Q1.
(a) CFTR is a protein that is found in cell membranes.
This protein is responsible for transporting sodium ions across cell membranes using active transport.
(i) Describe the process of active transport.

(2)

.....

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(ii) In some people a DNA mutation causes the production of a faulty CFTR protein. This results in cystic fibrosis. Explain how an individual can inherit cystic fibrosis from their parents.

(2)

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(iii) The faulty CFTR protein is unable to bind to the endoplasmic reticulum in the cell following protein synthesis. Suggest how this might affect the CFTR protein.

(2)

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(iv) The CFTR protein is made up of 1408 amino acids. Calculate the number of nucleotides found in one strand of the CFTR gene.

(2)

number of nucleotides = ...

(v) Describe the structure of a nucleotide found in a DNA molecule. **(3)**

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(b) There are 20 different amino acids that can be joined to form a polypeptide chain. The table gives some base sequences that code for five of these amino acids.

Code	Name of amino acid
AAT or AAC	asparagine
TAT or TAC	tyrosine
TTT or TTC	phenylalanine
CGT or CGG	arginine
CAT or CAC	histidine

Diagram 1 shows part of the gene that codes for a CFTR protein that functions normally.

Diagram 2 shows the same part of the gene with a mutation that causes cystic fibrosis.

AATATCATCTTTGGTGTTTCCTATGAT

Diagram 1

AATATCATCGGTGTTTCCTATGAT

Diagram 2

Describe the changes that occur in the gene and the protein that cause cystic fibrosis.

(3)

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(Total for question = 14 marks)

Q2.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(a) Bacteria can cause disease in humans.

The diagram shows how one type of white blood cell helps to defend the body against disease.

(i) Complete the diagram by drawing the shape of the white blood cell at stage 2.

(1)

(ii) The box lists words associated with bacteria and disease.

acids	enzymes	erythrocytes	lymphocytes	phagocytes	toxins

Use words from the box to complete the sentences.

(2)

White blood cells called ..... engulf bacteria.
These white blood cells contain ..... to digest bacteria.

(iii) One way that white blood cells defend the body from disease is shown in the diagram.

State another way in which white blood cells defend the body against disease. **(1)**

.....
..... (b) The table lists structures found in some cells. Place ticks in boxes to show which structures are found in bacterial cells and which are found in human skin cells. One row has been completed for you.

(3)

Structures	Bacterial cell	Human skin cell
nucleus		
DNA		
cytoplasm	✓	✓
cell wall		

(c) Viruses can also cause diseases in humans.

Many viruses contain RNA as their genetic material.

Which statement describes the structure of RNA?

(1)

☒ **A** a double-stranded helix containing the bases ATGC

☒ **B** a double-stranded helix containing the bases AUGC

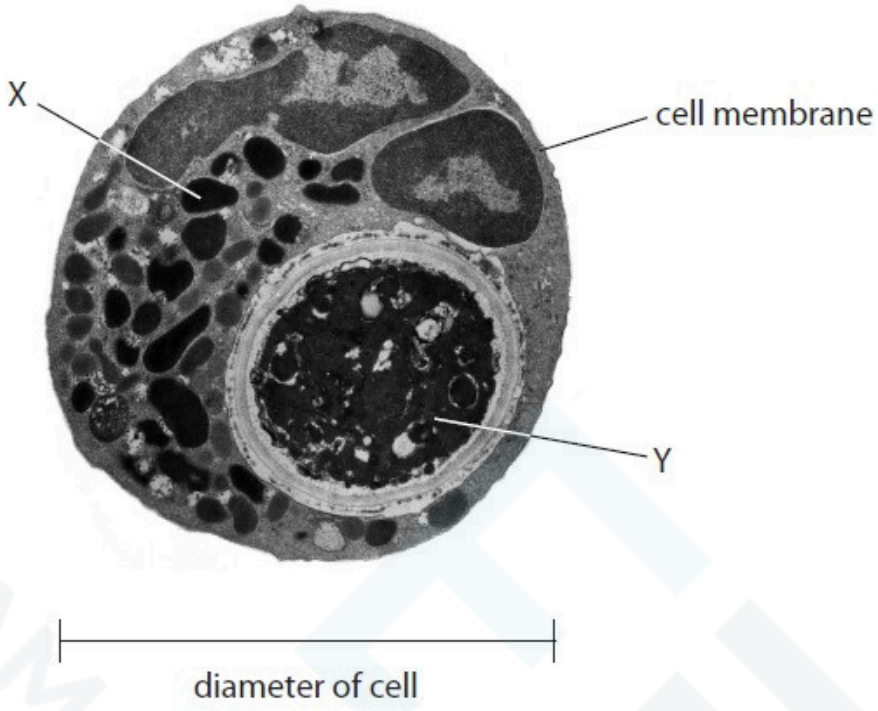
☒ **C** a single-stranded helix containing the bases ATGC

