Revision Pack Topic 1- Cell Biology

Cell structure	R/A/G
Eukaryotes and prokaryotes	
Plant and animal cells (eukaryotic cells) have a cell membrane, cytoplasm and genetic material enclosed in a nucleus.	
Bacterial cells (prokaryotic cells) are much smaller in comparison. They have cytoplasm and a cell membrane surrounded by a cell wall. The 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.	
Demonstrate an understanding of the scale and size of cells.	
Be able to make order of magnitude calculations, including the use of standard form.	
Animal and plant cells	
Explain how the main sub-cellular structures, including the nucleus, cell membranes, mitochondria, chloroplasts in plant cells and plasmids in bacterial cells are related to their functions. Most animal cells have the following parts: • a nucleus • cytoplasm • a cell membrane • mitochondria • ribosomes. In addition to the parts found in animal cells, plant cells often have: • chloroplasts • a permanent vacuole filled with cell sap. Plant and algal cells also have a cell wall made of cellulose, which strengthens the cell	
Required practical activity 1: use a light microscope to observe, draw and label a selection of plant and animal cells. A magnification scale must be included.	
Cell specialisation	
Explain how the structure of different types of cell relate to their function in a tissue, an organ or organ system, or the whole organism.	
Cells may be specialised to carry out a particular function: • sperm cells, nerve cells and muscle cells in animals • root hair cells, xylem and phloem cells in plants.	
Cell differentiation	
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.	
Microscopy	
Understand how microscopy techniques have developed over time	
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.	
Carry out calculations involving magnification, real size and image size using the formula: magnification = size of image/size of real object	
Cell division	

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Chromosomes	
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.	
Mitosis and the cell cycle	
During the cell cycle the genetic material is doubled and then divided into two identical cells. Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria. The DNA replicates to form two copies of each chromosome. 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 important in the growth and development of multicellular organisms.	
Stem cells	
A stem cell is an undifferentiated cell of an organism which is capable of giving rise to many more cells of the same type, and from which certain other cells can arise from differentiation. Students should be able to describe the function of stem cells in embryos, in adult animals and in the meristems in plants. Stem cells from human embryos can be cloned and made to differentiate into most different types of human cells. Stem cells from adult bone marrow can form many types of cells including blood cells. Meristem tissue in plants 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	
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: • 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.	
Transport in cells	
Diffusion	
Substances may move into and out of cells across the cell membranes via diffusion. 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. Some of the substances transported in and out of cells by diffusion are oxygen and carbon dioxide in gas exchange, and of the waste product urea from cells into the blood plasma for excretion in the kidney.	
Factors which affect the rate of diffusion are: • the difference in concentrations (concentration gradient) • the temperature • the surface area of the membrane.	
A single-celled organism has a relatively large surface area to volume ratio. This allows sufficient transport of molecules into and out of the cell to meet the needs of the organism.	
Calculate and compare surface area to volume ratios.	
Explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area to volume ratio.	
Explain how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants, are adapted for exchanging materials. In multicellular organisms, surfaces and organ	

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systems are specialised for exchanging materials. This is to allow sufficient molecules to be transported into and out of cells for the organism's needs.	
The effectiveness of an 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.	
Osmosis	
Water may move across cell membranes via osmosis. Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane	
Calculate percentage gain and loss of mass of plant tissue.	
Required practical activity 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.	
Active transport	
Describe how substances are transported into and out of cells by diffusion, osmosis and active transport. Explain the differences between the three processes.	
Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient). This requires energy from respiration. Active transport allows mineral ions to be absorbed into plant root hairs from very dilute solutions in the soil. Plants require ions for healthy growth. It also allows sugar molecules to be absorbed from lower concentrations in the gut into the blood which has a higher sugar concentration. Sugar molecules are used for cell respiration.	

