

BIOLOGY

LEAVING CERTIFICATE
HIGHER LEVEL

CELL DIVISION



**THE DUBLIN
ACADEMY OF
EDUCATION**

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EXAM FOCUS

- The Leaving Cert Biology Exam is broken into 3 sections

Section A 25%	Section B 15%	Section C 60%
Answer 5/6 Qs (20 m)	Answer 2/3 Qs (30 m)	Answer 4/6 Qs* (60 m)
Unit 1: 2 Qs	23 Experiments	Unit 1: 1 Q
Unit 2: 2 Qs		Unit 2: 2 Qs
Unit 3: 2 Qs		Unit 3: 3 Qs

UNIT 2 (40% - 47.5%)

- How does it appear?

Section A	Section B	Section C
2 Qs (2 x 20 marks)	Experiments 6-14 (30 marks)	2 Qs* (2 x 60 marks)
		*may contain experiment

HISTORY OF TOPIC	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05
Cell Div	20m	20m	24m	20m	20m	20m	24m	X	20m	X	20m	20m	20m	X	20m
DNA + Gen Eng	36m	29m	36m	X	52m	36m	20m	33m	30m	42m	20m	30m	60m	30m	29m
Evolution + Heredity	X	24m	15m	30m	6m	9m	9m	20m	18m	X	48m	X	X	45m	X
Genetics + Gen Crosses	24m	27m	12m	26m	33m	24m	27m	30m	51m	44m	36m	60m	20m	30m	51m

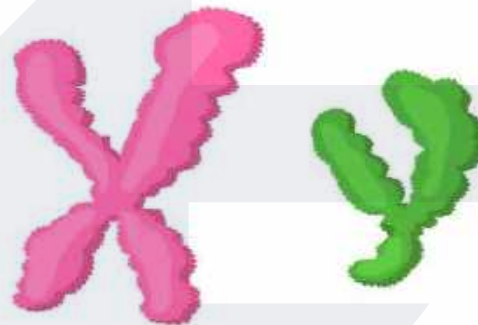
Cell Division



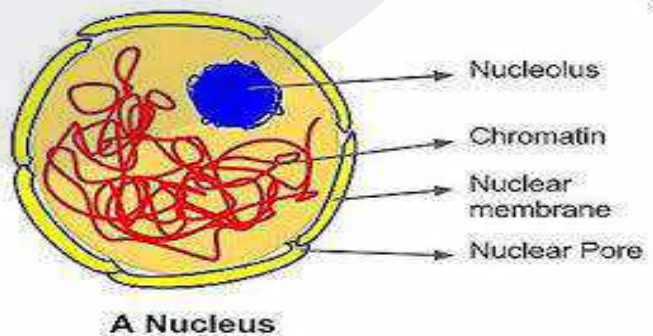
Cell Continuity:

Cell Continuity refers to the fact that all cells are produced from the division of existing live cells.

A Chromosome is a section of DNA and protein.



Chromatin is a mass of elongated chromosomes in the nucleus (when not dividing).



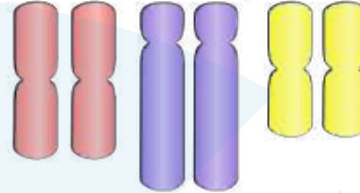
Haploid Cell = Cell with one set of chromosomes

*Diploid Cell = Cell with two sets of chromosomes
(Chromosomes occur in pairs)*

Haploid (N)



Diploid (2N)



Mitotic Cell Cycle:

The continuous generation of new cells

1) Interphase

- Cell grows
- New organelles are made
- DNA replicates

2) Mitosis*

- Nucleus divides forming two identical nuclei

3) Cell Division (Cytokinesis)

- Cells split in two with a nucleus in each



Mitosis (PMAT)

