Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 3 GCE

Monday 13 May 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **8BI0/01**

Biology B

Advanced Subsidiary

PAPER 1: Core Cellular Biology and Microbiology

You must have:
Scientific 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.*
- 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.

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 (a) Plants take up magnesium ions and nitrate ions from the soil. These inorganic ions are dissolved in the water in the soil.

(i) Magnesium ions and nitrate ions are incorporated into molecules made by the plant.

Which row in the table shows the molecules that incorporate these ions?

(1)

		amino acids	chlorophyll	nucleotides
☒	**A**	magnesium ions	nitrate ions	magnesium ions
☒	**B**	magnesium ions	nitrate ions	nitrate ions
☒	**C**	nitrate ions	magnesium ions	nitrate ions
☒	**D**	nitrate ions	magnesium ions	magnesium ions

(ii) Explain why these ions dissolve in water.

(2)

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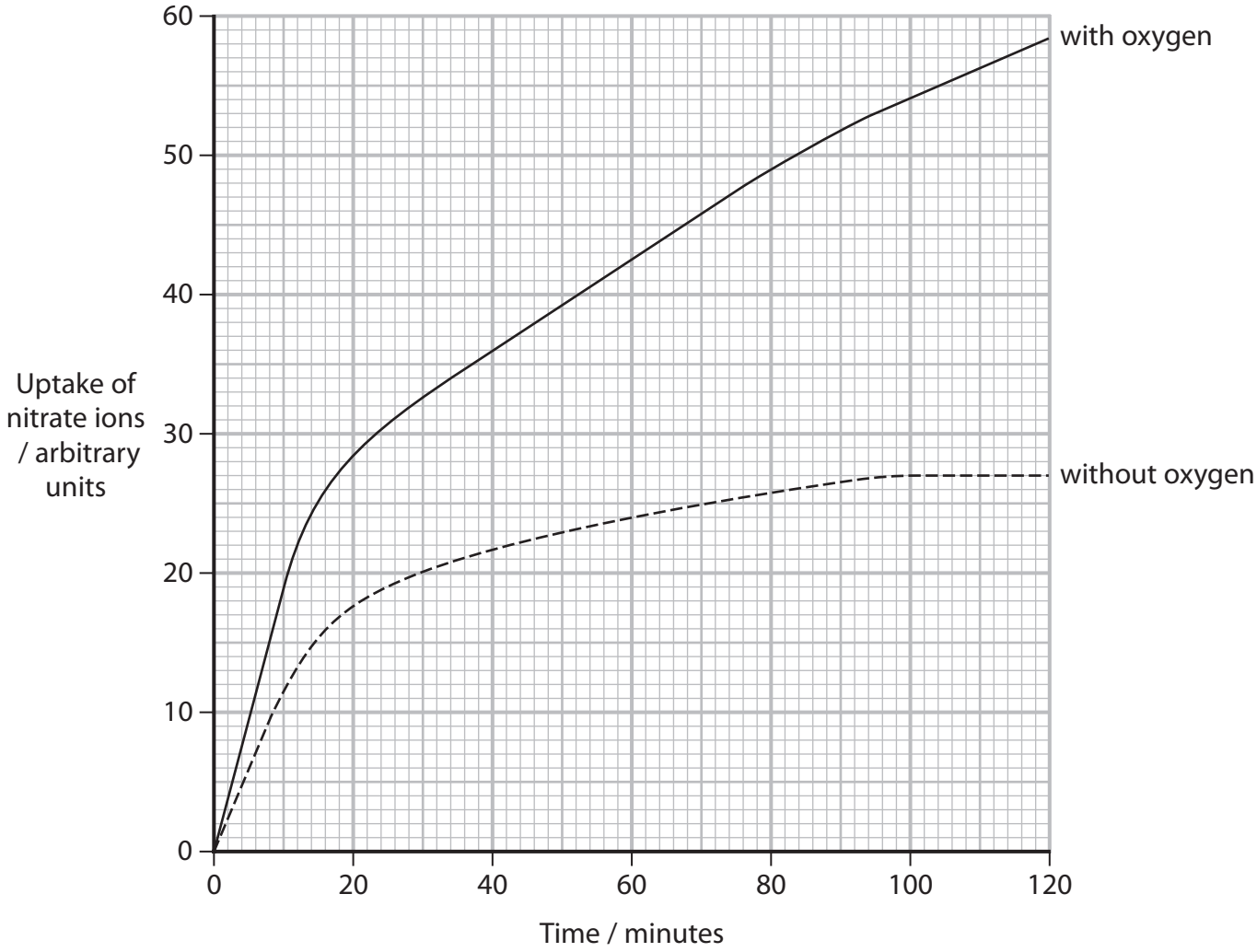
(b) The graph shows the uptake of nitrate ions by a plant in the presence and absence of oxygen.



