Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Biology B

Advanced Subsidiary
Paper 1: Core Cellular Biology and Microbiology

Thursday 25 May 2017 – Afternoon **Time: 1 hour 30 minutes**	Paper Reference **8BI0/01**

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.
- 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 question(s) 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.

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 and animal cells contain a number of organelles.

The table gives information about some of these organelles.

Organelle	Information about the organelle
P	10^{-9} m in size involved in translation
Q	contains thylakoids
R	involved in aerobic respiration
S	2500 nm in size involved in protein modification
T	6 μm in size has a double membrane
U	has a single membrane

(a) Which of the following describes the structure of organelle **S**?

(1)

☒ **A** network of interconnecting tubules

☒ **B** pair of cylinders at right angles to one another

☒ **C** stacks of curved cisternae

☒ **D** two subunits with a groove

(b) Which row of the table is correct for organelles **Q** and **R** ?

(1)

	Found in animals cells	Found in plant cells
☒ **A**	**Q** and **R**	**Q** and **R**
☒ **B**	**Q**	**R**
☒ **C**	**R**	**Q** and **R**
☒ **D**	**Q** and **R**	**Q**

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(c) Which of the following shows the organelles in order of size from smallest to largest?

(1)

☒ **A** **P S T**

☒ **B** **P T S**

☒ **C** **S T P**

☒ **D** **T S P**

(d) The number of organelles in the table which contain DNA is

(1)

☒ **A** one

☒ **B** two

☒ **C** three

☒ **D** four

(e) The DNA of organelle **R** contains 37 genes. Thirteen of these genes code for proteins involved in part of aerobic respiration.

Calculate the percentage of genes coding for these proteins.

(1)

Answer ..... %

(Total for Question 1 = 5 marks)

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2 Some genetic disorders result from chromosome mutations.

(a) Translocation is one type of chromosome mutation.

Describe how translocation occurs.

(2)

(b) Name the type of chromosome mutation that results in Down's syndrome.

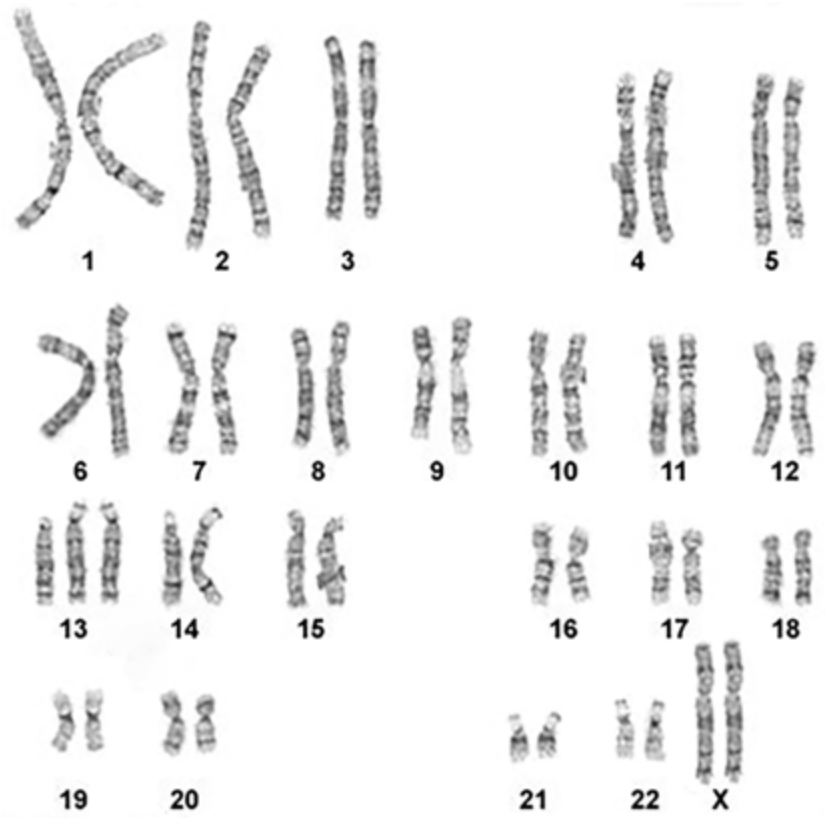
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(c) Genetic disorders can be diagnosed by looking at an individual's karyotype.

A karyotype shows the number of each type of chromosome present in a cell.

The diagram shows the karyotype of the cells taken from a female embryo.



Explain what conclusion can be made about this female embryo.

(2)

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(Total for Question 2 = 5 marks)

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3 A student made a squash preparation of a root tip to observe the stages of mitosis.

(a) The student used the following statements to identify cells in metaphase.

