OXFORD

INTERNATIONAL AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

INTERNATIONAL AS

BIOLOGY (9610)

Unit 1 The diversity of living organisms

Thursday 9 May 2019 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

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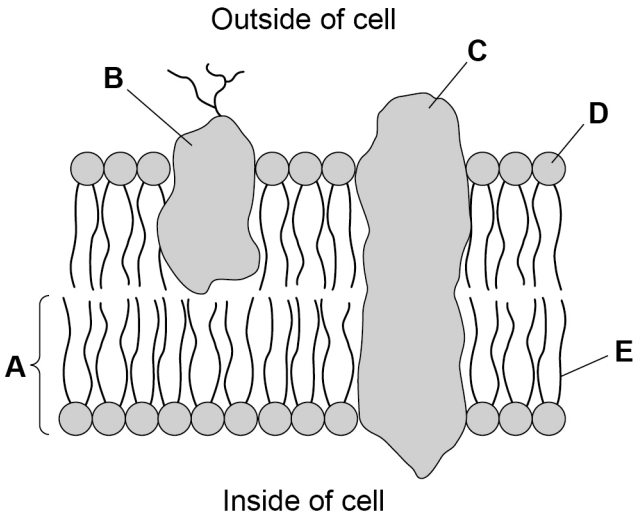
Answer **all** questions in the spaces provided.

0 1 **Figure 1** shows part of the structure of a plasma membrane.

Figure 1



0 1 . 1 Add the missing information to complete **Table 1**.

[3 marks]

Table 1

Name of structure	Letter
	A
Hydrocarbon chain	
	C

0 1 . 2 Explain why the structure of a membrane is described as 'fluid-mosaic'.

[2 marks]

Do not write outside the box

0 1 . 3 Suggest the function of cholesterol in the plasma membrane.

[1 mark]

6

Turn over for the next question

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0 2 **Figure 2** shows a photograph of the Chinese giant salamander. This species is only found in rivers and streams in China.

Figure 2

Table 2 shows the taxa and the names of the taxa used to classify this species of giant salamander. They are **not** in the correct order.

Table 2

	Taxon	Name of taxon
J	Family	Cryptobranchidae
K	Kingdom	Animalia
L	Order	Urodela
M	Genus	Andrias
N	Class	Amphibia
O	Species	davidianus
P	Phylum	Chordata
Q	Domain	Eukarya

0 2 . 1 Put letters from **Table 2** into the boxes below in the correct order.

Some boxes have been completed for you.

[1 mark]

Q	**K**					**M**	**O**

0 2 . 2 Give the binomial name of this giant salamander.

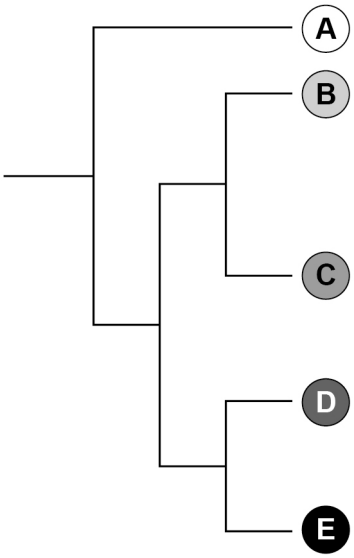
[1 mark]

Do not write outside the box

0 2 . 3 Scientists have discovered five new species, **A**, **B**, **C**, **D** and **E**, of Chinese giant salamander. In their natural habitat all of these species are in danger of extinction. Large populations of species **B** are kept in captive breeding farms.
The Chinese government has taken action to conserve salamanders by releasing individual salamanders from the breeding farms into rivers.

Figure 3 shows how species **A**–**E** may have evolved.

Figure 3



Explain what **Figure 3** shows about the evolutionary relationships between species **B** and the other four species.

[2 marks]

0 2 . 4 To construct **Figure 3** the scientists extracted a gene from the mitochondrial DNA of tissue samples from individual salamanders of the five new species (**A**–**E**).

The gene extracted from the mitochondrial DNA codes for a protein.

