Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Biology B

Advanced
Paper 1: Advanced Biochemistry, Microbiology and Genetics

Specimen paper for first teaching September 2015
Time: 1 hour 45 minutes

Paper Reference
9BI0/01

You may need a ruler, pencil and a calculator.

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 90.
- 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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PEARSON

Answer ALL questions.

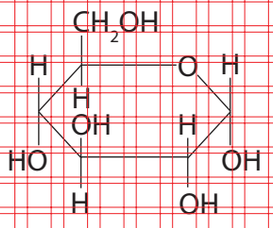
Write your answers in the spaces provided.

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 ☒.

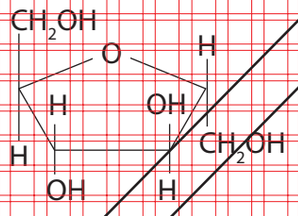
1 Glucose is broken down by respiration and produces ATP as a source of energy for metabolic reactions in cells.

The diagram shows the structure of four carbohydrates.

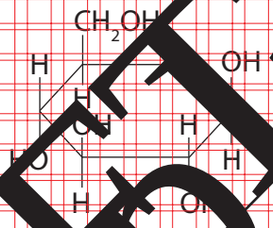
A



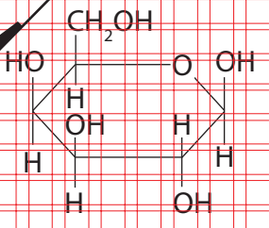
B



C



D



(a) Which of the structures is a glucose?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

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(b) (i) Which of the following stages of aerobic respiration produces four molecules of carbon dioxide for each glucose molecule?

(1)

- ☒ **A** glycolysis
- ☒ **B** Krebs cycle
- ☒ **C** link reaction
- ☒ **D** oxidative phosphorylation

(ii) Which of the following is the approximate percentage of total ATP produced, directly from the Krebs cycle?

(1)

- ☒ **A** 0%
- ☒ **B** 5%
- ☒ **C** 63%
- ☒ **D** 100%

(iii) Describe how glucose is converted to pyruvate in glycolysis.

(3)

Partial

(Total for Question 1 = 6 marks)

2 The electron carriers in chloroplasts are inhibited by detergent.

Detergents dissolve lipids.

(a) Explain how detergents inhibit the functioning of electron carriers in chloroplasts.

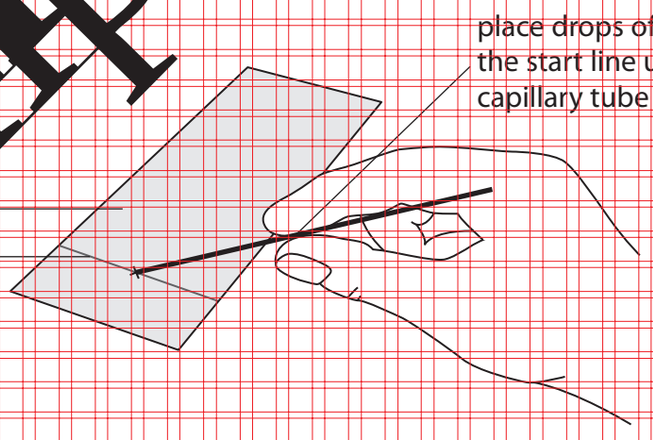
(3)

(b) Photosynthetic pigments in leaves can be separated by chromatography.

A leaf extract can be made by grinding up leaves in a solvent.

The diagram shows how the extract is applied to chromatography paper.

The extract is applied one drop at a time. The paper is dried before the next drop of extract is applied.



DRAFT

Explain why the paper is dried before the next drop of extract is applied.

(3)

.....

.....

.....

.....

