Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|

**Pearson Edexcel Level 3 GCE**

Centre Number | Candidate Number

# Thursday 4 June 2020

Morning (Time: 2 hours) | Paper Reference **9BN0/01**

# Biology A (Salters Nuffield)

## Advanced

## Paper 1: The Natural Environment and Species Survival

**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 100.
- 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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P 6 1 8 2 0 A 0 1 3 2

Pearson

**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** Some diseases are linked to a failure in the endoplasmic reticulum (ER).

Cells of people with these diseases contain proteins that are folded incorrectly.

Some of these proteins are enzymes.

(a) Protein synthesis in eukaryotic cells occurs in

**(1)**

☒ **A** 70S ribosomes in the nucleus

☒ **B** 70S ribosomes on the endoplasmic reticulum

☒ **C** 80S ribosomes in the nucleus

☒ **D** 80S ribosomes on the endoplasmic reticulum

(b) (i) Many of the proteins synthesised become extracellular enzymes.

Describe what happens to these proteins following the process of translation until they are released from the cell.

**(3)**

(ii) Cells in people with these diseases produce incorrectly folded enzyme molecules.

Explain why enzymes that are incorrectly folded cannot carry out their function.

**(3)**

**(Total for Question 1 = 7 marks)**

**2** The golden snub-nosed monkey (*Rhinopithecus roxellana*) is endemic to high mountainous regions of China.

This endangered species of monkey feeds on seeds.

(a) State what is meant by the term endemic.

**(1)**

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(b) The population size of this species has decreased due to changes in its habitat. Climate change is one of the factors affecting the habitat of this species.

(i) Which of the following causes global warming?

**(1)**

☒ **A** a decrease in carbon dioxide and methane in the atmosphere that trap infrared radiation

☒ **B** a decrease in carbon dioxide and methane in the atmosphere that trap ultraviolet radiation

☒ **C** an increase in carbon dioxide and methane in the atmosphere that trap infrared radiation

☒ **D** an increase in carbon dioxide and methane in the atmosphere that trap ultraviolet radiation

(ii) Which of the following could provide evidence for climate change?

**(1)**

- ☒ **A** dendrochronology, peat bog pollen analysis and ice cores
- ☒ **B** ice cores, classification and peat bog pollen analysis
- ☒ **C** niche, dendrochronology and classification
- ☒ **D** niche, dendrochronology and ice cores

(c) Golden snub-nosed monkeys live in areas with very cold winters.

The seeds in their diet contain lipids and carbohydrates.

Climate change is reducing seed production by plants in their habitat.

Discuss the impact of climate change on the monkey population.

**(4)**

**(Total for Question 2 = 7 marks)**

**3** Humans are surrounded by microorganisms in the air, water and food.
Some microorganisms are pathogenic.
The human body has several barriers to prevent infection by pathogens.

(a) Complete the table by putting a tick (✓) in the box if the type of barrier is correct.
If the type of barrier is not correct, place a cross (✕) in the box.

**(2)**

| Type of barrier | Keratin in the skin | Lysozyme in mucus | Hydrochloric acid in the stomach |
|---|---|---|---|
| Physical | | | |
| Chemical | | | |

(b) Explain why the presence of microorganisms on the skin and in the gut helps to prevent pathogenic organisms multiplying in the body.

**(3)**

(c) The human gut contains more than a thousand species of bacteria. Only 30 to 40 of these species are found in the stomach.

Explain why there are relatively few species of bacteria in the stomach.

**(2)**

**(Total for Question 3 = 7 marks)**

**4** Thalassaemia is a recessive genetic disorder that affects the production of haemoglobin. It is caused by a gene mutation.

Scientists are developing methods to repair gene mutations such as the one that causes thalassaemia.

(a) A gene mutation can be a change in a single base in the

**(1)**

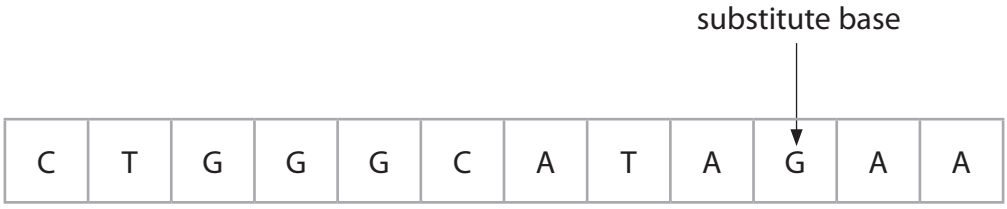
☒ **A** DNA that codes for a different amino acid

☒ **B** DNA that codes for a different monosaccharide

☒ **C** RNA that codes for a different amino acid

☒ **D** RNA that codes for a different monosaccharide

(b) One of the most common mutations causing thalassaemia is the substitution of one adenine base with guanine. The diagram shows the location of the mutation in part of the DNA strand coding for four amino acids.




