

A. Cell structure part 1 – Eukaryotes, prokaryotes and animal and plant cells

1. Describe the similarities and differences between a typical plant and a typical animal cell. (4)

- *Typical animal and plant cells contain the following structures: nucleus, cytoplasm, cell membrane, ribosomes, mitochondria (2)*
- *Plant cells also contain a permanent vacuole, a cell wall and chloroplasts (2)*

2. Ribosomes synthesise proteins. Explain what this means. (2)

- *Synthesise means to make/produce*
- *From amino acids*
- *Ribosomes are the site of protein production/where proteins are made*

3. Explain why the mitochondria in cells are important. (3)

- *Cells require energy to function*
- *Mitochondria are the site of respiration*
- *Energy is released in respiration*

4. The table below shows the number of mitochondria in different mammalian cells.

Type of mammalian cell	Number of mitochondria per cell			Mean number of mitochondria
	1	2	3	
Stomach lining	1720	1850	1680	1750
Liver	2095	2210	1995	2100
Skin	290	315	295	300
Large intestine lining	1295	1429	1476	1400
Muscle	1853	1746	1801	1800
Kidney	1450	1650	1400	1500

a. Calculate the mean number of mitochondria in each cell and write these in the table. (6)

- *(1 mark for each correct mean)*

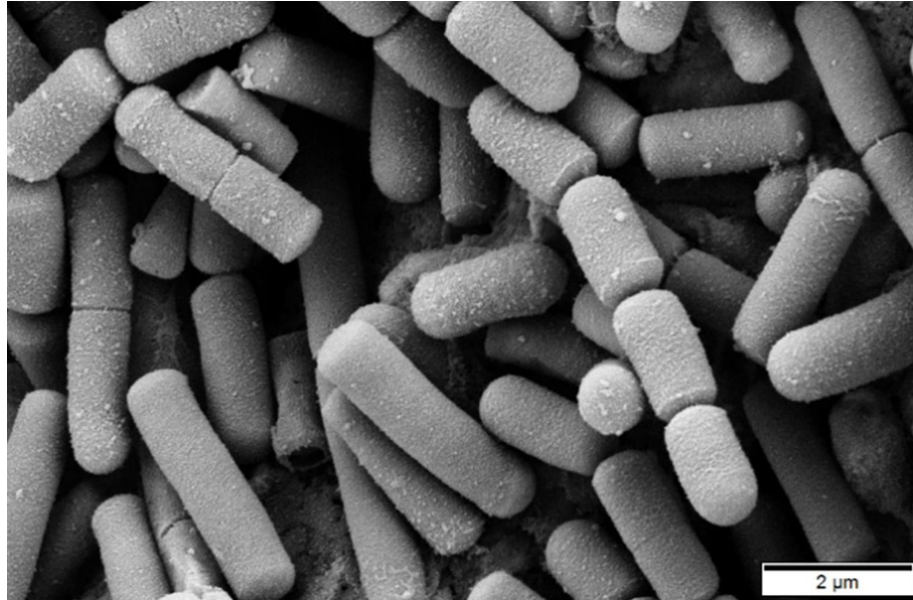
b. Use graph paper and a suitable method to display the data from the table. (4)
(Remember to add labels).

- *Bar chart (1)*
- *Axis labelled (1)*
- *Bars plotted correctly (1)*
- *Gap between bars (1)*

5. Extended response question:

The image below shows a type of bacteria called *Bacillus cereus*. It can cause food poisoning by releasing toxins that can make you vomit.

Bacteria are prokaryotic cells.



Recall the typical structures in a prokaryotic cell and describe the function of each of the structures.

(6)

- Level 3 (5-6 marks)
All structures in a bacterial cell named AND the function of each described.
- Level 2 (3-4 marks)
Most structures named AND most functions described.
- Level 1 (1-2 marks)
Some structures named OR some functions described

Biology content:

Cell part	Function
Cytoplasm	Most chemical processes take place here, controlled by enzymes
Cell membrane	Controls the movement of substances into and out of the cell
Cell wall	Strengthens the cell
Bacterial DNA	Contains DNA that controls the function of the cell and makes/synthesises proteins that the cell needs
Plasmid (DNA)	Small ring of DNA often used as a vector in genetic modification

