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 26 May 2016 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
8BI0/01

You must have a ruler, HB 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 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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P 4 9 8 3 1 A 0 1 3 2

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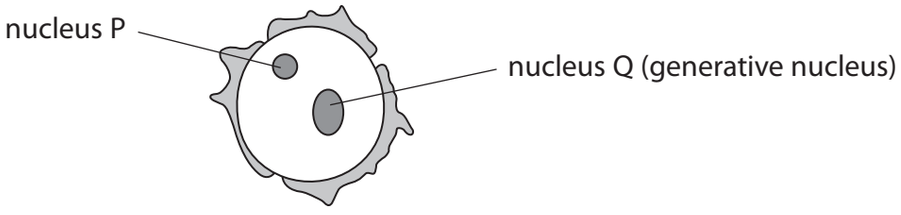
Answer ALL questions.

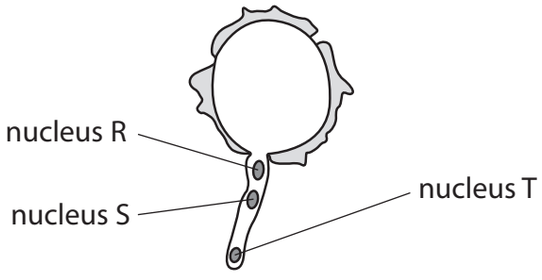
Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The diagram shows a pollen grain, before and after germination.

Before germination



After germination



(a) In which part of the plant are pollen grains made?

(1)

☒ **A** anther

☒ **B** embryo sac

☒ **C** filament

☒ **D** stigma

(b) One species of grass has a diploid number of 14 chromosomes.

Which row of the table is correct for this species of grass?

(1)

	Chromosome number	
	Nucleus P	**Nucleus Q**
☒ **A**	14	14
☒ **B**	14	7
☒ **C**	7	14
☒ **D**	7	7

(c) Which of the following is a correct statement?

(1)

☒ **A** nucleus P divides by meiosis to form nuclei R and S

☒ **B** nucleus P divides by mitosis to form nuclei R and S

☒ **C** nucleus Q divides by meiosis to form nuclei R and S

☒ **D** nucleus Q divides by mitosis to form nuclei R and S

(d) The following three statements were made by a student:

- nucleus R and S will fertilise the endosperm nucleus
- the genetic material in nucleus R or S could become part of the zygote
- nucleus T will fertilise the female gamete

The number of correct statements is

(1)

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(Total for Question 1 = 4 marks)

2 (a) A laboratory technician made a 1 mol dm^{-3} glucose solution and a 1 mol dm^{-3} maltose solution.

In order to do this, the technician calculated the molecular mass of both sugars.

The table shows the molecular mass of the elements present in these sugars.

Element	Molecular mass
carbon	12
hydrogen	1
oxygen	16

(i) Explain why the molecular mass of one glucose molecule is 180.

(2)

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(ii) Calculate the molecular mass of maltose.

(2)

Answer .....

(b) Give **two** differences between the structure of a ribose molecule and the structure of a glucose molecule.

(2)

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(Total for Question 2 = 6 marks)

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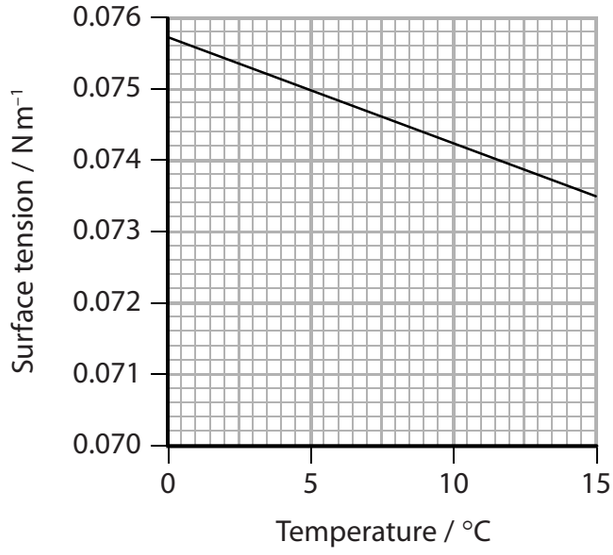
3 Pond skaters are insects. They can move on the surface of water due to the high surface tension of water.

