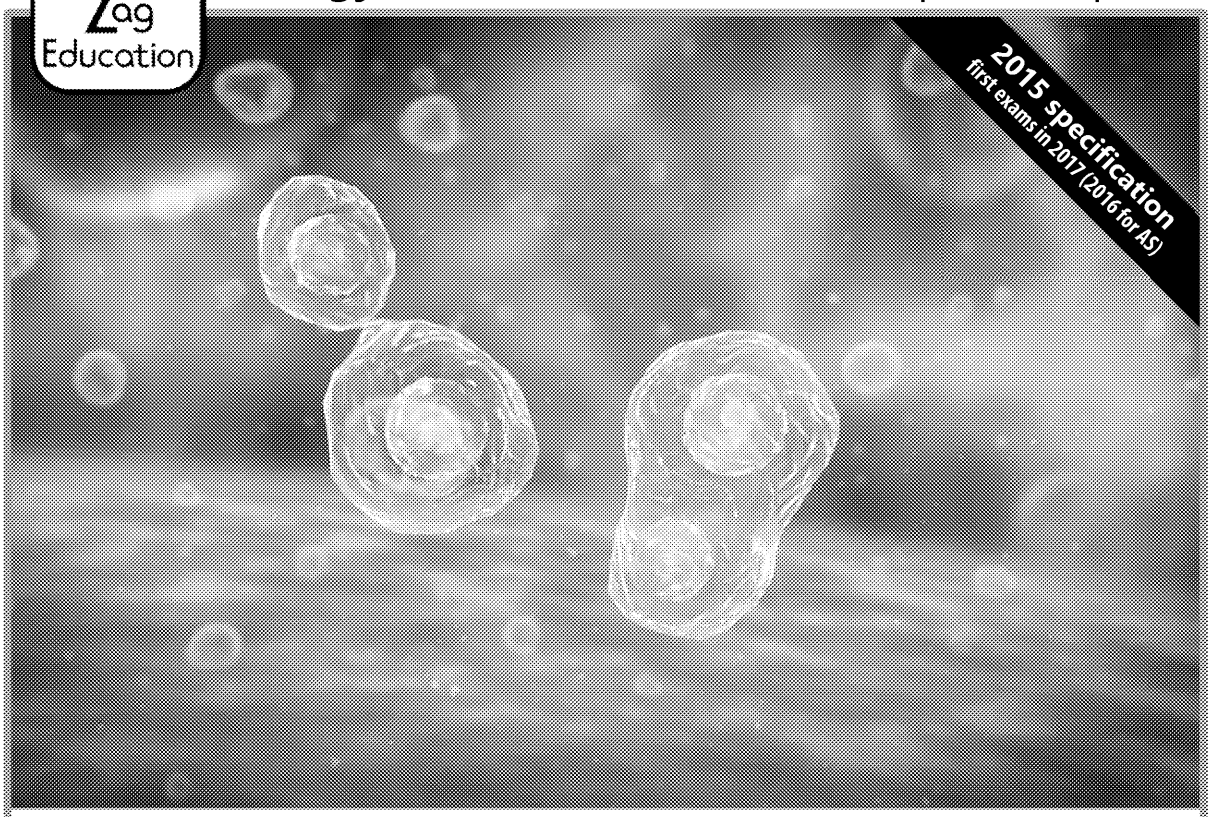
Zig Zag Education

Biology AS and A Level | Edexcel | 8B10



Topic Tests

for Edexcel AS / A Level Year 1 Biology B

Update v1.1, 06 October 2017

zigzageducation.co.uk

POD 6686

Contents

Teacher's Introduction

These topic tests have been designed to help you and your students assess their knowledge of a topic after you have taught each section of the **AS/A Level Year 1 Edexcel Biology B** specification. Each topic test is closely tied to the specification, ensuring all aspects of the course will be covered.

Each topic test provides a variety of question styles, including:

- **Quick-testing questions** – these test basic understanding and knowledge of terminology, and allow immediate identification of weaker topics
- **Long-answer questions** – these are exam-style questions that require use of comprehensive knowledge and aid practice of writing skills and exam technique
- **Missing-information questions** – these allow key knowledge to be tested without it being time-consuming and provide context for further questions
- **Diagram-and-graph-dependent questions** – these require identification of features, and interpretation of data and application of knowledge, as well as testing mathematical skills
- **Practical questions** – cover aspects of practicals from planning and risk awareness to data analysis and evaluation, as well as testing all mathematical skills
- **Context-dependent questions** – these push students to apply their knowledge to unfamiliar situations, spot key points within provided information and draw on multiple aspects of the course

Tests have been aimed to take approximately 30 minutes and contain on average between 25 and 35 marks, though please note that this has not been possible where topics are brief and introductory or require more detailed knowledge and assessment. Larger topics have often been split into multiple tests, with each test containing a variety of questions (details in table on the right). All information for a question is provided within the test; however, some questions will require use of a calculator and ruler.

Topic Test	Topic Number	Number of Marks
1	1.1/1.2/1.3	27
2	1.1/1.2/1.3	22
3	1.4	18
4	1.4	32
5	1.5	35
6	1.6/1.7	28
7	2.1	48
8	2.2	38
9	2.3	29
10	2.3	22
11	2.4/2.5	49
12	3.1	35
13	3.2/3.3	19
14	3.2/3.3	28
15	4.1	40
16	4.2	49
17	4.3	26
18	4.3	21
19	4.4	46
20	4.5/4.6/4.7	50

Remember!

Always check the exam board website for new information, including changes to the specification and sample assessment material.

Students are able to see the number of marks allocated for each question, allowing them to judge the detail required in their answers, as in exam conditions. Full answers are at the end of the resource and are accompanied by marker instructions, providing quick guidelines on what answers would and would not be accepted in exam conditions.

All diagrams and graphs have been designed with black-and-white photocopying in mind, so that key features will not be lost.