- Pairs of homologous chromosomes lined up along the equator of each cell.
- Crossing over taking place.
- Chromatids visible.

The number of correct statements about metaphase in root tip cells is

(1)

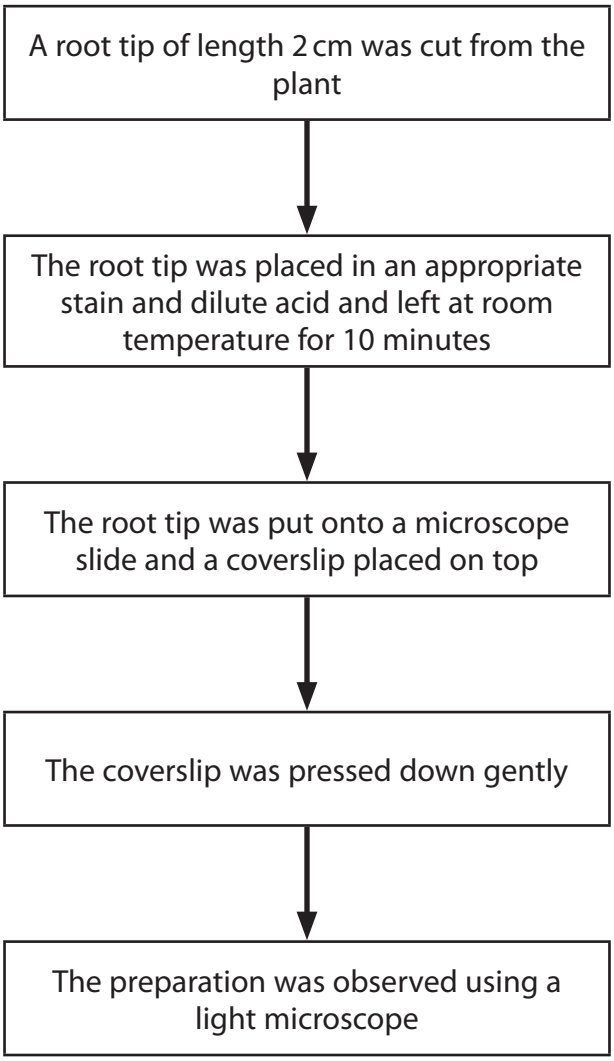
☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(b) The diagram shows the method that the student used.



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The student was disappointed with the slide that had been prepared because the nuclei were poorly stained and no stages of mitosis could be seen.

(i) Explain why the student had to make sure that an appropriate stain was used.

(2)

(ii) Describe the changes that need to be made to this method to allow stages of mitosis to be seen.

(4)

(Total for Question 3 = 7 marks)

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4 Most human cells use carbohydrate as a source of energy.

(a) Explain why glycogen releases energy more slowly than glucose.

(2)

(b) When human cells have used up carbohydrate, they will use lipid and then protein as a source of energy.

The table shows the water content and energy content of three food sources.

Food source	Water content / arbitrary units	Energy content in dry matter / kJ g^{-1}	Energy content in wet matter / kJ g^{-1}	Total energy stored / kJ
Carbohydrate	2 to 3	16.8	4.2 to 6.3	3528
Triglyceride	0	37.8	37.8	567 000
Protein	2 to 3	16.8	4.2 to 6.3	100 800

(i) Explain why the water content of triglyceride is different from the water content of carbohydrate and protein.

(3)

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(ii) Using the information in the table, explain why triglycerides are a good energy store.

(2)

(iii) Explain why the **'total energy stored'** column in this table is of limited use in drawing conclusions about the energy content of these food sources.

(2)

(Total for Question 4 = 9 marks)

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5 Eukaryotic cells and prokaryotic cells have similarities and differences in their ultrastructure.

(a) Compare and contrast the ultrastructures of eukaryotic cells and prokaryotic cells.

(4)

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(b) Some antibiotics inhibit RNA synthesis and protein synthesis in cells.

Actinomycin D, Rifamycin and α-Amanitin are antibiotics that work by binding to molecules in a cell. This inhibits protein synthesis.

The scientists who developed these antibiotics had to find out which types of cell were affected and which molecule they were binding to.

The table shows the types of cell that these antibiotics affect and the molecule that they bind to.

Antibiotic	Type of cell affected	Molecule that the antibiotic binds to
Actinomycin D	Prokaryotic and eukaryotic	DNA
Rifamycin	Prokaryotic only	RNA polymerase
α-Amanitin	Eukaryotic only	RNA polymerase

(i) Describe the structure of a DNA molecule.

(3)

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(ii) Explain the effect of Actinomycin D on protein synthesis.

(3)

(iii) Explain the effect of Rifamycin and α-Amanitin on protein synthesis.

