Cell biology Revision materials

Content will be tested on Biology Paper 1

Checklist

Keypoints:	☺	☹
Cells & microscopy		
Label the major features of animal, plant and bacterial cells		
Describe differences between animal and plant cells		
Describe the functions of all the parts – e.g nucleus, ribosomes etc		
Use Magnification=Image/Actual to calculate size of cells or magnification		
Use prefixes centi, milli, micro and nano and change numbers between these units		
Describe what is meant by 'differentiation' or specialisation		
Relate a cells specialised features to its function		
Describe how microscopy has developed over time and give advantages of the electron microscope over the light microscope		
Describe the stages in the cell cycle		
Recognise & define mitosis and give examples of it may occur		
Define the term 'stem cells'		
Name sources of stem cells and describe their use – adult, embryo and meristem		
Evaluate the use of stem cells in medical research and treatments		
Transport		
Describe diffusion and the factors that can affect the rate		
Describe how organs and surfaces are specialised for effective diffusion – lungs, gills in fish, roots and leaves in plants		
Define the term osmosis and give examples of where it happens		
Define the term 'Active Transport' and explain why it is necessary		

Sections

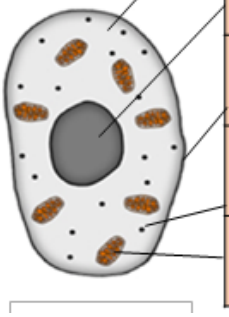
4.1.1.1 Eukaryotes and prokaryotes

- Eukaryotic cells have their genetic material enclosed in a nucleus.
- Prokaryotic cells are much smaller in comparison and their genetic material is not enclosed in a nucleus. It is a single DNA loop and there may be one or more small rings of DNA called plasmids.

You must know the function of each organelle, identify differences and similaries between the types of cells.

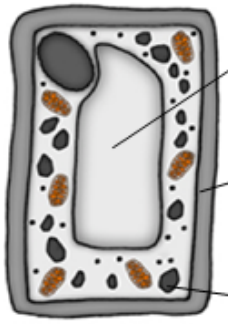
Eukaryotes include all plants and animal organism.

- A typical animals cell:



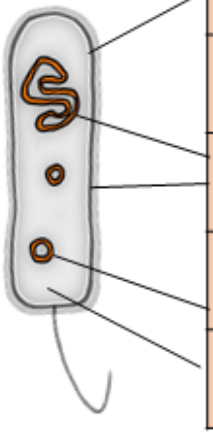
cytoplasm	*site of chemical reactions in the cell*	gel like substance containing enzymes to catalyse the reactions
nucleus	*contains **genetic material***	controls the activities of the cell and codes fro proteins
cell membrane	*semi permeable*	controls the movement of substances in and out of the cell
ribosome	*site of protein synthesis*	mRNA is translated to an amino acid chain
mitochondrion	*site of respiration*	where energy is released for the cell to function

A typical plant cell: Contains all the parts of animal cells plus extras.



permanent vacuole	*contains cell sap*	keeps cell turgid, contains sugars and salts in solution
cell wall	*made of cellulose*	supports and strengthens the cell
chloroplast	*site of photosynthesis*	contains chlorophyll, absorbs light energy

Prokaryotes are often recognised as 'bacteria'. Bacteria cells are much smaller than plants and animals.



cell membrane	*site of chemical reactions in the cell*	gel like substance containing enzymes to catalyse the reactions
bacterial DNA	*not in nucleus floats in the cytoplasm*	controls the function of the cell
cell wall	***NOT** made of cellulose*	supports and strengthens the cell
plasmid	*small rings of DNA*	contain additional genes
cytoplasm	*semi permeable*	controls the movement of substances in and out of the cell

Exam practice 1:

Q1. Living organisms are made of cells.

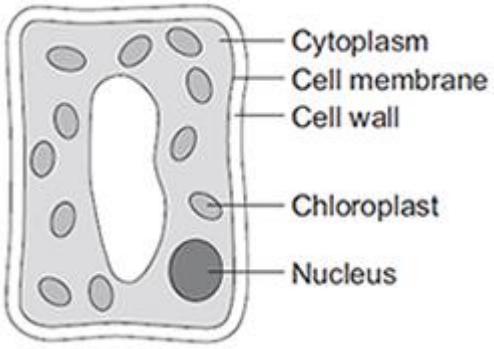
(a) Animal and plant cells have several parts. Each part has a different function.

Draw **one** line from each cell part to the correct function of that part.

Cell part	Function
Cell membrane	Where most energy is released in respiration
Mitochondria	Controls the movement of substances into and out of the cell
Nucleus	Controls the activities of the cell
	Where proteins are made

(3)

(b) The diagram below shows a cell from a plant leaf.



Which **two** parts in the diagram above are **not** found in an animal cell?

1. _____

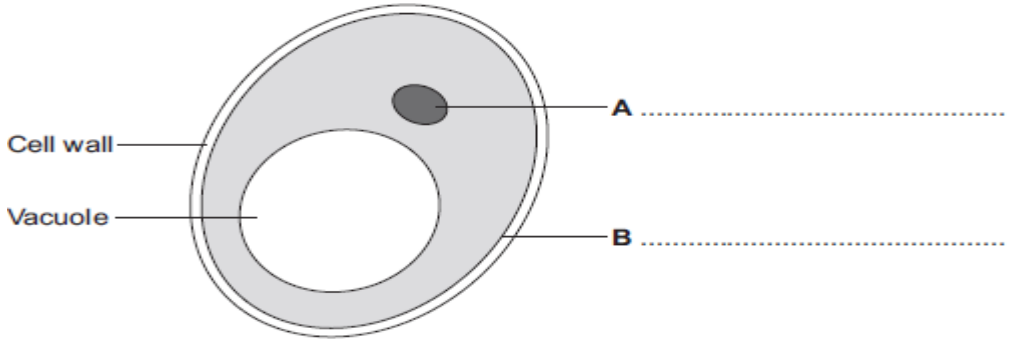
2. _____

(2)

(Total 5 marks)

Q2. Human cells and yeast cells have some parts that are the same.

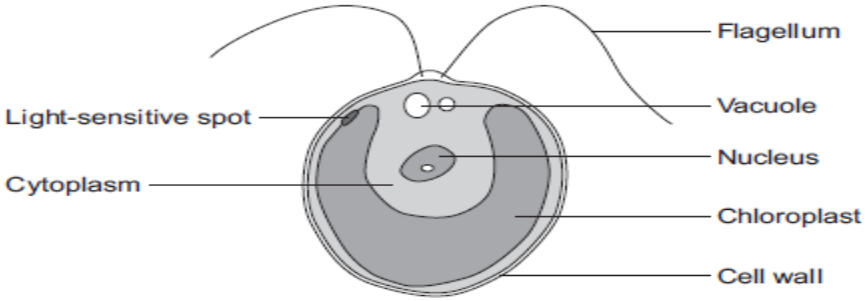
(a) The diagram shows a yeast cell.



Parts **A** and **B** are found in human cells and in yeast cells. On the diagram, label parts **A** and **B**.

(2)

Q3. The diagram below shows a single-celled alga which lives in fresh water.



(a) Which part of the cell labelled above:

(i) traps light for photosynthesis

_____

(1)

(ii) is made of cellulose?

_____

(1)

Q4. Some infections are caused by bacteria.

(a) The genetic material is arranged differently in the cells of bacteria compared with animal and plant cells.

Describe **two** differences.

_____

_____

_____

_____

(2)

4.1.1.4 Growth and differentiation

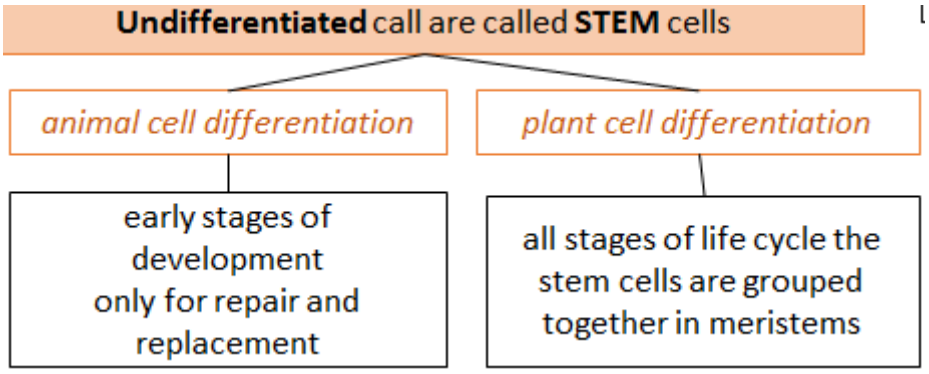
Differentiation is a process by which cells **become specialised and adap**ted to carry out **a particular function**.

As an organism develops, cells differentiate to form different types of cells.
- Most types of animal cell **differentiate at an early stage**.
- Many types of plant cells retain the ability to differentiate **throughout life**.