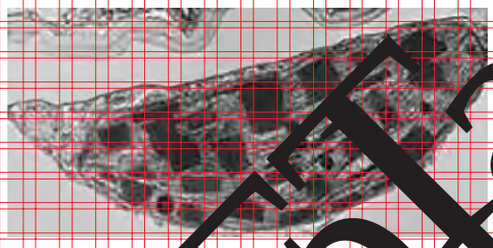
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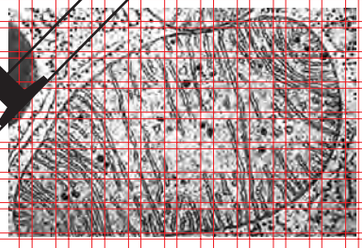
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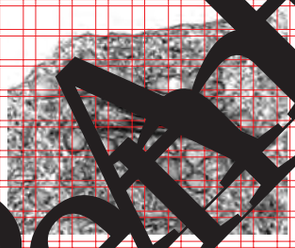
(c) The electron micrographs show four different organelles.

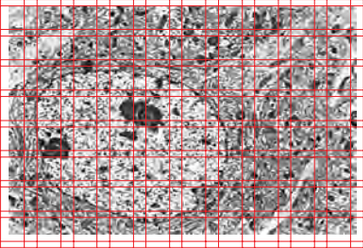


A



B





D

Which of these organelles contains the photosynthetic pigments?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 2 = 7 marks)

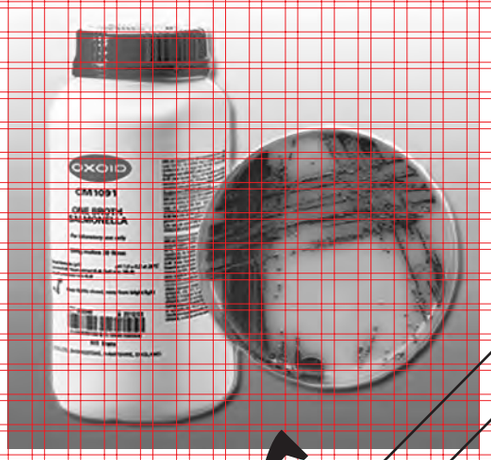
Reprint

3 *Salmonella* can cause severe vomiting and diarrhoea.

Public health laboratories use the Salmonella Rapid Culture technique to confirm a *Salmonella* infection.

This can accurately identify *Salmonella* as purple stained colonies within 48 hours.

Previous methods for the identification of *Salmonella* infections took four days.



(a) Explain the advantages of using this technique in public health laboratories.

(3)

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(b) Explain why it is important that aseptic technique is used when carrying out the Salmonella Rapid Culture technique.

(2)

(c) Which of the four statements describes the *Salmonella* endotoxin?

(1)

☒ **A** lipopolysaccharide in the cell wall membrane

☒ **B** lipopolysaccharide secreted by the cell

☒ **C** polypeptide in the cell wall membrane

☒ **D** polypeptide secreted by the cell

(Total for Question 3 = 6 marks)

Partial Removed

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Draft

4 In July 2014, scientists announced that '*Tpl2*-KO' knockout mice were resistant to inflammation of the spinal cord.

(a) Describe what is meant by '*Tpl2*-KO' knockout mice.

(2)

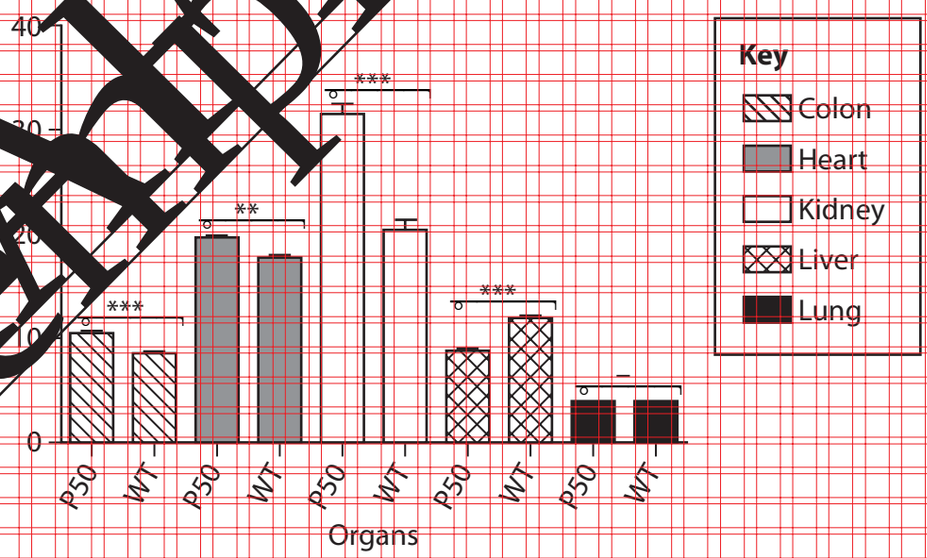
(b) A different knockout mouse strain, called P50, has also been developed.

