Solutions

Each answer shows the steps, then the **result**.

2.1

(a)

- centromere

(b)

- telomeres

2.2

- the DNA is replicated / copied

2.3

- **metaphase**

2.4

- the cytoplasm divides to form two daughter cells

3.1 B

- DNA is replicated in the S phase

3.2 B

- Telomeres carry no genes, so losing a little does not lose genes

3.3

- mitosis copies the DNA exactly (S phase) and separates identical sister chromatids, so each daughter gets an identical set of genes; any two of: growth / replacement of dead cells / tissue repair / asexual reproduction

3.4

(a)

- an unspecialised cell that can keep dividing and can differentiate into specialised cells

(b)

- the cell divides repeatedly without stopping, forming an uncontrolled mass of cells – a tumour

3.5

(a)

- mitotic index $= \dfrac{\text{cells in mitosis}}{\text{total cells}} = \dfrac{24}{200} = \mathbf{0.12}$

(b)

- the fraction of cells in mitosis estimates the fraction of the cycle spent in mitosis

$$t = 0.12 \times 20 \text{ h} = 2.4 \text{ h} = \mathbf{144} \text{ minutes}$$

3.6

- the centromeres divide and the sister chromatids separate, moving to opposite poles, centromere first
- the spindle fibres shorten, pulling the chromatids apart so each new cell gets one copy of each chromosome