The photograph shows four pond skaters on the surface of water.

(a) Explain how the properties of water molecules result in surface tension.

(3)

(b) The graph shows the effect of temperature on the surface tension of water.



A pond skater has a mass of 0.02 g and has a length of 20 mm in contact with the surface of the water.

The force that this pond skater exerts on the surface of the water can be calculated using the equation:

force in newtons = mass in kilograms × 9.8

(i) Calculate the force exerted by the pond skater for each millimetre length of contact with the surface of the water.

Give your answer in standard form.

(3)

Answer .....

(ii) This pond skater can stay on the surface of water even on a hot day in summer.

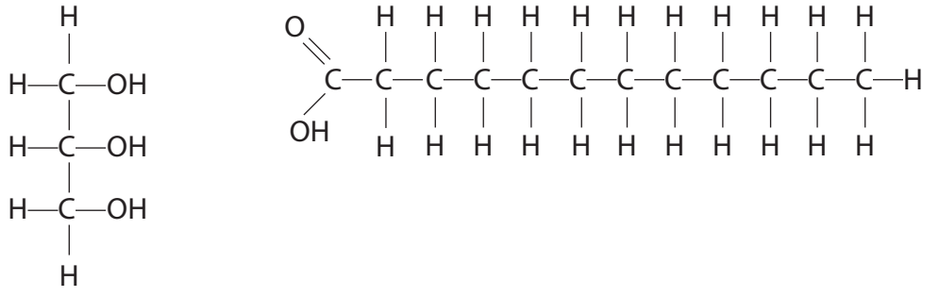
Use your calculated value and the graph to explain why this pond skater can stay on the surface of water.

(3)

(Total for Question 3 = 9 marks)

4 Glycerol molecules and fatty acid molecules are used in the synthesis of cell membranes.

The diagram shows a molecule of glycerol and a molecule of a fatty acid.



(a) Which of the following describes the reaction when these two molecules are joined together?

(1)

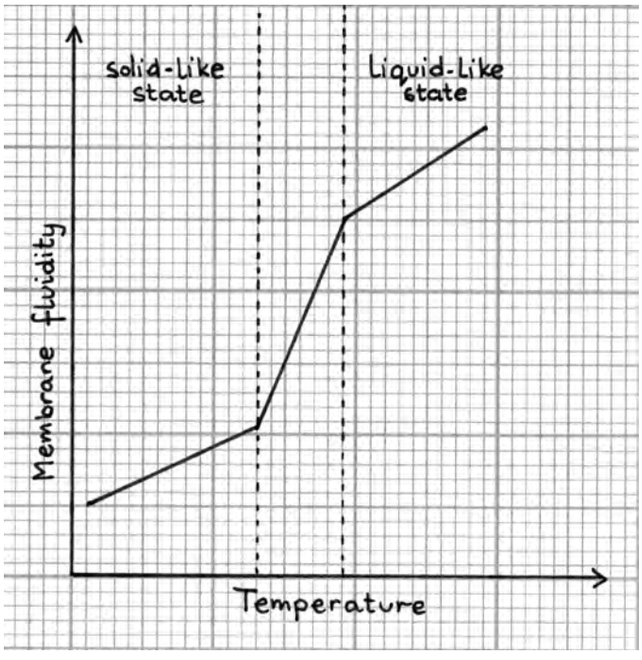
☒ **A** condensation reaction forming an ester bond

