

Cell Division, Cell Diversity & Cellular Organisation

Model Answers 2

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Foundations in Biology
Topic	Cell Division, Cell Diversity & Cellular Organisation
Booklet	Model Answers 2

Time allowed: 45 minutes

Score: /33

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

The image shows a stage in mitosis.



Which of the following options, **A** to **D**, is the stage of mitosis shown above?

- A** anaphase
- B** metaphase
- C** prophase
- D** telophase

[1]

The chromosomes are aligned on the equator of the spindle

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Question 2

There are two types of nuclear division, mitosis and meiosis. Meiosis incorporates two divisions of the nucleus.

Which table shows the correct results of nuclear division?

A

	Genetic variation	Reduction division
Mitosis	✗	✗
Meiosis 1	✓	✓
Meiosis 2	✗	✗

C

	Genetic variation	Reduction division
Mitosis	✗	✓
Meiosis 1	✓	✗
Meiosis 2	✓	✓

B

	Genetic variation	Reduction division
Mitosis	✗	✗
Meiosis 1	✓	✓
Meiosis 2	✓	✗

D

	Genetic variation	Reduction division
Mitosis	✗	✗
Meiosis 1	✓	✓
Meiosis 2	✗	✓

[1]

Mitosis does not lead to genetic variation, nor does it reduce the number of chromosomes

That eliminates C

Meiosis I reduces the number of sets of chromosomes from 2 to 1 and leads to variation by independent assortment

Meiosis II also leads to genetic variation when independent assortment happens again, BUT it doesn't reduce the number of chromosomes as they each consist of two chromatids

Question 3

(a) Fig. 2.1, **on the insert**, shows a yeast cell with scars resulting from its reproductive process.

(i) Name the process of asexual reproduction in yeast.

[1]

Budding

Note: this is a specific process to yeast, therefore mitosis or asexual reproduction will not be accepted here

(ii) Outline the process of asexual reproduction in yeast.

[2]

- Yeast undergoes **mitosis**
- There is a swelling/bulge in the surface of the yeast cell
- The **nucleus** moves into the bulge before
- The bulge is **pinched off** (called a bud)
- There is an **uneven distribution** of **cytoplasm** between the parent cell and the bud

A diagram to show the process of budding in yeast:

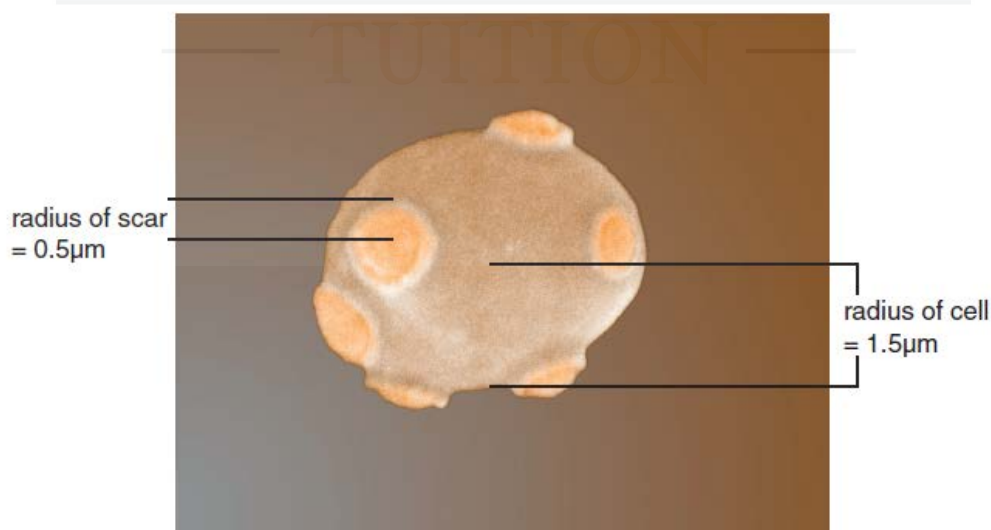
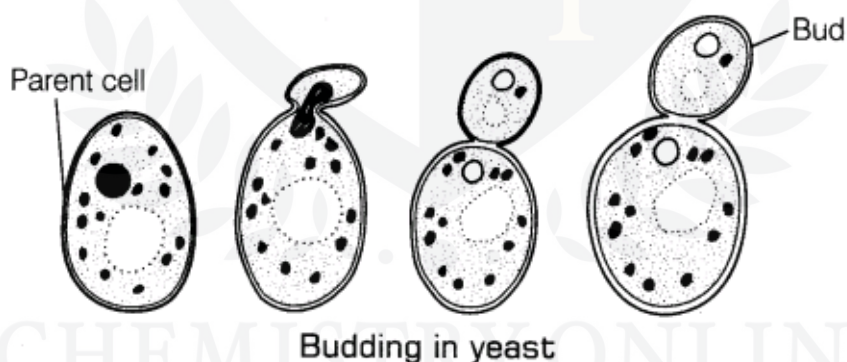


