Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Biology

Advanced Subsidiary

Unit 3: Practical Biology and Research Skills

Monday 19 January 2015 – Morning
Time: 1 hour 30 minutes

Paper Reference
WBI03/01

You must have:
Ruler, Calculator, HB pencil

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 40.
- 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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 4 5 0 3 0 A 0 1 1 6

PEARSON

Answer ALL questions.

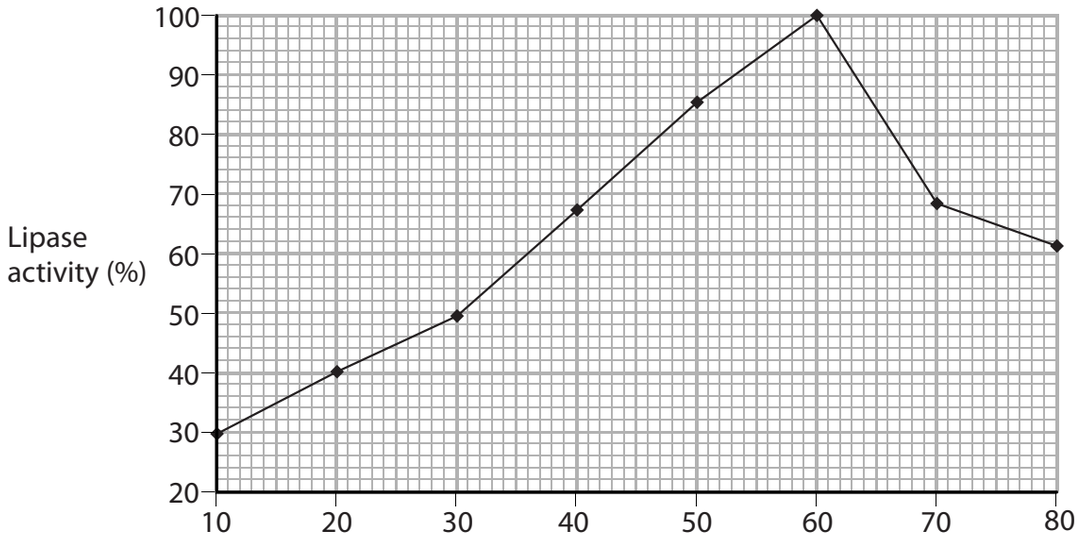
1 Triglycerides from palm oil are added to ethanol in the production of biodiesel.
The enzyme lipase can be used as a catalyst in the production of biodiesel.

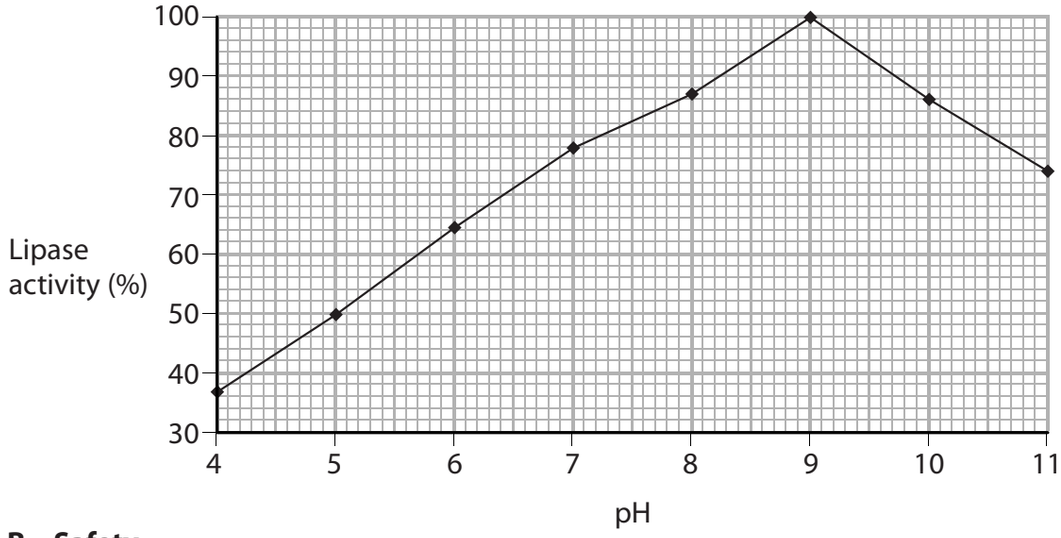
This process is shown in the diagram below.

Part of a datasheet for the enzyme lipase is shown below.