☒ **B** condensation reaction forming a glycosidic bond

☒ **C** hydrolysis reaction forming an ester bond

☒ **D** hydrolysis reaction forming a glycosidic bond

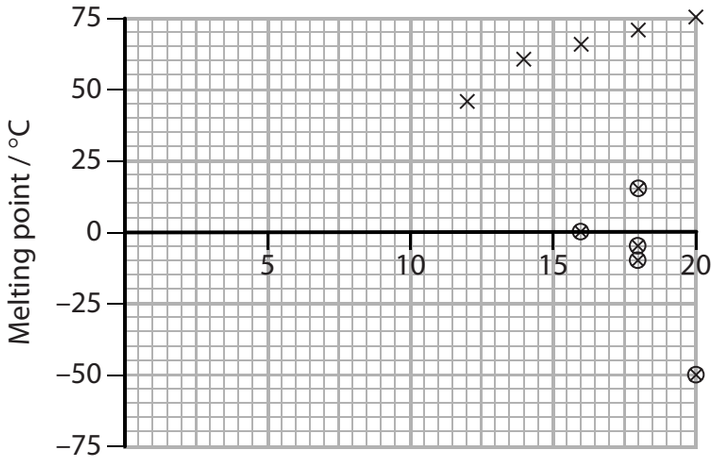
(b) This graph was sketched by a student to show how membrane fluidity changes with temperature.

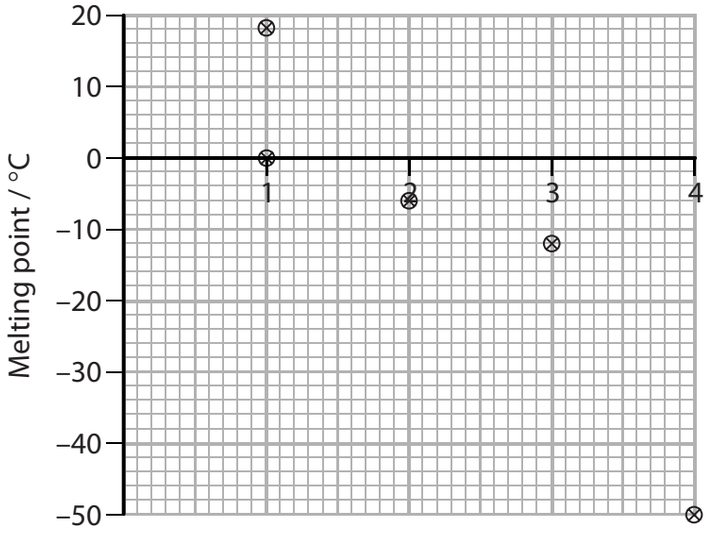


(i) Describe the relationship between membrane fluidity and temperature as shown by this graph.

(2)

(ii) The student found two graphs about the structure of lipids and their melting points.





The student stated that membrane fluidity depends on the fatty acids present.

Analyse the data in these two graphs and the sketched graph to comment on this statement.

(4)

(Total for Question 4 = 7 marks)

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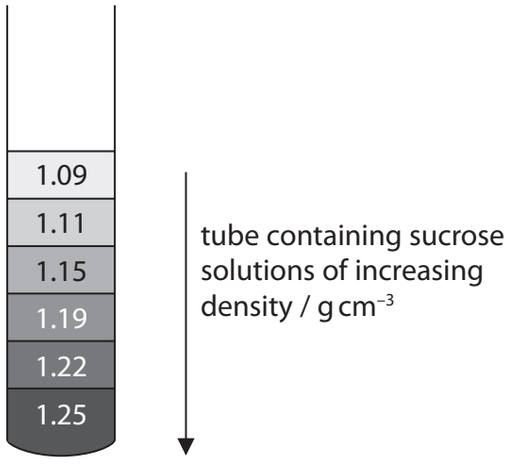
5 A scientist separated the components of animal cells using density gradient centrifugation.

The density gradient is made by layering sucrose solutions of different density on top of each other in a tube, as shown in the diagram.

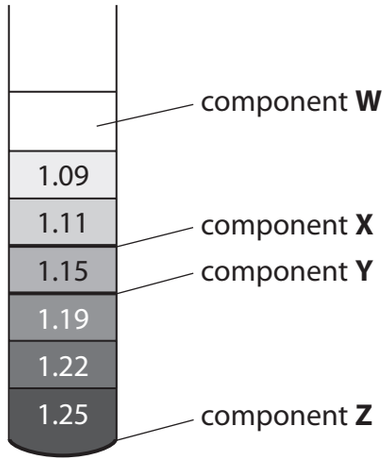


The animal cells were broken up in a salt solution which was then placed on top of the sucrose column.