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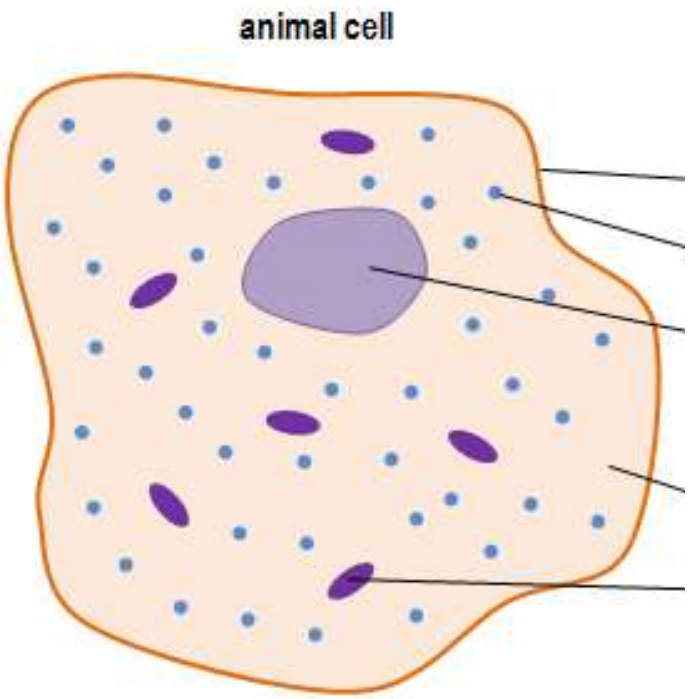
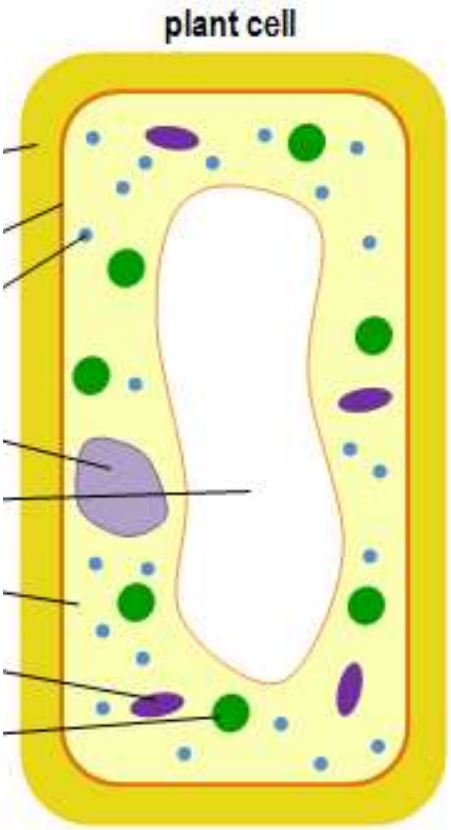
Cell Structure

What is the difference between eukaryotic and prokaryotic cells?

Label the different parts of the animal and plant cells.





Compare the relative sizes of plant, animal and bacterial cells.

How does the structure of a prokaryotic (bacterial cells) differ from that of eukaryotic (plant and animal) cells?

What is an order of magnitude and how are they used to compare cells in Biology?

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Cell membrane	**Contains genetic material, DNA**
Cell wall	**Site of aerobic respiration**
Chloroplast	**Small ring of DNA found in bacterial cells**
Cytoplasm	**Surrounds the cell, provides strength**
Nucleus	**Thin layer around a cell controlling the substances passing in and out**
Vacuole	**Site of protein synthesis**
Mitochondria	**Material inside a cell where most chemical reactions take place**
Ribosome	**Contains chlorophyll, for photosynthesis**
Plasmid	**Space filled with cell sap in the cytoplasm**

Match up the correct term to the definition.

In the boxes below, explain how you would use a microscope to study a sample of animal or plant cells.

Preparing a slide:
Using a Microscope:
Drawing Your Observations:

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In order to complete magnification questions, you must first be able to convert numbers into standard form and back again.