Data sheet for lipase

A The following graphs show the effect of temperature and pH on lipase activity





B Safety

Enzymes can cause allergic reactions

An investigation was carried out into the effect of lipase concentration on the breakdown of palm oil.

Palm oil, ethanol and lipase were put into a reaction chamber. At suitable time intervals, samples were taken. The production of glycerol was measured.

(a) In this investigation the temperature and pH were controlled.

(i) Using the information given, suggest a suitable value for the temperature and pH. Describe how each of these could be controlled.

(4)

Temperature value .....

How temperature could be controlled

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pH value .....

How pH could be controlled

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(ii) Write a risk assessment for this investigation.

This assessment should include suggestions of the risks and how to minimise them.

(3)

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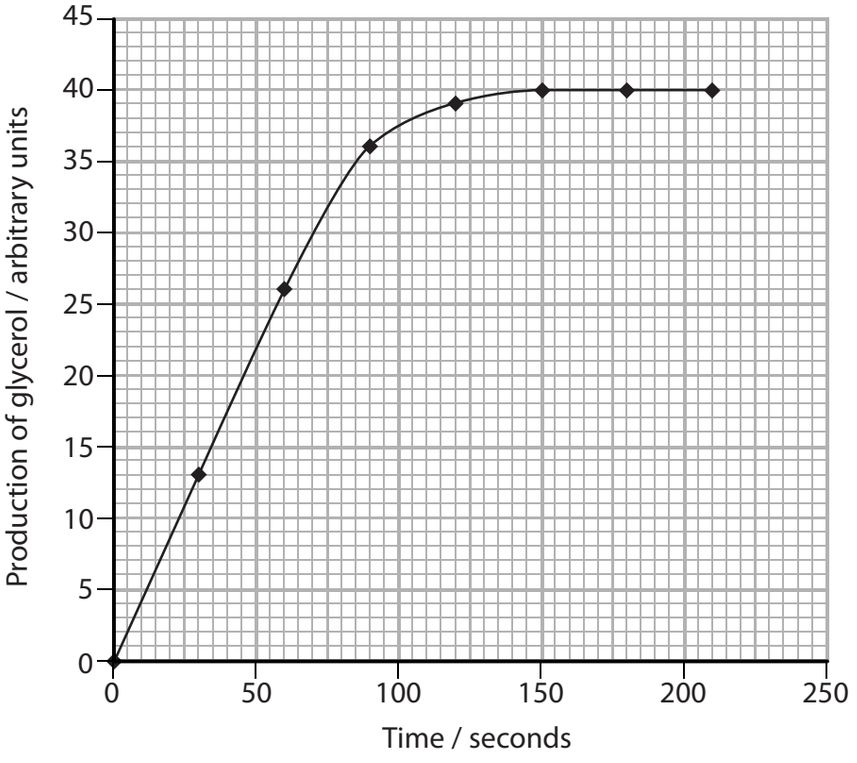
(b) The graph below shows the production of glycerol at one concentration of lipase.



Using the information in the graph, calculate the initial rate of reaction for this concentration of lipase.

Show your working.

(3)

