



Oxford Cambridge and RSA

A Level Biology A

H420/02 Biological diversity

Practice paper – Set 2

Time allowed: 2 hours 15 minutes



You must have:

- the Insert (Inserted)

You may use:

- a scientific or graphical calculator
- a ruler

First name										
Last name										
Centre number						Candidate number				

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets [].
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **32** pages.

2
SECTION A

You should spend a maximum of 20 minutes on this section.

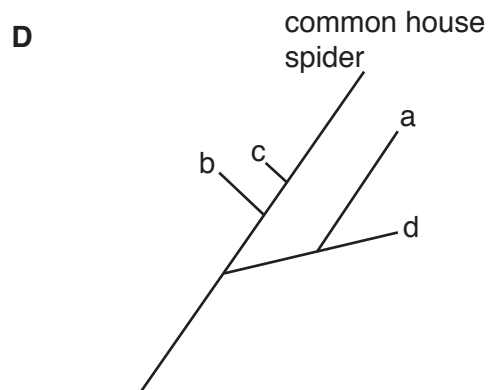
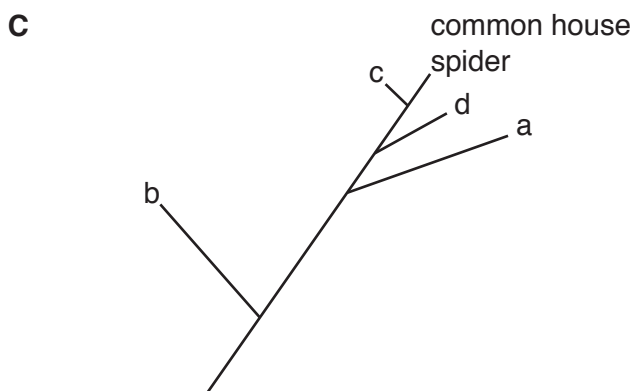
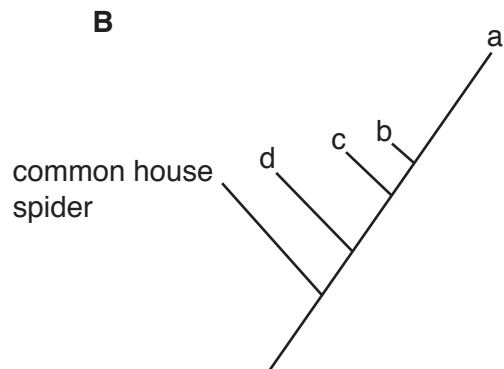
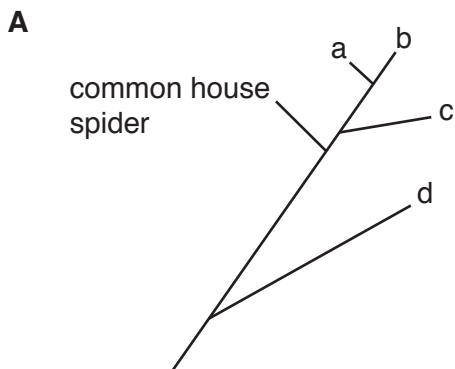
Write your answer to each question in the box provided.

Answer **all** the questions.

- 1 Scientists sequenced the DNA of the common house spider and four other species a, b, c and d that look similar. Analysis revealed the following differences from the DNA of the common house spider.

Species	Number of differences from DNA of common house spider
a	23
b	72
c	6
d	18

Which phylogenetic tree matches these data?



Your answer

[1]

2 A patient has been diagnosed with an autoimmune disease.

Which of the treatments, **A** to **D**, is most likely to relieve the symptoms?

- A** a course of antibiotics
- B** a vaccination containing antibodies
- C** drugs to suppress the immune system
- D** surgery to remove the affected parts

Your answer

[1]

3 The list below describes some types of plant found during primary succession on a sand dune.

- i a legume that contains nitrogen fixing bacteria
- ii hardy grasses that can resist desiccation
- iii large mature trees
- iv small herbs that can tolerate salty spray
- v small trees and bushes

In which order are these plants most likely to grow successfully?