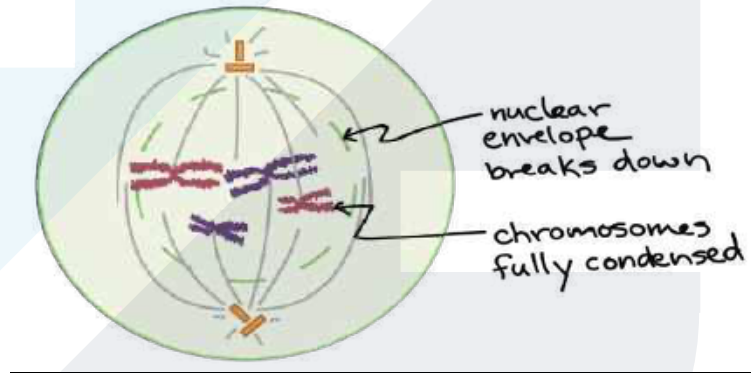
Role of Mitosis

- 1) Growth and repair in a multicellular organism e.g. David Lewis
- 2) Asexual Reproduction in a single-celled organism e.g. binary fission in bacteria



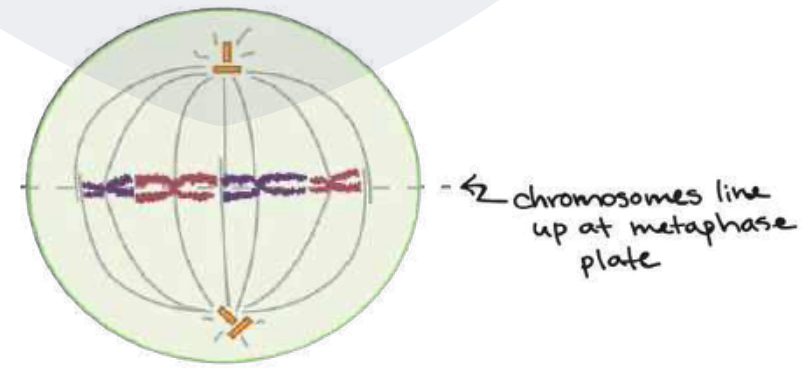
Prophase

- Nuclear membrane begins to breakdown
- Chromatin contract
- Spindle fibres form in cell cytoplasm
- Nucleolus disappears



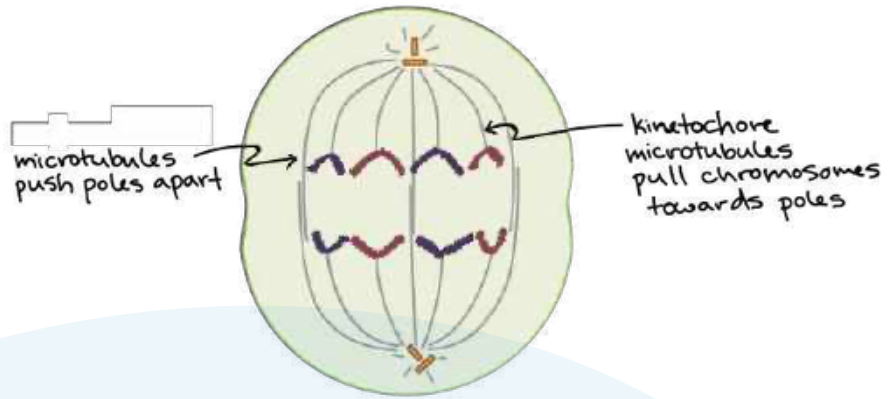
Metaphase

- Chromosomes arranged in single file in middle of the cell
- Spindle fibres attach to the centromere of each chromosome



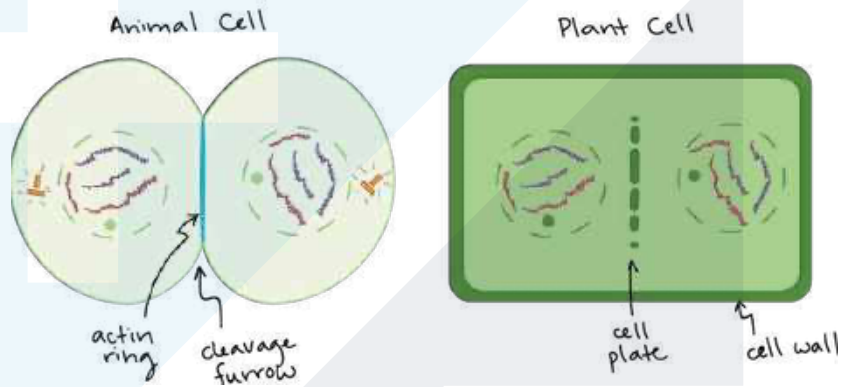
Anaphase

- Spindle fibres contract splitting the pairs
- Two identical sets of chromosomes are produced at either end of the cell



Telophase

- Spindle fibres break down
- Chromosomes begin to form chromatin again
- A membrane forms around the chromosomes creating a nucleus



Animal cell divides by developing a cleavage furrow which divides the cytoplasm.