☒ **D** a single-stranded helix containing the bases AUGC

(Total for question = 8 marks)

Q3.

(a) The image is an electron micrograph of a human body cell.



(Source: © Science History Images/Alamy)

(i) The table gives information about parts of the human body cell.

Complete the table by giving the missing information.

(2)

Part	Name of part	Function
X		release energy from glucose
Y	nucleus	

(ii) Electron microscopes and light microscopes can both be used to view body cells.

Which of these is an advantage of using an electron microscope?

(1)

☒ **A** more cell structures can be seen with greater resolution

☒ **B** more cell structures can be seen with less resolution

☒ **C** fewer cell structures can be seen with greater resolution

☒ **D** fewer cell structures can be seen with less resolution

(iii) The actual diameter of this human body cell before magnification is 0.05 mm.

Use information from the image to calculate the magnification of the cell.

(3)

magnification = ...

(b) Body cells produce carbon dioxide.

Describe how carbon dioxide passes from a body cell into the blood.

(2)

.....

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.....

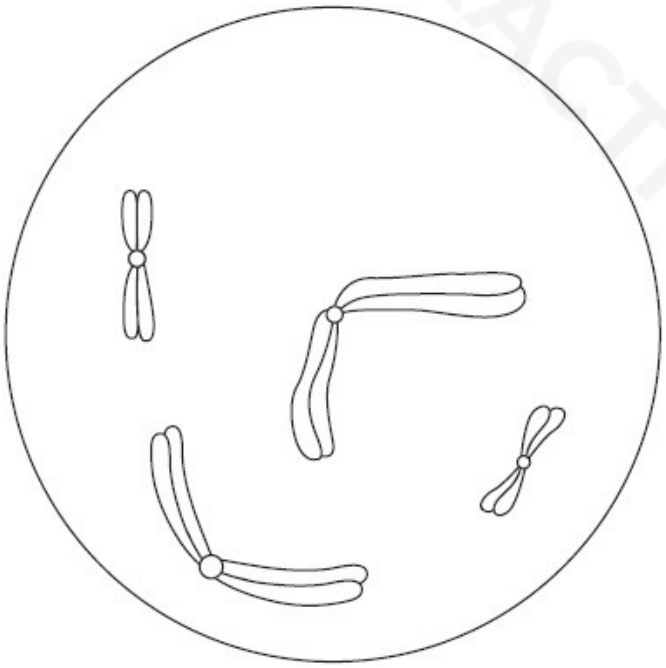
.....

(Total for question = 8 marks)

Q4.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows a cell in the early stages of mitosis.



(a) (i) Which molecule is found in the chromosomes?

(1)

☒ **A** DNA

☒ **B** glucose

☒ **C** glycogen

☒ **D** mRNA

(ii) Draw a circle around two homologous chromosomes on the diagram. **(1)**

(iii) State how the diagram shows that this is not a human cell.

(1)

.....

.....

(b) Describe what happens to the chromosomes during the four stages of mitosis.

(5)

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(Total for question = 8 marks)

Q5.

(a) Two types of nucleic acid are found in cells. These are DNA and RNA.

Describe **three** differences between DNA and RNA.

(3)

1 .....
..... 2
.....
..... 3
.....
.....

(b) The symbols shown can be used to represent the components of nucleotides that join together to make nucleic acid.

Draw a section of RNA consisting of two nucleotides using the symbols given.

(c) A student investigates DNA taken from a human cheek cell. The student finds that 37% of the nucleotides contain adenine. **(3)**

(i) Calculate the percentage of nucleotides in the sample that contain guanine.
Show your working.

(3)

percentage containing guanine = ... %

(ii) The student repeats the investigation twice using a muscle cell and then a red blood cell.