- A** i – ii – iii – iv – v
- B** ii – v – iv – i – iii
- C** ii – iv – i – v – iii
- D** ii – iv – iii – v – i

Your answer

[1]

4 The following statements are about organisms that cause disease.

- 1 Athletes foot and ringworm are caused by fungi.
- 2 Malaria and tuberculosis are caused by protoctistsans.
- 3 Ring rot and black sigatoka are caused by bacteria.

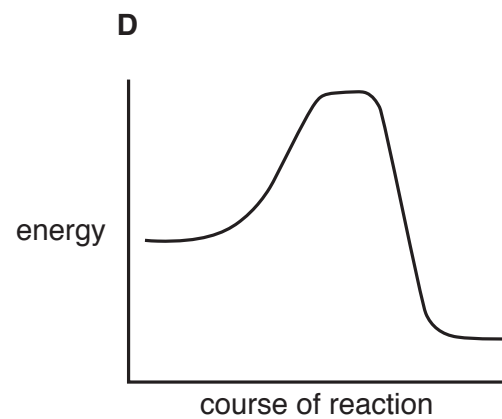
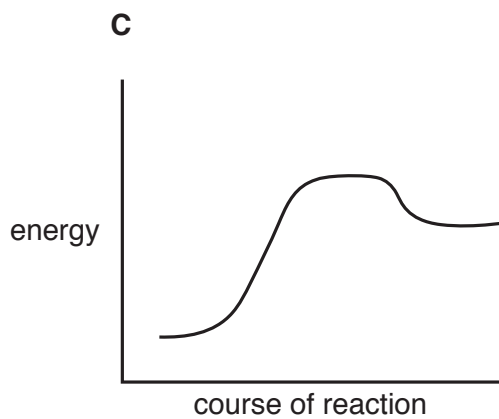
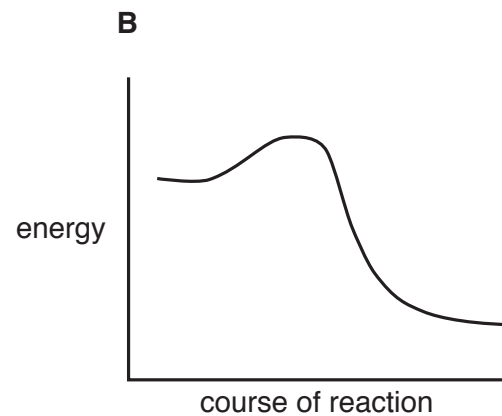
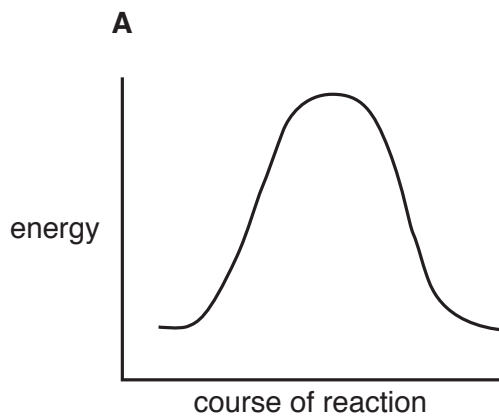
Which of the statement(s) is/are correct?

- A** 1, 2 and 3
B only 1 and 2
C only 2 and 3
D only 1

Your answer

[1]

5 Which of the graphs, **A** to **D**, represents the energy changes involved during an enzyme-controlled anabolic reaction?



Your answer

[1]

6 The following statements are about enzyme action.

- 1 Enzymes can affect the function of organelles.
- 2 Enzymes can affect the structure of an organism.
- 3 Enzymes only work inside cells.

Which of the statement(s) is/are correct?

- A** 1, 2 and 3
- B** only 1 and 2
- C** only 2 and 3
- D** only 1

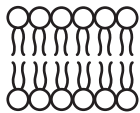
Your answer

[1]

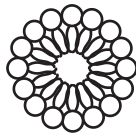
7 When interpreting the results of an experiment to investigate the effect of detergent on plasma membranes, a student looked for a diagram to show what the phospholipids may look like in the presence of detergent.

Which of the diagrams, **A** to **D**, should the student use?

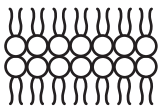
A



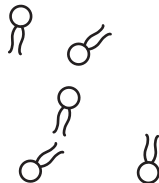
B



C



D



Your answer

[1]

8 What is the main advantage of the polymerase chain reaction (PCR) when it is used as part of the process to sequence the genome of an endangered species?

