Cambridge Assessment International Education

Interactive

Interactive Example Candidate Responses
Paper 3 (May/June 2016), Question 1
Cambridge International AS & A Level Biology 9700

Version 1.0

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Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

Plan the use of the **two hours** to make sure that you finish all the work that you would like to do.

If you have enough time, consider how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

1 Plant cells contain an enzyme, catalase, which catalyses the hydrolysis (breakdown) of hydrogen peroxide into oxygen and water. An extract of plant tissue contains catalase.

You are required to investigate the effect of temperature (independent variable) on catalase in a plant extract solution.

You are provided with:

labelled	contents	hazard	volume/cm^3
P	plant extract solution	none	100
H	hydrogen peroxide solution	harmful irritant	100

You are advised to wear suitable eye protection, especially when using the hydrogen peroxide solution, **H**. If **H** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard ..irritant harmful irritant..

level of risk ..medium..[1]

(b) You are required to keep a sample of 10 cm^3 of the solution in **P** to test at the temperature of the room.

Then heat the remaining solution in **P** and remove 10 cm^3 samples of the solution at different temperatures including a sample at the **maximum** temperature of 70 °C.

(i) Use the thermometer to measure the temperature of the room.

temperature ..22.5 °C..[1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70 °C.

State the other temperatures at which you will remove each sample.

..30 , 40 , 50 , 60 in degrees Celsius..

..[2]

Select page

HIGH | MIDDLE | LOW

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
1(b)(v)	
1(b)(vi)	
1(c)	

Q1	Mark scheme	
(a)(i)	*(risk assessment)* (hydrogen peroxide) harmful or irritant + medium or high ;	**[1]**
(b)(i)	*(measures room temperature)* whole number or to half a degree + °C ;	**[1]**
(b)(ii)	*(decides on interval for temperature)* at least three additional temperatures + whole numbers + even intervals ; °C ;	**[2]**
(b)(iii)	*(recording results)* 1. table drawn + heading, temperature + °C ; 2. heading, time + seconds ; 3. records results for at least five temperatures ; 4. correct pattern of results ; 5. times recorded as whole seconds ; 6. records results for repeats + means calculated ;	**[6]**
(b)(iv)	*(source of error with reason)* appropriate error with reason ; e.g. concentration of hydrogen peroxide decreases appropriate error with reason ; e.g. different volumes of extract on each square of filter paper	**[2]**
(b)(v)	*(conclusions)* (as temperature increases, activity increases) more successful collisions or more enzyme-substrate-complexes / ESCs ; (decreased / no activity) denatures or changed shape of active site ;	**[2]**
(b)(vi)	*(modification to investigate another variable)* 1. (to standardise temperature) stated temperature + thermostatically controlled water-bath ; 2. (independent variable) at least five concentrations of catalase ; 3. (method) simple dilution / proportional dilution / serial dilution ;	**[3]**
(c)	*(chart)* 1. (x-axis) different plant species + (y-axis) initial rate of activity of catalase / s–1 ; 2. (scale on x-axis) even width of bars + (scale on y-axis) 0.05 to 2 cm, labelled at least each 2 cm ; 3. correct plotting of five bars ; 4. five bars labelled with each horizontal line drawn as a thin line + each column labelled ;	**[4]** **[Total: 21]**

EXAMINER COMMENTS | MARK SCHEME

Proceed as follows:

1. Put 10 cm^3 of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm^3 of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top.
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

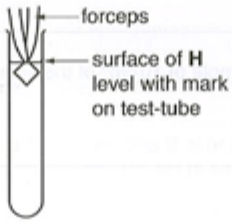

Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

    If the time is more than 120 seconds, stop timing and record 'more than 120'.

Select page

HIGH | MIDDLE | LOW

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
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EXAMINER COMMENTS | MARK SCHEME

17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

temperature /°C	time taken for square to return to surface /s	
	1	2
20.5	10	13
30.0	16	12
40.0	19	16
50.0	21	21
60.0	35	35
70.0	more than 120	more than 120

[6]

(iv) Identify **two** significant sources of error in this investigation.

