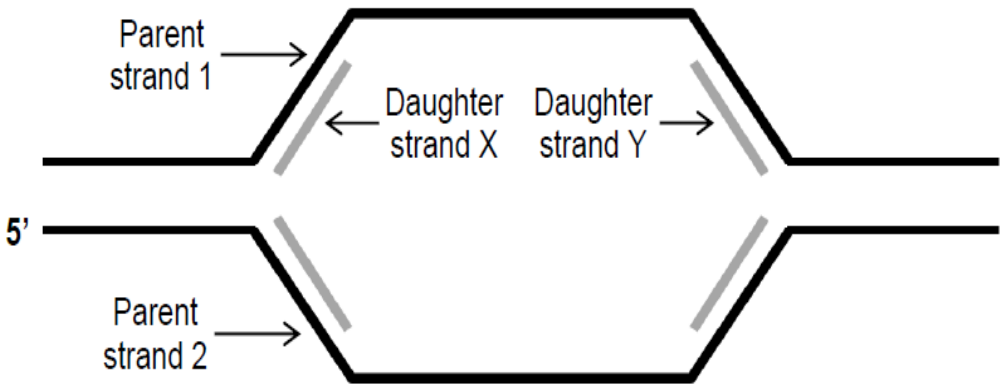
2018 DNA Structure and Replication MCQ

2018 / H2 / AJC PRELIM / P1 Q7

1 A simplified representation of a replication bubble is shown in the figure below. Parental strands 1 and 2 and the growing daughter strands X and Y are indicated.



Which of the following statements about the synthesis of daughter strands **X** and **Y** is correct?

A Daughter strands **X** and **Y** are synthesised away from their respective replication forks.

B Daughter strand **X** is synthesised continuously while daughter strand **Y** is synthesised in the form of Okazaki fragments.

C Daughter strand **X** is synthesised in the 5' → 3' direction while daughter strand **Y** is synthesised in the 3' → 5' direction.

D To synthesise daughter strands **X** and **Y**, both parental strands 1 and 2 are read in the 3' to 5' direction.

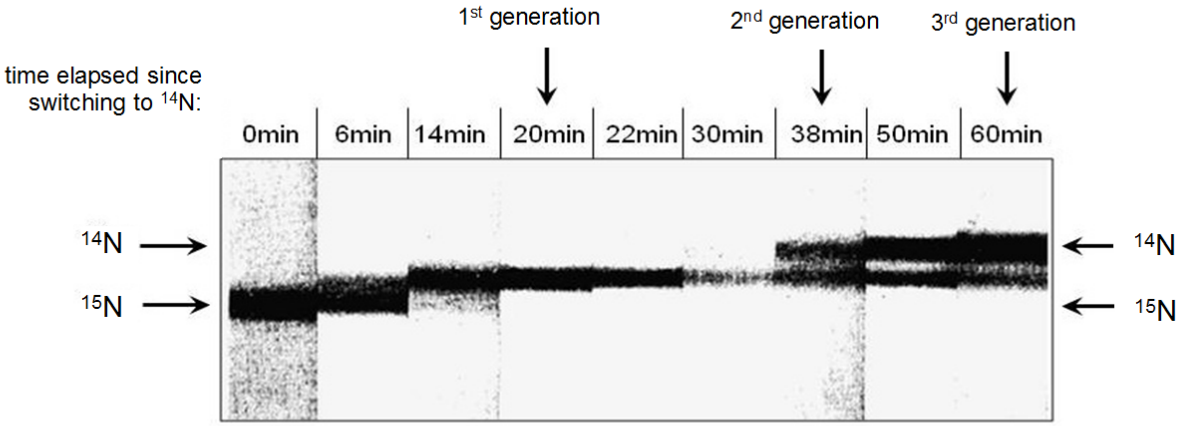
2018 / H2 / ACJC PRELIM / P1 Q8

2 In an investigation to study the mode of DNA replication, *Escherichia coli* (*E. coli*) cells were grown in a nutrient medium containing heavy isotope of nitrogen (^{15}N) for an extended period of time until all the DNA was labelled.