B. Cell structure part 2 - Cell specialisation and cell differentiation

1. Eukaryotic cells can undergo differentiation. What does the term differentiation mean?

(2)

- *How a cell changes over time (1)*
- *To become specialised (for a particular function) (1)*

2. Explain how animal stem cells are different from plant stem cells. (3)

Any 3 from:

- *Animal stem cells usually differentiate at the early stages of their life*
- *Stem cells in adult animals are mainly used for replacement or repair*
- *Plant cells differentiate throughout their life cycle*
- *Plant stem cells are grouped together in structures called meristems*

3. Extended response question:

Compare and contrast the structure and function of sperm cells and nerve cells. (6)

- *Level 3 (5-6 marks)*
Compare at least three structures AND discuss the function of sperm cells AND nerve cells.
- *Level 2 (3-4 marks)*
Compare at least two structures AND discuss the function of sperm cells AND nerve cells.
- *Level 1 (1-2 marks)*
Compare at least two structures OR functions for sperm cells AND nerve cells.

Biology content:

Sperm cells:

Function is to fertilise an egg.

- *Streamlined with a long tail to swim to the egg.*
- *Acrosome in the head containing enzymes to digest the egg cell membrane.*
- *Large number of mitochondria in the mid-section to release energy for movement.*

Nerve cells:

Function is to carry electrical signals.

- *Long to carry signals long distances.*
- *Branched connections to connect to other nerve cells and form a network around the body.*
- *Insulating sheath to enhance transmission of electrical signals.*

C. Cell structure part 3 – Microscopy and (culturing microorganisms bio only)

1. Describe some advantages and disadvantages of the light microscope as compared to an electron microscope. (4)

Advantages:

- *small and portable*
- *(relatively) low cost*
- *(relatively) easy to use*

Disadvantages:

- *lower resolution*
- *lower magnification*

2. The diagram below shows sperm cells travelling towards an egg cell.

The real length of the sperm cell labelled A is 42 μm .



Calculate the magnification of the sperm cell. (4)

- *Image (I) length of sperm = 21 mm*
- *Real (A) length of sperm = 42 μm
Convert to mm = 0.042 mm*

A 

Magnification = size of image (I) / real size of the object (A)

- *$M = 21/0.042 = 500$*

3. The diagram shows an image of human cheek cells.

The magnification of the cheek cells is x 100.

Calculate the real length of the cheek cell labelled B. (3)

B



- *Image (I) length of cell = 6 mm
Magnification = x 100*

Magnification (M) = size of image (I) / real size of the object (A)

- *Rearrange to give*

Real size of the object (A) = size of image (I) / magnification (M)

$A = 6/100 = \underline{0.06\text{mm}}$

4. Extended response question:

A student has been asked to observe onion cells under a microscope.

State the equipment they would need and describe the procedure they would use. (6)

You do not need to discuss the risks.

- Level 3 (5-6 marks)

A logical plan that INCLUDES most equipment that will allow cells to be viewed under the microscope AND describes how to use the microscope correctly

- Level 2 (3-4 marks)

A plan that INCLUDES some equipment that will allow cells to be viewed under the microscope AND describes how to use the microscope with most of the steps in the correct order

- Level 1 (1-2 marks)

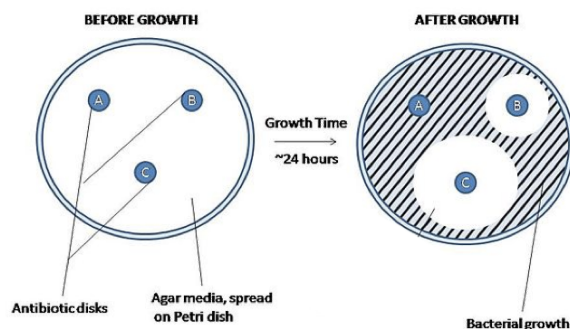
Simple plan that lists some equipment OR describes how to use the microscope with most of the steps in the correct order

Equipment: Microscope, glass slides, coverslip, scalpel (sharp knife), iodine or stain, microscope

Procedure:

- o *Cut a section of onion and peel of the epidermis (thin inner layer)*
- o *Place the specimen onto slide.*
- o *Stain the specimen using iodine.*
- o *Gently lower cover slip onto the specimen without trapping air bubbles.*
- o *Soak up any excess liquid with a paper towel.*
- o *Switch on the light source or move the mirror and place your slide on the stage.*
- o *Use the lowest objective lens and turn the focusing wheel to move the lens close to the slide.*
- o *Slowly adjust the focusing wheel until you can see a clear image.*
- o *Increase the magnification by changing the objective lens and re-focus.*

5. **(Biology only)** The image below shows the results of an experiment on antibiotics.



