Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME **Script 6**

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

CAMBRIDGE International Examinations

1 Many fungi are decomposer organisms which carry out extracellular digestion. To do this they secrete a number of enzymes.

A group of students made a solution of enzyme extract from a fungus. The extract contained the enzyme amylase. They wanted to find out the concentration of amylase in the extract.

They were provided with:

- $0.5\,g\,dm^{-3}$ stock solution of amylase
- starch agar plates with wells into which enzyme solutions can be placed. Starch agar plates are Petri dishes containing agar mixed with starch.

Fig. 1.1 shows how the students used the plates to find the concentration of amylase.

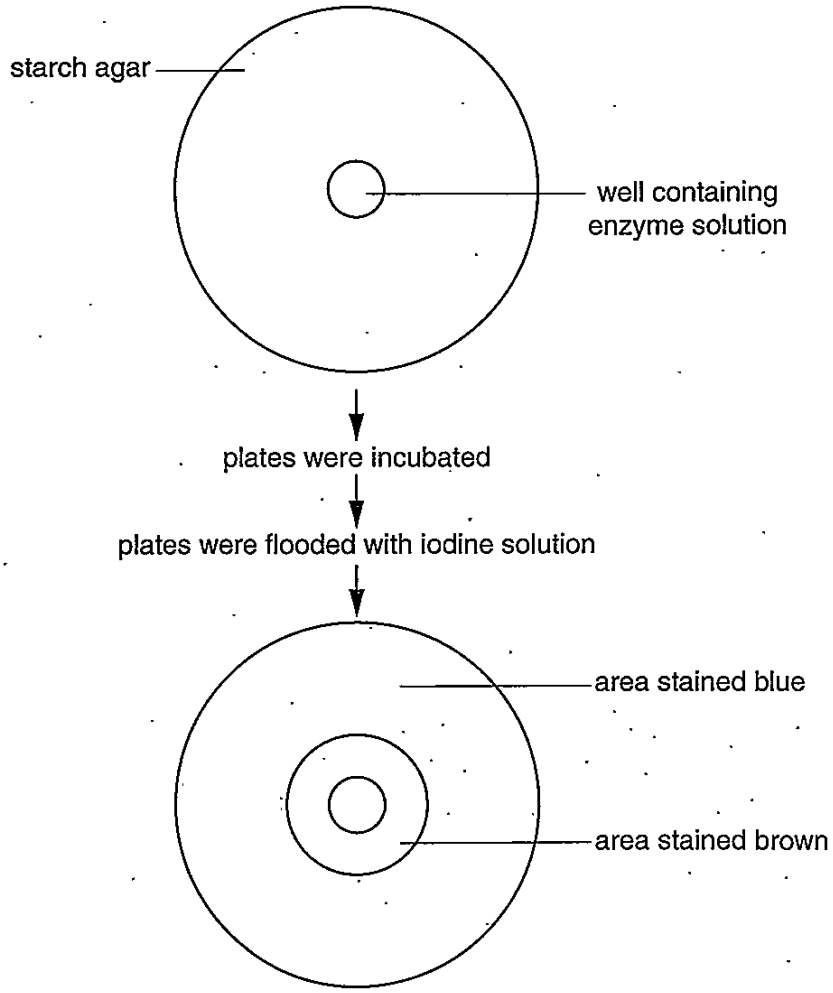

Fig. 1.1

The students thought that the area stained brown was proportional to the amylase concentration.

(a) Identify the independent and dependent variables in this investigation.

independent variable ..... Concentration of enzyme amylase. .....

dependent variable ..... Area stained brown. ..... [2]

(b) Describe how the students could use the method outlined in Fig. 1.1 to find out the concentration of the enzyme amylase in their extract.
Your method should be detailed enough for another person to follow.