Explain the results that the student should expect for each investigation. **(5)**

muscle cell
.....
.....
.....
.....

red blood cell
.....
.....
.....
.....

(d) The DNA of rice plants can be modified to produce Golden Rice. Golden Rice has been modified to have high levels of

(1)

☒ **A** insect resistance

☒ **B** iron

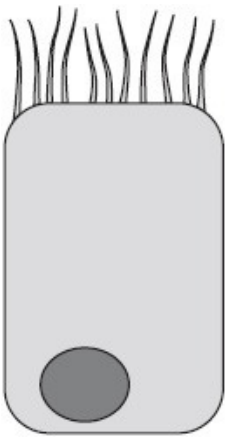
☒ **C** protein

☒ **D** vitamin A

(Total for question = 15 marks)

Q6.

The diagram shows a cell from the human breathing system.



(a) (i) Add these labels to the diagram.

- cilia
- cell membrane
- nucleus

(3)

(ii) Each of the cell structures has a particular function.

The boxes give a list of structures and functions.

Draw **one** straight line from each structure to its function.

(3)

Structure	Function
	holds the genetic code
cilia	site where most chemical reactions occur
cell membrane	controls the entry and exit of substances
nucleus	makes proteins
	moves mucus through the trachea

(b) (i) Cigarette smoking affects the function of the cell shown in the diagram.

Name a substance in cigarette smoke that causes damage to this cell.

(1)

.....

(ii) Describe how cigarette smoking affects the cell shown in the diagram.

(2)

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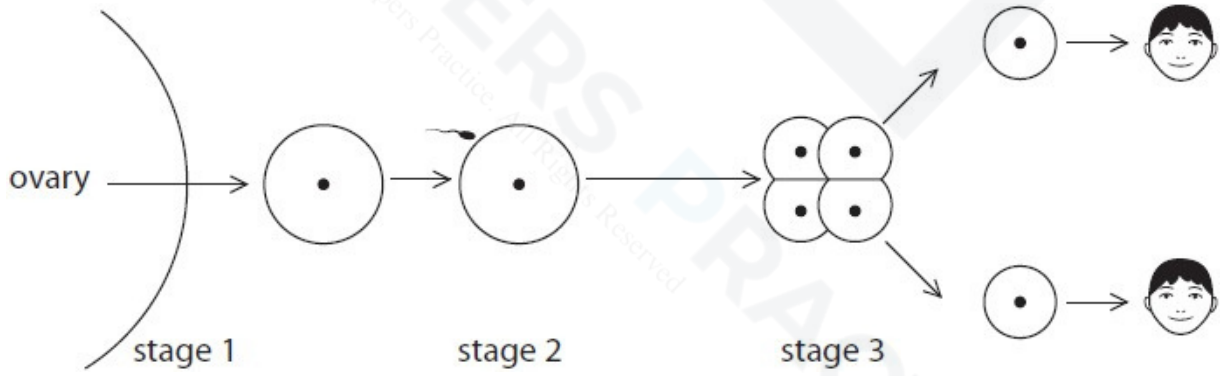
(Total for question = 9 marks)

Q7.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(a) The diagram shows how genetically identical twins are produced.



(i) Name the process that occurs at stage 1.

(1)

.....

(ii) Name the process that occurs at stage 2.

(1)

.....

(iii) Use information from the diagram to explain how genetically identical twins are formed.

(2)

.....

.....

.....

.....

(b) (i) In-vitro fertilisation (IVF) increases the chance of producing twins. Which hormones are given to a female at the start of IVF treatment?

(1)

☒ **A** FSH and LH

☒ **B** LH and oestrogen

☒ **C** oestrogen and progesterone

☒ **D** progesterone and FSH

(ii) Describe the procedures in IVF after hormone treatment.

(4)

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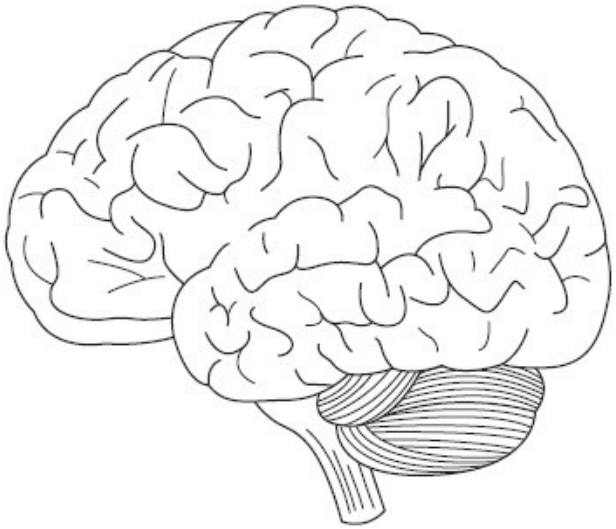
(Total for question = 9 marks)

Q8.