The tube was then spun in a centrifuge.

This caused the cell components to move different distances down through the sucrose column according to their density.

The diagram shows the position of some cell components in the sucrose column after centrifugation.



The table shows the density of some cell organelles.

Organelle	Density / g cm^{-3}
endoplasmic reticulum	1.16
Golgi apparatus	1.15 to 1.16
lysosome	1.12
mitochondrion	1.19

(a) Component **W** was present after centrifugation.

Explain what might be present in component **W** other than water and salt.

(2)

(b) Which row correctly identifies the organelles present in component **X** and component **Y**?

(1)

	Component X	Component Y
☒ **A**	endoplasmic reticulum	mitochondrion
☒ **B**	Golgi apparatus	lysosome
☒ **C**	lysosome	Golgi apparatus
☒ **D**	mitochondrion	Golgi apparatus

(c) Explain which other organelle would be present in component **Z**.

(2)

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(d) Explain how rough endoplasmic reticulum can be separated from smooth endoplasmic reticulum using density gradient centrifugation.

(2)

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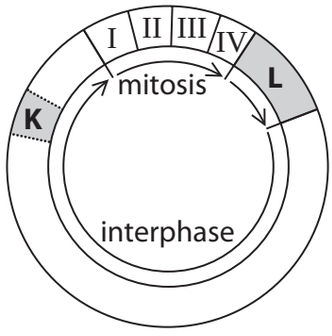
(Total for Question 5 = 7 marks)

6 Mitosis is one of the stages of the cell cycle.

The diagram represents some of the stages in the cell cycle.



(a) Explain why cells carry out mitosis.

(2)

(b) Explain what happens to the DNA content and the number of chromosomes in the stage labelled **K**.

(4)

(c) Name the stage of the cell cycle labelled **L**.

(1)

.....

(d) The duration of each stage of the cell cycle is directly proportional to the number of cells in that stage.

A student made a squash preparation of a root tip and counted the number of cells in each stage of the cell cycle.

The results are shown in the table.

Stage of cell cycle	Number of cells
Interphase	169
Prophase	5
Metaphase	8
Anaphase	2
Telophase	62

(i) The cells in this root tip had a cell cycle time of 23 hours.

Calculate the time, in minutes, that these cells spent in anaphase.

(2)

Answer ..... mins

(ii) The student then used the same method to study mitosis in a root tip from another plant of the same species.

The student worked out that the cells spent 8% less time in anaphase.

Calculate the time, in minutes, that these cells spent in anaphase.

(2)

Answer ..... mins

(iii) Explain why these two calculated values are not identical.

(2)

(Total for Question 6 = 13 marks)

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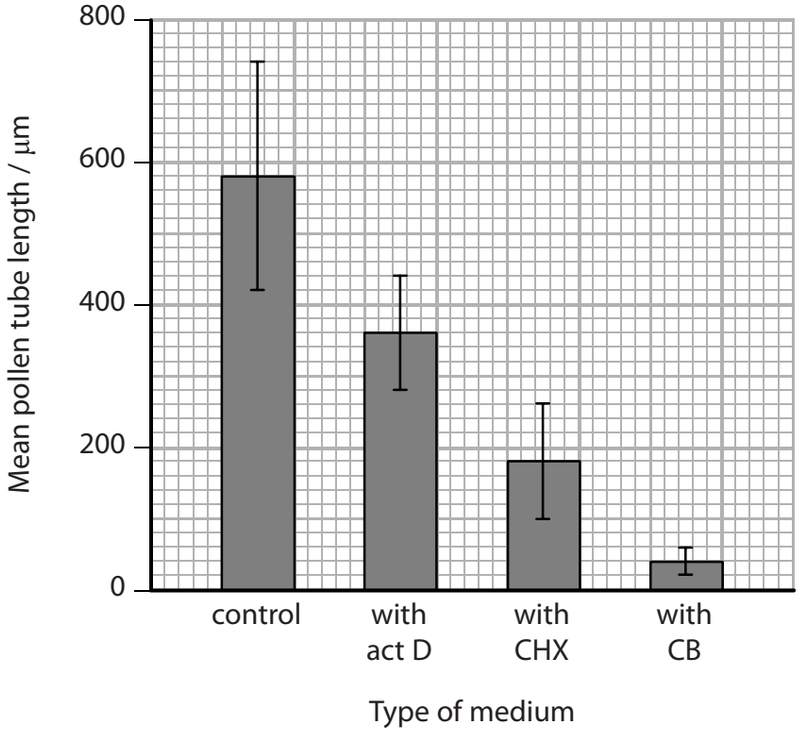
7 A student investigated the effect of three inhibitors on the growth of pollen tubes.