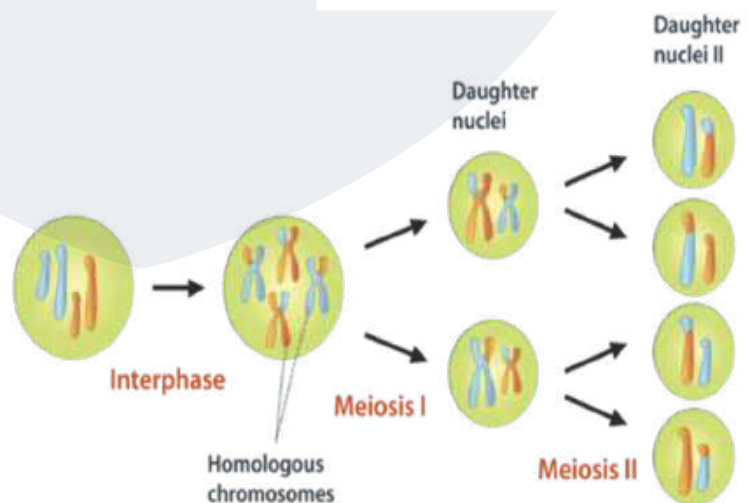
Plant cell divides by forming a cell plate and then a middle lamella around it.

Meiosis

Meiosis is a type of cell division where the daughter nuclei contain half the chromosome number of the parents.

Humans: testes and ovaries

Flowering Plants: anther and ovule



Role of Meiosis

- 1) Produces gametes needed for sexual reproduction e.g. sperm and egg
- 2) Increases genetic variation important for evolution e.g. independent assortment of chromosomes

