St Ninian's High School

Biology Department

Cell Biology Class Notes

Name: _____

Cultivating Excellence in Science

National 5 Cell Biology

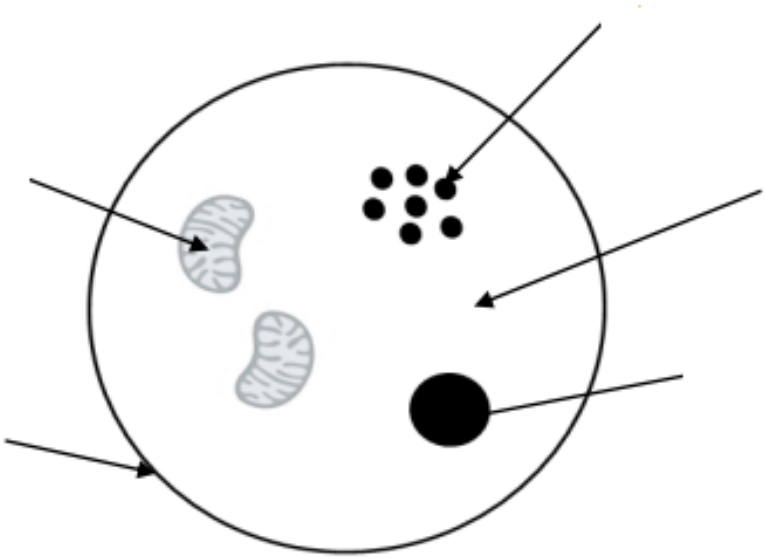
The outline of the National 5 Cell Biology Course is as follows:

S3 Multicellular: Course Outline	
Key Area 1:	Cell Ultrastructure
Key Area 2:	Genetic Engineering
Key Area 3:	DNA & Production of Proteins
Key Area 4:	Enzymes
Key Area 5:	Respiration
Key Area 6:	Transport across cell membranes

Cell Ultra Structure

Animal Cell

There are _____ key features in an animal cell.



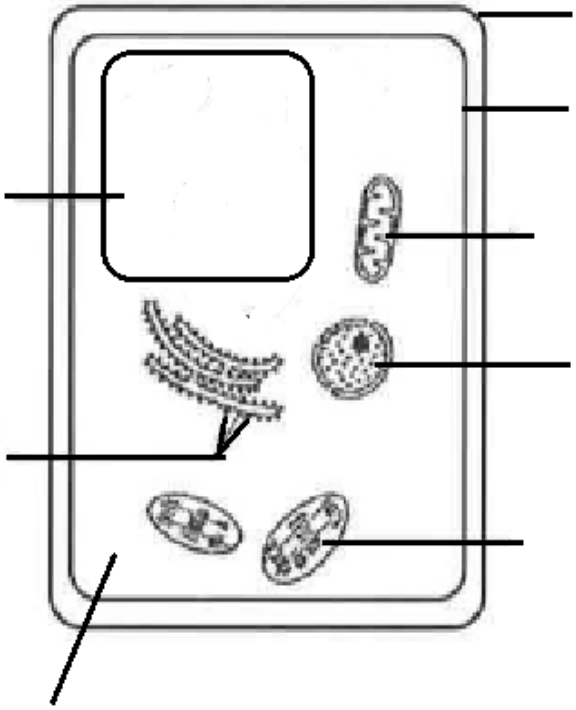
Cell Ultra Structure

Plant Cell

There are _____ key features in a plant cell.

However not all plant cells have all 8 structures e.g. plant roots/onion cells are not

_____ in colour and therefore do not contain any _____



Hint!

Don't get mitochondria and chloroplasts confused!

Mitochondria = wiggly line in middle

Chloroplast = stacks of discs

Cell Ultra Structure

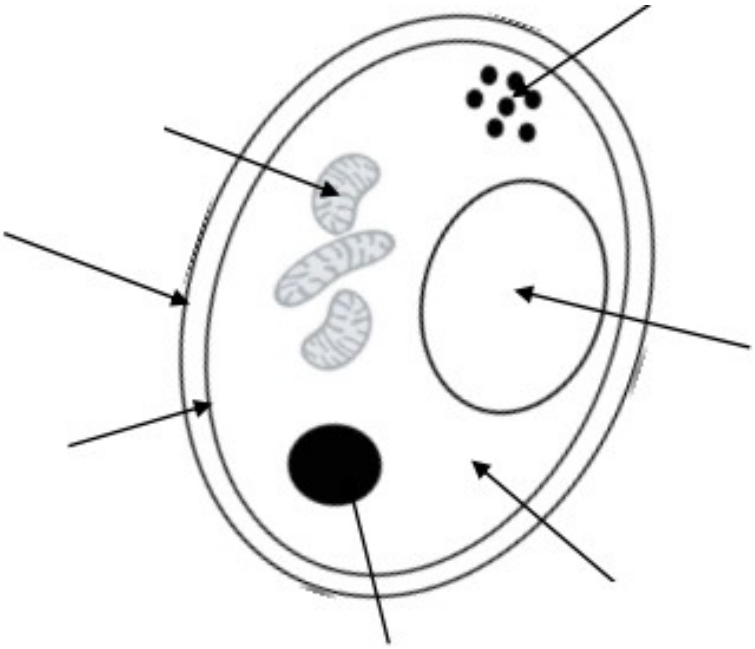
Yeast Cell

There are _____ key features in a yeast cell.

It is identical to a plant cell apart from TWO differences.

1. It is _____ in shape not _____ like a plant cell.

2. It does not contain any _____.



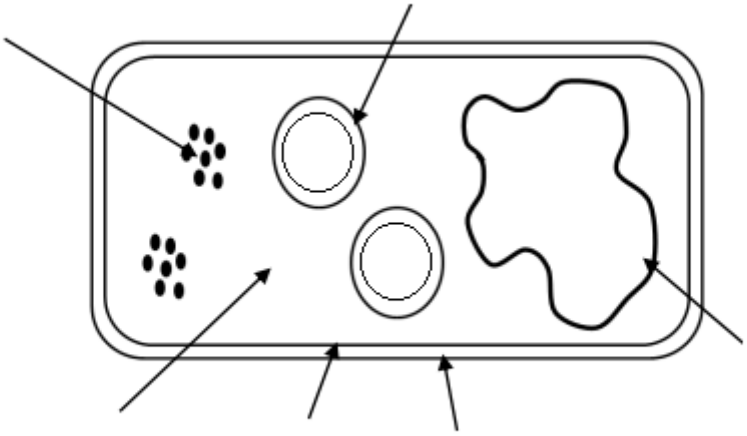
Cell Ultra Structure

Bacterial Cell

There are _____ key features in a bacterial cell.

There is an absence of _____ in bacterial cells e.g.

_____



Differences in cell wall composition

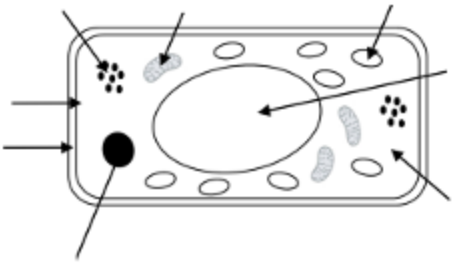
The cell wall is made of _____ in plant cells

but is made of different materials in _____ &

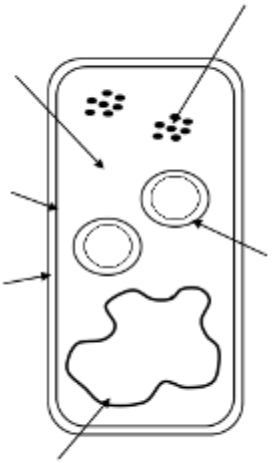
_____ cells

Cell Ultra Structure Mind map

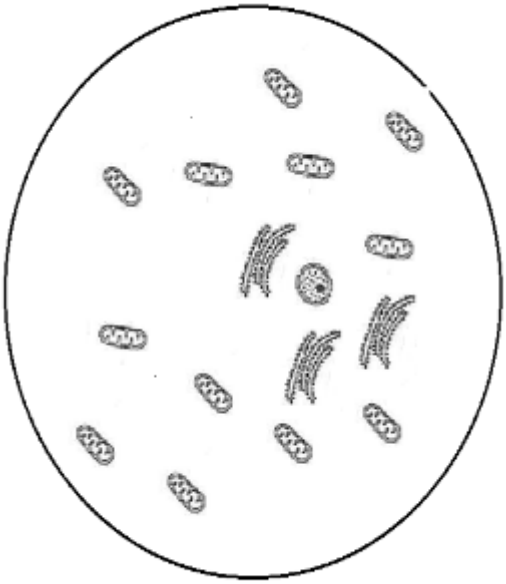
Plant cell



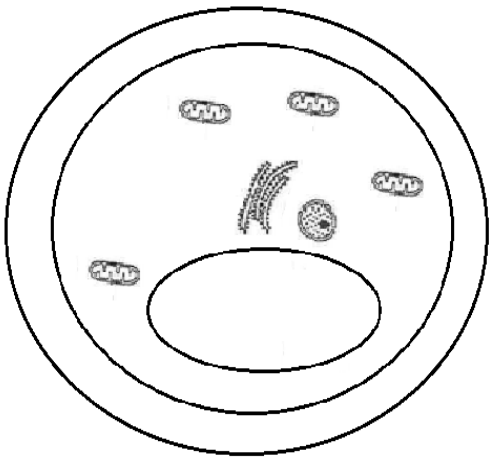
Bacterial cell



Animal cell



Yeast Cell

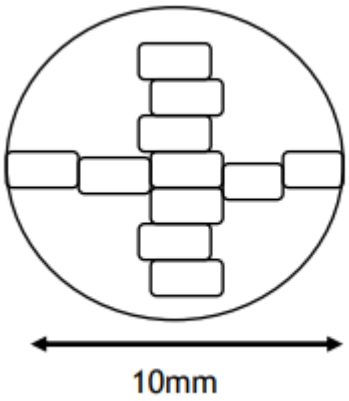


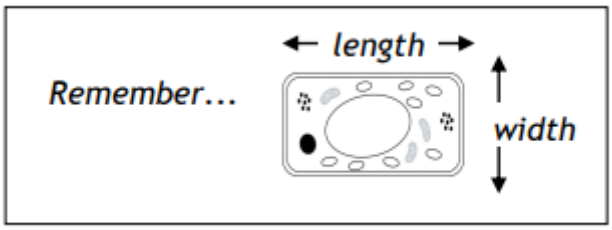
Cell Ultra Structure

Cell structure	Function	P	A	B	F
Ribosome					
Mitochondrion					
Cytoplasm					
Cell membrane					
Nucleus					
Cell Wall					
Vacuole					
Chloroplast					
Plasmid					
Free floating DNA					

Recap Cell Microscope Calculations

Calculate the average length & breadth of the potato cells in micrometres.



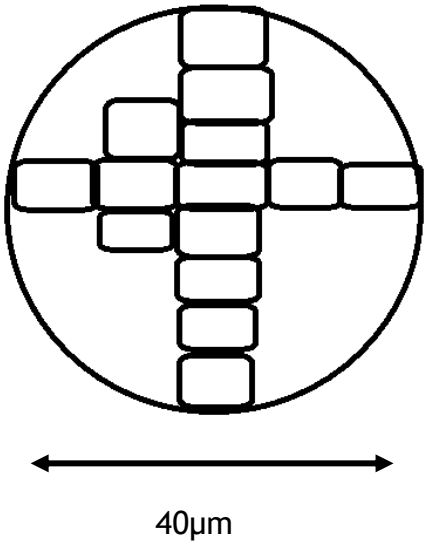


Average Length Calculation = 35µm/5 cells = 7µm

Average Breadth calculation 35µm/7 cells = 5µm

Example 1

Calculate the average length & breadth of the onion cells in micrometres.

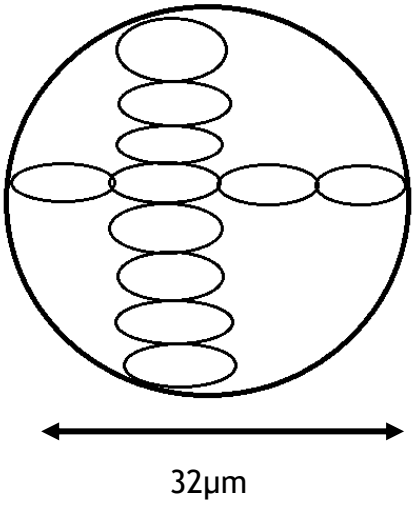


Average Length = _____µm

Average Breadth = _____µm

Example 2

Calculate the average length & breadth of the cheek cells in micrometres.

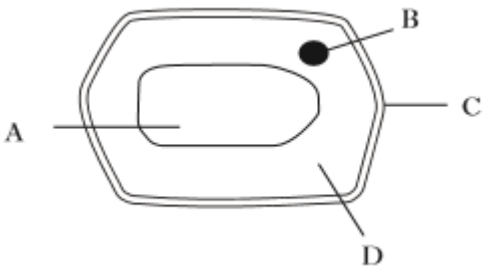


Average Length = _____µm

Average Breadth = _____µm

Self Assessment— Cell Ultra structure

Questions 1 and 2 refer to the plant cell diagram below.



1. Which of the plant cell components shown above is made from cellulose?

2. Which labelled part controls cell activities?

3. Which line in the table below correctly identifies the structures of a bacterium.

	Nucleus	Cytoplasm	Cell membrane
A	Present	Present	Present
B	Absent	Present	Present
C	Present	Present	Absent
D	Absent	Absent	Present

4. Which organelle below is responsible for protein synthesis?

A Vacuole
B Mitochondrion
C Chloroplasts
D Ribosomes

5. Which structural feature is found in a plant cell and not in an animal cell?

A Nucleus
B Cell wall
C Cell membrane
D Cytoplasm

6. Which of the following is NOT a correct statement?

A Only plant, fungal and bacterial cells have a cell wall
B All cells contain ribosomes
C All cells contain a nucleus
D All cells contain cytoplasm

7. State the organelle found in plant leaf mesophyll cells but not plant root cells.

A Vacuole
B Mitochondrion
C Chloroplasts
D Ribosomes

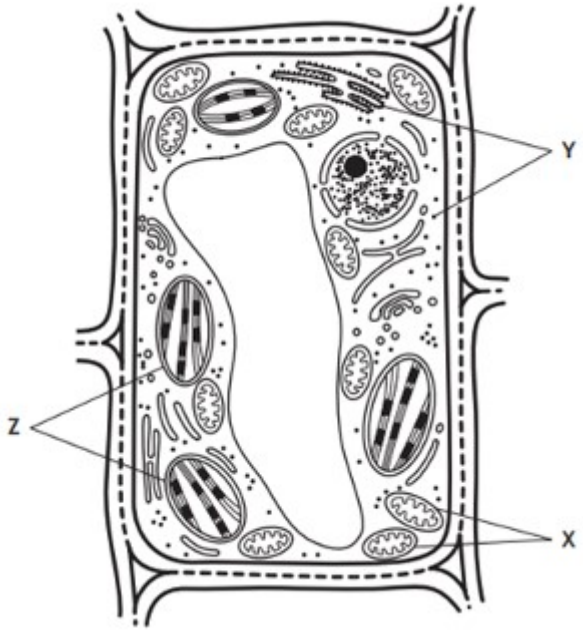
8. The site of aerobic respiration in a cell is the

A Vacuole
B Mitochondrion
C Chloroplasts
D Ribosomes

Self Assessment— Cell Ultra structure

1. A variegated leaf contains green and white areas. A student investigated cells from both these areas by looking at them under a microscope.

One of these cells is shown below.



a) State the name for the following organelles from the diagram above.

X _____

Y _____

Z _____ 3

b) Describe the function of organelle X

_____

_____ 1

c) The student concluded that this cell is from the green area.
Explain why the student's conclusion is correct.

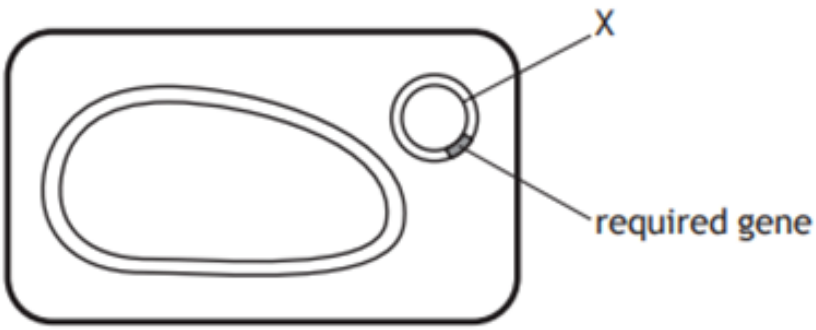
_____

_____

_____ 2

Self Assessment— Cell Ultra structure

2. The diagram below is a drawing by a student when viewing a particular type of cell under a microscope.



a) State the name for organelle X.

_____ 1

b) Describe the function of organelle X.

_____

_____ 1

c) This cell also contains an organelle that is the site of protein synthesis.

(i) Add this organelle to the diagram above

(ii) Name the organelle that is the site of protein synthesis

_____ 1

c) The student concluded that this cell is from a yeast cell.
Explain why the student's conclusion is incorrect.

_____

_____

_____ 2

Cell Ultra structure—Where am I in my learning?

Where am I in my learning?

Traffic light the following I can statements to decide how well you are progressing through this sub topic.

Review 1

I can label and state the function of the 5 parts to an animal cell: nucleus, cytoplasm, cell membrane, ribosomes and mitochondria.	
I can label and state the function of the 8 parts to a plant cell: nucleus, cytoplasm, cell membrane, ribosomes, mitochondria, vacuole, chloroplasts and cell wall.	
I can label and state the function of the 7 parts to a fungal (yeast) cell: nucleus, cytoplasm, cell membrane, ribosomes, mitochondria, vacuole, and cell wall.	
I can label and state the function of the 6 parts to a bacterial cell: cytoplasm, cell membrane, cell wall, ribosomes, plasmids and free floating DNA.	
I can explain that plant roots are not green but plant leaves are green as only leaves contain chloroplasts for photosynthesis.	
I can state that the cell wall in bacterial, yeast and plant cells are made of different substances. Only the plant cell wall is made of cellulose (carbohydrate).	
I can work out the average length/breadth of a cell in micrometers from a diagram looking at cells under a microscope.	

My next steps are:

_____

_____

Cell Ultra structure—Where am I in my learning?

Where am I in my learning?

Traffic light the following I can statements to decide how well you are progressing through this sub topic.

Review 2

I can label and state the function of the 5 parts to an animal cell: nucleus, cytoplasm, cell membrane, ribosomes and mitochondria.	
I can label and state the function of the 8 parts to a plant cell: nucleus, cytoplasm, cell membrane, ribosomes, mitochondria, vacuole, chloroplasts and cell wall.	
I can label and state the function of the 7 parts to a fungal (yeast) cell: nucleus, cytoplasm, cell membrane, ribosomes, mitochondria, vacuole, and cell wall.	
I can label and state the function of the 6 parts to a bacterial cell: cytoplasm, cell membrane, cell wall, ribosomes, plasmids and free floating DNA.	
I can explain that plant roots are not green but plant leaves are green as only leaves contain chloroplasts for photosynthesis.	
I can state that the cell wall in bacterial, yeast and plant cells are made of different substances. Only the plant cell wall is made of cellulose (carbohydrate).	
I can work out the average length/breadth of a cell in micrometers from a diagram looking at cells under a microscope.	

My next steps are:

_____

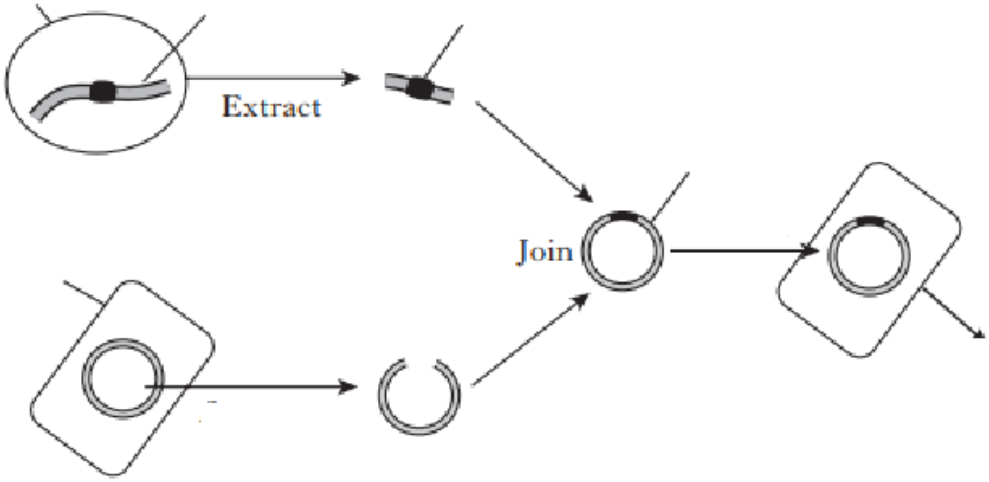
_____

Genetic Engineering

Genetic Engineering

_____ information is transferred from one _____ to another.

Stages of Genetic Engineering



Stage one

_____ section of DNA that contains required _____ from source _____

Stage Two

Extract required gene from chromosome using _____

Stage 3

Remove _____from bacterial cell and _____ open plasmid using same _____.

Stage 4

_____required _____ into bacterial plasmid using _____.

Stage 5

Insert _____into host _____ cell to produce a _____ organism.

Real Life Genetic Engineering Examples

Genetic Engineering for Medicine

Example 1

Human _____ gene inserted into _____ cell

Example 2

Human _____ gene inserted into _____ cell

Genetic Engineering for Food Production

These food are also called genetically modified i.e. _____ foods and is a

controversial topic due to potential _____ concerns.

Diagram

Example 1

Genes inserted to make tomatoes have longer _____.

Example 2

Genes inserted to make food _____ resistant

e.g. _____ resistance in potatoes.