Bio ONLY: Write a conclusion for this experiment. (4)

Any four from:

- *The ring around the disk where no bacteria have grown is called the zone of exclusion.*
- *The zone of exclusion shows how effective the antibiotic is at killing bacteria.*
- *'A' has no antibiotic properties as it does not kill any bacteria.*
- *'B' has antibiotic properties as it kills some bacteria around the disk.*
- *The most effective is 'C' as it kills the most bacteria around the disk.*

D. Cell division

1. Describe the relationship between the cell, genes, DNA and chromosomes.

You may draw a diagram if you wish. (3)

Any three from:

- *The cell contains a nucleus*
- *Nucleus contains chromosomes*
- *Chromosomes made of coiled strands of DNA*
- *Genes are a section of DNA that codes for a protein*

2. Explain why mitosis is important for multicellular organisms. (3)

Any three from:

- *Repairs cells*
- *Replace cells*
- *Mitosis is how new cells are formed*
- *Two daughter cells formed are clones of the original cell, to keep the same favourable characteristics as the parent*

3. Discuss the advantages and disadvantages of the use of plant stem cells. (4)

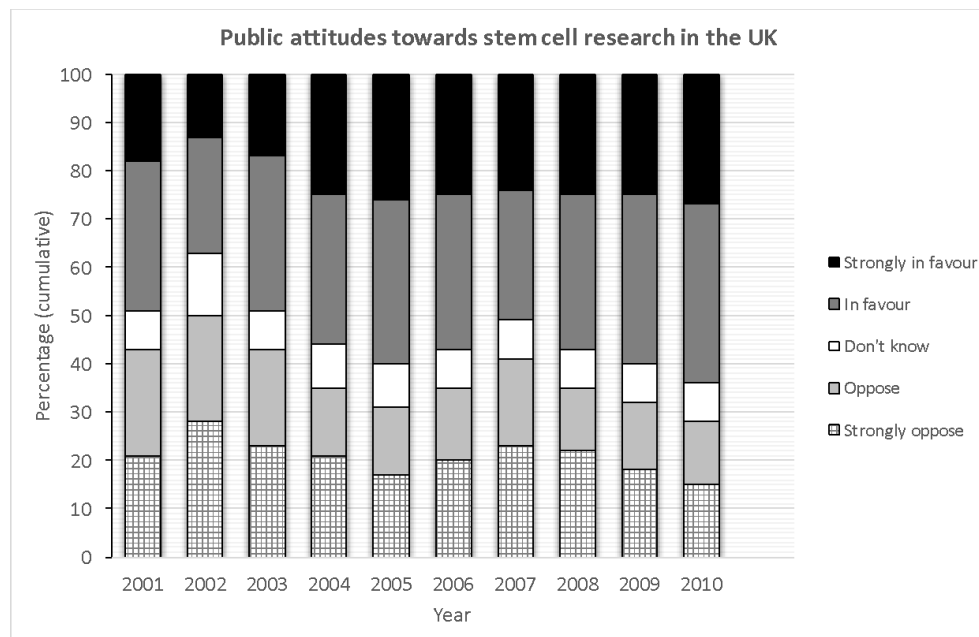
Advantages:

- *Rare species can be cloned*
- *Crop plants with useful features can be cloned (allow specific examples)*

Disadvantages:

- *Some rare species may compete with crop plants or economically useful plants*
- *Cloned plants may be susceptible to disease due to identical genes*

4. The chart below shows public attitudes towards stem cell research using human embryos.



a. Describe the trend ‘in favour’ **and** ‘strongly in favour’ between 2001 and 2010. (3)