Convert the following numbers into standard form:

a) 1580_____
b) 0.23_____
c) 0.00056_____
d) 156_____
e) 0.00000000067_____

Professor Smart has invented a shrinking ray. He tests it on his cat, Fluffy, by shrinking it down to 0.06mm long.

The Professor looks at Fluffy using a light microscope. The image that he sees is **9mm long.**

Calculate the magnification of Professor Smart's image.

Fluffy's tail **is 0.02mm long**. The professor now looks at him using a x300 magnification.
Calculate how long Fluffy's tail will be on the magnified image.

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Define the following terms:

Undifferentiated _____

Differentiated _____

Specialised _____

Complete the table to show the adaptations of specialised cells

Cell	Sketch	Function	Adaptations
Sperm cell			
Nerve cell			
Muscle cell			
Root hair cell			
Phloem cell			
Xylem cell			

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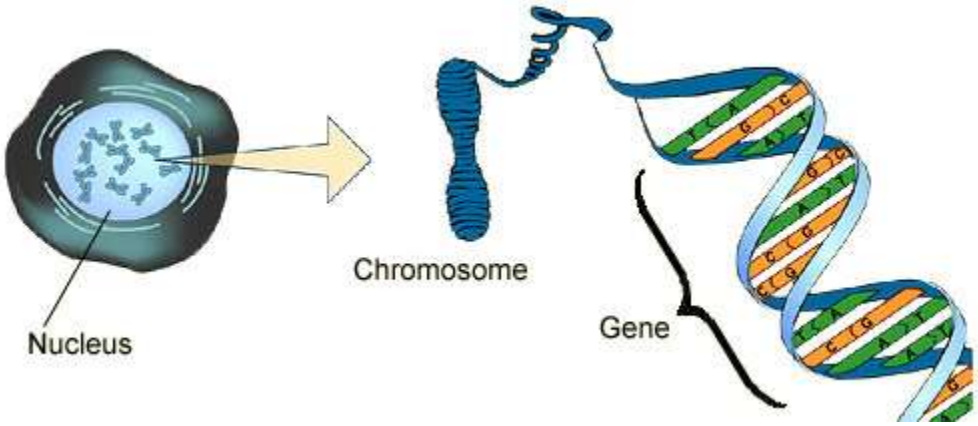
Label the below diagram with the terms: **DNA, gene, nucleus and chromosome**.

Explain the relationship between these terms and compare them in terms of size.