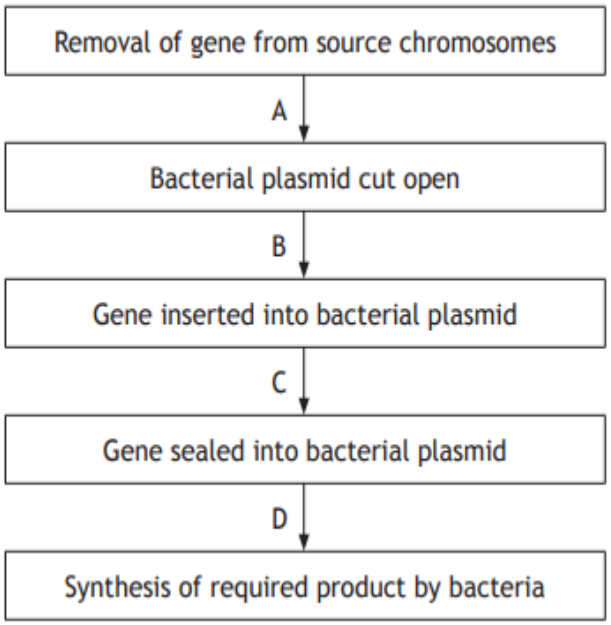
Example 3

_____ genes inserted into rice turning it _____.

Genetic Engineering Mindmap

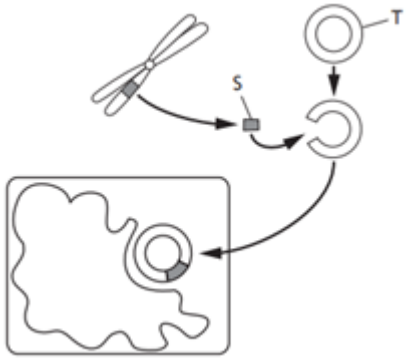
Self Assessment— Genetic Engineering

Q1. Some stages of genetic engineering are shown below.



Which letter indicates the stage where the plasmid is inserted into a bacterial cell?

Q2. The diagram below shows stages in the production of a substance such as insulin by genetic engineering.



Which line in the table below correctly identifies S and T?

	S	T
A	Gene	Plasmid
B	Gene	Bacterium
C	Chromosome	Plasmid
D	Chromosome	Bacterium

3. Which row in the table identifies the order of stages involved in genetic engineering?

	Stage in Genetic Engineering			
	1st	2nd	3rd	4th
A	Required gene identified	Gene and plasmid extracted	Gene inserted into plasmid	Modified cells grown
B	Required gene identified	Gene inserted into plasmid	Gene and plasmid extracted	Modified cells grown
C	Gene inserted into plasmid	Required gene identified	Modified cells grown	Gene and plasmid extracted
D	Gene inserted into plasmid	Modified cells grown	Gene and plasmid extracted	Required gene identified

Self Assessment— Genetic Engineering

1. Genetic engineering is used to produce growth hormone. The growth hormone gene is identified and removed from a human chromosome. This gene is then used in the genetic engineering process which involves a number of stages.

The table below shows the stages but they are not in the correct order.

a) Complete the table, entering a number (2 to 5) in each remaining box, to show the correct order for each stage. 1

Stages	*Number*
bacterial plasmid cut open	
bacteria multiply and synthesise growth hormone	
growth hormone gene inserted into bacterial plasmid	
bacterial plasmid removed from bacterium	1
bacterial plasmid inserted into bacterium	

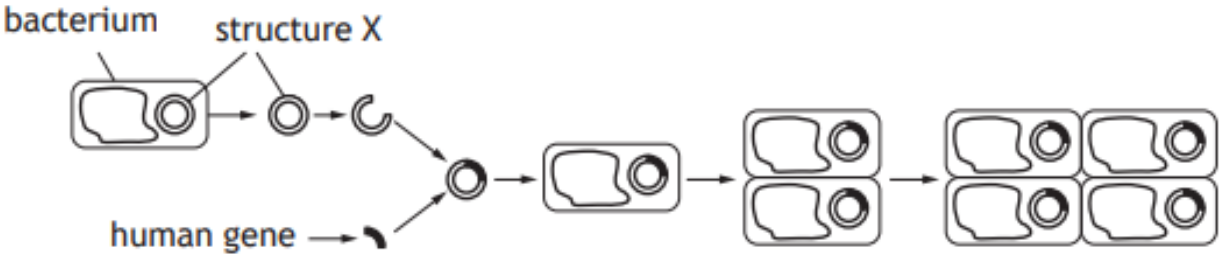
(b) Name another product of genetic engineering.

_____ 1

(c) Name the molecules used to cut open the bacterial plasmid.

_____ 1

2. The diagram below represents part of the process of genetic engineering.



Structure X is removed from the bacterium and modified during this process.

a) Name structure X.

_____ 1

The bacteria have an initial concentration of 1000 cells/cm3 . Each cell divides once every 30 minutes.

b) Calculate how long it will take for the concentration to become greater than 15 000 cells/cm^3 .

_____ hours 1

c) Describe what happens after the gene has been inserted into the bacterial plasmid.

_____

_____ 1

DNA

DNA Function

DNA carries the _____ information for making _____

The section of DNA which codes for _____specific protein is termed a _____.

Gene 1 example Gene 2 example Gene 3 example

Genetic Code

DNA carries the genetic code for proteins by its _____ different bases that join together in a specific way.

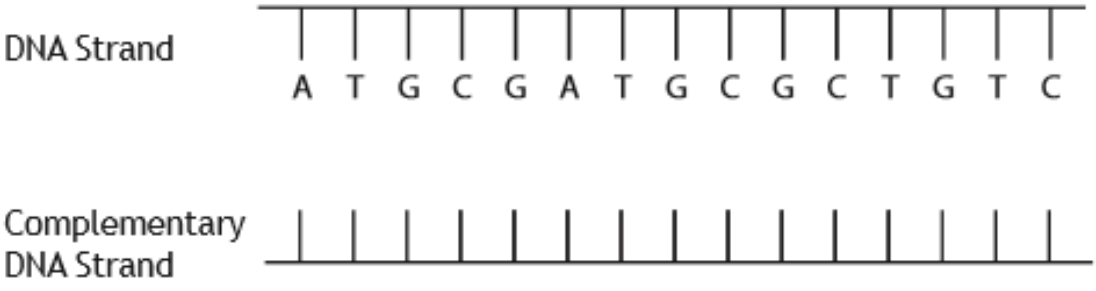
Complementary DNA bases (Handy Hint—Glasgow is a City, Ayr is a Town)

Base A called _____ always binds with base T called _____

Base C called _____ always binds with base G called _____

DNA Genetic Code Example

Complete the second strand of DNA below using the complementary base pair rule shown above which would code for 1 _____.



DNA Structure

DNA Structure

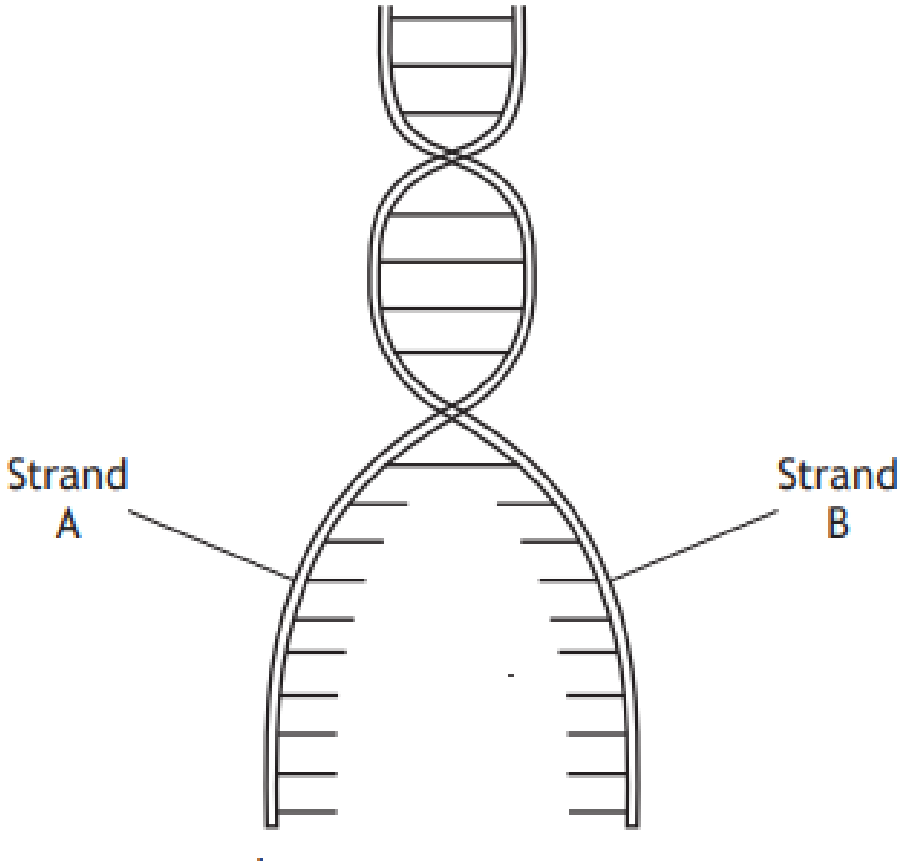
DNA is made up of _____ strands which coil together to form a _____

_____.

The two strands of DNA are held together by _____ base pairs.

Diagram

Add the 4 complementary bases to the following 3D structure of DNA



DNA Calculations

Worked Example 1 (easier)

If there are 1200 bases in total and 300 are adenine (A) – calculate how many are cytosine (C)?

A - 300 bases = T – _____bases so A & T = _____bases

G + C = 1200 bases– _____bases = _____bases for both G + C

Therefore, Guanine (G) = _____ divided by 2 = _____C bases

Worked Example 2 (easier)

If there are 400 bases that are cytosine (C) and 1000 bases in total on the two strands calculate how many are thymine (T)?

C - 400 = G – _____ so G & C =

A + T = 1000 bases – _____bases = _____bases for both G + C

Therefore, Thymine (T)= _____ divided by 2 = _____T bases

Worked Example 3 (harder—extra final step)

If there are 4000 bases in total and 10% are thymine (T), calculate the number that are guanine (G)?

T - 10% of bases = A - _____% of bases = _____% of bases are A and T

G + C bases = 100%- _____% = _____% bases left are G & C

Therefore Guanine (G) = _____% divide by 2 = _____% of bases are G

Now find 40% of the total (4000 bases) = 40/100 X _____ = _____G bases

DNA Calculations—easier

1. There are 5000 bases in total in each example below. Using the information below calculate the number of the relevant bases.

(i) If there are 1000 adenine (A) bases, calculate the number of cytosine (C) bases.

(ii) If there are 500 guanine (G) bases, calculate the number of thymine (T) bases,

(iii) If there are 600 thymine (T) bases, calculate the number of guanine (G) bases

2. If there are 2000 bases in total and 100 are cytosine (C) – calculate how many are cytosine (C)?

DNA Calculations— harder

3. If there are 3000 bases in total and 10% are thymine (T), calculate the number that are guanine (G)?

4. If there are 5000 bases in total and 20% are guanine (G), calculate the number that are adenine (A)?

5. If there are 800 bases in total and 30% are cytosine (C), calculate the number that are Thymine (T)?

6. If there are 1400 bases in total and 25% are adenine (A), calculate the number that are cytosine (C?

Making Proteins

Problem with protein synthesis

DNA is found in the _____ of the cell and is the _____ information that codes for _____ that are made at the _____.

However as DNA is _____ stranded it is too _____ to pass through the _____ _____ nuclear membrane to go to the ribosome.

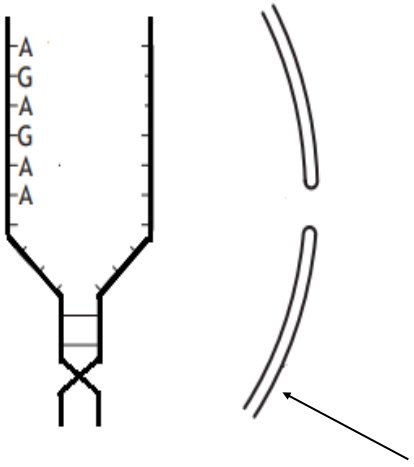
Task

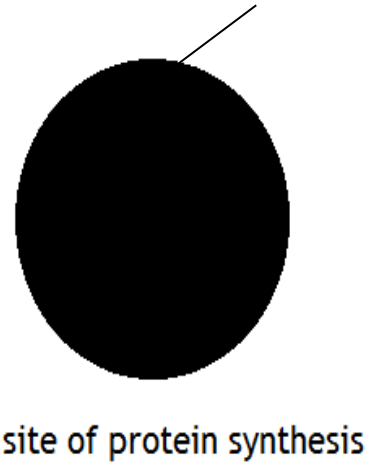
Add the following labels to the diagram:

ribosome nuclear membrane DNA strand 1 & 2 cytoplasm.

Task 2

Complete the complementary DNA bases on the second DNA strand below.





Making Proteins

Solution

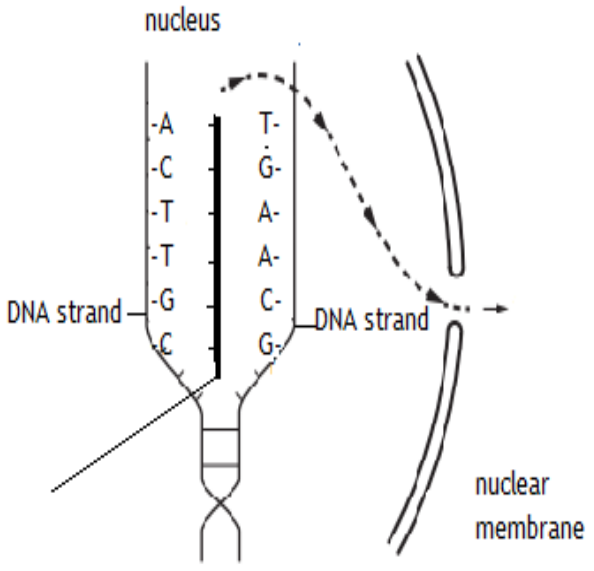
DNA makes a _____ stranded copy of the genetic code by _____ base pairing one of the two original DNA strands.

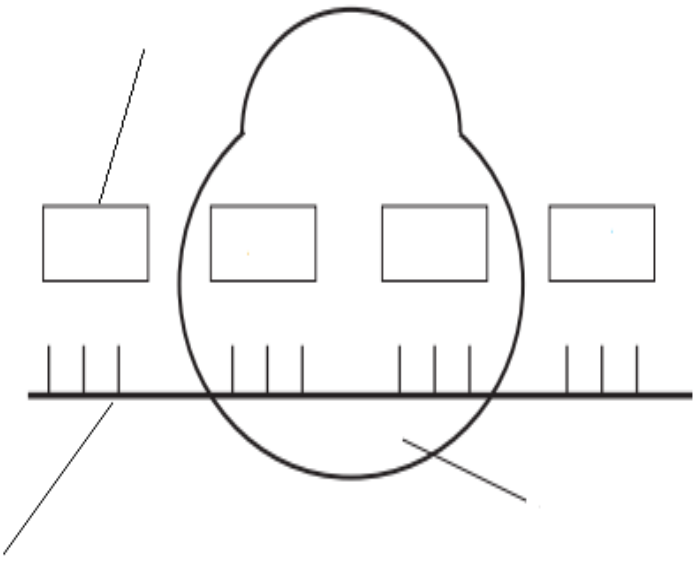
The newly synthesised molecule is called _____ (mRNA)

Function of mRNA

Carries a _____copy of the genetic code from the _____to the _____.

Depending on the mRNA code specific _____ _____ are assembled in a specific _____ producing a particular _____.





Making Proteins

There are only 20 different amino acids that make up all the different types of proteins. For some amino acids there is more than 1 base sequence which codes for the particular amino acid.

Using the table on the next page, find the amino acid sequence for the following base sequence.

1 a) Base Sequence - ATA AAT GGG AAA TAT

Amino acid Sequence _____

b) Amino Acid Sequence—serine arginine leucine tyrosine lysine

Base Sequence _____

c) Amino Acid Sequence— tryptophan alanine isoleucine cysteine glutamic acid

Base Sequence _____

2. State which word this base code is spelling out using the table on the next page

ATA CTG AAT GTG GAG GCA ATA AAT CTG AAT GGG TAT

Amino Acid Sequence

_____

Our alphabet

_____

Making Proteins

Decoding base sequences

Our Alphabet	Amino Acid	Base Sequence
A	Alanine	GCT
B	Alanine	GCA
C	Cysteine	TGC
D	Aspartic Acid	GAT
E	Glutamic Acid	GAG
F	Phenylalanine	TTT
G	Glycine	GGG
H	Histidine	CAT
I	Isoleucine	ATA
J	Isoleucine	ATC
K	Lysine	AAG
L	Leucine	CTG
M	Methionine	ATG
N	Asparagine	AAC
O	Asparagine	AAT
P	Proline	CCC
Q	Glutamine	GAG
R	Arginine	CGT
S	Serine	TCA
T	Threonine	ACT
U	Threonine	ACG
V	Valine	GTC
W	Tryptophan	TGC
X	Tryptophan	TAC
Y	Tyrosine	TAT
Z	Tyrosine	AAA

Making Proteins

Using the table on the last page, find the DNA base sequence and Amino Acid sequence for your first name.

Your First Name _____

Amino Acid Sequence _____

_____

Base Sequence _____

_____

Create your own base sequence code and get a friend to decode it.

Base Sequence _____

_____

_____

Decoded message (our alphabet)

_____

_____

_____

Different proteins

There are many different types of proteins produced at the ribosome which all have different _____ & _____.

Important protein functions

Name of Protein	Protein Function	Shape of Protein
Structural proteins		
Hormones		
Enzymes		
Antibodies		
Receptors		

Different proteins

Producing different proteins

Different DNA _____ sequence

↓

Different _____ sequence

↓

Different protein _____ & _____

Example 1 - Enzyme

Example 2—Antibody

DNA sequence

Amino Acid

Protein Shape

Protein function

Self Assessment— DNA & Proteins

Q1. Which of the following shows the correct DNA base pairing?

A
A – C
C – G
G – C
T – A

B
A – T
C – G
G – T
T – A

C
A – G
C – G
G – A
T – A

D
A – T
C – G
G – C
T – A

Q2. Hormones are composed of

A glycerol

B glucose

C protein

D starch.

Q3. Proteins have different functions. Which of the following statements identifies a protein and its function?

A Hormones carry oxygen around the body.

B Enzymes carry chemical messages around the body.

C Antibodies defend the body against disease.

D Cellulose provides strength and structure to a plant cell wall.

4. Which is the complementary base of Thymine?

A cytosine
B adenine
C adenosine
D guanine

5. Which of the following molecules carries a complementary version of the genetic code from nucleus to ribosome?

A DNA
B amino acids
C mRNA
D proteins

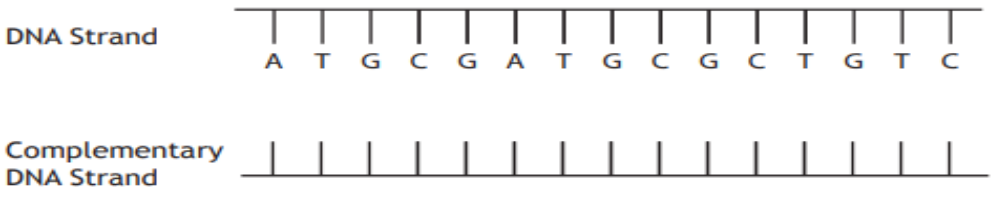
6. If a DNA sequence is altered which of the following is NOT affected?

A amino acid sequence
B protein structure
C protein function
D ribosome

DNA Self Assessment

1. DNA is a double stranded molecule. The following diagram shows part of one strand.

a) Complete the diagram to show the complementary strand.



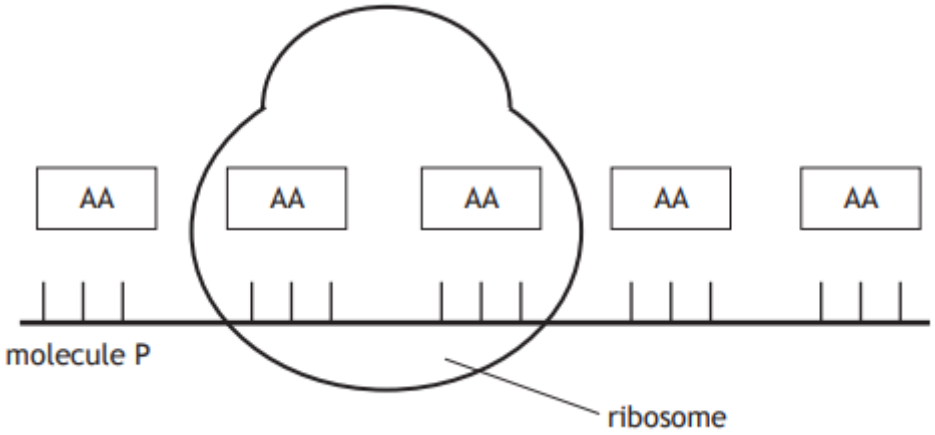
1

b) DNA contains genetic material which controls the synthesis of chemicals made from amino acids.

Name the type of chemicals synthesised.

_____ 1

The diagram below shows an example of one of these chemicals being synthesised.



c) Name molecule P and describe how it determines the sequence of amino acids, represented by AA , as shown in the diagram.

