Tailored Tutors

CELL DIVISION

Topics for this weeks class:

Cell Cycle
Mitosis
Gene mutations
Meiosis
Genetic Variation

Playlist of videos to take notes on before the web class:

AQA VIDEOS	OCR VIDEOS	EDEXCEL VIDEOS
Mitosis	Cell Cycle & Mitosis	Gene Mutations
Mitosis & Cancer	Mitosis	Cell Division
Binary Fission	Gene Mutations	Before Meiosis
Before Meiosis	Meiosis Key Terms	Meiosis & Genetic Variation
Introduction to Meiosis	Before Meiosis	Mitosis
Meiosis	Meiosis	
Meiosis & Genetic Variation	Meiosis & Genetic Variation	
Gene Mutations		
Chromosome Mutation		

Q1.

(a) The following statements describe stages of mitosis.

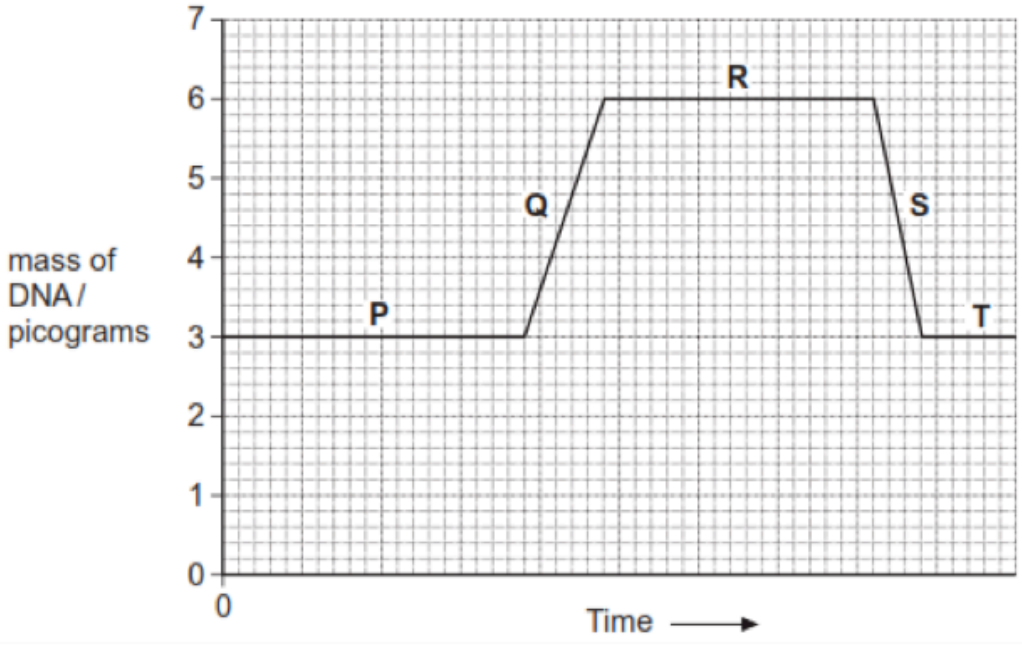
A chromosomes align at the centre of the cell attached to spindle fibres
B chromatids are in groups at the poles
C chromosomes become visible
D chromatids move towards the poles

Complete the table by entering the appropriate letter.

Stage of mitosis	**Letter of description of the stage**
Prophase	
Metaphase	
Anaphase	
Telophase	

(3)

(b) The graph shows changes in the mass of DNA in a cell during one cell cycle.
Five stages have been identified on the graph.



(i) Which letter represents the stage when DNA is replicating?

(1)

(ii) Explain the change in the DNA content during stage **S**.

_____

_____

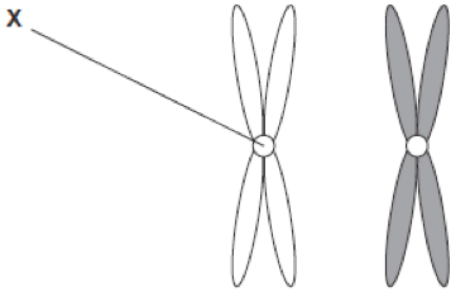
(1)

(Total 5 marks)

Q2.

(a) **Figure 1** shows one pair of homologous chromosomes.

Figure 1



(i) Name **X.**

_____

(1)

(ii) Describe the role of **X** in mitosis.

_____

_____

_____

_____

_____

(2)

(iii) Homologous chromosomes carry the same genes but they are **not** genetically identical.Explain why.