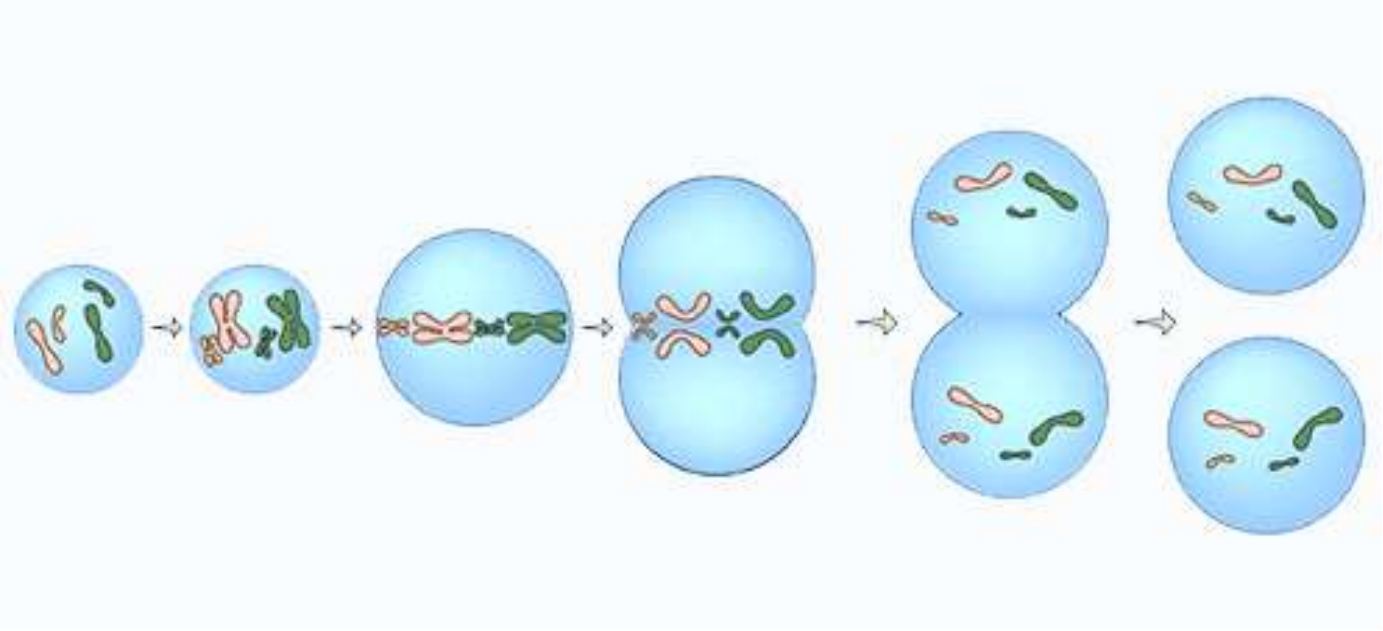


Body cells in multicellular organisms divide to produce new cells as a series of stages called the **cell cycle.**

What is mitosis?_____

_____

Your teacher will help you to annotate the below diagram showing the stages in cell division and mitosis.



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What is a stem cell? _____

How do adult stem cells and embryonic stem cells differ? _____

Differences between animal stem cells and plant stem cells:

Animal	Plant

Potential uses of stem cells:

1) Cure disease _____
2) Replace faulty cells _____
3) Therapeutic cloning _____
4) Producing clones in plants _____

What are the risks associated with the use of stem cells in medicine?

_____

Why are some people against stem cell research?

_____

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Diffusion:

i) What is diffusion?

i) What affects the rate of diffusion? And how does it affect the rate of diffusion?

i) Examples of diffusion:

Active Transport:

i) What is active transport?

ii) What does active transport need?

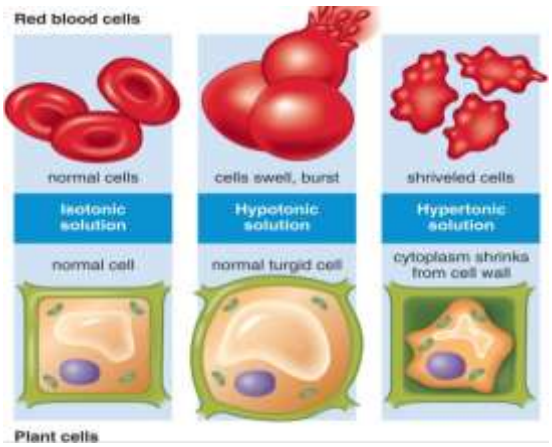
iii) Give some examples of where active transport occurs:

Osmosis:

i) What is osmosis?

ii) How does osmosis differ from diffusion?

ii) Explain why each of the following happens in terms of the movement of water:



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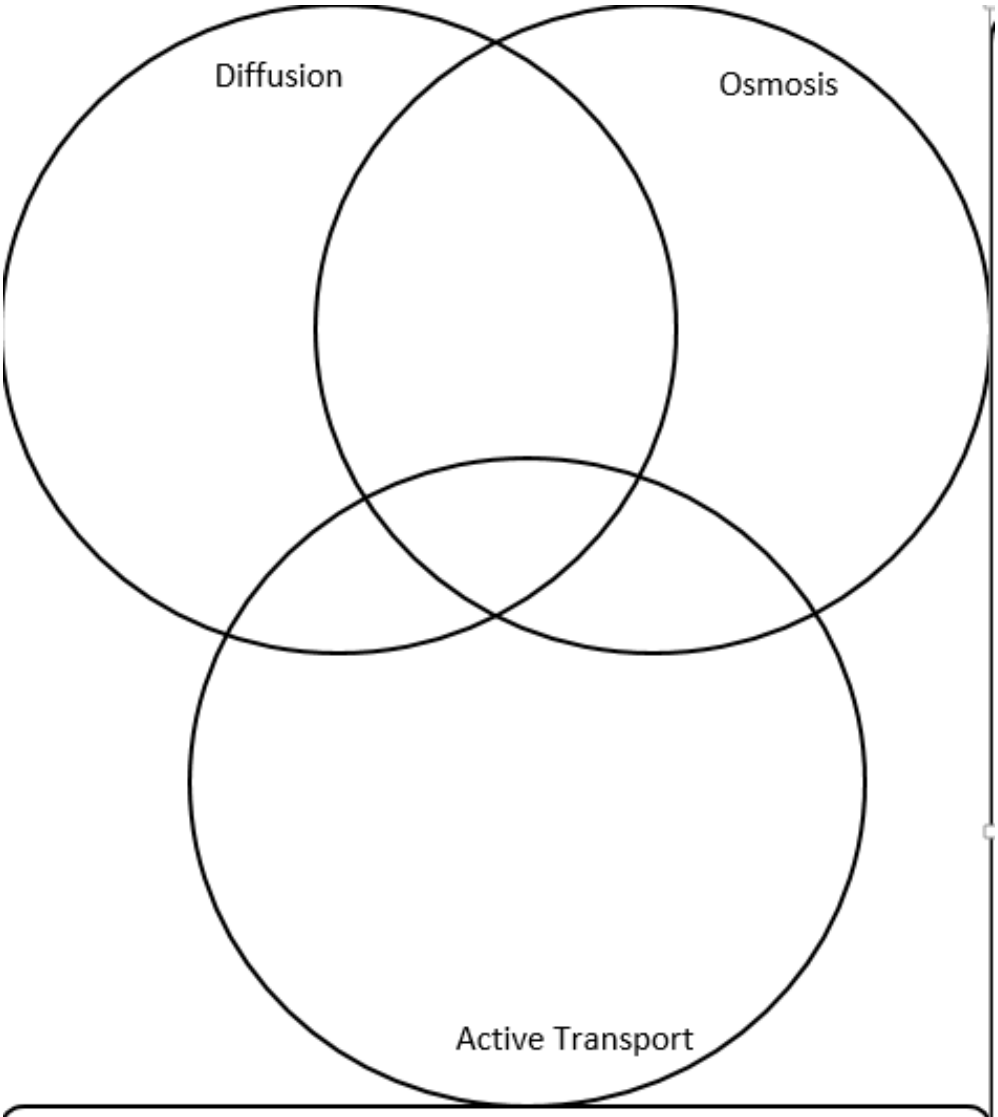

1) How solutes move
2) Movement of liquid water
3) Movement of water vapour
4) Requires energy
5) Movement is against a concentration gradient
6) Must take place across a membrane
7) Describes the movement of oxygen from the alveolus into the blood
8) How nitrates enter a root hair cell
9) Why potato chips swell when put into distilled water
10) Rate is affected by changes in temperature
11) Is a passive process
12) Movement of the molecules is down a concentration gradient

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What is **surface area to volume ratio** and why does it matter?