Explain why this mutation affects the function of the haemoglobin molecule.

**(3)**

(c) The RNA produced during transcription is known as pre-mRNA. Pre-mRNA can be modified before being translated on the ribosome.

(i) Describe how the pre-mRNA may be modified before being translated on the ribosome.

**(2)**

(ii) Explain why modification of pre-mRNA enables one gene to give rise to more than one protein.

**(2)**

**(Total for Question 4 = 8 marks)**

**5** Reproduction in mammals involves specialised cells called gametes. The production and structure of the gametes can be affected by chemicals in the environment.

(a) (i) A sperm cell contains a specialised lysosome called the acrosome.

Describe the role of the acrosome in fertilisation.

**(3)**

(ii) Following fertilisation a zygote is formed.

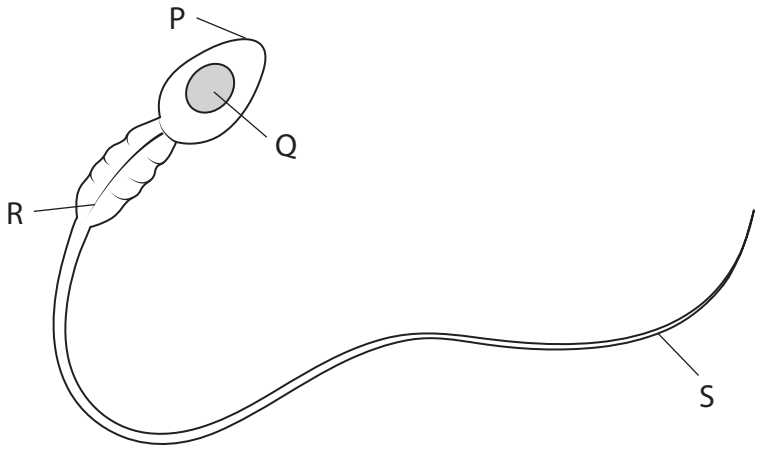
The zygote then divides by

**(1)**

- ☒ **A** meiosis to produce diploid cells
- ☒ **B** meiosis to produce haploid cells
- ☒ **C** mitosis to produce diploid cells
- ☒ **D** mitosis to produce haploid cells

(b) Human fertility may be affected by chemicals in the environment such as polychlorinated biphenyls (PCBs). It is thought PCBs affect the functioning of the mitochondria.

(i) The diagram shows the structure of a sperm cell.






Which labelled part of the sperm cell contains mitochondria?

**(1)**

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(ii) The table shows the effect of different concentrations of PCB on the speed of movement of sperm cells.

| PCB concentration / mg dm$^{-3}$ | Mean speed of sperm / μm s$^{-1}$ |
|---|---|
| 0 | 37 |
| 1 | 35 |
| 5 | 29 |
| 25 | 28 |

Calculate the percentage decrease in the mean speed of sperm in 25 mg dm$^{-3}$ of PCB compared with the control.

**(2)**

Answer .....

(iii) Deduce how PCBs could affect the speed of movement of sperm.

