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## Cambridge International AS & A Level

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BIOLOGY

9700/52

Paper 5 Planning, Analysis and Evaluation

February/March 2024

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

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and the brokelo

## **INSTRUCTIONS**

- Answer all questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your answer to each question in the space provided.
- Do not use an erasable pen or correction fluid.
- Do not write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

## (a) Come students decided to investigate how placing small onions in different c NOLTAMROANIA

- The total mark for this paper is 30. anois มะเป โด ละวาก รกับสบาวิธ กอนันใจล ของเปล่าอาเนอง ล
- The number of marks for each question or part question is shown in brackets [ ].

This document has 16 pages.

ATTAMATEMANTA

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Onions are vegetables that are harvested from the plant *Allium cepa*. In many countries, small onions are used to make pickled onions. Pickled onions can be stored for a long time because the growth of microorganisms is prevented.

Pickled onions are made using this method. 2A Isrocitsmeini agbitdary

- Remove the dry outer layer from small onions.
- Place the onions in a sodium chloride solution for several hours.
- Remove the sodium chloride solution and place the onions in a solution of ethanoic acid (vinegar).

Fig. 1.1 shows a container of pickled onions and some fresh onions that have not been pickled.

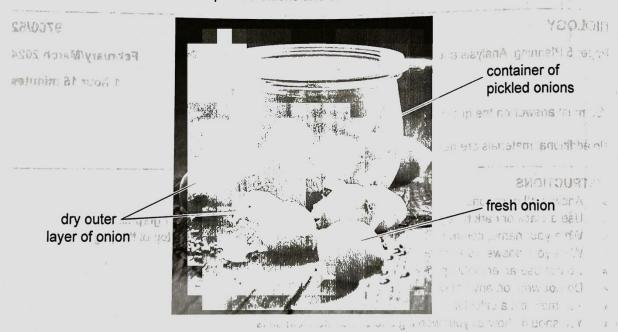


Fig. 1.1

- (a) Some students decided to investigate how placing small onions in different concentrations of sodium chloride solution affects the mass of the onions. So the second of the onions of
  - (i) Identify the independent variable in this investigation.



The students were given a 20.0% stock solution of sodium chloride. The students decided to use the stock solution to make sodium chloride solutions with concentrations of 0.0%, 1.0%, 5.0%, 10.0%, 15.0% and 20.0% as asswers at reality vib ent.

3

Tive of the small chans were placed into each of the extra pract placed into The students made 140 cm<sup>3</sup> of these solutions in separate beakers.

The onions were left in the sedium chloride solutions for 2 hours Complete Table 1.1 to show how 140 cm<sup>3</sup> of these solutions could be made by proportional dilution of the 20.0% stock solution of sodium chloride.

percentage concentrati	1000	volume of 20.0% at the	volume of afford and afford a fight
of sodium chloride solution		sodium chloride solution	/cm³
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1.0			1 1
5.0			The state of the s
10.0	1 1		2.1.1.1.014
15.0	- 1-1		112. (.8.
20.0			the ogains

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to months of the same

- The students carried out this procedure.
  - The dry outer layer was removed from 30 small onions.
  - Five of the small onions were placed into each of the six beakers containing the sodium chloride solutions prepared by the students.

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- The onions were left in the sodium chloride solutions for **2 hours**.
- The mean percentage change in mass of the five small onions in each beaker was calculated. In multiple ratherway work & . US ed. in notice tempitation of

The students then repeated the whole procedure using a new set of 30 small onions. This time the onions were left in the sodium chloride solutions for 48 hours.

percentage concentration

after 2 hours

Fig. 1.2 shows the results of the investigation.