These *E. coli* cells were then transferred to a nutrient medium containing only light isotope of nitrogen (^{14}N) and were allowed to multiply over three generations. The DNA of the *E. coli* cells was then harvested at nine different time intervals.

Subsequently, density gradient centrifugation of these *E. coli* DNA using caesium chloride was performed.

The diagram shows the results obtained.



Which statements are consistent with the results observed?

1 The generation time for *E.coli* is about 20 minutes.

2 In the 1st generation, only hybrid $^{14}N/^{15}N$ DNA was produced.

3 In the 3rd generation, 75% hybrid $^{14}N/^{15}N$ DNA and 25% light $^{14}N/^{14}N$ DNA were produced.

4 In the subsequent 4th generation, only light $^{14}N/^{14}N$ DNA would be produced.

A 1 and 2

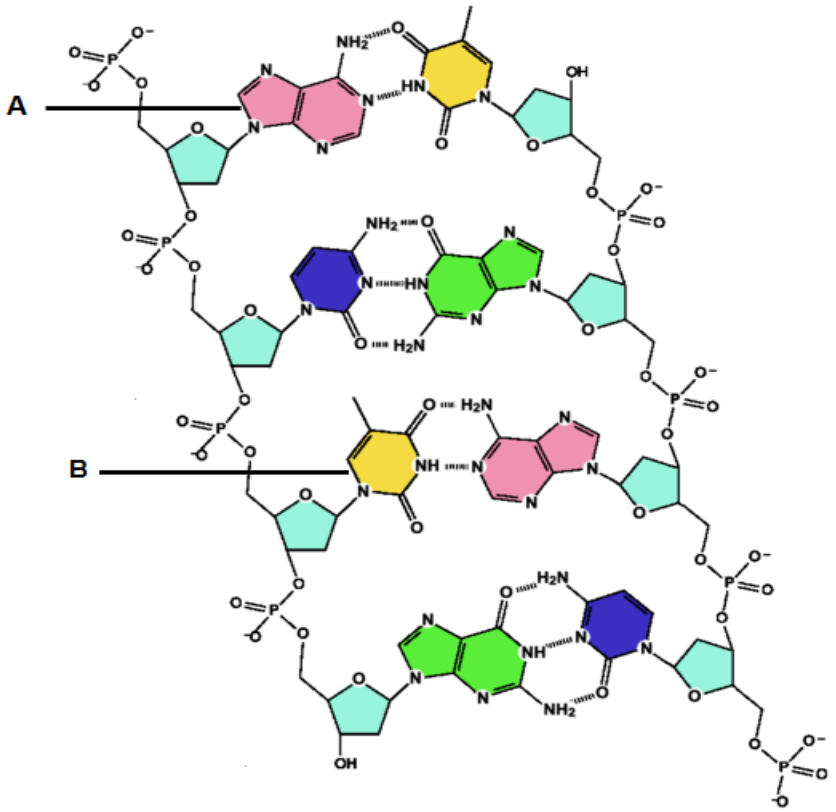
B 2 and 3

C 1 and 4

D 1, 3 and 4

2018 / H2 / DHS PRELIM / P1 Q13

3 The figure below shows a DNA molecule.



Which statement(s) correctly describe the polynucleotide?

1	The structure labelled A corresponds to that of a purine, while the structure labelled B corresponds to that of a pyrimidine.
2	The antiparallel nature of DNA double helix allows phosphodiester bonds to form between the nitrogenous bases of opposite strands.
3	Width of DNA double helix is 2μm.
4	The wound DNA double helix consists of alternating major grooves and minor grooves along its axis.