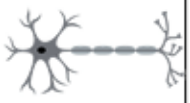
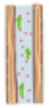
In mature animals, cell division is mainly restricted to **repair** and **replacement**. As a cell differentiates it acquires different **sub-cellular structures** to enable it to carry out a certain function. It has become a **specialised cell**.

You should be able to explain the importance of cell differentiation:

All cells in an early animal or plant embryo are unspecialised (stem cells).
Differentiation fulfils organisms' requirements for different cells to carry out different roles (e.g., muscle cells, sperm cells, gut lining cells).



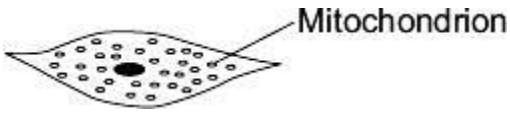
Examples of specialised cells:

specialised animal cells	**nerve**		*carry electrical signals*	long branched connections and insulating sheath
	sperm		*fertilise an egg*	streamlined with a long tail acrosome containing enzymes large number of mitochondria
	muscle		*contract to allow movement*	contains a large number of mitochondria long
specialised plant cells	**root hair**		*absorb water and minerals from soil*	hair like projections to increase the surface area
	xylem		*carry water and minerals*	TRANSPIRATION - dead cells cell walls toughened by lignin flows in one direction
	phloem		*carry glucose*	TRANSLOCATION - living cells cells have end plates with holes flows in both directions

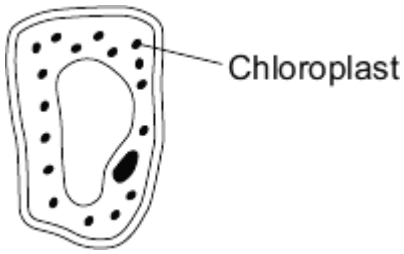
Exam practice 2:

Q1. The diagrams show four cells, **A**, **B**, **C** and **D**.

A

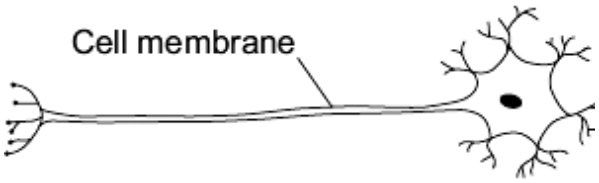


B



C

D



Use letters **A**, **B**, **C** or **D** to answer these questions.

(a) Which cell can photosynthesise?

(1)

(b) Which cell is adapted for receiving and sending information?

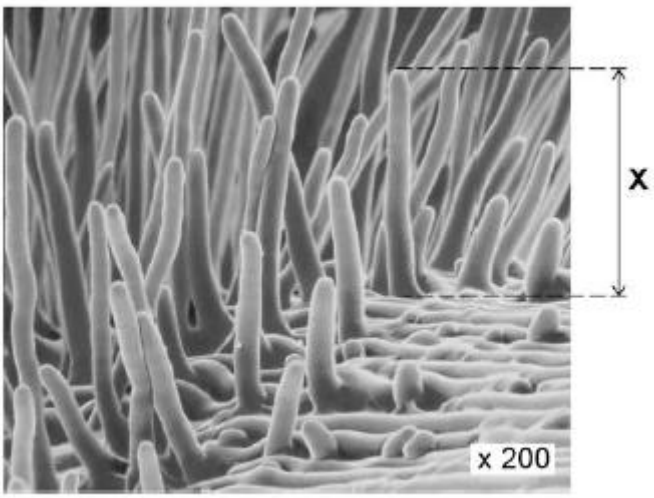
(1)

(c) Which cell is adapted to respire quickly?

(1)

(Total 3 marks)

Q2. The image below shows part of a root from a cress plant.



(c) Root hair cells take up water from the soil.

Explain **one** way in which the root hair cell is adapted to this function.

_____

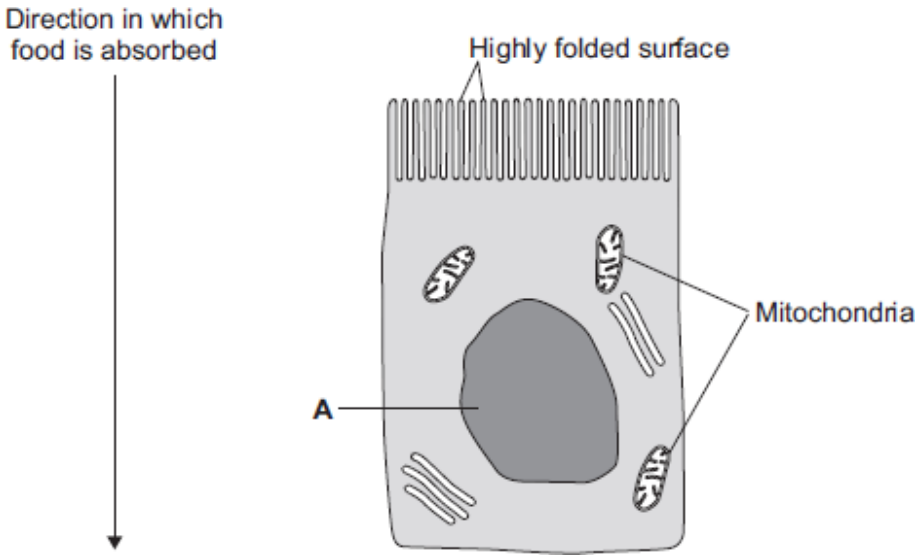
_____

_____

_____

(2)

Q3. The image below shows an epithelial cell from the lining of the small intestine.



(a) (i) In the image above, the part of the cell labelled **A** contains chromosomes.

What is the name of part **A**?

_____

(1)

(ii) How are most soluble food molecules absorbed into the epithelial cells of the small intestine?

Draw a ring around the correct answer.

diffusion **osmosis** **respiration**

(1)

(b) Suggest how the highly folded cell surface helps the epithelial cell to absorb soluble food.

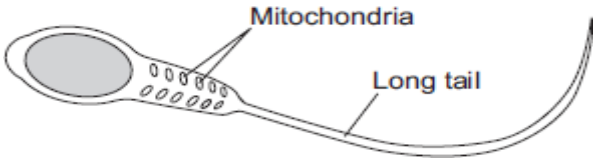
_____

_____

(1)

Q5. (b) Cells can be specialised for a particular job.

The diagram shows the structure of a human sperm cell.



Describe how the long tail and the mitochondria help the sperm to do its job.

Long tail _____

_____

Mitochondria _____

_____

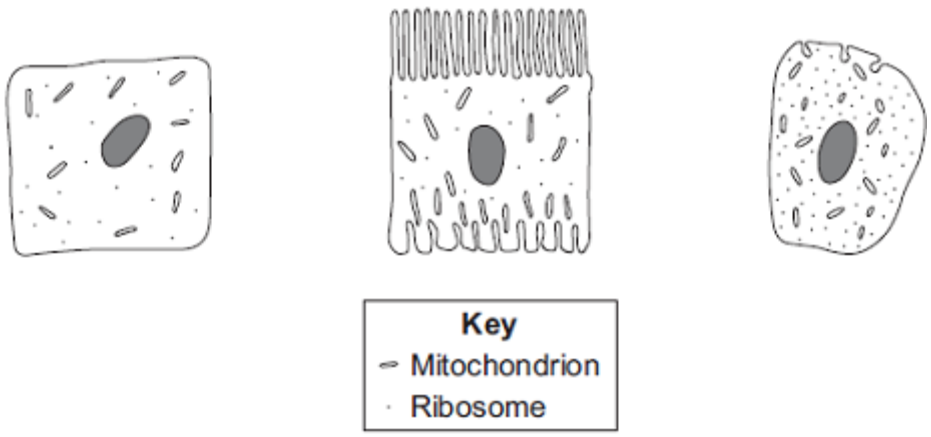
_____

(4)

(Total 9 marks)

Q7. Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.

A **B** **C**



(b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

_____

(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

_____

_____

_____

_____ **(2)**

4.1.2.3 Stem cells

A stem cell is an **undifferentiated** cell of an organism, they have not become specialised. They are capable of giving rise to **many more cells of the same type**, and from which certain other cells can arise from differentiation.

An egg and sperm cell fuse to form a **zygote**, a single new cell. That cell divides and becomes a hollow ball of cells – the embryo. The inner cells of this ball are the **embryonic stem cells** that can be cloned (mitosis) and made to differentiate into most different types of human cells.

An **adult stem cell** is an undifferentiated cell of an organism that can give rise to many more cells of the same type. Stem cells from **adult bone marrow** can form many types of cells including blood cells.

The stem cells from **plant meristem** tissue can differentiate into any type of plant cell, **throughout the life of the plant.**

Treatment with stem cells may be able to help conditions such as **diabetes and paralysis**.