**(2)**

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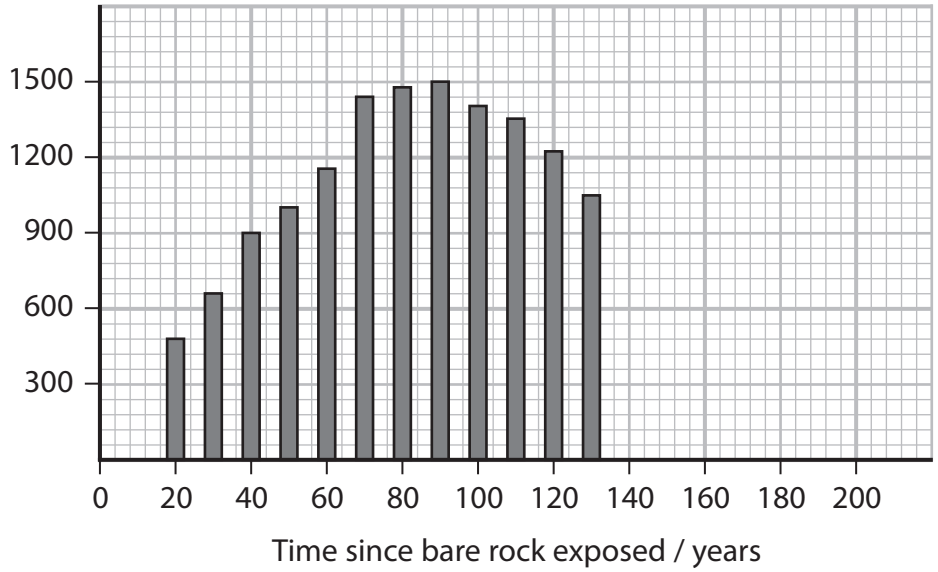
**(Total for Question 5 = 9 marks)**

**6** The photograph shows a glacier at the top of a mountain.
Glaciers in many areas of the world are retreating (reducing in size).
The line on the photograph shows the position of the front edge of the glacier in 1985.

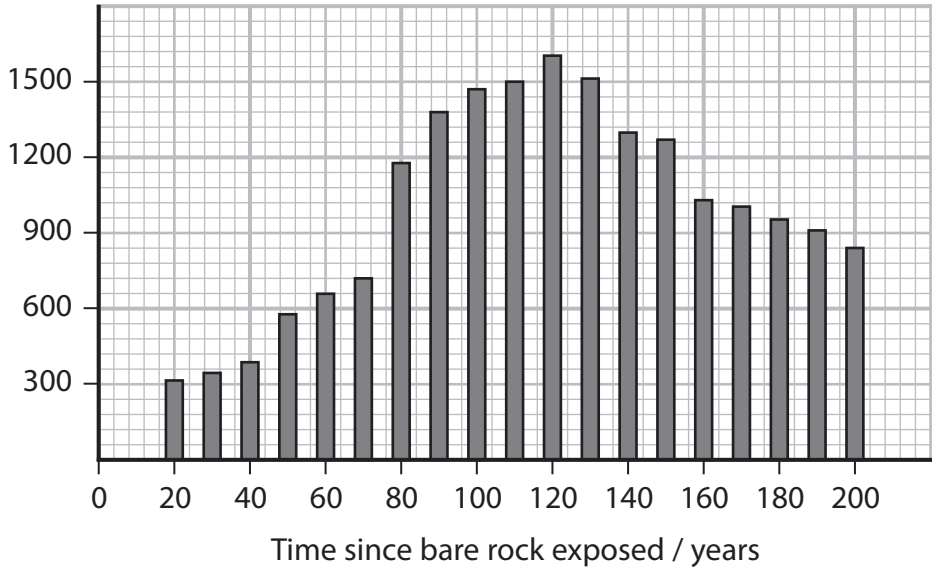

Bare rock is exposed as the glacier retreats. Two hundred years ago, bare rock was exposed after a glacier retreated. A study has been made of the long-term changes in vegetation on that area of rock after the retreat of the glacier.

The graphs show the abundance of three species of tree since the bare rock was exposed as the glacier retreated. The abundance of each species was measured every ten years for 200 years.