(a) The diagram shows a human brain.



Add lines labelled X, Y and Z to the diagram to show the areas of the brain that control these functions.

(3)

X voluntary actions
Y balance
Z breathing rate

(b) Parkinson's disease affects the cells in the brain that help to control body movement. The affected cells are unable to communicate effectively with neurones that cause muscles to contract.

(i) Name the type of neurone that causes muscles to contract.

(1)

.....

(ii) Give one difference between neurones that cause muscles to contract and

neurones that transmit nerve impulses from receptor organs.

(1)

.....

.....

(iii) Explain how one neurone communicates with another neurone.

(3)

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(c) Recent scientific research into the treatment of Parkinson's disease has involved the use of stem cells. Explain how stem cells could be used to reduce the symptoms of Parkinson's disease.

(3)

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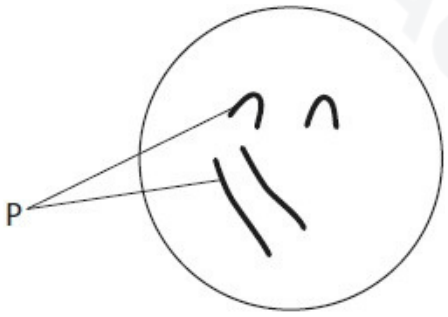
(Total for question = 11 marks)

Q9.

(a) The diagram shows the nucleus of a cell.



(i) Name the structures labelled P.

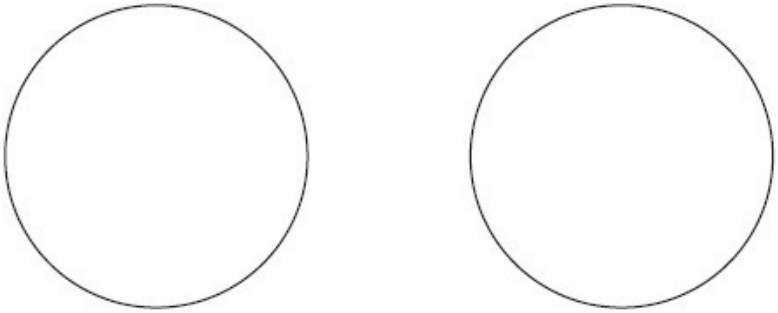
(1)

.....

(ii) The cell divides by mitosis and two nuclei are produced.

Draw the appearance of the two nuclei.

(2)



(b) Before mitosis can occur, the DNA of the cell must replicate.

The table lists stages of DNA replication.

Write the numbers 1, 2, 3 and 4 in the boxes to show these stages in the correct order.

(1)

Stage	Number
complementary bases pair up	
DNA double helix unwinds	
strands separate	
two DNA helices form	

(c) The DNA of the nucleus is analysed.

The table shows the results.

Base	X	adenine	Y	Z
Pecentage base in DNA (%)	30	20	30	20

(i) Identify base Z.

(1)

.....

(ii) Give the possible identities of base X.

(1)

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(d) Meiosis is another type of cell division.

Explain why meiosis is important in humans.

(4)

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(Total for question = 10 marks)

Q10.

(a) A student uses a light microscope to observe some cells taken from the inside of her cheek.

The table lists steps in the student's method.

The steps are not in the correct order.

(i) Place a number in each box to show the correct order of steps that the student should follow.

The first and last steps have been done for you.

(2)

	Steps
	select a suitable objective lens
5	adjust focusing wheel to obtain a clear image
1	remove cells from the inside of the cheek
	place microscope slide onto the microscope stage
	smear the cell sample onto a microscope slide

(ii) The objective lens magnifies cells on the slide making them look bigger.

State an advantage of magnifying the cells.

(1)

.....
..... (iii)
Suggest why the student was unable to see the cell sample even though the microscope was at the correct

magnification and focused.