Pollen grains were incubated in a control medium.

In addition, some pollen grains were also incubated in three media, each containing one inhibitor.

The inhibitors used were actinomycin D (act D), cycloheximide (CHX) and cytochalasin B (CB).

The results of this investigation are shown in the graph.



The student made the following conclusions from these results:

Conclusion 1: all three inhibitors affected pollen tube growth

Conclusion 2: pollen grown in CB grew the slowest

Conclusion 3: the control result was the least repeatable

Conclusion 4: more pollen grains germinated in the control group

(a) Analyse the results of this investigation to comment on each of these conclusions.

(4)

(b) (i) Actinomycin D (act D) inhibits transcription.

Explain why pollen tubes could still grow in the presence of act D.

(2)

(ii) Cycloheximide inhibits translation.

Describe the process of translation.

(4)

(iii) Cytochalasin B prevents the addition of monomers in the synthesis of the protein actin.

Describe how monomers are bonded to a polypeptide chain during the synthesis of actin.

(2)

(Total for Question 7 = 12 marks)

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8 Genetic variation results from the recombination of alleles during meiosis.

(a) State what is meant by the term **allele**.

(1)

(b) (i) Which row of the table correctly shows when independent assortment and crossing over take place during meiosis?

(1)

		Independent assortment	Crossing over
☒	**A**	metaphase I	anaphase I
☒	**B**	metaphase I	prophase I
☒	**C**	prophase I	anaphase I
☒	**D**	prophase I	metaphase I

(ii) Describe the process of crossing over that occurs during meiosis.

(3)

(c) The table shows some data on the genome size, haploid number of chromosomes and the recombination rate of several species of animals.

Species	Genome size / Mb	Haploid number of chromosomes	Recombination rate / au
Dog	2500	39	1.6
Human	3000	23	1.2
Sheep	3000	27	1.2
Cow	3000	30	1.1
Macaque	3100	21	0.7
Baboon	3100	21	0.6
Opossum	3500	11	0.2
Wallaby	3700	8	0.2

Analyse the data to comment on the relationship between genome size, haploid number of chromosomes and recombination rate.

(4)

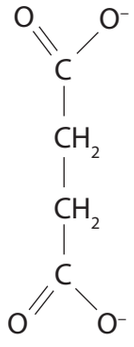
(Total for Question 8 = 9 marks)

9 Succinate dehydrogenase is an enzyme found in mitochondria.

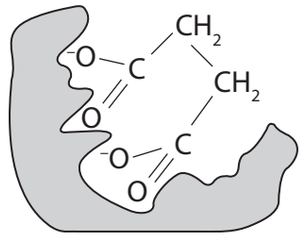
Succinate dehydrogenase converts succinate to fumarate.

The diagrams show the structure of succinate, succinate binding to the active site of succinate dehydrogenase and the structure of fumarate.

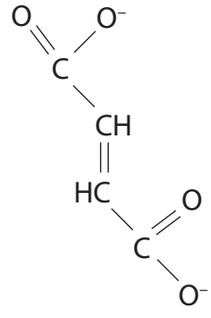
Structure of succinate



Succinate binding to succinate dehydrogenase



Structure of fumarate

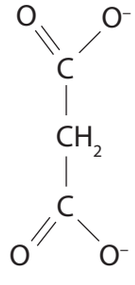


(a) Explain the role of the active site in the conversion of succinate to fumarate.

(3)

(b) The activity of succinate dehydrogenase is inhibited by malonate.

The diagram shows the structure of malonate.