We hope you find these tests useful during your teaching.

June 2016

Update v1.1, October 2017

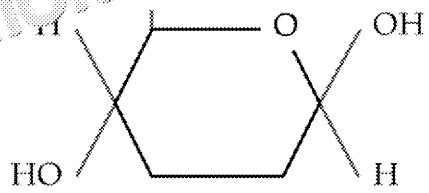
In review of getting this endorsed, some changes have been made:

- questions have been added/removed/modified in some tests to match the Edexcel B specification more closely
- small corrections and clarifications have been made to some questions and answers
- closely linked topic tests have been merged

Topic Test 1: Carbohydrates, Lipids and Protei

1. What is the name of the sweet-tasting monomer that makes up carboh

2. a) Name the monomer shown below.
   b) Explain how this monomer compares with i[illegible]omer. Use a drav
   your answer.



3. Copy and fill in the missing words in the following statement:

   A _____ reaction causes two glucose monosaccharides to form
   bond between them, creating a disaccharide called maltose. If more m
   added, a _____ is formed.

4. Glycogen is produced within animals, whereas cellulose is produced i
   Give three ways glycogen and cellulose differ in their structure and fu

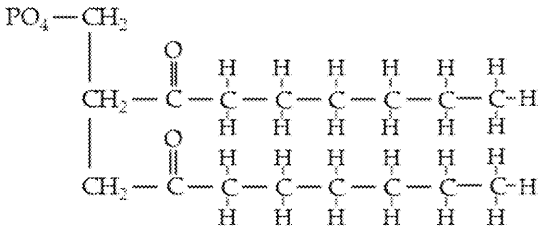
5. Lipids form fats and oils. Give two uses for lipids within the body.

6. Which lipid has three fatty acids [illegible]glycerol?

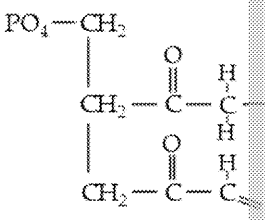
7. Name the reaction shown in a fatty acid and glycerol, and name the bo

8. Summarise the difference between the phospholipids shown below.

Phospholipid A



Phospholipid B

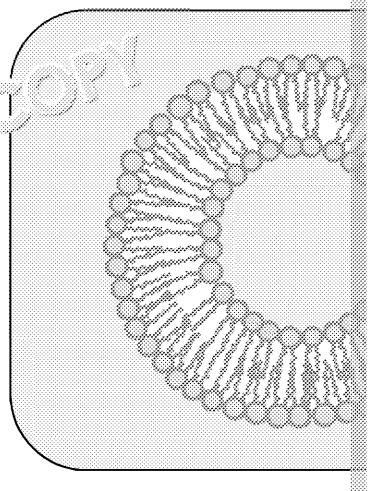


9. How does the structure of triglycerides c[illegible]an also form phospholipids?

10. Figure A is a simplified drawing of a phospholipid.
Explain why phospholipids form the structure shown in Figure B upo

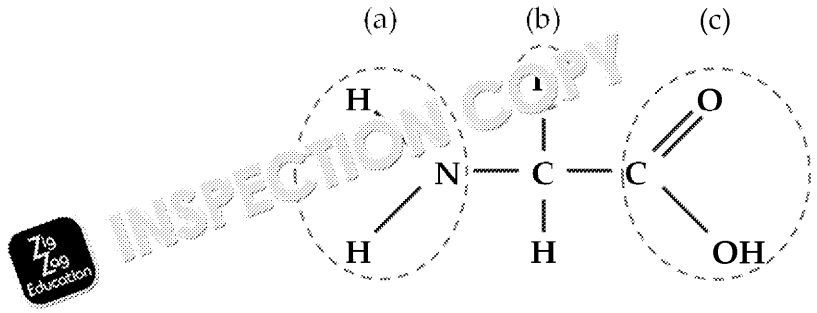
Figure A

Figure B



Topic Test 2: Carbohydrates, Lipids and Protei

1. Name the three parts of an amino acid labelled in the diagram below:



2. Copy the text and fill in the missing words in the following statement

   A _____ is formed from two amino acids. The amino acids a
   _____ bond, which is created through a _____ reacti

3. a) Give two differences between fibrous and globular proteins, in te
   functions.
   b) Give an example of each type.

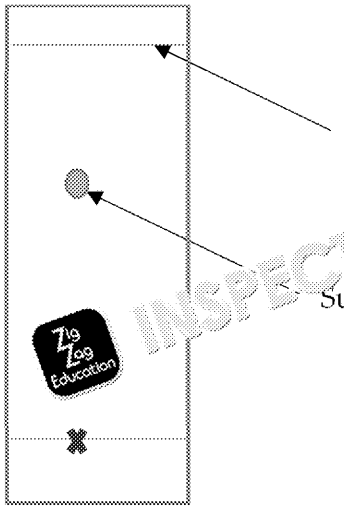
4. Proteins formed from polypeptides often have a complicated hierarch
   a) List three types of bonds involved in tertiary protein structure.
   b) Place these bonds in order of their bond strength, from weakest t
   c) How is the quaternary structure of a pr ein different from the te
   d) State one common quaternary pr ein found in the body.

5. Give three differenc e structure and function of collagen

6. Using yer chromatography, amino acids can be identified based
   a meas of how far a substance travels relative to the solvent. The R
   calculated using:

$$R_f = \frac{\text{Distance travelled by substance}}{\text{Distance travelled by solvent}}$$

   Calculate the R_f value of the amino acid below and identify the amino
   values.



Amino ac
Cystein
Leucine
Tryptoph
Histidin
Phenylalan
Methioni

Topic Test 3: DNA and Protein Synthes

1. What does DNA stand for?

2. Figure 1 below shows a section of DNA.
   a) Name the monomer labelled A.
   b) Identify the three parts of the monomer, labelled B, C and D.
   c) Name the bond labelled E.