A 1 only

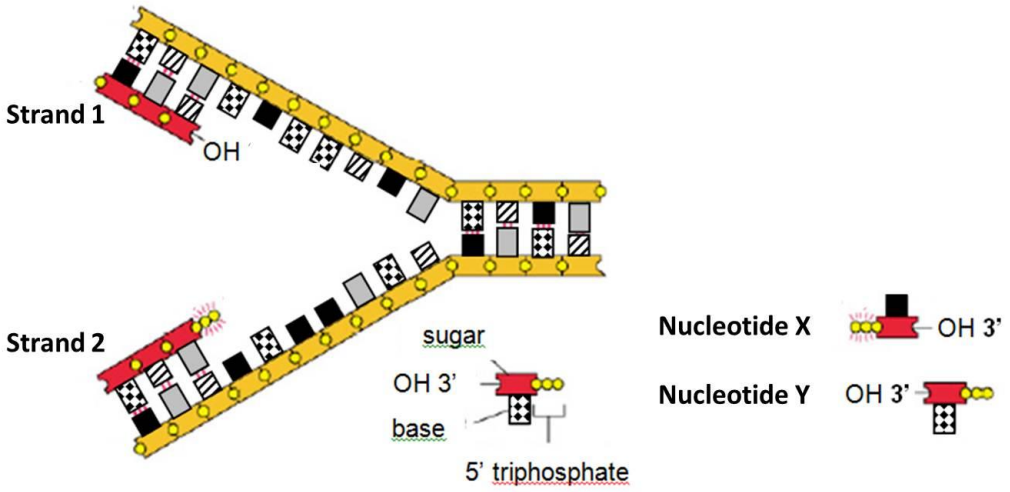
B 1 and 4 only

C 2 and 3 only

D 1, 3 and 4 only

2018 / H2 / DHS PRELIM / P1 Q15

4 DNA replication is illustrated in the following figure.



Which of the following correctly describes the addition of the next nucleotide(s) in the DNA strands undergoing replication?

A Nucleotide **X** will be added to the leading strand, which is strand 1.

B Nucleotide **Y** will be added to the leading strand, which is strand 1.

C Nucleotide **X** will be added to the lagging strand, which is strand 1.

D Nucleotide **Y** will be added to the leading strand, which is strand 2.

2018 / H2 / MJC PRELIM / P1 Q6

QUESTION 5
Two polynucleotide strands make up a DNA molecule.

What is a correct description?

A The percentage of cytosine is 50% of that of guanine in the whole molecule.

B The percentage of cytosine is the same as that of guanine in each strand.

C The percentage of cytosine is the same as that of guanine in the whole molecule.

D The percentage of cytosine is the same in each strand of the molecule.

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QUESTION 6
Which of the following statements explain the difference in the direction in which the two strands of a DNA molecule are synthesised?

1 The replication of DNA is semi-conservative.
2 DNA polymerase can only add deoxyribonucleotides to the 3'OH group.
3 Each DNA molecule consists of two anti-parallel polynucleotides.
4 The synthesis of the lagging strand requires many more RNA primers.

A 1 and 2 only **B** 2 and 3 only **C** 1, 2 and 4 only **D** 2, 3 and 4 only

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7 Which row best describes the functions of the enzymes involved in DNA replication?

	unwinding of the DNA molecules	assembly of the leading strand	filling in of gaps between new DNA fragments	fusing together of new DNA fragments
A	polymerase	ligase	polymerase	helicase
B	helicase	polymerase	polymerase	ligase
C	ligase	polymerase	helicase	polymerase
D	helicase	polymerase	ligase	polymerase

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8 Francis Crick and James Watson, who published the first acceptable structure for DNA, added this statement to their account.

> "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material."

What is the specific pairing they mention for the copying mechanism now known to take place?

A Each purine with either pyrimidine and each pyrimidine with either purine

B Each purine with itself or the other purine and each pyrimidine with itself or the other pyrimidine

C Each pyrimidine with a particular purine and each purine with a particular pyrimidine

D Each pyrimidine with itself and each purine with itself

2018 / H2 / PJC PRELIM / P1 Q12

9 During semi-conservative replication of DNA in eukaryotic cells, the following processes occur.

1 Free nucleotides are hydrogen bonded to those on the exposed strand.
2 Hydrogen bonds are broken between the complementary base pairs.
3 The cell receives the signal to begin to divide.
4 Covalent bonds form between adjacent nucleotides on the same strand.
5 The DNA double helix is unwound.

