DNA Replication: AQA A Level Biology Exam Questions by Topic

16 questions · 39 marks · about 51 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Paper 1 · June 2025 · Q03.1 · 5 marks

0 3 . 1 Describe the semi-conservative replication of DNA.

[5 marks]

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Question 2 · AS Paper 1 · June 2018 · Q03.2 · 2 marks

0 3 . 2 Give **two** features of DNA **and** explain how each one is important in the semi-conservative replication of DNA.

[2 marks]

1 _____

2 _____

Question 3 · A level Paper 3 · June 2017 · Q05.1 · 2 marks

0 5 . 1 Name **two** enzymes involved in the semi-conservative replication of DNA.

[2 marks]

1 _____

2 _____

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Question 4 · AS Paper 1 · June 2017 · Q01.3 · 2 marks

0 1 . 3 The enzymes DNA helicase and DNA polymerase are involved in DNA replication.

Describe the function of each of these enzymes.

[2 marks]

DNA helicase _____

_____

_____

_____

DNA polymerase _____

_____

_____

_____

Question 5 · AS Paper 2 · November 2020 · Q02.4 · 2 marks

0 2 . 4 In the process of semi-conservative DNA replication, the two strands within a DNA molecule are separated. Each then acts as a template for the formation of a new complementary strand.

Describe how the separation of strands occurs.

[2 marks]

_____

_____

_____

_____

_____

_____

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Question 6 · AS Paper 2 · June 2019 · Q03.2 · 1 mark

A scientist replicated DNA in a test tube. To do this, he mixed an enzyme with identical single-stranded DNA fragments and a solution containing DNA nucleotides.

0 3 . 2 Name the enzyme used in this DNA replication.

[1 mark]

Question 7 · A level Paper 1 · November 2020 · Q05.1 · 2 marks

0 5 . 1 Describe the role of DNA polymerase in the semi-conservative replication of DNA.

[2 marks]

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Question 8 · A level Paper 1 · June 2018 · Q09.1 · 3 marks

0 9 . 1 Describe the role of **two** named enzymes in the process of semi-conservative replication of DNA.

[3 marks]

[Extra space]

Question 9 · information from earlier in the question

A scientist replicated DNA in a test tube. To do this, he mixed an enzyme with identical single-stranded DNA fragments and a solution containing DNA nucleotides.

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Question 9 · AS Paper 2 · June 2019 · Q03.3 · 3 marks

0 3 . 3 Use your knowledge of semi-conservative replication of DNA to suggest:

[3 marks]

1. the role of the single-stranded DNA fragments _____

2. the role of the DNA nucleotides. _____

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Question 10 · AS Paper 1 · June 2016 · Q01.2 · 3 marks

0 1 . 2 When HIV infects a human cell, the following events occur.

- A single-stranded length of HIV DNA is made.
- The human cell then makes a complementary strand to the HIV DNA.

The complementary strand is made in the same way as a new complementary strand is made during semi-conservative replication of human DNA.

Describe how the complementary strand of HIV DNA is made.

[3 marks]

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Question 11 · A level Paper 1 · June 2019 · Q06.2 · 5 marks

The scientists determined the percentage of heart cells undergoing DNA replication by using a chemical called BrdU. Cells use BrdU instead of nucleotides containing thymine during DNA replication.

0 6 . 2 Describe how BrdU would be incorporated into new DNA during semi-conservative replication.

[5 marks]

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Question 12 · AS Paper 2 · June 2019 · Q03.1 · 1 mark

0 3 . 1 Name the **two** scientists who proposed models of the chemical structure of DNA and of DNA replication.

[1 mark]

Questions, mark schemes and examiners' report extracts © AQA.

Scientists designed an experiment to investigate DNA replication.

