Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 3 GCE

Time 1 hour 30 minutes

Paper reference **8BI0/01**

Biology B

Advanced Subsidiary
PAPER 1: Core Cellular Biology and Microbiology

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.
- 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 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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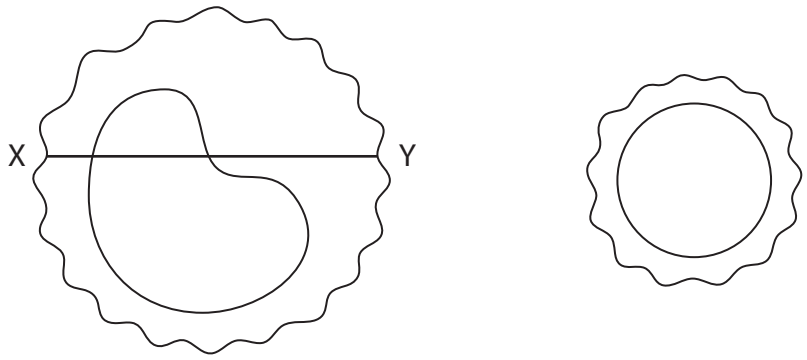
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Answer ALL questions.

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 student drew two types of white blood cell, from a slide viewed using a light microscope.



Cell A Cell B

The student used the internet to research the actual diameter of these two types of cell.

The student found several values for the diameters of cell A and cell B. They used the mean value for the diameter of cell B to calculate the magnification of the drawing of cell B.

The student calculated the magnification of the drawing of cell B to be ×1571.

The student found the following values for the diameter of cell A:
0.016 mm, 0.022 mm, 0.019 mm, 0.021 mm, 0.017 mm.

(a) Calculate the magnification of the drawing of cell A, using the mean diameter of this cell.

Measure the diameter of cell A between the points X and Y on the diagram.

(2)

Answer .....

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(b) This method of calculating the magnification of these drawings is not accurate.

Describe a method that the student could use to calculate the magnification accurately.

(3)

(Total for Question 1 = 5 marks)

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2 Triglycerides, found in living organisms, have different melting points.

Two factors that affect the melting point of a triglyceride are:

1. the length of the fatty acid chains
2. whether the fatty acid chains are saturated or unsaturated.

(a) A triglyceride is made from the components glycerol and fatty acids.

(i) How many of the following statements about triglycerides are correct?

(1)

- a glycerol molecule is joined to each fatty acid by an ester bond
- an unsaturated fatty acid has at least one double bond between two carbon atoms
- all triglycerides have three fatty acids joined to a glycerol

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(ii) The table shows the relative atomic mass of the elements present in a triglyceride.

Element	Relative atomic mass
carbon	12
hydrogen	1
oxygen	16

How much lower is the molecular mass of this triglyceride molecule, after it has been made from its components, compared with the sum of its component molecules?

(1)

☒ **A** 18

☒ **B** 33

☒ **C** 54

☒ **D** 99

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(b) (i) Stearic acid and arachidic acid are both fatty acids.

Arachidic acid has two more carbon atoms than stearic acid.

The melting point of stearic acid is 69 °C and the melting point of arachidic acid is 76 °C.

Calculate the percentage increase in the melting point, resulting from the presence of two more carbon atoms.

Give your answer to two decimal places.

(1)

Answer ..... %

(ii) Devise a method to investigate how the length of the fatty acids and the degree of saturation of the fatty acids affect the melting point of triglycerides.

(3)

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(Total for Question 2 = 6 marks)

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3 Recombination of alleles can be due to the crossing over that occurs during meiosis. This process results in gametes with different combinations of alleles and genetic variation in the offspring.

(a) When does crossing over first take place?