Suggest **one** possible function of this protein.

[1 mark]

Question 2 continues on the next page

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0 2 . 5 Comparing the base sequence of a gene provides more information than comparing the amino acid sequence of the protein for which the gene codes.

Explain why.

[2 marks]

0 2 . 6 Suggest **two** reasons why scientists are concerned about the release of individual salamanders from the captive breeding farms.

[2 marks]

1

2

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Turn over for the next question

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0 3 **Figure 4** shows the mRNA base sequence transcribed from a section of a gene.

Figure 4

G A U G G C A G U C U G A G C

0 3 . 1 The sequence in **Figure 4** contains several codons.

What is a codon?

[2 marks]

0 3 . 2 **Table 3** shows some mRNA base sequences and what they code for.

Table 3

mRNA	Amino acid / stop code
AAU, AAC	Asn
AGU, AGC	Ser
GAU, GAC	Asp
GGU, GGC	Gly
CUG, CUA, UUA, UUG	Leu
CGA	Arg
UGA	Stop code

Complete **Table 4** to show:

- the original DNA that this mRNA sequence was transcribed from
- the amino acids that would be coded for by this sequence.

Use information from **Table 3** to help you.

[3 marks]

Table 4

DNA															
mRNA	G	A	U	G	G	C	A	G	U	C	U	G	A	G	C
Amino acid															

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0 3 . 3 A different base could replace cytosine in the mRNA sequence shown in **Figure 4**. The new code would produce a peptide with the same primary structure.

Name this base.

[1 mark]

0 3 . 4 Some individuals have a mutation which deletes one of the bases from the mRNA sequence shown in **Figure 4**. This results in a peptide with only the first three amino acids.

Figure 5 shows the same mRNA sequence as **Figure 4**.

Draw a circle on **Figure 5** around the base that was deleted.

[1 mark]

Figure 5

G A U G G C A G U C U G A G C

0 3 . 5 The sequence with the deletion contains 14 nucleotides and so should code for 4 amino acids.

Why are only 3 amino acids coded by this sequence?

[1 mark]

8

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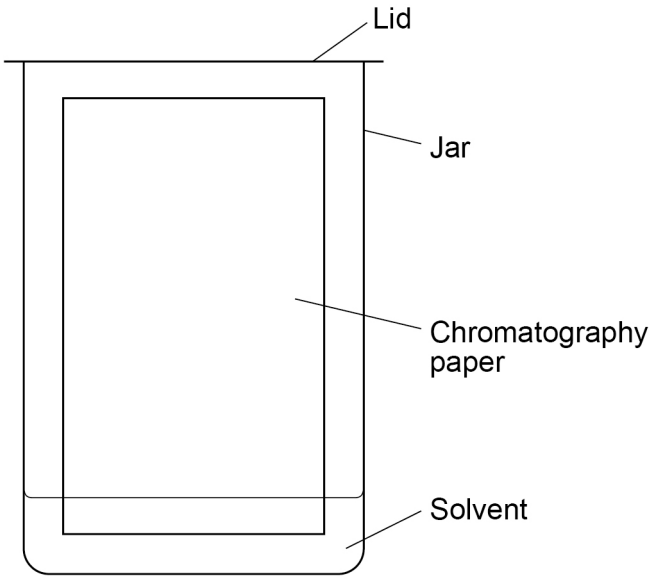
0 4 Students separated a mixture of amino acids using paper chromatography.

Figure 6 shows the apparatus the students used.

Figure 6



0 4 . 1 Describe how the students should have put the solution containing a mixture of amino acids onto the chromatography paper before the paper is put in the jar.

[3 marks]

Do not write outside the box

0 4 . 2 Suggest **two** practical precautions that the students should take when doing this investigation.

[2 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

Question 4 continues on the next page

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0 4 . 3 **Figure 7** shows a chromatogram produced by the students.
V, **W**, **X**, **Y** and **Z** are different amino acids.