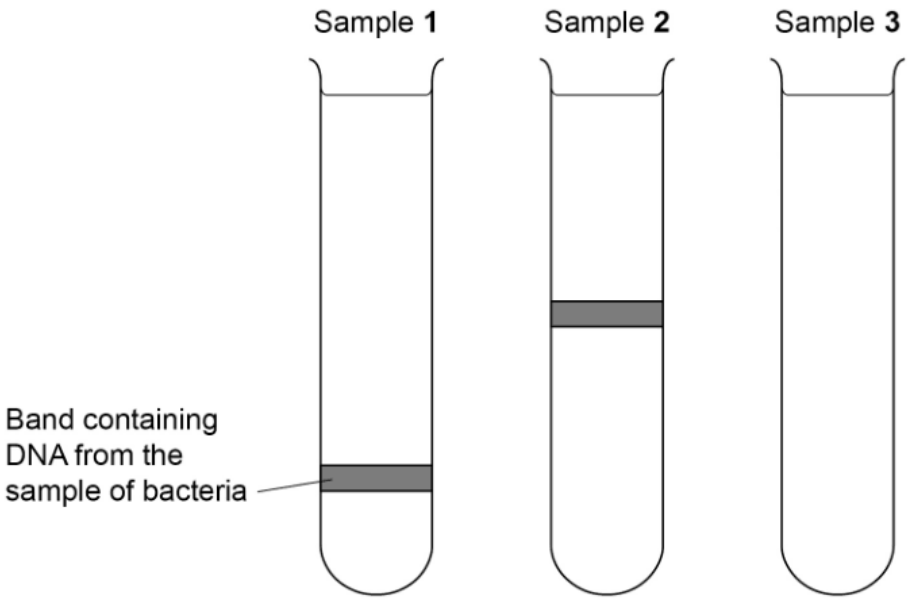
They grew bacteria for several generations in a nutrient solution containing a heavy form of nitrogen (^{15}N). They obtained DNA from a sample of these bacteria (sample **1**).

The scientists then transferred the bacteria to a nutrient solution containing a light form of nitrogen (^{14}N). They allowed the bacteria to grow and divide twice. After each division, they obtained DNA from a sample of bacteria (sample **2** and sample **3**).

They suspended DNA from each sample of bacteria in a solution in separate tubes. They spun these tubes in a centrifuge at the same speed and for the same time. Based on its density, DNA settled as bands in each tube.

Figure 5 shows the scientists' results.

Figure 5



0 3 . 2 Explain the position of the DNA band in sample **2** in **Figure 5**.

[2 marks]

Questions, mark schemes and examiners' report extracts © AQA.

Question 14 · AS Paper 1 · June 2025 · Q03.3 · 1 mark

0 3 . 3 Complete sample **3** in **Figure 5** to show the result you would expect after two divisions.

[1 mark]

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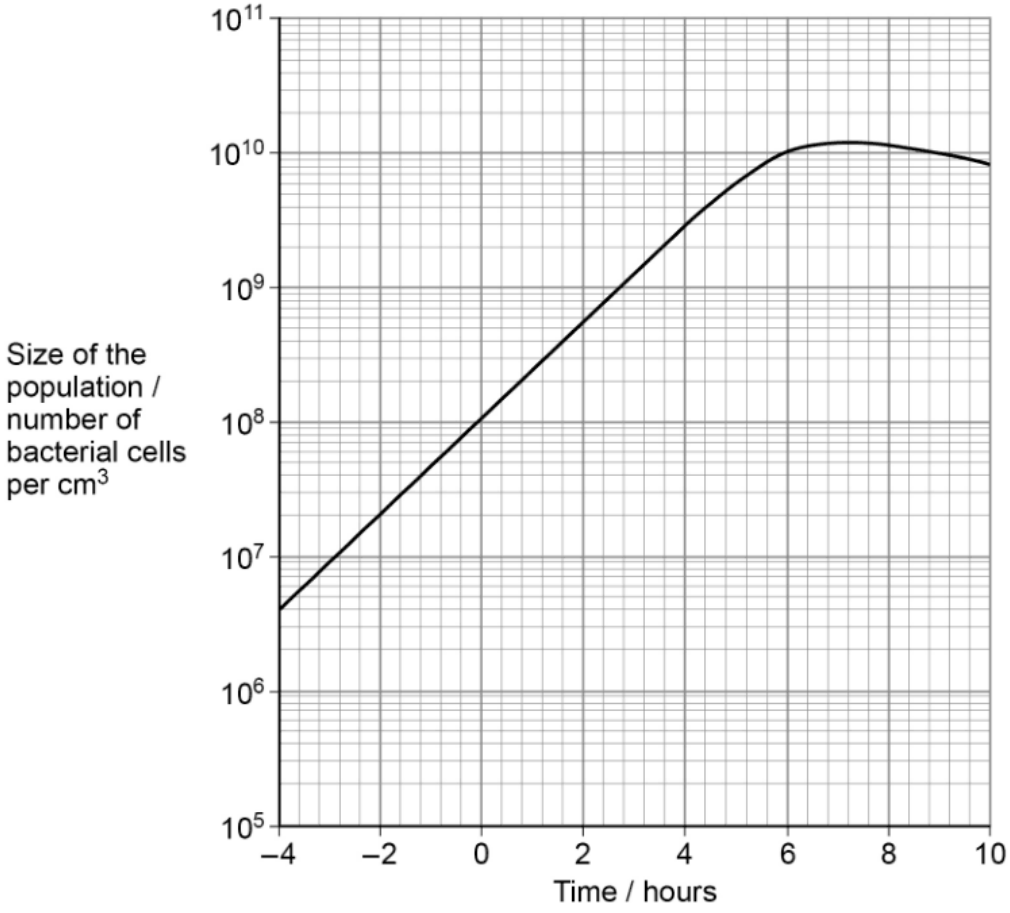
After Watson and Crick proposed the model of DNA structure, scientists investigated the possible mechanisms for DNA replication.