At least, prepare 3 different concentrations of amylase solution by diluting the given solution. (for eg:- 0.5 gdm^{-3}, 0.25 gdm^{-3}, 0.10 gdm^{-3}). Then use these concentrations of enzyme to hydrolyse starch. ~~Use same~~ Then also test the hydrolysis of starch by the extracted enzyme. Use same volume of amylase solutions in each condition. Use a syringe to apply a fixed volume of enzyme in the well at the centre of petri dish. Remember to keep same depth of agar-starch mixtures at each places in the dish. Use buffer solutions to maintain the pH. Incubate the plates at a constant temperature of around 25-30 °C. While performing iodine test after the incubation, apply iodine of fixed volume to all plates. ~~Remb Rembe~~ Remember to let the enzyme activity for same time in each case. After arranging all apparatus, apply enzyme at last to the well and fix the time you will let the enzyme to perform its activity. (for eg:- 10 minutes then perform iodine test immediately). Use stopwatch to measure time. Use the tracing paper with square boxes to measure the area of stained brown after starch test. Compare the area given by of extract and other concentrations of amylase to determine the concentration of amylase in extract. This is a less risk experiment but remember if you are allergic to enzymes and agar. Use gloves in such case. [8]

(c) There are different types of amylase enzyme. They hydrolyse starch in different ways. Two of these enzymes are:

- β-amylase hydrolyses every second α-1,4 glycosidic bond in starch molecules
- γ-amylase hydrolyses all α-1,6 glycosidic bonds and all α-1,4 glycosidic bonds in starch molecules.

In a second investigation, the students were provided with two beakers, **A** and **B**. One contained β-amylase and the other contained γ-amylase. They used these solutions to hydrolyse 25 cm^3 samples of 0.5 g dm^{-3} starch solution.

Suggest **and** explain how the students could identify which beaker contained β-amylase and which contained γ-amylase.

~~The solution when~~ ~~The beaker which gives~~ Perform benedict's test with both solutions after hydrolysis (Heat with benedict's reagent). The solution which gives brick red precipitate contains γ-amylase because as each bonds are broken in starch, α-glucose molecules are produced which gives positive test with benedict's test. The solution containing β-amylase does not change colour as there are only non-reducing sugar in the solution. [2]

(d) Humans produce the enzyme α-amylase in their salivary glands. There may be many copies of the gene coding for α-amylase on chromosome 1. The concentration of the α-amylase in the saliva is positively correlated with the number of copies of this gene.

In a third investigation, the students obtained saliva from six people, **A** to **F**. Equal volumes of saliva were added to wells in agar plates similar to those shown in Fig. 1.1.
The plates were incubated for the same length of time and the area of the brown zone for each sample of saliva was calculated.

Table 1.1 shows results of this investigation.

Table 1.1

enzyme extract	area of brown zone / mm^2					
	plate 1	plate 2	plate 3	plate 4	plate 5	plate 6
A	3632	3848	3632	3632	3632	3848
B	2827	2827	2642	2463	(1963)	2827
C	2124	1963	1963	2124	1963	2124
D	1385	1257	(1809)	1257	1257	1385
E	656	707	707	656	707	656
F	298	298	314	314	298	298

(i) Identify **two** results in Table 1.1 that may be anomalous. Show your answers by circling the two values. [2]

(ii) State how the students should deal with these anomalies.

They should omit these anomalies and take consideration ~~average~~ ~~only~~ of only remaining values. [1]

(iii) The students decided to calculate the standard deviations of their results using the formula:

$$s = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}$$

Key to Symbols

s = standard deviation x = a result $\bar{x}$ = mean Σ = sum of n = sample size

Use Table 1.2 and the formula above to calculate the standard deviation for the results for person **F**.