Molecule P _____

Description _____

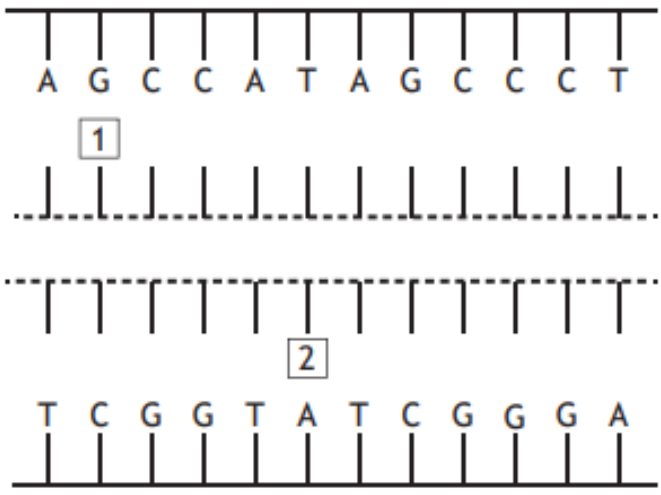
_____ 2

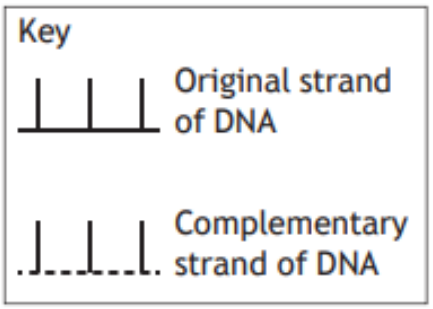
d) Name the part of the cell where molecule P was made.

_____ 1

DNA Self Assessment

2. (a) Forensic scientists can take small quantities of DNA and use a process to make large quantities. Each DNA molecule is separated and used to make two complementary strands as shown below.





Give the full names of bases labelled 1 and 2 in the diagram above. **2**

1 _____

2 _____

(b) The bases in a strand of DNA make up the code for the production of proteins. The DNA for every individual person varies.

Describe the way in which this code differs from person to person. **1**

_____

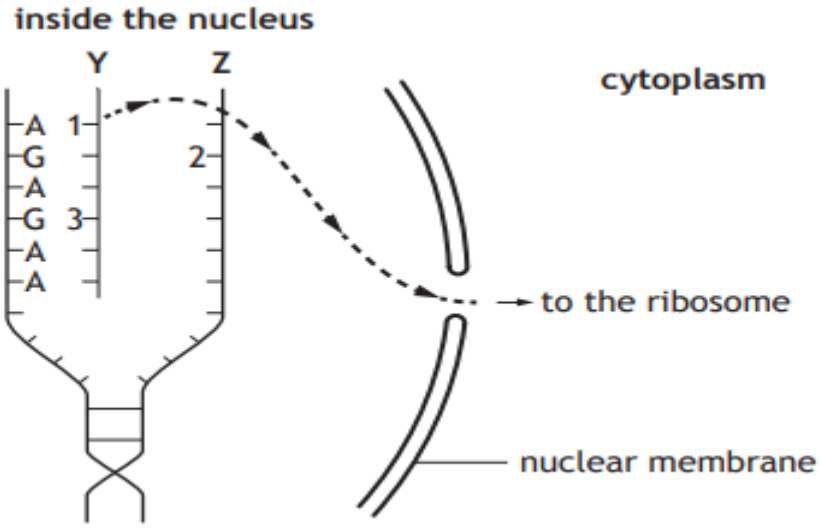
_____

(c) Name the single stranded molecule which carries a complementary copy of the code from the DNA in the nucleus to the ribosome for protein synthesis. **1**

_____

DNA Self Assessment

3. The diagram below shows how genetic information in the nucleus is used in the first stage of making a protein.



(i) Name molecule Y.

_____ 1

(ii) Underline one option in each bracket to make the following sentences correct.

1. The molecules represented by the letter **A** are { bases / genes / proteins }
2. The complementary strand **Z** would have the letter { A / C / G / T } at position **2** in the diagram.

2

b) Name the basic units which are joined together to make a protein at the ribosome.

_____ 1

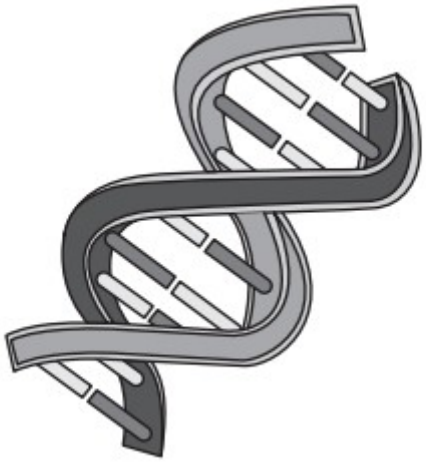
c) The diagram above shows a section of the code to make a protein such as amylase. Describe how the code to make the protein insulin would differ from this.

_____

_____ 1

DNA Self Assessment

4. DNA contains the genetic information which is used to make proteins in a cell. The diagram below represents part of a DNA double helix.



a) Describe how the sequence of amino acids in a protein is coded for by DNA.

_____

_____ 1

b) Describe two effects that a change in the sequence of amino acids would have on a protein.

_____

_____ 2

c) Name one protein made in a pancreas cell.

_____ 1

Enzymes: Lock & Key Theory

Enzymes function as _____in all _____ cells.

Biological catalysts

_____cellular reactions and remain

_____in the process.

Lock and Key theory

Enzymes interact with a molecule called a _____at the enzyme's _____.

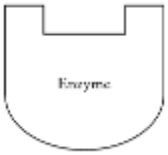
This causes an _____ complex to form facilitating the formation of a _____.

Draw a diagram of the substrate, enzyme, enzyme-substrate complex product and active site in the space below.

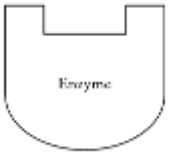
Specific Enzymes

Enzymes only interact with _____ type of substrate molecule .

This is because the _____of the enzyme's active site of is _____ to its specific _____.



Substrate is specific to enzyme



Substrate is NOT specific to enzyme

Factors affecting Enzyme Activity

Factors affecting Enzyme Activity

All proteins including enzymes are affected by

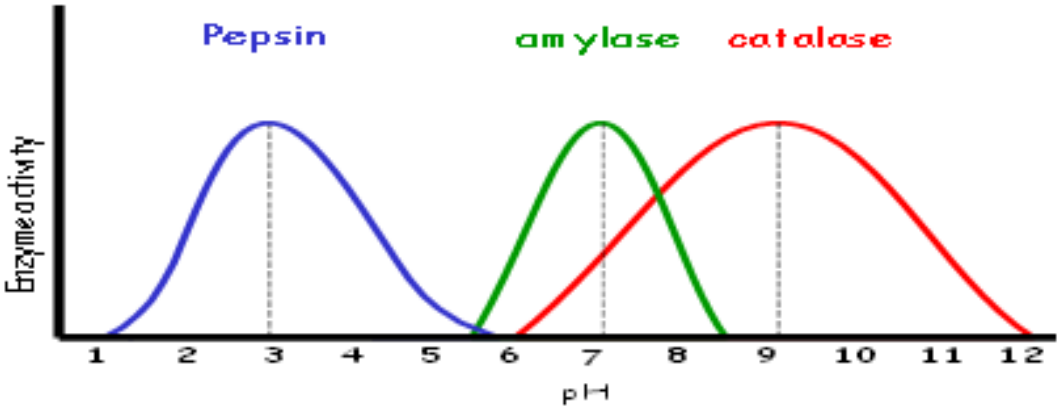
1. _____ 2. _____

<u>Optimum Conditions</u>

The temperature at which an enzyme is **most active** is termed its _____ temperature and is ALWAYS _____°C in humans.

Each enzyme has its own optimum pH - there is no need to learn the optimum pH for each enzyme.

Using the graph below state the optimum pH for the following enzymes



(i) Pepsin _____

(ii) Amylase _____

(iii) Catalase _____

Denatured Enzymes

Denatured Enzymes

High temperatures above _____°C OR pH outside the enzyme's working range cause the enzyme to _____.

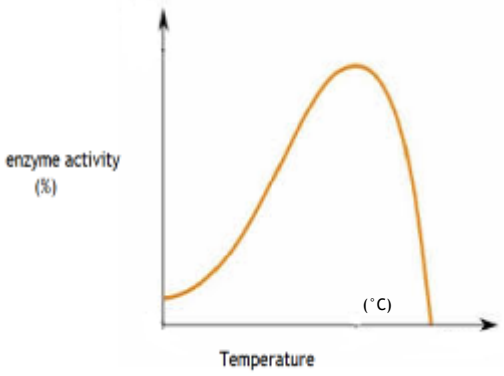
This means the _____ of the _____ is destroyed meaning the enzyme will no longer bind to the _____ which will increase/decrease reaction rate.

<u>Denatured enzyme diagram</u>

Denatured Enzyme—Quick Revision

Annotate on the graph on the right hand side the following key points:

a) Optimum temperature
b) When enzyme is denatured



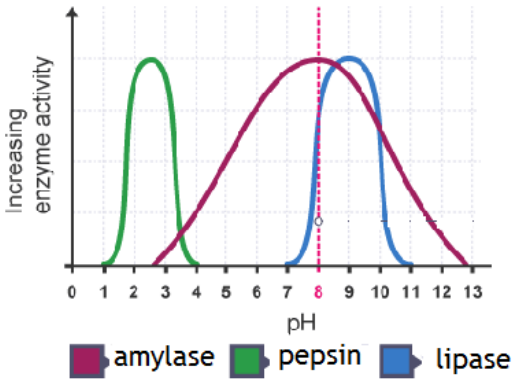
Using the second graph below answer the following questions.

1. State which enzyme (s) will be denatured at pH 3?

   _____

2. State which enzyme works over the biggest pH range?

   _____



Degrading Enzymes

Degrading Enzymes

These enzymes are commonly used during _____ to break down

_____ molecules into _____ more soluble molecules.

Diagram

Examples of degrading enzymes

1. _____

2. _____

3. _____

4. _____

Diagram

Draw the substrate, enzyme, active site, substrate-enzyme complex and products for a degrading enzyme reaction in the space below.

Synthesising Enzymes

Synthesising Enzymes

These enzymes build up (synthesise) _____ substrate molecules into _____ product molecules.

Diagram

Example of Synthesising enzyme

The only synthesising enzyme you need to know is found in plants and is called

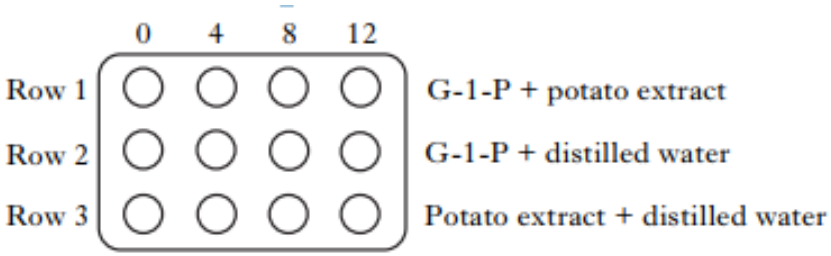
_____.

Lock and Key theory

Draw the substrate, enzyme, active site, substrate-enzyme complex and products in the space below.

Synthesising Enzyme Experiment

In an investigation into the synthesis of starch from glucose-1-phosphate (G-1-P) by the enzyme phosphorylase, a tile was set up as shown below. Starch-free potato extract was used as the source of phosphorylase and three rows were set up and the starch produced measured at 4 minute intervals from 0 minutes to 12 minutes by adding iodine which should turn the solution blue black.



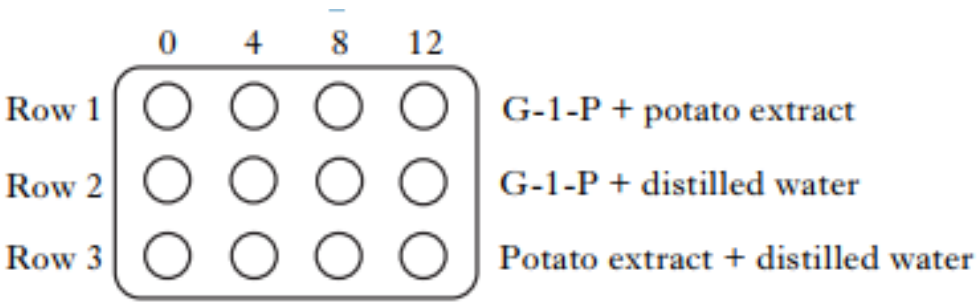
Row 2 and Row 3 were set up as controls. Explain why these controls were set up.

Row 2 _____

_____

Row 3

Complete the results below on the diagram.



Synthesising Enzyme Experiment

Give a reason why it could be suggested that the results of the experiment could be said to be unreliable.

_____

_____ 1

Name two variables that should be controlled in this experiment to ensure valid results.

1. _____

2. _____ 2

Potatoes are normally a rich source of starch. Explain why the source of potato extract had to have the starch removed before the experiment began.

_____

_____ 1

In this experiment name the following molecules.

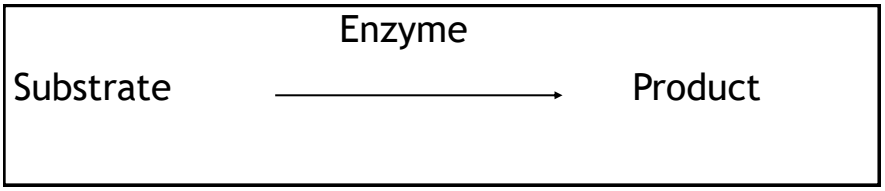
(i) Substrate _____

(ii) synthesising enzyme _____

(iii) product _____ 3

Degrading & Synthesising Enzymes

Word equations are used to illustrate the stages in degradation and synthesis reactions in the format.



Degrading Enzyme Word equations

amylase → SAM

pepsin → PPAA

lipase → FLAG

catalase → HPCOW

Synthesising Enzyme Word equations

phosphorylase → G1PPS

Degrading & Synthesising Enzymes

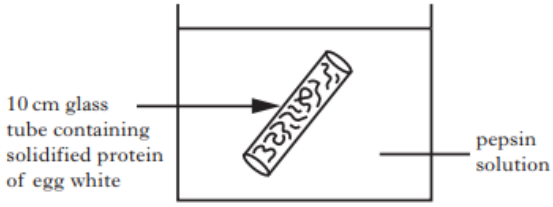
Complete the grid below using terms related to your learning on enzymes. The first box has been completed for you.

Answer the following questions read out by your teacher and first person to cross out all words to shout out BINGO!

Degrading reaction			

Enzyme Past Papers

1. An investigation was carried out into the effect of pH on pepsin activity. Four experiments were set up as shown in the diagram below at pH 2, 5, 7 and 10.



The table below shows the lengths of the protein after one hour at each pH.

pH	*length* (cm)
2	6
5	8
7	9
10	10

What is the optimum pH for pepsin?

A pH2

B pH5

C pH7

D pH10

2. The enzyme phosphorylase was added to a 4% glucose-1-phosphate solution. After one hour, the concentration of glucose-1-phosphate had fallen to 0·1%. How many times lower was the concentration after one hour than at the start?

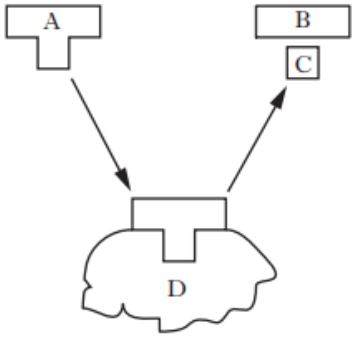
A 97·5

B 40·0

C 3·9

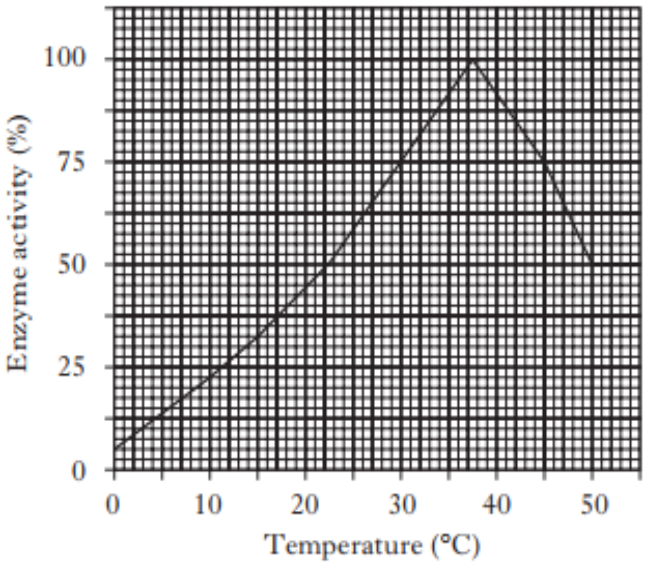
D 0·1

3. The diagram below represents a degradation reaction involving an enzyme.



Which letter identifies the substrate?

4. The graph below shows the effect of temperature on the activity of an enzyme.



The increase in enzyme activity (%) as the temperature rises from 22·5 °C to 30 °C is

A 25

B 50

C 67

D 75.

Enzyme Past Papers

5. Which term refers to the process by which complex molecules are formed from simple molecules?

A Digestion

B Synthesis

C Degradation

D Respiration

6. Which of the following correctly describes amylase?

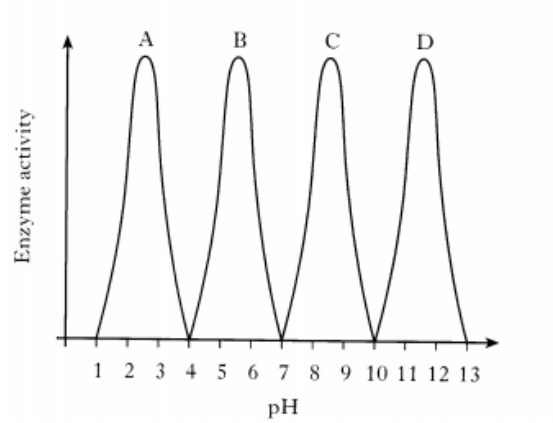
A It breaks down starch into amino acids.

B It builds up glucose-1-phosphate into starch.

C It breaks down proteins into peptides.

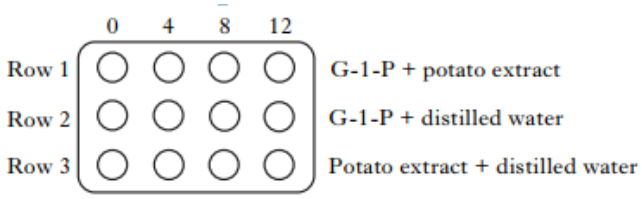
D It breaks down starch into maltose.

7. The following graph shows the results of an investigation into the effect of pH on the activity of four enzymes



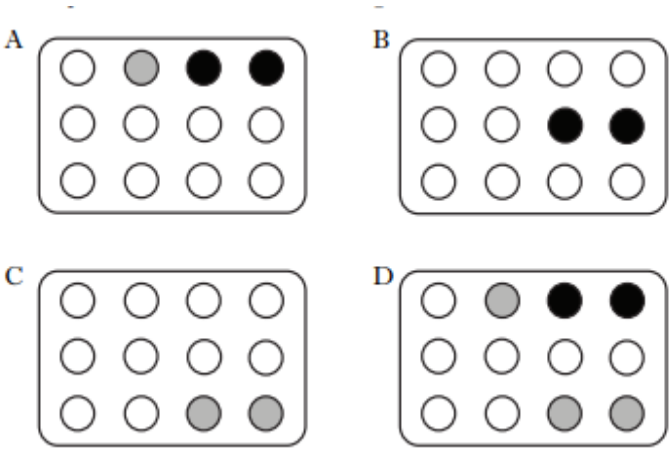
Which one of these could be pepsin in the stomach.

8. In an investigation into the synthesis of starch from glucose-1-phosphate (G-1-P) by the enzyme phosphorylase, a tile was set up as shown below. Starch-free potato extract was used as the source of phosphorylase



.

Iodine solution was added to the columns at the time intervals shown. Which of the following tiles shows the expected result of this investigation?



9. A reaction takes place because the active site of an enzyme is complementary to

A one type of substrate molecule

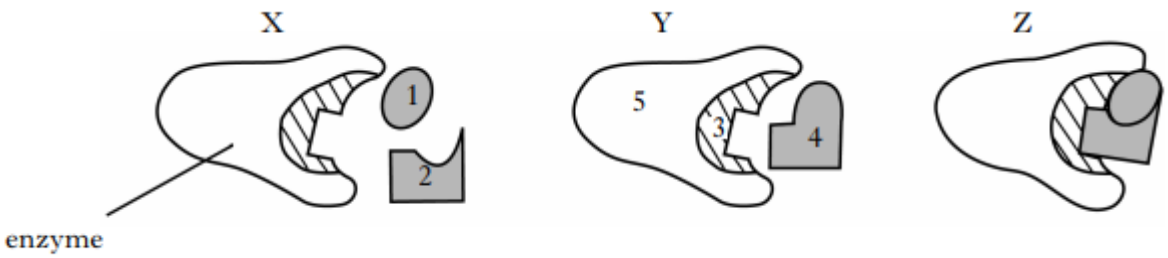
B all types of substrate molecule

C one type of product molecule

D all types of product molecules

Enzyme Past Papers

1. The diagram below shows three stages X, Y and Z that occur when an enzyme converts its substrate into a product.



This enzyme promotes the breakdown of a complex molecule into simpler molecules.

(i) Put the stages into the correct order to show this degradation reaction. 1

_____ → _____ → _____

(ii) Which number in the diagram shows the active site?

_____ 1

(b) Complete the following sentence by underlining the correct word from the choice in brackets.