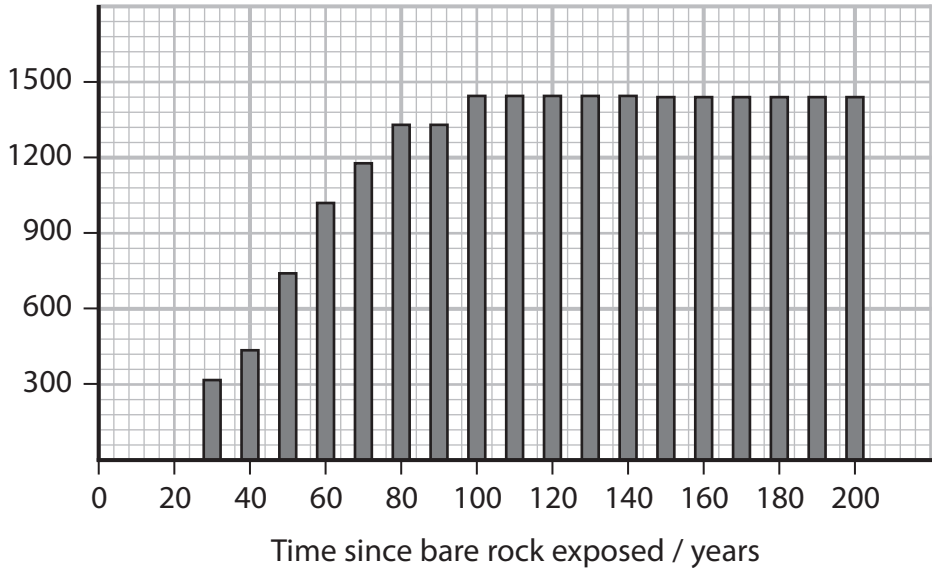
Alder




Spruce




Hemlock



(a) Comment on the changes in the abundance of these three species over 200 years.

**(4)**

(b) Explain what happened to the bare rock to allow the growth of these trees.

**(3)**

(c) Plants such as lupin are often found in the early stages of glacial retreat. Lupin plants have nodules on their roots containing nitrogen-fixing bacteria that convert atmospheric nitrogen to ammonium ions. Plants can use ammonium ions as a source of nitrogen.

Explain why lupin plants are able to grow in the early stages of glacial retreat.

**(3)**

**(Total for Question 6 =10 marks)**

**7** There are two main types of woodland in the UK. One consists of broadleaved deciduous trees, the other contains coniferous trees that have needle-like leaves.

(a) The table shows some of the species of plant growing underneath the trees in a deciduous woodland.

| Species | Number of individuals of each species (n) | n(n – 1) |
|---|---|---|
| Woodrush | 2 | |
| Holly | 8 | |
| Bramble | 1 | |
| Yorkshire fog | 9 | |
| Sedge | 3 | |

(i) Complete the table to show n(n – 1) for each species of plant.

**(1)**

(ii) Calculate the diversity index (D) using the data in the table.

$$D = \frac{N(N-1)}{\Sigma n(n-1)}$$

**(2)**

Answer .....

(b) Another measure of diversity is species richness.

(i) Species richness is the number of

**(1)**

☒ **A** different alleles in one species

☒ **B** different species in one area

☒ **C** individuals of one species in one area

☒ **D** individuals of one species in different habitats

(ii) Devise an investigation to compare species richness of the plants growing under the trees in a deciduous woodland with that of a coniferous woodland.

**(5)**

(c) In a study of two woodlands, 11 species of plant were found in a deciduous woodland and 4 different species in a coniferous woodland.

The table shows the other data recorded in this study.

| Factor | Deciduous woodland | Coniferous woodland |
|---|---|---|
| Mean light intensity 10 cm above soil level / lux | 1075 | 543 |
| Mean pH of soil | 7 | 5 |
| Mean air temperature 10 cm above soil level / °C | 18 | 18 |
| Mean soil moisture content (%) | 45 | 47 |

Assess the reasons for the differences in the number of species between these two types of woodland.

**(4)**

**(Total for Question 7 = 13 marks)**

**8** The photograph shows an orangutan. These animals inhabit the forests of Borneo and Sumatra.

They are critically endangered, largely due to habitat loss and hunting.

Managed breeding programmes in zoos are an important factor in the conservation of the orangutan.