Analyse the data to describe **two** conclusions that can be made about the uptake of nitrate ions by this plant.

(2)

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(Total for Question 1 = 5 marks)

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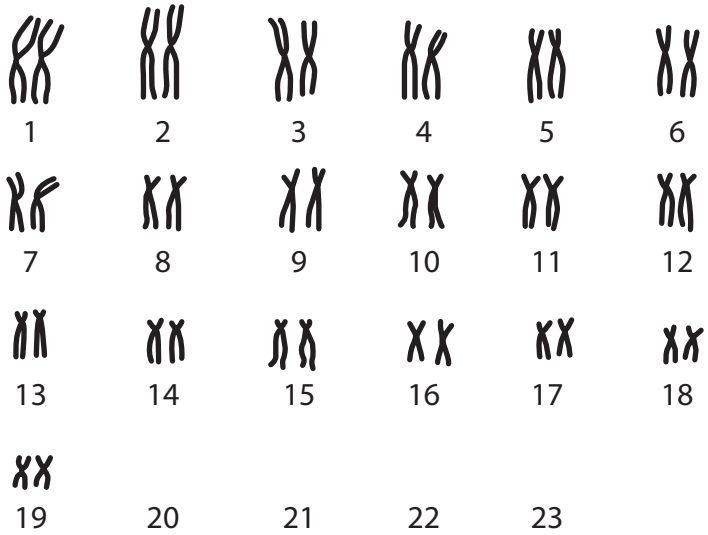
2 Chromosome mutations include non-disjunction and translocation.

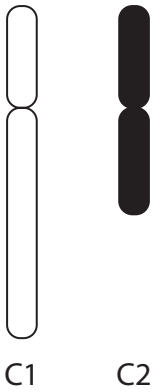
(a) The diagram shows part of a karyotype from a female with Down's syndrome.

Complete the diagram to show the full karyotype of a female with Down's syndrome.

(2)



(b) The diagram shows two chromosomes, C1 and C2, before translocation.



Draw a diagram to show the appearance of these two chromosomes after translocation has occurred.

(1)

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(c) The table shows some features of a control group of females without Turner's syndrome and a group of females with Turner's syndrome.

Feature	Control group n = 11	With Turner's syndrome n = 37
Mean mass / kg ± SD	45.2 ± 19.3	36.7 ± 14.8
Mean height / cm ± SD	146.3 ± 21.3	134.8 ± 20.0
Body mass index (BMI)		20.2

(i) Complete the table to show the BMI for the control group, using the formula:

$$\text{BMI} = \text{mass in kg} \div (\text{height in metres})^2$$

(2)

(ii) Analyse the data to comment on the conclusions that could be made about the effect of Turner's syndrome on these features.

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(Total for Question 2 = 9 marks)

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3 *Bacillus subtilis* and *Pseudomonas aeruginosa* are two types of bacteria.

(a) (i) Which pair of structures is found in these bacteria?