Fig. 2.1

- (b) (i) A yeast cell can continue producing new cells until its surface is covered by scars.

The surface area of a sphere is given by the formula $4\pi r^2$, where $\pi = 3.14$.

The area of a circle is given by the formula πr^2 .

Assuming that the cell in Fig. 2.1 contained no scars, calculate how many potential new cells could be produced by this cell.

Show your working.

[2]

Firstly you need to work out the total surface area of the cell (i.e. a sphere) radius of cell from insert is 1.5um:

- $4 \times 3.14 \times 1.5^2 = 28.26$

The work out the surface area of one scar (again, you can see the radius of scar is 0.5um on insert):

- $3.14 \times 0.5^2 = 0.785$

Therefore find out how many scars would fit on one cell:

- $28.26 / 0.785 = 36$

- (ii) Even when the environmental conditions are perfect, one yeast cell rarely produces the calculated number of potential new cells.

Suggest why the reproductive potential of the yeast cell is not reached.

[1]

The reproductive potential is not reached because:

- A new bud cannot occur on an old scar
- there may not be enough space between scars for another bud
- A yeast cell is unlikely to be a true sphere
- There may have been a mutation

Exam tip: this is a 'suggest' question so you will not have directly been taught this. You need to use what you already know and apply some logic

(c) Yeast cells separate after cell division. In a multicellular organism, the cells do not separate but become organised to form the body structure.

Describe how the cells in a multicellular organism are organised.

[5]



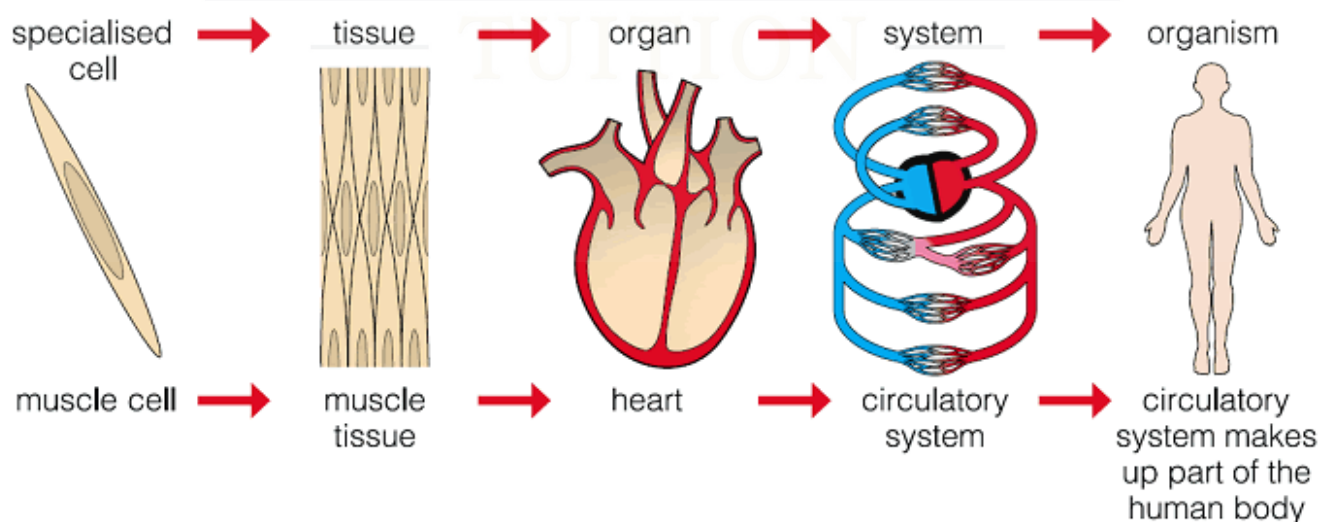
In your answer you should use appropriate technical terms, spelled correctly.