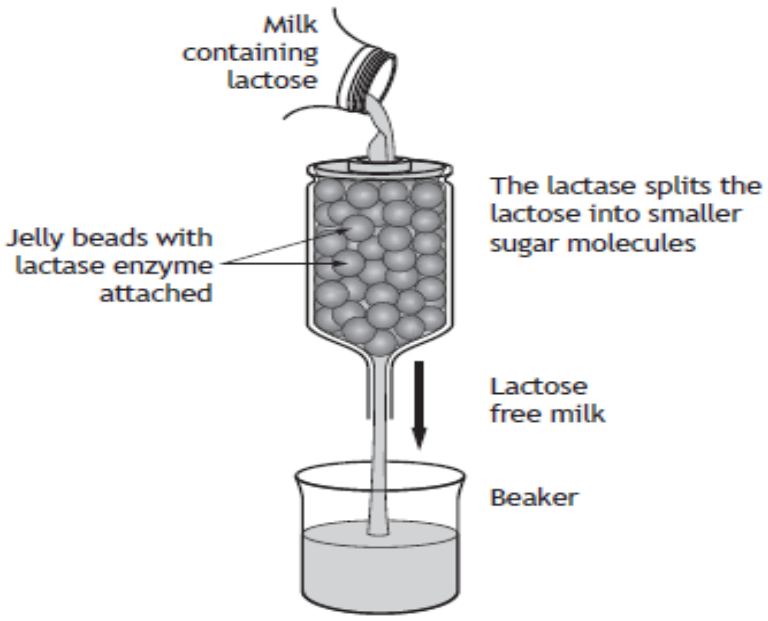
Enzymes are made of fat / protein/carbohydrate 1

(c) Describe what happens to an enzyme when it is denatured.

_____

_____ 1

2. The diagram below shows how the enzyme lactase is used in the production of lactose-free milk.



(a) (i) Underline one option in each of the brackets to make the following sentences correct. 2

This process is an example of a {degradation / synthesis} reaction.

In this reaction, lactose is the {product / substrate} of lactase.

(ii) A fault in the production resulted in boiling water running over the lactase enzyme.

Using your knowledge of enzymes, predict how the milk produced would differ from the expected product.

Explain your answer. 2

Prediction _____

_____

Explanation _____

_____

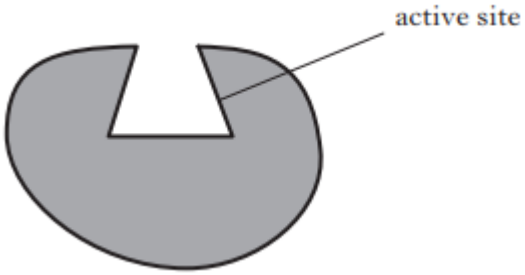
(b) Enzymes such as lactase are biological catalysts.

Explain the role of enzymes in living cells. 1

_____

_____

3. The diagram below represents an enzyme which carries out a synthesis reaction.



a Describe what is meant by the term "synthesis reaction"

_____

_____ 1

b Explain why a denatured enzyme no longer works.

_____

_____

_____ 2

C Name a factor, other than temperature, which affects enzyme activity.

_____ 1

d Complete the following word equation for the enzyme catalase. 1

hydrogen peroxide $\xrightarrow{\text{catalase}}$ _____ and _____

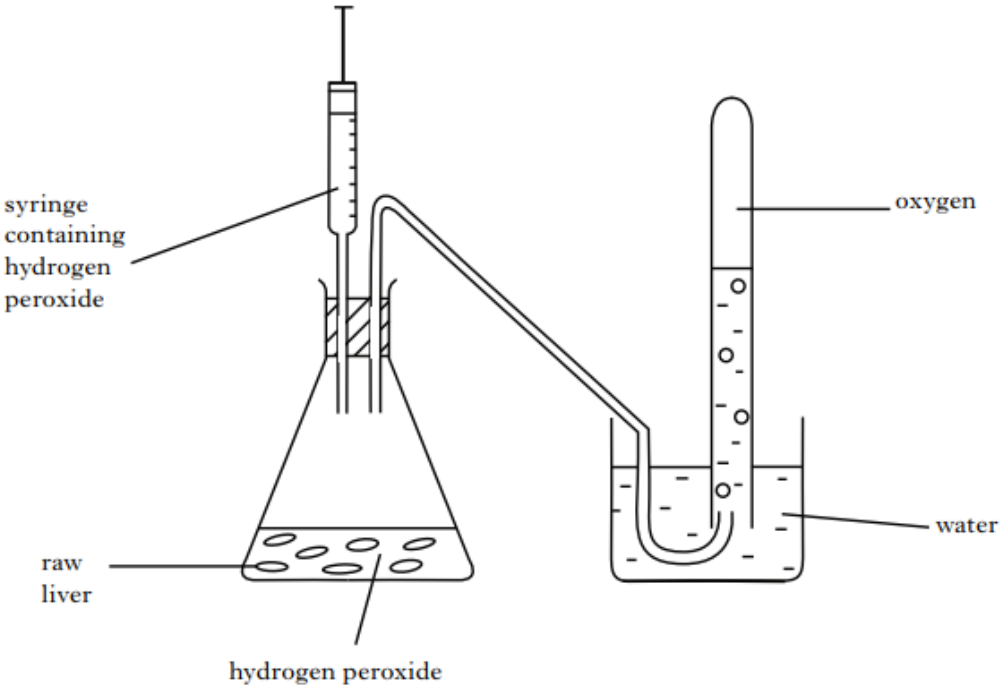
substrate **products**

Enzyme Experiments

4. Liver contains the enzyme catalase which carries out the following reaction.

hydrogen peroxide ⟶ water + oxygen

The investigation shown below was carried out to demonstrate the effect of pH on catalase activity in liver. Hydrogen peroxide of different pH values was added to 1 g of chopped raw liver.



The time taken to collect 1cm^3 of oxygen was recorded and the results are shown in the table below.

pH of hydrogen peroxide solution	*Time to collect 1 cm^3 of oxygen* (seconds)			*Average time to collect 1cm^3 of oxygen* (seconds)
	Trial 1	*Trial 2*	*Trial 3*	
7	76	77	81	78
8	56	58	57	57
9	50	45	40	45
10	53	50	53	52
11	59	69	70	66

Enzyme Experiments

a) Name the independent variable altered in this investigation

_____ 1

b) From the table, state the optimum pH for catalase in liver

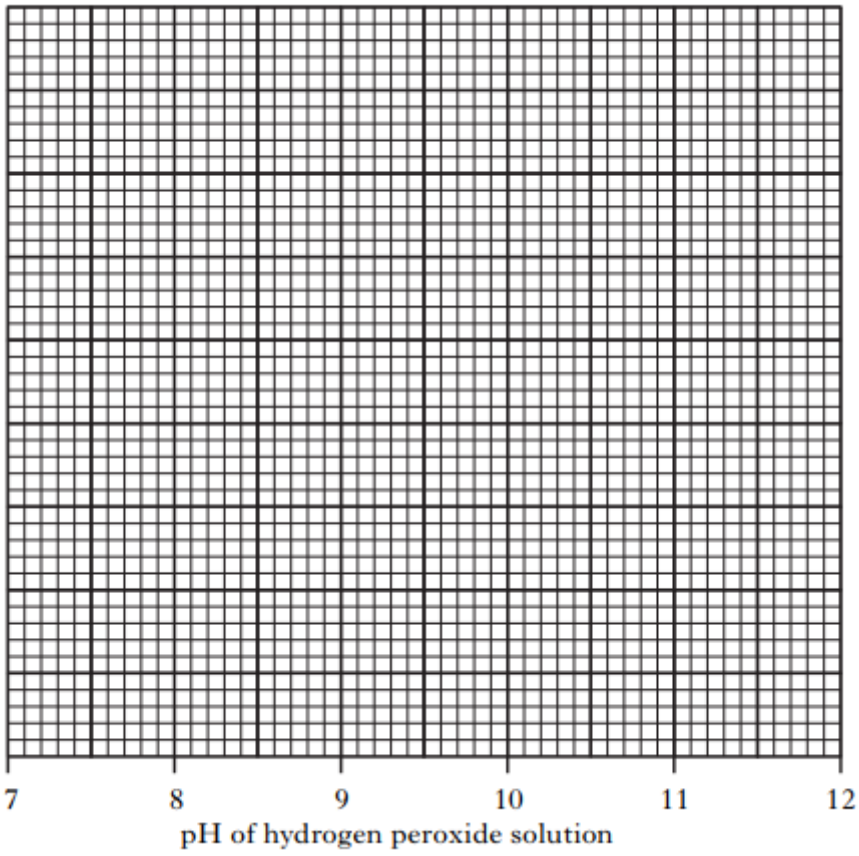
_____ 1

c) Explain why the experiment was repeated at each pH value and averages calculated.

_____

_____ 1

d) Draw a line graph of the average time taken to collect 1 cm3 of oxygen against pH of hydrogen peroxide solution.



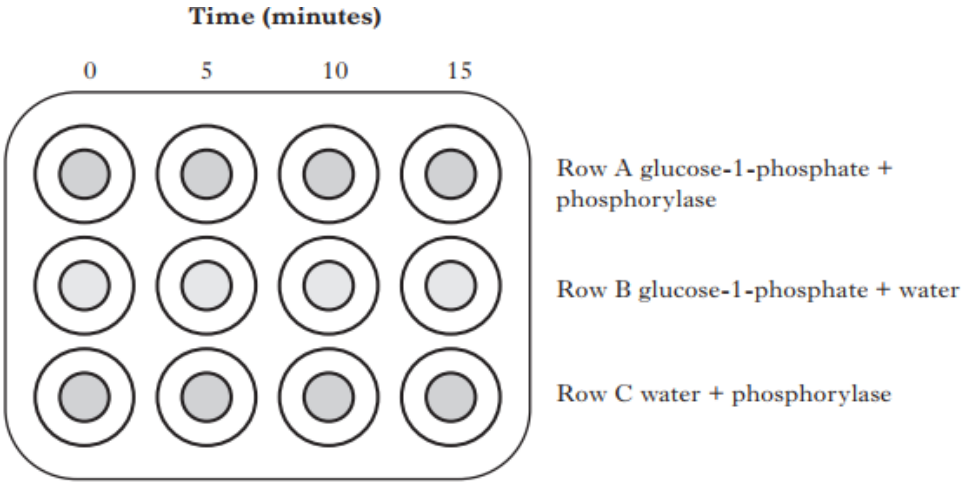
2

e) Predict the average time to collect 1 cm3 of oxygen at pH12.

_____ seconds 1

Enzyme Experiments

5. The diagram below shows an investigation into the activity of the phosphorylase enzyme. A spotting tile was set up as shown below. Each column was then tested at the times shown.



(i) Name the product formed in row A.

_____ 1

(ii) Name the chemical that could be used to identify this product.

_____ 1

(iii) Row C acts as a control. Explain the purpose of this control.

_____

_____ 1

(b) Decide if each of the following statements about enzymes is True or False, and tick (¤) the appropriate box. If the statement is False, write the correct word(s) in the Correction box to replace the word underlined in the statement.

Statement	True	False	Correction
During denaturation, the substrate changes shape			
Amylase is a synthesis enzyme			
Lipase breaks down protein			

6. Catalase, an enzyme found in living tissues, is involved in the breakdown of hydrogen peroxide into water and oxygen.

In an investigation, catalase was extracted in solution from a variety of tissues and used to soak paper discs. These discs were then dropped into beakers of hydrogen peroxide, as shown in Diagram 1. As the oxygen was released the discs returned to the surface, as shown in Diagram 2.

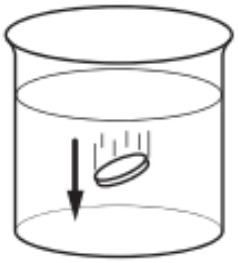


Diagram 1

Diagram 2

The time taken for these discs to return to the surface was recorded and shown in the table.

Type of tissue	*Time for disc to return to the surface* (s)
Apple	108
Banana	44
Carrot	68
Liver	8
Onion	70
Potato	72

(a) Describe the aim of this investigation.

_____

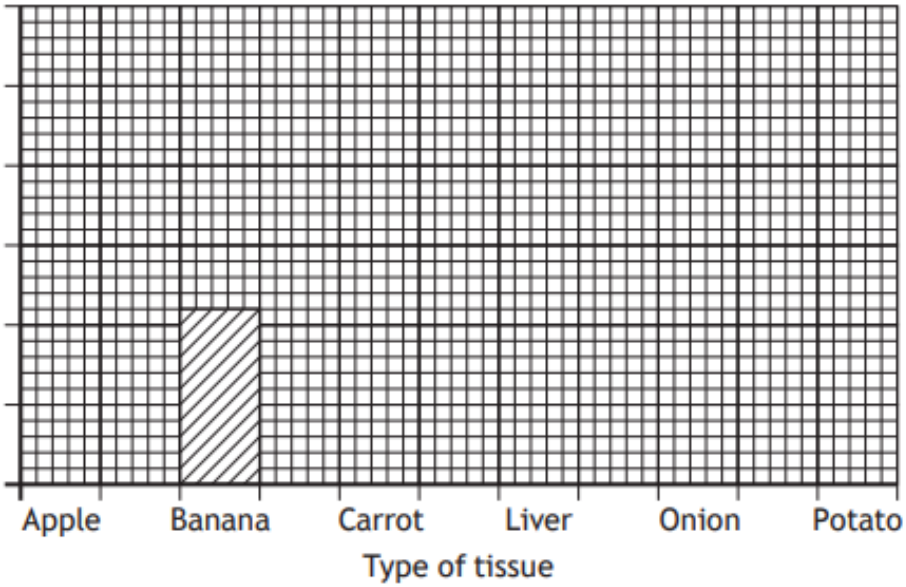
_____ 1

(b) State the independent variable.

_____ 1

C) On the grid below, complete the vertical axis and the remaining bars to show the time taken for the discs to return to the surface, for each tissue. **2**

(An additional grid, if required, can be found on *Page 26*)



d) The aim of the experiment was to investigate catalase activity in a variety of tissues.

Using the information given, write an appropriate conclusion for this experiment. **1**

Conclusion _____

_____

_____

e) The experiment was carried out at pH 7, the optimum pH for catalase.

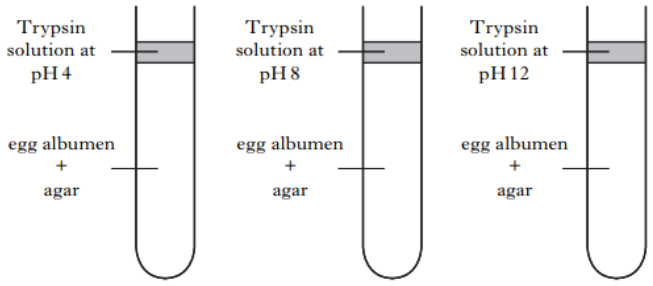
Complete the following sentence, using the words **increase, decrease** or **stay the same**, to predict what would happen if the experiment was repeated at pH 4. **1**

At pH 4, the rate of oxygen production would _____

in each tissue.

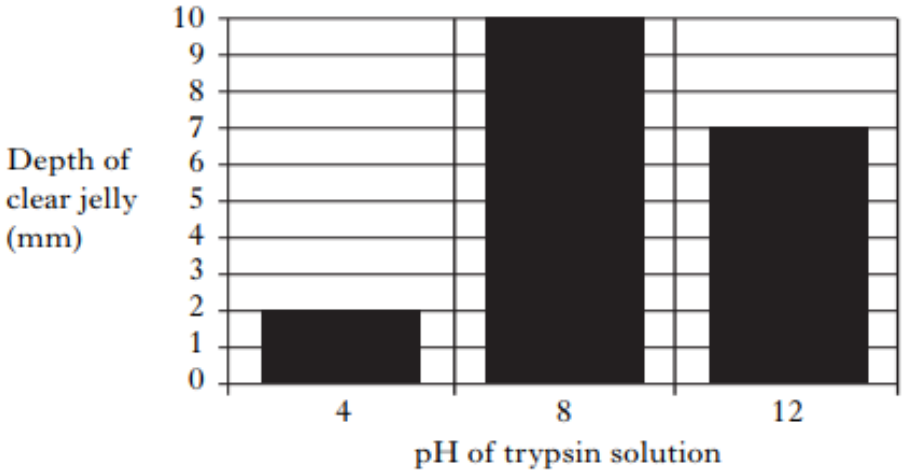
Enzyme Experiments

7. The diagram below shows an investigation into the effect of pH on the digestion of protein by trypsin.



Egg albumen is the source of protein. It is added to agar to give a cloudy, white jelly. When the egg albumen is digested the jelly turns clear. The test tubes were left in a warm place for 24 hours. At the end of this time the depth of the clear jelly was measured.

The graph below shows results from this investigation.



a) Name the dependent variable.

_____ 1

b) Describe the relationship between pH and trypsin activity as shown in the graph.

_____

_____

_____ 2

c) Predict the depth of clear jelly with trypsin at pH 2.

_____ mm 1

8. (a) Hydrogen peroxide can damage cells and lead to cell death. Catalase is an enzyme which breaks down hydrogen peroxide into oxygen and water.

Scientists in New Zealand investigated the link between the level of catalase in sheep livers and the fat in their meat. The hypothesis was that the higher the level of liver catalase, the greater the fat content of the meat.

In the investigation, they examined 9 sheep with a high percentage of fat and 15 sheep with a low percentage of fat. The sheep with the high percentage of fat had an average catalase level of 4800 K/g and those with the lower percentage of fat had an average catalase level of 3600 K/g.

The scientists concluded that their hypothesis was correct.

(i) Name the substrate of catalase. 1

_____

(ii) Identify an aspect in the planning of the investigation that would suggest that the hypothesis might not be proven correct. 1

_____

_____

(iii) A further investigation proved that the hypothesis was correct.

Describe how this investigation could help farmers to select only sheep with a low percentage of fat, to provide meat for consumers following a low fat diet. 1

_____

_____

(b) The optimum temperature for the activity of catalase is 37°C.

Predict what would happen to the activity of catalase if the temperature was lowered to 34°C. 1

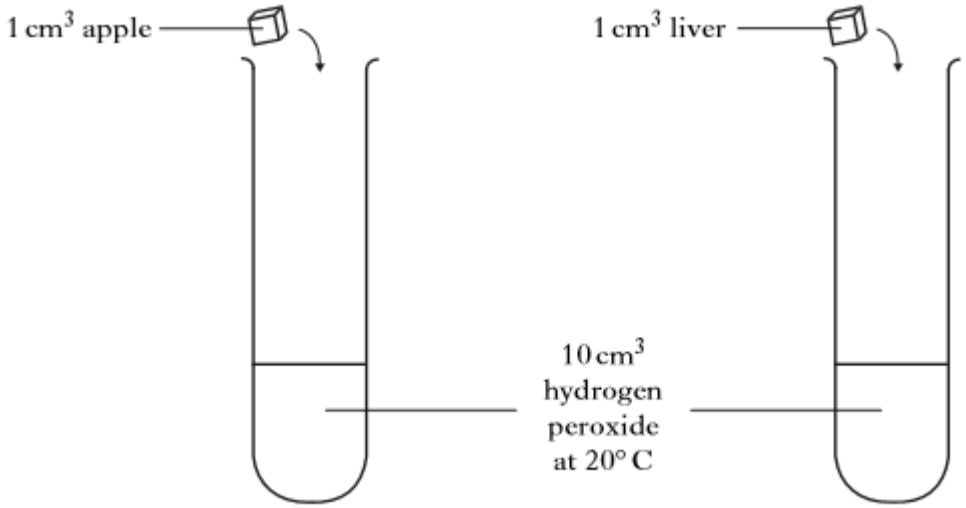
_____

Total marks 4

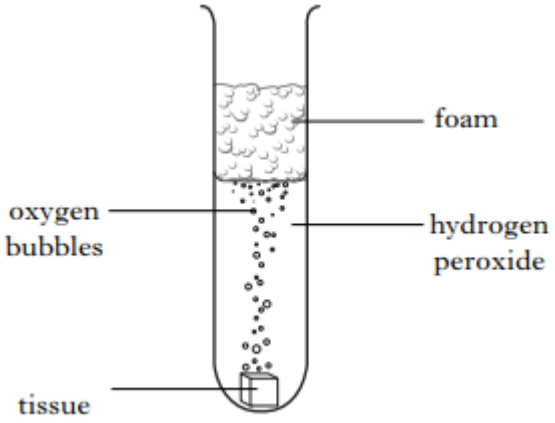
Measuring Enzyme Activity

Liver and apple tissue contain different types of catalase enzyme.

A piece of liver or apple was added to hydrogen peroxide and foam was produced as the reaction proceeded.



State two variables, not shown in the diagram, that must be kept constant for a valid comparison



Glucose as chemical energy

Food molecules such as _____ contains a store of _____ energy.

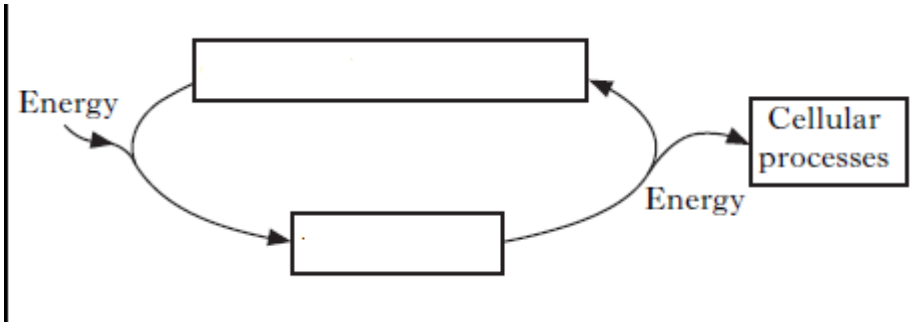
The energy found in glucose is _____by all cells in the body through a series of _____ controlled reactions called _____

The energy released from the breakdown of _____ is used to Generate the high energy compound _____ from _____ and _____ during respiration

The energy transferred by the high energy ATP can be used for cellular activities that require energy including

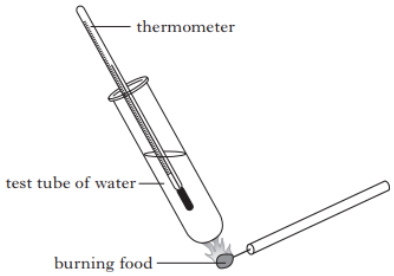
1. _____
2. _____

Summary Diagram



Burning Food Respiration Experiment

Aim: To investigate which type of food releases the most energy during respiration.



Independent variable is _____

Dependent Variable is _____

Control

Exact same set up but no _____.