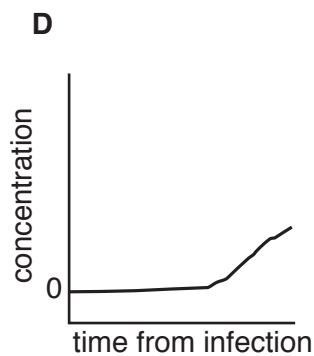
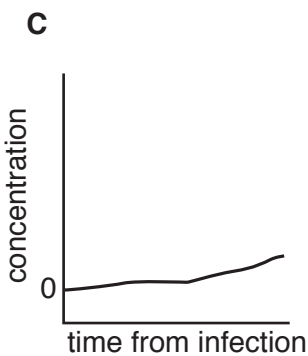
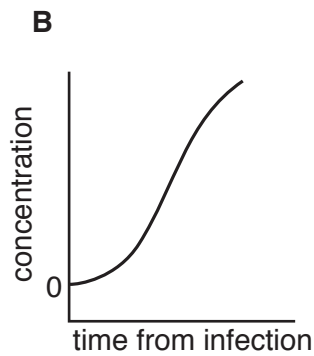
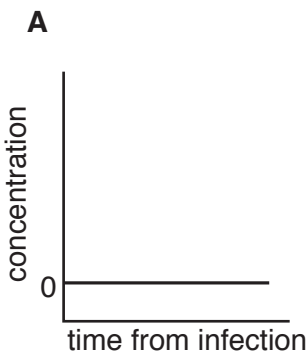
- A it is cheaper than rearing animals
- B it never makes mistakes
- C it reproduces DNA rapidly
- D only a small sample of DNA is required

Your answer

[1]

9 The graphs below show the concentration of antibodies in the blood of four people after a first natural exposure to an antigen. One of the people had been vaccinated against this antigen previously.

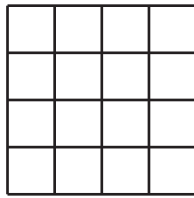
Which of the graphs, **A** to **D**, represents the person who had been vaccinated?



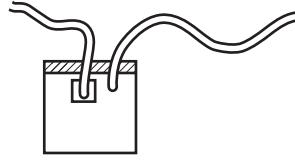
Your answer

[1]

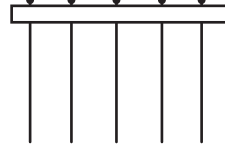
- 10 The images show four pieces of apparatus that could be used to collect data about biodiversity in the field.



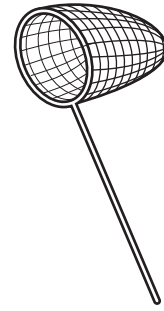
frame quadrant

P

pooter

Q

point quadrat

R

sweep net

S

Which row, **A** to **D**, describes when each piece of apparatus would be used to measure species evenness and richness in a meadow?

Row	Measuring species richness	Measuring species evenness
A	Q, S	R
B	P	P, R
C	P, Q, R, S	P, Q, R, S
D	P, Q, R, S	P, Q, S

Your answer

[1]

- 11 The following statements describe the benefits of *ex situ* conservation.

- 1 Conditions can be maintained at the optimum.
- 2 Many specimens can be conserved in a small space.
- 3 The health of individuals can be monitored constantly and treatment provided if necessary.

Which of the following, **A** to **D**, identifies the statement(s) that apply to seed banks?

- A** 1, 2 and 3
B only 1 and 2
C only 2 and 3
D only 1

Your answer

[1]

12 Which of the statements, **A** to **D**, does **not** provide evidence for natural selection?

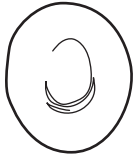
- A** Clover plant populations produce higher hydrogen cyanide toxin levels in areas where snails are common.
- B** Fossils of animals identical to species living today can be found in shallow rocks.
- C** Insects can rapidly develop resistance to insecticides such as DDT.
- D** Resistant forms of *Staphylococcus aureus* were not known before 1961.