(1)

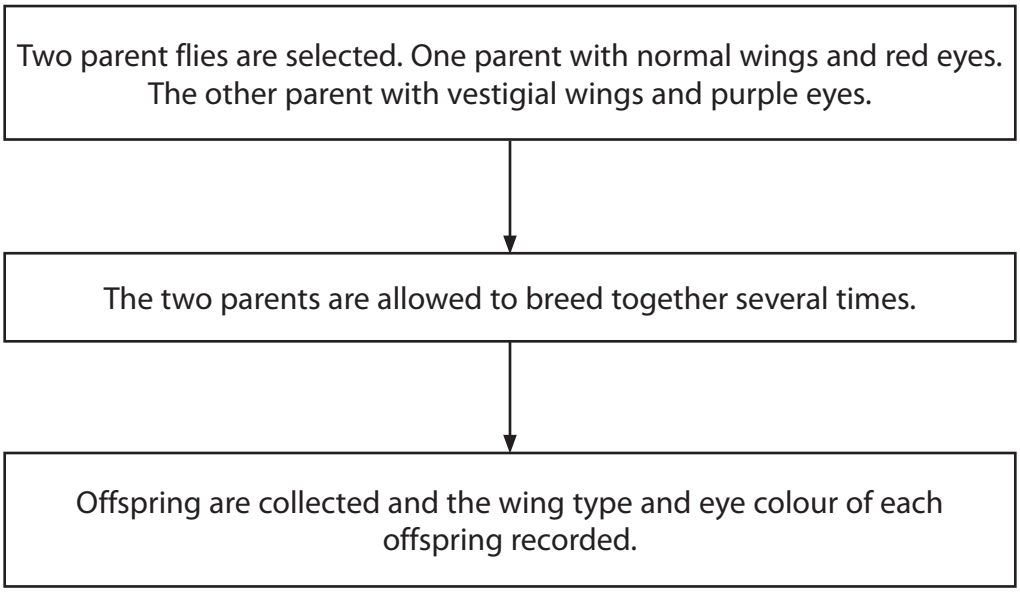
- ☒ **A** metaphase I
- ☒ **B** metaphase II
- ☒ **C** prophase I
- ☒ **D** prophase II

(b) Crossing over occurs between two genes found on the same chromosome.

The recombination frequency reflects the likelihood of crossing over occurring. It depends on how close the genes are on the chromosome.

In fruit flies, the gene for wing type is located on the same chromosome as the gene for eye colour.

The flow diagram shows an experiment used to calculate the recombination frequency for these two genes.



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The table shows the results of one experiment.

Description of offspring	Number recorded
Normal wings and red eyes	672
Vestigial wings and purple eyes	592
Normal wings and purple eyes	75
Vestigial wings and red eyes	69

The recombinant frequency is the percentage of offspring that have a different combination of characteristics compared with the parents. It is the proportion of the total number of offspring.

Calculate the recombinant frequency for this pair of genes.

Give your answer to three significant figures.

(1)

Answer ..... %

(c) The table shows the recombinant frequencies between four genes, J, K, L and M, located on the same chromosome.

Pairs of genes	Recombinant frequency (%)
J and K	12.0
J and M	15.0
L and K	3.0
L and M	6.0

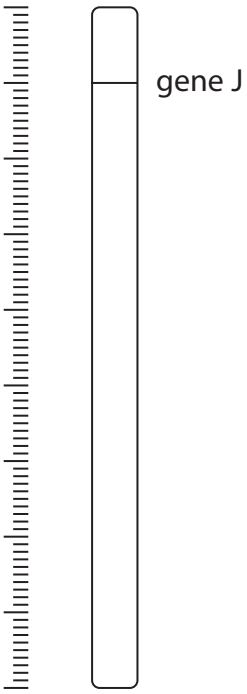
A genetic map can be produced by drawing a scale diagram to show the location of these genes.

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The diagram shows the position of gene J on a chromosome.

Complete the diagram to show the position of genes K, L and M on this chromosome.

(3)



(d) Explain why crossing over between two different genes, located on a pair of homologous chromosomes, results in a maximum of 50% of gametes with the recombinant alleles.