(1)

☒ **A** nucleoid and 70S ribosomes

☒ **B** nucleoid and 80S ribosomes

☒ **C** nucleus and 70S ribosomes

☒ **D** nucleus and 80S ribosomes

(ii) Name **three other** structures that are surrounded by the cell wall of bacteria.

(2)

1 .....

2 .....

3 .....

(b) A scientist determined the thickness of the cell wall of these bacteria.

The thickness of the cell wall of *B. subtilis* is 55.4 nm and the thickness of the cell wall of *P. aeruginosa* is 2.4 nm.

(i) Calculate the ratio of the thickness of the cell wall of *B. subtilis* to that of *P. aeruginosa*.

Give your values to **two** significant figures.

(1)

Answer .....

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(ii) Some antibiotics affect only Gram positive bacteria.

Explain which of *B. subtilis* or *P. aeruginosa* will be affected by these types of antibiotics.

(2)

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(c) *Bacillus subtilis* was grown in a culture. At the start the culture contained 6×10^3 cells and after two hours the culture contained 1.7×10^5 cells.

Calculate the mean rate of increase in the number of bacteria in this culture.

Give your answer in cells per minute.

(2)

Answer ..... cells per minute

(Total for Question 3 = 8 marks)

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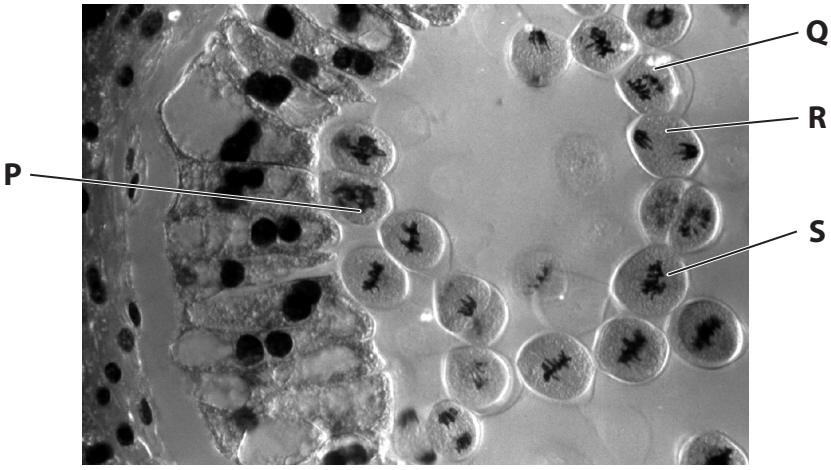
4 Sexual reproduction occurs in flowering plants.

(a) The photograph shows meiosis in a bluebell plant.



(Source: SCIENCE PICTURES LTD/SCIENCE PHOTO LIBRARY)

(i) Which cell is in the latest stage of meiosis?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

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(ii) Devise a practical procedure to determine the total percentage of cells in both metaphase I and metaphase II in a bluebell.

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(b) Explain how meiosis results in genetic variation in a flowering plant.

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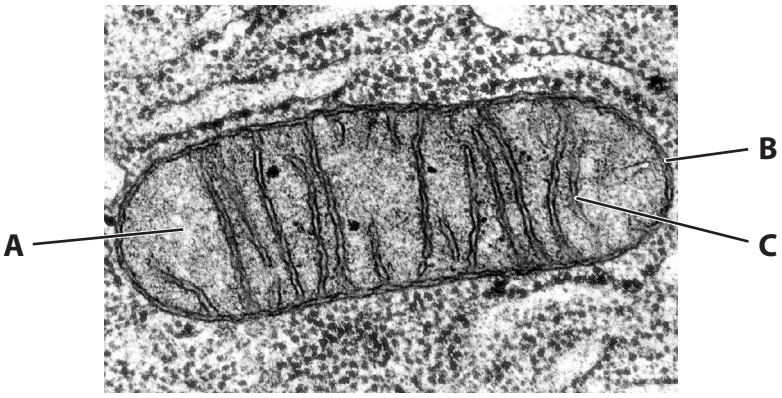
5 The photograph shows a mitochondrion, as seen using an electron microscope.