Premature ageing can be caused by overactive NAD dehydrogenase. This enzyme is found in mitochondria.

This enzyme can cause a build up of superoxides that damage the mitochondria.

The graph shows the level of NAD dehydrogenase in different tissues of P50 mice and in wild type (WT) mice. Significance levels for *p* are also shown.

*** $-p < 0.001$; ** $p < 0.01$



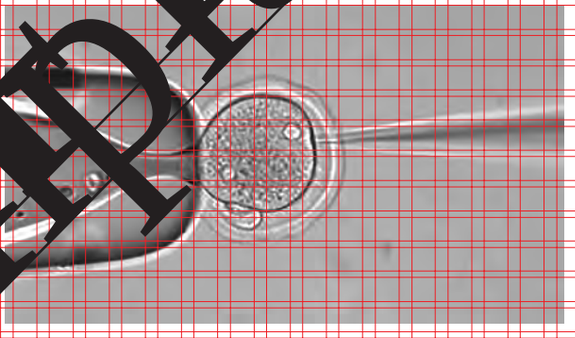
RAFTar

Use the information in the graph to predict the probability of damage occurring to the mitochondria in the organs shown.

(4)

(c) Genetic modification of mammals can be carried out using microinjection of recombinant DNA. Microinjection of DNA has a low success rate.

The photograph shows this technique being carried out using a micropipette.



In an investigation, 275 eggs were microinjected with DNA. Eight of these resulted in the birth of a live mammal, one of which was transgenic.

- Calculate the percentage success rate for producing transgenic offspring.
- Give your answer to two significant figures.

(2)

Answer ..... %

Exemplar

(ii) The success rate of DNA microinjection is lower in plants.

Plant cells have a cell wall and an internal turgor pressure. The micropipette used for DNA microinjection can cause a drastic loss of pressure and the plant cell dies.

An alternative technique is to place protoplasts into polyethylene glycol (PEG) containing the DNA. A protoplast is a plant cell with its cell wall removed.

PEG stimulates endocytosis.

This alternative technique had a success rate of up to 20% for producing genetically modified plants.

Analyse this information to explain why this alternative technique has increased the success rate of genetic modification.

(3)

REMPLAR

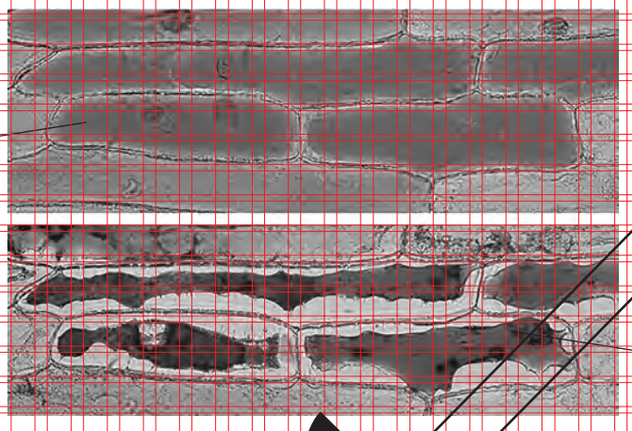
(Total for Question 4 = 11 marks)

5 The cells of all living organisms contain over 60% water.

A student investigated the effect of salt solution on plant cells.