Your answer

[1]

13 Which of the diagrams, **A** to **D**, is a stem cell?

A



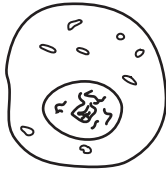
B



C



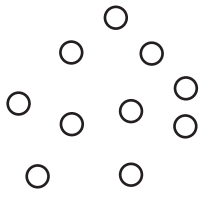
D



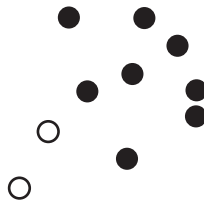
Your answer

[1]

14 Diagrams X, Y and Z represent populations of microorganisms.



X



Y



Z

Which of the sequences, A to D, demonstrates the changes caused by addition of a drug to which some individuals are resistant?

- A Y, X, Z
- B Z, Y, X
- C Z, X, Y
- D Y, Z, X

Your answer

[1]

15 Which of the following, A to D, is an **incorrect** statement about blood cells?

- A Erythrocytes and neutrophils are derived from the same stem cells.
- B Erythrocytes develop large numbers of ribosomes early in their differentiation.
- C The majority of organelles in red blood cells are broken down by hydrolysis.
- D Neutrophils undergo mutation during differentiation.

Your answer

[1]

10
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SECTION B

Answer **all** the questions.

16 A student investigated the distribution of buttercups (*Ranunculus bulbosus*) in a field which contained a pond. The student noticed that the buttercups near the pond looked slightly different from those further away. After further investigation the student identified the buttercups near the pond as a different species (*Ranunculus repens*).

(a) (i) Describe how the student would use a belt transect to investigate the distribution of the two buttercup species.

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..... **[3]**

(ii) Use the space below to show the format of a results table suitable for recording the results of the student’s investigation. (You do not need to include any suggested data.)

[2]

- (b) As the ground dipped towards the pond the soil became obviously wetter. The student thought that the soil moisture might affect the distribution of the two buttercup species.

Suggest **one** biotic factor that might affect the distribution of the buttercups.

.....
 [1]

- (c) As an extension to the field work the student decided to investigate the effect of soil moisture on the germination of buttercup seeds.

The student planted *R. bulbosus* seeds into five pots and maintained the soil moisture in each pot at a different level (0%, 20%, 40%, 60% and 80%). This was repeated with seeds of *R. repens*. After four weeks the student counted the number of plants that had germinated in each pot.

Table 16 shows the results of the student's investigation.

Soil moisture (%)	Number of seedlings germinated	
	<i>R. bulbosus</i>	<i>R. repens</i>
0	0	0
20	23	8
40	46	15
60	16	42
80	4	33

Table 16

- (i) State **two** factors that should be controlled as part of this investigation.