(Source: © CNRI/SCIENCE PHOTO LIBRARY)

(a) Name the parts labelled **A**, **B** and **C**.

(2)

A .....

B .....

C .....

(b) Draw a diagram of this mitochondrion.

(2)

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(c) The actual length of this mitochondrion is 0.9 μm.

(i) What is the magnification of this photograph?

(1)

☒ **A** ×1200

☒ **B** ×8200

☒ **C** ×12 000

☒ **D** ×82 000

(ii) The magnification of this photograph can be shown as a scale bar.

Complete the 1 cm scale bar for this photograph.

(1)

1 cm scale bar ├──┤

Answer ..... μm

(d) Explain why specimens have to be stained with coloured dyes when viewed using a light microscope and not when using an electron microscope.

(2)

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(Total for Question 5 = 8 marks)

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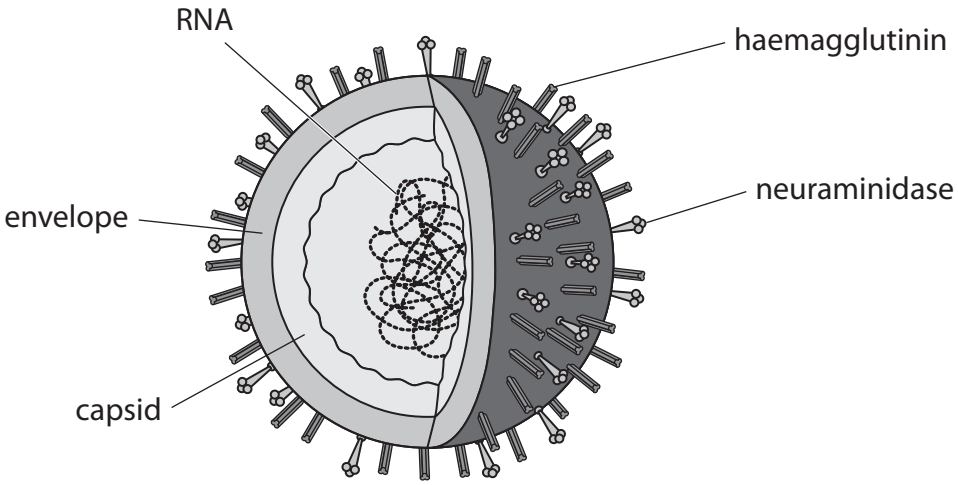
6 The diagram shows the structure of the influenza virus.



(a) The influenza virus has a helical capsid.

Which virus also has a helical capsid and an envelope?

(1)

☒ **A** Ebola

☒ **B** human immunodeficiency virus

☒ **C** λ (lambda) phage

☒ **D** tobacco mosaic virus

(b) Neuraminidase is an enzyme.

Describe the structure of an enzyme.

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*(c) The host cells of the influenza virus are the cells lining the airways. These cells are coated in mucus.

Neuraminidase and haemagglutinin are glycoproteins present in the envelope of the influenza virus.

Neuraminidase and haemagglutinin are important in the lytic cycle of this virus.

Neuraminidase breaks bonds between sialic acid groups and other molecules.

Sialic acid is found on glycoproteins present in the cell membrane, mucus and the envelope of the virus.

Haemagglutinin is a glycoprotein that binds to sialic acid groups.

The lytic cycle of the influenza virus includes the following steps:

1 the virus attaches to a cell

2 the virus moves until it attaches to the correct cell surface receptor

3 new virus particles are made inside the host cell

4 new virus particles bud from the host cell

5 new virus particles are attached to the outside of the host cell membrane and to each other

6 new virus particles infect new host cells.

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Explain the importance of neuraminidase and haemagglutinin in the spread of infection of the influenza virus in the body.