Exchange surface	Process	Adaptations for the exchange of substances
Alveoli	Gas exchange	
Villi	Absorbing the products of digestion	
Leaf	Gas exchange	
Gill	Gas exchange	

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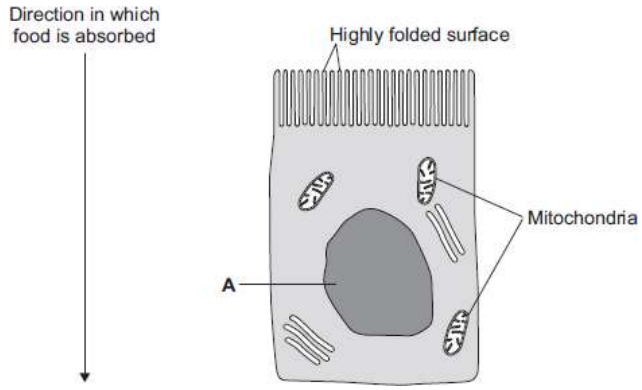
Q1. The image below shows an epithelial cell from the lining of the small intestine.



(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)

(c) Epithelial cells also carry out active transport.

(i) Name **one** food molecule absorbed into epithelial cells by active transport.

.....

(1)

(ii) Why is it necessary to absorb some food molecules by active transport?

.....

.....

(1)

(ii) Suggest why epithelial cells have many mitochondria.

.....

.....

(2)

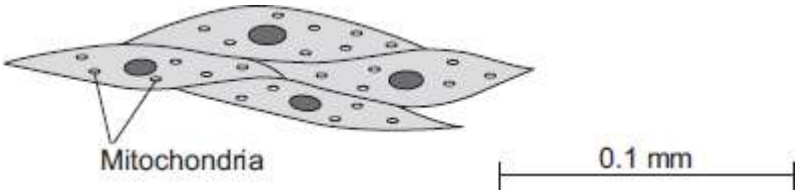
d) Some plants also carry out active transport.

Give **one** substance that plants absorb by active transport.

.....

(1)
(Total 8 marks)

Q2. The image below shows some muscle cells from the wall of the stomach, as seen through a light microscope.



(a) Describe the function of muscle cells in the wall of the stomach.

.....

.....

.....

.....

(2)

(b) **Figure above** is highly magnified.

The scale bar in **Figure above** represents 0.1 mm.

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

.....

.....

.....

.....

Magnification = ... times

(2)

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(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 **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)

Q3. Stem cells can be collected from human embryos and from adult bone marrow. Stem cells can develop into different types of cell.

The table gives information about using these two types of stem cell to treat patients.

Stem cells from human embryos	Stem cells from adult bone marrow
It costs £5000 to collect a few cells.	It costs £1000 to collect many cells.
There are ethical issues in using embryo stem cells.	Adults give permission for their own bone marrow to be collected.
The stem cells can develop into most other types of cell.	The stem cells can develop into only a few types of cell.
Each stem cell divides every 30 minutes.	Each stem cell divides every four hours.
There is a low chance of a patient's immune system rejecting the cells.	There is a high chance of a patient's immune system rejecting the cells.
More research is needed into the use of these stem cells.	Use of these stem cells is considered to be a safe procedure.

Scientists are planning a new way of treating a disease, using stem cells.

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

(a) Give **three** advantages of using stem cells from embryos instead of from adult bone marrow.

1 .....

2 .....

3 .....

(3)

(b) Give **three** advantages of using stem cells from adult bone marrow instead of from embryos.

1 .....

2 .....

3 .....

(3)

(Total 6 marks)

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)

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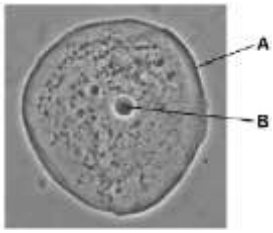
(d) Why is cell specialisation (differentiation) important for the development and growth of a healthy baby from a fertilised egg?

.....

.....

(2)
(Total 8 marks)

Q5.Figure 1 shows an animal cell.



(a) What is structure **A**?

Tick **one** box.

- Cell membrane ☐
- Cell wall ☐
- Chromosome ☐
- Cytoplasm ☐

(1)

(b) What is structure **B**?

Tick **one** box.

- Chloroplast ☐
- Mitochondria ☐
- Nucleus ☐
- Vacuole ☐

(1)

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(c) **Figure 2** shows a sperm cell.

