1.7 Cell cycle, cell death and cancer biology

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

KEY WORDS tumour suppressor gene

Objective

Apply cycle timing, doubling arithmetic and two-hit logic to cancer reasoning.

1 Key knowledge and worked examples

■ **The cycle and the gates**

G1 11 h, S 8 h, G2 4 h, M 1 h = 24 h ✓; checkpoints at G1/S, G2/M, spindle; exits to G0 or apoptosis (caspases, ATP-dependent). p53 is the damage gate.

■ **Worked example: thirty silent generations**

$2^{30} = 1.07 \times 10^9$ cells ≈ 1 cm^3 ✓ – a detectable tumour is thirty generations old; ~6 mutations survive per division (unit 1.3), mostly passengers.

2 Practice

2.1 What fraction of the 24 h cycle is S phase? [3]

2.2 How many cells after 10 doublings? [3]

2.3 One gate, two hits: why do tumour suppressors need both alleles lost? [3]

3 Exam-style questions

3.1 A screening programme detects 0.5 cm tumours (~10^8 cells).

Compute the doublings to detection. Estimate the doublings to a lethal ~10^{12}-cell burden. State the screening implication of this gap. [7]

3.2 Fictional Li–Fraumeni pedigree (one inherited mutant p53 allele).

Explain why every cell starts one gate down. State the second event that removes the gate entirely. Explain why incidence in this family is early and multi-organ, referencing the ~6-mutations-per-division background. [7]