

Solutions

2.1

- $8/24 = 1/3$ ✓.

2.2

- $2^{10} = 1024$.

2.3

- Loss of function is recessive at the cell level: the remaining allele still supplies the gate.

3.1

- 10^8 cells: $2^n = 10^8 \rightarrow n = \log_2 10^8 \approx 26.6$ ✓.
- 10^{12} : $\log_2 10^{12} \approx 39.9$ ✓.
- Gap ≈ 13 doublings between detectable and lethal – screening buys time by entering the exponential early.

3.2

- Every cell carries one non-functional p53 allele.
- A somatic hit (mutation, deletion, methylation) on the second allele removes the checkpoint entirely – two-hit.
- Background ~ 6 mutations/division across many tissues $\times$ decades: second hits arrive early and often $\rightarrow$ early, multi-organ cancers.