Figure 7

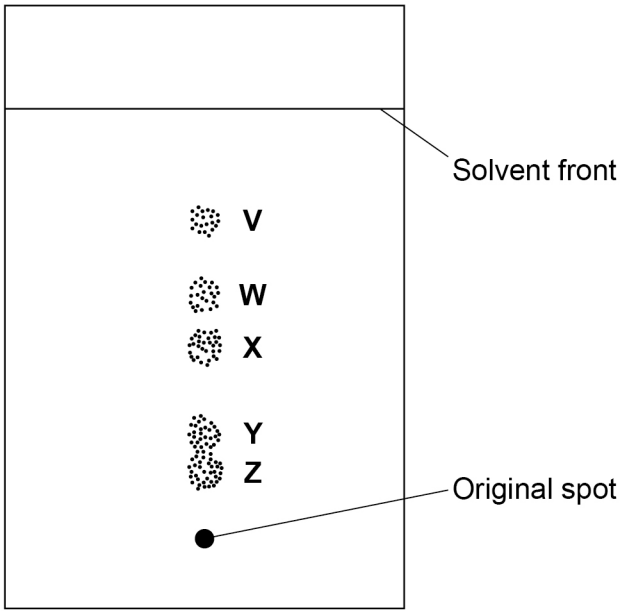

Table 5 shows the R_f values for some amino acids.

Table 5

Amino acid	**R_f value**
Alanine	0.38
Arginine	0.20
Phenylalanine	0.68
Threonine	0.35
Tyrosine	0.45

Identify amino acid **X**.

Give the reason for your answer.

[2 marks]

Amino acid **X** is _____

Reason _____

_____

_____

Do not write outside the box

0 4 . 4 Name the part of an amino acid that causes different R_f values.

[1 mark]

0 4 . 5 Describe **two** ways that the students could use chromatography to separate amino acids **Y** and **Z** more clearly.

[2 marks]

1

2

10

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0 5 Glycogen is a polymer made of long branching chains of glucose.
A glycogen molecule is very similar in structure to amylopectin in starch, with 1–6 glycosidic bonds forming the branches.

Glycogen is formed in a polymerisation reaction. Glucose molecules are added to the chain by the enzyme glycogen synthase. Glycogen synthase can only do this if there are three glucose molecules already in the chain.

To start the chain, the first glucose molecule attaches by one of its hydroxyl groups to the amino acid tyrosine in a molecule of a protein called glycogenin. Whilst attached to glycogenin, up to seven more glucose molecules can join the chain. This will then allow the glycogen synthase to continue the polymerisation.

Glycogenin remains attached to the reducing end of the glycogen molecule during polymerisation. The entire globular complex of glycogenin and glycogen may contain 30 000 glucose monomers.

0 5 . 1 Define the term 'polymer' (line 1).

[1 mark]

0 5 . 2 Which form of glucose is found in glycogen?

[1 mark]

Tick (✓) **one** box.

- α ☐
- β ☐
- γ ☐
- δ ☐

Do not write outside the box

0 5 . 3 Glycogen can be hydrolysed into many molecules of a disaccharide.

Name this disaccharide.

[1 mark]

0 5 . 4 Glycogenin remains attached to the reducing end of the glycogen molecule during polymerisation (lines 12 to 13).

Glycogenin with the attached chain of glucose molecules is tested with:
- Benedict's solution
- biuret reagent.

Complete **Table 6** to show the colour that you would expect in each test.

[2 marks]

Table 6

Test	Final colour
Add Benedict's solution and heat	
Add biuret reagent	

0 5 . 5 Explain your answer to the final colour after treatment with biuret reagent.

[1 mark]

Question 5 continues on the next page

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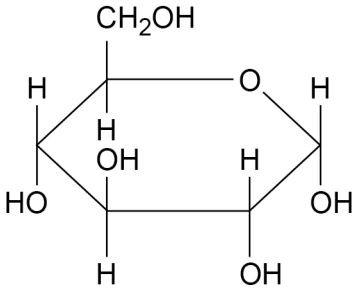
0 5 . 6 To start the chain, the first glucose molecule attaches by one of its hydroxyl groups to the amino acid tyrosine in a molecule of a protein called glycogenin (lines 7 to 8, page 14).