Difficulty to cut the filter paper in exactly 1cm x 1cm
Concentration of substrat H will decrease after carring
out to several experiment. Hence, the concentration of H might not
be the same for every experiment repeated experiment.

.....[2]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

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(v) Explain how the enzyme catalase was affected by the change in temperature.

as temperature increases, the time taken for square to return to surface increased, as temperature increases, more/less less enzyme substrate complex is formed and so, less oxygen produce, so time taken to return to surface increases, the enzyme (catalase) is no longer active at 70°C, this shows at this temperature it is denatured and does not bind to hydrogen peroxide. [2]

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

use a thermostatically controlled water bath.

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

Prepare 5 different concentration ↑ solutions of the catalase by simple or serial dilution. E.g of concentrations 1.0, 0.8, 0.4, 0.2. Setup also a control with water so concentration 0. Add equal volume of catalase to individual test tubes. Drop the filter paper soaked into P and measure time taken. Repeat for accuracy. [3]

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
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1(b)(vi)	
1(c)	

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EXAMINER COMMENTS | MARK SCHEME

(c) A student investigated the activity of catalase in plant extracts from different species of plants, **R**, **S**, **T**, **U** and **V**, by measuring the initial rate of activity.

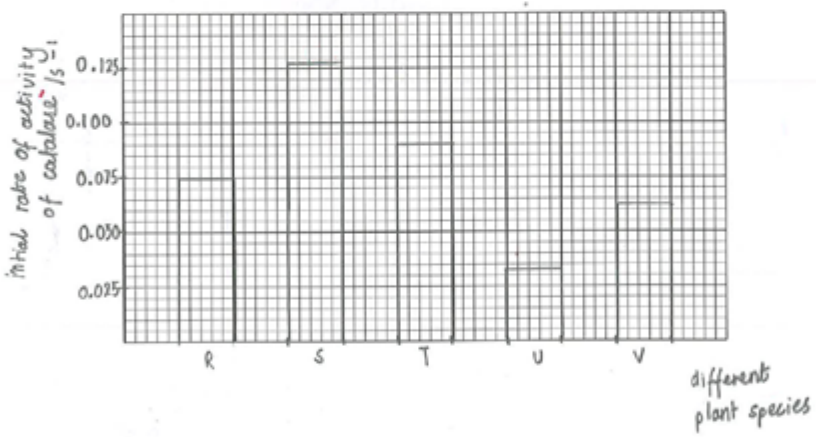
Table 1.1 shows the results for this investigation.

Table 1.1

different plant species	initial rate of activity of catalase /s^{-1}
R	0.0750
S	0.1275
T	0.0900
U	0.0325
V	0.0625

You are required to use a sharp pencil for charts.

Plot a chart of the data shown in Table 1.1.



[4]

[Total: 21]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

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Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

Plan the use of the **two hours** to make sure that you finish all the work that you would like to do.

If you have enough time, consider how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

1 Plant cells contain an enzyme, catalase, which catalyses the hydrolysis (breakdown) of hydrogen peroxide into oxygen and water. An extract of plant tissue contains catalase.

You are required to investigate the effect of temperature (independent variable) on catalase in a plant extract solution.

You are provided with:

labelled	contents	hazard	volume/cm^3
P	plant extract solution	none	100
H	hydrogen peroxide solution	harmful irritant	100

You are advised to wear suitable eye protection, especially when using the hydrogen peroxide solution, **H**. If **H** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard Harmful irritant (hydrogen peroxide solution)

level of risk Medium ..... [1]

(b) You are required to keep a sample of 10 cm^3 of the solution in **P** to test at the temperature of the room.

Solution P

Solution P

Then heat the remaining solution in **P** and remove 10 cm^3 samples of the solution at different temperatures including a sample at the **maximum** temperature of 70 °C.

(i) Use the thermometer to measure the temperature of the room.

temperature 26 °C ..... [1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70 °C.