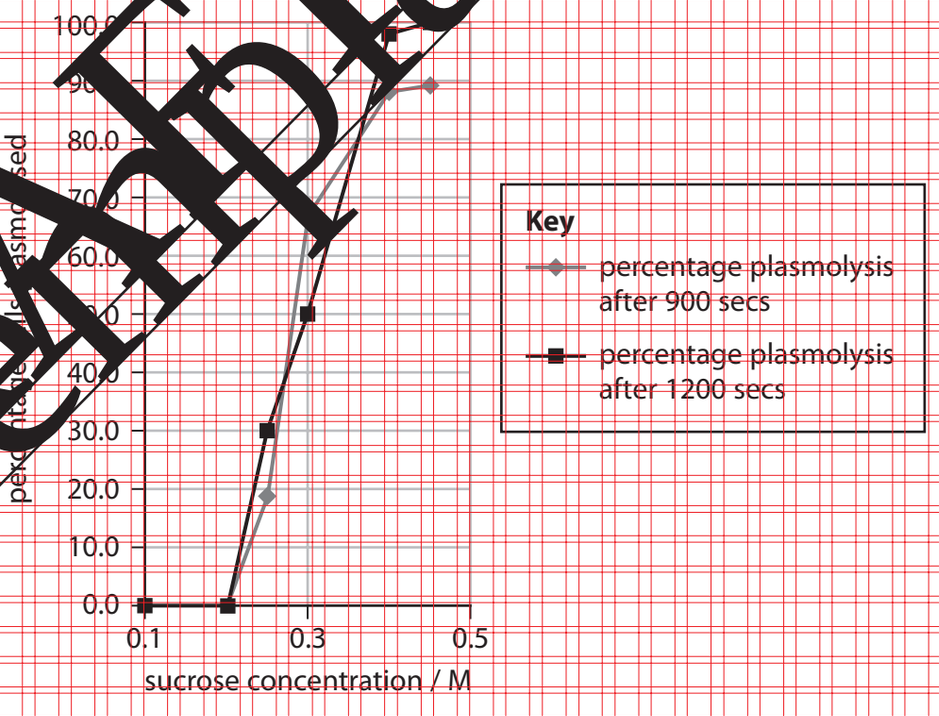
The photomicrograph shows some red onion cells that were placed in a strong salt solution in her investigation.

Some of these cells are plasmolysed because the cytoplasm has lost water, shrunk and pulled away from the cell wall.



As part of her research, the student found some data on the effect of sucrose concentration on plasmolysis in the epidermal cells of another plant species.

The graph shows the data that she found.



DRAFT

*(a) The student concluded that the osmotic potential of these cells was equivalent to 0.3 M of sucrose.

Analyse the data to explain why the osmotic potential of these cells is not necessarily equivalent to 0.3 M sucrose.

(6)

SAMPLE

(b) Water is needed for the transport of mineral ions through a plant.

Farmyard manure contains many mineral ions.

(i) Calcium ions in manure promote the growth of plants by increasing

(1)

☒ **A** amino acid synthesis

☒ **B** the production of chlorophyll

☒ **C** the strength of the middle lamella between cells

☒ **D** water loss by the leaves

(ii) Which of the following is the mechanism by which these calcium ions are transported from soil water into plants?

(1)

☒ **A** active transport

☒ **B** exocytosis

☒ **C** osmosis

☒ **D** transpiration

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(c) Water is the major component of tissue fluid in mammals.

In humans, left side heart failure can cause symptoms such as breathlessness, palpitations and a rapid pulse.

The table shows the mean blood pressure in the lung capillaries of patients with left side heart failure compared with healthy individuals.

Group	Mean blood pressure in the lung capillaries / arbitrary units
Healthy individuals	0.90
Left side heart failure	2.75

(i) Calculate the percentage increase in the mean blood pressure in the lung capillaries due to left side heart failure.

(1)

Answer ..... %

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(ii) This increased blood pressure in the capillary will cause more tissue fluid to be formed.

Analyse this information to explain the symptom of breathlessness.

(2)

(iii) In healthy individuals, only 80% of excess tissue fluid is reabsorbed directly into the blood stream.

Describe how the remaining 20% is reabsorbed.