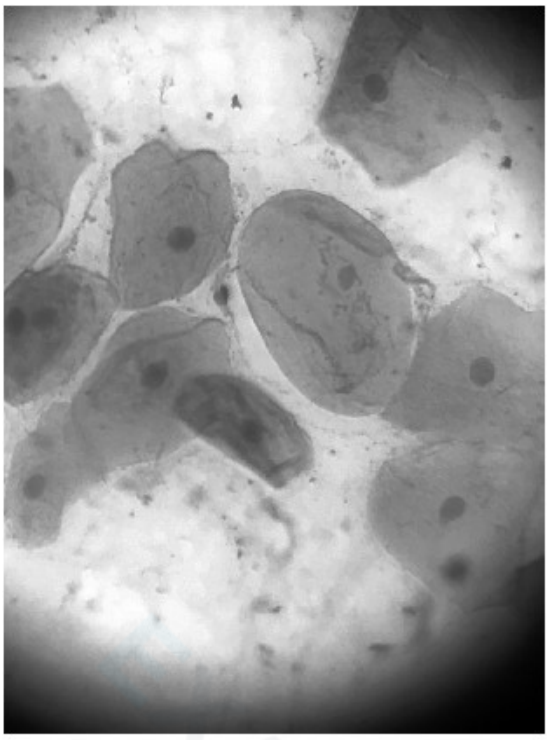
(1)

.....
..... (iv)
Give two ways that the student could avoid health hazards when working with living cells.

(2)

1 .....
..... 2
.....
..... (b) The photograph shows an image of a cheek cell seen under a light microscope using a 10× eyepiece lens and

a 40× objective lens.



© Esmiles/Shutterstock

(i) Calculate the total magnification used to view the cheek cell.

(1)

total magnification = ...

(ii) The actual diameter of the cheek cell shown in the photograph is 0.018 mm.
Convert the diameter of the cheek cell into micrometre (µm).
[1 µm = 10–6 m]

(2)

diameter = ... µm

(Total for question = 9 marks)

Q11.

P. vivax is one of several parasites that can cause malaria.

(a) Explain how P. vivax is transmitted from one person to another.

(3)

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(b) The table shows the total number of deaths from malaria and the number of deaths caused by P. vivax. It shows the data for five different regions of the world in 2015.

Region of the world	Q	R	S	T	U
Total number of deaths from malaria	191 000	800	3800	14 400	1200
Number of deaths caused by *P. vivax*	1000	500	1400	4900	700

(i) Compare the number of deaths caused by P. vivax with the total number of deaths from malaria in regions Q and R.
Include calculations to support your answer.

(3)

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.....

(ii) Suggest one reason why the number of deaths from malaria varies across the different regions.

(1)

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(c) Scientists are developing a vaccine to protect against malaria. Explain how vaccinating individual people will help to protect a whole population from malaria.

(3)

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(d) P. vivax reproduces by asexual reproduction and sexual reproduction. Explain why it is an advantage for a species to reproduce by both methods.

(3)

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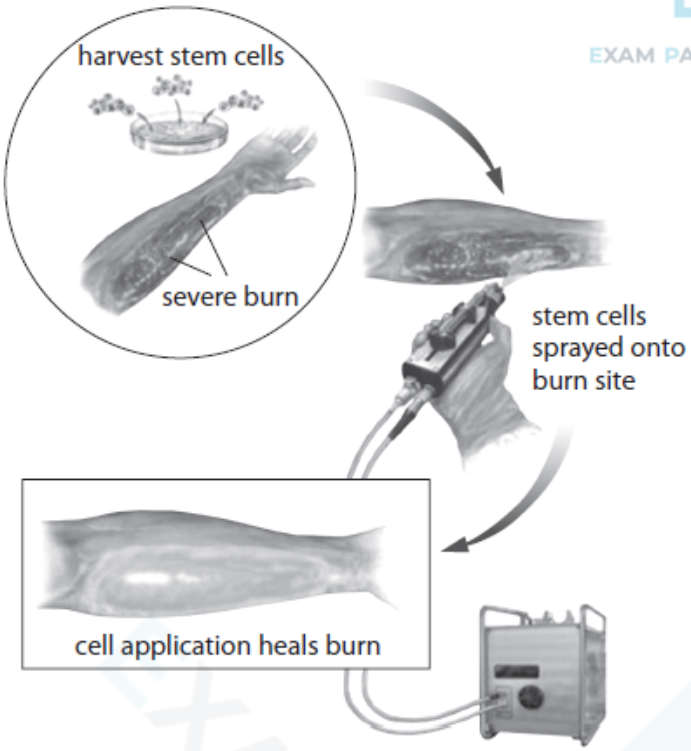
(Total for question = 13 marks)

Q12.