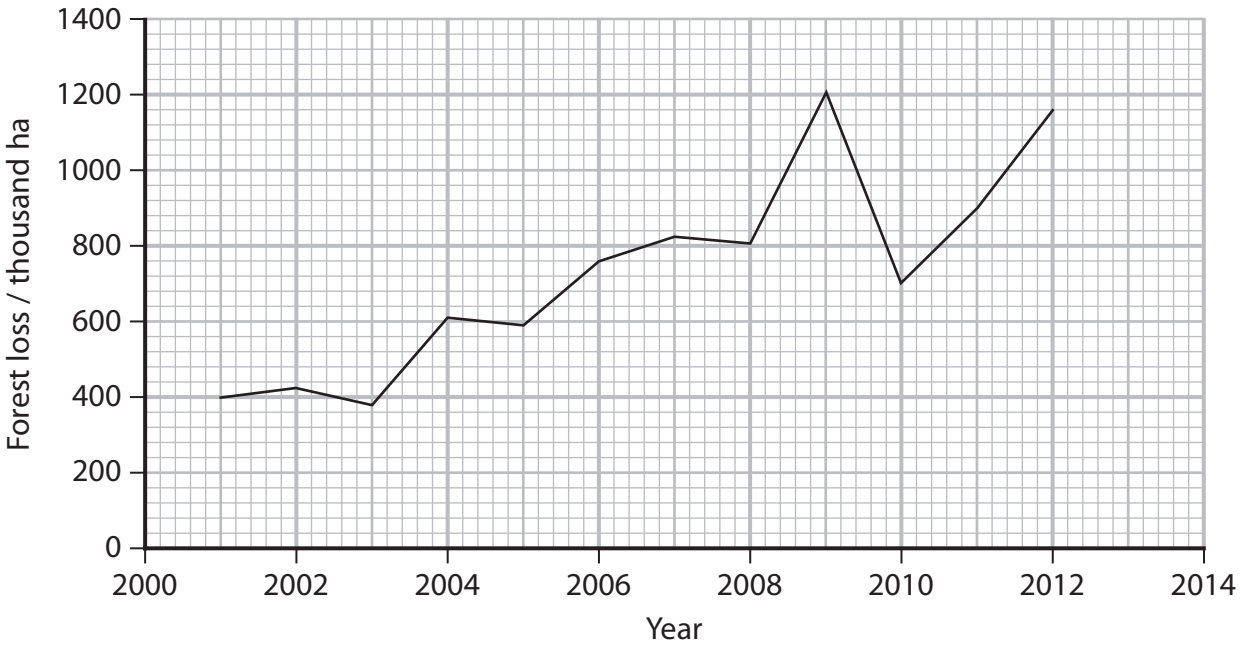
(a) Explain how breeding programmes in zoos maintain the genetic diversity of captive populations.

**(3)**

(b) The orangutan population in Borneo decreased by 60% between 1950 and 2010.

This has been linked to loss of habitat. Deforestation has resulted in the loss of natural habitat.

The graph shows the area of forest loss in Borneo from 2001 to 2012.




(i) Calculate the mean rate at which forest was lost between 2010 and 2012.

**(2)**

Answer .....

*(ii) Land use has changed over time in Borneo, with areas of forest being removed due to logging. The land may then be used for planting oil palms, which are not a suitable habitat for orangutans.

The following comments refer to other issues concerning the conservation of orangutans in Borneo.

- Over the past 100 years, 80% of suitable habitat for orangutans has been lost.
- Only 2% of the remaining forest suitable as orangutan habitat is protected.
- From 1999 to 2015, the orangutan population decreased by 50%.
- Captive-bred orangutans may spread human diseases into wild populations.
- When captive-bred orangutans are released, their offspring often die young because the females have not learnt parenting behaviour from older individuals.
- Large numbers of orangutans are hunted in Borneo, even though they are a protected animal.

It has been stated that habitat protection is more important than captive breeding programmes for the conservation of orangutans in Borneo.

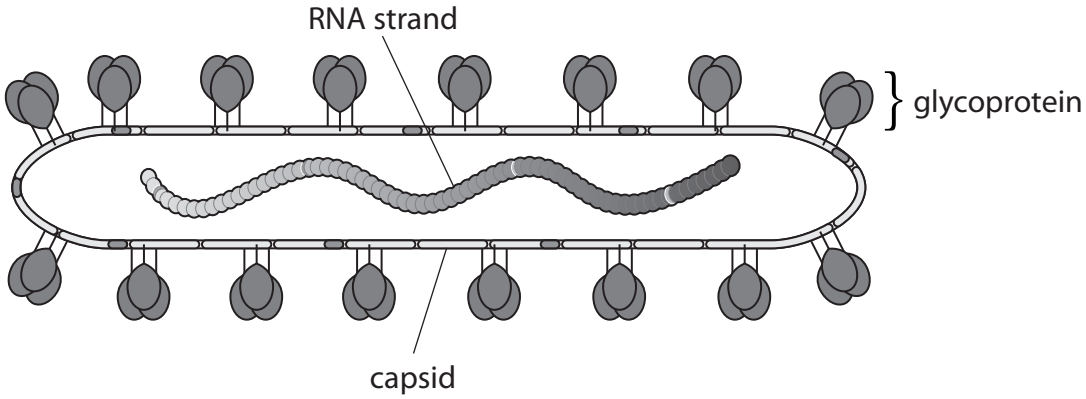
Evaluate this statement.