(3)

(Total for Question 3 = 8 marks)

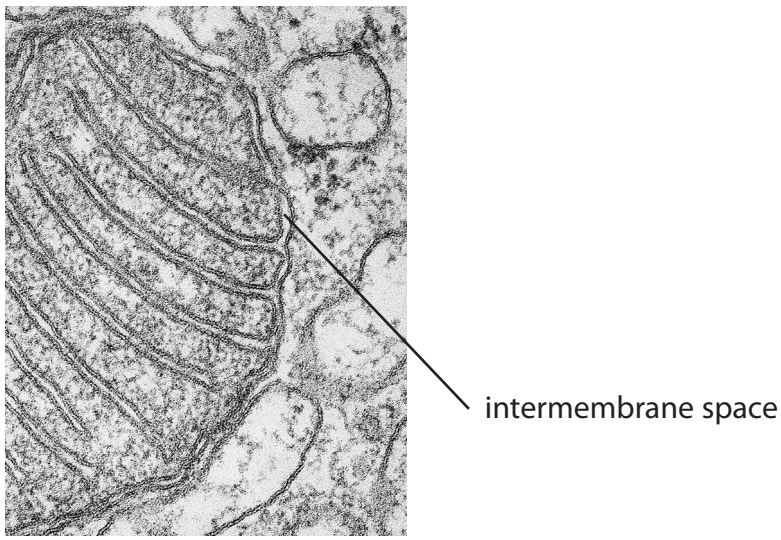
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4 Cells and some cell organelles are surrounded by a membrane.

(a) Explain the arrangement of phospholipids in a membrane.

(2)

(b) The photograph shows part of a mitochondrion, as seen using an electron microscope.



(Source: © DON W. FAWCETT/SCIENCE PHOTO LIBRARY)

(i) State why the intermembrane space can be seen in this photograph, when it is not always visible in photographs of mitochondria using other electron microscopes.

(1)

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(ii) The width of each membrane in this photograph is 6 nm.

Calculate the actual width of the intermembrane space in the region labelled on this photograph.

(2)

Answer ..... nm

(c) The table shows the percentage of some types of membrane in one cell from a liver and one cell from a pancreas.

Type of membrane	Percentage of total membranes (%)	
	Cell from a liver	Cell from a pancreas
Plasma cell membrane	2	5
Rough endoplasmic reticulum	35	60
Smooth endoplasmic reticulum	16	<1
Golgi apparatus	7	10
Mitochondria	39	21
Secretory vesicle	not determined	3
Other	1	between 0 and 1

Analyse the data to explain three differences in the percentages of these types of membrane in these two cells.

(3)

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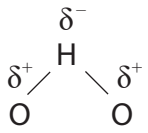
(Total for Question 4 = 8 marks)

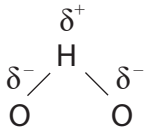
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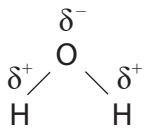
5 The dipole nature of water gives this molecule properties that are important for living organisms.

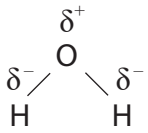
(a) Which diagram shows the dipole nature of water?

(1)