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(Total for Question 6 = 10 marks)

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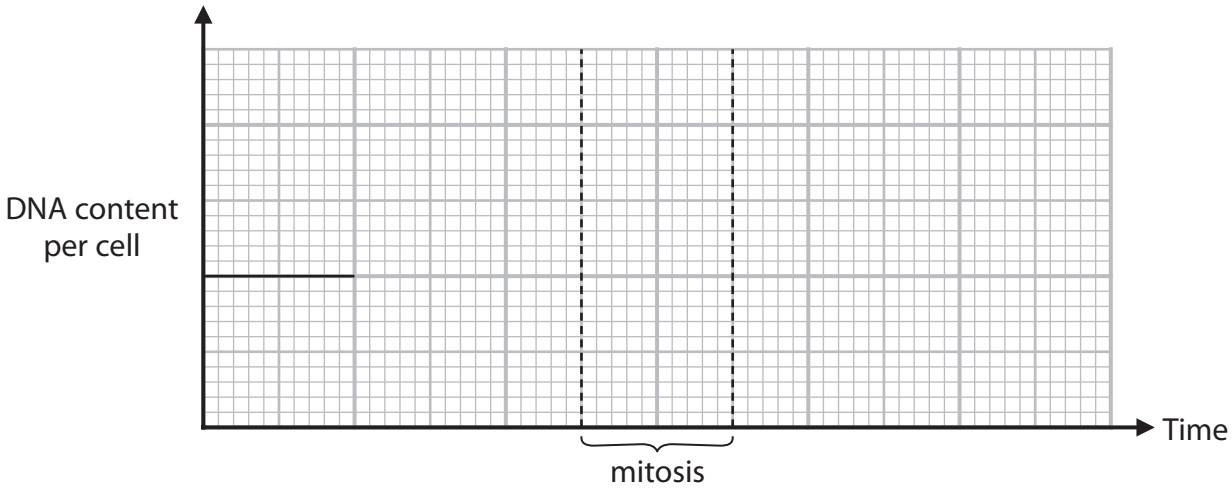
7 The synthesis of DNA takes place during the cell cycle.

(a) Sketch a graph to show how the DNA content of a cell changes during one cell cycle that includes mitosis.

(3)



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*(b) The experiments of Meselson and Stahl contributed to our current understanding of DNA replication.

The diagram shows the stages involved in one experiment.

Stage 1

Bacteria grown for several generations in a culture medium containing heavy nitrogen (^{15}N)

↓

Stage 2

Bacteria from stage 1 grown for one generation in a culture medium containing light nitrogen (^{14}N)

↓

Stage 3

Bacteria from stage 2 grown for one generation in a culture medium containing light nitrogen (^{14}N)

↓

Stage 4

Bacteria from stage 3 grown for one generation in a culture medium containing light nitrogen (^{14}N)

After each stage, a sample of DNA was taken from the bacteria and the DNA molecules separated using a density gradient in a tube.

The heavier DNA molecules form bands lower down the gradient than lighter DNA molecules.

The size of each band is proportional to the percentage of DNA molecules in the sample.

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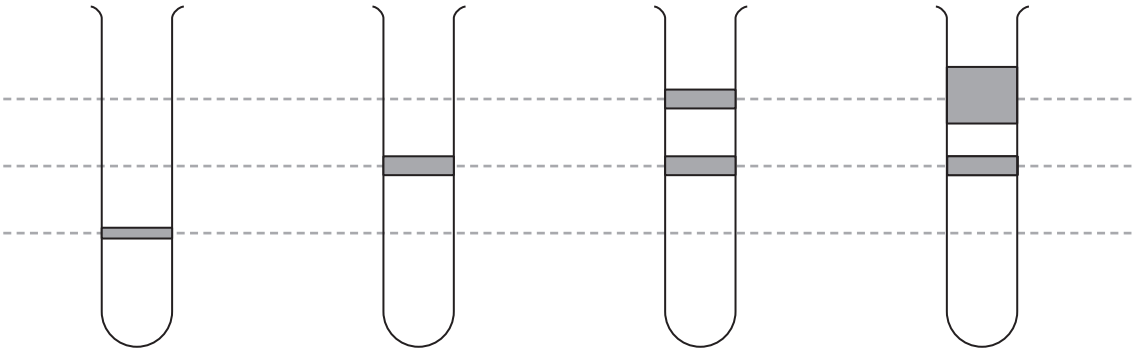
The diagram shows the results of this experiment.