Which shows the correct order of some of the processes?

A 3 → 1 → 2 → 4

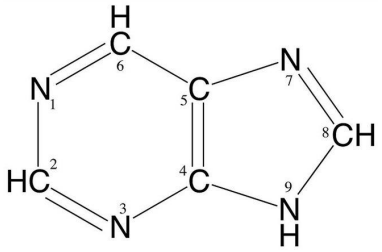
B 3 → 2 → 4 → 5

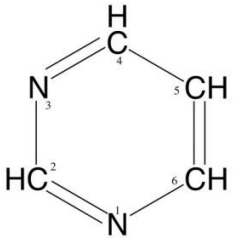
C 5 → 2 → 1 → 4

D 5 → 2 → 3 → 1

2018 / H2 / RI PRELIM / P1 Q7

10. The structures of purine and pyrimidine are shown below.





Which of the following correctly shows the number of carbon atoms in the corresponding nucleic acid?

	Molecule	Number of carbons in the molecule
A	DNA strand with the sequence ATCGAAA	33
B	mRNA molecule with the sequence AUCGAAA on 1 strand	30
C	DNA molecule with the sequence ATCGAAA on 1 strand	33
D	DNA strand with the sequence ATCGAAA	68

2018 / H2 / RVHS PRELIM / P1 Q8

11 An unknown organism has a linear double-stranded DNA genome like that in a eukaryote. When its DNA replication was examined, it was revealed that although the process is semi-conservative, no Okazaki fragments were observed in the multiple replication forks. In addition, the end-replication problem of shortened daughter strands was not observed.

Which statement correctly explains this phenomenon?

A The organism's DNA is antiparallel.

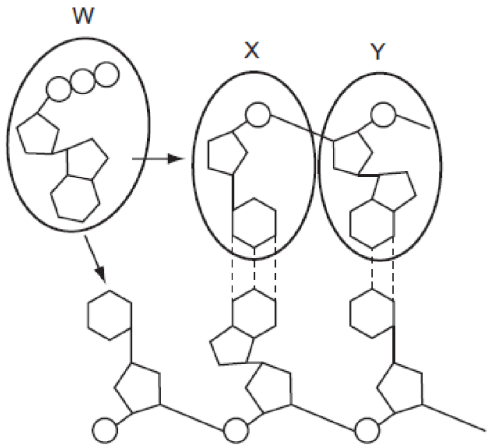
B DNA replication only starts at the 3' end of each template strand.

C DNA polymerases synthesise DNA in both 5' to 3' and 3' to 5' direction.

D DNA ligases are not involved in the DNA replication process.

2018 / H2 / RVHS PRELIM / P1 Q9

12 The diagram shows the synthesis of a polynucleotide. **W** is a nucleoside triphosphate and the arrows indicate the location where **W** form bonds with the polynucleotide.



Which statements are correct?

1 The base in **W** could be the purine, adenine.

2 The base in **Y** is the purine guanine.

3 The base in **X** is the pyrimidine, cytosine

4 The base in **X** could be the pyrimidine, uracil

A 1 and 3

B 2 and 3

C 2 and 4

D All of the above

2018 / H2 / SAJC PRELIM / P1 Q7

13 3 different polynucleotide molecules (X, Y and Z) were isolated from a eukaryotic cell. One of them is a double-stranded DNA gene, while the other two are the pre-mRNA and mature mRNA that the DNA gene codes for.

The adenine nucleotide content of all 3 molecules was examined and shown in the table below:

Molecule	Percentage of adenine nucleotides in the molecule / %
X	49
Y	52
Z	53

Based on the information given, which of the following conclusions is/are valid and true?

1 X is definitely the DNA gene.
2 Z is definitely the mature mRNA.
3 The pre-mRNA molecule has more uracil than guanine in it.
4 Y has more purine nucleotides than pyrimidine nucleotides in it.