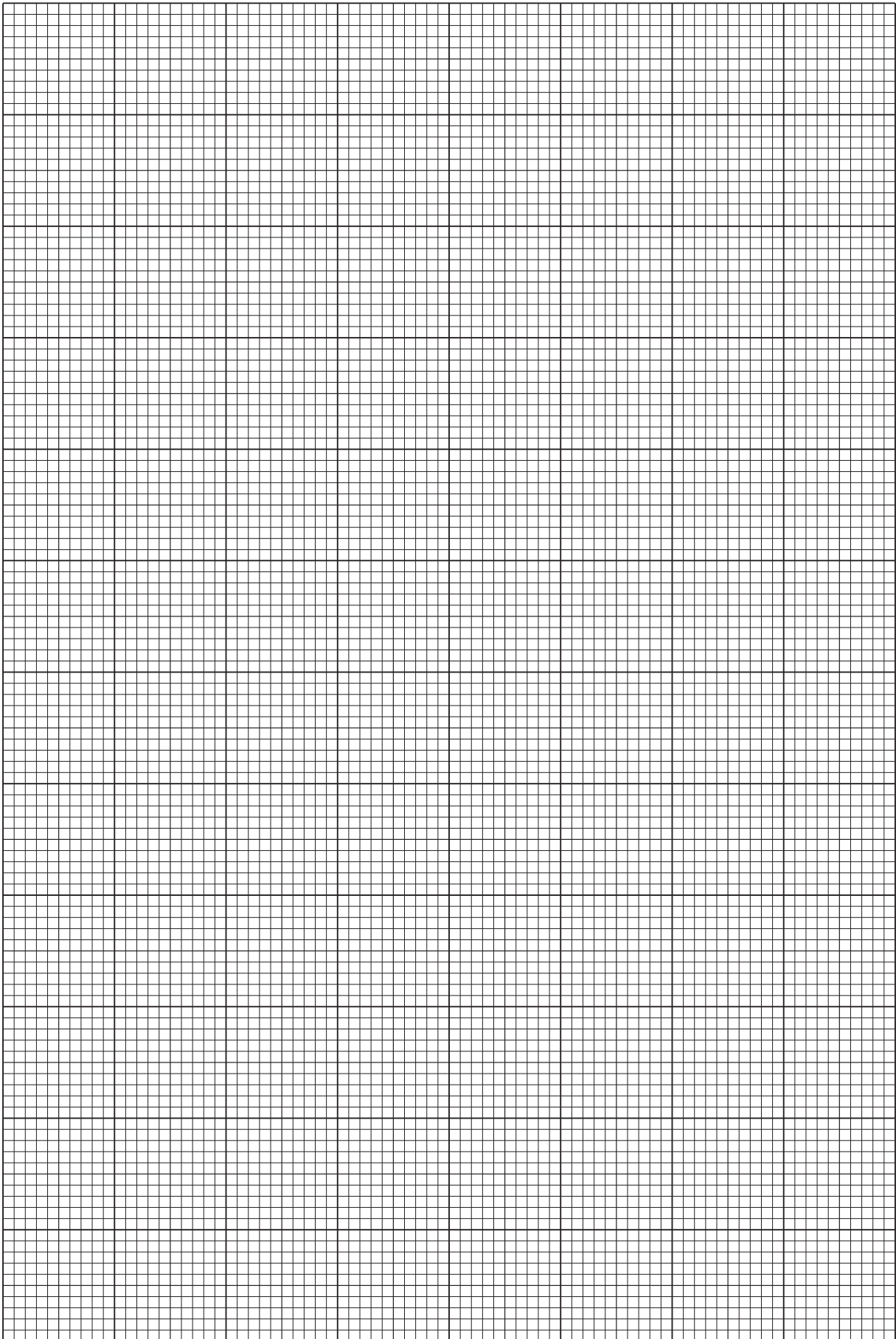
1

2

[2]

- (ii) Use the grid provided on page 13 to plot the results of this investigation.

[4]



- (d) The student used Spearman's rank correlation to show that germination is correlated to soil moisture in *R. repens*.

The value of Spearman's rank correlation coefficient (r_s) is calculated using the formula:

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

where d is the difference in rank within each pair and n is the number of pairs.

- (i) Use the following table to calculate the value of $\sum d^2$.

Soil moisture (%)	Rank (R1)	Number of seedlings germinated	Rank (R2)	d (R1-R2)	d ²
0	1	0	1	0	0
20	2	8	2	0	0
40	3	15	3	0	0
60	4				
80	5				
				$\sum d^2$	

[2]

- (ii) Use your value of $\sum d^2$ to calculate the value of r_s .

$r_s = \dots\dots\dots$ [2]

- (iii) The critical value at $p = 0.05$ is 1.0.

What can the student conclude about the correlation between soil moisture and germination in *R. repens*?

.....

 [1]

17 In pigeons, the male bird is homogametic (XX) and the female bird is heterogametic (XY).

Feather colour in pigeons is a sex-linked characteristic that is affected by one gene which has three alleles.

In female birds allele C^r produces ash red feathers, C^{br} produces brown feathers and C^{bl} produces blue feathers.

C^r is dominant to C^{br} , which is dominant to C^{bl} .

(a) A pigeon breeder crossed an ash red male with a brown female. The two eggs hatched to produce one brown male and one blue female.

Use a genetic diagram to explain these results.

Male

Female

Parental genotypes:

Gametes:

F1 generation
genotype:

phenotype:

[4]

- (b) Pigeons can live for 15 years in captivity. They are kept in small mixed flocks but tend to be monogamous (have one partner). Each season the female produces two eggs.

A student used a genetic diagram to show the breeder that over a number of generations the following ratio of offspring could be expected from the breeding pair.

1 ash red male : 1 brown male : 1 ash red female : 1 blue female

The breeder decided to test this prediction.

Over a number of breeding seasons records were kept of the offspring produced by the same pair of birds. Table 17.1 shows the results recorded by the breeder.