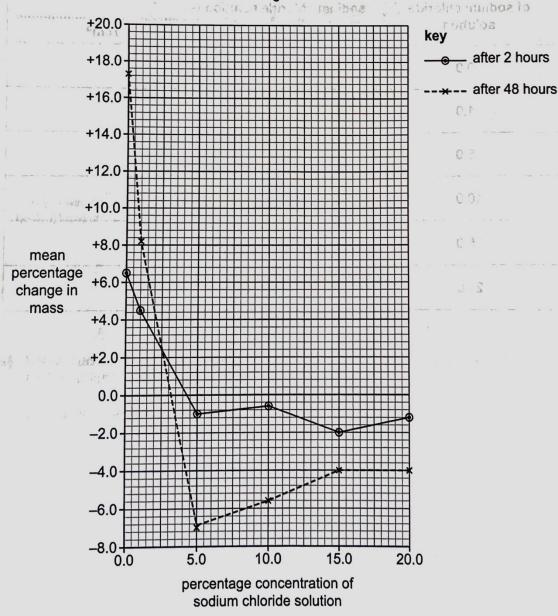


Fig. 1.2

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. 14	(i) E	kplain wh	ny the stu	udents o

(ii)

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Explain why the students calculated the	ne percentage change in mass of the
	San a make a series of Nide 2011 But I was a series of CHA
	[1]
	Sanday Francisco
One of the students concluded that:	the water potential of a
The water potential of the onio 4.2% sodium chloride solution.	on cells is the same as the water potential of a
With reference to the information pro suggest reasons why this conclusion s	rovided, including the results shown in Fig. 1.2, should <b>not</b> be accepted.
E.F.2	8.4
ct of temparature on the wild as us acco-	opposite the effect of investigate the effect
duter layer from a funcip on a legit in this phocies into a beat and depth of your bloods.	If an until Hear, the student removed this of the far blocks in a student placed one of the far in Fig. 1 4. Water ordered the block by bu
100 cm³ beaker	[4]
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Fig. 1.4

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(c) The turnip, Brassica rapa, is a root vegetable. Turnips are grown in many parts of the world.

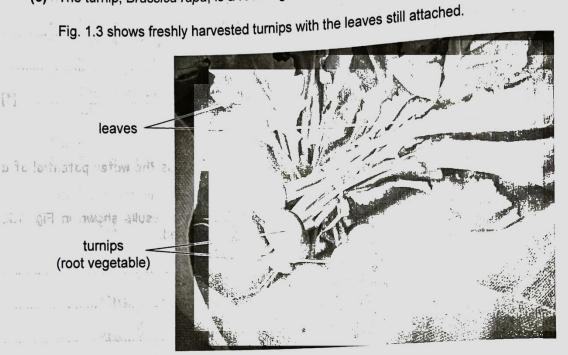


Fig. 1.3

A student decided to investigate the effect of temperature on the rate of osmosis in turnips.

In an initial test, the student removed the outer layer from a turnip and cut the turnip into small blocks. The student placed one of the turnip blocks into a beaker of distilled water, as shown in Fig. 1.4. Water entered the block by osmosis.

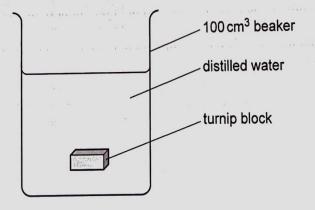


Fig. 1.4

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(i) The student was provided with additional turnips and standard laboratory apparatus.

Describe a method that the student could use to investigate the effect of increasing the temperature, over a range from 10°C to 50°C, on the rate of osmosis in turnip blocks.

Do **not** include the risk assessment or how to calculate the rate of osmosis from the results.

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**序辑** 

[2]

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(ii) Complete the sketch graph shown in Fig. 1.5 to predict the effect of increasing the temperature, over a range from 10°C to 50°C, on the rate of osmosis in turnips.

अभे अंख कृतिक Include axis labels with units in your answer.

remone we solve one better a solve of the control o

Fig. 1.

(iii) Suggest one hazard of your method in (c)(i), the risk associated with the hazard and the precaution that would need to be taken.

hazard	
risk	
precaution	

[Total: 17]

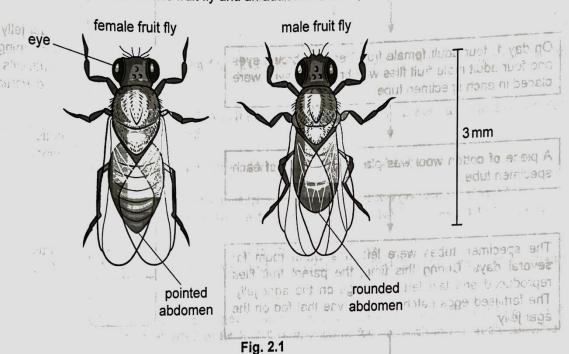
[1]

(

Drosophila melanogaster is a small fruit fly that is often used in research on genetics.