_____

_____

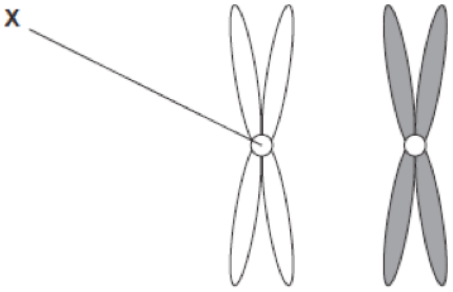
_____

(1)

(b) **Figure 2** shows three pairs of homologous chromosomes in a cell at the end of cell division.

Figure 2

Figure 1



(i) The appearance of each chromosome in **Figure 2** is different from those shown in **Figure 1.** Explain why.

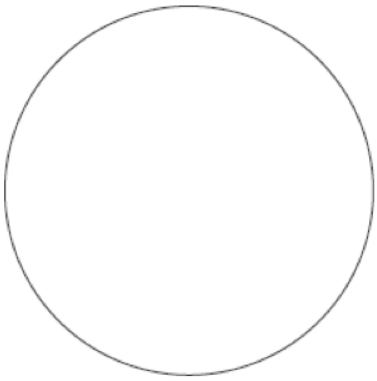
_____

_____

_____

(1)

(ii) Complete the diagram to show the chromosomes in one cell that could be produced from the cell in **Figure 2** as a result of meiosis.



(2)

(iii) Other than independent segregation, give **one** way in which meiosis allows the production of genetically different cells.

_____

_____

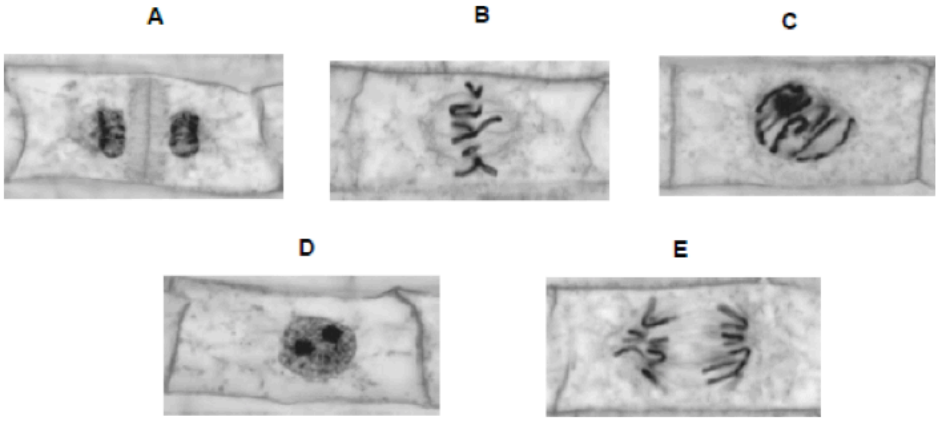
_____

(1)

(Total 8 marks)

Q3.

The figure below shows some cells from an onion root tip at different stages of the cell cycle.



(a) Place stages **A** to **E** in the correct order. Start with stage **D**.

D _____

(1)

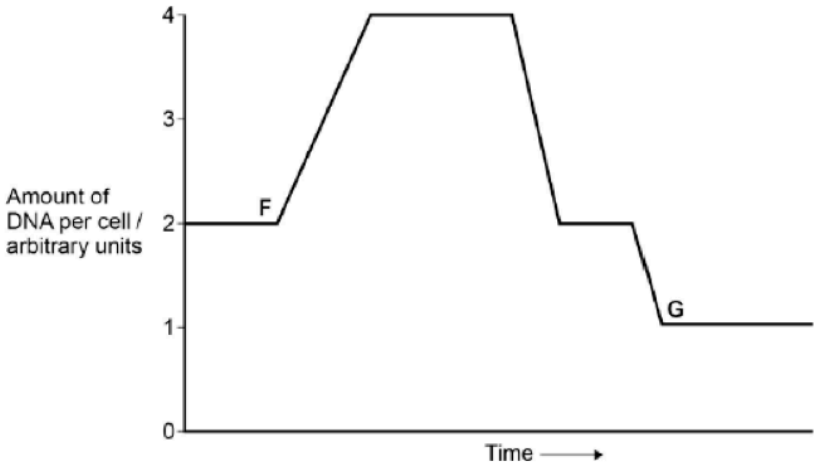
To obtain these images, the onion root tip was cut off, stained and put on a microscope slide. A cover slip was placed on top. The root tip was then firmly squashed and viewed under an optical microscope.

(b) Complete the table below to give **one** reason why each of these steps was necessary.

