

Total: 24 marks

Objective

1 Key knowledge and worked examples

2 Practice

2.3 What lesion class does nucleotide excision repair own? [3]

3 Exam-style questions

Compute E. coli's copy time (4.6 Mb, 1000 nt/s, bidirectional). Compute the human single-origin time and the 30 000-origin time. Explain why eukaryotes need many origins AND why S phase still takes 8 h. [8]

Solutions

2.1

- Polymerases extend $5' \rightarrow 3'$ only; on the antiparallel template that means synthesising away from the fork in restarted fragments.

2.2

- $4.6 \times 10^6 / (2 \times 1000) = 2300 \text{ s} \approx 38 \text{ min} \checkmark$.

2.3

- Bulky helix-distorting lesions, e.g. UV thymine dimers.

3.1

- Rate $\times 100 \rightarrow 6.4 \times 10^9 \times 10^{-7} \approx 640$ mutations per division $\checkmark$.
- Colon epithelium divides constantly, so the elevated rate compounds into driver mutations early.
- Missing: mismatch repair; remaining: polymerase selectivity and proofreading.

3.2

- E. coli: $2300 \text{ s} \approx 38 \text{ min}$ (above).
- Human single origin: $6.4 \times 10^7 \text{ s} \approx 2.0 \text{ years} \checkmark$.
- 30 000 origins: $\sim 35 \text{ min}$ synthesis $\checkmark$.
- Many origins because forks stall at damage and chromatin; 8 h because origins fire in timed clusters and chromatin must be opened and reassembled.