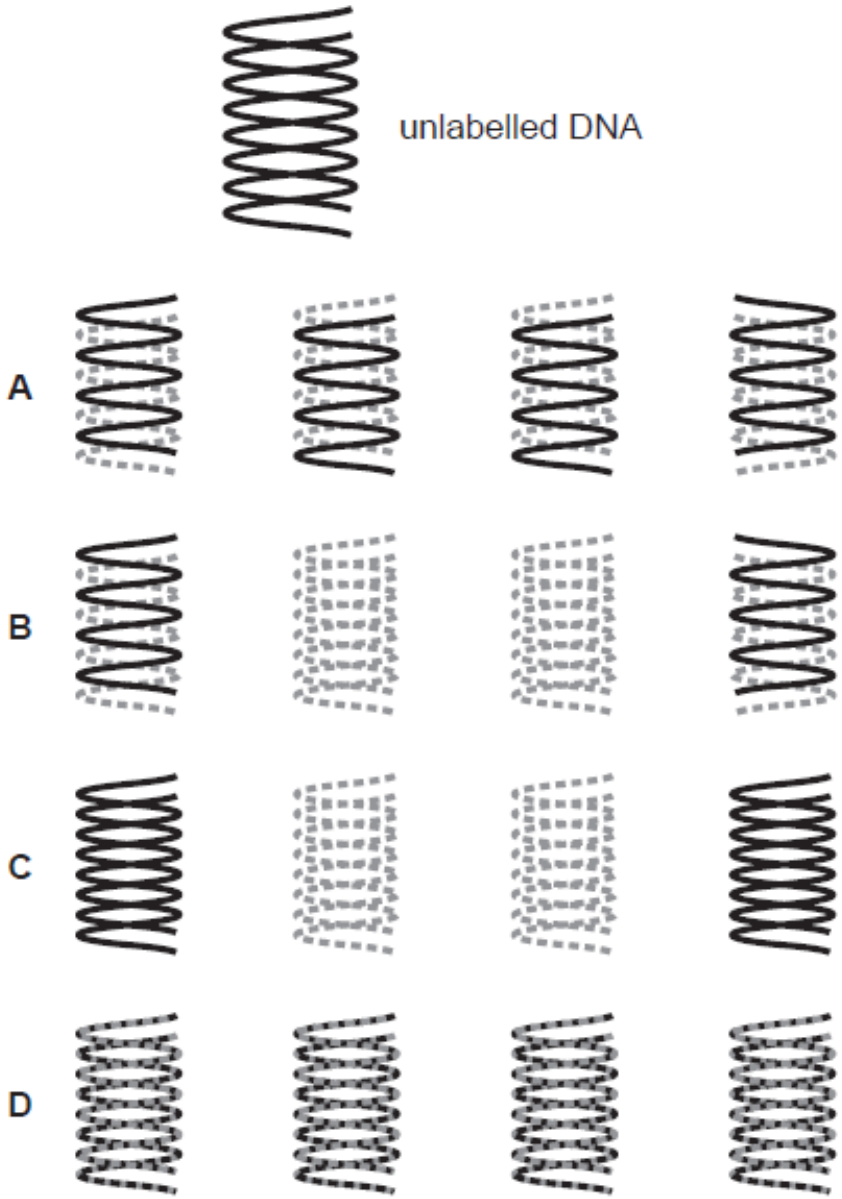
A 1 and 2
B 1, 2 and 4
C 1, 3 and 4
D 2, 3 and 4

2018 / H2 / VJC PRELIM / P1 Q6

14 The sets of diagrams show four possible outcomes when an unlabelled molecule of DNA is allowed to replicate twice in the presence of ^{15}N-labelled nucleotides.

Labelled sections of DNA are represented by dotted lines.

Which set of diagrams correctly shows the result of DNA replication?



2018 DNA Structure and Replication MCQ ANS			
Question	**Answer**	**Question**	**Answer**
1	**D**		
2	**A**		
3	**B**		
4	**A**		
5	**C**		
6	**B**		
7	**B**		
8	**C**		
9	**C**		
10	**D**		
11	**C**		
12	**A**		
13	**C**		
14	**B**		