Wild fruit flies normally have dark red eyes due to the presence of a brown pigment, ommochrome, and a bright red pigment, drosopterin. Some agait joily containing nutrients and water was DUTT. 334: placed in the Noticer of several si

Fig. 2.1 shows an adult female fruit fly and an adult male fruit fly.



A biologist carried out an investigation to determine the roles of two genes that are involved in the determination of eye colour in adult fruit flies. Both genes have two alleles. Indeed on Type on Type

Earlier research by other scientists suggested that:

- the synthesis of the brown pigment ommochrome depends on the gene B/b
- the synthesis of the bright red pigment drosopterin depends on the gene R/r.

developed from the lavae and went ready for croasens The biologist obtained the parent fruit flies shown in Table 2.1. Golfstened brooks on southing of

Table 2.1

parent fruit flies	genotype	phenotype
female	BBrr	brown eyes
male	bbRR	bright red eyes

nigle halbin

The biologist carried out the procedure shown in Fig. 2.2 to cross the parent fruit flies and obtain first

generation offspring.

mm E

Some agar jelly containing nutrients and water was placed in the bottom of several specimen tubes.

On day 1, four adult female fruit flies with brown eyes and four adult male fruit flies with bright red eyes were placed in each specimen tube.

A piece of cotton wool was placed in the top of each specimen tube.

The specimen tubes were left in a warm room for several days. During this time, the parent fruit flies reproduced and laid fertilised eggs on the agar jelly. The fertilised eggs hatched into larvae that fed on the agar jelly.

On day 7, the parent fruit flies were removed from each | parellable for the experience of specimen tube.

By day 12, the first generation of adult fruit flies had developed from the larvae and were ready for crossing to produce the second generation. The make it is more

Fig. 2.2

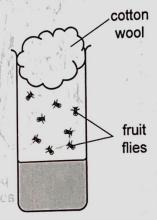
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containing nutrients and water



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day 7.					
	Teble 2.2 shows the results of this coss				
	Table 2.7				
	[1]				

The biologist wanted to cross the first generation of fruit flies with one another to produce the second generation of fruit flies.

The first generation of adult fruit flies in the specimen tubes on day 12 were a mixture of females and males and had **not** yet mated.

The biologist crossed the first generation of fruit flies with one another by:

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- preparing fresh specimen tubes in which to produce the second generation of fruit flies
- using a chemical to anaesthetise the first generation of adult fruit flies so that they were temporarily unable to move
- separating the adult female fruit flies and adult male fruit flies
- placing four adult female fruit flies and four adult male fruit flies into each of the fresh specimen tubes.

flie	ggest a method that the biologist could use to separate anaesthetised adult female fruit s and anaesthetised adult male fruit flies and place four of each into a fresh specimen
tuk	e.  (i) State the pull hypothesis for this of squared (X2) test.
	- S. Serri J. Agricus - Diensche für 16. julie.
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(ii) The e affion for the cost factor of the given

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(c) The biologist expected the cross to result in a phenotypic offspring ratio of 9:3:3:1 in the second generation.

Table 2.2 shows the results of this cross.

Table 2.2

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offspring phenotype (second generation)	expected phenotypic ratio	observed number
dark red eyes	es in the space	691
brown eyes	3	260
bright red eyes	ot da <b>3</b> a m as	
white eyes	16 16 16 16 16 16 16 16 16 16 16 16 16 1	क्राज्यक्ष । क्षाज्यक्ष १९४१ <b>७७</b> १ १९ १ क्षाज्यक्ष । इत
total		1248

The biologist used the chi-squared  $(\chi^2)$  test to compare the observed and expected results for this cross.

I)	State	e the null	hypothesis	for this chi-squared ( $\chi^2$ ) test.	
			The state of the state of	or defend the following the many that the contract of the contract of	
		1-7 c al			

(ii) The equation for the calculation of  $\chi^2$  is:

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

key to symbols:

O = observed result

E =expected result

 $\Sigma$  = sum of

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Complete Table 2.3 to calculate the value of  $\chi^2$  for the results of this cross shown in the Table 2.2. The same companies are special brunch as a minimum and a second services. eyes of adult fruit flies.