(2)

(Total for Question 5 = 13 marks)

DRAFT

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Sample

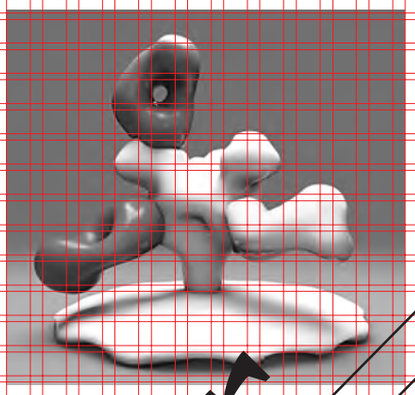
6 In 2014, the British nurse Will Pooley contracted Ebola. He was given the experimental drug Zmapp and he recovered.

Zmapp contains three monoclonal antibodies that bind to Ebola glycoprotein.

Changes to viral proteins are essential for fusion of the virus with the host cell membrane.

This process delivers the viral RNA into the cell cytoplasm.

The model shows how the three monoclonal antibodies bind to the Ebola glycoprotein.



(a) (i) Analyse the information to explain the success of Zmapp in treating patients with Ebola.

(3)

Exemplar

(ii) The rate of mutation in the Ebola virus is as fast as that of the influenza virus.

The Ebola genome codes for seven proteins, one of which is the glycoprotein.

Explain what effect a mutation may have on the effectiveness of Zmapp.

(2)

(iii) Zmapp is an experimental drug. Although it has not undergone clinical trials, animal testing has shown it to be effective.

Explain why the use of Zmapp to treat Will Pooley had ethical implications.

(3)

Exemplar

(b) The Ebola virus contains RNA that cannot be translated into protein directly.

First, RNA polymerase must produce a strand of RNA complementary to the viral RNA.

The diagram shows a section of the RNA contained in the Zaire Ebola virus.

A	A	A	A	A	A	C	A	C	A	C	A	G	G	U

(i) Give the RNA strand that the RNA polymerase would make from this section of RNA.

(1)

The table shows part of the genetic code.

RNA triplet	Amino acid	RNA triplet	Amino acid
AAA	Lysine	ACA	Threonine
AAG	Lysine	GGA	Glycine
CAU	Histidine	GGC	Glycine
CAC	Histidine	GUG	Valine
CCA	Proline	UGU	Cysteine
UUU	Phenylalanine	GGG	Glycine
UGG	Tryptophan	GUU	Valine

Exemplar

(ii) The genetic code was worked out by using radioactive synthetic RNA molecules and analysing the polypeptide produced.

The table shows some of the results obtained.

Synthetic RNA molecule	**Amino acids incorporated into the polypeptide**
contains only U	phenylalanine
contains only A	lysine
contains U and G in a 5:1 ratio	20% cysteine, 20% valine, 4% glycine, 5% tryptophan

Explain how these results give evidence for the genetic code.

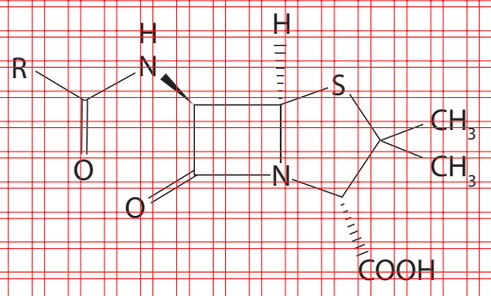
(3)

Rehpal

(Total for Question 6 = 12 marks)

7 Tetracycline and penicillin are two antibiotics that are commonly used to treat bacterial infections.

The diagram shows the structure of penicillin.



(a) Penicillin acts on bacterial cells by

(1)

☒ **A** inhibiting peptidoglycan cross-link formation in the cell wall

☒ **B** interfering with t-RNA carrying the amino acid methionine

☒ **C** preventing aerobic respiration by blocking the Krebs cycle

☒ **D** preventing t-RNA binding to ribosomes during protein synthesis

(b) In 2013, an Australian scientist said that 'evolution was winning the antibiotics arms race'.

Comment on the statement made by this scientist.

(5)

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*(c) Antibiotics are not an effective treatment for viral infections such as influenza.

Influenza infections can be prevented by vaccination.

In February 2015, BBC News reported:

"The current death rate in England and Wales is running about one-third higher than its normal rate for this time of year. A combination of influenza and very cold weather may be responsible."