DNA taken after stage 1 | DNA taken after stage 2 | DNA taken after stage 3 | DNA taken after stage 4

Analyse the data to explain the results of this experiment and how it contributed to our current understanding of DNA replication.

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(Total for Question 7 = 9 marks)

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8 Carbohydrates can be classified as monosaccharides, disaccharides, or polysaccharides.

(a) The table gives some information about polysaccharides.

For each polysaccharide, put **one** cross in the appropriate box, in each row, to show the type of glycosidic bond present.

(3)

Polysaccharide	Type of glycosidic bond			
	both 1–4 and 1–6	1–4 only	1–6 only	neither 1–4 nor 1–6
cellulose	☒	☒	☒	☒
glycogen	☒	☒	☒	☒
starch	☒	☒	☒	☒

(b) Monosaccharides and disaccharides are either reducing sugars or non-reducing sugars.

The presence of a reducing sugar, such as glucose, can be identified using the Benedict's test. The method can be used to determine the concentration of the reducing sugar.

The diagram shows the steps involved in the Benedict's test.

Step 1

Add Benedict's solution to the sugar solution in a test tube

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Step 2

Place the test tube in a hot water bath until the colour changes

↓

Step 3

Determine the concentration of reducing sugar from a colour chart

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The table shows the colour chart.

Colour after heating	blue	green	yellow	orange	red
Concentration of reducing sugar / mg dm^{-3}	0	<1000	1000 to 1500	1500 to 2000	>2000

(i) Describe **two** limitations of using this method for determining the concentration of reducing sugars.

(2)

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(ii) This method can be modified to determine the concentration of non-reducing sugars.

Non-reducing sugars, such as sucrose, must be heated in acid before step 1.

A student was given a solution containing both glucose and sucrose.

Devise a method, using the Benedict's test, to determine the concentration of each of these sugars in this solution.

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(Total for Question 8 = 9 marks)

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9 The membranes of cells and organelles contain many types of lipids.

(a) Phospholipids are one type of lipid found in cell membranes.

(i) Explain the role of phospholipids in the cell membrane.

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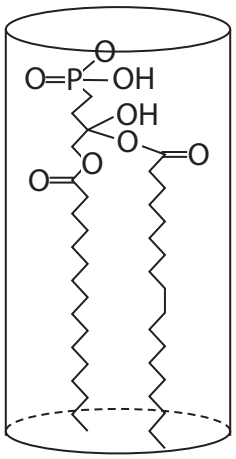
(ii) The diagram shows a phospholipid drawn inside a cylinder.



The cross-sectional area of this cylinder is 0.3 nm^2.

