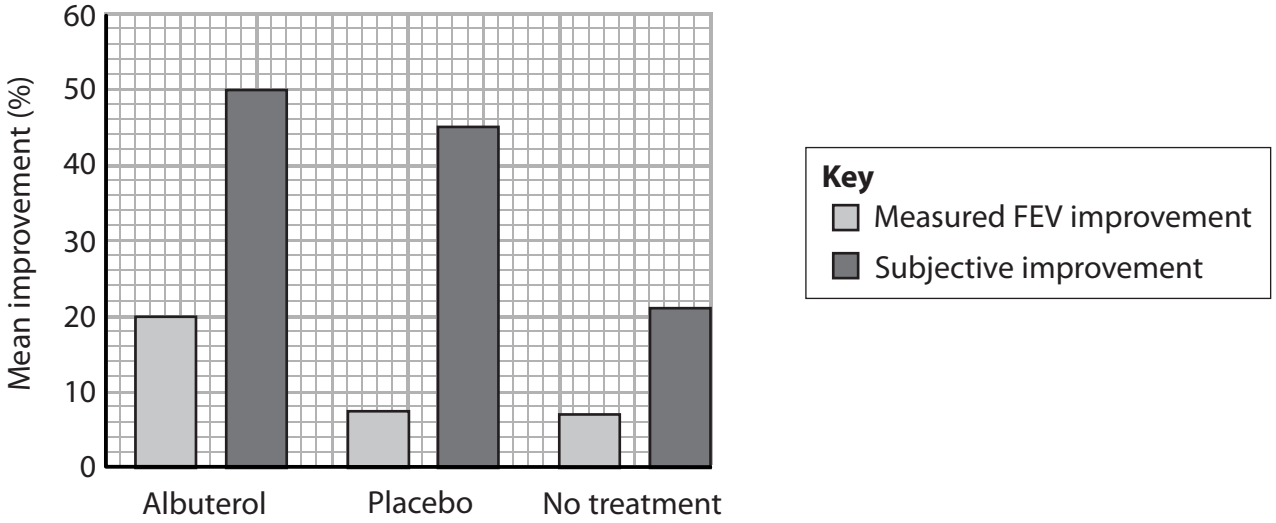
8 Medicinal drugs undergo clinical trials before they are licensed to be used.

(a) Albuterol is a drug used to reduce the symptoms of asthma.

In a clinical trial, people with asthma were given either Albuterol, a placebo or no treatment.

Measured improvement (FEV improvement) can be used to indicate the effectiveness of the treatment in reducing the symptoms of asthma. FEV is forced expiratory volume. Asthma reduces FEV.

The people in the trial were also asked to describe their improvement and this was recorded as 'subjective improvement'.



Comment on the measured improvement (FEV improvement) and subjective improvement for the different treatments.

(3)

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(b) In January 2016, a clinical trial of a different drug involved 128 healthy volunteers aged 18 to 55. In this trial, different doses of the drug were given to 90 of these volunteers and the others were given a placebo.

Six people, who were given the drug, became ill and had to be treated in hospital.

(i) Explain why healthy volunteers were given different doses of the drug or a placebo.

(2)

(ii) The trial tested increasing the dose of the drug. The six people who fell ill were the first to receive higher doses over the course of several days.

Which of the following is the correct ratio of those who took the drug to those who fell ill?

(1)

☒ **A** 14 : 1

☒ **B** 15 : 1

☒ **C** 18 : 1

☒ **D** 21 : 1

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(iii) Compare and contrast this drug testing protocol with that used by William Withering when he tested digitalis soup.

(3)

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 80 MARKS

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