Why?

To prove that the _____ affects the _____.

Validity of Results

To ensure valid results the following variables were kept constant.

1. _____

2. _____

3. _____

Reliability of Results

To ensure the results were reliable the results should be _____ for each _____.

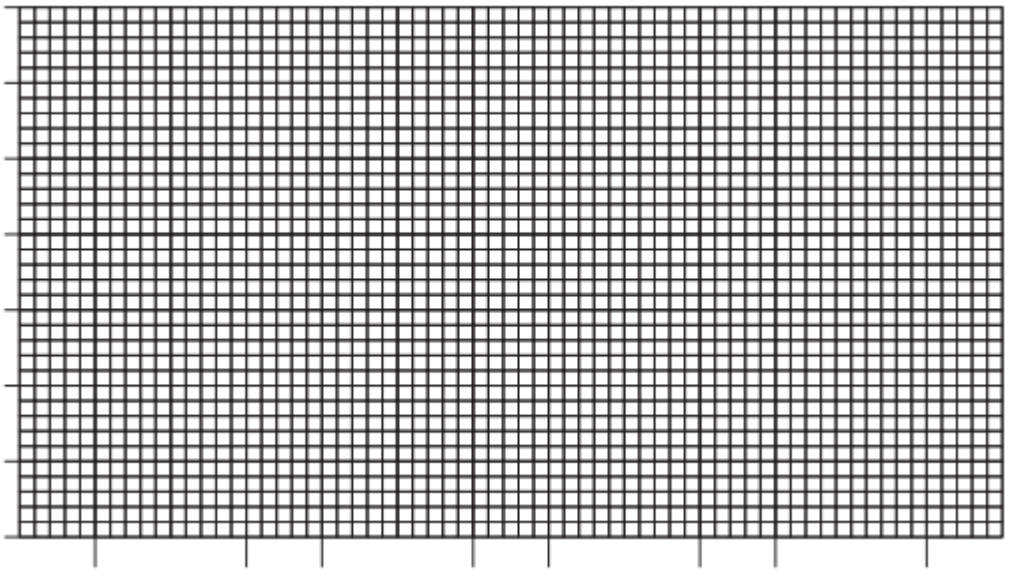
Burning Food experiment

Table of Results

Type of Food	Starting water Temperature (°C)	Final water Temperature (°C)	Change in water Temperature (°C)

Bar Graph of Results

Plot the type of food against the change in water temperature.



Conclusion

_____

_____

Aerobic Respiration

Respiration is a _____ step process controlled by _____

to allow _____ (high energy compound) to be produced.

Name	Reaction	ATP produced	O_2 required	Location
1	⟶			
2	⟶			

Step 1

_____ is converted into two molecules of _____

producing _____ ATP in a process called _____ which occurs in

the _____. _____ is not required for this process.

Step 2

Each molecule of _____ is converted into _____ and

_____ producing a further _____ATP in the

_____ if _____ is present.

Aerobic Respiration Flow chart

Fermentation

Fermentation

Fermentation is a _____ stage process controlled by _____

to produce only _____ ATP in the absence of _____ in the

_____

Step 1

_____ is converted into two molecules of _____

producing _____ ATP in a process called _____ in

the _____.

Step 2

In the absence of _____each molecule of _____ is converted

into the following depending on the type of cell.

Animal cells (muscle cells)

Pyruvate ⟶

Plant/yeast cells

Pyruvate ⟶

Word Equation Summaries

Fermentation in plant/yeast cells

Fermentation in animal cells

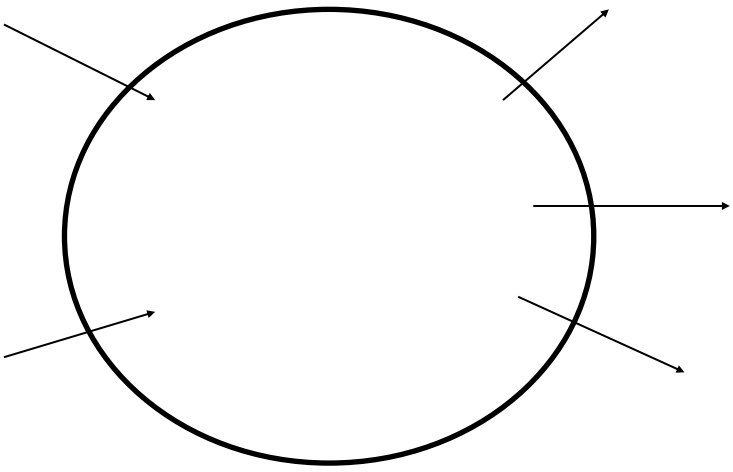
Aerobic respiration

Handy Hint— Girls Only Want Chocolate Orange Eggs

Overall Summary Diagram Aerobic respiration

Raw materials needed

Products produced



Respiration

Fermentation vs Aerobic Respiration

Process	Location	ATP produced	O_2 required	Products produced
Fermentation				Animal cells - Plant/yeast cells
Aerobic Respiration				

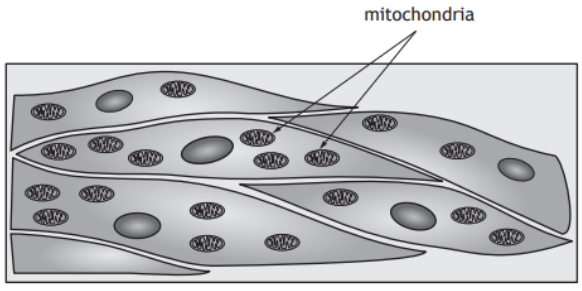
Cells & Mitochondria

The higher the energy requirement of a cell the _____ the mitochondria present in the cell.

Examples of Specialised cells with high energy requirements

1. Muscle cells to produce lots of _____ for _____.

2. Sperm cells to produce lots of _____ for _____.

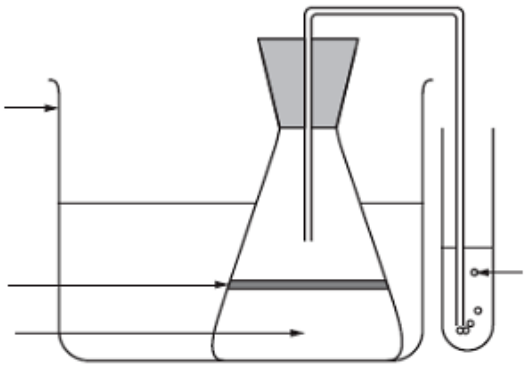


Measuring Fermentation Rate

To measure the effect of _____ on **fermentation rate** in yeast the following set up is used.

Label the diagram of the apparatus.

Water bath glucose solution yeast solution oil layer bicarbonate indicator



Measuring Fermentation rate

The time it takes the following chemicals to change colour can be used as an indicator of fermentation.

Remember the longer the time, the _____ the rate of fermentation

1. Bicarbonate indicator

Bicarbonate indicator is a chemical used to measure for the presence of CO_2 as it changes from _____ to _____ when CO_2 is present.

The time it takes the bicarbonate indicator to change colour can be used as an indicator of fermentation.

2. Lime water

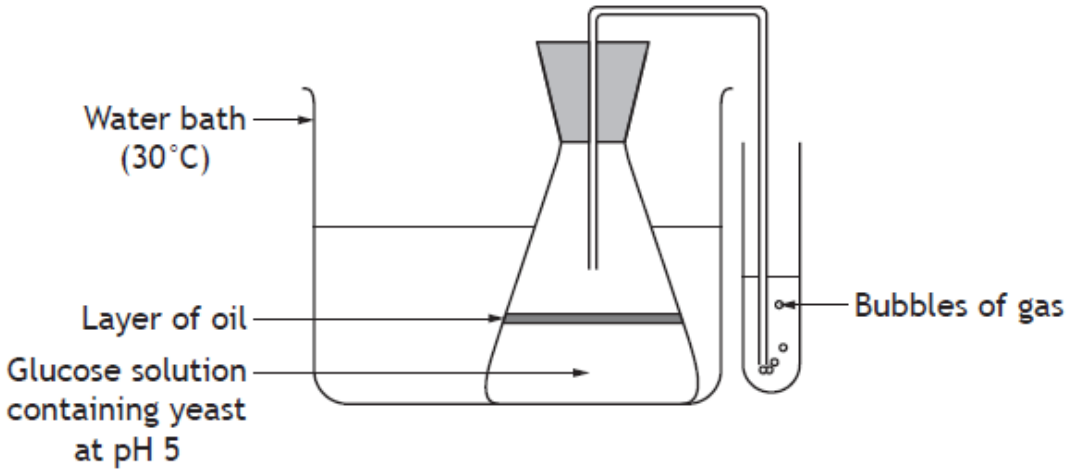
Lime water is a chemical used to measure for the presence of CO_2 as it changes from _____ to _____ when CO_2 is present.

Purpose of oil layer

To ensure fermentation occurs and not aerobic respiration , the oil layer acts as a barrier preventing _____ from the _____entering the solution.

Measuring Fermentation Rate

1. An investigation was carried out to find the effect of pH on fermentation by yeast, using the apparatus shown. Six groups of students carried out the investigation.



The investigation was repeated at pH 3, pH 7 and pH 9.

The number of bubbles produced each minute was counted.

Each group carried out the investigation several times and calculated average values for their results, as shown in the table below.

	Average number of bubbles produced per minute			
Group	*pH 3*	*pH 5*	*pH 7*	*pH 9*
1	8	25	17	0
2	10	21	13	3
3	15	23	14	0
4	17	22	16	0
5	19	24	12	1
6	22	17	18	9

(a) Name the independent variable in this experiment. 1

_____

(b) Draw a conclusion from the results above.

_____

_____ 1

1

Measuring Fermentation Rate

(c) This investigation could be adapted to find the effect of a variable other than pH.

Choose **one** variable from the list. Describe **two** ways that the apparatus would be adapted to demonstrate the effect of this variable. 2

List

Type of yeast

Temperature

Concentration of glucose solution

Chosen variable _____

Adaptation 1 _____

_____

Adaptation 2 _____

_____

d) Explain how the reliability of the experiment could be improved.

_____

_____ 1

e) Name the gas produced during fermentation in yeast.

_____ 1

f) Name another type of organism that also produces CO2 during fermentation.

_____ 1

g) Explain the purpose of the oil layer in the flask.

_____

_____ 1

h) A control of the same set up but dead yeast was conducted. Explain why this was necessary.

_____

_____ 1

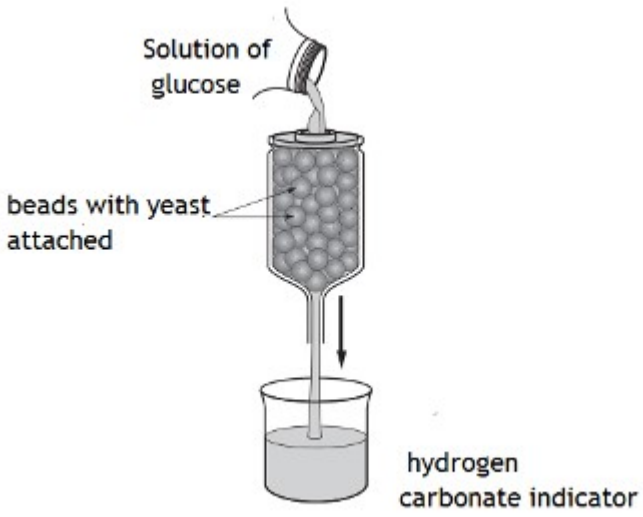
Measuring Fermentation

2. An experiment was set up to investigate the effect of glucose concentration on the rate of fermentation in yeast.

Before starting the experiment the yeast was immobilised by attaching the yeast to jelly beads to make it easier to separate the yeast from the alcohol produced at the end of the experiment.

The glucose and solution was incubated in a water bath at 30 °C for 10 minutes before the start of the experiment.

After starting the experiment, the time taken for the hydrogen carbonate indicator to turn from red to yellow was measured.



a) State the aim of the investigation

_____

_____

_____

b) State the following variables based on the information above.

Independent variable _____

Dependent variable _____

c) State two variables that have to be kept constant for VALID results apart from temperature.

_____

_____

d) State how temperature was controlled in this experiment from the information in the passage.

_____

e) A control was not carried out in this experiment but is also important for VALID results.

(i) Describe how to set up a control in this experiment.

_____

_____

(ii) Explain why a control is necessary for VALID results.

_____

_____

f) The student only took one reading at each glucose concentration. Explain how to improve the reliability of the results.

_____

_____

g) The student's noted the results as follows. Turn this information into a table with two headings using the grid below.

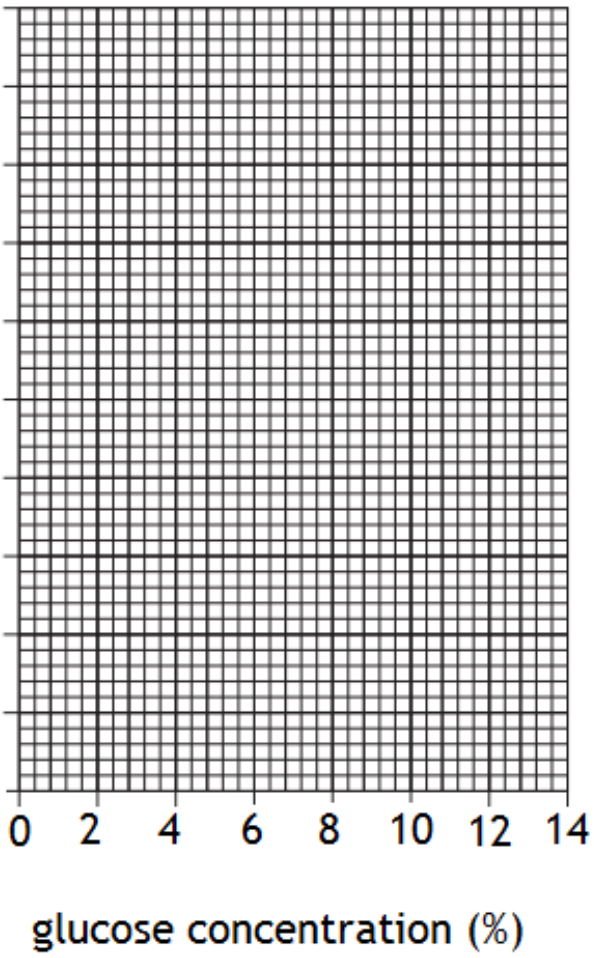
6% glucose ~ 150 seconds to turn hydrogen carbonate colourless

2% glucose ~ 250 seconds to turn hydrogen carbonate colourless

4% glucose ~ 225 seconds to turn hydrogen carbonate colourless

8% glucose ~ 100 seconds to turn hydrogen carbonate colourless

h) On the grid below, complete the vertical axis and plot a line graph to show the effect of glucose concentration on the time taken for the hydrogen carbonate to go colourless.



(i) Predict the time taken for the hydrogen carbonate to change colour at 10% glucose concentration

_____ seconds

(i) State the conclusion that can be drawn from the results of the experiment in terms of the effect of glucose concentration on rate of fermentation

_____

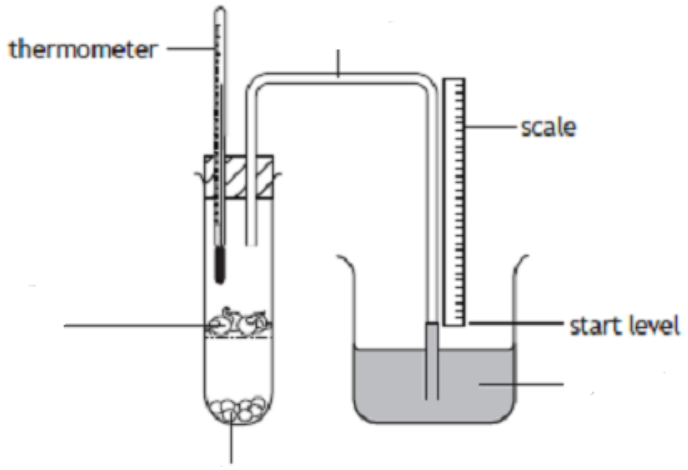
_____

Measuring Respiration Rate

To measure the effect of _____ on **respiration rate in** germinating (alive) peas the following set up is used.

Label the diagram of the apparatus.

Chemical to absorb CO_2 Germinating peas capillary tube coloured liquid



Measuring the Rate of respiration

The chemical is added to the test tube to absorb all the _____.

This causes the _____ to move _____ the tube to replace the lost gas.

This is taken as a way of measuring the uptake of _____ by the organism

Independent variable Dependent variable

Control set up

Exact same set up but _____.

Variables kept constant

1. _____

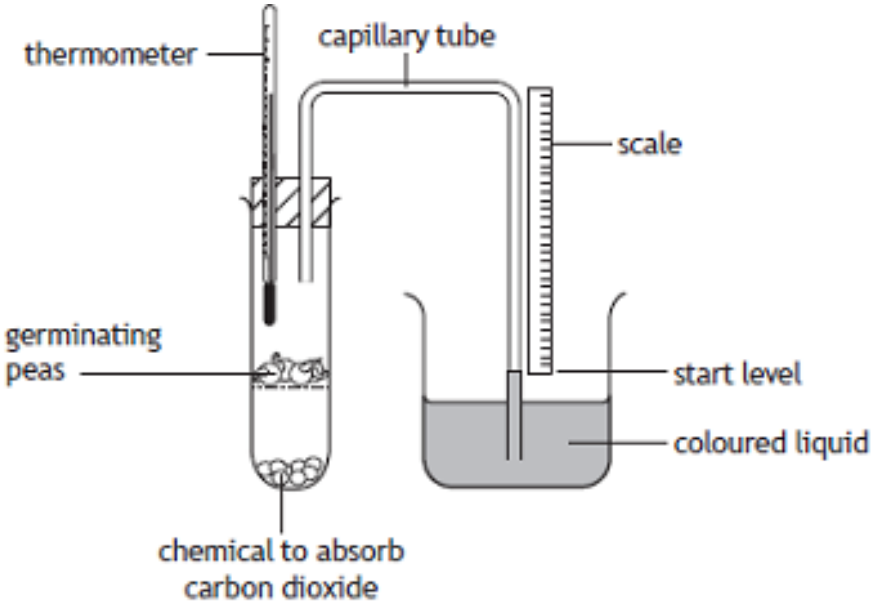
2. _____

Reliability

Repeat at each _____

Measuring Respiration Rate

An investigation on the effect of temperature on respiration rate was carried out using the following respirometer set up.



The results are shown below.

Temperature	Time for dye to move up tube (seconds)
10	90
15	65
20	42
30	25

Name the dependent variable in the experiment.

_____ 1

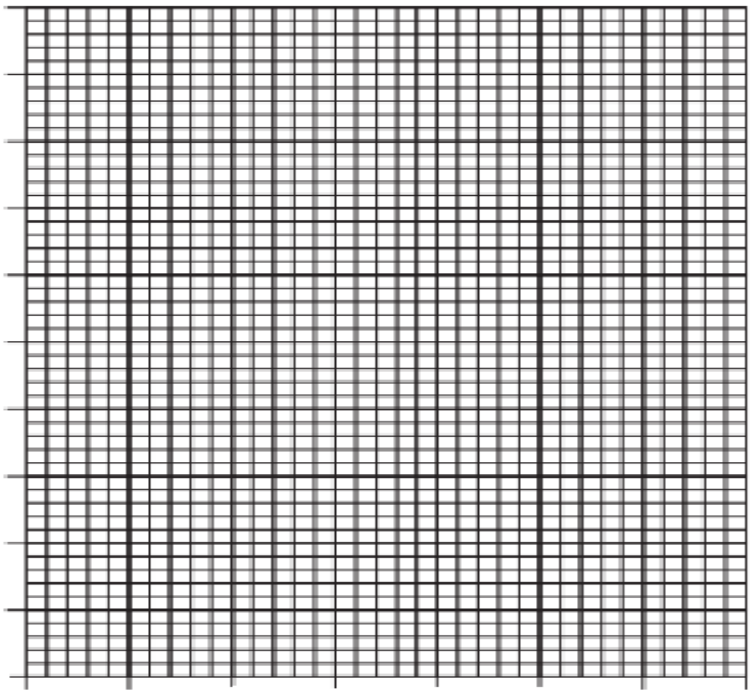
Name two variables kept constant in this experiment to ensure a valid experiment.

1. _____

2. _____ 2

Measuring Respiration Rate

Draw a line graph of the results.



Temperature (degrees celsius)

Predict the time taken to move the dye up the tube at 50 degrees Celsius and explain your answer.

Prediction _____

Explanation _____

_____

_____ 2

Draw a conclusion about the effect of temperature on the respiration rate.

_____

_____ 1

Measuring Respiration Rate

Another set up to prove that all organisms respire is shown below using 4 flasks.

Flask 1

The first flask contains sodium hydroxide to remove _____ from the air.

Flask 2 (P)

In flask 2 there should be no _____ hence the lime water solution will stay _____.

Flask 3 (Q)

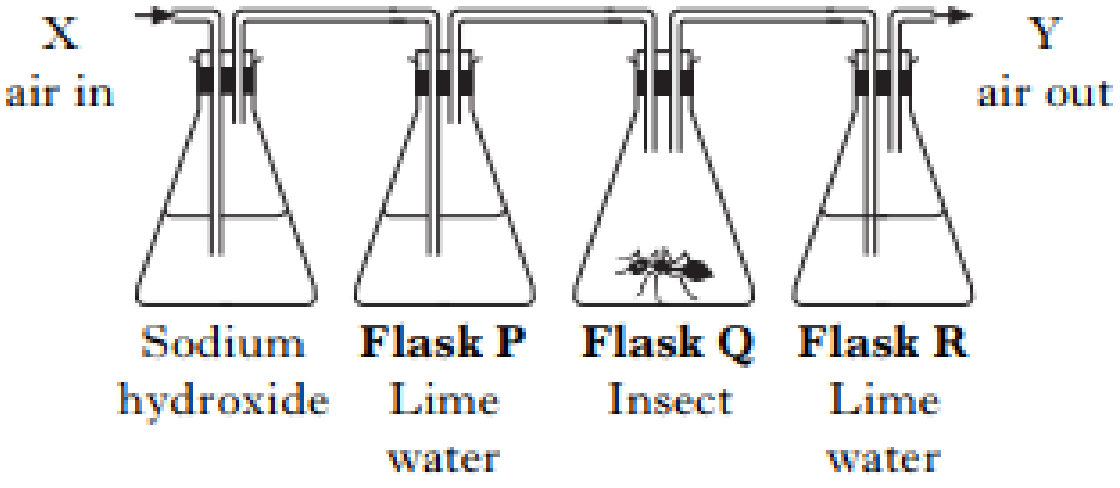
In flask 3 there is a respiring organism which will produce _____.