(i) Explain why malonate inhibits the activity of succinate dehydrogenase.

(2)

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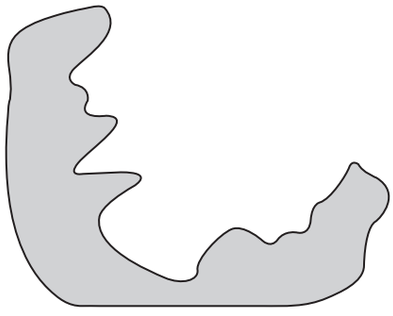
(ii) On the diagram, draw malonate binding to succinate dehydrogenase.

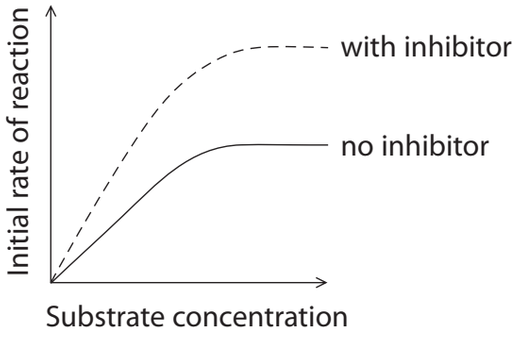
(1)



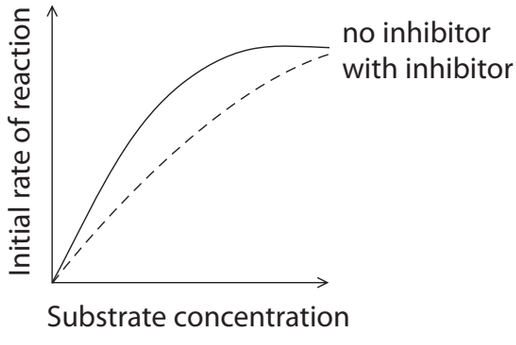
(iii) Which of the following graphs represents the effect of this type of inhibitor?

(1)

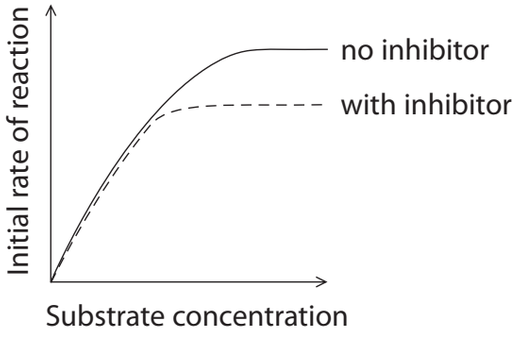
☒ **A**



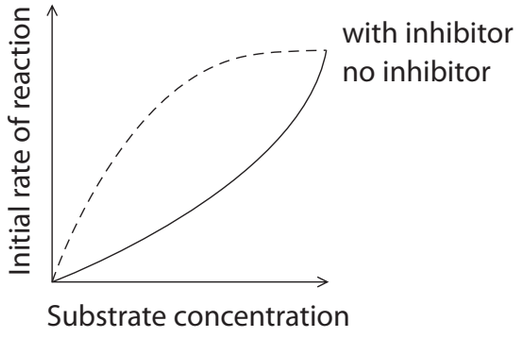
☒ **B**



☒ **C**



☒ **D**



*(c) The rate of reaction of succinate dehydrogenase can be measured using a methylene blue solution.

Methylene blue starts off blue but changes to colourless as succinate is converted to fumarate.

A student investigated the effect of malonate on the rate of reaction of succinate dehydrogenase.

The student used the following steps.

Step 1. Succinate solution was poured into a beaker up to the 25 cm^3 mark.

Step 2. Ten drops of succinate dehydrogenase solution and three drops of methylene blue solution were added.

Step 3. The beaker was left on the bench until the methylene blue became colourless and the time for this change was recorded.

Step 4. Steps 1 to 3 were repeated using two different concentrations of succinate solution.

The whole procedure was repeated with the addition of 15 cm^3 of malonate solution with the succinate solution in **Step 1**.

Criticise the method used in this investigation.

(6)

(Total for Question 9 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

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