4.1.2.3 Stem cell dilemmas

Stem cells may be very useful in **treating conditions** where cells are damaged or not working properly, such as **diabetes and paralysis**.
They could be used to **replace the damaged cells.**

In **therapeutic cloning** an embryo is produced with the same genes as the patient. **Stem cells from the embryo** are **not rejected** by the patient's body so they may be used for medical treatment.
The use of stem cells has potential **risks** such as transfer of **viral infection**, and some people have **ethical** or **religious objections.**

Stem cells from **meristems in plants** can be used to produce **clones of plants quickly** and **economically**. This could be used for a number of reasons:
• Rare species can be cloned to protect from extinction.
• Crop plants with special features such as disease resistance can be cloned to produce large numbers of identical plants for farmers.

Task:

1. Explain why embryonic stem cells are useful in medical research. (3)

2. The first embryonic stem cell trials took place in October 2010 to treat a patient. This patient had been left partially paralysed by nerve damage after a spinal injury.

Explain why it is an advantage to use embryonic stem cells to treat spinal injuries.(3)

Exam practice 3:

Q1. (c) Human stem cells can develop into many different types of human cell.

(i) Use the correct answer from the box to complete the sentence.

embryos	**hair**	**nerve cells**

Human stem cells may come from

_____

(1)

(ii) Use the correct answer from the box to complete the sentence.

cystic fibrosis	**paralysis**	**polydactyly**

Human stem cells can be used to treat

_____

(1)

Q3. (c) After a baby is born, stem cells may be collected from the umbilical cord. These can be frozen and stored for possible use in the future.

(i) What are stem cells?

_____

_____

_____

_____

(2)

(ii) Suggest why it is ethically more acceptable to take stem cells from an umbilical cord instead of using stem cells from a 4-day-old embryo produced by In Vitro Fertilisation (IVF).

_____

_____

(1)

(iii) Stem cells taken from a child's umbilical cord could be used to treat a condition later in that child's life.

Give **one** advantage of using the child's own umbilical cord stem cells instead of using stem cells donated from another person.

_____

_____

(1)

(iv) Why would it **not** be possible to treat a genetic disorder in a child using his own umbilical cord stem cells?

_____

_____

(1)

Q4.(b) Stem cells can be taken from human embryos.

In therapeutic cloning, an embryo is produced that has the same genes as the patient.

(i) Name **one** source of human stem cells, other than human embryos.

_____

(1)

(ii) Stem cells from embryos can be transplanted into patients for medical treatment.

Give **one** advantage of using stem cells from embryos, compared with cells from the source you named in part (i).

_____

_____

(1)

Q5. (c) Stem cells from a recently dead embryo can be grown in special solutions.

Some facts about stem cells are given below.

- Stem cells from an embryo can grow into any type of tissue.
- Stem cells may grow out of control, to form cancers.
- Large numbers of stem cells can be grown in the laboratory.
- Stem cells may be used in medical research or to treat some human diseases.
- Patients treated with stem cells need to take drugs for the rest of their life to prevent rejection.
- Collecting and growing stem cells is expensive.

Use **only** the information above to answer these questions.

(i) Give **two** advantages of using stem cells.

1. _____

_____

2. _____

_____

(2)

(ii) Give **two** disadvantages of using stem cells.

1. _____

_____

2. _____

_____

(2)

Q6 (e) As a plant grows, new root hair cells are formed from unspecialised cells.

How does an unspecialised cell become a new root hair cell?

Tick **one** box.

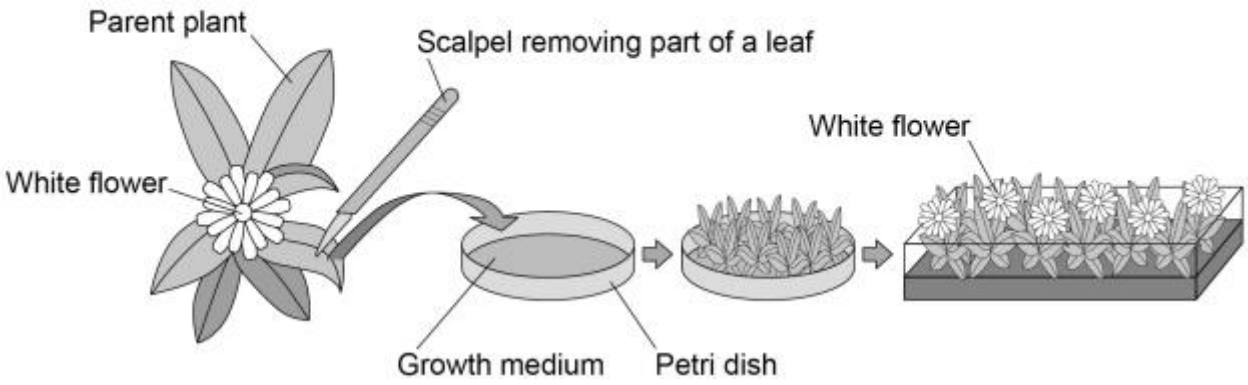
- Differentiation ☐
- Metabolism ☐
- Transpiration ☐
- Transport ☐

(1)

Scientists can clone plants using tissue culture.

Figure 2 shows the process of tissue culture.

Figure 2



(f) Why might scientists want to clone plants?

Tick **one** box.

- To create new species of plants. ☐
- To introduce variation into plants. ☐
- To protect endangered plants from extinction. ☐
- To reduce disease resistance in plants. ☐

(1)

(g) What is the advantage of cloning plants using tissue culture?

Tick **one** box.

No special equipment is needed. ☐

Plants can be produced quickly. ☐

The flowers are all different colours. ☐

The offspring are all genetically different. ☐

(1)

Higher Tier only:

Read the information about stem cells.

> Stem cells are used to treat some human diseases.
>
> Stem cells can be collected from early embryos. These stem cells have not begun to differentiate, so they could be used to produce any kind of cell, tissue or organ. The use of embryonic stem cells to treat human diseases is new and, for some diseases, trials on patients are happening now.
>
> Stem cells can also be collected from adult bone marrow. The operation is simple but may be painful. Stem cells in bone marrow mainly differentiate to form blood cells. These stem cells have been used successfully for many years to treat some kinds of blood disease. Recently there have been trials of other types of stem cell from bone marrow. These stem cells are used to treat diseases such as heart disease.

Evaluate the use of stem cells from embryos or from adult bone marrow for treating human diseases.

You should give a conclusion to your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

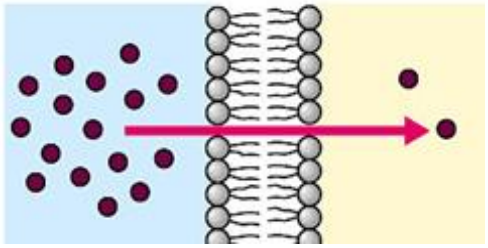
(Total 5 marks)

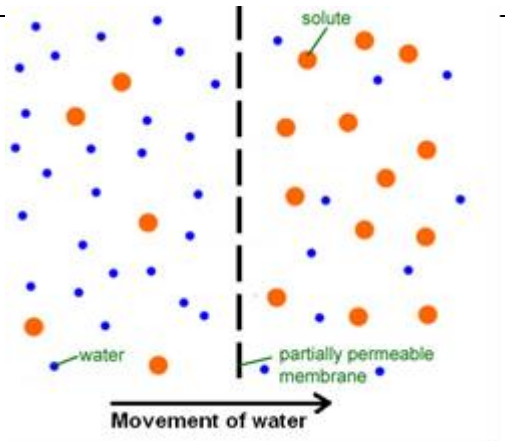
4.1.3 Transport in cells.

There are 3 methods you need to know about:

You will need to be able to

- Describe how substances are transported into and out of cells by diffusion, osmosis and active transport.
- Explain the differences between the three processes.

Diffusion	• Substances e.g. Oxygen, carbon dioxide move into and out of cells across the cell membranes. • Diffusion is the spreading out of the particles of any substance in solution, or particles of a gas, resulting in a **net movement** from an area of higher concentration to an area of lower concentration. • **No energy** is required (**Passive**)	
	Factors that affect the rate of diffusion are: • The difference in concentrations (concentration gradient) • The temperature • The surface area of the membrane	
Osmosis	• **Water** moves across cell membranes via osmosis. • Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a **partially permeable membrane**. • **No energy** is required (**Passive**)	*Note the theory of osmosis is linked to required practical 2 in which you need to demonstrate:* • Use of percentages • Calculate percentage gain and losses of plant mass. • Interpret graphs • Plot graphs



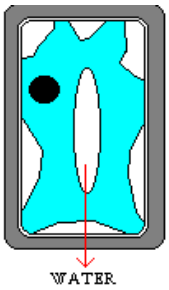
AO3 Application of osmosis:

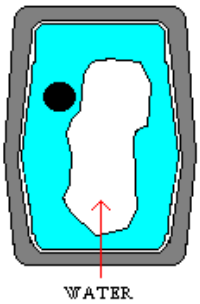
Osmosis in animal cells:

If animal cells are placed in a solution that has a higher solute concentration than the cytoplasm, then water will leave the cell by osmosis, until it shrinks and dies. If animal cells are placed in a solution that has a lower solute concentration than the cytoplasm, then water will enter the cell by osmosis until it bursts. **This is why it is vital that we maintain the concentration of our body fluids at an equal solute concentration to our cells cytoplasm.**

Osmosis in plant cells:

If plant cells are placed in a solution that has a higher solute concentration than the cytoplasm, then water will leave the cell by osmosis, and the cell membrane separates from the cell wall. This will cause a plant to wilt.