Two scientists grew a bacterial population, providing them with a nitrogen source containing only the heavy isotope of nitrogen, ^{15}N. As soon as all the DNA in this population contained ^{15}N, the scientists changed the nitrogen source to one containing only the lighter isotope of nitrogen, ^{14}N. They changed the nitrogen source at 0 hours.

During the investigation, the scientists measured the size of the population of bacterial cells.

Figure 11 shows the scientists' results.

Figure 11



0 9 . 2 The generation time for a population of bacteria is the time taken for all the bacteria to divide once by binary fission.

Use **Figure 11** and the following equation to calculate the generation time for this population of bacteria. Give your answer in hours.

[2 marks]

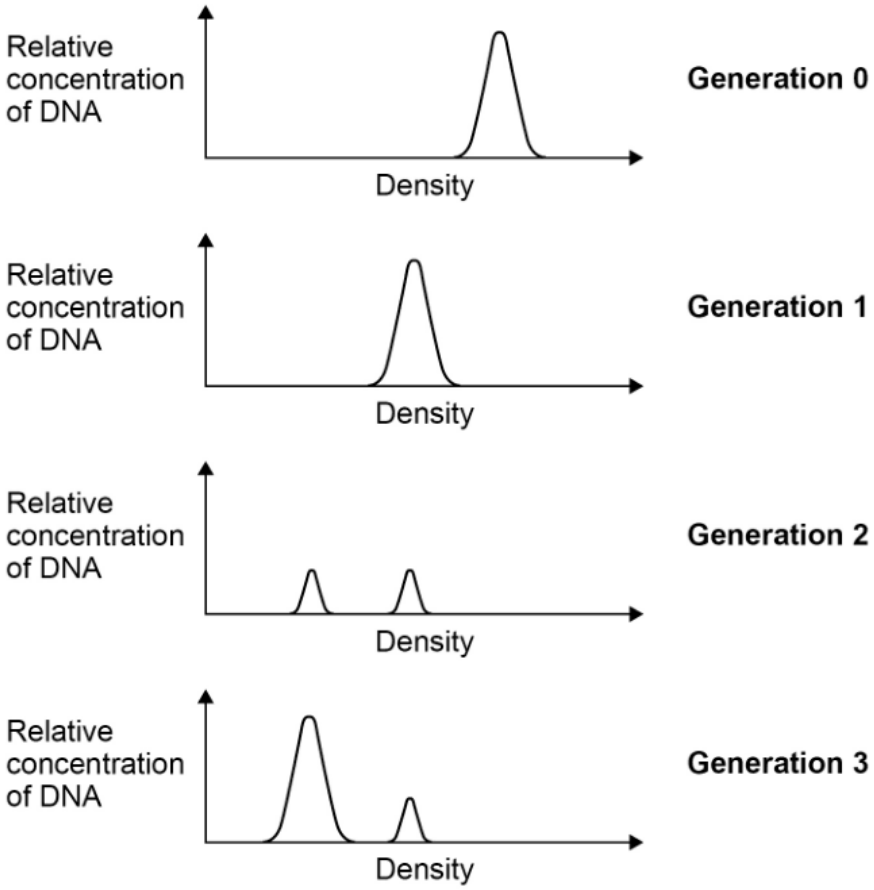
$$\text{Number of generations} = \frac{\log_{10}\left(\frac{\text{size of population at time +4 hours}}{\text{size of population at time −4 hours}}\right)}{\log_{10} 2}$$

At intervals during this investigation, the scientists removed samples of the bacterial population, isolated the DNA and measured the density of the DNA.

DNA made using ^{15}N has a higher density than DNA made using ^{14}N.

Figure 12 shows the scientists' results.