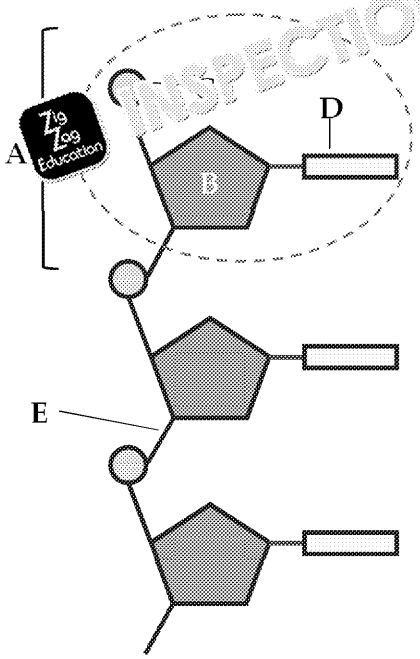
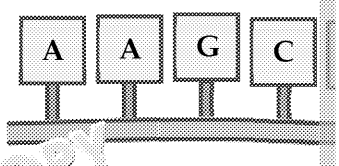


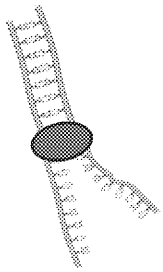
Figure 1

Figure 2



3. a) Copy the DNA strand in Figure 2 and add the antiparallel strand.
   b) Draw on the number of hydrogen bonds between the base pairs.

4. Copy the text below and fill in the missing words in the following process:

The enzyme _____ unwinds the DNA strand and breaks the _____ bonds.	_____ are attracted to exposed complementary
	
_____ bonds are formed when the enzyme _____ initiates _____ reactions to join the deoxyribose phosphate backbone together.	Half of the original DNA molecule is now part of a new DNA fragment.
	

5. What is the advantage of the above process of DNA replication?

Topic Test 4: DNA and Protein Synthes

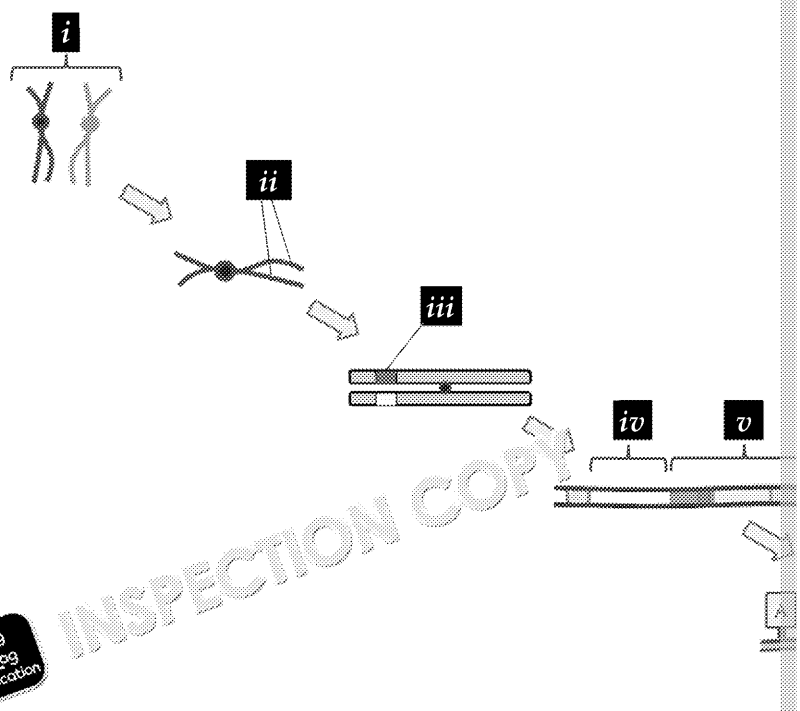
1. Copy the text and fill in the missing words in the process below:

   The triplet code of DNA codes for specific _____. The code is ___ non-overlapping and _____, which means that most amino acids h

2. Describe the function of introns.

3. Label the levels of ... formation *i* to *vi*, using the words provid

   Allele ...*le code* *Chromatids* *Exon* *Intron* *Homologou*



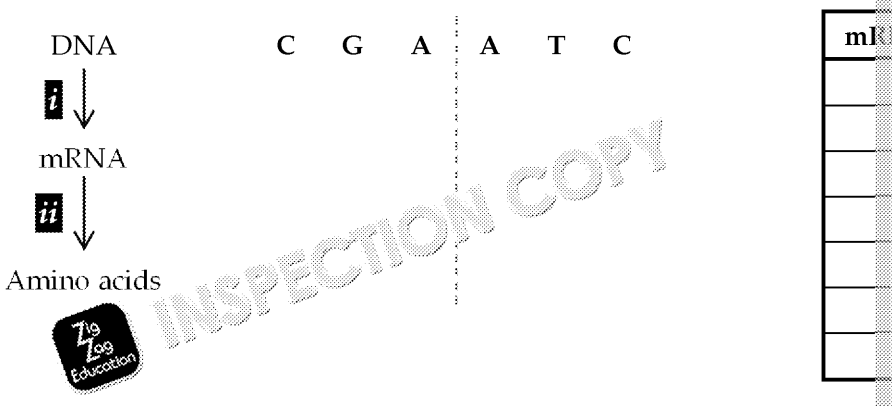
4. Compare the structures of mRNA and tRNA.