Table 1.2

plate	x	$x-\bar{x}$	$(x-\bar{x})^2$
1	298	−5	25
2	298	−5	25
3	314	11	121
4	314	11	121
5	298	−5	25
6	298	−5	25
Σ	$\Sigma x = 1820$		342
$\bar{x}$	303		

answer 8.27 [2]

(iv) Suggest an explanation for the results shown in Table 1.1.

from A to F, there is decrease in the numbes of copies of gene coding for α-amylase on chromosome 1. So, there is decrease in the numbes of concentration of amylase in the saliva of people while testing from A to F because of which area of brown zone decrease from A to F. There are some variations on the area ~~in~~ in different plates within a person. It may be because of the difficulty to measure area efficiently. [3]

[Total: 20]

2 The speed at which an electrical impulse travels along a nerve can be determined by carrying out a nerve conduction velocity (NCV) test.

Surface electrodes are placed on the skin over nerves at various locations. They produce a very mild electrical charge, which stimulates the nerve.

The resulting electrical activity in the nerve is measured by a recording electrode. The distance between the electrodes and the time it takes for electrical impulses to travel between them are used to determine the nerve conduction velocity.

Fig. 2.1 shows how the NCV is measured in the ulnar nerve of the human forearm.

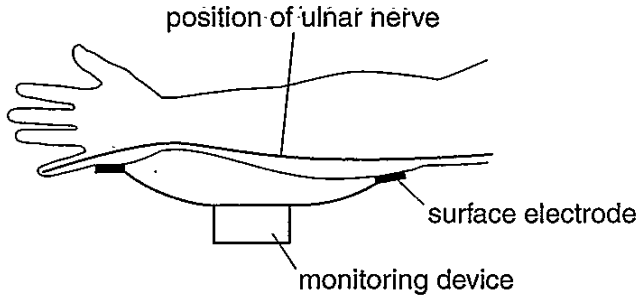

Fig. 2.1

An investigation to measure the NCV in the ulnar nerve in females of different ages was carried out on 394 individuals.

(a) Suggest **three** variables which the investigators should have standardised.

1) The distance between the two electrodes should be kept constant as change in distance affects time of conduction.

1) The positions at which the electrodes are used should be constant because the depth of nerve from skin affects the current that passes to ~~nerve electrode~~ nerve for its stimulation.

2) The positions at which the ~~hands~~ hands are kept during the experiment. There may be difference in velocity, when hand is bent or slanted. So, position should be kept constant. [3]

3) The temperature at which experiment is performed. Temperature may affect the rate of conduction of impulse.

Table 2.1 shows the results of this investigation.

Table 2.1

age category/years	mean conduction velocity ± S_M	confidence limits	
		lower limit	upper limit
30–39	54.3 ± 1.200	51.90	56.70
40–49	54.7 ± 0.645	53.41	55.99
50–59	52.4 ± 0.600	51.20	53.60
60–69	52.2 ± 0.675	50.85	53.55
70–79	49.0 ± 1.075	46.85	51.15

S_M = standard error

(b) The confidence limit = mean ± 2 S_M.

Use this formula to calculate the missing confidence limits. Use the space below for any working and enter your answers in Table 2.1.

lower limit = 52.2 − 2 × 0.675
= 50.85

upper limit = 52.2 + 2 × 0.675
= 53.55

[1]

One conclusion from these data is that mean conduction velocity in the ulnar nerve varies significantly with age.

(c) (i) Identify **two** age categories which appear to support this conclusion and give a reason for your choice.

age categories 30-39 *and* 70-79

reason ~~The mean~~ The error bars do not overlap. ~~These age-groups have a large difference in mean.~~ The confidence limits do not overlap. [2]

(ii) State which statistical test could have been used to confirm this conclusion and give a reason for your choice.

test t - test

reason The data is continuous. and have similar mean. [2]

(iii) State a null hypothesis for this test.

There is no significant difference between the conduction velocity of nerves of people of different ages. [1]

(d) State **one** reason why the results of the investigation were considered to be reliable.

~~Because there is very less gap between the confidence limits for all age groups.~~ [1]

→ Large number of individuals tested for, so the data are reliable. [Total: 10]