# 11.5 Antimicrobial and anticancer drugs

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

**KEY WORDS** selective toxicity

## Objective

Targets by absence; schedules by cycle.

## 1 Key knowledge and worked examples

### ■ Two selectivities

Antibacterial targets human cells lack (wall, 30S/50S, gyrase, folate – MED08) ✓. Anticancer by timing: S-phase antimetabolites (methotrexate, fluorouracil), M-phase vinca and taxanes, alkylators any phase ✓.

### ■ Worked example: the margin

Marrow, gut and hair cycle too – the narrow margin writes the toxicity list ✓. Fractionation meets more cells in their vulnerable phase.

## 2 Practice

**2.1** Name the two axes of selectivity (one word each). [3]

**2.2** In which phase do antimetabolites act? [3]

**2.3** Which anticancer class is cycle-independent? [3]

## 3 Exam-style questions

**3.1** Three illustrative anticancer agents: methotrexate, a vinca alkaloid, an alkylator.

Assign the cell-cycle phase of each (S; M; any) with the mechanism ✓. Explain why fractionating the S-phase agent over time meets more cells in phase than the same total as one bolus ✓. Predict the three tissues that pay for the narrow margin ✓. [8]

**3.2** A fictional antibacterial fails despite an intact target map.

Give two resistance mechanisms from MED08 ($\beta$-lactamase opening the ring; altered target PBP2a) and the arithmetic behind combinations (mutation supply $10^{-7}$–$10^{-9}$ per cell per generation; two independent hits multiply) ✓. [7]

## Solutions

**2.1**

- Absence (bacteria) and timing (cancer) ✓.

**2.2**

- S-phase (DNA synthesis) ✓.

**2.3**

- The alkylators – DNA damage regardless of phase ✓.

**3.1**

- Methotrexate: S-phase (antifolate, blocks nucleotide synthesis) ✓.
- Vinca: M-phase – spindle assembly fails ✓.
- Alkylator: any phase ✓.
- Fractionation: cells arrive in S over time; spread dosing meets more of them ✓.
- Tissues that pay: marrow, gut mucosa, hair follicles ✓.

**3.2**

- $\beta$-lactamase hydrolyses the ring before the target ✓.
- PBP2a: the target reshaped, binding lost ✓.
- Combinations: two independent mutations multiply to ~$10^{-14}$–$10^{-18}$ – effectively none in the culture ✓.

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