

2024 Bi H2 Q1

Section: DNA and the Genome

Topic: Replication of DNA

Question Summary

The polymerase chain reaction (PCR) amplifies a DNA fragment by repeating three stages - denaturation, annealing, and extension. Each cycle doubles the amount of DNA, resulting in exponential amplification.

Worked Solution

- (a)(i) The temperature required for stage 3 (extension) is approximately 70-80°C.
- (a)(ii) During stage 3, a heat-tolerant DNA polymerase synthesises new DNA strands by adding complementary nucleotides to the primers.
- (b)(i) Ligase is not needed in PCR because the primers provide a continuous template and no fragments require joining.
- (b)(ii) DNA polymerase from human cells would be unsuitable as it would denature at the high temperature used during stage 1 (denaturation).
- (d) Percent DNA polymerase = $(0.4 / 25.0) \times 100 = 1.6\%$.
- (e) After 8 cycles, number of DNA molecules = $70 \times 2^8 = 17,920$ molecules.

Final Answer

- > 1.6% DNA polymerase in reaction tube
- > 17,920 copies after 8 cycles

Revision Tips

- PCR involves three stages repeated in cycles: denaturation, annealing, and extension.
- Taq polymerase is heat-tolerant and essential for PCR.
- Each cycle doubles the DNA quantity - exponential growth.
- Ligase is not required since fragments are not joined.