☒ **A** 

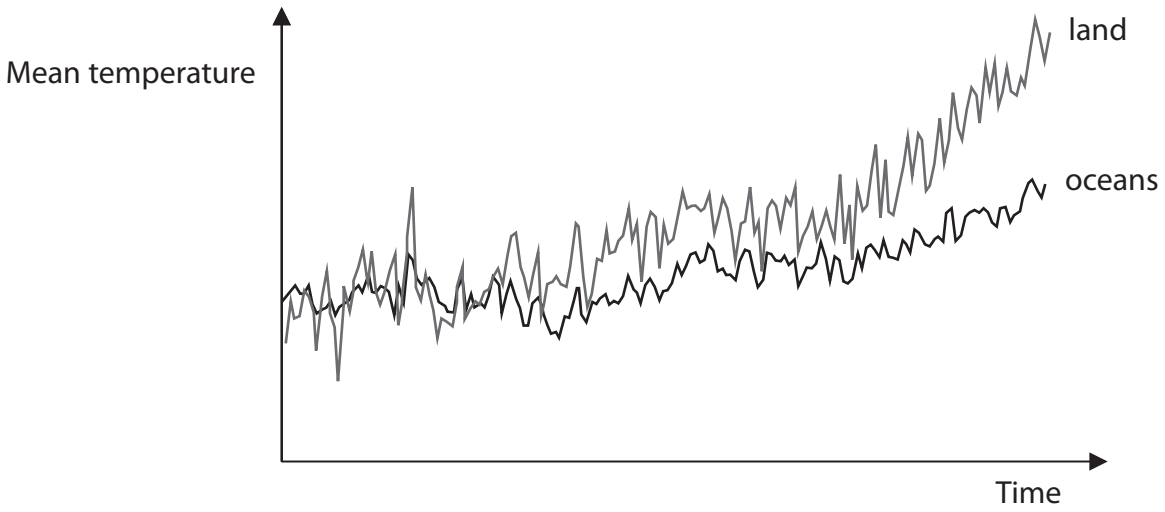
☒ **B** 

☒ **C** 

☒ **D** 

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(b) The graph shows the mean temperatures of land and oceans over a period of 70 years.



(i) Explain how the dipole nature of water results in the mean temperature change of the oceans, over the 70 years, being less than that of the land.

(2)

(ii) Explain the importance of this lower change in mean temperature to organisms, such as fish, that live in the oceans.

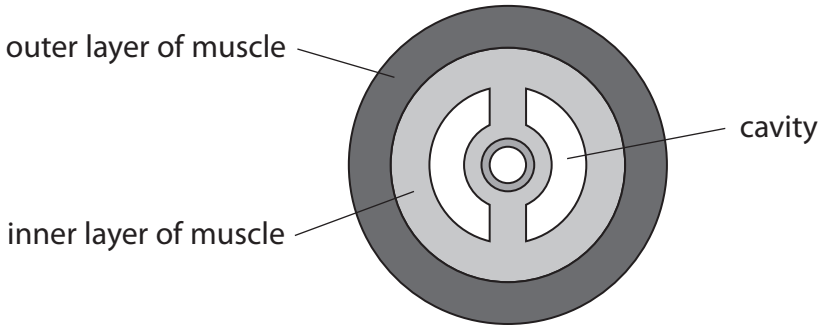
(2)

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(c) Some animals, such as earthworms, have a hydrostatic skeleton.

A hydrostatic skeleton consists of a cavity filled with a water-based fluid, surrounded by two layers of muscle.

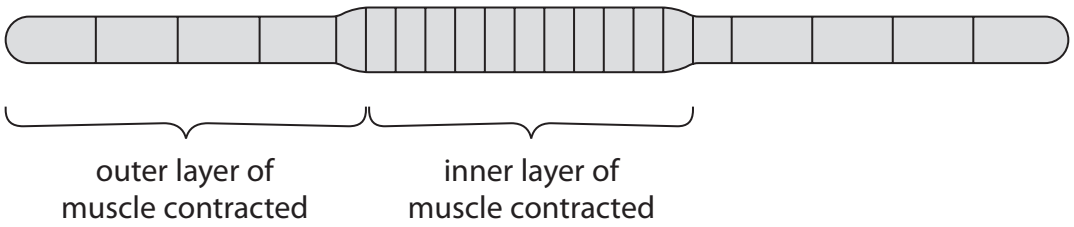
The diagram shows a section through an earthworm.



When the outer layer of muscle contracts in one section of the earthworm, this section becomes longer.

When the inner layer of muscle contracts in one section of the earthworm, this section becomes shorter.