(3)

(Total for Question 5 = 13 marks)

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6 (a) The classification of viruses is based on structure and nucleic acid types.

(i) Which of the following pairs of viruses both have an envelope?

(1)

☒ **A** Ebola and λ (lambda) phage

☒ **B** human immunodeficiency virus and Ebola

☒ **C** λ (lambda) phage and tobacco mosaic virus

☒ **D** tobacco mosaic virus and human immunodeficiency virus

(ii) Which of the following pairs of viruses both have a helical capsid?

(1)

☒ **A** Ebola and tobacco mosaic virus

☒ **B** λ (lambda) phage and Ebola

☒ **C** human immunodeficiency virus and λ (lambda) phage

☒ **D** tobacco mosaic virus and human immunodeficiency virus

(b) When a bacterial cell is infected with λ (lambda) phage, the virus will enter the lytic cycle.

(i) Describe the lytic cycle of a virus.

(3)

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(ii) The multiplicity of infection (MOI) is one factor that determines whether a virus enters the lytic cycle or latency.

$$\text{MOI} = \frac{\text{number of infectious virus particles}}{\text{number of target cells present}}$$

A scientist needed to use a MOI of 0.5 for an investigation.

The virus particles were at a concentration of $2 \times 10^9\,\text{cm}^{-3}$ and the bacteria were at a concentration of $8 \times 10^8\,\text{cm}^{-3}$.

Calculate the volume of virus particles that should be added to $0.25\,\text{cm}^3$ of bacteria.

(3)

Answer ..... cm^3

(Total for Question 6 = 8 marks)

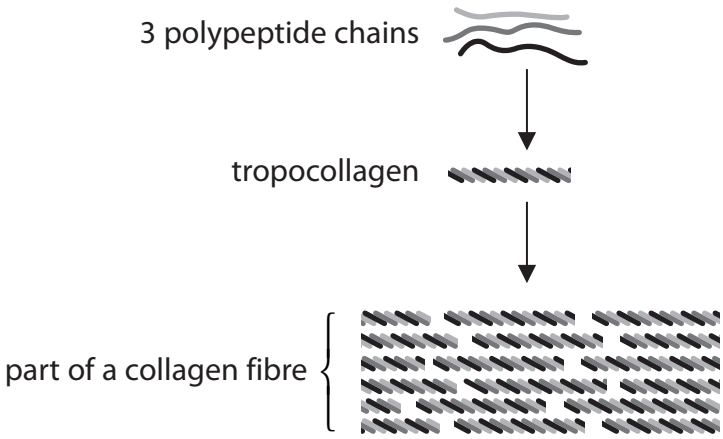
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7 Collagen is a structural protein found in connective tissue.

(a) The diagram shows the components of a typical collagen fibre.



(i) Explain the significance of repeating sequences of amino acids in the formation of tropocollagen.

(2)

(ii) Which of the following bonds holds the 3 polypeptide chains together in the tropocollagen?

(1)

☒ **A** ester

☒ **B** glycosidic

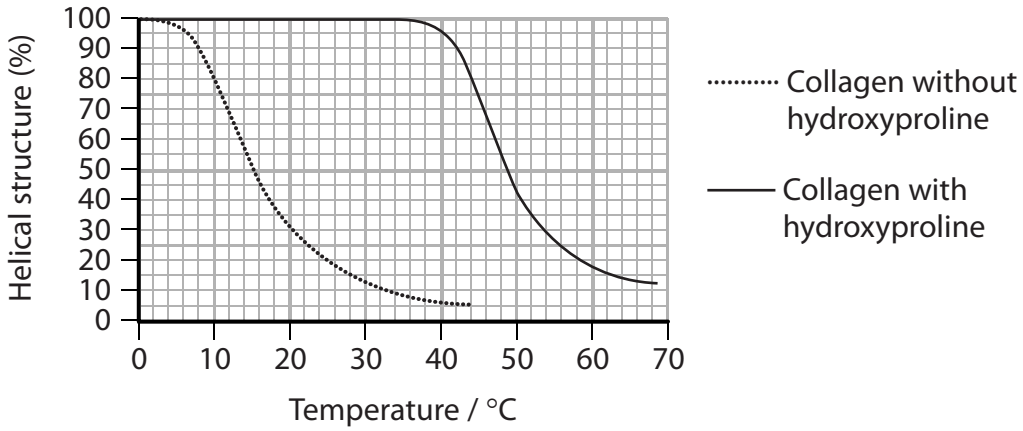
☒ **C** hydrogen

☒ **D** peptide

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(b) Hydroxyproline and proline are components of collagen.

The graph shows the effect of temperature on the helical structure of collagen with hydroxyproline and collagen without hydroxyproline.