Year	Males		Females	
	Ash red	Brown	Ash red	Blue
1		1		1
2	1		1	
3		1		1
5**	1			1
6	1	1		
7	2			
8		1	1	
9		1		1
10	1			1
11	1		1	
total	7	5	3	5

** in year 4 there were two brown female chicks

Table 17.1

The chi-squared test can be used to assess the probability of achieving these observed results. The value of chi-squared is given by the formula:

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

- (i) Use Table 17.2 to calculate the value of chi-squared using the ratio predicted by the student as the expected results.

	Ash red male	Brown male	Ash red female	Blue female	Total
O	7	5	3	5	20
E	5	5	5	5	20
(O-E)²					
(O-E)²/E					

Table 17.2

$\chi^2 = \dots\dots\dots$ [2]

- (ii) The critical value of chi-squared for three degrees of freedom at a probability of 0.05 is 7.81.

What can you conclude about the observed results collected by the breeder in Table 17.1?

..... [1]

- (iii) Explain why the observed results did not exactly match the predicted results.

.....
..... [1]

- (c) In year 4 the breeder noticed that the two chicks were brown feathered females. The student had not predicted that brown feathered females would be produced. The value of E for this category would be zero. Therefore the breeder had left this category out of the results table.

- (i) What effect would adding this unexpected result into the results table have on the value of chi-squared?

..... [1]

- (ii) Assuming that the student had made an accurate prediction about the ratio of offspring, what might the breeder have concluded about the parents of the chicks in year 4?

..... [1]

(iii) Explain how you have reached this conclusion.

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..... [2]

18 (a) Triglycerides consist of glycerol combined with three fatty acids.

Fig. 18 shows a glycerol molecule and a fatty acid molecule.

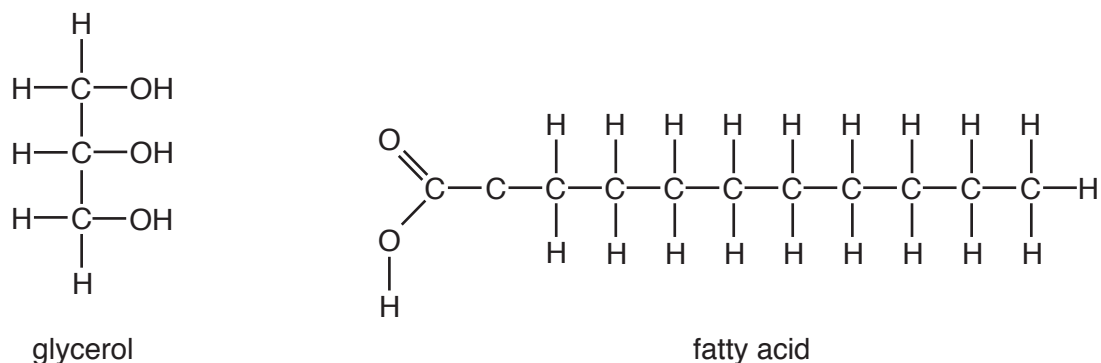


Fig. 18

(i) In the space below draw a monoglyceride molecule.

[2]

(ii) Name the bond formed between the glycerol and the fatty acid.

..... [1]

(iii) Name the other molecule formed when this bond is made.

..... [1]

(b) Energy can be stored in living organisms in the form of carbohydrates or lipids.

Name the carbohydrate molecules used to store energy in plants and animals.

plants

animals

[1]

21
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Turn over for the next question

- 19 (a) A student investigated the effect of concentration on the rate of diffusion. The student placed identical cubes of agar jelly containing phenolphthalein indicator into hydrochloric acid. Phenolphthalein is pink when alkaline but turns colourless in acidic conditions.

The student used a range of concentrations of hydrochloric acid (0.0, 0.1, 0.2, 0.4 and 0.8M) and measured the time taken for the pink colour in the agar to completely disappear using a stop watch. The student carried out three measurements at each acid concentration.

The student's results are recorded in Fig. 19.