5. Copy the text and fill in the missing words in the process below:

   - In _____ the DNA strands are separated and free nucleoti
     enzyme _____ to form _____ RNA.
   - The mRNA leaves the nucleus and binds to a _____ for __

6. Describe the roles of the following structures or molecules in translati
   a) Ribosome
   b) tRNA
   c) ATP

7. Copy and complete the diagram below by adding the mRNA and am
DNA, and label steps *i* and *ii*.



8. Compare substitution and deletion mutations.

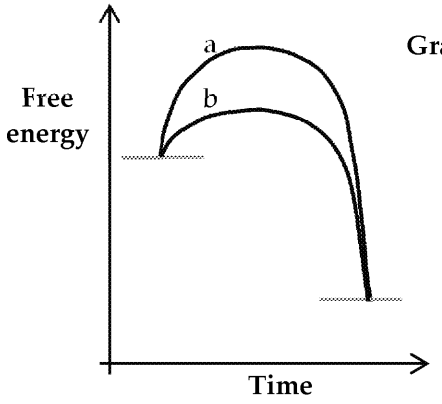
9. Give an example of a disease caused by a single substitution mutation.

Topic Test 5: Enzymes *(1.5)*

1. What two features do globular proteins have that make them good en

2. Define a catalyst.

3. a) What is activation energy?
   b) Copy Graph 1 (below). M[illegible] tivation energy of both reactio
   c) Does line a or lin[illegible] ow[illegible] reaction catalysed by an enzyme?



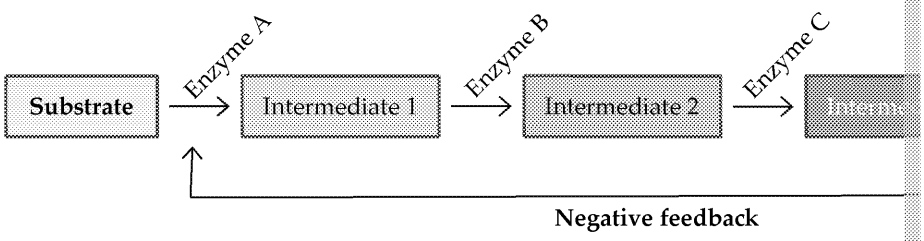
Graph 1

4. The induced fit model is commonly used to explain how enzymes inte
   What does the model suggest?

5. Some amino acids that are not pa[illegible] yme's active site are chan
   Explain whether or not thi[illegible] fect the functioning of the enzym

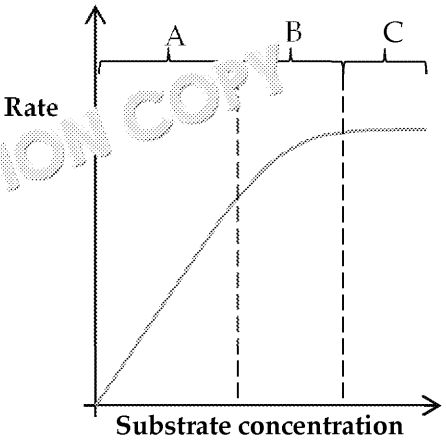
6. Descri[illegible] d[illegible]ence between competitive and non-competitive inh

7. What process does the diagram below represent?



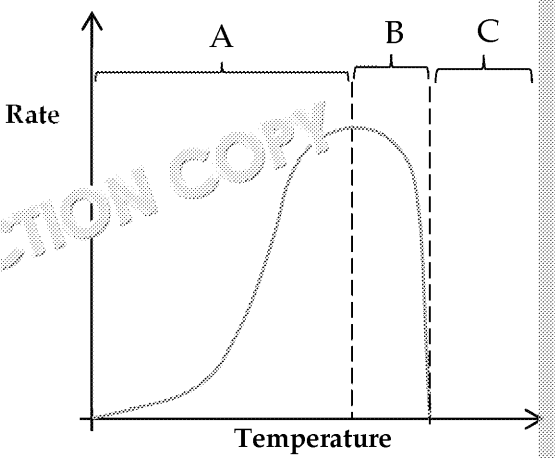
8. Graph 2 shows the rate of an enzyme-catalysed reaction with increasi
Explain the relationship between rate of reaction and substrate concer

Graph 2



9. Graph 3 shows the rate of an enzyme-catalysed reaction with increasi
Explain the shape of the graph during phases A, B and C.

Graph 3

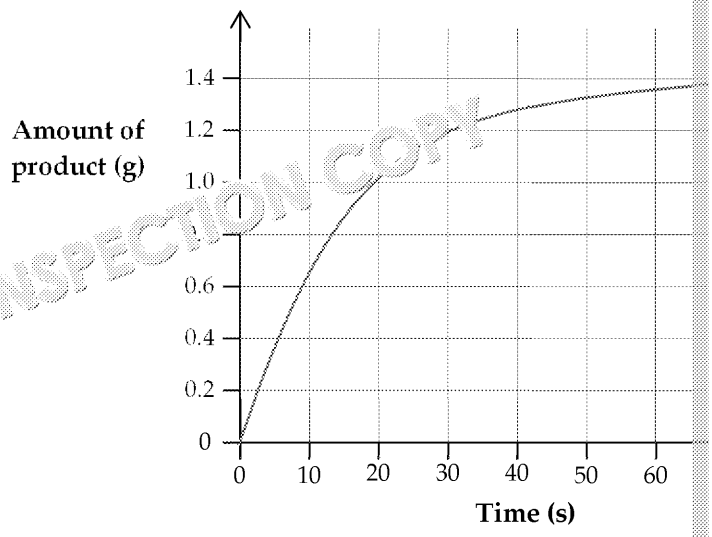


10. An experiment was set up to identify to which group an unknown dig
initial rate of reaction in the presence of the enzyme was measured in t
and the results recorded:

	Initial rate of reaction (g min	
	pH 3.0	pH 6.0
Repeat 1	0.27	1.35
Repeat 2	[illegible]	1.41
Repeat 3	[illegible]	1.40
Repeat [illegible]	0.32	** 0.71 **
[illegible]an	*0.31*	*1.39*

a) Calculate the result for repeat 4 at pH 8.0 (repeat ***y***). You must sh
b) A water bath was used throughout the experiment. Before repea
accidentally turned off.
Explain why the value from repeat 4 was not considered when ca

c) The reaction was repeated at pH 8.2 and the amount of product p
against time. Calculate the initial rate of reaction (to 2 dp, in g mi
graph below.



d) 8.2 is the enzyme's optimum pH. What does this mean?
e) Where in the human body does the pH suggest this enzyme is ac
f) Based on the information in the table above, what would happen
enzyme if it were released into the stomach? Justify your answer.
g) Explain why pH affects the function of an enzyme.