The diagram shows a new approach to treating severe burns.



(a) The stem cells used in this treatment are extracted from the patient's skin.

Name the type of stem cells that are used to treat the burn.

(1)

.....

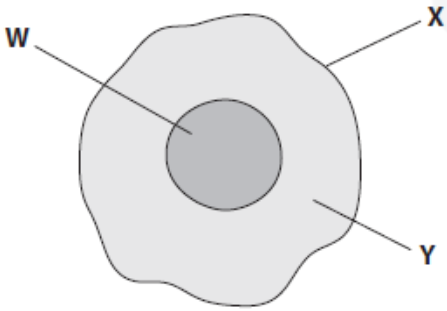
(b) Give **one** reason why it is important that stem cells are taken from the patient's own skin and not the skin of a donor.

(1)

.....

.....

(c) The diagram shows a stem cell taken from the skin of the patient.



Name parts **W**, **X** and **Y**.

(3)

W .....

X .....

Y .....

(d) The stem cells used to treat the burn eventually form new skin tissue that heals the wound. Describe how these stem cells form new skin tissue.

(3)

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(e) Describe advantages of using this method of treating severe burns instead of growing the patient's skin cells in a petri dish in a laboratory.

(3)

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(f) Give reasons why some people might object to the use of certain types of stem cell in medical research.

(2)

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.....

(Total for question = 13 marks)

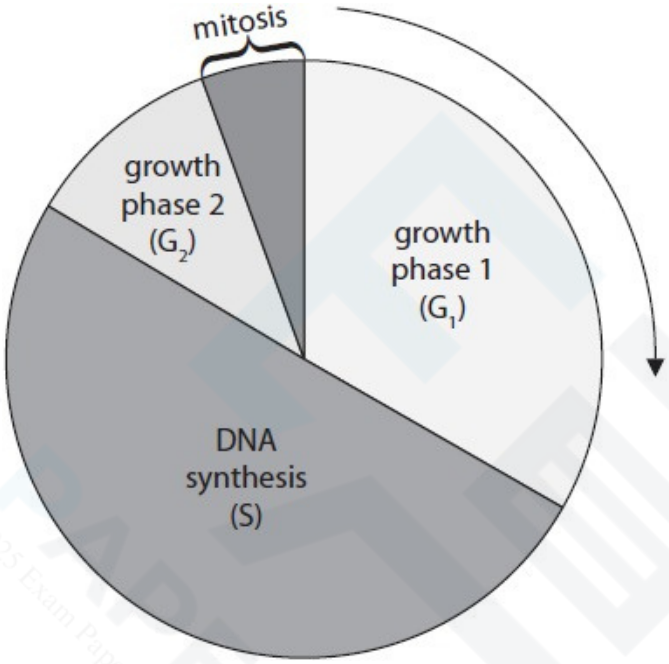
Q13.

(a) Cells in the body go through several cell cycles in their lifetime.

Each cell cycle is divided into different stages.

Different events take place in the cell during each stage.

The diagram shows one cell cycle of a body cell.



(i) One cell cycle takes 24 hours to complete.

The total time spent in G1 and G2 is ten hours.

Calculate the time spent in mitosis.

(2)

time = ... hours

(ii) Each of the phases of the cell cycle prepare the cell for mitosis.

Suggest the events that take place in the growth phases of the cell cycle.

(2)

.....

.....

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.....

(iii) The cell cycle completes by producing two new body cells.

Describe the genetic features of the two cells produced by mitosis. **(2)**

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(iv) The table lists some of the stages of mitosis. Complete the table by giving details of the event that takes place in each stage.

(3)

Stage	Events
metaphase	
anaphase	
telophase	

(b) Describe the role of DNA polymerase in the synthesis of new DNA molecules.