In the same month, the Daily Telegraph and the Daily Mail newspapers used the following headlines:

"The 'flu jab given to millions is useless"

"The 'flu jab is a waste of time"

The National Health Service (NHS) responded by describing these newspaper headlines as irresponsible.

Evaluate the NHS response to these newspaper headlines.

(6)

Reflar

(Total for Question 7 = 12 marks)

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Exemplar

8 (a) Inflammation helps to destroy bacteria.

Which row of the table is correct for the structure of bacteria?

(1)

	Cell wall	Cell membrane	80S ribosomes	Mitochondria
☒ **A**	absent	present	absent	present
☒ **B**	present	absent	present	absent
☒ **C**	present	present	absent	absent
☒ **D**	absent	absent	present	present

(b) Inflammation is also associated with high blood pressure (hypertension).

Measurement of cytokine levels in the blood may be used to assess the severity of pulmonary arterial hypertension (PAH) in patients waiting for a heart transplant.

Which of the following is a correct statement about cytokines?

(1)

☒ **A** lipids that destroy host infected cells

☒ **B** lipids that activate T killer cells

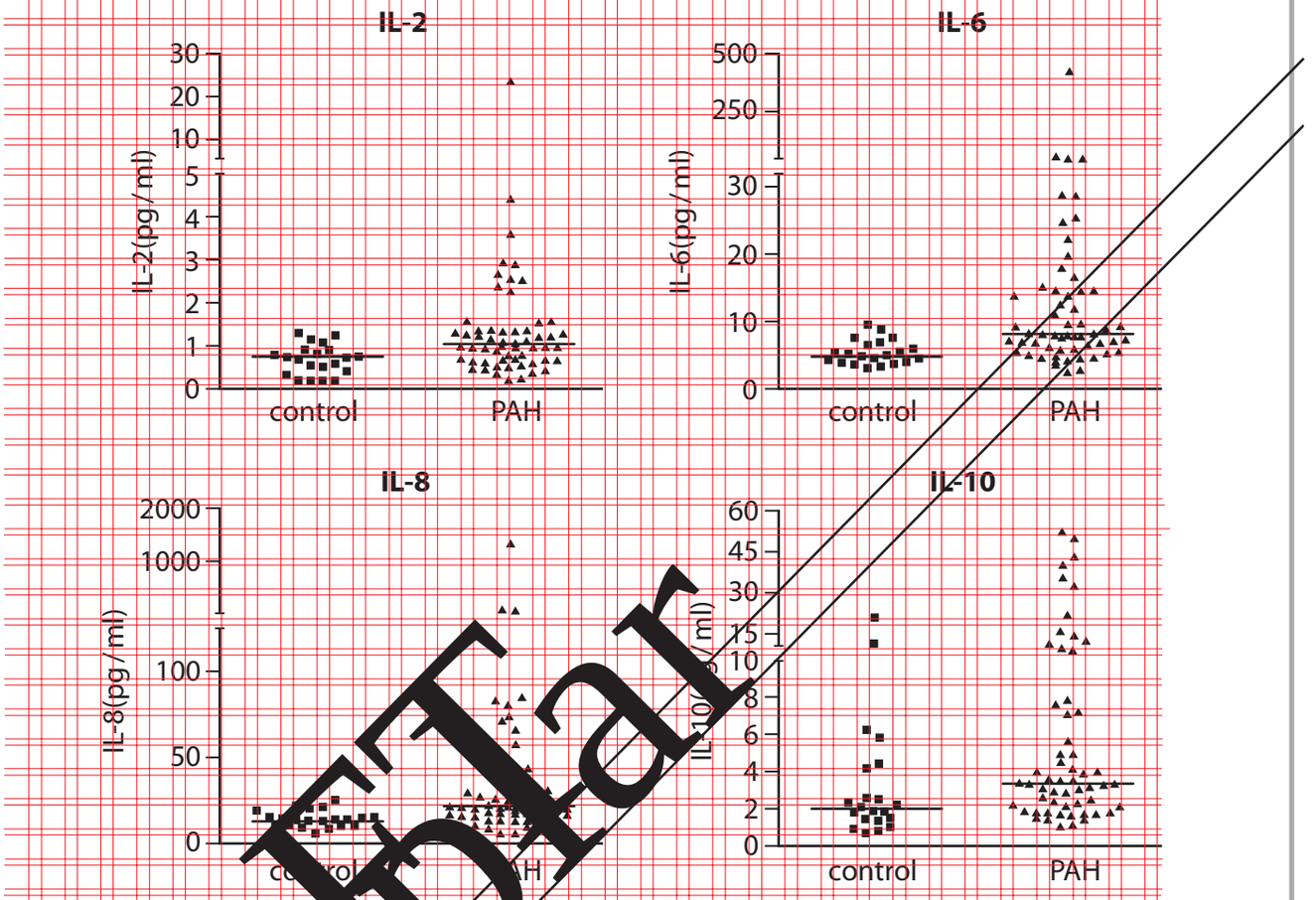
☒ **C** proteins that activate host infected cells