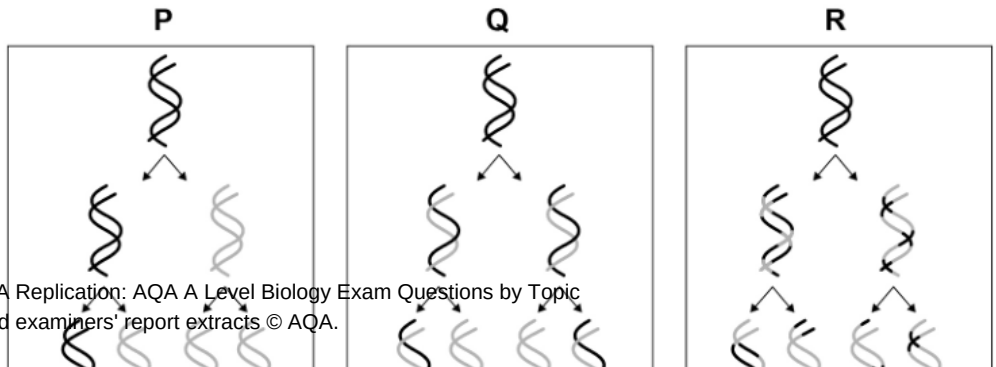
Figure 12



There are **three** possible models of DNA replication.

These models are shown in **Figure 13**.

Figure 13



Questions, mark schemes and examiners' report extracts © AQA.

Mark schemes

Question 1 · AS Paper 1 · June 2025 · Q03.1 · 5 marks

03.1	Max 5 from: 1. DNA helicase unwinds DNA/double helix **OR** DNA helicase separates strands **OR** DNA helicase breaks hydrogen bonds; 2. Both strands act as templates; 3. (Free DNA) nucleotides line up in complementary pairs/A-T and G-C; 4. DNA polymerase joins nucleotides (of new strand); 5. Forming phosphodiester bonds; 6. (Each new DNA molecule consists of) one old/original/template strand and one new strand;	5 max (5 x AO1)

1. Reject hydrolyses hydrogen bonds
1. Accept 'unzip' for unwind

2. Accept description of 'template', eg exposed bases on single (polynucleotide) strands
4. Reject forms hydrogen bonds/joins bases

Questions, mark schemes and examiners' report extracts © AQA.

Question 2 · AS Paper 1 · June 2018 · Q03.2 · 2 marks

03.2	1. Weak / easily broken hydrogen bonds between bases allow two strands to separate / unzip; 2. Two strands, so both can act as templates; 3. Complementary base pairing allows accurate replication;	2 max

1. and 2. may appear in the same feature 3. Allow description of complementary base pairing and accurate replication.

Question 3 · A level Paper 3 · June 2017 · Q05.1 · 2 marks

05.1	1. (DNA) helicase; 2. (DNA) polymerase;	2	**List Rule Applies** Accept (DNA) ligase/ Primase/telomerase/ Topoisomerase/DNA gyrase Reject RNA Accept phonetic spellings

Question 4 · AS Paper 1 · June 2017 · Q01.3 · 2 marks

01.3	1. DNA helicase – (unwinding DNA and) breaking hydrogen bonds / bonds between chains / bases / strands; 2. DNA polymerase – joins (adjacent) nucleotides OR forms phosphodiester bond / sugar-phosphate backbone;	2	1. Accept H bonds. 1. Accept hydrolyses for breaks 2. Reject forms hydrogen bonds (between nucleotides / bases)

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Question 5 · AS Paper 2 · November 2020 · Q02.4 · 2 marks

02.4	1. DNA helicase; 2. Breaks hydrogen bonds between base pairs/ AT and GC/complementary bases OR Breaks hydrogen bonds between polynucleotide strands;	2	2. Reject hydrolysis of hydrogen bonds

TOTAL		**7**	

Question 6 · AS Paper 2 · June 2019 · Q03.2 · 1 mark

03.2	DNA polymerase; 1	Correct spelling

Question 7 · A level Paper 1 · November 2020 · Q05.1 · 2 marks

05.1	1. Joins (adjacent DNA) nucleotides; 2. (Catalyses) condensation (reactions); 3. (Catalyses formation of) phosphodiester bonds (between adjacent nucleotides);	2 max

1. Reject suggestions that it forms hydrogen bonds or joins complementary bases.

1. Reject 'nucleotide bases'.

Questions, mark schemes and examiners' report extracts © AQA.

Question 8 · A level Paper 1 · June 2018 · Q09.1 · 3 marks

09.1	1. (DNA) helicase causes breaking of hydrogen/H bonds (between DNA strands); 2. DNA polymerase joins the (DNA) nucleotides; 3. Forming phosphodiester bonds;	3	1. Reject 'helicase hydrolyses hydrogen bonds'. 2. Reject if suggestion that DNA polymerase joins the complementary nucleotides or forms H bonds. 2. Reject if joining RNA nucleotides or forming RNA.