State the other temperatures at which you will remove each sample.

30 °C , 40 °C , 50 °C , 60 °C and 70 °C (Maximum)

..... [2]

Select page

HIGH | MIDDLE | LOW

Your Mark

1(a) [ ]

1(b)(i) [ ]

1(b)(ii) [ ]

1(b)(iii) [ ]

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1(b)(v) [ ]

1(b)(vi) [ ]

1(c) [ ]

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EXAMINER COMMENTS

MARK SCHEME

Proceed as follows:

1. Put 10 cm^3 of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm^3 of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top.
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

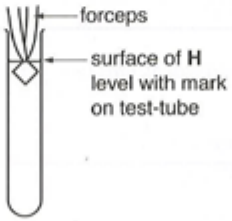

Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

    If the time is more than 120 seconds, stop timing and record 'more than 120'.

Select page

HIGH | MIDDLE | LOW

	Your Mark
1(a)	
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EXAMINER COMMENTS | MARK SCHEME

17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

Temperature of / °C solution in test dish.	Time taken for the square to return to the surface / s
24.0	53.97
30.0	55.09
40.0	57.19
50.0	More than 120
60.0	More than 120
70.0	More than 120

[6]

(iv) Identify **two** significant sources of error in this investigation.

Error in measuring the temperature of plant extract during heating.

Unequal size of filter paper (may vary with each square)

.....[2]

Select page

HIGH | MIDDLE | LOW

	Your Mark
1(a)	
1(b)(i)	
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EXAMINER COMMENTS

MARK SCHEME

Select page

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(v) Explain how the enzyme catalase was affected by the change in temperature.

The enzyme catalase has the optimum temperature of 40°C. Higher than 40°C such as 50°C and above, may make the enzyme to denature. The lower the temperature, the less energy it receive but as it goes higher (up to 40°C), the more energy it receives. So, temperature affects the rate of reaction of the enzyme [2]

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

use thermostatically controlled water bath

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

use titration to measure the ~~four~~ 6 different concentration of catalase. Take at least ~~six~~ different concentration of catalase of same volume. Use the squares to investigate the reaction with hydrogen peroxide. Higher concentration will ~~be~~ and faster form more enzyme-substrate complex hence more ~~x~~ reaction. [3]

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
1(b)(v)	
1(b)(vi)	
1(c)	

Q1	Mark scheme
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EXAMINER COMMENTS | MARK SCHEME

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(c) A student investigated the activity of catalase in plant extracts from different species of plants, **R**, **S**, **T**, **U** and **V**, by measuring the initial rate of activity.

Table 1.1 shows the results for this investigation.

Table 1.1

different plant species	initial rate of activity of catalase /s^{-1}
R	0.0750
S	0.1275
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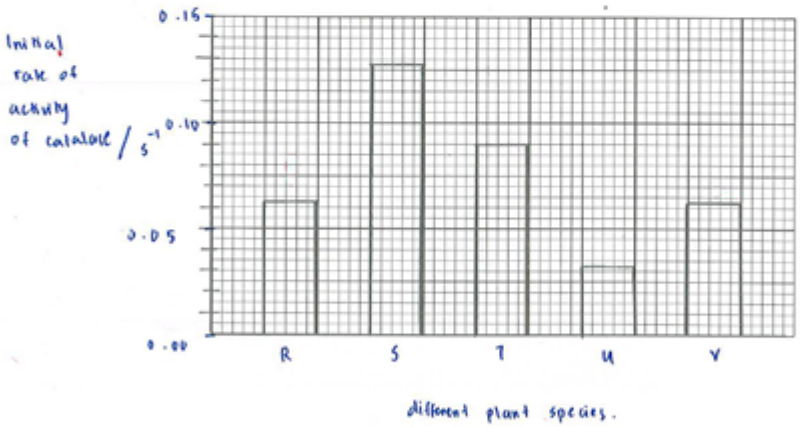
You are required to use a sharp pencil for charts.