Step	Reason
Taking cells from the root tip	
Firmly squashing the root tip	

(2)

The figure below shows how the amount of DNA per cell changed during interphase and meiosis in an animal.



(c) Explain how the behaviour of chromosomes causes these changes in the amount of DNA per cell between **F** and **G**.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(d) What would happen to the amount of DNA per cell at fertilisation of cell **G?**

_____

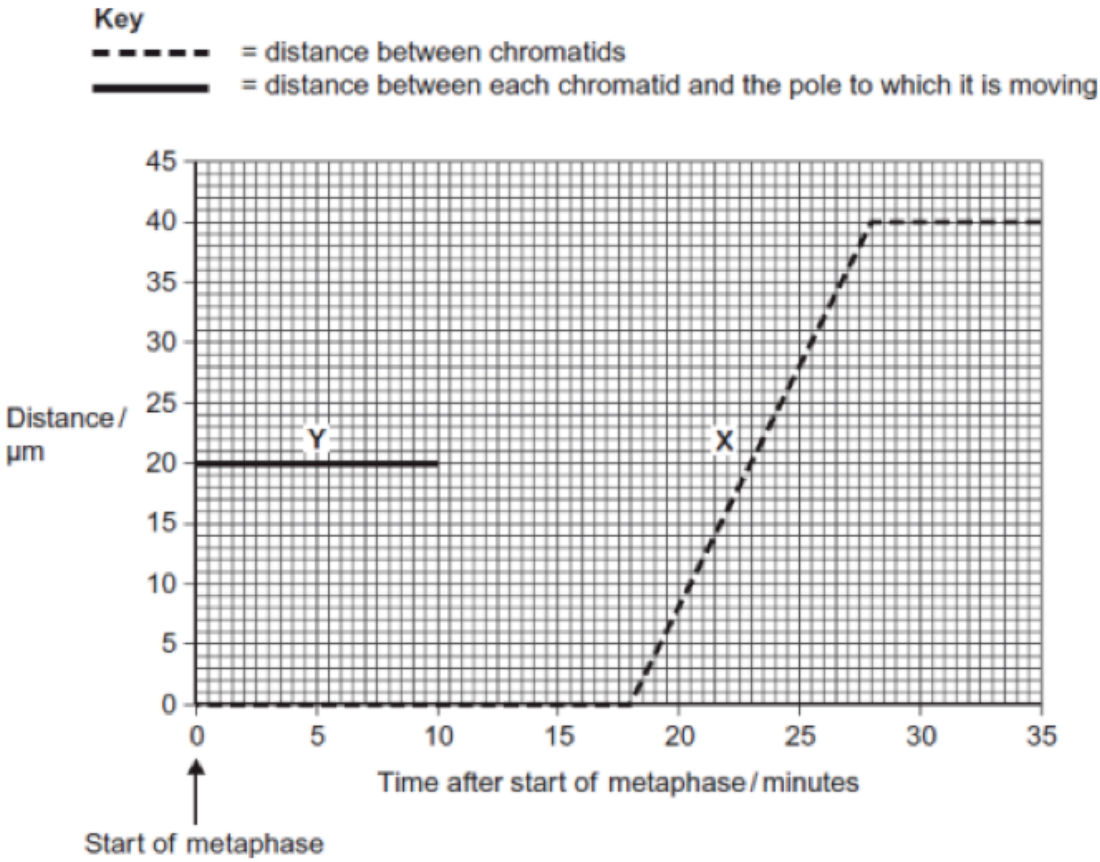
_____

(1)

(Total 7 marks)

Q4.

(a) The graph shows information about the movement of chromatids in a cell that has just started metaphase of mitosis.



(i) What was the duration of metaphase in this cell?

_____ minutes

(1)

(ii) Use line **X** to calculate the duration of anaphase in this cell.

_____ minutes

(1)

(iii) Complete line **Y** on the graph.

(2)

(b) A doctor investigated the number of cells in different stages of the cell cycle in two tissue samples, **C** and **D.** One tissue sample was taken from a cancerous tumour. The other was taken from non-cancerous tissue. The table shows his results.

	Percentage of cells in each stage of the cell cycle	
Stage of the cell cycle	Tissue sample **C**	Tissue sample **D**
Interphase	82	45
Prophase	4	16
Metaphase	5	18
Anaphase	5	12
Telophase	4	9

(i) In tissue sample **C**, one cell cycle took 24 hours. Use the data in the table to calculate the time in which these cells were in interphase during one cell cycle. Show your working.

Time cells in interphase _____ hours

(2)

(ii) Explain how the doctor could have recognised which cells were in interphase when looking at the tissue samples.