Differences: Mitosis -V- Meiosis

Mitosis

Same number of chromosomes in daughter and parent cell

One cell forms two new cells

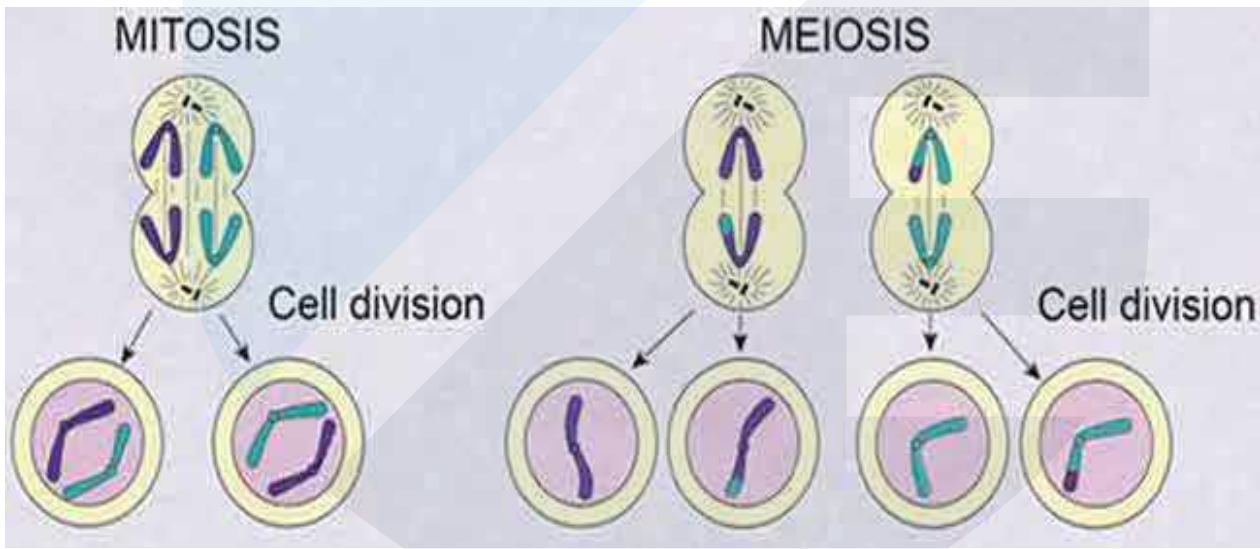
Genes identical to parent cell

Meiosis

Half the number of chromosomes in daughter cell

One cell forms four new cells

Genes different to parent cell



Cancer

Cancer: a malignant abnormal mass of multiplying cells
(Over 200 forms which display common characteristics)

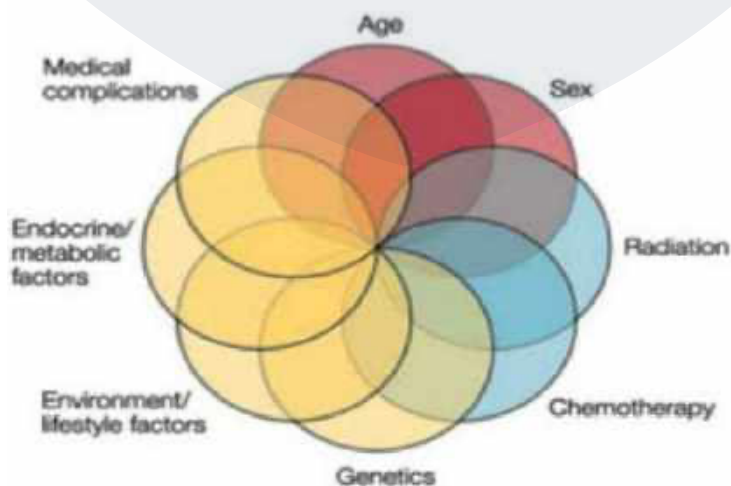
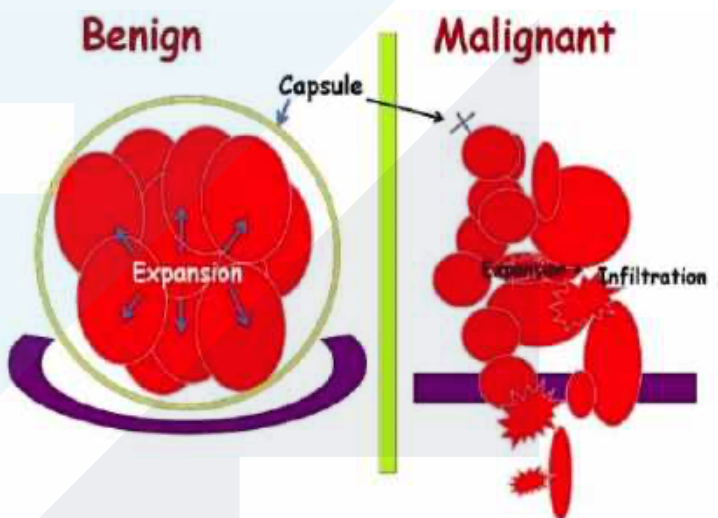
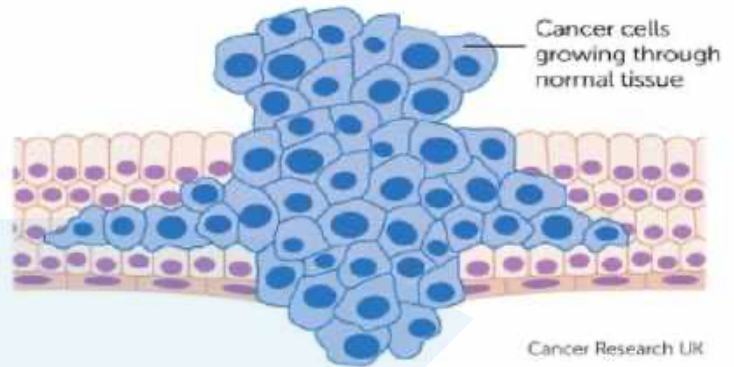
Cells can lose the ability to control the rate of mitosis. This mass of cells is called a tumour.