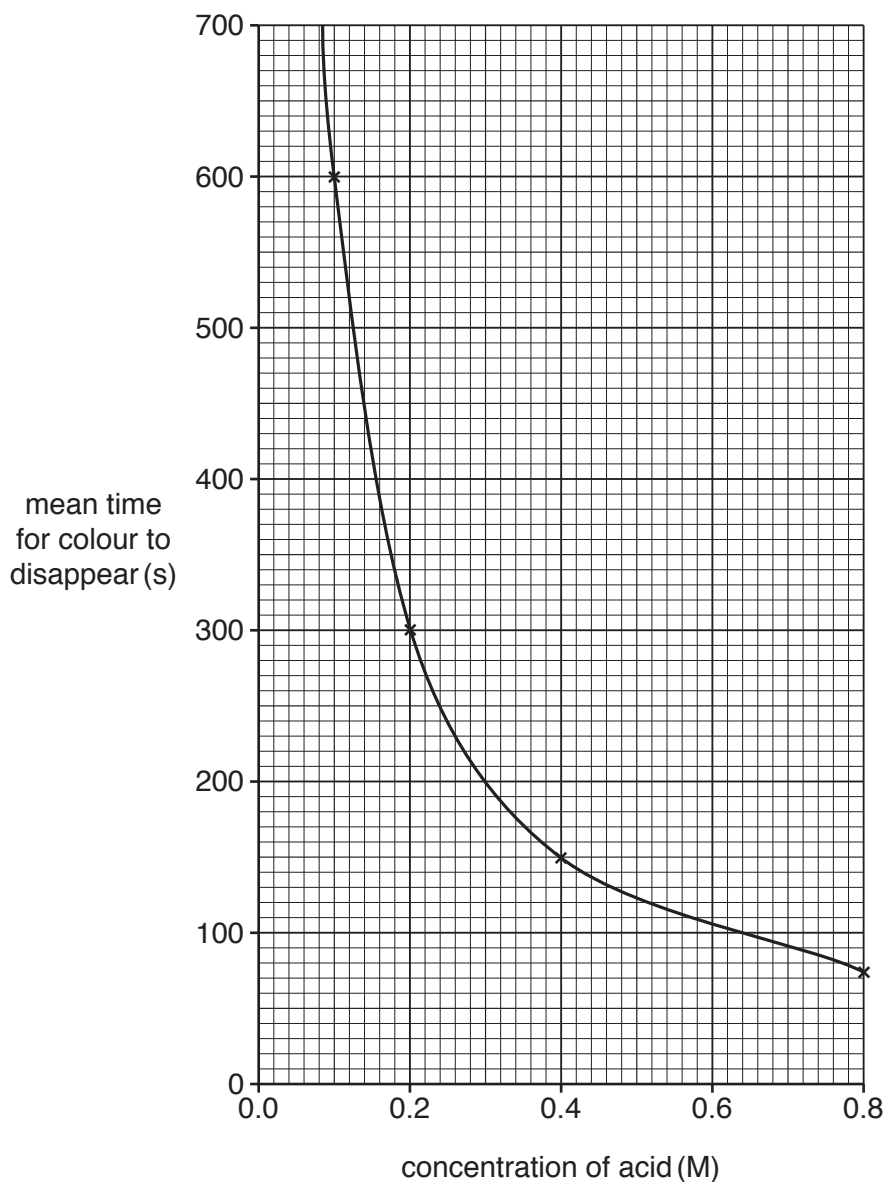


Fig. 19

- (i) The student was supplied with a solution of 1M hydrochloric acid.

The student decided to make 50 cm³ of each solution required.

Describe how the student created the concentrations shown using a serial dilution technique.

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..... [3]

- (ii) Use the graph in Fig. 19 to estimate the expected time taken to completely discolour a block in 0.3M hydrochloric acid.

..... [1]

- (iii) The student found it very hard to determine exactly when the colour completely disappeared. The results were not easily repeatable.

Describe and explain how this problem could be displayed quantitatively on the graph.

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..... [2]

- (iv) The student was using 10 mm agar blocks. The teacher suggested that using larger agar blocks could make the results more easily repeatable.

Explain why using larger agar blocks would make the results more repeatable.

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..... [2]

- (b) Another student repeated the experiment using 30mm agar blocks. However, as the end of the lesson approached the blocks still had large areas of pink colour left. The student modified the method and removed all the blocks from the acid at the same time.

Suggest how the student could use the partly-discoloured blocks to measure the rate of diffusion.