If plant cells are placed in a solution that has a lower solute concentration than the cytoplasm, then water will enter the cell by osmosis until it is fully turgid, and the cell wall prevents any more water entering**. This is important in enabling plants to remain upright.**

Sports Drinks: Most soft drinks contain water, sugar and ions.

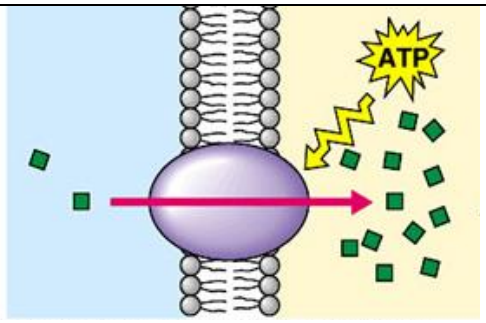
- Sports drinks contain sugars to replace the sugar used in energy release during the activity.
- They also contain water and ions to replace the water and ions lost during sweating.
- If water and ions are not replaced, the ion / water balance of the body is disturbed and the cells do not work as efficiently.

Energy drinks:

- Contain the same concentration of ions as the body fluids, and a high concentration of glucose. This enables rapid uptake of glucose.

Rehydrating drinks:

- These contain lower concentration of ions than in body fluids.
- This enables rapid uptake of water by **osmosis.**
- These drinks enable people to become quickly rehydrated after exercise.

Active transport	• Substance move from a more dilute solution to a more concentrated solution, **against a concentration gradient.** • This requires **energy** from **respiration**. • Substances are 'carried' across the cell membrane via protein carriers. **Key examples include:** ▪ Absorption of mineral ions by the root hair cells in roots in plants. • Absorption of glucose by epithelial cells in the small intestine	 A carrier protein transport the substance across the cell membrane. Energy (ATP) is used to change the shape of the protein carrier. Energy is released from respiration.

Transport of substance in multicellular organisms.

In multicellular organisms, surfaces and organ systems are specialised for exchanging materials. The effectiveness of the exchange surface is increased by:

- Having a large surface area
- A membrane that is thin, to provide a short diffusion path
- (in animals) having an efficient blood supply
- (in animals, for gaseous exchange) being ventilated.

You should be able to apply these principles to how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants are adapted for exchanging materials.

Exam questions and reinforcement will be covered in the 'Cellular organisation revision pack'

Q1. Earthworms are small animals that live in soil. Earthworms have no specialised gas exchange system and absorb oxygen through their skin.

(a) What is the name of the process in which oxygen enters the skin cells?

Tick **one** box.

Active transport ☐

Diffusion ☐

Osmosis ☐

Respiration ☐

(1)

The table below shows information about four skin cells of an earthworm.

Cell	Percentage of oxygen	
	Outside cell	Inside cell
A	9	8
B	12	8
C	12	10
D	8	12

(b) Which cell has the smallest difference in percentage of oxygen between the outside and the inside of the cell?

Tick **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(c) Which cell will oxygen move **into** the fastest?

Tick **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

Q2. Gases enter and leave the blood by diffusion.

(a) Define the term diffusion.

_____

_____

(1)

(b) Name the main gases that diffuse into and out of the blood **in the lungs**.

Into the blood _____

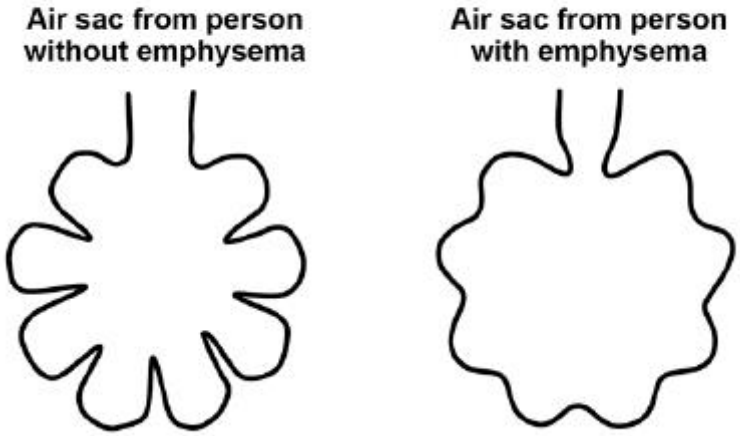
Out of the blood _____

(1)

(c) Smoking can cause emphysema.

Look at **Figure 1** below.

Figure 1



Emphysema causes the walls of the air sacs in the lungs to break down

Explain how this will affect the diffusion of gases into and out of the blood.

_____

_____

_____

_____

(2)

Q3. Substances can move into and out of cells.

(a) (i) How does oxygen move into and out of cells?

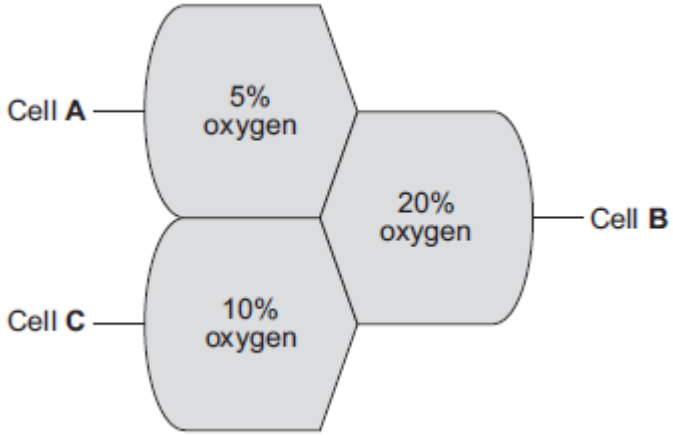
Draw a ring around **one** answer.

diffusion **digestion** **photosynthesis**

(1)

(ii) **Diagram 1** shows the percentage concentration of oxygen in three cells, **A**, **B** and **C**.

Diagram 1



Oxygen can move from cell to cell.

Into which cell, **A**, **B** or **C**, will oxygen move the fastest?

(1)

(b) (i) How does water move into and out of cells?

Draw a ring around **one** answer.

breathing **osmosis** **respiration**

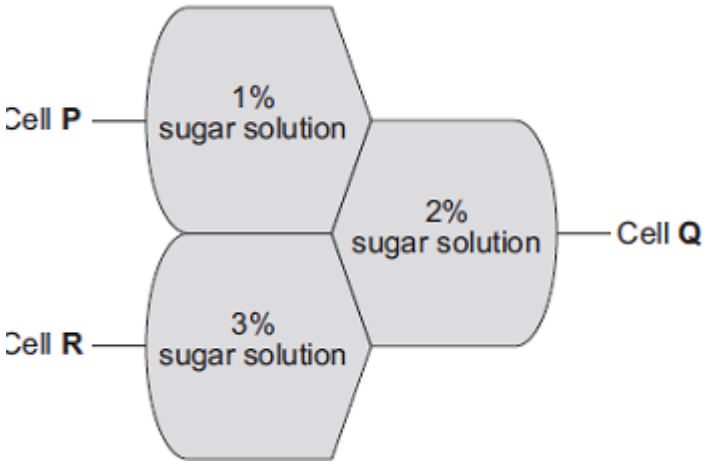
(1)

(ii) Differences in the concentration of sugars in cells cause water to move into or out of cells at different rates.

Diagram 2 shows three different cells, **P**, **Q** and **R**.

The information shows the percentage concentration of sugar solution in cells **P**, **Q** and **R**.

Diagram 2



Water can move from cell to cell.

Into which cell, **P**, **Q** or **R**, will water move the fastest? ☐

(1)

(Total 4 marks)

Q4. Plant roots absorb water from the soil by osmosis.

(a) What is osmosis?

_____

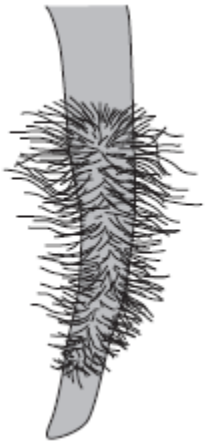
_____

_____

_____

(3)

(b) The image below shows part of a plant root.



The plant root is adapted for absorbing water from the soil.

Use information from the diagram to explain how this plant root is adapted for absorbing water.

_____

_____

_____

_____

(3)

(Total 6 marks)

Q5. Cells, tissues and organs are adapted to take in different substances and get rid of different substances.

The table shows the concentration of four ions outside cells and inside cells.

