InkBiology

ANSWER BOOK

DNA replication: one old strand in every new molecule

Nucleic acids, genomes and protein synthesis · Unit B05

AQA 3.4.1 · OCR A 2.1.3, 2.1.6 · Edexcel A Topic 2.7 · CAIE 6.1

5 questions · 17 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

A1 **B1** helicase breaks the hydrogen bonds between the paired bases, so the two strands separate and the helix unwinds. **B1** ligase joins the Okazaki fragments of the lagging strand into one continuous strand, forming the phosphodiester bonds between them. [2]

SECTION B · Standard, 3 to 5 marks

B1 **B1** DNA helicase breaks the hydrogen bonds between complementary bases, so the two strands separate and the helix unwinds. **B1** each of the two separated strands acts as a template. **B1** free DNA nucleotides align against the exposed bases by complementary base pairing, adenine to thymine and cytosine to guanine. **B1** DNA polymerase catalyses the condensation reactions that join the aligned nucleotides, forming phosphodiester bonds along the new backbone. **A1** each daughter molecule ends up with one original strand and one newly synthesised strand, which is what semi-conservative means. [5]

B2 **B1** DNA polymerase can only attach a nucleotide to a free 3′ hydroxyl group, so it can only build a strand in the 5′ to 3′ direction. **B1** the two template strands are antiparallel, so the enzyme cannot travel the same way along both of them. **B1** on one template it moves in the direction the replication fork is opening, producing one continuous leading strand. **B1** on the other it must work away from the fork, so it waits for template to be exposed and copies a short piece backwards each time, giving the Okazaki fragments of the lagging strand. [4]

B3 **M1** the two original heavy strands are never destroyed, so exactly two molecules contain one. **M1** after four divisions there are $2^4 = 16$ molecules altogether, so the proportion is $2 \div 16$. **A1** 12.5 per cent of the molecules contain a ^{15}N strand, the remaining 87.5 per cent being entirely light. [3]

B4 **B1** the substitution may fall in a non-coding stretch of DNA, so no polypeptide is affected by it. **B1** the altered triplet may code for the same amino acid as the original, so the polypeptide is unchanged. **B1** the amino acid may change in a region of the protein where the substitution makes no difference to the folded shape, so the protein still functions. [3]