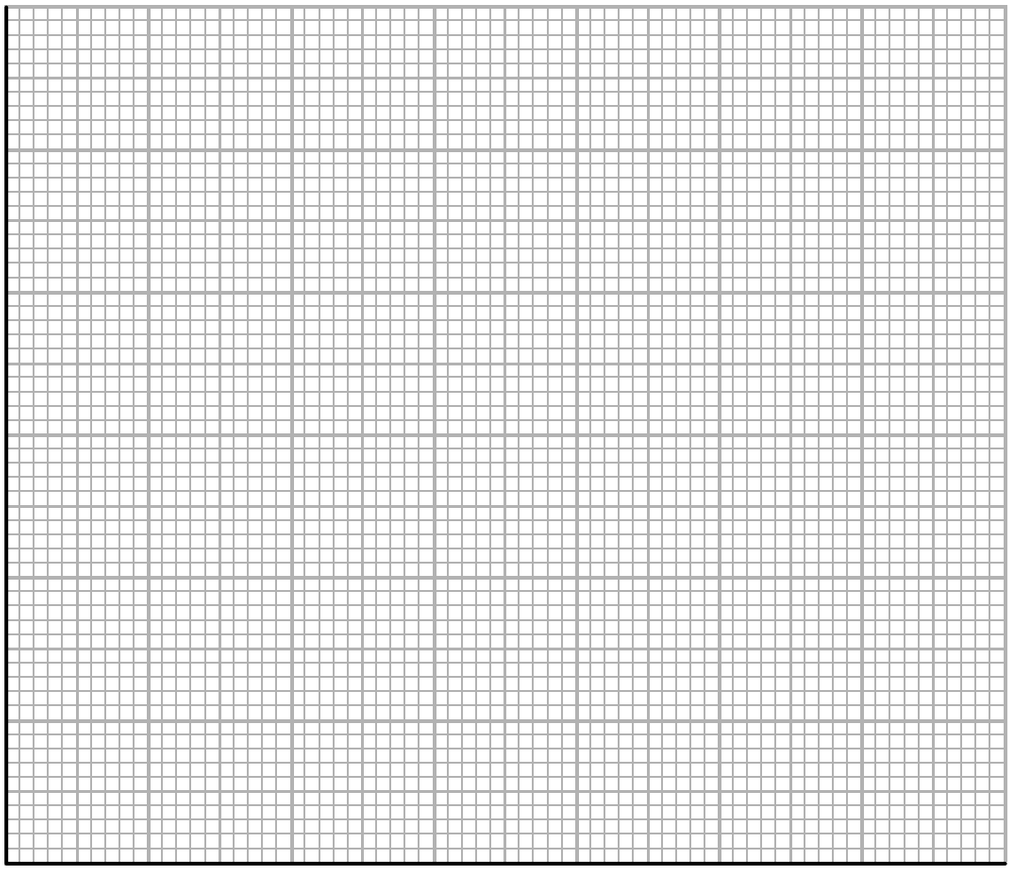
Initial rate of reaction = ...

(c) The initial rates of reaction for a range of lipase concentrations are shown in the table below.

Lipase concentration (%)	Initial rate of reaction / arbitrary units s^{-1}
0.0	0.00
0.5	0.20
1.5	0.42
3.0	0.75
4.5	0.76
5.5	0.79

(i) Plot these data in a suitable graphical form.

(4)



(ii) Suggest what further information is needed to estimate the reliability of these data.

(2)

(iii) Suggest which concentration of lipase should be used for the economic conversion of oil to biodiesel. Use the information in your graph to explain your answer.

(4)

(Total for Question 1 = 20 marks)

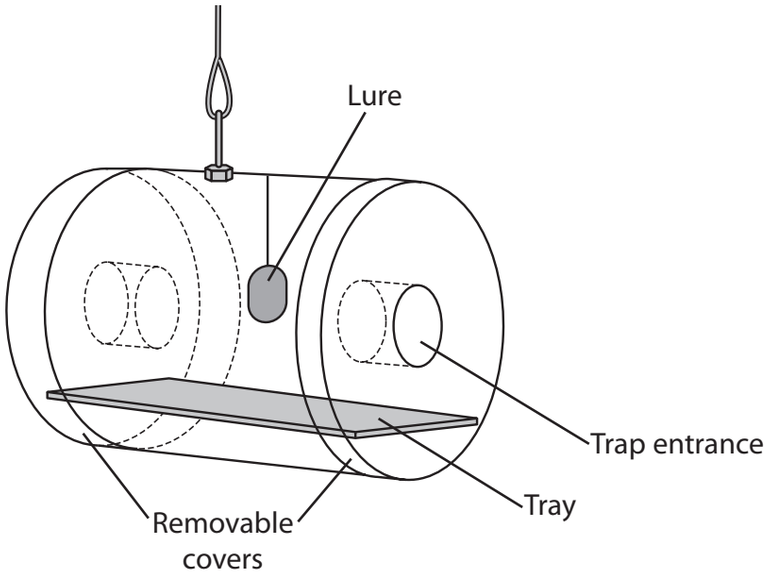
2 Read the following extract from a student's unfinished visit or issue report on the topic of the control of the oriental fruit fly (*Bactrocera dorsalis*).

1. Fruit flies are one of the most destructive insect pests among almost a million different kinds of known living insect. Their economic importance is widely recognised among scientists and farmers. The species discussed in this report, *Bactrocera dorsalis,* is the dominant pest species of the Tephritid family that causes many crop losses for farmers and South East Asian nations.

2. The insect is able to bring about 100% damage to the harvest if not monitored. *B. dorsalis* damages fruit by laying eggs beneath the skin of fruits. Only ripe and nearly ripe fruits are attacked. They lay eggs in the soft spots or cracks in fruit, leaving unsightly holes. This spoils the fruits' appearance and reduces its value, especially in the case of passion fruit *(Passiflora edulis)*.