Question 9 · AS Paper 2 · June 2019 · Q03.3 · 3 marks

03.3	**Role of single-stranded DNA fragments** 1. Template; 2. Determines order of nucleotides/bases; **Role of DNA nucleotides** 3. Forms complementary pairs / A – T, G - C **OR** Forms complementary (DNA) strand;	3	3. Ignore forms complementary bases 3. Accept sequence/ chain for strand
TOTAL		**5**	

Question 10 · AS Paper 1 · June 2016 · Q01.2 · 3 marks

01.2	1. (Complementary) nucleotides/bases pair **OR** A to T **and** C to G; 2. DNA polymerase; 3. Nucleotides join together (to form new strand)/phosphodiester bonds form;	3	1. & 3. Ignore '(DNA polymerase) forms base pairs/nucleotide pairs' If clearly writing rote answer about DNA replication **2 max** e.g. helicase or separating strands

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Question 11 · A level Paper 1 · June 2019 · Q06.2 · 5 marks

6.2	1. DNA helicase; 2. Breaks hydrogen bonds (between 2 DNA strands); 3. BrdU complementary to <u>adenine</u> (on template strand) **OR** BrdU forms hydrogen bonds with <u>adenine</u> (on template strand); 4. DNA polymerase joins (adjacent) <u>nucleotides</u> (to incorporate BrdU into the new DNA strand); 5. <u>Phosphodiester bonds</u> form (between nucleotides);	5	2. Reject 'hydrolyses hydrogen bonds' 2 and 3. Accept H bonds for hydrogen bonds. 4. Reject if DNA polymerase catalyses complementary base pairing or if DNA polymerase catalyses nucleotides joining to template strand.

Question 12 · AS Paper 2 · June 2019 · Q03.1 · 1 mark

03.1	Watson **and** Crick **OR** Crick **and** Watson;	1	Correct spelling Ignore first/given/fore names

Question 13 · AS Paper 1 · June 2025 · Q03.2 · 2 marks

03.2	1. (Produced by) semi-conservative replication **OR** One old/original strand and one new strand; 2. (Contains) ^{14}N/light (strand) **and** ^{15}N/heavy (strand);	2 (2 x AO2)

Question 14 · AS Paper 1 · June 2025 · Q03.3 · 1 mark

03.3	One band level with band in sample 2 **and** one band higher, drawn onto the sample 3 tube;	1 (1 x AO2)	Allow lines of any thickness Ignore lines drawn on the other tubes Both lines needed for mark

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Question 15 · A level Paper 1 · November 2021 · Q09.2 · 2 marks

09.2	Correct answer for 2 marks, 0.8376308/0.84/0.8 (hours);; Accept for 1 mark, Evidence of 4×10^6 **and** 3×10^9 (written in any format, for correct readings from graph) **OR** Evidence of 9.550746785 (correct number of generations) **OR** Evidence of 1.1938443348 (correct generations/ hour) **OR** Evidence of 50.26 (correct generation time in minutes) Incorrect reading of graph, 3×10^6 **and** 2×10^9 Accept for 1 mark, calculation carried out correctly Evidence of 9.380821784 (correct calculation of number of generations)	2	Accept correct rounding to any number of decimal places
	OR Evidence of 1.172602723 (correct calculation of generations/ hour) **OR** Evidence of 51.16822503 (correct calculation of generation time in minutes) **OR** Evidence of 0.8528037505 (correct calculation of generation time in hours) Incorrect reading of graph, $10^{6.4}$ **and** $10^{9.3}$ **OR** $10^{6.3}$ **and** $10^{9.2}$ Accept for 1 mark, calculation carried out correctly Evidence of 9.633591475 (correct calculation of number of generations) **OR** Evidence of 1.204198934 (correct calculation of generations/ hour) **OR** Evidence of 49.82565445 (correct calculation of generation time in minutes)		

Question 16 · A level Paper 1 · November 2021 · Q09.3 · 3 marks

09.3	1. (Model) Q **and** (Name) Semi-conservative (replication); Explanation 2. (Model) **P** (is unsupported because) There should be two peaks in generation 1 **OR** (Only) one peak is shown in generation 1 **OR** There should be 3:1 (ratio) of peaks in generation 2 **OR** There should **not** be an intermediate/^{15}N ^{14}N peak in generation 1/2/3 **OR** The original/generation 0/^{15}N peak should be in generation 1/2/3; 3. (Model) **R** (is unsupported because) There should be >2 peaks in generation 2/3 **OR** There should be one wide/overlapping peak in generation 3;	3	Accept answers 2. and 3. in either order Accept for 'peak', density OR distribution 3. Accept for '>2', many OR several

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