Flask 4 (R)

In flask 4 there should now be _____ hence the lime water will change from

_____ to _____

Label the following diagram to show if there is CO_2 present/absent in each flask and the state of the lime water in Flask P and R below.



Respiration Questions

1. The energy released from glucose is used to synthesise

A Pi

B ADP

C ATP

D pyruvate

2.Which of the following stages in respiration would result in the production of 38 molecules of ATP?

A Glucose to pyruvate

B Pyruvate to lactate

C Pyruvate to carbon dioxide and water

D Glucose to carbon dioxide and water

3. Four reactions in the respiration pathway are shown below.

1. Glucose to pyruvate
2. Pyruvate to carbon dioxide and water
3. Pyruvate to lactic acid
4. Pyruvate to ethanol and carbon dioxide

Which of the reactions can occur in yeast?

A 2 and 3 only

B 2 and 4 only

C 1, 2 and 3 only

D 1, 2 and 4 only

4. Which of the following processes release energy used to form ATP?

A muscle cell contraction

B breakdown of glucose

C protein synthesis

D nerve impulse transmission

5. Which line in the table below correctly identifies the yield of ATP per glucose molecule in aerobic respiration and fermentation?

	Number of ATP molecules	
	Fermentation	Aerobic respiration
A	2	36
B	3	38
C	36	2
D	38	2

6. What is the difference in the number of ATP molecules produced per glucose molecule by fermentation compared to aerobic respiration?

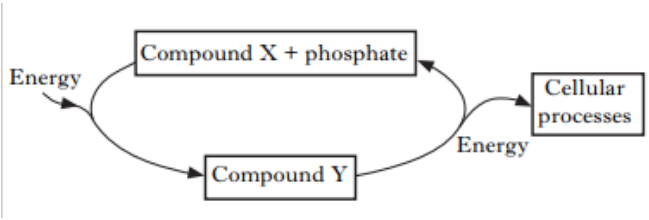
A 2

B 36

C 38

D 40

7.The diagram below shows energy transfer within a cell.



Which line in the table identifies correctly compounds X and Y?

	X	*Y*
A	glucose	CO_2
B	CO_2	ADP
C	ADP	ATP
D	ATP	glucose

Respiration Questions

8. Which of the following increases in the muscles of an athlete and causes muscle fatigue during a race?

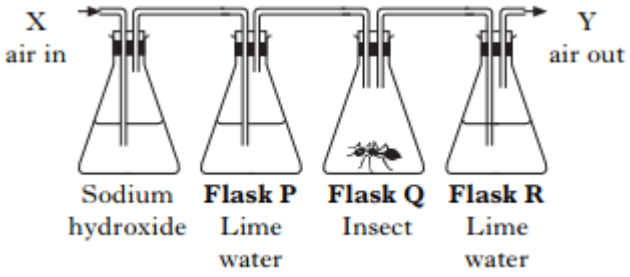
A Lactic acid

B Glucose

C Oxygen

D ATP

9.The following experiment was set up.



Sodium hydroxide solution absorbs carbon dioxide from air.

Lime water turns from clear to cloudy in the presence of carbon dioxide.

Air is drawn through the apparatus from X to Y, passing through each flask in turn.

Predict what would happen to the results if two insects were used in flask Q. The lime water in

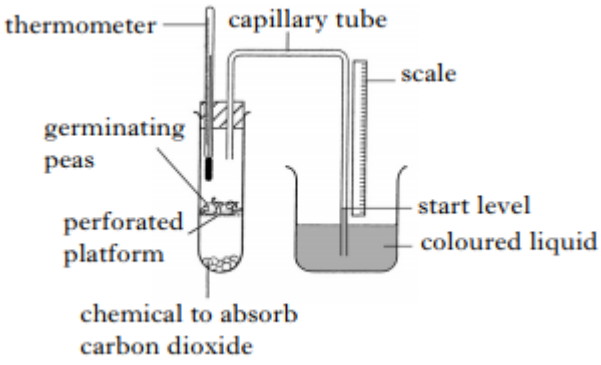
A Flask P turns cloudy more slowly

B Flask P turns cloudy more quickly

C Flask R turns cloudy more slowly

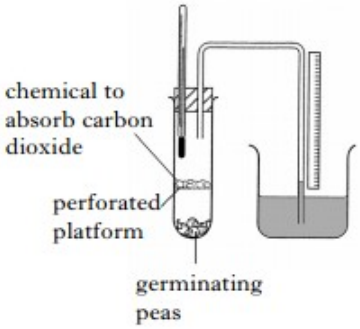
D Flask R turns cloudy more quickly

10.The apparatus below was used to investigate respiration in germinating peas.

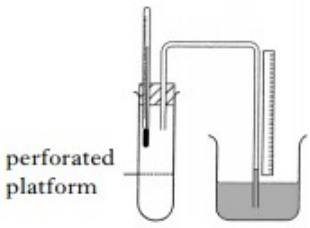


A suitable control for this investigation would be

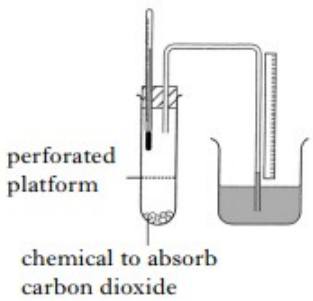
A



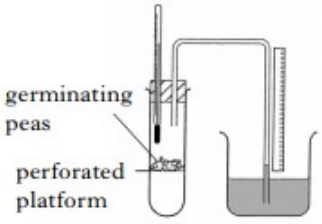
B



C



D



Respiration Questions

11. Which of the following shows the correct location and number of ATP molecules released from a molecule of glucose during fermentation?

A occurs in cytoplasm and produces 2ATP

B occurs in cytoplasm and produces 38 ATP

C occurs in mitochondria and produces 2 ATP

D occurs in mitochondria and produces 38 ATP

12. Which of the following is NOT true of aerobic respiration?

A produces carbon dioxide and water

B begins in cytoplasm

C controlled by enzymes

D requires light energy

13. Which of the following is NOT produced during aerobic respiration?

A carbon dioxide

B oxygen

C water

D ATP

14. Which of the following is produced during fermentation in yeast cells?

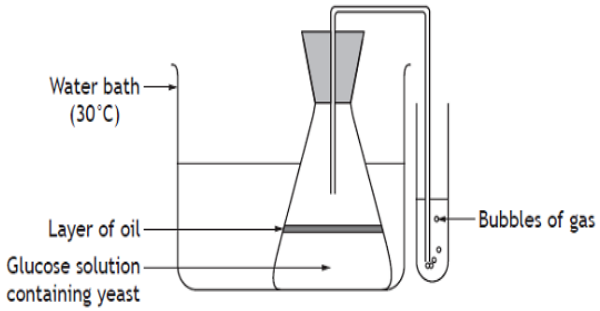
A lactate

B water

C oxygen

D carbon dioxide

The rate of fermentation of yeast was measured using the following set up.



15. The purpose of the oil layer in the flask is to ensure that

A oxygen from the solution is not released into the flask

B oxygen from the air does not enter the solution

C carbon dioxide from the solution is not released into the flask

D carbon dioxide from the air does not enter the solution

16. A control flask was set up to show the fermentation rate was due to the activity of yeast.

The solution in the control flask was

A yeast and glucose

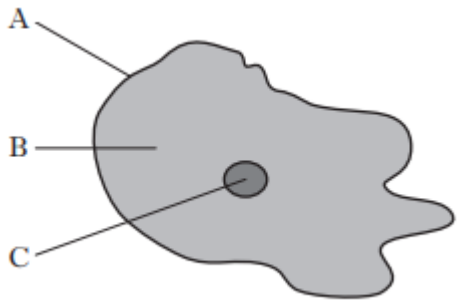
B dead yeast and glucose

C yeast and water

D dead yeast and water

Respiration Questions

1. The diagram below represents a single-celled organism called Amoeba. This organism carries out respiration to provide energy for cellular activities.



Glycolysis is the first stag Amoeba cell.

(a) State which letter in the diagram shows the cytoplasm.

_____ 1

(b) Describe what happens during glycolysis.

_____

_____

_____ 2

(c) State one cellular activity that uses the energy released by respiration.

_____ 1

(d) State the location of aerobic respiration

_____ 1

(e) Compare the ATP produced during fermentation compared to aerobic respiration.

_____

_____ 1

2. Muscle tissue can be dark or light in colour.

Dark tissue cells use oxygen to release energy.

Light tissue cells do not use oxygen to release energy.

(a) Name the process by which energy is released in the dark tissue cells. 1

_____

(b) (i) Name the substance which muscle cells break down to produce pyruvate. 1

_____

(ii) When pyruvate is being formed, enough energy is released to form two molecules of a high energy compound.

Complete the word equation below to show how this compound is generated. 1

_____ + _____ ⟶ _____

(c) The table below shows the average percentage of dark and light tissue cells. These cells were found in the muscles of athletes training for different events at the 2014 Commonwealth games in Scotland.

Type of Athlete	*Average percentage of dark tissue cells* (%)	*Average percentage of light tissue cells* (%)
cyclist	60	40
swimmer	75	25
shot putter	40	60
marathon runner	82	18
sprinter	38	62

(i) Using information in the table, identify which type of athlete would be likely to produce the most lactic acid in their muscle cells. Justify your answer. 2

Type of athlete_____

Justification_____

_____

(ii) A sample of muscle tissue from an athlete was examined and found to contain a total of 360 cells.

90 of these cells were light tissue cells.

Identify which type of athlete the sample was taken from. 1

Space for calculation

Type of athlete _____

Total marks 6

3. MARKS

(a) Cellular processes occur in different parts of the cell.

Name the energy producing process which starts in the cytoplasm and is completed in the mitochondria. 1

_____

(b) As a result of the complete breakdown of a number of glucose molecules, 114 molecules of ATP were produced.

State the number of glucose molecules which were broken down to achieve this. 1

Space for calculation

_____ Glucose molecules

(c) Explain why a sperm cell contains more mitochondria than a skin cell. 1

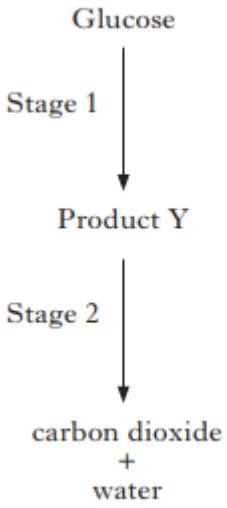
_____

_____

_____

Respiration Questions

4. The process of aerobic respiration in a muscle cell is outlined below.



(a) (i) Name Stage 1.

_____ _____ 1

(ii) Name product Y from Stage 1.

_____ 1

(iii) What other substance must be present for Stage 2 to occur?

_____ 1

(b) ATP is formed during respiration and broken down for uses in cells.

(i) How many molecules of ATP are formed from each glucose molecule during :

Stage 1 only? _____

Both Stage 1 and Stage 2? _____ 2

(ii) What two molecules are produced when ATP is broken down?

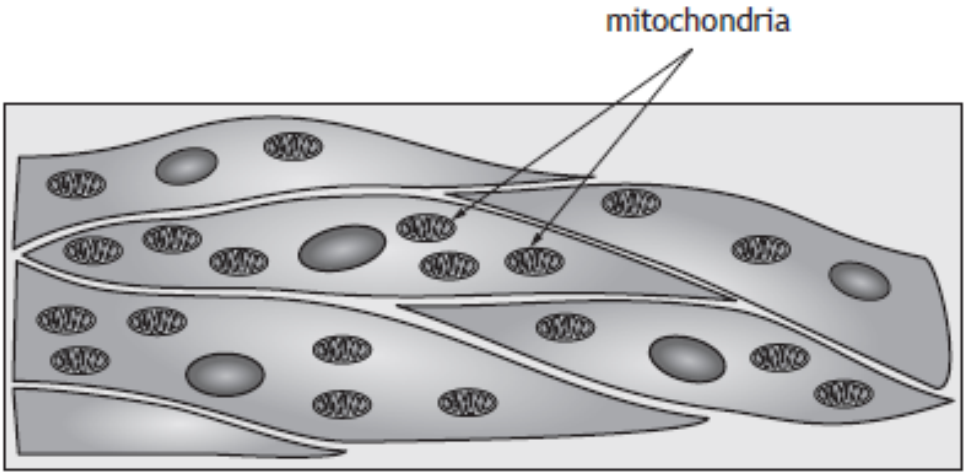
_____ 1

(iii) State one use of the energy released when ATP is broken down.

_____ 1

Respiration Questions

5. The diagram below shows muscle cells.



(a) (i) Explain why muscle cells require many mitochondria. 1

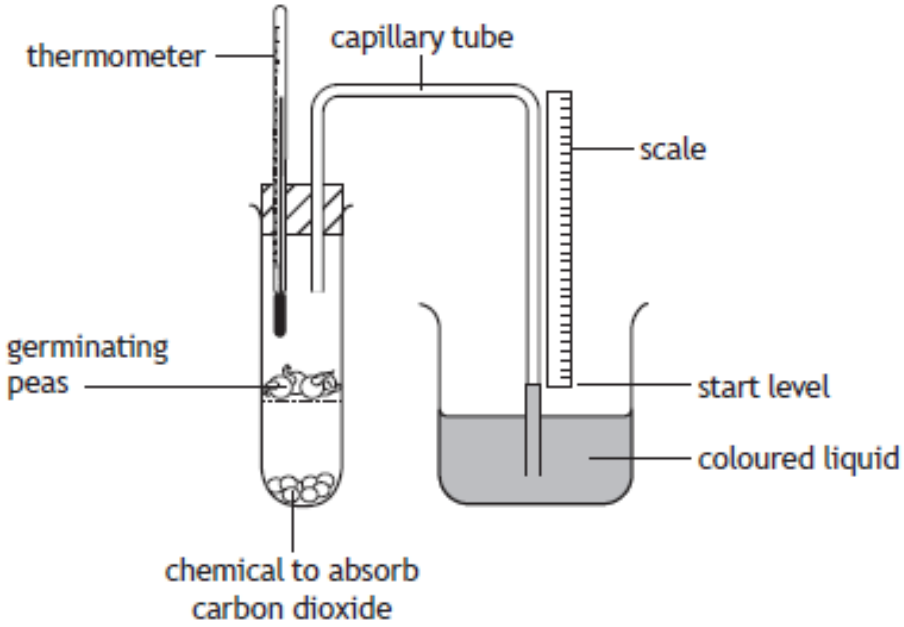
(ii) Name one substance produced by a cell carrying out aerobic respiration. 1

(b) A muscle cell will carry out fermentation when oxygen is not available.

Describe the fermentation pathway in muscle cells. 3

Measuring Respiration Rate

6. A student investigated the effect of temperature on the rate of respiration in germinating (growing) peas. Using the arrangement shown, four respirometers labelled A–D were set up at the temperatures shown in the table below.



The level of the coloured liquid was measured on the scale at the start of the investigation and again after 20 minutes. The rise in liquid level was due to oxygen uptake by the germinating peas. The results are shown in the table.

Respirometer	*Temperature* (°C)	*Contents*	*Rise in liquid level* (mm)	*Rate of oxygen uptake* (mm per minute)
A	15	Germinating peas	14	0·7
B	15	Dead peas	0	0
C	25	Germinating peas	26	
D	25	Dead peas	0	0

(a) (i) Complete the table above by calculating the rate of oxygen uptake per minute by the peas in respirometer C. 1

Space for calculation

(ii) Using the results from the table complete the following conclusion by underlining one option in the bracket. 1

Increasing the { temperature / liquid level / oxygen uptake } increases the rate of respiration in germinating peas.

(iii) Another respirometer was set up at 60 °C with germinating peas and the coloured liquid did not rise. The student concluded that the peas were not respiring.

Explain why this temperature prevented the peas from carrying out respiration. 2

_____

_____

_____

(iv) Respirometers B and D were set up as control experiments.

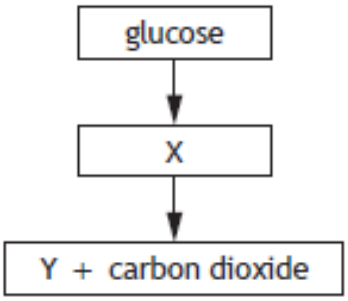
Describe the purpose of the controls in this investigation. 1

_____

_____

_____

(b) The diagram below represents the fermentation pathway in a plant cell.



Choose either molecule X or Y and state its name. 1

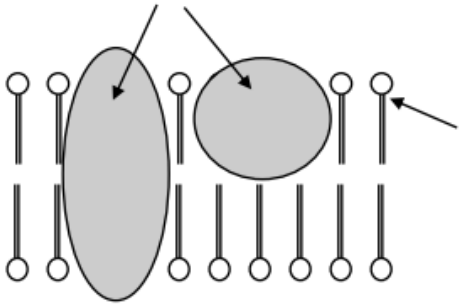
Molecule _____

Name _____

Transport across the membrane

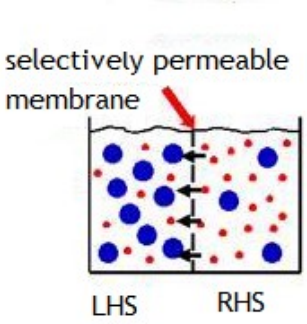
Structure of Cell membrane

The cell membrane is made up of two key structures as shown in the diagram below.



Selectively Permeable Membrane

The membrane allows _____ molecules to pass through but not _____ molecules.



Only the _____ dots in the diagram can move from the left to the right hand side or vice versa.

Examples of small molecules

1.

2.

3.

4.

5.

Examples of large molecules

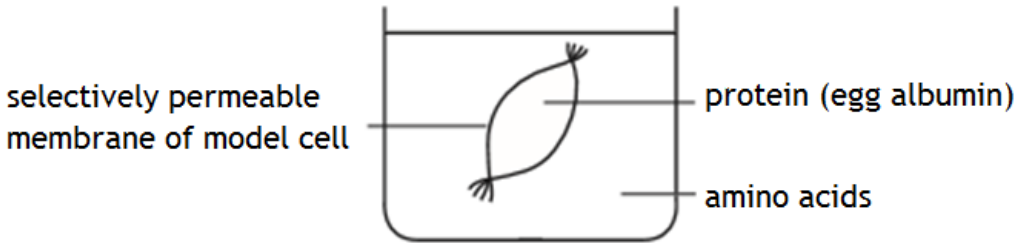
1.

2.

3.

Self Assessment— Selectively Permeable Membrane

The diagram below shows a model cell that was set up to investigate the movement of molecules through a selectively permeable membrane using protein (egg albumin) and amino acids.

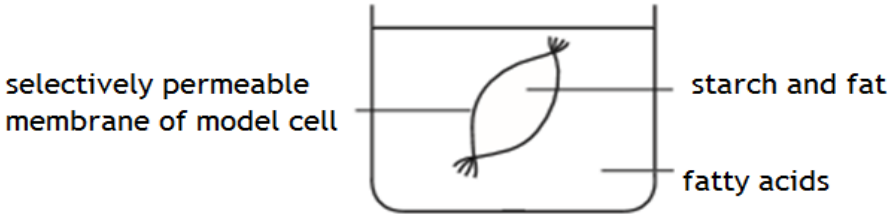


Using the diagram above predict after one hour, what would be found inside and outside the model cell.

(i) Outside model cell _____

(ii) Inside model cell _____

The diagram below shows a model cell that was set up to investigate the movement of molecules through a selectively permeable membrane using fatty acids, fat and starch



Using the diagram above predict after one hour, what would be found inside and outside the model cell.

(i) Outside model cell _____

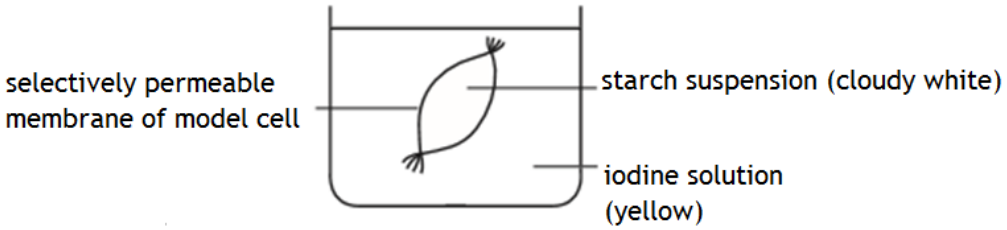
(ii) Inside model cell _____

Self Assessment— Selectively Permeable Membrane

The diagram below shows a model cell that was set up to investigate the movement of molecules through a selectively permeable membrane.

Two molecules were used in the experiment; iodine a small soluble yellow molecule was placed outside the model cell and starch a large molecule that appears cloudy white due to it being insoluble was placed inside the bag as shown below.

When iodine comes into contact with starch a blue-black substance is formed.



After one hour, the colour change inside the bag where the starch suspension originally was would be

A cloudy white to yellow
B remains cloudy white
C cloudy white to blue-black
D yellow to cloudy white

After one hour, the colour change outside the bag where the iodine solution originally was would be

A remain yellow
B yellow to cloudy white
C yellow to blue-black
D cloudy white to yellow

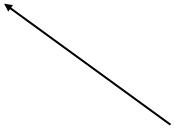
Transport across the membrane

There are two ways to transport molecules/ions across the membrane.