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..... [3]

(b) Beavers were hunted to extinction in the UK about 500 years ago. Recently a trial reintroduction in Scotland was hailed as a great success after researchers found that the animals had ‘transformed the landscape’. After five years the beavers had:

- constructed dams – the largest of which was 18 m long and 1.6 m high
- felled trees
- created canals
- built lodges (large nests)
- successfully reproduced.

(i) Beavers are considered to be a keystone species.

Explain why they are a keystone species in their native Canada.

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..... [2]

(ii) One benefit of the reintroduction of beavers in Scotland was an increase in habitat diversity.

Explain how the following activities could have contributed to increased habitat diversity.

constructed dams

.....

felled trees

.....

built lodges

.....

[3]

(iii) Suggest **one** other benefit of the reintroduction of beavers.

.....

..... [1]

- (c) Increasing habitat diversity may lead to an increase in species diversity and genetic diversity.

Explain why species diversity and genetic diversity may be increased as a result of the beavers' activity.

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..... [2]

- (d) Some land owners have expressed concern about the impact that beavers can have on rural businesses.

Suggest **two** arguments that may be used by local business leaders against the introduction of beavers. State whether these outweigh the arguments presented by the naturalists.

argument 1

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argument 2

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[4]

21 (a) Charles Darwin was aware of the role that some farmers have in altering the course of evolution. He had observed that farmers could breed animals and plants so that certain characteristics become more exaggerated.

(i) Name the type of selection used by farmers to breed exaggerated features in animal or plant species.

..... [1]

(ii) Name **one** example of a plant that has been bred by farmers to show exaggerated features and describe the feature that has been exaggerated.

.....
..... [1]

(b) Fig. 21, **on the insert**, shows a wolf (*Canis lupus*) and two breeds of dog.

All dog breeds belong to the same species (*Canis lupus familiaris*) that evolved from wolves.

Darwin made the following statement in his book *The origin of species*:

‘Man selects only for his own good; Nature only for that of the being which she tends.’

This has been paraphrased as:

‘Man selects for looks; nature selects for survival.’

Discuss this statement using examples of dog breeds such as those shown in Fig. 21.

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..... [4]

- (c) The Kennel Club is an organisation that protects and promotes the health and welfare of dogs. It also publishes descriptions to define each breed.

Explain why such an organisation is necessary.

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..... [3]

Turn over for the next question

22 Fig. 22 shows four nucleotides.

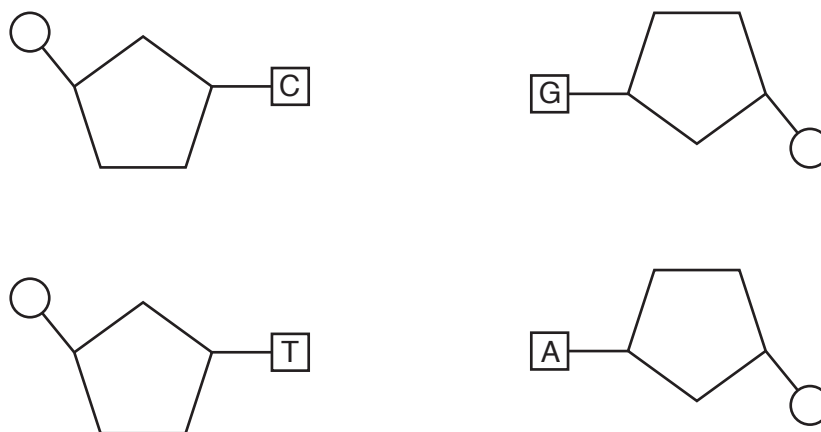


Fig. 22

- (a) **On Fig. 22**, draw and label the bonds holding the nucleotides together as part of a DNA molecule. [2]
- (b) (i) **On Fig. 22**, use the letter **R** to label a bond that would be made by the action of a ligase enzyme. [1]
- (ii) **On Fig. 22**, use the letter **P** to label a bond that would be broken during the hottest step of the PCR reaction. [1]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large area of lined paper for writing. It features a vertical solid line on the left side, creating a margin. The rest of the page is filled with horizontal dotted lines, providing space for writing answers.

A large rectangular area with a solid vertical line on the left side and horizontal dotted lines extending across the page, providing a grid for writing answers.



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