Ion	**Concentration outside cells in mmol per dm^3**	**Concentration inside cells in mmol per dm^3**
Sodium	140	9
Potassium	7	138
Calcium	2	27
Chloride	118	3

(a) Use information from the table above to complete the following sentences.

Sodium ions will move into cells by the process

of _____ .

Potassium ions will move into cells by the process

of _____ .

(2)

Extended writing questions:

Q6. In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Diffusion is an important process in animals and plants.

The movement of many substances into and out of cells occurs by diffusion.

Describe why diffusion is important to animals and plants.

In your answer you should refer to:

- animals
- plants
- examples of the diffusion of named substances.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

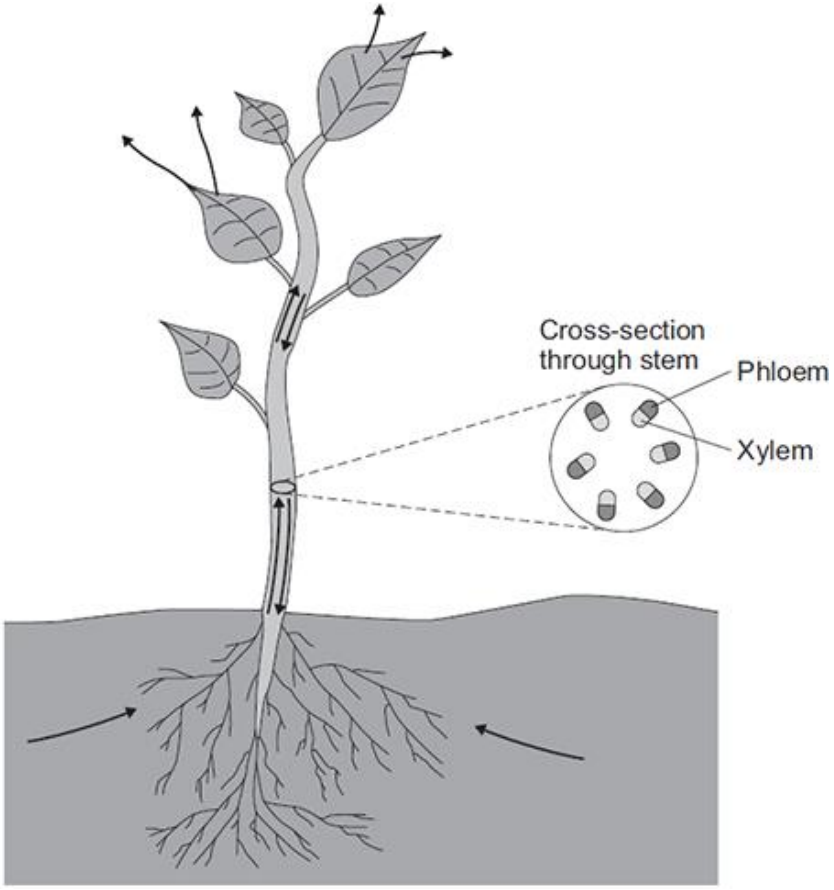
_____

(Total 6 marks)

Q7. In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Plants transport many substances between their leaves and roots.

The diagram below shows the direction of movement of substances through a plant.



Describe how **ions**, **water** and **sugar** are obtained and transported through plants.

In your answer you should refer to materials moving upwards in a plant and to materials moving downwards in a plant.

(Total 6 marks)

Higher tier only

Q8.(a) The concentration of sulfate ions was measured in the roots of barley plants and in the water in the surrounding soil.

The table shows the results.

	Concentration of sulfate ions in mmol per dm^3
Roots of barley plants	1.4
Soil	0.15

Is it possible for the barley roots to take up sulfate ions from the soil by diffusion?

Draw a ring around your answer. **Yes / No**

Explain your answer.

_____

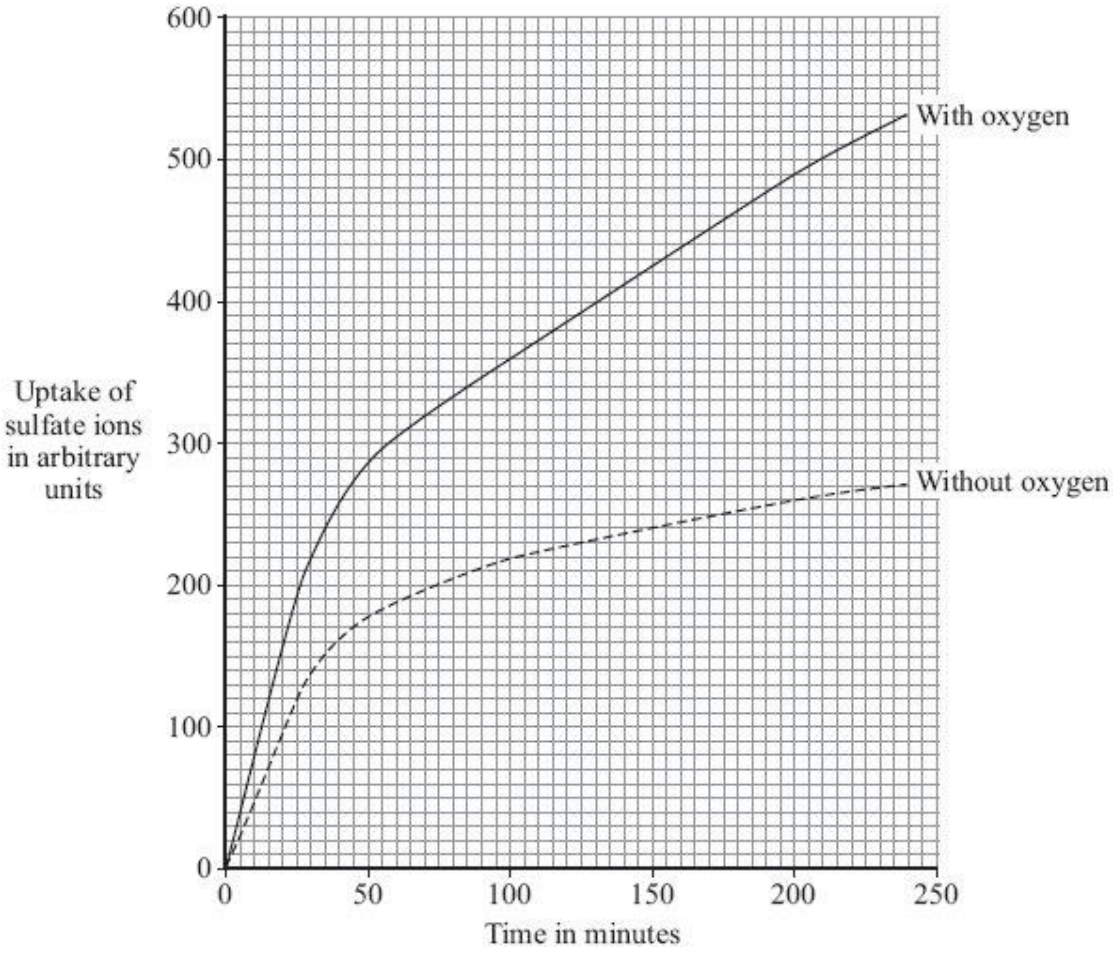
_____

_____

(2)

(b) Some scientists investigated the amounts of sulfate ions taken up by barley roots in the presence of oxygen and when no oxygen was present.

The graph below shows the results.



(i) The graph shows that the rate of sulfate ion uptake between 100 and 200 minutes, **without** oxygen, was 0.4 arbitrary units per minute.

The rate of sulfate ion uptake between 100 and 200 minutes, **with** oxygen, was greater.

How much greater was it? Show clearly how you work out your answer.

_____

_____

_____

Answer _____ arbitrary units

(2)

(ii) The barley roots were able to take up more sulfate ions with oxygen than without oxygen.

Explain how.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q9.(a) Some scientists investigated the rates of absorption of different sugars by the small intestine.

In one experiment they used a piece of normal intestine.
In a second experiment they used a piece of intestine poisoned by cyanide. Cyanide is poisonous because it prevents respiration.

The results are shown in the table.

	Relative rates of absorption	
Sugar	**Normal intestine**	**Intestine poisoned by cyanide**
Glucose	1.00	0.33
Galactose	1.10	0.53
Xylose	0.30	0.31
Arabinose	0.29	0.29

(i) Name **two** sugars from the table which can be absorbed by active transport.

1. _____

2. _____

(1)

(ii) Use evidence from the table to explain why you chose these sugars.

_____

_____

_____

_____

_____

_____

_____

(3)

(b) All of the sugars named in the table can be absorbed by diffusion.

Explain how information from the table provides evidence for this.