1.

Movement of molecules from _____ to _____ concentration

_____ the concentration gradient

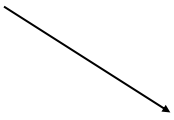


_____ energy (ATP) for _____ in membrane to actively transport molecules/ions across membrane

2.

Movement of molecules from _____ to _____ concentration.

_____ the concentration gradient.



_____ energy (ATP) required for this process.

Two types of passive transport are _____ &

_____ which is the special name for the transport of water.

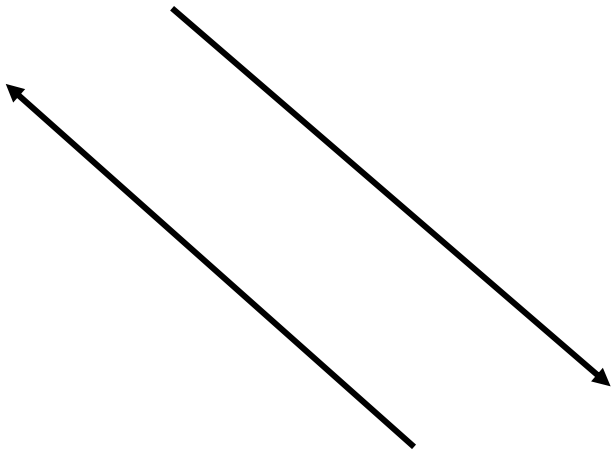
Transport across the membrane

Table summarising differences

Type of transport	Higher to lower OR lower to higher concentration	Concentration Gradient	Energy required?

Summary Gradient Diagram

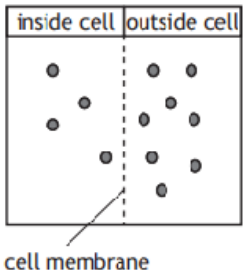
Higher Concentration



Lower Concentration

Self Assessment— Passive/Active Transport

1. Using the diagram below state the name for the following processes.



(i) When water moves from outside to inside the cell.

_____

(ii) When molecules/ions move from inside to outside the cell

_____

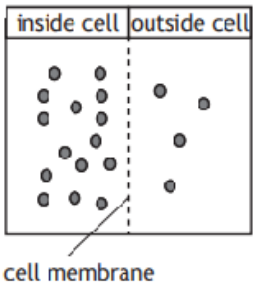
(ii) When molecules/ions move from outside to inside the cell

_____

(iv) Describe the direction of movement of molecules/ions that requires ATP/energy.

_____

2. Using the diagram below state the name for the following processes.



(i) When molecules/ions move from inside to outside the cell

_____

(ii) When molecules/ions move from outside to inside the cell

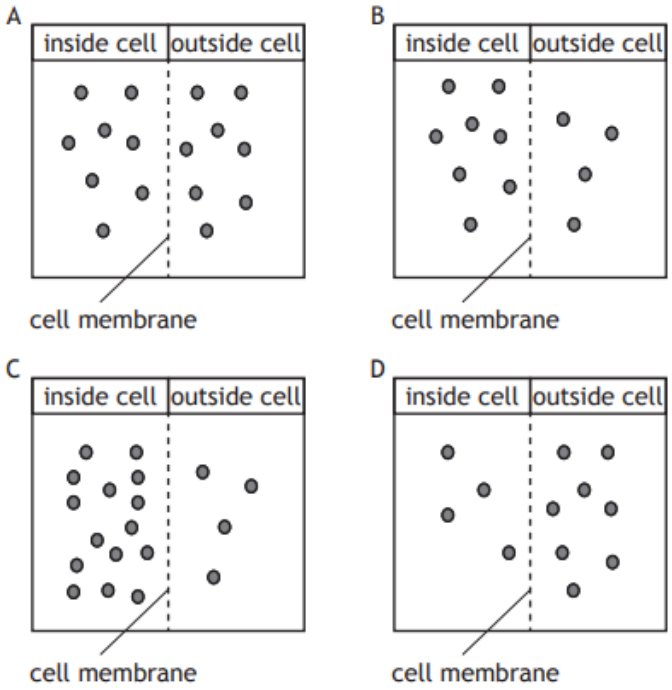
_____

(iii) Describe the direction of movement of molecules/ions that requires ATP/energy.

_____

Self Assessment— Passive/Active Transport

3 Looking at the diagrams below, answer the following questions.



(i) Which diagram (s) moving from outside to inside represent passive transport

_____

(ii) Which diagram (s) moving from outside to inside represent going against a concentration gradient.

_____

(iii) Which diagram represents the diffusion of carbon dioxide during respiration

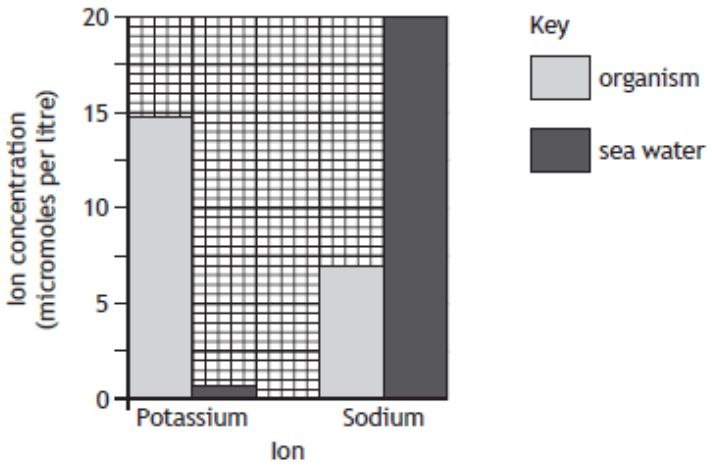
_____

(iv) Which diagram above moving from inside to outside the cell does not represent the movement by passive or active transport.

_____

Self Assessment— Passive/Active Transport

The graph shows the concentrations of ions in a single-celled organism and the sea water surrounding it.



Use the graph to identify which of the following statements is correct.

A Sodium ions will move into the organism by active transport.

B Sodium ions will move out of the organism by diffusion.

C Potassium ions will move out of the organism by active transport.

D Potassium ions will move into the organism by active transport.

(a) State a feature of the cell membrane which allows the movement of only some substances into the cell. 1

_____

(b) Osmosis is a process which can occur across the cell membrane.

(i) Choose either the leaf cell or red blood cell by ticking (✓) one of the boxes below.

Describe the effect of osmosis on this type of cell if it was placed in pure water. 1

Leaf cell ☐ Red blood cell ☐

Effect on the cell _____

_____

(ii) 1 Name a process, other than osmosis, which allows molecules to pass through the cell membrane. 1

_____

2 Give a definition of the process chosen. 1

_____

_____

_____

Osmosis in Animal Cells

Definition of Osmosis

The movement of _____ molecules from a _____

_____concentration to a _____

concentration through a _____

membrane.

Animal Cells

Distilled Water Solution

There is an increases/decreases in mass

↓

The effect on the animal cells is that they will burst/shrink

Salt/Sugar Solution

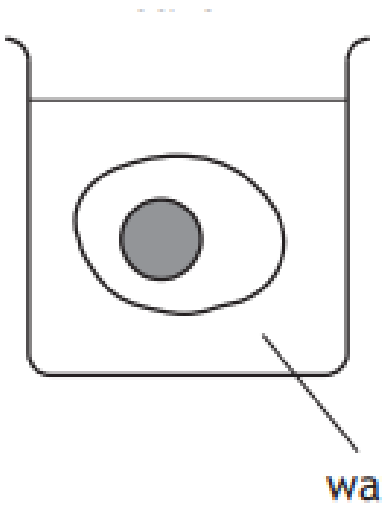
There is an increases/decreases in mass

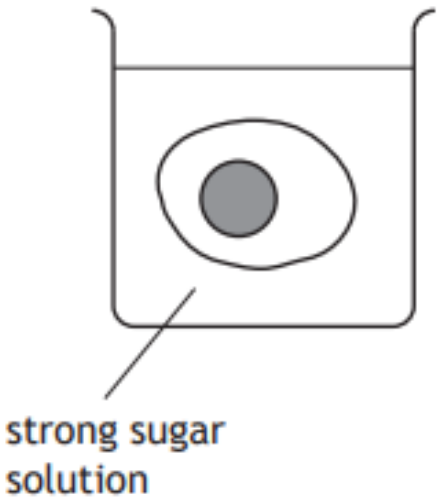
↓

The effect on the animal cells is that they will burst/shrink

Task

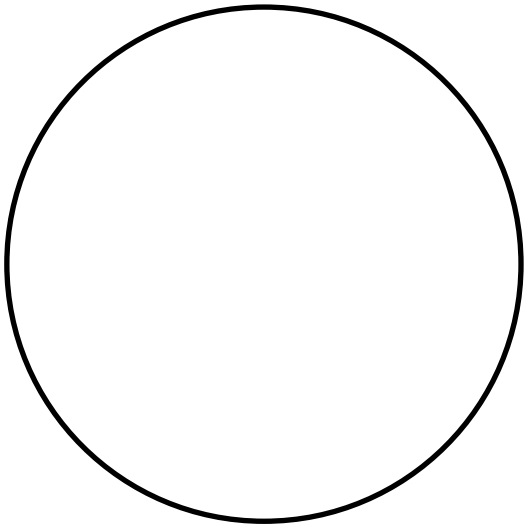
State where the Higher water concentration (HWC) and lower water concentration is (LWC) using an arrow to show the direction of water movement and state whether the cells burst or shrink in each situation.



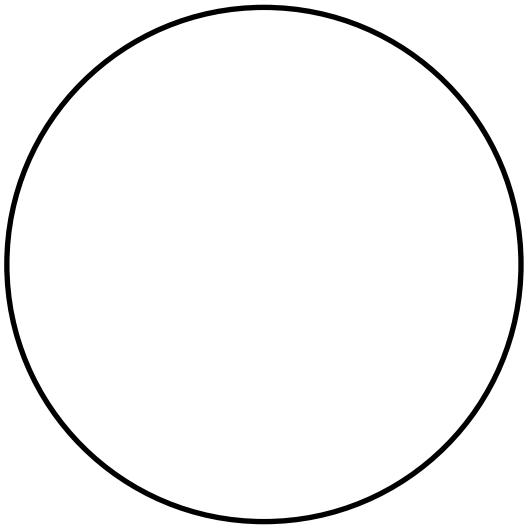


Importance of diffusion

The following molecules diffuse in/out of a cell during *respiration*.



The following molecules diffuse in/out of a cell during *photosynthesis*.



Self Assessment— Osmosis in Animal Cells

1. If a red blood cell has a solute concentration of 0.5% and the solution has a solute concentration of 1% answer the following questions.

a) State the location of the higher water concentration

_____

b) State whether the red blood cells will increase or decrease in mass.

_____

c) Explain how osmosis caused the change in mass of the red blood cells.

_____

_____

_____

d) State the effect of being left in the solution on the red blood cell

_____

2. If a muscle cell has a solute concentration of 1% and the solution has a solute concentration of 2% answer the following questions.

a) State the location of the higher water concentration

_____

b) State whether the muscle will increase or decrease in mass.

_____

c) Explain how osmosis caused the change in mass of the muscle cells.

_____

_____

_____

d) State the effect of exposure to the solution on the muscle cell

_____

Osmosis Animal Cell Experiment

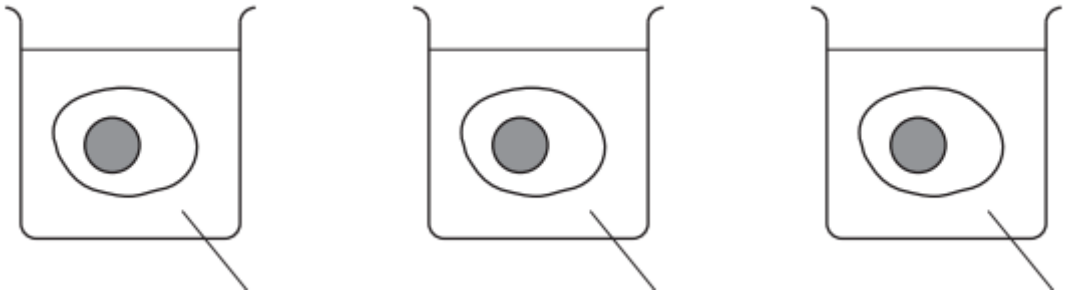
Eggs can be used to investigate osmosis by dissolving the shell in vinegar as the egg contents remain inside a thin membrane.

An investigation was carried out into the effect of salt concentration on the mass of the eggs.

The eggs were weighed and placed in beakers of the appropriate solution then left for 24 hours before being blotted dry and then re-weighed.

Experimental Set up

Complete the labels for the diagram below based on your experimental set up.



a) Aim of Experiment _____

_____

_____

b) Independent variable _____

Dependent variable _____

c) Suggest why the eggs were blotted dry before being reweighed.

_____

_____

Osmosis Animal Cell Experiment

c) State two variables that have to be kept constant for VALID results apart from temperature.

_____

_____

d) State how temperature was controlled in this experiment from the information in the passage.

_____

e) A control was not carried out in this experiment but is also important for VALID results.

(i) Describe how to set up a control in this experiment.

_____

_____

(ii) Explain why a control is necessary for VALID results.

_____

_____

Osmosis Animal Cell Experiment

f) The student only took one reading at each salt e concentration. Explain how to improve the reliability of the results.

_____

_____

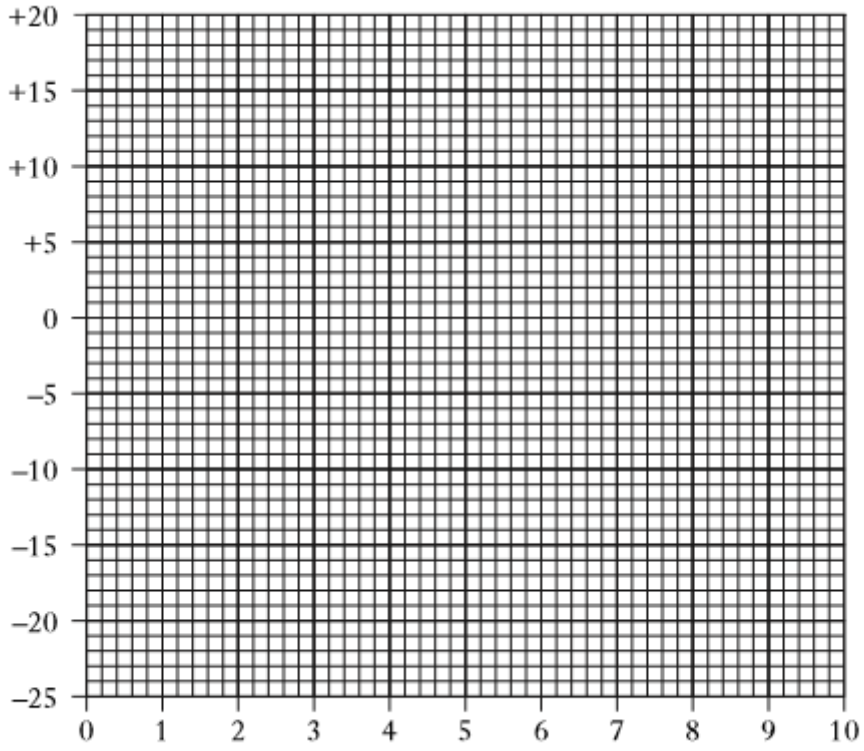
g) Note down your results below and then turn this into a table with two headings.

Rough notes

Table of results

Osmosis Animal Cell Experiment

h) On the grid below, complete the labels on the X and Y axis and plot a line graph to show the effect of salt concentration on the mass of the egg.



(i) Predict the time taken for the hydrogen carbonate to change colour at 10% glucose concentration

_____ seconds

(J) State the conclusion that can be drawn from the results of the experiment in terms of the effect of glucose concentration on rate of fermentation

_____

_____

Percentage Increase Calculations

Osmosis in Plant Cells

Plant Cells

Plant cells are surrounded by an extra outer layer called the _____

compared to animal cells which provides _____ preventing plant

cells bursting or shrinking due to osmosis.

Distilled Water Solution

There is an increases/decreases in mass

↓

The effect on the plant cells is that they will become **turgid/ plasmolysed**

Salt/Sugar Solution

There is an increases/decreases in mass

↓

The effect on the plant cells is that they will become **turgid/ plasmolysed**

Task

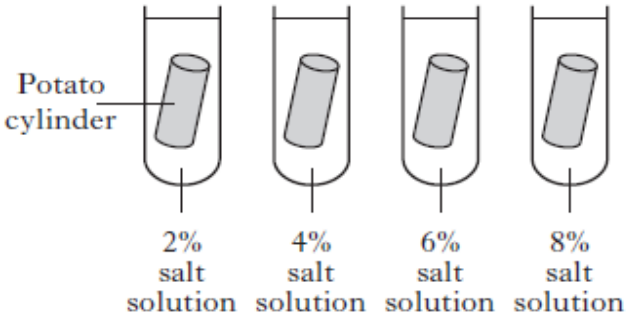
State where the Higher water concentration (HWC) and lower water concentration is (LWC) using an arrow to show the direction of water movement and state whether the cells become turgid or plasmolysed in each situation

Distilled water solution

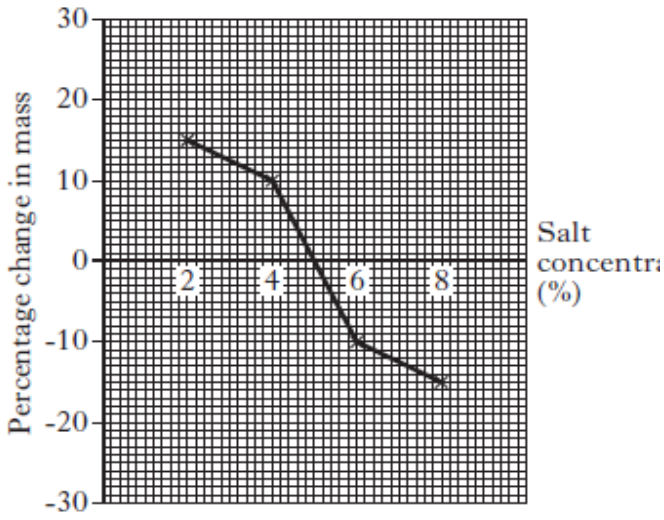
Concentrated sugar solution

Osmosis in Plant Cells

. Four potato cylinders of equal mass were placed in four separate test tubes as shown below.



After two hours, the percentage change in mass of each cylinder was calculated and the results plotted on the graph below.



In which concentration of salt would the potato cylinders be most flaccid?

A 8%

B 5%

C 2%

D 0%

. When the experiment was repeated with 10% salt the initial mass was 20 g and the final mass was 16·8 g.

What was the percentage decrease in mass?

A 3·2%

B 16%

C 20%

D 84%

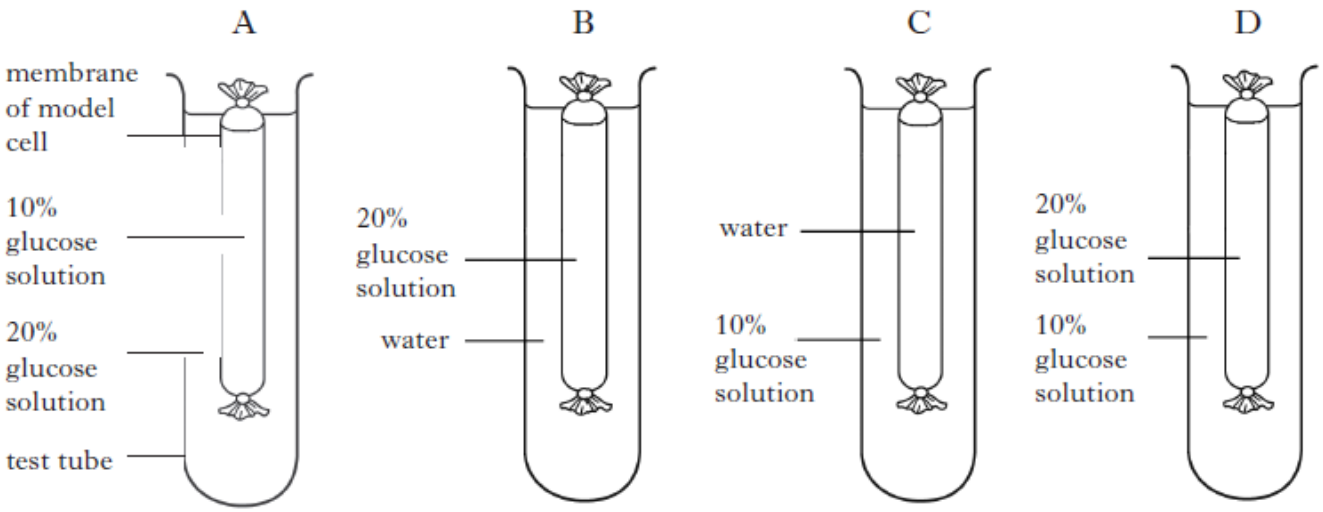
Osmosis in Animal/Plant Cells

Marks

4. The following diagrams show an investigation into osmosis using four model cells.

The model cells were weighed before placing them in the test tubes.

After one hour the model cells were taken out of the test tubes and reweighed.



(*a*) What feature of the membrane of the model cell makes it suitable for this investigation?

_____ **1**

(*b*) State the letters of the model cells which would have increased in mass after one hour.

_____ **1**

(*c*) What should be done to the model cells before each weighing to obtain valid results?

_____ **1**

(*d*) Predict which model cell would have the greatest change in mass after one hour.

Give a reason for your choice.

Model cell _____ **1**

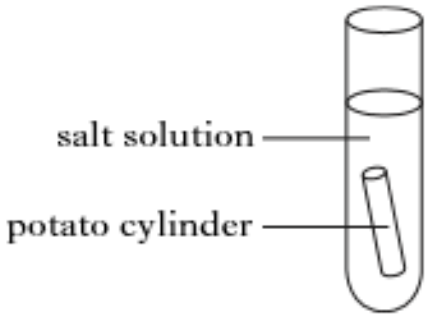
Reason _____

_____ **1**

Transport across the membrane

An investigation was carried out to find the effect of different concentration of salt solutions of different concentrations on the mass of potato tissue.

