1.2 Cell division and stem cells

Name: _____ Class: _____ Date: _____ **Total: 18 marks**

KEY WORDS chromosomes • mitosis • stem cell

Objective

Describe the cell cycle and mitosis, and evaluate stem cell sources with benefits and risks. Original questions for spec statements 4.1.2.1–4.1.2.3.

1 Key knowledge and worked examples

Overall stage	What happens
Preparation	Growth; more ribosomes/mitochondria; DNA copied
Mitosis	One chromosome set to each end; nucleus divides
Final division	Cytoplasm/membrane divide; two identical cells

Chromosomes are DNA molecules carrying many genes; body-cell chromosomes normally come in pairs. A gene is a section of DNA. Preparation includes growth, more ribosomes/mitochondria and replication to make two copies of each chromosome. The final cells receive identical genetic information. Do not replace a division point with preparation when describing mitosis.

Original 2023 Q05.6 [3] / sheet Q3.1 model: one set of chromosomes is pulled to each end (1); nucleus divides (1); cytoplasm or membrane divides to form two cells (1). Original 2024 Q08.1 already gives replication: another change is growth or more ribosomes/mitochondria.

Figure 9

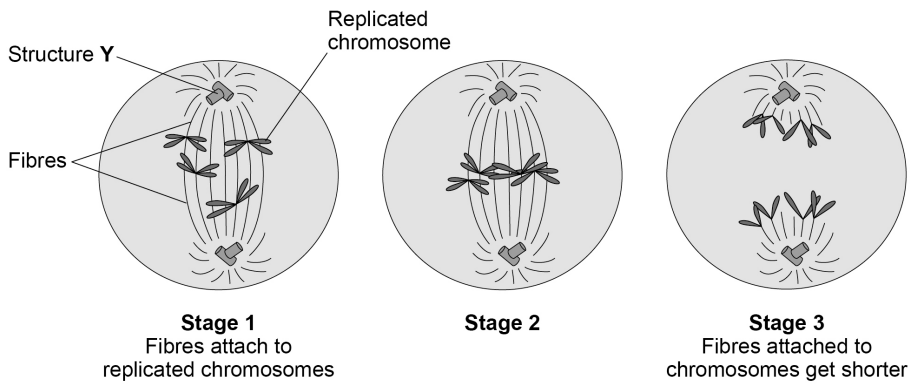

Figure 9 shows stages within division, not the three overall cell-cycle stages. Original Q08.4 [2]: drug X stops fibres attaching. Chromosomes cannot be pulled to each end (1), so the nucleus cannot divide / identical cells cannot form (1). Q08.5: stopping division stops tumour growth. Living hair-follicle/repair cells also need division, explaining hair loss or delayed healing; dead hair shafts do not divide.

Stem cells: undifferentiated cells can make more of the same type and differentiate into other types.

Source	Differentiation potential
Embryo	Most human cell types
Bone marrow	Many types including blood cells; narrower range
Meristem	Any plant cell type throughout life

Original 2025 Q07.1: embryonic cells can differentiate into **liver cells**, the useful property for liver disease. Donated stem cells may be rejected. Therapeutic cloning instead supplies cells with the patient's genes, avoiding rejection in the syllabus model; viral transfer remains possible. Potential applications include diabetes/paralysis treatment.

Teacher comparison model, not an official six-mark scheme: embryos offer a wider cell-type range but their destruction raises ethical objections. Adult marrow has a narrower range and avoids embryo destruction. Both require safety assessment. Original 2025 Q07.2 accepts embryo destruction or lack of consent; a religious objection needs explanation. Viral transfer is a biological risk, not an ethical reason.

Meristems: plant stem-cell tissue (original 2023 Q01.2); cells can differentiate throughout plant life. Cloning rare plants can protect against extinction; cloning useful crops gives many identical plants quickly and economically. Disease resistance is a selected crop trait, not an automatic result of cloning.

2 Practice

2.1 State where chromosomes are found in a body cell, and what genes are. [2]

2.2 Name the stage of the cell cycle before mitosis and state two things the cell does in it. [3]

2.3 Give one benefit and one risk of therapeutic cloning. [2]

3 Exam-style questions

3.1 Describe the process of cell division by mitosis. [3]

3.2 A drug stops cell division.

(a) Explain why a tumour treated with this drug stops growing. [2]

(b) Explain one side effect a patient on this drug might have. [2]

3.3 Scientists can clone rare plants from meristem tissue.

(a) Explain why meristem cells can become any type of plant cell. [2]

(b) Give two benefits of cloning rare species this way. [2]

Solutions

2.1 In the nucleus; genes are sections of DNA that code for a protein / a characteristic.

2.2 Growth and DNA replication stage: the cell grows and replicates its DNA / increases sub-cellular structures such as ribosomes and mitochondria.

2.3 Benefit: stem cells with the patient's own genes are not rejected / can replace damaged tissue; risk: transfer of viral infection.

3.1 After DNA replication, one set of chromosomes is pulled to each end of the cell; the nucleus divides; the cytoplasm or cell membrane divides to form two identical cells. DNA replication is preparation, not a substitute for one of these three division points.

3.2 (a) Tumour growth depends on cells dividing by mitosis; the drug stops mitosis so no new tumour cells form. (b) Cells that normally divide rapidly are also stopped – e.g. living hair-follicle cells, repair cells or blood-producing marrow; so hair falls out / wounds heal slowly / fewer blood cells.

3.3 (a) Meristem cells are undifferentiated stem cells; they retain the ability to differentiate into any plant cell throughout the plant's life. (b) Cloning can protect the rare species from extinction; large numbers of that rare plant can be produced quickly and economically. Disease-resistant crop production is a separate application, not a property guaranteed for the rare plant.