_____

_____

_____

_____

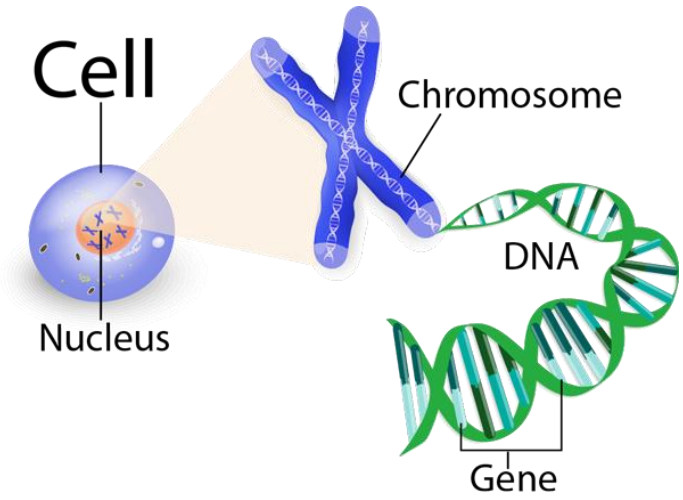
_____

(2)

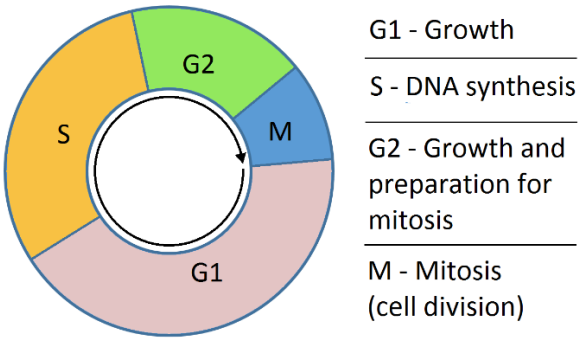
(Total 6 marks)

4.1.2.1 Cell division

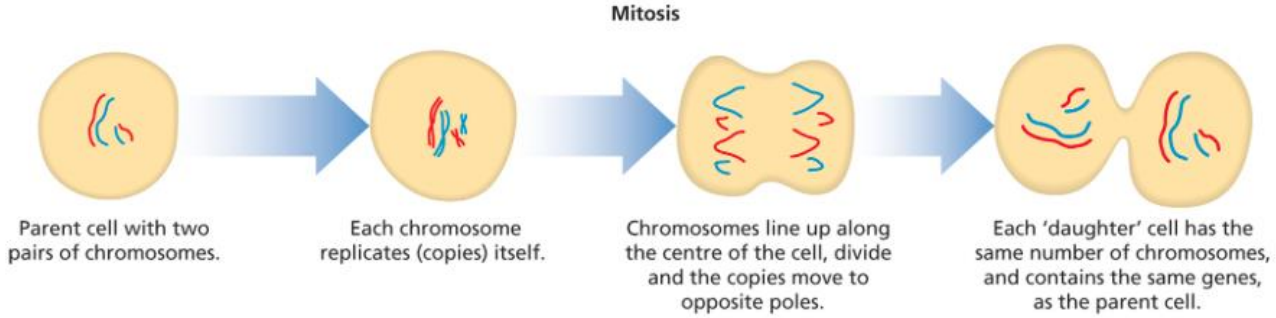
The **nucleus** of a cell contains chromosomes made of **DNA molecules**.
Each **chromosome** carries a large number of **genes**.
In **body cells** the chromosomes are normally found in **pairs**.



Cells divide in a **series of stages called the cell cycle**. During the cell cycle the **genetic material is doubled** and then **divided** into **two identical cells**.



(G1) Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria.
(S) The DNA replicates to form two copies of each chromosome.
(M) In mitosis one set of chromosomes is pulled to each end of the cell and the nucleus divides.
Finally the cytoplasm and cell membranes divide to form two identical cells.



Cell division by **mitosis** is for: **growth, repairing cells/tissues, replacing worn out tissues/cells** (e.g blood cells)

Q1. This question is about the cell cycle.

(a) Chromosomes are copied during the cell cycle.

Where are chromosomes found?

Tick **one** box.

- Cytoplasm ☐
- Nucleus ☐
- Ribosomes ☐
- Vacuole ☐

(1)

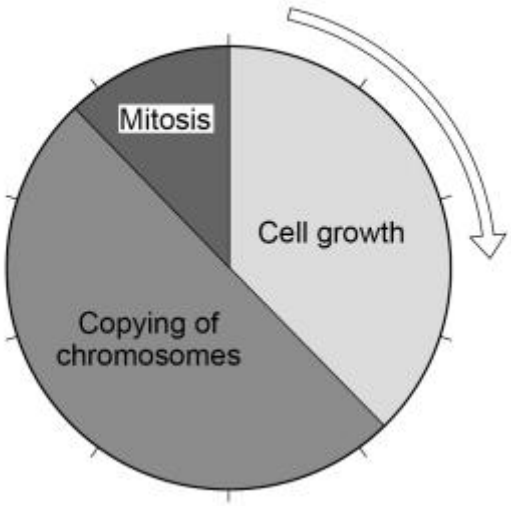
(b) What is the name of a section of a chromosome that controls a characteristic?

_____

(1)

Figure 1 shows information about the cell cycle.

Figure 1



(c) Which stage of the cell cycle in **Figure 1** takes the most time?

Tick **one** box.

- Cell growth ☐
- Copying of chromosomes ☐
- Mitosis ☐

(1)

(d) During mitosis cells need extra energy.

Which cell structures provide most of this energy?

Tick **one** box.

Chromosomes	☐
Cytoplasm	☐
Mitochondria	☐
Ribosomes	☐

(1)

(e) The cell cycle in **Figure 1** takes two hours in total.
The cell growth stage takes 45 minutes.

Calculate the time taken for mitosis.

_____

_____

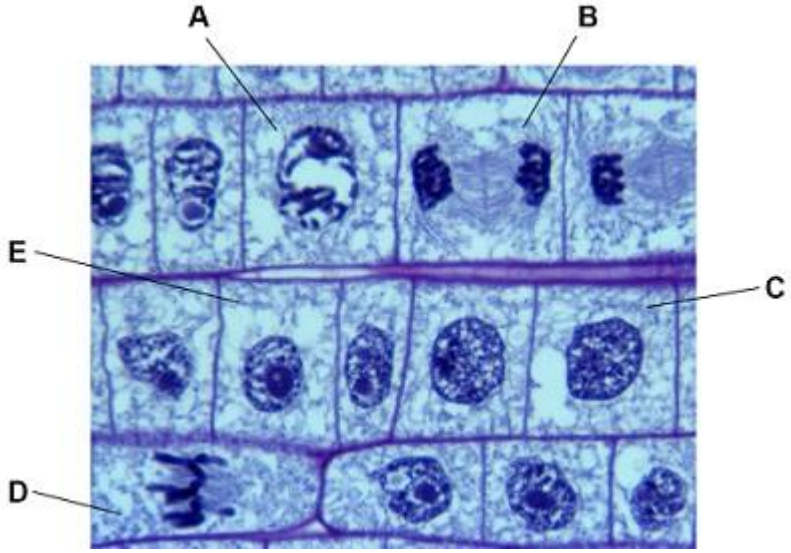
_____

_____

Time = _____ minutes

(2)

Figure 2 shows some cells in different stages of the cell cycle.



(f) Which cell is **not** dividing by mitosis

Tick **one** box.

A	☐	B	☐	C	☐	D	☐

(1)

(g) Cell **E** in **Figure 2** contains 8 chromosomes.

Cell **E** divides by mitosis.

How many chromosomes will each new cell contain?

Tick **one** box.

2 ☐

4 ☐

8 ☐

16 ☐

(1)

(h) Why is mitosis important in living organisms?

Tick **one** box.

To produce gametes ☐

To produce variation ☐

To release energy ☐

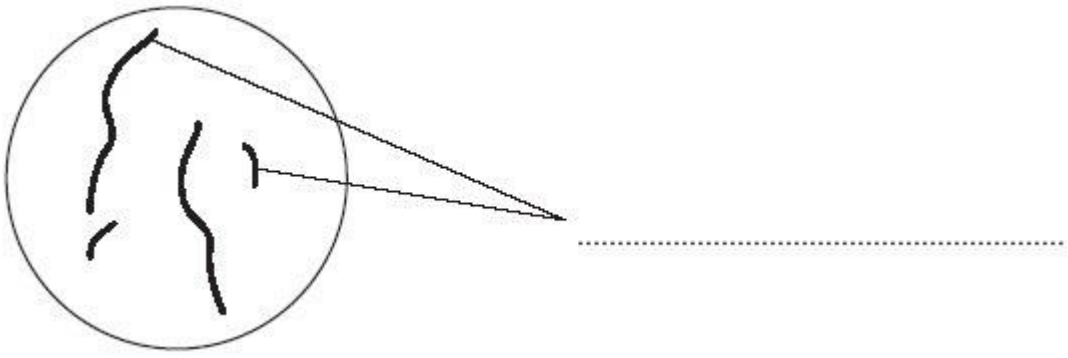
To repair tissues ☐

(1)

(Total 9 marks)

Q2. **Diagram 1** shows the nucleus of a body cell as it begins to divide by mitosis.