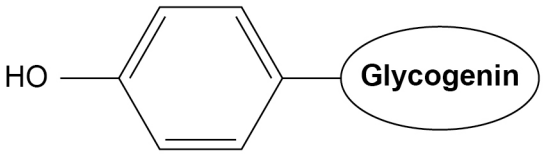
Figure 8 shows a molecule of glucose and a molecule of tyrosine in glycogenin.

Figure 8

Glucose



Tyrosine in glycogenin

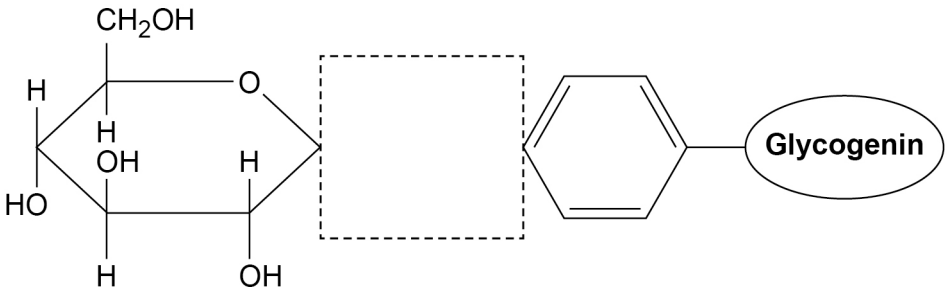


A condensation reaction forms a bond between the glucose and the tyrosine molecules.

In **Figure 9**, fill the box to show the bond formed between the two molecules.

[1 mark]

Figure 9



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0 5 . 7 Scientists used an enzyme to completely hydrolyse two different types of glycogen, **A** and **B**. Glycogen **A** and glycogen **B** contained different numbers of 1–6 glycosidic bonds.

Table 7 gives information about the two types of glycogen.

Table 7

Type of glycogen	Number of 1–6 glycosidic bonds per molecule	Time taken for complete hydrolysis / minutes
A	6000	61
B	3000	323

Calculate the percentage increase in time taken for complete hydrolysis of glycogen **B** compared to glycogen **A**.

Use information from **Table 7**.

[2 marks]

Percentage increase = _____ %

0 5 . 8 Suggest why the time taken for hydrolysis is much longer if there are fewer 1–6 glycosidic bonds in the glycogen molecule.

[2 marks]

Question 5 continues on the next page

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0 5 . 9 The scientists found that 1 millimole of bacterial glycogen completely hydrolysed in 228 minutes.

Calculate the rate for this reaction.

[2 marks]

Rate = _____ mmol h^{-1}

13

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0 6 . 1 Haemoglobin is a protein with a quaternary structure.

What is the meaning of 'quaternary structure'?

[1 mark]

Question 6 continues on the next page

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Erythropoietin (EPO) is a hormone produced naturally in the body. EPO increases the production of red blood cells.

Scientists investigate the effect of alpha lipoic acid (ALA) on the production of EPO.

This is the method the scientists use:

- place 16 students into two groups of 8; one is the experimental group and the other is the control group
- give the 8 students in the experimental group a daily pill containing ALA
- measure the EPO concentration in the blood of the students in both groups after 10 days
- instruct the students to complete a 90 minute exercise session
- measure the EPO concentration in the blood of the students at three intervals after the exercise session.

The results are shown in **Table 8**.

Table 8

Group	**Mean concentration of EPO in blood sample / arbitrary units (± 1 standard deviation)**			
	Before exercise (after 10 days)	**20 minutes after exercise**	**24 hours after exercise**	**48 hours after exercise**
Control	7.22 (±1.31)	13.41 (±4.89)	10.95 (±4.85)	7.88 (±5.16)
Experimental (given ALA)	12.36 (±2.50)	16.51 (±5.52)	19.63 (±10.25)	23.90 (±11.24)

0 6 . 2 Suggest how the control group should have been treated in this investigation.