Benign tumours: cells eventually stop dividing and are not life-threatening

Malignant tumours: Uncontrolled division of tumours that can invade and disrupt surrounding tissue

Metastasis is the ability of cancer cells to detach from original mass and travel around the body via blood or lymph, thus forming secondary malignant masses.

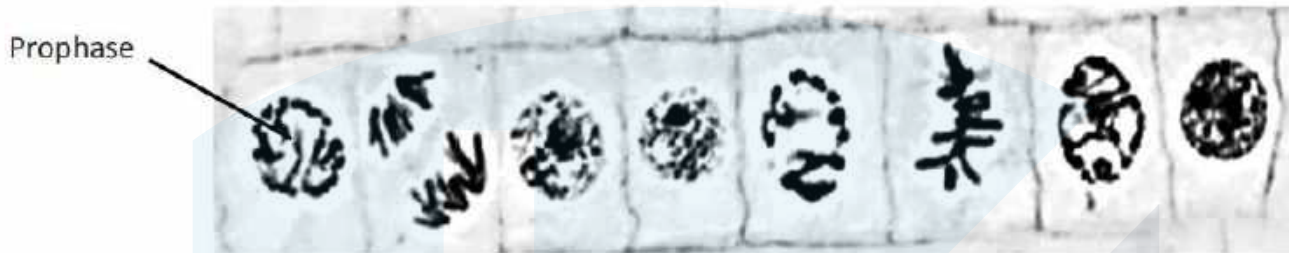
Carcinogens are any factor that transforms a normal cell into a cancer cell e.g. cigarette smoke, radiation, some viruses



Past Exam Questions

Exam Paper 2019, Question 4:

4. The photograph below is of plant cells undergoing different stages of mitosis. The cells are not shown in any particular order.



- (a) Which type of microscope is used in the school laboratory to observe cells like these?

--

- (b) The first cell is in prophase. Give two observable events that happen during prophase.

1.
2.

- (c) On the photograph, use the letter **M** to label a cell that is undergoing metaphase.

- (d) On the photograph, use the letter **A** to label a cell that is undergoing anaphase.

- (e) After mitosis, the cell divides in two.

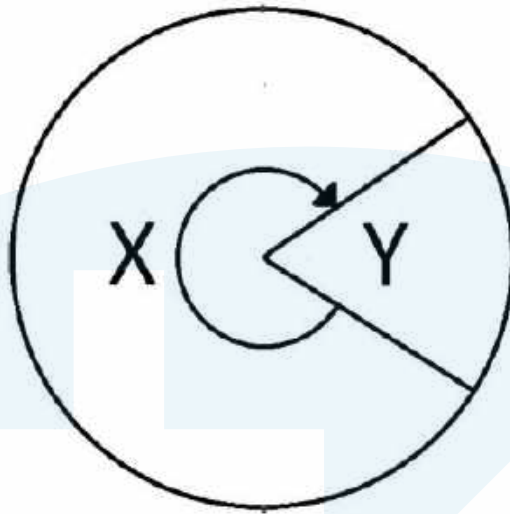
This happens differently in animal cells and in plant cells.

Describe what happens in animal cells **and** in plant cells during this stage.

Animal cells.
Plant cells.

Exam Paper 2018, Question 3:

3. The diagram represents the cell cycle.



(a) What stage of the cell cycle is represented by X?

(b) There are two types of cell division, mitosis and meiosis. Define *mitosis*.

(c) State **two** ways in which meiosis differs from mitosis.

1.

2.

(d) Explain the term *cancer*.

Exam Paper 2017, Question 13 c):

- (c) Answer the following questions in relation to the cell cycle.
- (i) Explain the term *diploid*.
 - (ii) Draw a labelled diagram to show the position of the chromosomes during anaphase of mitosis in a diploid nucleus in which $2n = 4$.
 - (iii) After telophase of mitosis, how do 1. animal cells; 2. plant cells, split in two?
 - (iv) What is the function of mitosis in 1. single-celled organisms; 2. multi-celled organisms?