Diagram 1



(a) Use a word from the box to label **Diagram 1**.

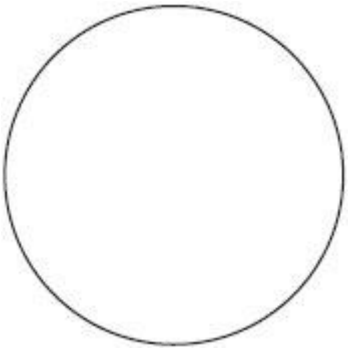
alleles	**chromosomes**	**gametes**

(1)

(b) Complete **Diagram 2** to show what the nucleus of one of the cells produced by this

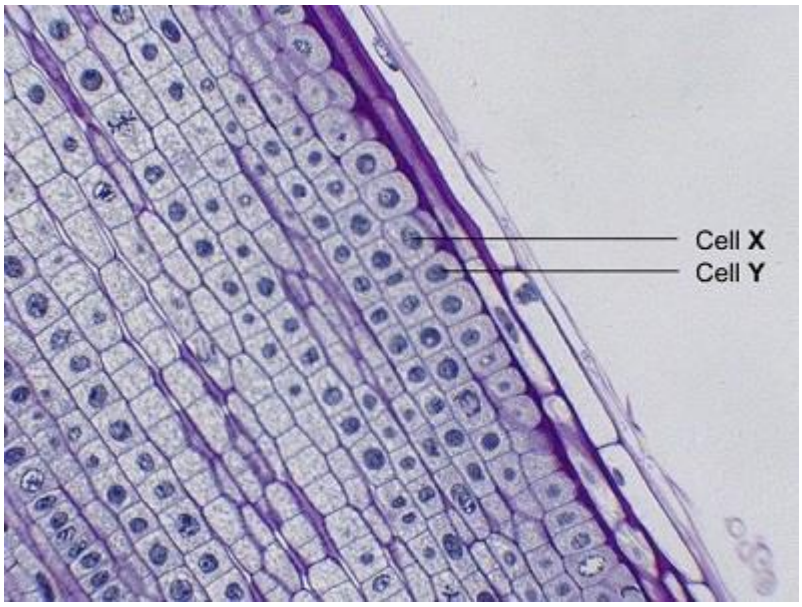
mitosis would look like.

Diagram 2



(1)

Q3. The photograph shows some cells in the root of an onion plant.



By UAF Center for Distance Education [CC BY 2.0], via Flickr

(a) Cells **X** and **Y** have just been produced by cell division.

(i) Name the type of cell division that produced cells **X** and **Y**.

_____

(1)

(ii) What happens to the genetic material before the cell divides?

_____

(1)

Q4.(a) How many pairs of chromosomes are there in a body cell of a human baby?

_____

(1)

(b) Place the following in order of size, **starting with the smallest,** by writing numbers **1** – **4** in the boxes underneath the words.

chromosome	nucleus	gene	cell
☐	☐	☐	☐

(1)

(c) For a baby to grow, its cells must develop in a number of ways.

Explain how each of the following is part of the growth process of a baby.

(i) Cell enlargement

_____

(1)

(ii) The process of cell division by mitosis

_____

_____

_____

_____

_____

_____

(3)

(d) Why is cell specialisation (differentiation) important for the development and growth of a healthy baby from a fertilised egg?

_____

_____

(2)

(Total 8 marks)

4.1.1.5 Microscopy

Key skills to demonstrate:	☺ ☹
• Calculate the magnification of a light microscope. • Carry out calculations using the formula: $$real\ size = \frac{image\ size}{magnification}$$ • Rearrange the equation to calculate image size or magnification	
• convert values for the units: cm, mm, µm and nm.	

Microscopes (optical or electron) can be defined by the **resolving power (resolution**) and their **magnification**.

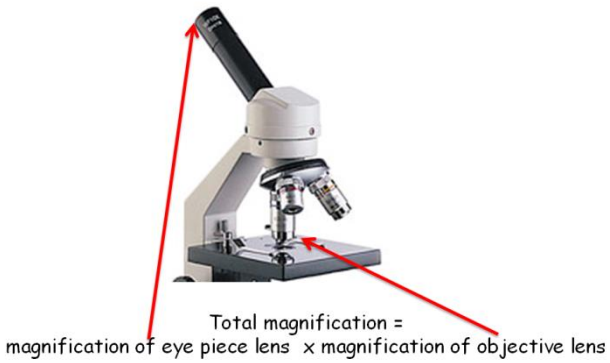
- **Magnification:** how many times bigger the shown image is when compared to the actual object.
- **Resolution:** the minimum distance apart that two objects can be to appear as separate items. Greater resolution = clearer image and finer details can be seen

An **electron microscope** has much **higher magnification and resolving power** than a light microscope. This means that it can be used to **study cells in much finer detail**. This has enabled biologists to see and understand many more sub-cellular structures.

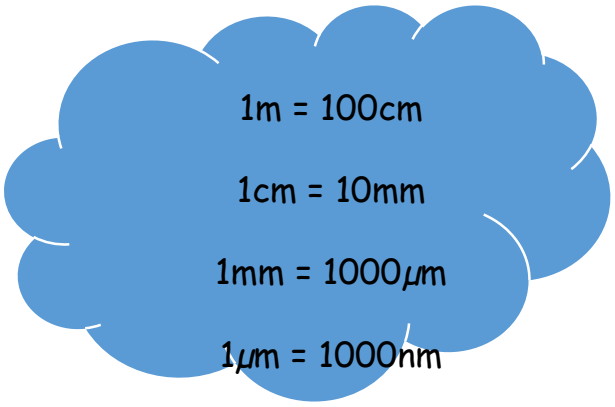
Light microscope	**Electron microscope**
Beam of light passed through cells	Beams of electrons passed through cells
Lower magnification	Higher magnification
Lower resolution	Higher Resolution
Can only see bigger organelles (e.g. nucleus)	Can see very small organelles e.g. ribosomes

Calculating total Magnification of a compound light microscope

How to work out the magnification



Eyepiece Magnification	**Objective Magnification**	**Overall Magnification**
X10	X4	
X10	X10	
X10	X40	
X10	X100	



You can use the formula triangle to rearrange the equation: e.g.

A plant cell in a photograph measures 15 mm (1.5cm) across. This is the image size. If the actual size of the cell is 20 μm (micrometers), *what is the magnification in the photograph?*

1. Write out the equation using the triangle e.g

   Magnification= Image / Actual

2. Make sure all the units are the same. E.g change the μm into mm

   20 μm / 1000 = 0.02 mm

3. Put in the values to your equation e.g 15 mm / 0.02mm = magnification
4. Now carry out the calculation: 15 / 0.02 = x750 magnification. This means the image is 750 times bigger than its actual size.

Exam practice 6

Q1. Cells can be classified according to their structure.

(a) Complete **Table 1** to show which features each cell type has.

Write a tick or a cross in each box.

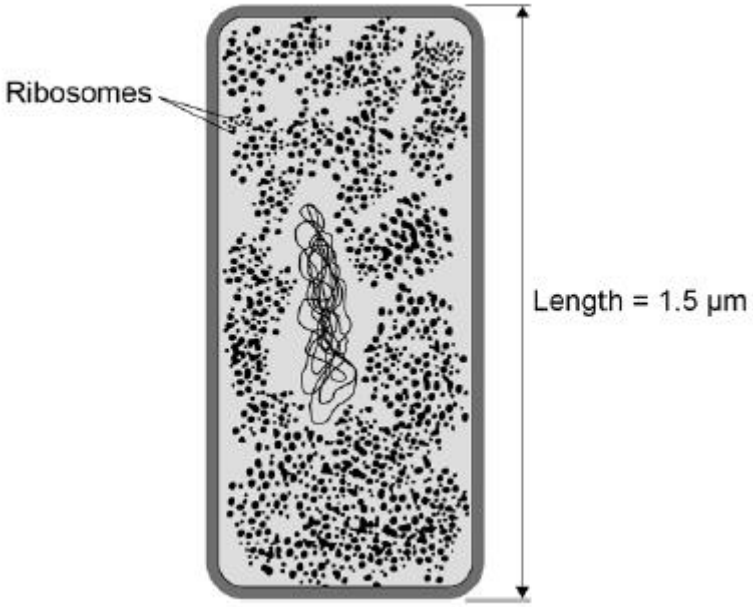
Table 1

	Nucleus	Plasmids	Cytoplasm
Prokaryotic cell			
Eukaryotic cell			

(2)

Figure 1 shows a cell.

Figure 1



(b) What type of cell is shown in **Figure 1**.

Tick **one** box.

An animal cell ☐

A bacterial cell ☐

A plant cell ☐

(1)

(c) The cell in **Figure 1** contains ribosomes.

What is the function of ribosomes?

_____

_____

(1)

(d) There are 1000 micrometres (μm) in a millimetre (mm).

The length of the cell in **Figure 1** is 1.5 micrometres (μm).

Give the length of the cell in millimetres (mm).