Topic Test 6: Water and Inorganic Ions

1. a) What is meant by each of the words in the phrase 'inorganic ion'?
   b) State the formula for:
      i) A calcium ion
      ii) A nitrate ion

2. What is the main property of ions that makes them useful in different

3. Copy the table showing the roles of different ions in plants and fill in in the

Inorganic ion	Role
Nitrate ions	Structure of DNA and _____
_____	Backbone of DNA; used to convert AD
_____	For the formation of the middle lamel
Magnesium ions	For the production of _____

4. What characteristic of water means it forms hydrogen bonds with oth

5. Describe and explain two properties of water that allow transport and

6. Copy the text and fill in the missing words in the following statement

   Water is a good _____; there, substances can dissolve and reactions to take place. It is an _____ in hydrolysis and _____ are crucial for producing large _____ chains from repeating m

7. Many can only survive within a very small temperature range.
   a) Describe the property of water that means bacteria can survive in environments where air temperatures fluctuate rapidly.
   b) Arctic fish live below ice sheets in water that should be freezing. the ice sheets make the surrounding environment more favourab

8. In addition to the two characteristics explained in question 5, describe of water that are important within living organisms.

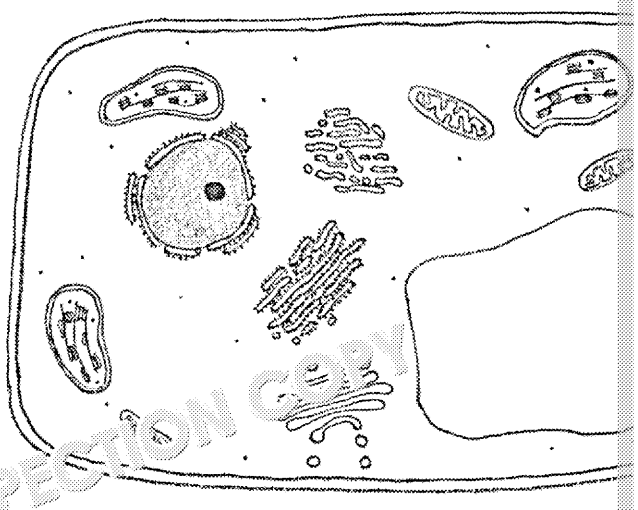
Topic Test 7: Eukaryotic and Prokaryotic C
and Function *(2.1)*

1. Copy and fill in the missing words in the scale hierarchy:

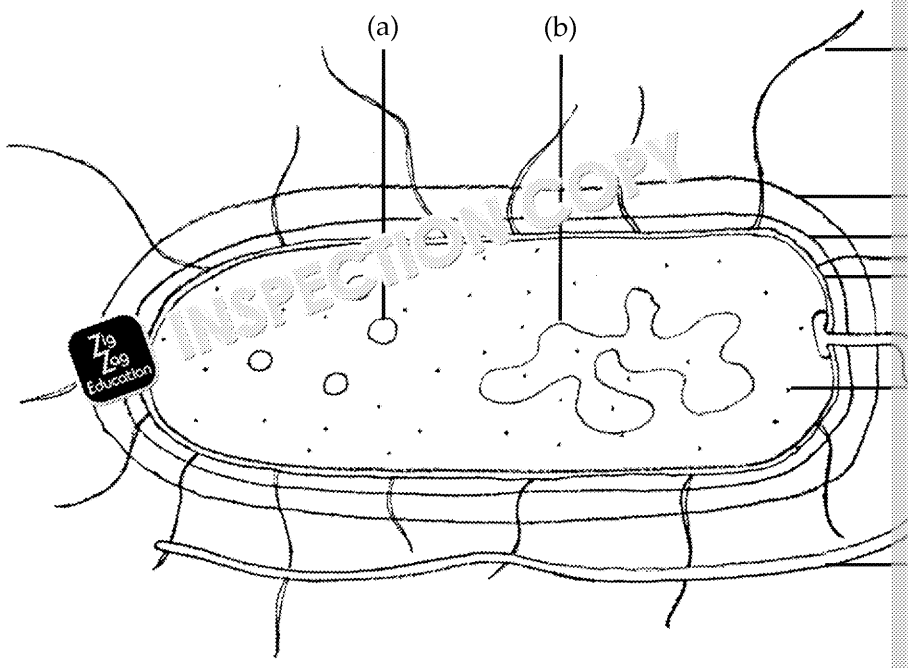
_____ ⟶ Cells ⟶ _____ ⟶ _____ ⟶

2. a) Match each organelle to its f[illegible] and its function by matching [illegible] numbers.
   b) Copy the cell [illegible] below and write the number of each organ[illegible]

1. [illegible]leus	a) Flattened sacs that bud into vesicles
2. Mitochondria	b) Double membrane with pores
3. Golgi apparatus	c) Small vesicles
4. Lysosomes	d) Double membrane, free DNA
5. Ribosomes	e) Thin tubes with many vesicles
6. Rough ER	f) Folded inner cristae
7. Smooth ER	g) Thin tubes coated in ribosome[illegible]
8. Vacuole	h) [illegible]ge sac of liquid
9. Chloro[illegible]	i) Structures made partly of proteins; can be 70S or 80S
1[illegible] wall	j) Rigid cellulose/chitin polymers