The diagram shows the shape of an earthworm when each layer of muscle contracts.



Explain how the dipole nature of water enables the muscle layers to push against the fluid in the cavity and change the shape of the earthworm.

(3)

(Total for Question 5 = 8 marks)

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6 Mitosis is involved in growth and repair of tissues and organs.

(a) Describe the differences between a tissue and an organ.

(2)

(b) Metaphase is one stage of mitosis.

(i) Draw and label the parts of a chromosome, as it would appear during metaphase of mitosis.

(2)

(ii) Describe the events that take place during metaphase of mitosis.

(2)

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(c) In cancers, cells divide uncontrollably.

Colchicine is an anti-cancer drug that inhibits mitosis.

The effects of treating cells with colchicine were investigated.

Animal cells were cultured in a single layer in plastic dishes.

Colchicine was added to the culture and the mean number of cells in three stages of mitosis was determined over a period of 192 hours.

The table shows the results of this investigation.

Time after treating cells with colchicine / hours	Mean number of cells		
	Prophase	Metaphase	Anaphase
0	11.7	33.3	15.3
6	9.3	41.3	9.3
12	3.0	41.7	3.0
24	3.7	49.0	0.0
48	4.3	68.7	0.0
96	2.3	80.0	0.0
192	0.7	86.3	0.0

(i) Explain the results shown in the table.

(3)

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(ii) Describe how these results could have been obtained.

(3)

(Total for Question 6 = 12 marks)

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7 Peptide hormones and steroid hormones are synthesised by endocrine glands.

Peptide hormones are transported dissolved in blood plasma. They bind to specific receptor molecules on the cell surface membranes of their target organs.

(a) Explain how the primary structure of a peptide hormone determines its properties.

(4)

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(b) Some peptide hormones are nonapeptides.

The table shows the amino acid sequences of three types of nonapeptide: A, B and C.

Type	Position of amino acid in the nonapeptide								
	1	2	3	4	5	6	7	8	9
A	cys	tyr	ile	gln	asn	cys	pro	arg	gly
B	cys	tyr	phe	gln	asn	cys	pro	arg	gly
C	cys	tyr	phe	gln	asn	cys	pro	lys	gly

(i) Compare and contrast the amino acid sequence of these three nonapeptides.

(3)

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(ii) Explain why the DNA base sequences coding for these three nonapeptides are more variable than their amino acid sequences.

(3)

(Total for Question 7 = 10 marks)

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8 Fruits consist mainly of sugars, fibre (cellulose) and water.

The sweetness of a fruit depends on the proportion of the different types of sugars that it contains.

The table shows the relative sweetness of five sugars.

Sugar	Relative sweetness
Fructose	1.73
Glucose	0.74
Sucrose	1.00
Maltose	0.32
Galactose	0.32

(a) (i) Which row of the table shows the sugars that are monosaccharides and the sugars that are disaccharides?

(1)

		Monosaccharides	Disaccharides
☒	**A**	fructose and glucose	galactose and maltose
☒	**B**	galactose and glucose	maltose and sucrose
☒	**C**	glucose and maltose	fructose and sucrose
☒	**D**	maltose and sucrose	galactose and glucose

(ii) How are two monosaccharides joined together to form a disaccharide?

(1)

☒ **A** by an ester bond formed during a condensation reaction

☒ **B** by an ester bond formed during a hydrolysis reaction

☒ **C** by a glycosidic bond formed during a condensation reaction

☒ **D** by a glycosidic bond formed during a hydrolysis reaction

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(b) The relative sweetness of a sugar solution can be determined by a taste test.

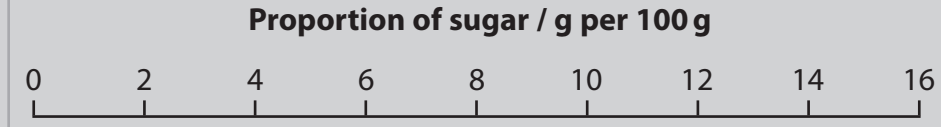
Devise an investigation, that a student could do, to confirm the relative sweetness of the sugars listed in the table.