Five test tubes were set up as shown below, each containing a different concentration of salt solution.



Each potato cylinder was weighed, placed in the solution and left for an hour. Each cylinder was then reweighed and the percentage (%) change in mass was calculated.

The table below shows the results of the investigation

Salt concentration ($g/100cm^3$)	*Change in mass* (%)
1	+15
3	+10
6	–5
8	–15
10	–20

State the independent and dependent variable.

Independent Variable _____

Dependent Variable _____

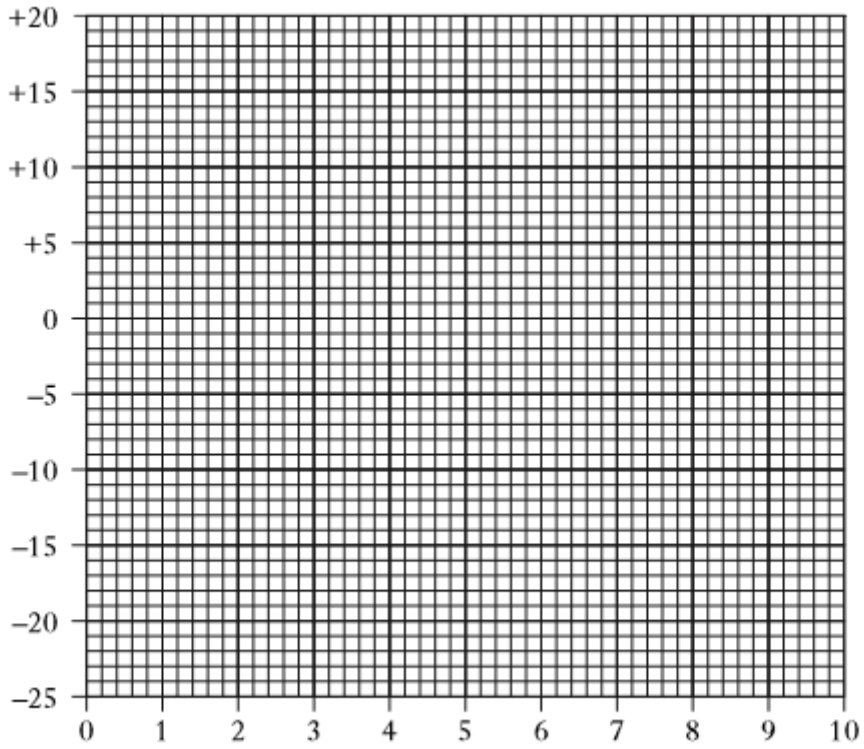
b) Time was kept constant in this investigation.
Name two other variables which must be kept constant for valid results.

_____

_____

c) Using the results given state the salt concentration which is nearest to the concentration of the potato tissue.
_____ g/100cm^3

d) Plot a line graph of salt concentration against the change in mass and add the appropriate label to each axis.

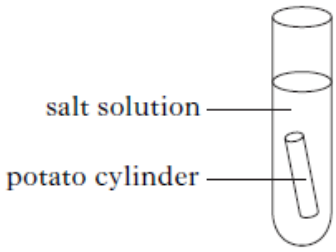


e) Predict the salt concentration that would produce a 10% decrease in mass

_____ g/100cm^3

Plant Cell Osmosis

An investigation was carried out to find the effect of salt solutions of different concentrations on the mass of potato tissue. Five test tubes were set up as shown below, each containing a different concentration of salt solution.



Each potato cylinder was weighed, placed in the solution and left for an hour. Each cylinder was then reweighed and the percentage (%) change in mass was calculated.

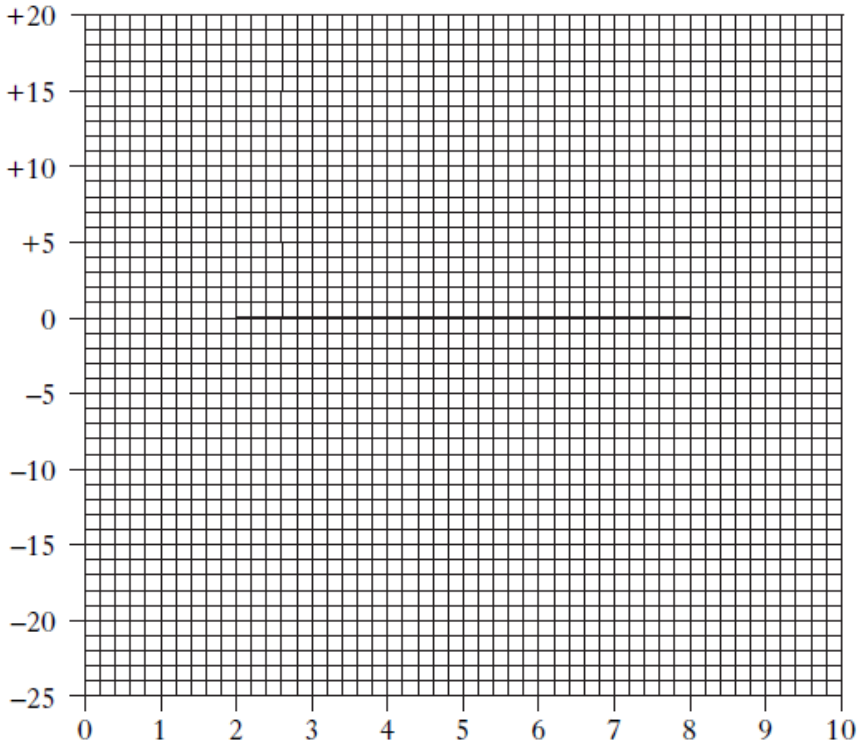
The table below shows the results of the investigation.

Salt concentration ($g/100\,cm^3$)	*Change in mass* (%)
1	+15
3	+10
6	–5
8	–15
10	–20

(*a*) (i) Add the appropriate label to each axis. **1**

(ii) Construct a **line graph** using the results given in the table. **1**

(Additional graph paper, if required, will be found on *Page thirty*.)



(*b*) Time was kept constant in this investigation.

Name **two** other variables which must be kept constant.

1 _____

2 _____ **1**

(*c*) Using the results given, state the salt concentration which is isotonic to the potato tissue. Explain your answer.

Isotonic concentration _____ $g/100\,cm^3$ **1**

Explanation _____

_____ **1**

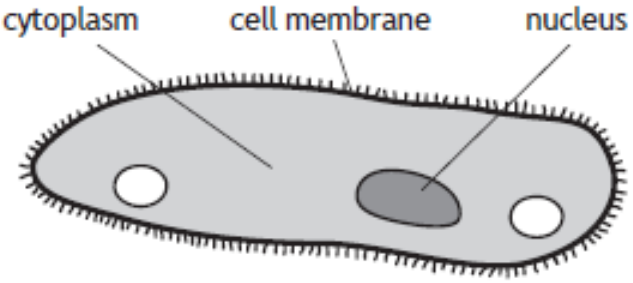
(*d*) Predict the salt concentration that would produce a 10% decrease in mass.

_____ $g/100\,cm^3$ **1**

Transport across the membrane

Paramecium is a single-celled organism which lives in fresh water.

The following diagram shows some of its structures.



(a) (i) Choose one of the following structures by ticking (✓) one of the boxes and describe its function. 1

Cytoplasm ☐ Cell membrane ☐ Nucleus ☐

Function _____

_____

(ii) The water concentration outside the paramecium is higher than the water concentration of the cytoplasm. This causes the diffusion of water into the cell.

Name this movement of water. 1

_____

(b) Name the structure present in a plant cell which prevents it from bursting when full of water. 1

_____

Importance of Diffusion

1. Which substance enters animal cells by diffusion and is used to produce ATP?

A Carbon dioxide

B Starch

C Water

D Glucose

2. Which line in the table below identifies the direction of diffusion of the three substances during muscle contraction?

	Substance		
	Glucose	*Oxygen*	*Carbon dioxide*
A	out	out	in
B	in	out	in
C	out	in	out
D	in	in	out

3. Which line in the table below identifies correctly the importance of diffusion to an animal cell?

	Raw material gained	*Waste product removed*
A	oxygen	glucose
B	carbon dioxide	oxygen
C	oxygen	carbon dioxide
D	glucose	oxygen

4. Which of the following diffuses out of a muscle cell during cellular respiration?

A oxygen

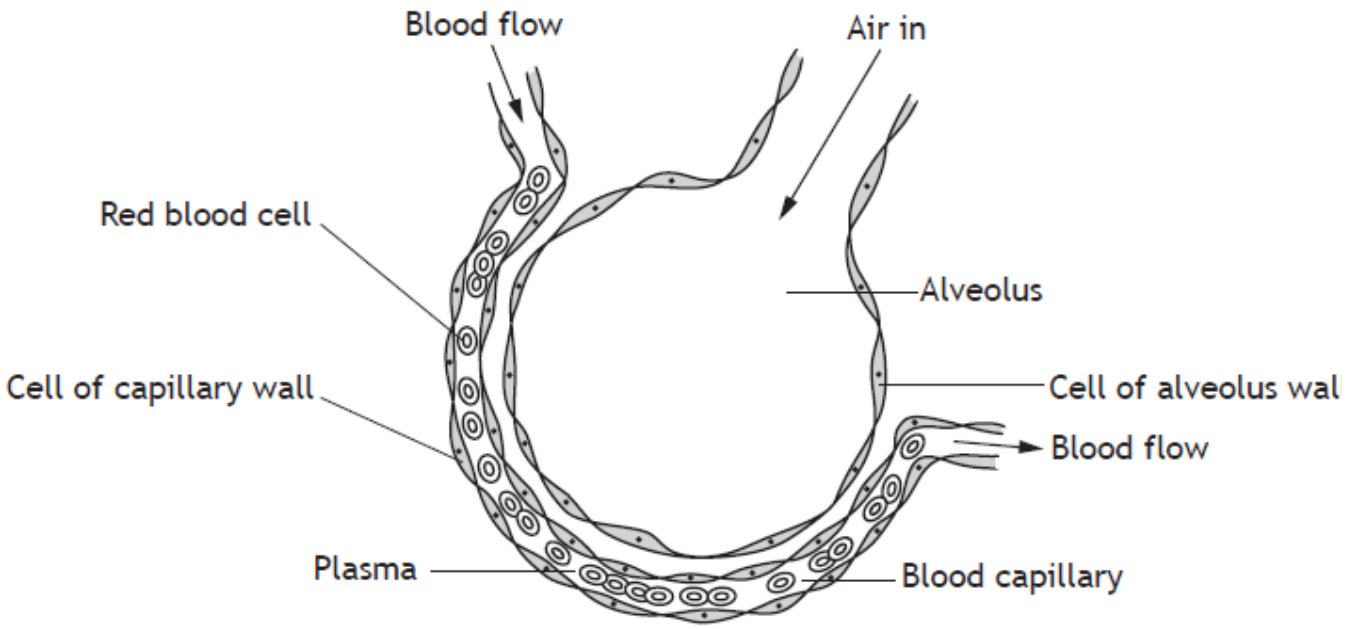
B glucose

C carbon dioxide

D amino acids

Importance of Diffusion: Alveolus

2. The diagram below shows a site of gas exchange in the lungs.



The table below shows the relative concentration of oxygen, carbon dioxide and water in these cells and plasma, the liquid part of the blood.

	Relative concentration of substances		
	oxygen	*carbon dioxide*	*water*
Plasma	low	high	medium
Red blood cell	low	high	medium
Cell of capillary wall	medium	medium	medium
Cell of alveolus wall	high	low	medium

(a) (i) Describe the pathway that oxygen would take when moving between these cells. 1

_____

_____

(ii) Explain why the oxygen moves along this pathway. 1

_____

_____

Importance of Diffusion: Alveolus

(b) State whether osmosis would occur between the cells of the capillary wall and the cells of the alveolus wall. Insert a tick (✓) in the correct box. 1

Osmosis would occur ☐ Osmosis would not occur ☐

Justify your answer.

_____

_____

f) A control was not carried out in this experiment but is also important for VALID results.

(i) Describe how to set up a control in this experiment.

_____

_____

(ii) Explain why a control is necessary for VALID results.

_____

_____

g) The student only took one reading at each glucose concentration.
Explain how to improve the reliability of the results.

_____

_____

h) State the conclusion that can be drawn from the results of the experiment in terms of the effect of salt concentration on the mass of the potato tissue.

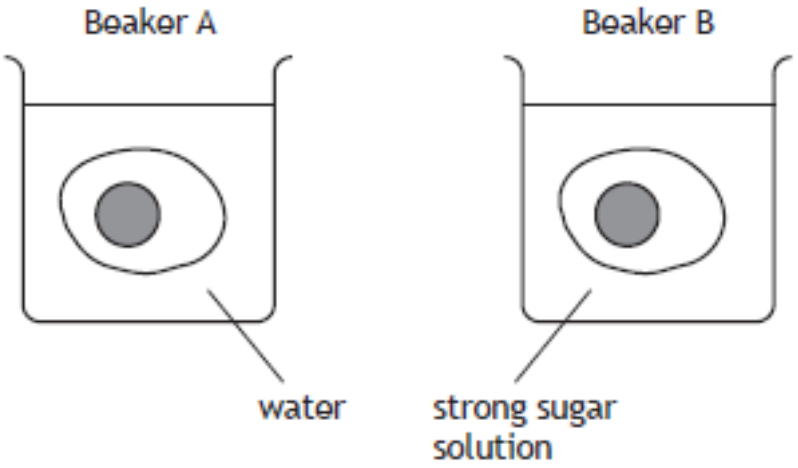
_____

_____

Transport across the membrane

(a) Shells can be removed from eggs by dissolving them in vinegar for 2-3 days. The egg contents remain inside a thin membrane.

In an investigation the shells from two eggs were removed. The eggs were then weighed and placed in beakers as shown below.



After 2 hours the eggs were removed from the beakers, blotted dry and reweighed. The results are shown in the following table.

Beaker	*Mass at start* (g)	*Mass after 2 hours* (g)	*Percentage change in mass*
A	54·0	67·5	
B	52·1	47·8	−8·2

(i) Complete the table by calculating the percentage change in mass for beaker A. 1

Space for calculation

(ii) Suggest why the eggs were blotted dry before being reweighed. 1

_____

_____

(iii) Choose either beaker A or B and explain how osmosis caused the change in mass of the eggs in that beaker. 2

Beaker _____

Explanation _____

_____

_____

(b) The movement of molecules in or out of cells can be by passive or active transport.

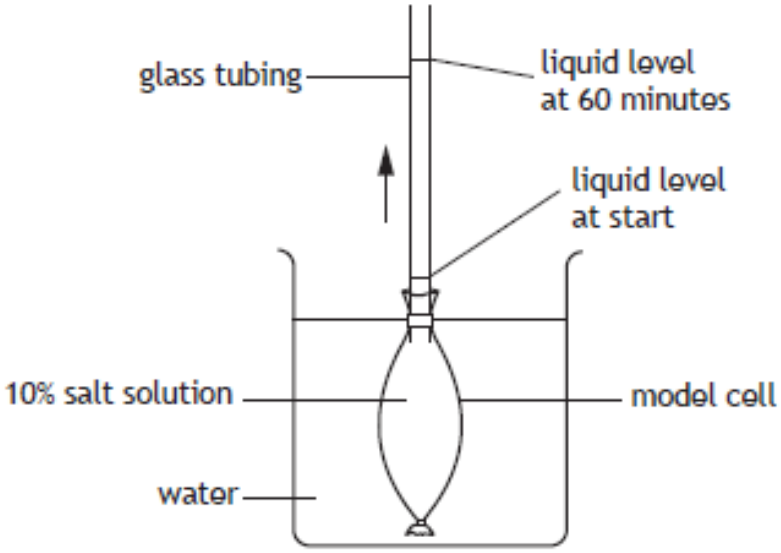
Describe one difference between passive and active transport. 1

_____

_____

Transport across the membrane

The apparatus shown below was used to investigate the movement of water into and out of a model cell. The model cell had a selectively permeable membrane.



The liquid level in the glass tubing was measured every 10 minutes for 60 minutes.

The results are shown in the table below.

Time (minutes)	*Liquid level* (mm)
0	10
10	22
20	32
30	40
40	48
50	56
60	64

(a) Name the process which caused the liquid level to rise. 1

(b) Explain how this process caused the liquid level to rise. 2

_____

_____

_____

(c) Calculate the average rate of movement of liquid in the glass tubing. 1

Space for calculation

_____ mm per minute

(d) When the investigation was repeated, the average rate of movement of liquid was slower.

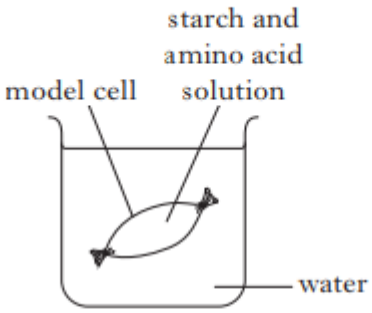
Suggest one difference in the way that the investigation was set up that could have caused this change in results. 1

_____

_____

Total marks 5

B A model cell was set up as shown below and left for two hours.



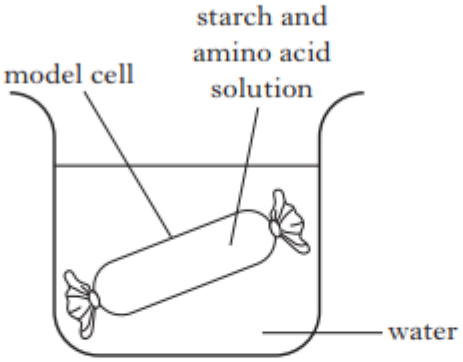
Describe the movement of molecules during the two hours by

(*a*) diffusion **and**

(*b*) osmosis. **5**

Transport across the membrane

(*a*) A model cell was made using a visking tubing bag filled with a starch and amino acid solution. It was placed into a beaker of water and left for two hours.



(i) Amino acids were detected in the water outside the model cell.

What process is responsible for this movement?

_____ **1**

(ii) Why would no starch be detected in the water outside the model cell?

_____

_____ **1**

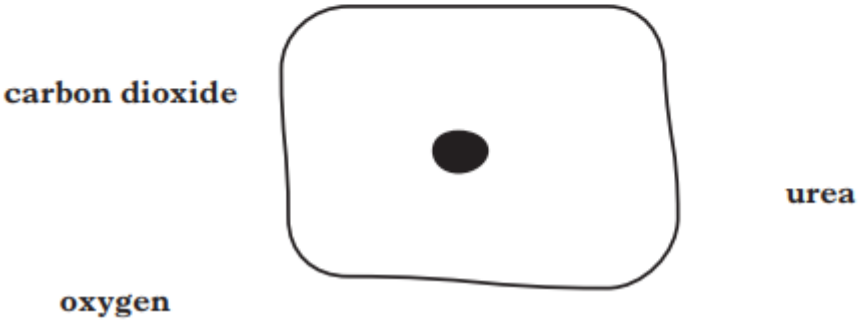
(iii) What would happen to the mass of the model cell during the two hour period? Explain your answer.

Mass of model cell _____

Explanation _____

_____ **2**

(*b*) The diagram below represents a respiring liver cell carrying out deamination.



Transport across the membrane—Where am I in my learning?

Where am I in my learning?

Traffic light the following I can statements to decide how well you are progressing through this sub topic.

Review 1

I can label the 2 parts to the cell membrane as proteins and phospholipids	
I can explain that the membrane is selectively permeable allowing only small molecules to pass through the membrane and not large molecules	
I can give examples of small molecules as O_2, CO_2, H_2O, fatty acids & glycerol, amino acids and glucose. I can give examples of large molecules as starch/protein/fat	
I can explain active transport in terms of moving from low to high concentration or against a concentration gradient.	
I can explain passive transport in terms of moving from high to low concentration or down a concentration gradient.	
I can explain that passive transport does not require ATP but active transport requires ATP for the membrane proteins to move the molecules/ions against the concentration gradient.	
I can explain that osmosis is a special case of diffusion involving water and can define osmosis as water moving from high water concentration to low water concentration through a selectively permeable membrane	
I can explain whether cells increase or decrease in mass when placed into water or concentrated salt/sugar solutions and can work out percentage change in mass	
I can explain why it is important to blot plant/animal tissue dry before reweighing in osmosis experiments	
I can state that animal cells burst in pure water whereas plant cells go turgid due to presence of cell wall. In concentrated sugar solution animal cells shrink whereas plant cells go plasmolysed	

My next steps are:

_____

_____

Transport across the membrane—Where am I in my learning?

Where am I in my learning?

Traffic light the following I can statements to decide how well you are progressing through this sub topic.

Review 2

I can label the 2 parts to the cell membrane as proteins and phospholipids	
I can explain that the membrane is selectively permeable allowing only small molecules to pass through the membrane and not large molecules	
I can give examples of small molecules as O_2, CO_2, H_2O, fatty acids & glycerol, amino acids and glucose. I can give examples of large molecules as starch/protein/fat	
I can explain active transport in terms of moving from low to high concentration or against a concentration gradient.	
I can explain passive transport in terms of moving from high to low concentration or down a concentration gradient.	
I can explain that passive transport does not require ATP but active transport requires ATP for the membrane proteins to move the molecules/ions against the concentration gradient.	
I can explain that osmosis is a special case of diffusion involving water and can define osmosis as water moving from high water concentration to low water concentration through a selectively permeable membrane	
I can explain whether cells increase or decrease in mass when placed into water or concentrated salt/sugar solutions and can work out percentage change in mass	
I can explain why it is important to blot plant/animal tissue dry before reweighing in osmosis experiments	
I can state that animal cells burst in pure water whereas plant cells go turgid due to presence of cell wall. In concentrated sugar solution animal cells shrink whereas plant cells go plasmolysed	

My next steps are:

_____

_____