**(6)**

**(Total for Question 8 = 11 marks)**

**9** Ebola virus disease (EVD) is a rare and deadly disease most commonly found in Africa. Following a severe outbreak in 2014, in which 11 000 people died, work has been underway to develop a vaccine.

The diagram shows the structure of an Ebola virus.




(a) Compare and contrast the structure of Ebola virus with that of the human immunodeficiency virus (HIV).

**(3)**

(b) A vaccine has been developed by genetically modifying a virus that infects cattle. In the genetically modified virus, one of the genes was replaced with a gene for a protein found in the Ebola virus.

In a trial of 52 volunteers, 48 developed antibodies against the Ebola virus within 14 days of injection.

(i) The type of immunity given by this vaccine is

**(1)**

☒ **A** artificial active immunity

☒ **B** artificial passive immunity

☒ **C** natural active immunity

☒ **D** natural passive immunity

(ii) Explain the role of T cells in the immunity to the Ebola virus that develops following the use of this vaccine.

**(3)**

(c) The vaccine is still undergoing clinical trials, but was given approval for use in recent Ebola outbreaks.

(i) Describe how clinical trials of a vaccine would be conducted.

**(3)**

(ii) The Ebola vaccine was given to health workers and immediate family of those with the disease.

Justify the use of this vaccine, even though the clinical trials had not been completed.

**(4)**

**(Total for Question 9 = 14 marks)**

**10** Farmers grow wheat plants to produce grain that is used to make flour. Farmers can use modern technology to monitor the mass and the moisture content of the grain in a field. Wheat can be sold at a higher price when it has a lower moisture content.

The table shows some data recorded from a field of wheat.

| Plot number | Moisture content of grains (%) | Mass of wheat grains / tonnes per Ha |
|---|---|---|
| 1 | 0.57 | 0.759 |
| 2 | 0.58 | 0.523 |
| 3 | 0.67 | 4.243 |
| 4 | 0.94 | 1.954 |
| 5 | 1.64 | 1.417 |
| 6 | 1.93 | 1.170 |
| 7 | 2.27 | 1.321 |
| 8 | 2.53 | 6.289 |
| 9 | 4.96 | 3.809 |
| 10 | 10.36 | 3.404 |
| mean | | 2.489 |

(a) (i) Which of the following describes the relationship between the mass of wheat grain and the moisture content of the wheat grain?

**(1)**

☒ **A** inverse correlation

☒ **B** negative correlation

☒ **C** no correlation

☒ **D** positive correlation

(ii) Calculate the standard deviation for the mass of wheat using the formula

$$s = \sqrt{\frac{\Sigma(x - \overline{x})^2}{n - 1}}$$

**(3)**

Answer .....

(b) Farmers use fertilisers to increase the growth of crops such as wheat.

(i) Fertilisers contain phosphate ion compounds.

Plants need phosphate in order to synthesise

**(1)**

☒ **A** both cellulose and phospholipids

☒ **B** both phospholipids and polysaccharides

☒ **C** both polynucleotides and phospholipids

☒ **D** both polynucleotides and polysaccharides

(ii) After the grain is harvested, farmers plough the stems (straw) from wheat plants into the soil. This improves the quality of the soil.
These stems contain polysaccharides.

Explain how microorganisms in the soil break down the stems.

**(3)**

*(c) Biological farming aims to reduce the use of fertilisers to add minerals to the soil.

The following is some information on biological farming.

- Biological farming makes use of products containing fungi that can be added to soil to improve soil life.
- Soil life is essential for converting nutrients into a plant-available form.
- Fungi form a network around the roots of plants to trap water and aid absorption of mineral ions.
- Some fungi provide protection from pathogens.

Devise a procedure, using wheat seedlings, to compare the effects of a biological farming product with the use of a chemical fertiliser on the growth of plants.

**(6)**

**(Total for Question 10 = 14 marks)**

**TOTAL FOR PAPER = 100 MARKS**

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