(24)

Exam Paper 2016, Question 6:

6. (a) What term is used to describe the long stage of the cell cycle when cell division is not occurring?

- (b) Name **two** types of biomolecule that are produced in the cell during this stage of the cell cycle.

(i) _____

(ii) _____

- (c) Name **one** organelle that is replicated at this stage of the cell cycle.

- (d) Give any **two** other changes which will have occurred in the cell by the end of this stage of the cell cycle.

(i) _____

(ii) _____

- (e) Suggest why mature human red blood cells do not undergo cell division.

Exam Paper 2015, Question 4:

4. Indicate whether the following statements are true or false by placing a tick (✓) in the appropriate box in each case.

- (a) Meiosis is an important source of variation.
- (b) Mitosis occurs in mature red blood cells in humans.
- (c) During mitosis the nuclear membrane temporarily disappears.
- (d) Meiosis gives rise to the haploid condition.
- (e) In multicellular organisms mitosis functions primarily in growth.
- (f) In plants, a cell plate forms during telophase of mitosis.
- (g) The human zygote divides by meiosis.

True	False

Exam Paper 2014, Question 5:

5. Indicate whether the following statements are true (T) or false (F) by placing a tick (✓) in the appropriate box in each case.

- (a) Single-celled organisms use meiosis for asexual reproduction.
- (b) In telophase of mitosis, a cleavage furrow forms in plant cells.
- (c) When a cell is not dividing it is said to be in prophase.
- (d) The nuclear membrane disappears in the early part of mitosis.
- (e) Centromeres give rise to the nuclear spindle.
- (f) Mitosis is a source of variation.
- (g) In multicellular organisms mitosis is primarily used for growth.

T	F

Exam Paper 2013, Question 11 c):

(c) Answer the following questions, which relate to events in the cell cycle.

- (i) What name is applied to the period of the cell cycle in which division is **not** taking place?
- (ii) Give a cellular process that occurs during this period in which the nucleus is not dividing.
- (iii) Draw a labelled diagram to show the position of the chromosomes during metaphase of mitosis in a nucleus in which $2n = 6$.
- (iv) 1. State a function of one of the structures, other than chromosomes, that you have labelled in your diagram of metaphase.
2. How does the structure carry out this function?
- (v) What term is used for the group of disorders in which control has been lost over the rate of mitosis?

Exam Paper 2011, Question 2:

2. Use your knowledge of mitosis to answer the following questions:

- (a) What is the role of mitosis in single-celled organisms?

- (b) What medical term is used for the group of disorders in which certain cells lose normal control of mitosis?

- (c) Suggest a possible cause of one of the group of disorders referred to in (b).

- (d) Name the stage of mitosis in which the chromosomes are located at the equator of the cell and before they begin to separate.

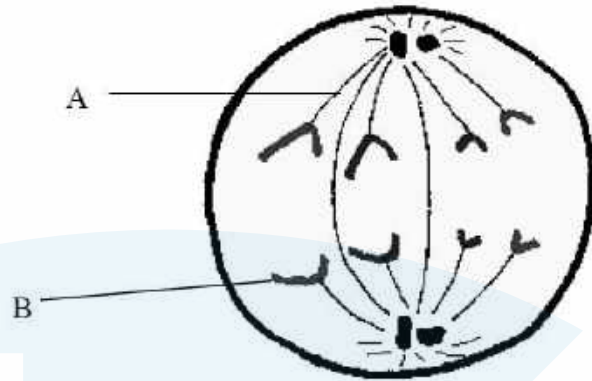
- (e) To what are the chromosomes attached in the stage of mitosis referred to in (d)?

- (f) Towards the end of mitosis, in what type of cell does a cell plate form?

- (g) Give one way in which mitosis differs from meiosis.

Exam Paper 2009, Question 5:

5. The diagram shows a stage of mitosis.



(a) Name this stage of mitosis. _____

(b) Give a feature from the diagram which allowed you to identify this stage.