(2)

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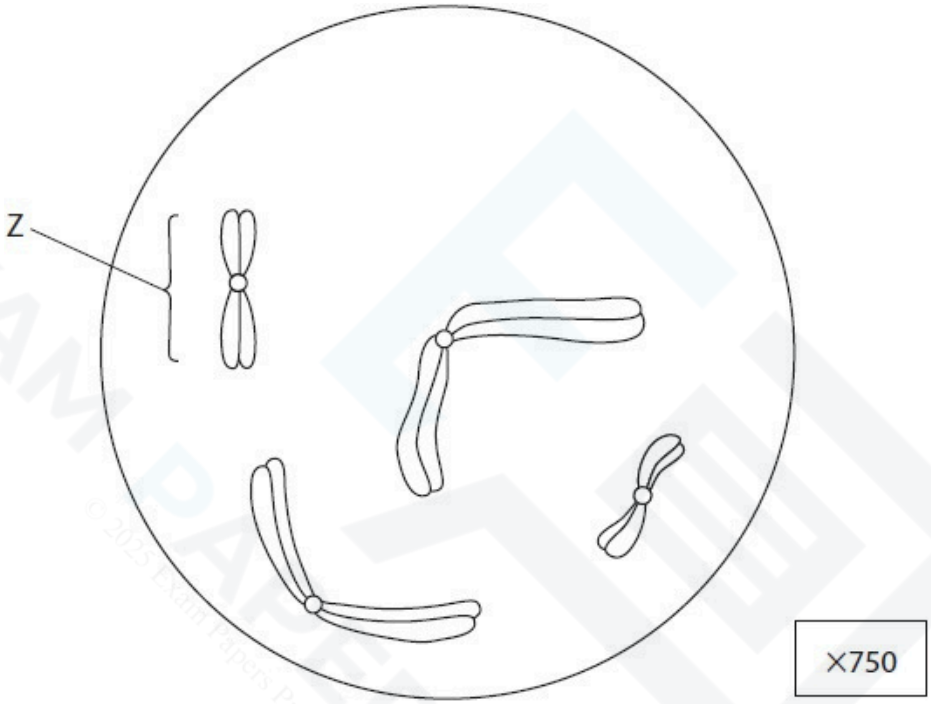
.....

(Total for question = 11 marks)

Q14.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows a cell in early stages of mitosis.



(a) The four stages of mitosis are:

- anaphase
- metaphase
- prophase
- telophase

(i) Give these stages in the correct order.

(2)

.....

.....

(ii) Draw a diagram of the cell as it would appear at metaphase.

(3)

(b) (i) Which one of these molecules would be found in structure Z?

(1)

☒ **A** DNA

☒ **B** mRNA

☒ **C** tRNA

☒ **D** ribose sugar

(ii) Calculate the length of structure Z in micrometres.

[1 micrometre = 1 × 10–6 m]

(3)

length of structure Z = ... micrometres

(c) Describe what is produced when a cell undergoes mitosis.

(2)

.....

.....

.....

.....

(Total for question = 11 marks)

Q15.

The diagram shows a sperm.

(a) (i) Describe the function of a sperm.

(2)

.....

.....

.....

.....

(ii) State two other structures, apart from mitochondria, that can be seen in the sperm if it is viewed using an electron microscope.

(2)

1 .....

2 .....

(b) Explain why there are a large number of mitochondria found in a sperm.

(3)

.....

.....

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.....

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.....

(c) The actual length of the sperm between X and Y on the diagram is 3 µm. Calculate the magnification of the sperm shown in the diagram. [1000 µm = 1 mm]

(4)

magnification = × .....

(Total for question = 11 marks)

Q16.

Skin and hair contain a pigment called melanin.

(a) (i) Describe the function of the pigment melanin in the skin.

(2)

.....

.....

.....

.....

(ii) State one other place, apart from hair and skin, where pigment is found in the body.

(1)

.....

(b) A condition known as white forelock is caused by a dominant allele H.

People with this condition have a white patch in their hair.

The condition causes a deficiency of the skin pigment melanin.
A woman who is heterozygous for white forelock produces children with a father who does not have the condition.
(i) Draw a genetic diagram to show the possible offspring from this cross.
The condition is not sex-linked.

(4)

(ii) Calculate the probability that these parents will produce a boy with the condition.

(3)

probability = ...

(c) White forelock is a result of a mutation in a molecule of DNA.

Describe how this mutation causes the white forelock phenotype.

(4)

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(Total for question = 14 marks)