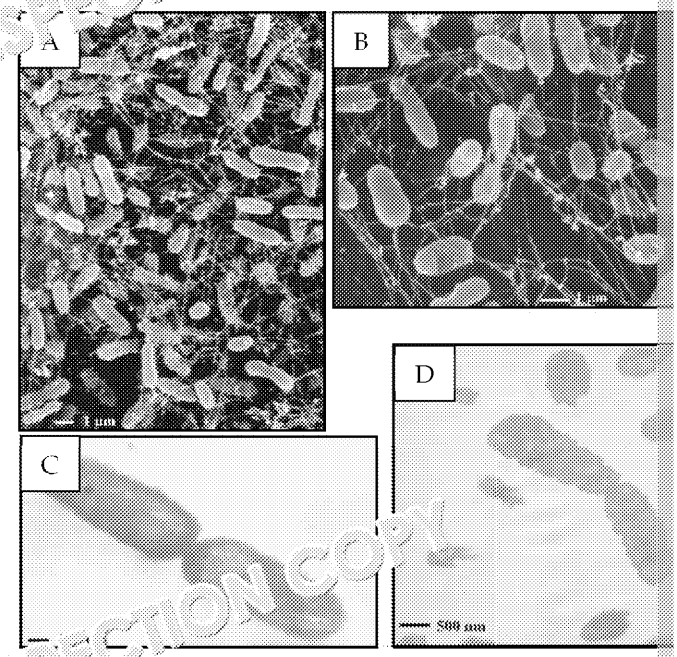
3. Copy the diagram below and label the features of the prokaryotic cell



4. What is the function of organelles a and f?

5. The properties of bacterial cell walls affect which antibiotics are chose
Explain why.

6. a) State the type of microscopy used in the pictures below.
b) What happens to the electron beam in the two types of microscop



7. a) Small distances on a microscope slide can be measured using the
On a particular microscope, one stage micrometer unit is 10 μm.
graticule unit equal (in μm to 1 dp) if 10 units on the micrometer
eyepiece graticule scale?

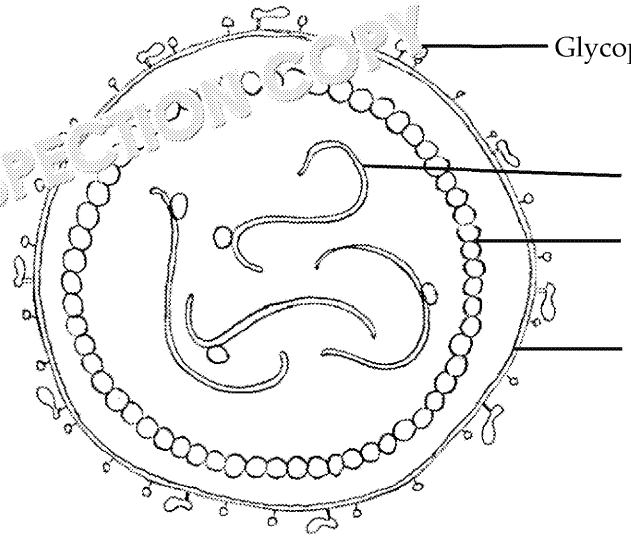
   b) A calibrated eyepiece graticule gives the length of a muscle cell a
What is the actual length of the cell in millimetres (to 3 sf)?

8. What is the difference between magnification and resolution?

9. Why is staining necessary for many microscope slide preparations?

Topic Test 8: Viruses *(2.2)*

1. a) Virus particles are acellular. Copy the virus particle below and la
   b) Describe and give an example of the three types of virus, based o



2. Copy the paragraph below and fill in the missing words in the proces

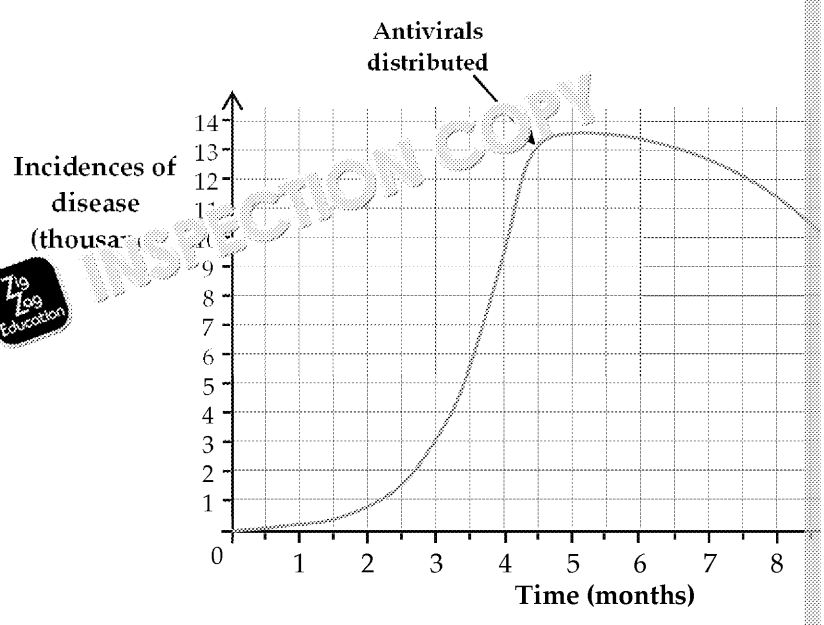
   A harmless, _____ virus inserts its genetic material into a host
   incorporated into the host cell's _____ and is replicated when
   _____ pathway. Alternatively, the m[illegible] an replicate inde
   _____ pathway – which produces new viruses and causes the

3. Why are viruses not considered to be alive?

4. Descri[illegible] viruses replicate.

5. The Ebola outbreak of 2014 had a mortality rate of up to 90 % and has
   a) Give three examples of how Ebola spreads.
   b) Explain how antivirals work and why they are limited in their eff
   c) What is a more common way of controlling a viral outbreak? Giv

6. The graph below shows the spread of a disease before and after antivi
Calculate the rate of decrease in incidences four months after the antiv
your answer to three significant figures.