In a multicellular organism:

- Cells **differentiate** into specialised cells
- Groups of cells that work together to perform a function form **tissues**
- Groups of tissues form **organs**
- Groups of organs form **organ systems**
- Different groups of organs/organ systems interact
- For example the circulatory system is an organ system (any other named cell, tissue, organ or system)

Exam tip: you must use at least two of the words in bold to gain the QWC mark.

A diagram to show the organisation of cells into tissues, organs and systems within a multicellular organism:



[Total: 11]

Question 4

(a) Yeast reproduces asexually by a process called budding. During this process, cell division occurs.

(i) Name the type of cell division that occurs in asexual reproduction.

[1]

The process of cell division is called

- Mitosis

(ii) Before the division of the nucleus of a cell, the genetic material must replicate.

Explain why this is essential.

[2]

It is essential that DNA replicates before division so:

- That the cells receive the full complement of chromosomes
- That the resulting cells are genetically identical

If replication did not occur and the cell split, the daughter cells would only receive half the genetic information from the parents.

(b) Unlike yeast, the nuclei of most eukaryotic organisms contain homologous chromosomes.

pairs of

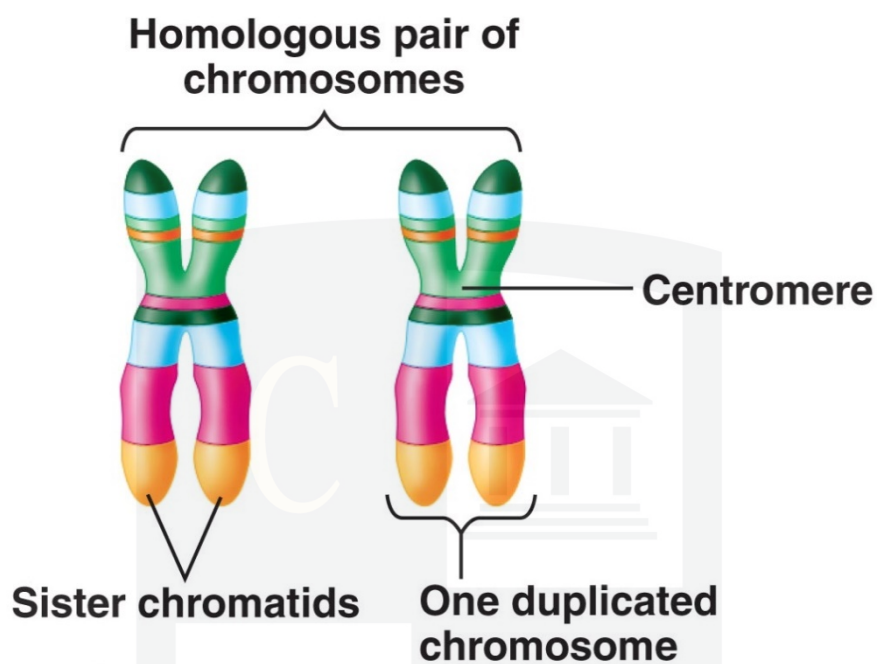
Explain what is meant by a *homologous pair of chromosomes*.

[3]

Homologous chromosomes are made up of:

- One **maternal** and one **paternal** copy
- They carry the **same genes**
- They carry **different alleles**
- In the same banding pattern
- They are the same length
- With the centromere in the same place
- They pair up in meiosis, forming bivalents.

Diagram to show homologous chromosomes:



(c) In most multicellular organisms, the cells produced by cell division are organised into tissues.

(i) State what is meant by the term *tissue*.

[2]

A tissue is:

- A collection of cells
- That are specialised
- Working together to perform a function

Exam tip: learn this definition, it comes up regularly.