(i) Analyse the data to explain the importance of hydroxyproline in the structure of collagen.

(2)

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(ii) The table shows information about the skin collagen of three animals and the body temperature of each animal.

Animal	Percentage of proline and hydroxyproline in skin collagen (%)	Body temperature / °C
Calf	23.2	37
Shark	19.1	24 to 28
Cod	15.5	10 to 14

The thermal stability of collagen is described by its shrinkage temperature (T_s). This is the temperature at which 50% of the helical structure is lost.

Analyse the data in the graph and the table to comment on the stability of collagen in these animals.

(4)

(Total for Question 7 = 9 marks)

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8 There are three different types of haemoglobin in the blood of an adult human. Each haemoglobin molecule is composed of four polypeptide chains.

(a) The table shows information about these types of haemoglobin.

Type of haemoglobin	Percentage present in the blood (%)	Types of polypeptide chain present
HbA_1	96	2α and 2β
HbA_2	3	2α and 2δ
HbF	1	2α and 2γ

Calculate the ratio of polypeptide chains present in the blood of an adult human.

(3)

Answer .....

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(b) The β, δ and γ polypeptide chains have similar amino acid sequences.

The table shows the sequence of nine amino acids in a part of each of these polypeptide chains.

Type of polypeptide chain	Sequence of amino acids
β	- phe - ala - thr - leu - ser - glu - leu - his - cys -
δ	- phe - ser - gln - leu - ser - glu - leu - his - cys -
γ	- phe - ala - gln - leu - ser - glu - leu - his - cys -

The β, δ and γ polypeptide chains are coded for by three different genes.

Compare and contrast the sequence of bases in the DNA coding for each of these parts of the three polypeptide chains.

(4)

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(c) Hereditary persistence of fetal haemoglobin (HPFH) is a condition that results from mutations in the genes coding for the β and δ polypeptide chains.

People with this condition produce HbF only.

The table shows the percentage saturation with oxygen, at different partial pressures, for HbF and HbA.

Partial pressure of oxygen / kPa	Percentage saturation of HbF with oxygen (%)	Percentage saturation of HbA with oxygen (%)
5.3	79	74
8.0	92	88
10.7	97	95
13.3	100	99

(i) State what is meant by the term **gene mutation**.

(1)

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(ii) With reference to the table, explain why people with HPFH are usually unaware that they have this condition.

(2)

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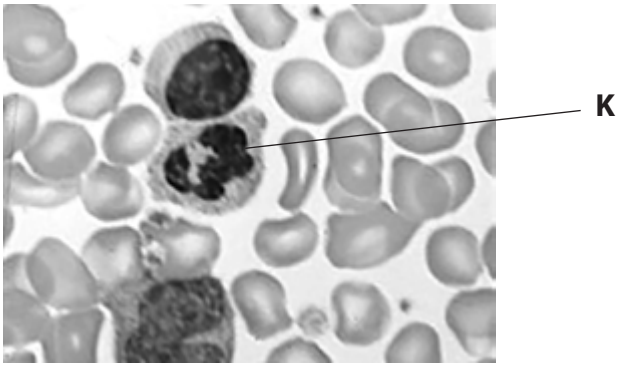
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(Total for Question 8 = 10 marks)

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9 Microscopy is a technique used to study structures that are not within the resolution range of the human eye.

(a) The photograph shows cells in a blood smear, as seen using a light microscope.



(i) Draw the cell labelled **K**, as shown in the photograph. Your drawing should have a magnification $\times 2$.

(4)

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(ii) Describe how to use a micrometer to determine how many times bigger your drawing is than the actual cell in the blood smear.

(4)

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*(b) A school wanted to buy some new microscope objective lenses that would give better resolution.

Several factors affect the resolution of a microscope.

The tables show some data that the school was given from a company selling microscope objective lenses.

Table 1

Magnification of objective lenses	Objective lenses P		Objective lenses Q		Objective lenses R	
	Numerical aperture	Resolution / μm	Numerical aperture	Resolution / μm	Numerical aperture	Resolution / μm
×4	0.10	2.75	0.13	2.12	0.20	1.38
×10	0.25	1.10	0.30	0.92	0.45	0.61
×40	0.65	0.42	0.75	0.37	0.95	0.29
×100	1.25	0.22	1.30	0.21	1.40	0.20

Table 2

Wavelength of light / nm	Resolution / μm
360	0.19
400	0.21
500	0.26
600	0.32
700	0.37

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Analyse the data in Table 1 and Table 2 to determine the extent to which resolution is affected by magnification, numerical aperture and the wavelength of light.

(6)

(Total for Question 9 = 14 marks)

TOTAL FOR PAPER = 80 MARKS

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