[2 marks]

Do not write outside the box

0 6 . 3 Explain why a control group was needed for this investigation.

[2 marks]

0 6 . 4 The scientists concluded that ALA could be used to increase EPO concentration.

Use information from **Table 8** to evaluate this conclusion.

[4 marks]

Question 6 continues on the next page

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0 6 . 5 Synthetic EPO is made artificially. Some athletes use synthetic EPO as a performance-enhancing drug.

Explain how synthetic EPO may improve the athlete's performance in endurance events.

[4 marks]

13

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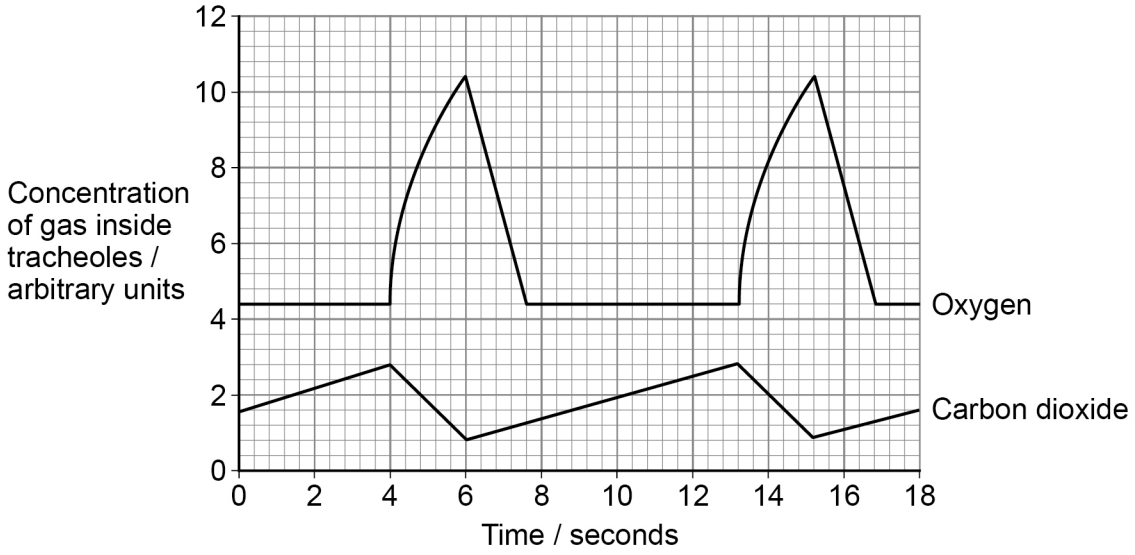
0 7 A scientist measured the change in concentration of oxygen and carbon dioxide inside the tracheoles of an insect.

The results are shown in **Figure 10**.

Figure 10



Use **Figure 10** to answer Questions **07.1** and **07.2**.

0 7 . 1 Suggest what stimulates the spiracles to open.

[2 marks]

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0 7 . 2 Give the total length of time that the insect's spiracles were open during the period shown in the graph.

Explain how you arrived at your answer.

[2 marks]

Total length of time _____ seconds

Explanation _____

0 7 . 3 Large insects can contract the muscles of their abdomen to force air in and out of the spiracles. This is called 'abdominal pumping' and it increases the efficiency of gas exchange between the tracheoles and the muscle tissue of the insect.

Give reasons why large, active insects use abdominal pumping, while small, less active insects do not.

[3 marks]

7

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0 8 DNA contains phosphorus.

0 8 . 1 Name the part of the DNA nucleotide which contains phosphorus.

[1 mark]

_____

0 8 . 2 Name **two** other biological molecules that **always** contain phosphorus.

[2 marks]

1 _____

2 _____

0 8 . 3 Name the enzyme that synthesises a new strand of DNA by forming bonds between the DNA nucleotides.

[1 mark]

_____

Question 8 continues on the next page

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0 8 . 4 Phosphorus has two forms, one non-radioactive (^{31}P) and one radioactive (^{32}P). Scientists can use a Geiger detector to measure the level of radioactivity emitted from the phosphorus atoms. They can use this information to calculate the proportion of radioactive to non-radioactive phosphorus atoms in a DNA polymer.