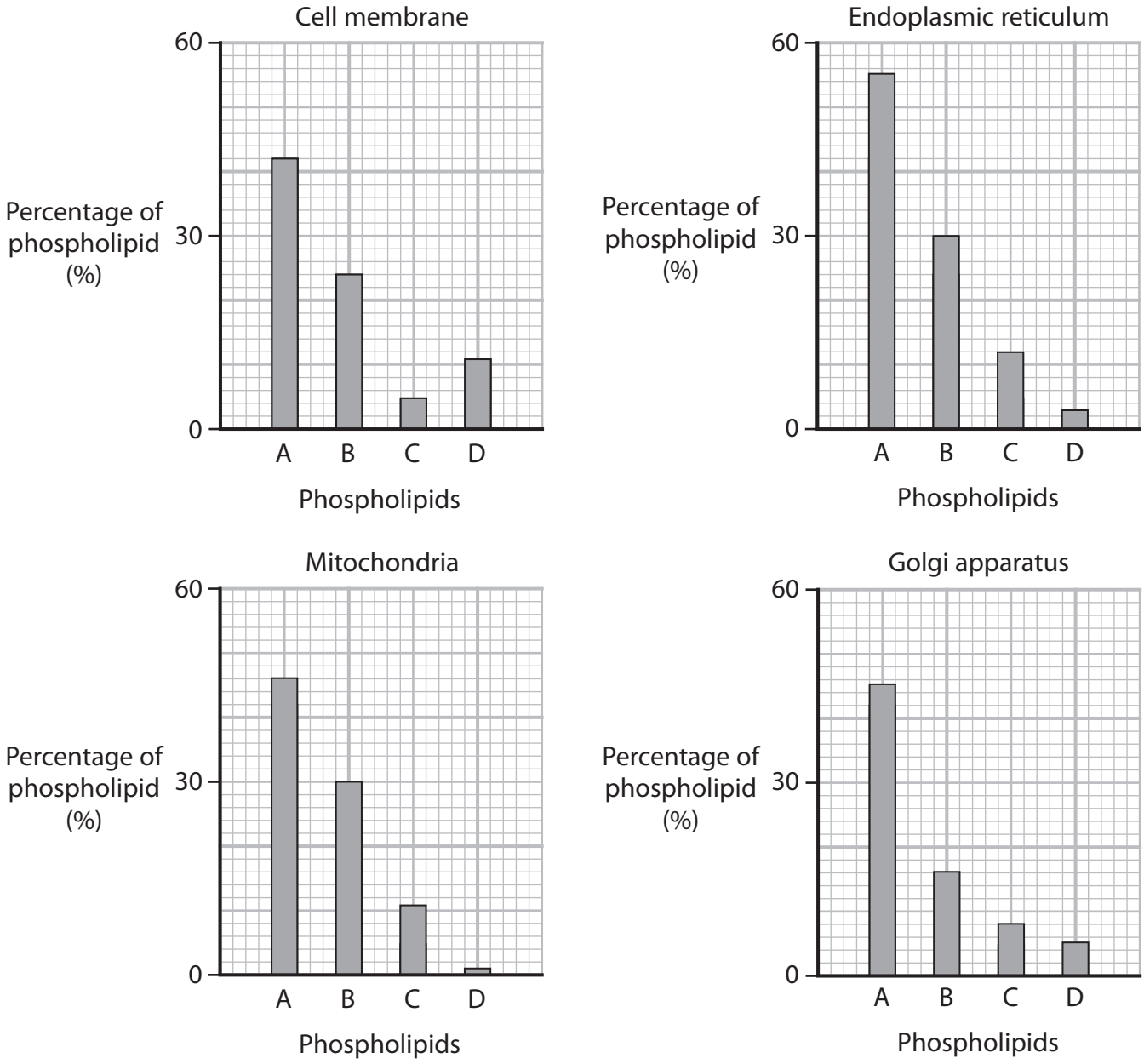
Calculate the number of phospholipid molecules in 1 μm^2 of a phospholipid bilayer.

Give your answer in standard form.

(3)

Answer .....

(b) The graphs show the percentage of four types of phospholipid, A, B, C and D, in the cell membrane and in the membranes of endoplasmic reticulum, mitochondria and Golgi apparatus.



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(i) Describe how the structure of one type of phospholipid can be different from the structure of another type of phospholipid.

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(ii) Compare and contrast the phospholipid content of these membranes.

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(iii) The scientists who produced the data did not expect the phospholipid content in the membranes of the endoplasmic reticulum and the Golgi apparatus to be different.

Explain why these scientists did not expect there to be a difference in the phospholipid content in the membranes of these two organelles.

(2)

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(Total for Question 9 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

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