- (ii) Complete Table 1.1 below comparing two types of epithelium, squamous epithelium and ciliated epithelium.

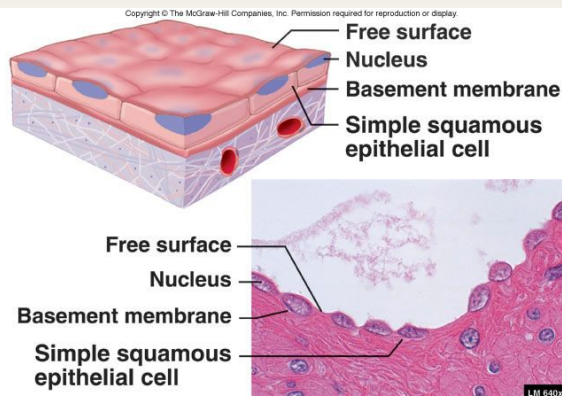
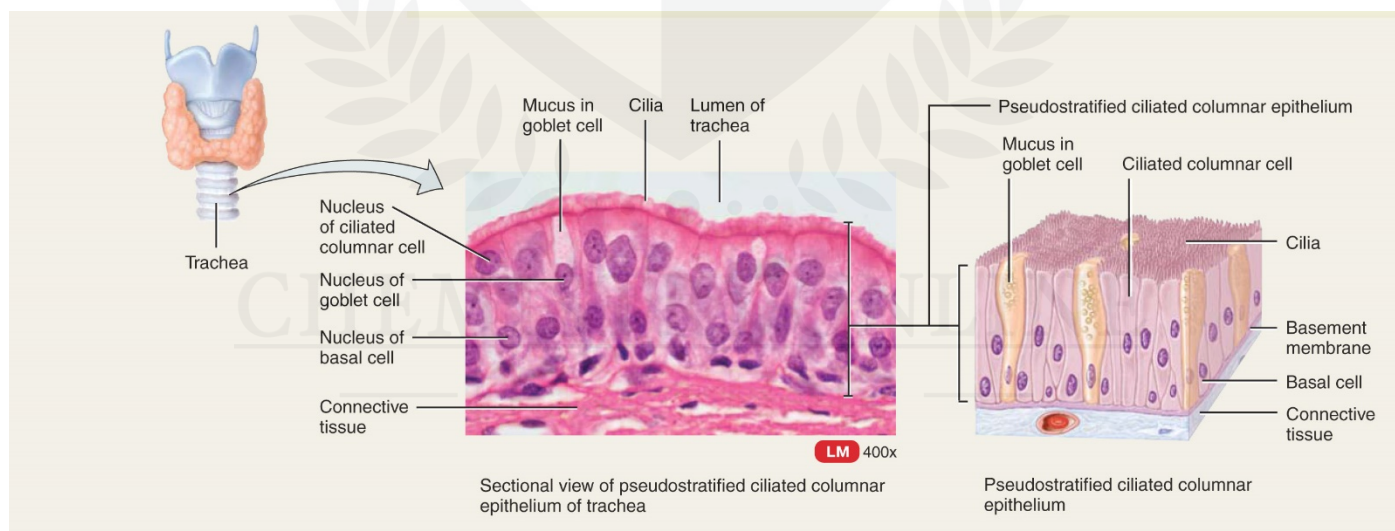
For each type of epithelium, state **one** function of the tissue and **one** specific location in the human body where it is found.

Table 1.1

[4]

type of epithelium	function of tissue	specific location in the human body
squamous	Acts as surface/ short diffusion pathway	Alveoli/ cheek lining/ blood vessels
ciliated	Move/ secrete mucus	Bronchioles/ bronchi/ trachea/ airways

Diagrams to show examples of squamous and ciliated epithelia:



(a) Simple squamous epithelium

[Total: 12]

Question 5

In plants, dividing cells can be found in meristematic tissue.

(a) Name **two** parts of a plant where meristematic tissue can be found.