Scientists investigate DNA replication. This is the method the scientists use:

- grow bacteria for several generations in a nutrient solution containing the radioactive form of phosphorus (^{32}P)
- extract DNA from a sample of the bacteria
- transfer the bacteria to a nutrient solution containing only the non-radioactive form of the phosphorus (^{31}P)
- allow the bacteria to grow and divide once
- extract DNA from a sample of the bacteria
- use a Geiger detector to measure the amount of radioactivity emitted from the DNA
- use a conversion table to relate the reading from the Geiger detector to the percentage of radioactive DNA in the molecule.

Table 9 shows the conversion table.

Table 9

Reading from the Geiger detector / MeV	Percentage radioactive DNA in the molecule
0.000	0
0.425	25
0.850	50
1.275	75
1.700	100

A DNA sample measured 1.500 MeV on the Geiger detector.

Calculate what percentage of radioactive DNA the DNA sample would contain.

Use information from **Table 9**.

Give your answer to **two** significant figures.

[2 marks]

Percentage contained = _____ %

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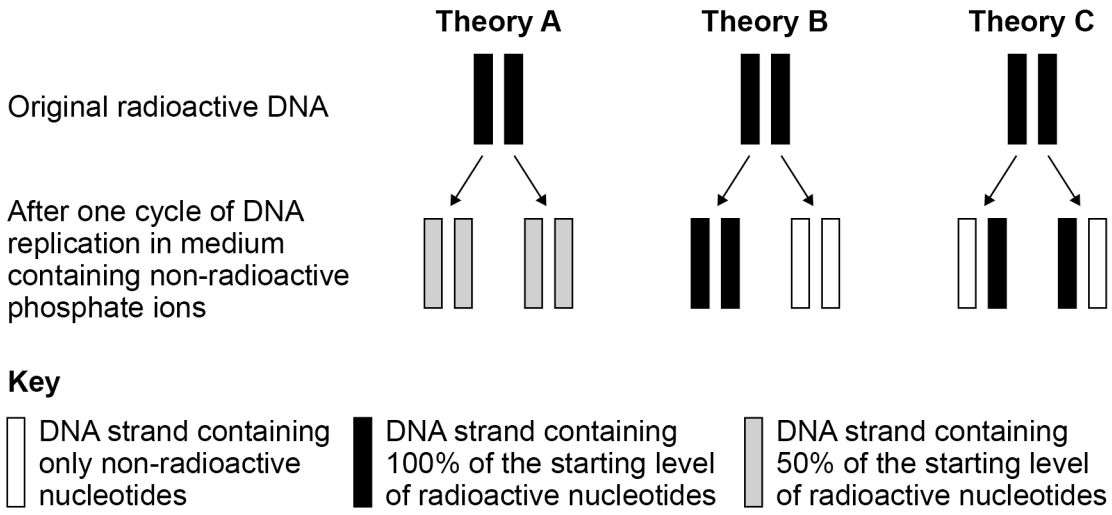
0 8 . 5 There are three main theories for the mechanism of DNA replication.

Figure 11 shows what the three main different theories predict about how new strands of DNA form.

Figure 11



Each theory, **A**, **B** or **C**, predicts that the DNA double-helix strands produced by the bacteria after one cycle of DNA replication would contain different amounts of radioactive DNA.

After the experiment, the actual results show that 50% of the nucleotides in all the DNA **molecules** are radioactive.

State which theory, **A**, **B** or **C**, is shown to be **incorrect** by these results.

[1 mark]

Question 8 continues on the next page

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0 8 . 6 The scientists then allowed enough time for the bacteria to complete another cycle of DNA replication in the medium containing non-radioactive phosphate ions. This time they found that half of the DNA molecules were non-radioactive and half were 50% radioactive.

Which theory did the scientists conclude was the only correct one?

Explain your answer.

Use the information above.

[2 marks]

9

END OF QUESTIONS

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