(c) Name the parts of the diagram labelled A and B.
A. _____
B. _____

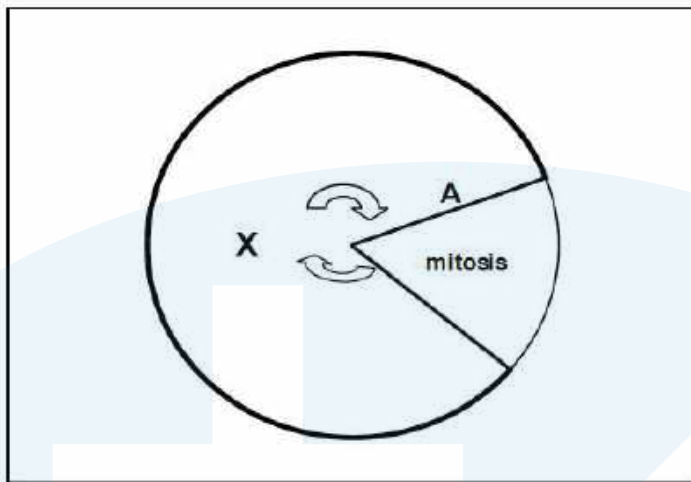
(d) What is the function of mitosis in single-celled organisms? _____

(e) Give **one** function of mitosis in multicellular organisms. _____

(f) Give **one** location where mitosis occurs in flowering plants. _____

Exam Paper 2008, Question 2:

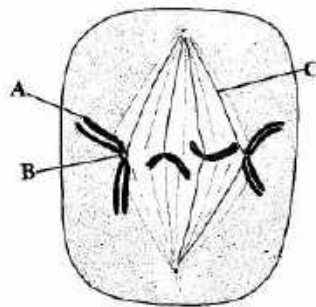
2. The diagram represents the cell cycle.



- (a) What stage of the cycle is represented by X?
- (b) Give the names of the two processes involving DNA which take place during stage X.
1..... 2
- (c) For convenience of study, mitosis is divided into four stages. List these in order starting at A.
.....
- (d) In which of the stages of mitosis that you have listed in (c) would you expect to see the spindle fibres contracting?
- (e) Explain the term diploid number
- (f) What term is used to describe a group of disorders of the body in which cells lose the normal regulation of mitosis?

Exam Paper 2007, Question 3:

3. Study the diagram of a stage of mitosis in a diploid cell and then answer the questions below.



- (a) Name A, B and C.
 A B C
- (b) What stage of mitosis is shown?
 Give a reason for your answer.
- (c) What is the diploid number of this nucleus which is undergoing mitosis?
- (d) Give a role of structure A.
- (e) Some cells in the human body undergo meiosis. Give one function of meiosis.....

Exam Paper 2005, Question 5:

- 5. (a) In the space below draw a diagram of a nucleus during metaphase of mitosis where $2n = 6$.
 Label the spindle and a centromere in your diagram.

- (b) State a function of mitosis in a single-celled organism.

- (c) State a function of mitosis in a multicellular organism.

- (d) State one way in which mitosis differs from meiosis.

- (e) When the normal control of mitosis in a cell is lost, cancer may result. Suggest **two** possible causes of cancer.
 1.
 2.

Solutions

Exam Paper 2018, Question 3:

3.		2(5) + 5(2)
	(a) <i>x</i> = Interphase	
	(b) <i>Mitosis:</i> (Cell or nuclear division) forming two Identical (daughter) cells (or nuclei) or same chromosome number as parent	
	(c) <i>Two ways meiosis differs from mitosis:</i> Four (new cells or nuclei) produced/ variation (or not identical)/ chromosome number halved	Any two
	(d) <i>Cancer:</i> (A group of disorders due to) uncontrolled (Rate of) mitosis (or cell division)	

Exam Paper 2017, Question 13 c):