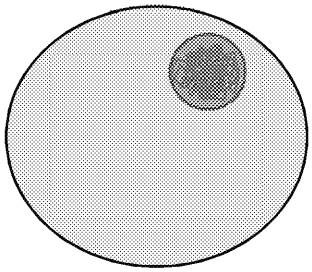
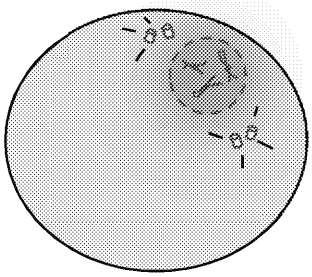
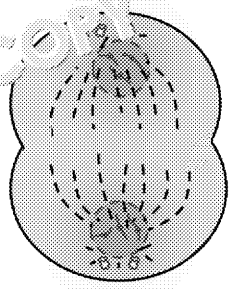
7. Drugs that are part way through their clinical trials are called 'untested
an epidemic.
Suggest two reasons for and against using untested drugs to treat a ra

Topic Test 9: Eukaryotic Cell Cycle and Di

1. Can all cells in a multicellular organism divide?

2. a) What is the name of the process non-sex cells use to divide?
   b) Give three examples where this process is used in live organisms.

3. During the cell cycle, a cell passes through several stages. Copy the te
   in the missing words and di[illegible] the following process:

_____ ir[illegible] _____ repli[illegible] ar[illegible] the organelles dupli[illegible]	In _____ the chromosomes become visible and the _____ disintegrates.	D[illegible] cl[illegible] ce[illegible]
		
In anaphase the _____ are split and pulled to opposite poles of the cell.	During _____ the nuclear envelope reforms around the separated chromatids.	C[illegible] w[illegible]
		

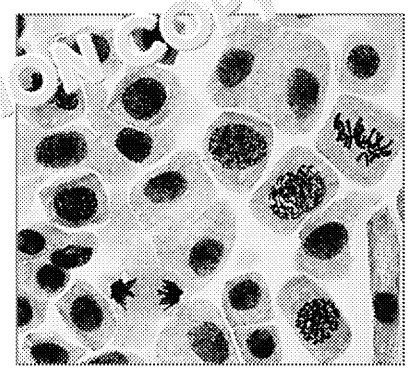
4. a) Name the overall process which occurs during stages 2–5 above.
   b) Describe how spindle fibres are involved in stages 2–5.

5. Name three essential functions of the process outlined above, and giv[illegible]

6. The mitotic index for a population is a ratio that can be calculated as f[illegible]

   Mitotic Index = Number of cells undergoing mitosis : Total num[illegible]

   Calculate the mitotic index of the sample of onion cells below.



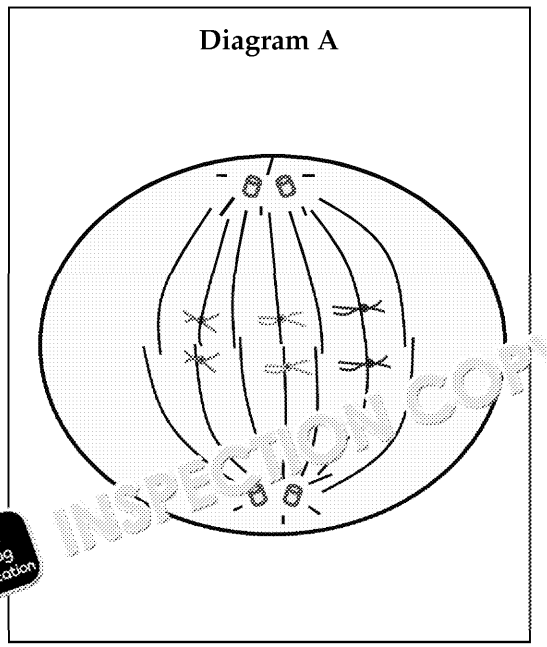
Topic Test 10: Eukaryotic Cell Cycle and Di

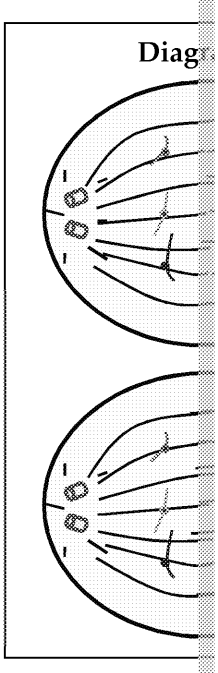
1. a) What types of cell are susceptible to mutation?
   b) Describe how mutations arise.

2. What is a translocation mutation?

3. Give the term used to describe a mutation that:
   a) has no effect on the polypeptide
   b) changes the amino acid codon to a stop codon

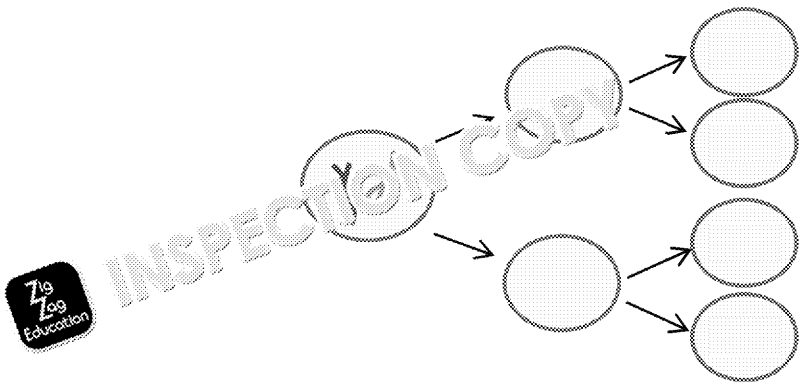
4. a) Describe the process of meiosis.
   b) How do the daughter cells produced by mitosis differ from those
   c) Name the stages shown in Diagram *A* and Diagram *B*.