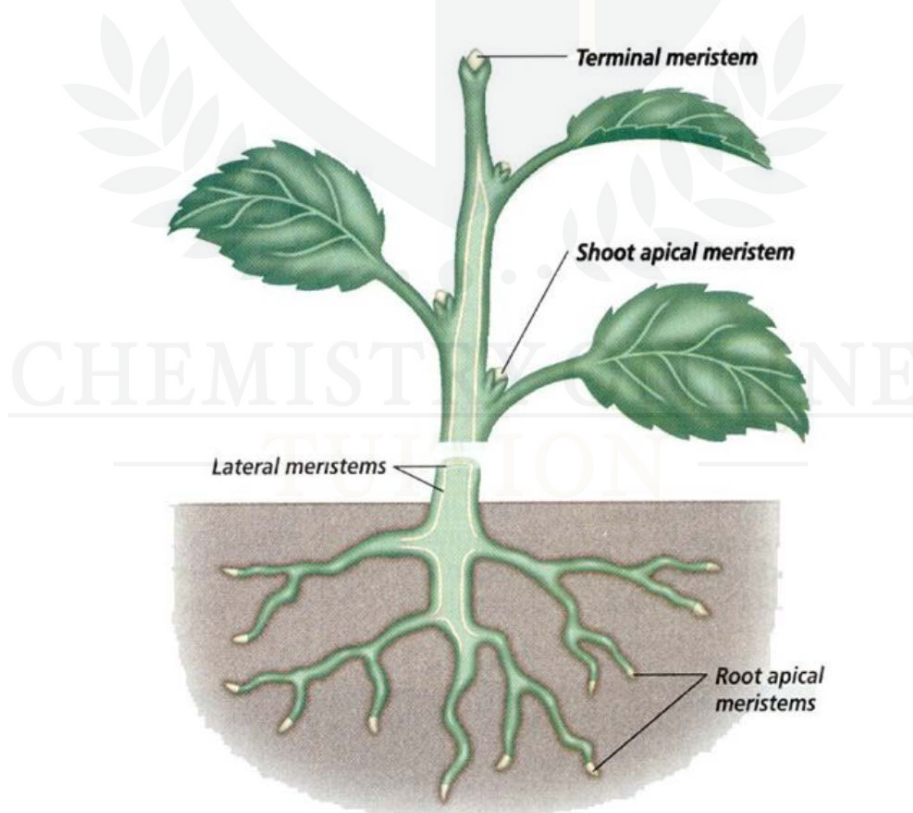
[2]

Two parts of a plant where meristematic tissue can be found are:

- Apex of root
- Apex of shoot
- Cambium
- Bud

Meristematic tissue in plants is where most of mitosis (cell division) occurs. Therefore the parts of the plant that have this tissue are the growing regions.

[Diagram to show the locations of meristematic tissue in plants:](#)



- (b) In an investigation, a student observed the cells in a stained section of meristematic tissue. The student counted how many cells could be seen in each stage of the cell cycle.

Table 4.1 shows the results.

Table 4.1

stage of cell cycle	percentage cells in stage (%)
interphase	82.00
prophase	4.34
metaphase	3.23
anaphase	3.23
telophase	7.20

- (i) Explain why the meristematic tissue needed to be stained for this investigation.

[2]

The meristematic tissue needed to be stained so that:

- The **chromosomes** were **visible**
- In order to distinguish between different stages of **mitosis**
- To provide **contrast**
- Because different structures take up different amounts of stain

- (ii) Name the type of nuclear division that occurs in a plant meristem.

[1]

The type of nuclear division is called:

- **Mitosis**

- (c) Using the results shown in Table 4.1, calculate the percentage of the cell cycle taken up by nuclear division. [2]

Show your working.

The percentage of the cell cycle taken up by nuclear division is:

- 100% - % taken up by interphase i.e. 100-82
- = 18.00%

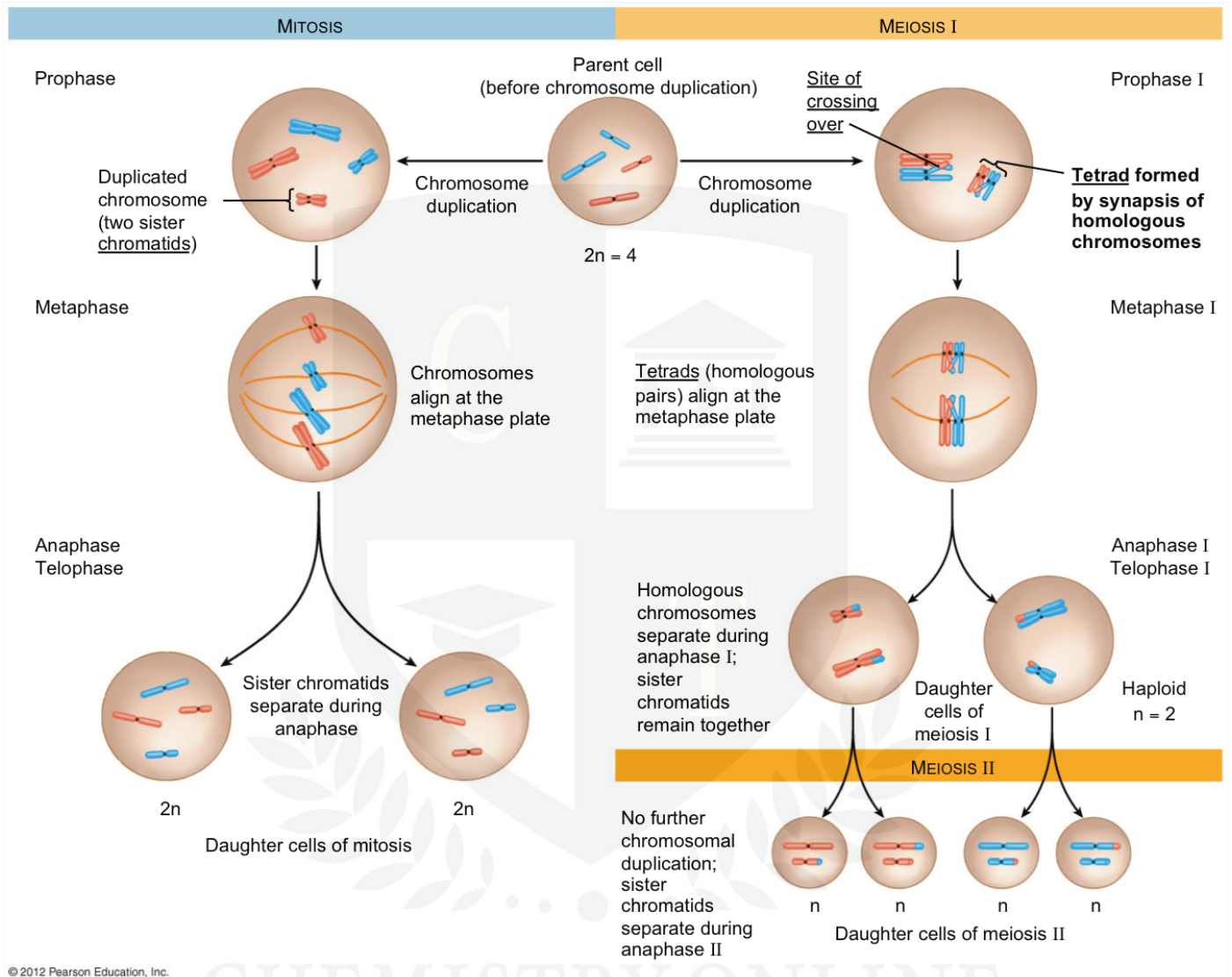
Mitosis includes the stages: Prophase, Metaphase, Anaphase and Telophase. It does not include Interphase. These are the only stages of the cell cycle, so all of these account for 100% of the cycle. Interphase accounts for 82%. Therefore mitosis accounts for the other 18%.

- (d) State **one** way in which the products of **meiosis** are different from the products of nuclear division in meristematic tissue. [1]

The products of meiosis are different to the products of mitosis as:

- The products of meiosis are not **genetically identical** (whereas the products of nuclear division in meristematic tissue are genetically identical)
- The daughter cells of meiosis are **haploid** (whereas they are **diploid** in mitosis)
- **Four** daughter cells are produced (only **two** in mitosis)
- The resulting cells are **gametes** in meiosis

A diagram to show the differences between meiosis and mitosis:



[Total: 8]