Give the value of  $\chi^2$  to four significant figures. So as a solution of the same  $\chi^2$  to four significant figures. So as a solution of the same  $\chi^2$  to four significant figures.

Table 2.3

					Alexander Comment	
offspring phenotype (second generation)	ond to the order		njamany scurer  E  Inv le ruoloo s	O-E A ber also sa	(O-E) <sup>2</sup>	$\frac{(O-E)^2}{e^{-E}}$
dark red eyes	691		1390	unidopini 1 98	rocate or the en	
brown eyes The load	260	*			Store in State	1. 4
bright red eyes	225	- Country			A Section 19	
white eyes	72	4.1	The state of the s	irypiqpi an	- C - P PET CHIRAL STATE (SEE	
total	1248	. 1	thoney the	ACCOUNT OF SHAPE AND SHAPE SHAPE		

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Fig 2

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The biologist compared the calculated value of  $\chi^2$  to the critical values at different probability values shown in Table 2.4. The protogist decided to enalyse all the pigments present in the eyes on the second generally

Table 2.4

degrees of freedom	probability (p)						
	0.95	0,90	0.50	10.0.10 to	0.05	0.01	
2	0.103	0.211	1.386	4.605	5.991	9.210	
idw a 31000m	0.352	0.584	2.366	6.251	7.815	11.345	
4	0.711	1.064	3.357	7.779	9.488	13.277	

nypothesis should be accepted or rejected.	
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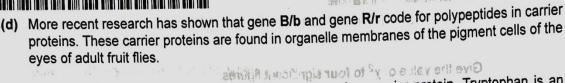
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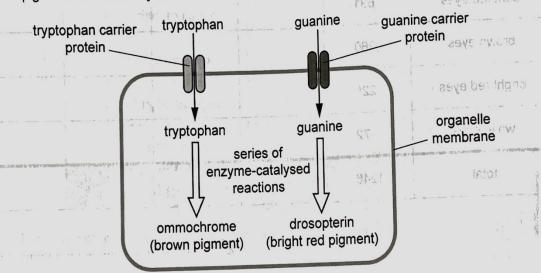


 Gene B/b codes for a polypeptide in the tryptophan carrier protein. Tryptophan is an amino acid. DO NOT WRITE IN THIS MARGIN

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Gene R/r codes for a polypeptide in the guanine carrier protein.

Fig. 2.3 shows how the dark red eye colour of wild fruit flies is produced in organelles in pigment cells of the eyes.



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The biologist decided to analyse all the pigments present in the eyes of the second generation of fruit flies.

The biologist started by extracting eye pigments from the adult fruit flies with dark red eyes and from the adult fruit flies with white eyes. The biologist then added a small volume of each liquid extract to chromatography paper and separated the pigments present by chromatography.

Fig. 2.4 shows the chromatography paper at the end of the procedure when viewed using visible light and ultraviolet light.

Pigment 1 and pigment 3 were visible only when viewed under ultraviolet light. Under visible light, pigment 2 was yellow and pigment 4 was bright red.

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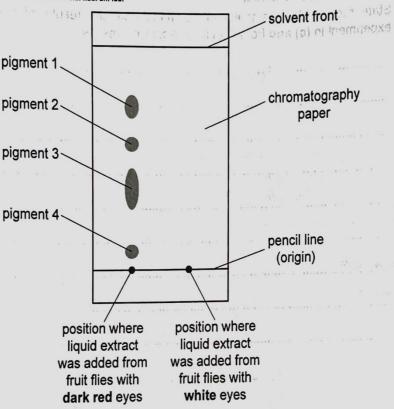


Fig. 2.4

The biologist calculated R<sub>f</sub> values for each pigment on the chromatography paper. The biologist used the R<sub>f</sub> values to confirm the identity of the pigments using a published source.

The formula for the calculation of R<sub>f</sub> is:

$$R_f = \frac{\text{distance moved by pigment}}{\text{distance from origin to solvent front}}$$

When measuring the distance moved by the pigment, the distance to the centre of the pigment should be measured.

Use Fig. 2.4 to calculate the R<sub>f</sub> value of pigment 1.