(c)	(i)	<i>Diploid:</i> Two of each chromosome or chromosomes in pairs [<i>allow two sets of chromosomes</i>]	4
	(ii)	<i>Anaphase diagram:</i> Showing eight chromosomes, correctly positioned, chromosome label <i>Labels: Chromosome, spindle, centromere</i>	4, 2, 0 2(2)
	(iii)	<i>Splitting in two after telophase:</i> 1. <i>Animal cells:</i> Cleavage (or furrow) formation or described 2. <i>Plant cells:</i> Cell plate formation or described	4 + 2
	(iv)	<i>Function of mitosis in:</i> 1. <i>Single-celled organisms:</i> (Asexual) reproduction 2. <i>Multi-celled organisms:</i> Repair (or renewal) of tissue or growth	4 + 2

Exam Paper 2016, Question 6:

6.	2(5) + 5(2)
(a) <i>Long stage of cell cycle:</i>	Interphase
(b) (i) (ii) <i>Biomolecule types produced:</i>	Nucleic acid (or DNA or RNA)/ protein/ fat/ carbohydrate
	<i>Any two</i>
(c) <i>Organelle replicated:</i>	Mitochondrion or chloroplast or ribosomes or centriole
(d) <i>Two other changes:</i>	Condensed (short or thick or coiled) chromosomes or chromosomes visible (under microscope)/ disappearance of nuclear membrane/ formation of spindle/ chromosomes duplicated or DNA replicated
	<i>Any two</i>
(e) <i>Why no division of red blood cells:</i>	No nucleus

Exam Paper 2015, Question 4:

4. 8 + 7 + 5(1)

(a)	T
(b)	F
(c)	T
(d)	T
(e)	T
(f)	T
(g)	F

Exam Paper 2014, Question 5:

5. 8 + 7 + 5(1)
F
F
F
T
F
F
T

Exam Paper 2013, Question 11 c):

(c) (i) *Interphase	3
(ii) Replication or growth or protein synthesis or respiration or photosynthesis	3
(iii) <i>Diagram:</i> spindle (or outline of cell) + chromosomes on equator + 6 double chromosomes	6, 3, 0
<i>Labels:</i> Chromosome(s) / spindle / centromere(s) / cell membrane	3(1)
(iv) 1. Function	3
2. How function is carried out	3
(v) Cancer	3

Exam Paper 2011, Question 2:

2.		6(3) + 2
(a)	Reproduction	
(b)	Cancer	
(c)	Named carcinogen	
(d)	Metaphase	
(e)	Spindle	
(f)	Plant (cell) or named example	
(g)	Two (daughter) cells or identical (daughter) cells or (daughter cells) same chromosome number (as mother cell) or can occur in haploid cells	

Exam Paper 2009, Question 5:

5.		6(3) + 2	
(a)	Anaphase		
(b)	Chromosomes separated or chromosomes near poles		
(c)	A = Spindle (fibre) B = Chromosome		
(d)	Reproduction		
(e)	Growth or (cell) replacement or repair or renewal or spore formation		
(f)	Meristematic tissue or root tips or shoot tips or buds or ovule or embryo sac or pollen		

Exam Paper 2008, Question 2:

2.	(a)	Interphase	2
	(b)	uncoiling / transcription / replication or duplication	2(2)
	(c)	Prophase / metaphase / anaphase/ telophase correct order showing all four	4(1) 4
	(d)	anaphase or 3 rd stage	2
	(e)	<u>Chromosomes</u> in pairs (two sets of <u>chromosomes</u>)	2
	(f)	Cancer or named group of cancers or tumour	2

Exam Paper 2007, Question 3:

Q 3.	(a)	A = chromosome [accept chromatid]	B = centromere	C = spindle	3(2)
	(b)	Stage: metaphase			2
		Reason: chromosomes on equator			3
	(c)	four			3
	(d)	comment on inheritance e.g. to carry genes, genetic code, code for protein			3
	(e)	to produce gametes or to reduce or to halve chromosome number [allow variation]			3

Exam Paper 2005, Question 5:

5.		Diagram (6, 0) + 7(2)	
	(a)	Diagram Labels – spindle - centromere	Diag 6.0
	(b)	Reproduction	
	(c)	Growth/ repair/ reproduction (only if development of macrospore/microspore is given)	
	(d)	No reduction in chromosomes/ no homologous pairing during process/ resulting nuclei identical/ two cells	
	(e)	Carcinogen /mutation / mutagen / example 1 / example 2 / radiation or named / virus any two	