Plot a chart of the data shown in Table 1.1.



[4]

[Total: 21]

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1(b)(i)	
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EXAMINER COMMENTS

MARK SCHEME

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Plan the use of the **two hours** to make sure that you finish all the work that you would like to do.

If you have enough time, consider how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

1 Plant cells contain an enzyme, catalase, which catalyses the hydrolysis (breakdown) of hydrogen peroxide into oxygen and water. An extract of plant tissue contains catalase.

You are required to investigate the effect of temperature (independent variable) on catalase in a plant extract solution.

$H \longrightarrow O_2 + H_2O$ (enzyme: catalase)

You are provided with:

labelled	contents	hazard	volume/cm³
P	plant extract solution	none	100
H	hydrogen peroxide solution	harmful irritant	100

100cm³ = P
H. 100cm³

You are advised to wear suitable eye protection, especially when using the hydrogen peroxide solution, **H**. If **H** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard Harmful irritant

level of risk low level [1]

(1) keep P: 10cm³ to room temp

(b) You are required to keep a sample of 10cm³ of the solution in **P** to test at the temperature of the room.

Remaining 90 heat. 10cm³ of each, 70°C → MAX

Then heat the remaining solution in **P** and remove 10cm³ samples of the solution at different temperatures including a sample at the **maximum** temperature of 70°C.

(i) Use the thermometer to measure the temperature of the room.

temperature 20·3 [1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70°C.

State the other temperatures at which you will remove each sample.

50°C, 55°C, 60°C, 70 65°, 70°.

[2]

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
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1(b)(vi)	
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EXAMINER COMMENTS | MARK SCHEME

Proceed as follows:

1. Put 10 cm^3 of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm^3 of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top.
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

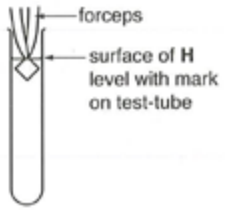

Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

    If the time is more than 120 seconds, stop timing and record 'more than 120'.

	Your Mark
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17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

	29°C	40°C	50°C	60°C	70°C
Time taken	14·28	42·35	50·32	113·20	more than 120
Time taken	13·12	50·10	49·23	115·56	more than 120
Time taken	14·56	49·81	51·06	110·23	more than 120
Avg.	14	47	150·61	113	more than 120

[6]

(iv) Identify **two** significant sources of error in this investigation.

1. Reaction time might be high in the investigation.

2. Impurities of the catalase solution might be mixed when new filter paper is introduced after each temperature

.....[2]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

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EXAMINER COMMENTS

MARK SCHEME

(v) Explain how the enzyme catalase was affected by the change in temperature.

when the temperature is increasing the time taken for the catalase enzyme to react also increases and at 60°c the enzyme denatures since the results shows a big difference between the results of 50°c - 60°c . [2]

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

Use thermostatic temperature

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

Use different concentration of enzyme, for example 5% to 10% and same temperature and concentration of Plant extract solution. Cut filter paper by 1cm x 1cm, dip it on the plant concentration into different concentration of enzyme catalase then take record the time. [3]

	Your Mark
1(a)	
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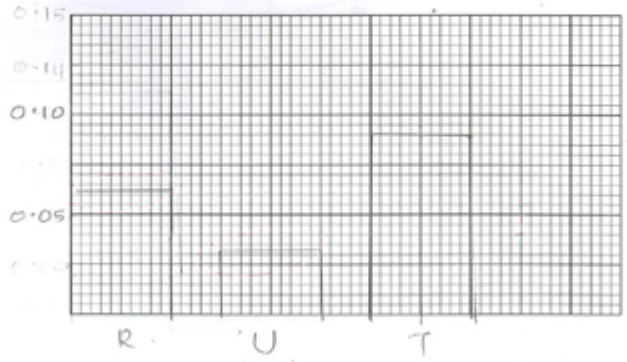

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EXAMINER COMMENTS

MARK SCHEME

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