(3)

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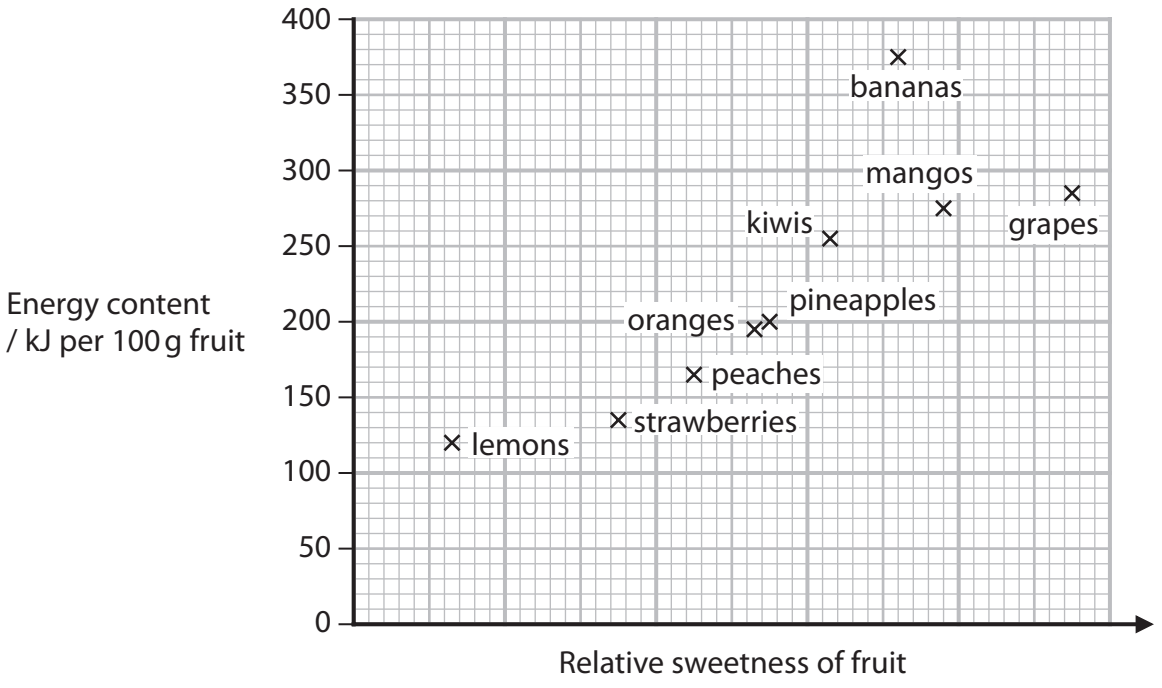
(c) The table shows the total sugar concentration of some fruits and the proportion of the sugars in each of these fruits.

Fruit	Total sugar concentration / g per 100 g	Proportion of sugar / g per 100 g
grapes	16.0	
mangos	14.0	
bananas	13.0	
kiwis	10.5	
pineapples	10.0	
oranges	8.8	
peaches	8.4	
strawberries	5.8	
lemons	2.5	



Key fructose glucose sucrose maltose galactose

The graph shows the energy content of some fruits and the relative sweetness of each of these fruits.



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(i) Determine the ratio of the proportion of sugars in mangos.

(1)

Answer .....

*(ii) Analyse the data to discuss the relationship between the sugar content, the relative sweetness and the energy content of these fruits.