3. The eggs hatch in one to three days after being laid. The larvae feed for nine to thirty-five days and then pupate in the soil under the host plant. Adult flies emerge after one or two weeks, depending on the climate. The life cycle continues around the year, which means they pose a year-round threat to host plants. Biologists have been working on solutions for many years.

4. The Steiner trap was introduced by Loren Franklin Steiner (1904–1977). The trap is made from a transparent plastic cylinder with removable covers. On both ends, there is a small opening that allows the flies to enter. A tray is placed at the lower part of the trap, to collect specimens for monitoring purposes. A wire hanger, placed on top of the trap body, is used to hang the trap from the plant. The trap should be placed at a height of about 2 m from ground level.



A Steiner Trap

5. The Steiner trap attracts flies using male-specific parapheromone lures, namely:

   - TML (trimedlure, t-butyl-4-(or 5)-chloro-2-methyl cyclohexane carboxylate)
   - ME (methyl eugenol)
   - CUE-lure (4-(p-acetoxyphonyl)-2-butanone).

   The lure is a piece of cotton soaked in $2cm^3$ to $3cm^3$ of a mixture of the parapheromone and an insecticide, usually Malathion.

6. The design of the Steiner trap has been revised several times when used in different regions of the world, according to its suitability. The original model of trap is very labour intensive. The removal of dead flies is time-consuming and not economic. The trap is made from plastic, which is expensive.

7. Field workers and orchard owners around the world have improved the original Steiner trap, depending on local needs and conditions.

8. The Revolutionary Modified Steiner trap is a popular model widely applied in the orchards of Malaysia. The trap uses methyl eugenol in the lure, but insecticide is excluded. The name "Revolutionary" was given to it as no insecticide is used, thus helping the environment. Openings of the trap, situated around the middle section of 1.5 dm^3 plastic bottles, allow only a one-way passage for the flies. A layer of oil or water (mixed with a small amount of soap or detergent, to reduce surface tension) is poured into the trap to drown the flies.

9. Although there are no data to prove the effectiveness of this modified trap, farmers and orchard owners in the region claim that it is the most effective way to eradicate and control populations of *B. dorsalis,* because of its low cost and it is easy to set up.

10. There are other ways to control fruit flies. For example, millions of sterile male flies are produced by gene technology. These male flies are then released into the wild, to allow mating between wild females and sterile males. The male flies either carry modified genes that stop the fertilisation of eggs, or genes that are inactive. This solution to the problem is very effective, because it uses the wide dispersal range of these flies. When the sterile flies mate with wild females, flies are wiped out over a wide area. This method of eliminating *B. dorsalis* from newly infested regions has been proven to be effective in the Ogasawara Islands, Japan.

11. This species of fruit fly is found to be the pollinator of *Bulbophyllum* orchids, the largest genus in the family Orchidaceae. This genus is the main source of most of the economically important ornamental orchids and consists of a number of threatened species. It is clear that, if the delicately balanced relationship between these two organisms is disturbed or destroyed, many of the *Bulbophyllum* species will face extinction due to the absence of pollinating insects.

(a) The student's teacher suggested that the report needed data and graphs to illustrate some of the points. The student did a web search and found the following table in a paper by G. H. S. Hooper and R. A. I. Drew in which they compared the Steiner trap with the Bateman trap using methyl eugenol as the lure.

Species	**Number of fruit flies caught in traps over a 40-week period**	
	Bateman	**Steiner**
Bactrocera cacuminatus	223	220
Bactrocera endriandea	242	502
Bactrocera mayi	87	126
Totals	**552**	**848**

(i) Make a sketch to show how you would make these data into a visual form to put into this report.

(4)

(ii) State which paragraph is the most appropriate place for this sketch.

(1)

Paragraph .....

(iii) Using the data in the table, compare the effectiveness of these two methods of trapping flies.

(4)

(b) The student decided to call the final report "Trapping methods used to help in the control of the oriental fruit fly (*Bactrocera dorsalis*)".

Explain an alternative solution to trapping for the control of this species of fruit fly.

(2)

(c) The report is expected to address environmental, economic and social implications.

(i) Explain **one** environmental and **one** economic implication considered in this report.

(4)

Environmental implication .....

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Economic implication .....

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(ii) Explain **one** social implication of the successful control of fruit flies for people in South East Asia.

(2)

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(d) Question 2(a) refers to a paper by G. H. S. Hooper and R. A. I. Drew.

State what further information you would need to be able to write a full reference for this paper.

(3)

(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS

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