- *Lowest 37% (+ or – 1) in 2002*
- *Highest 60% (+ or – 1) in 2005*
- *Since 2007 increasing*

b. Calculate the percentage decrease for ‘strongly opposed’ at its highest and lowest points. (3)

highest 28% lowest 15% 28-15 = 13

$$\frac{11}{28} \times 100 = 46\%$$

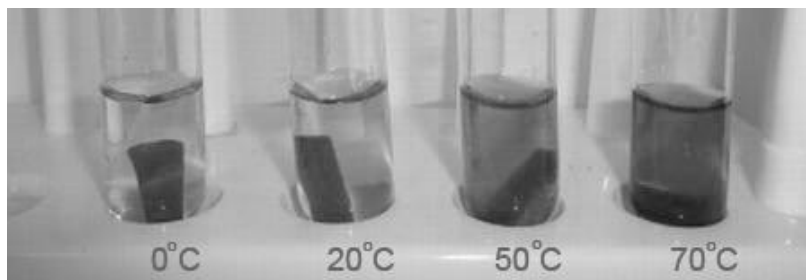
c. Explain why some people may strongly oppose the use of human embryos in research. (4)

Any 2 linked points:

- *Ethical reasons – destruction of the embryo*
- *Religious reasons – belief that life begins at fertilisation*
- *Risks – infections from the procedure, treatment may make disease worse*

E. Transport in cells

1. The image below shows beetroot in different temperatures of distilled water. The beetroot pieces are all the same size and shape and this is the result after 20 minutes.



Explain the results of this experiment. (4)

Any four from:

- *Dye in the beetroot*
- *Moves from an area of low concentration to high concentration*
- *There is a large/steep concentration gradient between the cells and the water*
- *At higher temperatures, the particles have more energy*
- *Particles move faster*

2. Plants and animals have adaptations that allow for efficient transport of substances in and out of cells. One of these adaptations is maintaining the concentration gradient.

a. Explain the importance of maintaining the concentration gradient in diffusion. (2)

- *The greater the difference between the concentrations (next to each other) the faster the rate of diffusion occurs*
- *If the concentrations are the same there is no net diffusion*

b. Describe the adaptations for transport in cells in plants and in animals. (4)

- *Two descriptions for named plant and animal structures from the specification (the small intestine and lungs in mammals; gills in fish; and the roots and leaves in plants)*

Animals:

- *Small intestines: villi, increased surface area, good blood supply, membranes very thin*
- *Lungs: alveoli, increased surface area, good blood supply, membranes very thin*
- *Gills in fish: gill filaments and lamella, increased surface area, good blood supply, membranes very thin*

Plants:

- *Roots: root hair cells, increased surface area*
- *Leaves: large surface area, thin, xylem, phloem, stomata*

3. Extended response question:

A student has been given the following equipment and has been asked to investigate the rate of osmosis in potato tissue at different salt concentrations.



Describe how you would use this equipment to investigate the rate of osmosis in potato tissue at different salt concentrations. How will you make it a fair test? (6)

Not all the equipment you will need is shown here. You will not need to write a risk assessment.

- **Level 3 (5-6 marks)**
A logical plan that INCLUDES sensible volumes and concentrations that would enable valid results to be obtained AND discusses control variables.
- **Level 2 (3-4 marks)**
A plan that INCLUDES some volumes or concentrations that would enable valid results to be obtained AND discusses at least one control variable.
- **Level 1 (1-2 marks)**
Simple plan that lists some volumes or concentrations that would enable results to be obtained.

Biology content: allow any sensible volumes and concentrations

- *Use a cork borer to cut potato cylinders of the same diameter.*
- *Trim the cylinders so that they are all the same length.*
- *Accurately measure and record the length and mass of each potato cylinder.*
- *Measure 10 cm³ of the 0.5 M salt solution and put into the first boiling tube. Label boiling tube as: 0.5 M salt.*
- *Measure 10 cm³ of 0.25 M salt solution and put into the second boiling tube. Label boiling tube as: 0.25 M salt.*
- *Measure 10 cm³ of the distilled water and put into the third boiling tube. Label boiling tube as water.*
- *Add one potato cylinder to each boiling tube. Make sure you know the length and mass of each potato cylinder in each boiling tube.*
- *Leave the potato cylinders in the boiling tubes for an hour/ overnight in the test tube rack.*
- *Remove the cylinders from the boiling tubes and carefully blot them dry with the paper towels.*
- *Re-measure the length and mass of each cylinder.*

Fair test: Same volume of salt solution/Same length and diameter of potato cylinders/Temperature of the salt solution/Length of time in the solution