(6)

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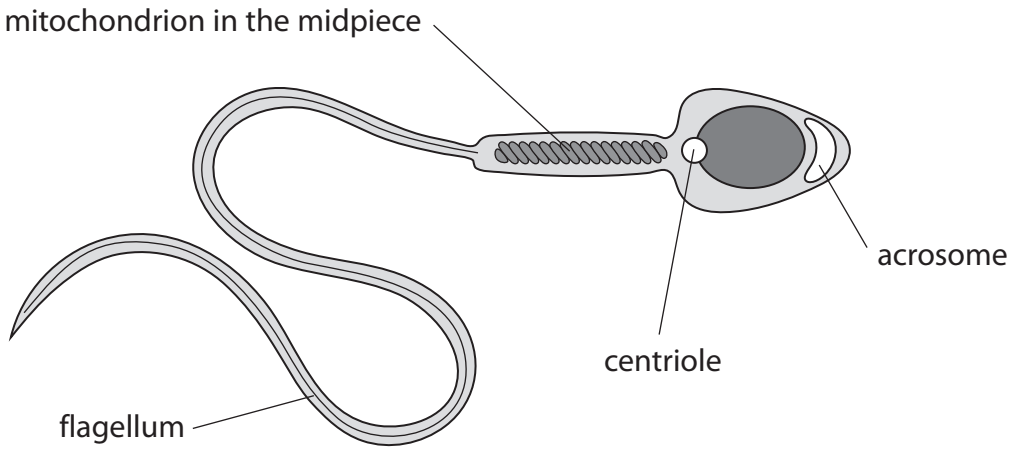
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(Total for Question 8 = 12 marks)

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9 Spermatogenesis is the process that results in the production of sperm cells.

The diagram shows a mature human sperm cell.



(a) (i) Which row of the table shows the type of nuclear division that takes place in spermatogonia and in primary spermatocytes?

(1)

		Spermatogonia	Primary spermatocytes
☒	**A**	meiosis I	meiosis II
☒	**B**	meiosis I	mitosis
☒	**C**	mitosis	mitosis
☒	**D**	mitosis	meiosis I

(ii) Which of the following pairs of cells are haploid?

(1)

☒ **A** primary spermatocytes and secondary spermatocytes

☒ **B** primary spermatocytes and spermatids

☒ **C** secondary spermatocytes and spermatids

☒ **D** spermatogonia and primary spermatocytes

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(b) Human sperm cells contain centrioles but human egg cells do not.

Explain the role of the centrioles in sperm cells following fertilisation.

(3)

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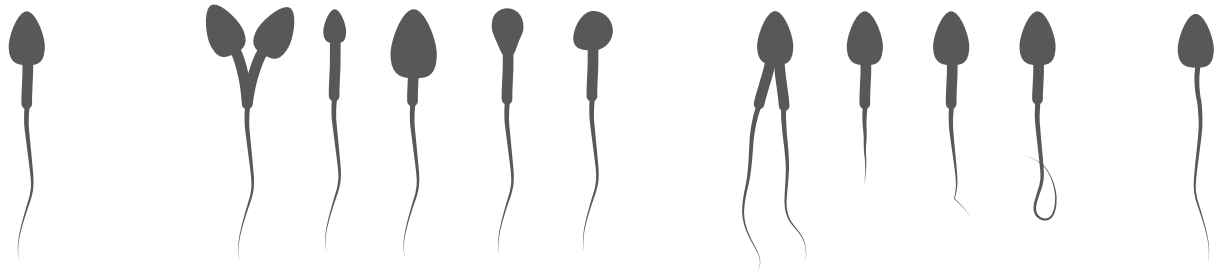
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*(c) Male infertility can be caused by a number of factors related to sperm cells:

- low sperm count
- structural defects of sperm cells
- absence of an acrosome
- mutations in the mitochondrial DNA
- chromosome mutations.

The diagrams show a normal sperm cell and some sperm cells with structural defects.



Normal Head defects Flagellum defects Midpiece defects

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Comment on how each of these five factors could result in male infertility.

(6)

(Total for Question 9 = 11 marks)

TOTAL FOR PAPER = 80 MARKS

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