☒ **D** proteins that activate T killer cells

Redacted

(c) The diagram shows the levels of four different cytokines in the blood of patients with PAH.

The horizontal lines represent the means.



(i) Calculate the percentage increase in the mean levels of IL-10 in patients with PAH.

(2)

Answer ..... %

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(ii) The mean levels of all four cytokines were higher in PAH patients. A statistical test of difference was used.

The table shows the *p* values obtained.

Cytokine	*p* value
IL-2	0.0008
IL-6	0.0001
IL-8	0.0001
IL-10	0.0140

Analyse the data in the graphs and in this table to explain the value of *p* for IL-10.

(2)

Rapid

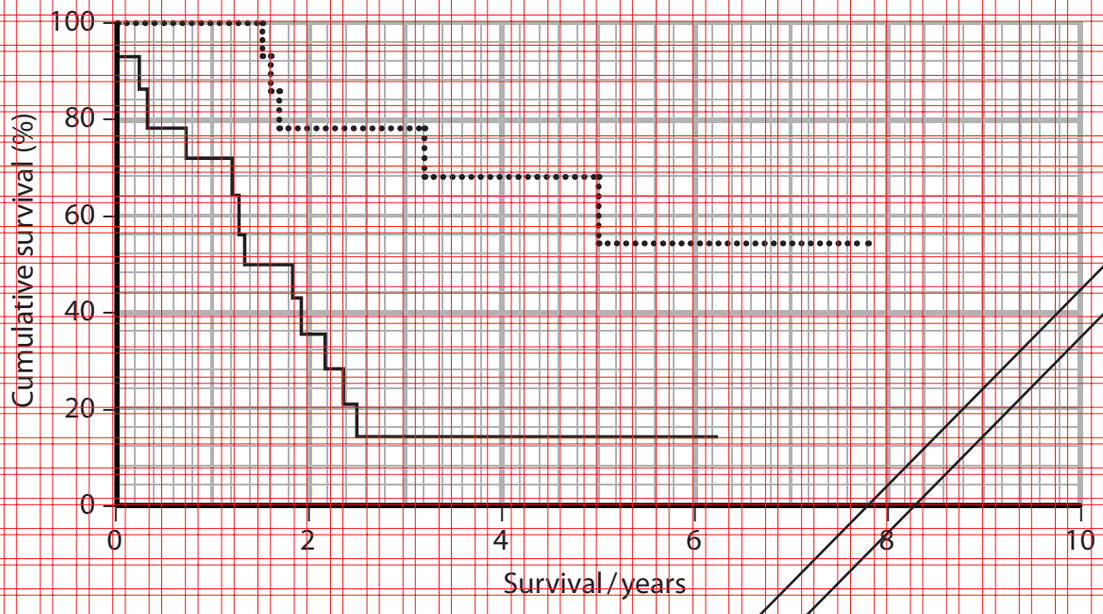
(iii) PAH causes damage to the pulmonary arteries, leading to failure of the right side of the heart and death.

Explain how PAH leads to failure of the right side of the heart.

(2)

Exemplar

(iv) The graph shows the survival rates for PAH patients with raised cytokine IL-10 levels.