_____

_____

_____

(1)

(iii) Which tissue sample, **C** or **D**, was taken from a cancerous tumour? Use information in the table to explain your answer.

_____

_____

_____

_____

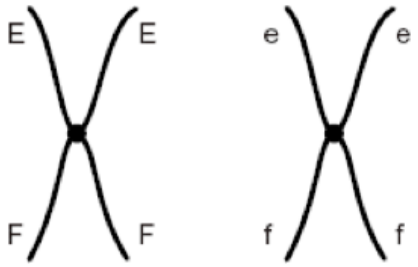
(2)

(Total 9 marks)

Q5.

Figure 1 shows a pair of chromosomes at the start of meiosis. The letters represent alleles.

Figure 1



(a) What is an allele?

_____

_____

(1)

(b) Explain the appearance of one of the chromosomes in **Figure 1**.

_____

_____

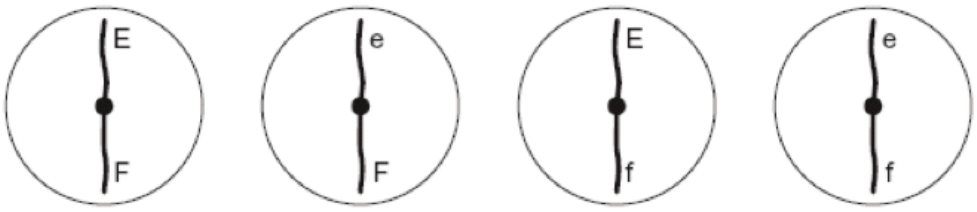
_____

_____

(2)

(c) The cell containing this pair of chromosomes divided by meiosis. **Figure 2** shows the distribution of chromosomes from this pair in four of the gametes produced.

Figure 2



(i) Some of the gametes formed during meiosis have new combinations of alleles.

Explain how the gametes with the combinations of alleles Ef and eF have been produced.

_____

_____

_____

_____

(2)

(ii) Only a few gametes have the new combination of alleles Ef and eF. Most gametes have the combination of alleles EF and ef. Suggest why only a few gametes have the new combination of alleles, Ef and eF.

_____

_____

(1)

(d) **Figure 3** shows a cell with six chromosomes.

Figure 3

(i) This cell produces gametes by meiosis. Draw a diagram to show the chromosomes in one of the gametes.

(2)

(ii) How many different types of gametes could be produced from this cell as a result of different combinations of maternal and paternal chromosomes?

(1)
(Total 9 marks)

Q6.

(a) Describe the appearance and behaviour of chromosomes during mitosis.

(5)

(b) Describe and explain the processes that occur during meiosis that increase genetic variation.

(5)
(Total 10 marks)

Q7.

(a) Describe what happens to chromosomes in meiosis.

(6)

(b) Meiosis results in genetic variation in the gametes which leads to variation in the offspring formed by sexual reproduction. Describe how meiosis causes this variation and explain the advantage of variation to the species.

(5)

(Total 11 marks)

Q1.

(a) Sequence: C,A,D,B (1 mark per correct box to 3 max)

3 max

(b) (i) Q

1

(ii) Cell/nucleus has divided / is dividing (into two)

Accept – mitosis (occurring)

Ignore refs to chromosomes dividing

1

[5]

Q2.

(a) (i) Centromere

Accept: if phonetically correct *Reject: centriole*

1

(ii) 1. Holds chromatids together

2. Attaches (chromatids) to spindle

3. (Allows) chromatids to be separated / move to (opposite) poles / (centromere) divides / splits at metaphase / anaphase

*3. **Q** Neutral: chromosomes or chromatids split / halved / divided*

3. Reject: reference to homologous chromosomes being separated

Accept 'chromosomes' instead of 'chromatids'

*Ignore incorrect names for **X***

2 max

(iii) (Homologous chromosomes) carry different alleles

Accept alternative descriptions for 'alleles' eg different forms of a gene / different base sequences

Neutral: reference to maternal and paternal chromosomes

1

(b) (i) (In **Figure 2**)

1. Chromatids have separated (during anaphase)

*1. **Q** Neutral: split / halved / divided*

1. Reject: reference to homologous chromosomes being separated

or

2. Chromatids have not replicated

1. & 2. Accept 'chromosomes' instead of 'chromatids'

or

3. Chromosomes formed from only one chromatid

*Accept converse arguments for **Figure 1***

Ignore references to the cell not dividing as in the question stem

Ignore: named phases

1 max

(ii) 1. Three chromosomes

Ignore shading

2. One from each homologous pair

Only one mark for three chromosomes shown as pairs of chromatids

2

(iii) Crossing over / alleles exchanged between chromosomes or chromatids / chiasmata formation / genetic recombination

Accept: description of crossing over eg sections of chromatids break and rejoin

Neutral: random fertilisation

Reject: reference to sister chromatids

***Q** Neutral: genes exchanged*

Neutral: mutation

1

[8]

Q3.