Figure 2

Describe how a sperm cell is adapted to carry out its function.

.....

.....

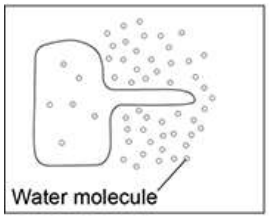
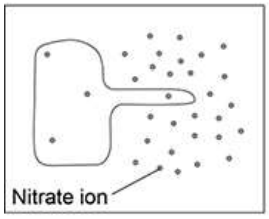
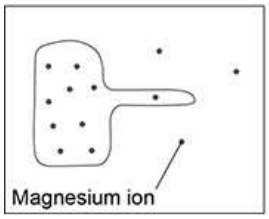
(1)

(d) Substances can move into and out of cells by three processes.

The diagrams show the concentration of different substances inside and outside a root hair cell.

How would each substance move into the root hair cell?

Draw **one** line from each root hair cell to the correct process.

Root hair cell	Process
	Active transport
	Diffusion
	Osmosis

(2)
(Total 5 marks)

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M1.(a) (i) nucleus

1

(ii) diffusion

1

(b) increases / larger surface area (for diffusion)
ignore large surface area to volume ratio

1

(c) (i) sugar / glucose
accept amino acids / other named monosaccharides

1

(ii) against a concentration gradient
or
from low to high concentration

1

(iii) (active transport requires) energy

1

(from) respiration

1

(d) minerals / ions
accept named ion ignore nutrients
do not accept *water*

1

(8)

M2.(a) contract / shorten
ignore relax
*do **not** allow expand*

1

to churn / move / mix food
accept peristalsis / mechanical digestion
ignore movement unqualified

1

(b) 400
acceptable range 390-410
allow 1 mark for answer in range of 39 to 41
allow 1 mark for answer in range of 3900 to 4100

2

(c) to transfer energy for use
allow to release / give / supply / provide energy
*do **not** allow to 'make' / ?produce' / 'create' energy*
allow to make ATP
ignore to store energy

1

y (aerobic) respiration **or** from glucose

*do **not** allow anaerobic*

*energy released **for** respiration = max 1 mark*

1

(d) (i) to make protein / enzyme

ignore 'antibody' or other named protein

1

(ii) too small / very small

allow light microscope does not have sufficient magnification / resolution

allow ribosomes are smaller than mitochondria

ignore not sensitive enough

ignore ribosomes are transparent

1[8]

M3. (a) comparisons are **not** required but should be credited
accept a clear indication of the statement even if incomplete

can develop into most other types of cell

1

each cell divides every 30 minutes

1

low chance of rejection by the patient's immune system

1

b) any **three** from:

- cheaper / only costs £1000

  *this **must** be comparative*

  ignore costs £1000

- can collect many (stem) cells
- adults give permission for their own bone marrow to be collected

  comparisons are not required but should be credited

- safe

3[6]

M4. (a) 23

1

(b) chromosome nucleus gene cell
2 3 1 4

1

(c) (i) any **one** from

(cells which are bigger) take up more space

(cells) have to get bigger **or** mature to divide**1**

ii) chromosomes duplicate **or**
make exact copies of self

accept forms pairs of chromatids

1

nuclei divide

*accept chromatids **or***
chromosomes separate

1

identical (daughter) cells formed

accept for example, skin cells make
*more skin cells **or** cells are clones*

1

(d) any **two** from

Differentiation mark
babies need **or** are made of different types of cells **or** cells that have different functions

Division or specialisation mark
as fertilised egg starts to divide each cell specialises to form a part of the body

accept specialised cells make
different parts of the body

Growth mark
specialised cells undergo mitosis to grow further cells

*accept cells divide **or** reproduce*
to form identical cells

2 **[8]**

M5.(a) cell membrane

extra boxes ticked negates mark

1

b) nucleus

extra boxes ticked negates mark

1

c) has a tail so it can swim (to an egg)

accept has many mitochondria to release energy to swim