_____

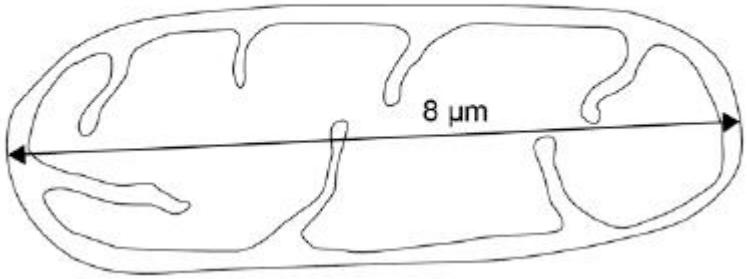
_____

Length of cell = _____ mm

(1)

Figure 2 shows a mitochondrion viewed with a microscope.

Figure 2



(e) Give **one** reason why the cell in **Figure 1** does **not** contain mitochondria.

Use information from **Figure 1** and **Figure 2**.

_____

_____

(1)

The cell in **Figure 1** divides once every 30 minutes.

Table 2 shows how many cells are present after a given time.

Table 2

Time in minutes	Number of cells present
0	1
30	2
60	4

(f) Calculate how many cells will be present after 2 hours.

_____

_____

_____

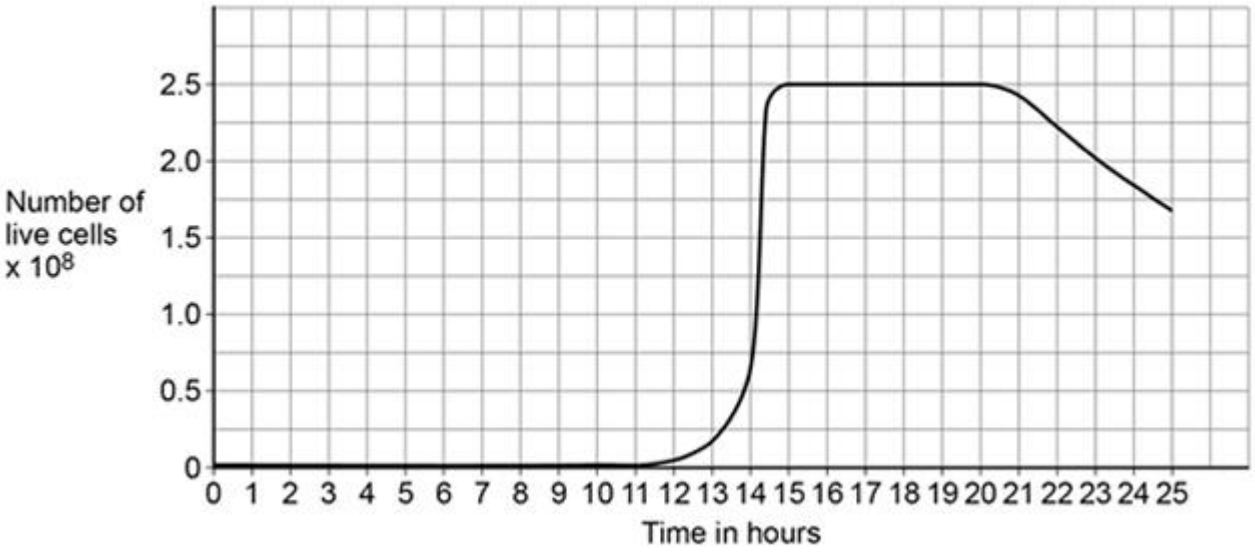
_____

Number of cells = _____

(2)

Cells like the one in **Figure 1** are kept in a culture solution for 25 hours.

The graph below shows the number of live cells present.



(g) Describe the changes in the number of live cells shown in the graph above in the first 20 hours.

Use data from the graph in your answer.

_____

_____

_____

_____

_____

_____

(3)

(h) Suggest **one** reason why the number of live cells decreases after 20 hours.

_____

_____

(1)

(Total 12 marks)

Q2. (b) Cheek cells are a type of body cell.

Body cells grow through cell division.

What is the name of this type of cell division?

Tick **one** box.

Differentiation ☐

Mitosis ☐

Specialisation ☐

(1)

(c) Ribosomes and mitochondria are **not** shown in **Figure 1**.

What type of microscope is needed to see ribosomes and mitochondria?

_____

(1)

(d) What is the advantage of using the type of microscope you named in part **(c)**?

Tick **one** box.

Cheaper ☐

Higher magnification ☐

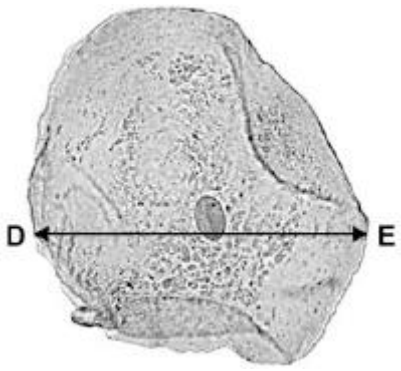
Lower resolution ☐

(1)

(e) The cheek cell in **Figure 2** is magnified 250 times.

The width of the cell is shown by the line **D** to **E**.

Figure 2



Calculate the width of the cheek cell in micrometres (µm).

Complete the following steps.

Measure the width of the cell using a ruler _____ mm

Use the equation to work out the real width of the cell in mm:

$$\textbf{real size} = \frac{\textbf{image size}}{\textbf{magnification}}$$

_____ mm

Convert mm to µm _____ µm

(3)

(f) A red blood cell is 8 µm in diameter.

A bacterial cell is 40 times smaller.

Calculate the diameter of the bacterial cell.

Tick **one** box.

0.02 µm ☐

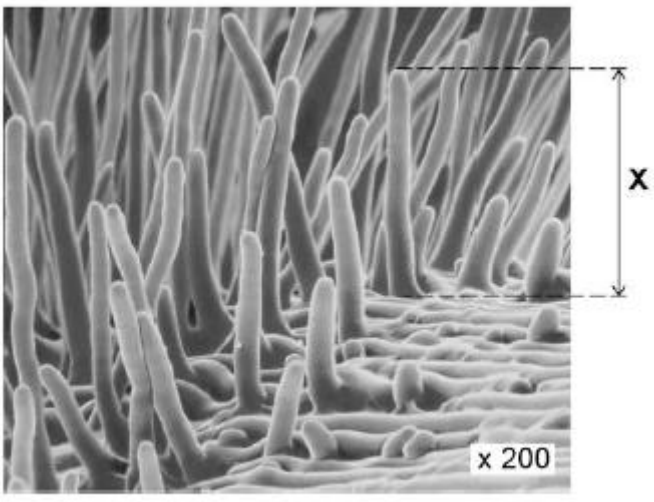
0.2 µm ☐

2.0 µm ☐

20.0 µm ☐

(1)

Q3. The image below shows part of a root from a cress plant.



(a) What type of microscope was used to create the image above?

_____

(1)

(b) The magnification of the cress root in the image above is × 200.
There are 1000 micrometres (µm) in a millimetre (mm).

Calculate the real length of the root hair, **X**.

Give your answer in micrometres (μm).

_____

_____

_____

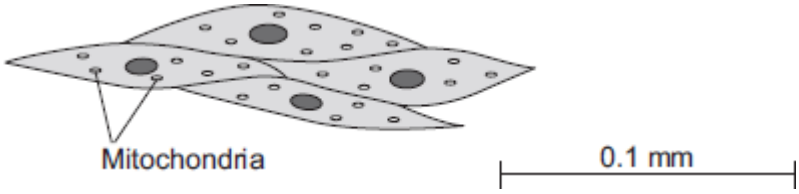
_____

Real length **X** = _____ μm

(2)

(Total 12 marks)

Q4. The image below shows some muscle cells from the wall of the stomach, as seen through a light microscope.



(b) The figure above is highly magnified.

The scale bar in the figure above represents 0.1 mm.

Use a ruler to measure the length of the scale bar and then calculate the magnification of the figure above.

_____

_____

_____

_____

Magnification = _____ times

(2)

(c) The muscle cells in **Figure above** contain many mitochondria.

What is the function of mitochondria?

_____

_____

_____

_____

(2)

(d) The muscle cells also contain many ribosomes. The ribosomes cannot be seen in the figure above.

(i) What is the function of a ribosome?

_____

_____

(1)

(ii) Suggest why the ribosomes **cannot** be seen through a light microscope.

_____

_____

(1)

(Total 8 marks)

Q5. The photograph shows a red blood cell in part of a blood clot. The fibres labelled **X** are produced in the early stages of the clotting process.

(a) Suggest how the fibres labelled **X** help in blood clot formation.

_____

(1)

(b) The average diameter of a real red blood cell is 0.008 millimetres.
On the photograph, the diameter of the red blood cell is 100 millimetres.

Use the formula to calculate the magnification of the photograph.

Diameter on photograph = Real diameter × Magnification

_____

_____

Magnification = _____

(2)