(a) (D)CBEA.

1

(b)

Step	Reason
(Taking cells from the root tip)	Region where mitosis / cell division occurs
(Firmly squashing the root tip)	To allow light through / make tissue layer thin

2

(c)

1. Chromosomes / DNA replicates (Increase)

2. Homologous chromosomes separate (First decrease)

3. Sister chromatids separate. (Second decrease)

3

(d) 1. (DNA would) double / go to 2 (arbitrary units).

1

[7]

Q4.

(a) (i) 18

Do not accept 17.5

1

(ii) 10

1

(iii) 1. Horizontal until 18 minutes

Allow + / - one small box

2. (Then) decreases as straight line to 0 µm at 28 minutes

2. Allow lines that start from the wrong place, ending at 0 at 28 minutes

2

(b) (i) Two marks for correct answer of 19.68 or 19.7

Accept 19hrs 41mins

One mark for incorrect answers in which candidate clearly multiplies by 0.82

Allow one mark for incorrect answers that clearly show 82% of 24 (hours)

2

(ii) 1. No visible chromosomes / chromatids / visible nucleus

1

(iii) **D** (no mark)

1. Lower % (of cells) in interphase / higher % (of cells) in mitosis / named stage of mitosis

1. Accept: 'less' or 'more' instead of '%'

1. Do not accept: higher % (of cells) in each / all stage(s)

2. (So) more cells dividing / cells are dividing quicker

2. Accept: uncontrolled cell division

*2. Do not award if Tissue **C** is chosen*

2

[9]

Q5.

(a) (Different) form / type / version of a gene / different base sequence of a gene

1

(b) Two / sister chromatids joined by a centromere

Due to DNA replication

2

(c) (i) Crossing over

1

Exchange (of alleles) between chromatids / chromosomes

Negate first marking point for answers which refer to independent segregation.

Chiasma / chiasmata = first marking point

1

(ii) Is infrequent / rare

References to it being 'random', 'occurs by chance' or 'doesn't always occur' should not be credited without a clear idea that it is rare or infrequent.

1

(d) (i) Three chromosomes shown

1

One from each homologous pair

For first mark point allow drawings showing three chromosomes as single or double structures.

1

(ii) 8

1

[9]

Q6.

(a) (During prophase)

1. Chromosomes coil / condense / shorten / thicken / become visible
2. (Chromosomes) appear as (two sister) chromatids joined at the centromere

(During metaphase)

3. Chromosomes line up on the equator / centre of the cell
4. (Chromosomes) attached to spindle fibres
5. By their centromere

(During anaphase)

6. The centromere splits / divides
7. (Sister) chromatids / chromosomes are pulled to opposite poles / ends of the cell / separate

(During telophase)

8. Chromatids / chromosomes uncoil / unwind / become longer / thinner.

No marks for naming the stages

Reject references to homologous chromosomes / pairing of chromosomes

Ignore references to spindle formation during prophase

5 max

(b)

1. Homologous chromosomes pair up
2. Independent segregation
3. Maternal and paternal chromosomes are re-shuffled in any combination
4. Crossing over leads to exchange of parts of (non-sister) chromatids / alleles between homologous chromosomes
5. (Both) create new combinations of alleles

5

[10]

Q7.

(a)
1. Chromosomes shorten / thicken / condense
2. Chromosomes associate in homologous / (described) pairs / formation of bivalents / tetrads
3. Crossing-over / chiasma formation
4. Join to spindle (fibres) / moved by spindle (*)
5. (At) equator / middle of cell (*)
6. (join via) centromere / kinetochore (*)
7. (Homologous) chromosomes move to opposite poles / chromosomes separate / move apart (*ALLOW* 'are pulled apart')
8. (Pairs of) chromatids separated in 2nd division

(*) OR " independent assortment"
unqualified = 1 mark

max 6

(b)
1. Crossing-over [*IGNORE* any wrong ref. to timing]
2. Independent / random assortment / orientation / segregation of (homologous) chromosomes in meiosis I
3. Independent / random assortment / orientation / segregation of chromatids in meiosis II

\+ Any **three** from:
4. Different adaptations / some better adapted
5. Some survive / example described
6. To reproduce
7. Pass on gene / allele
8. Allows for changing environment / different environment / example described

max 5

[11]