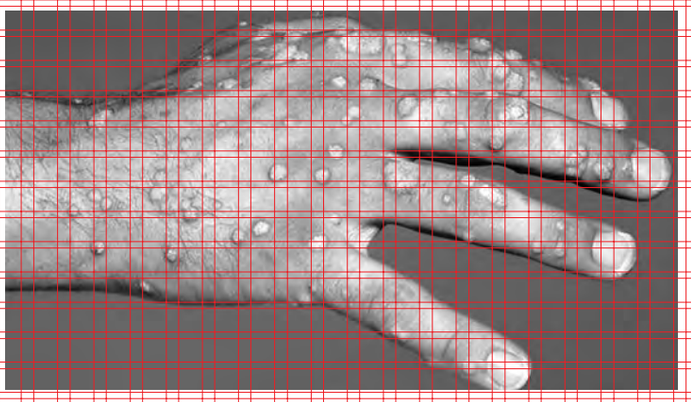
Calculate how many times worse the survival rate is for those patients with the highest levels of IL-10 after 2 years.

(2)

(Total for Question 8 = 10 marks)

Reprint

9 The photograph shows the hand of a person with the inherited condition 'WHIM'.



This condition results in a defective immune system, warts on the skin surface and an increased risk of cancer.

A woman had WHIM but her symptoms disappeared. However, she was worried that she had passed the condition on to her children.

Bone marrow is responsible for making white blood cells.

Scientists found that the woman had a single mutation in a bone marrow stem cell. This caused 'chromosome shattering' with the loss of 64 genes, including the defective gene.

(a) (i) Explain how this mutation in a bone marrow stem cell had cured her of WHIM.

(2)

Exemplar

(ii) Some people have complained about the use of stem cells from fetal cell lines in the development of Ebola vaccines.

Explain why these stem cells are being used to produce vaccines rather than bone marrow cells.

(2)

(b) Mouse embryonic fibroblasts can be converted into F-class ('fuzzy') pluripotent cells.

Scientists have shown that DNA demethylation may be involved in this conversion.

Explain how demethylation of DNA might cause this conversion.

(2)

RAPID

(Total for Question 9 = 6 marks)

10 Leukaemia is a type of cancer involving abnormal white blood cells.

In 2015, scientists announced that 1 in 5 people aged 90 or over had mutations linked to leukaemia.

The current UK population is about 64 million, of which 0.8% are aged 90 or over.

(a) (i) Calculate how many people aged 90 or over could have these mutations.

(2)

Answer .....

(ii) Patients with leukaemia were given injections of radioactive thymidine so that the growth rate of the leukaemia cells could be measured.

Thymidine is a molecule containing thymine and deoxyribose.

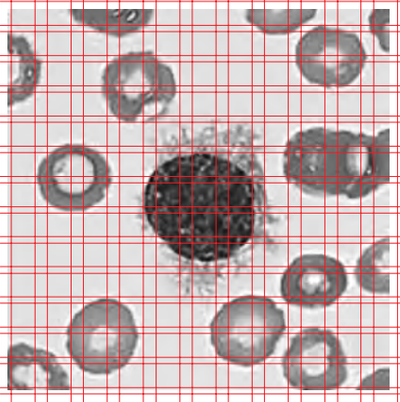
Analyse this information to explain how the radioactive thymidine could give an indication of the growth rate of the leukaemia cells.

(2)

Exemplar

(b) Hairy cell leukaemia is a rare form of the disease in which there is an increase in the number of abnormal B lymphocytes.

The photomicrograph shows one of these B lymphocytes.



The hairy cell lymphocytes have an unusually large nucleolus.

State the function of the nucleolus in this hairy cell lymphocyte.

(1)

(c) Leukaemia cells have a rapid growth rate and they tend to be small.

The cell cycle consists of three stages: interphase, mitosis and cytokinesis.

Explain which of these three stages would be shorter in a leukaemia cell.

(2)

(Total for Question 10 = 7 marks)

TOTAL FOR PAPER = 90 MARKS

Partial Retake

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Exemplar

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Exemplar

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Exemplar