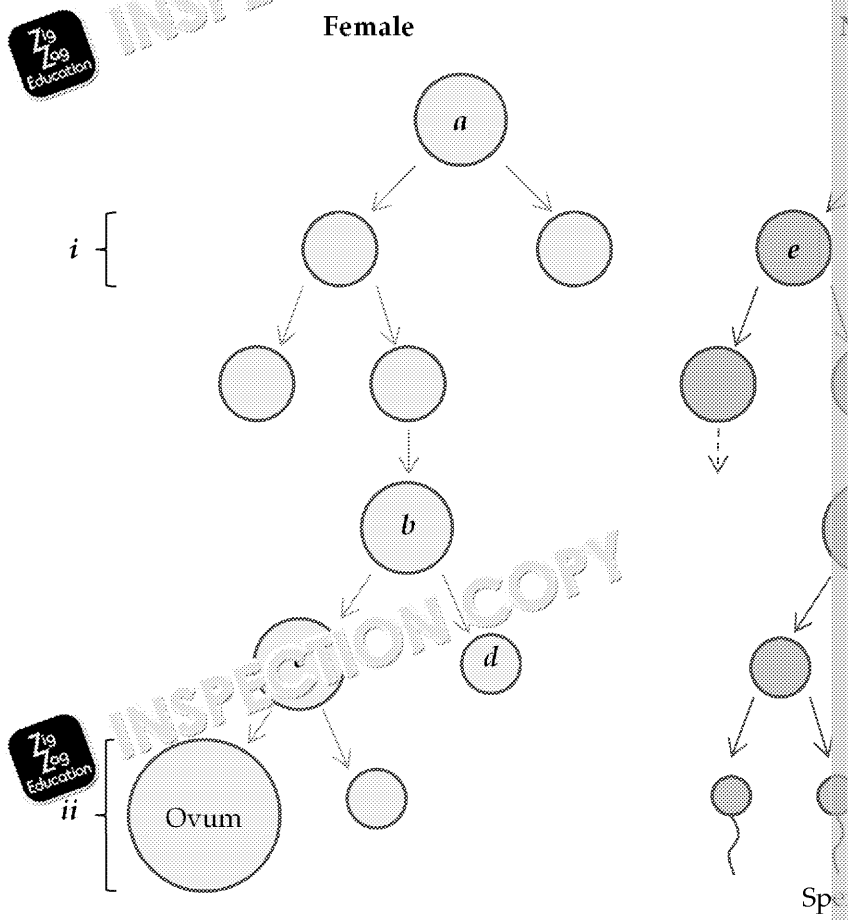
5. Describe the processes that produce variation within meiosis and fert

6. Down's syndrome is caused by an extra copy of chromosome 21.
   a) Copy the diagram below and draw what happened to the chrom
   b) What is the name of this process?



Topic Test 11: Sexual Reproduction in Plants and

1. The diagram below represents formation of gametes in both females a
   a) What are the processes of gamete formation in females and males
   b) Name cells *a* to *f*.
   c) Are the cells diploid or haploid at:
      i) Stage i?
      ii) Stage ii?

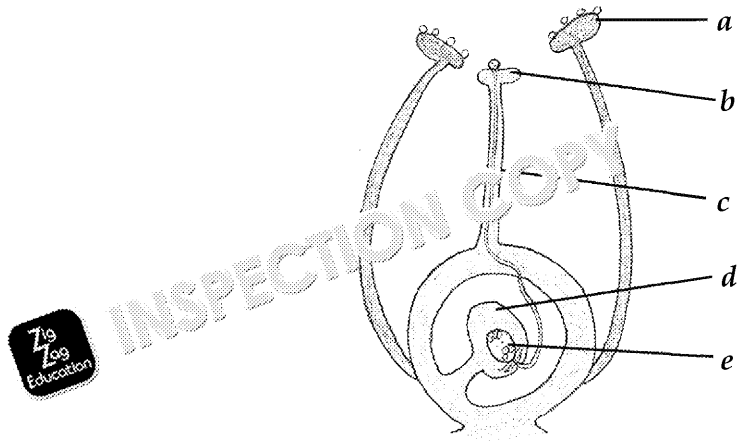


2. Copy the paragraph below and fill in the missing words in the proces

   Sperm cells contain an _____ that contains enzymes to penetrate t
   _____. Sperm cell penetration causes formation of a _____ m
   sperm from entering. Sperm penetration also causes the cell to compl
   second _____ and a _____ mature ovum. When the _____
   the ovum is considered fertilised.

3. How does formation of the blast[illegible] cells differ from normal body

4. Label features ***a*** to ***e*** in the diagram of plant reproductive organs belo



5. a) Copy the paragraph below, filling in the missing words in the pr

   The pollen _____ cell, which is _____, divides by _____
   _____. These divide by _____ to form _____ and on
   forming a pollen grain with two nuclei.

   b) Name and describe the functions of the two haploid nuclei in a p

6. a) What happens when a pollen grain lands on feature *b*?
   b) Describe the fates of the two generative nuclei after entering featu

7. Sucrose concentration can increase rate o pollen tube growth and ger
   concentration is between 10 a dl. A plant breeder tested a pl
   accelerate pollen tube gr th and germination.
   a) The table below shows the results of a dilution series. Plot a calib

	Dilution series			
	1	**2**	**3**	**4**
Sucrose concentration (mg/dl)	5	10	15	20
Colorimeter reading (arb. units)	2	7	13	18

   b) A sucrose-containing plant food provided a colorimeter reading o
   curve to predict whether the plant food will increase plant growt
   answer.

Topic Test 12: Classification (3.

1. a) Define a species.
   b) Suggest two weaknesses of this definition when applied to the na

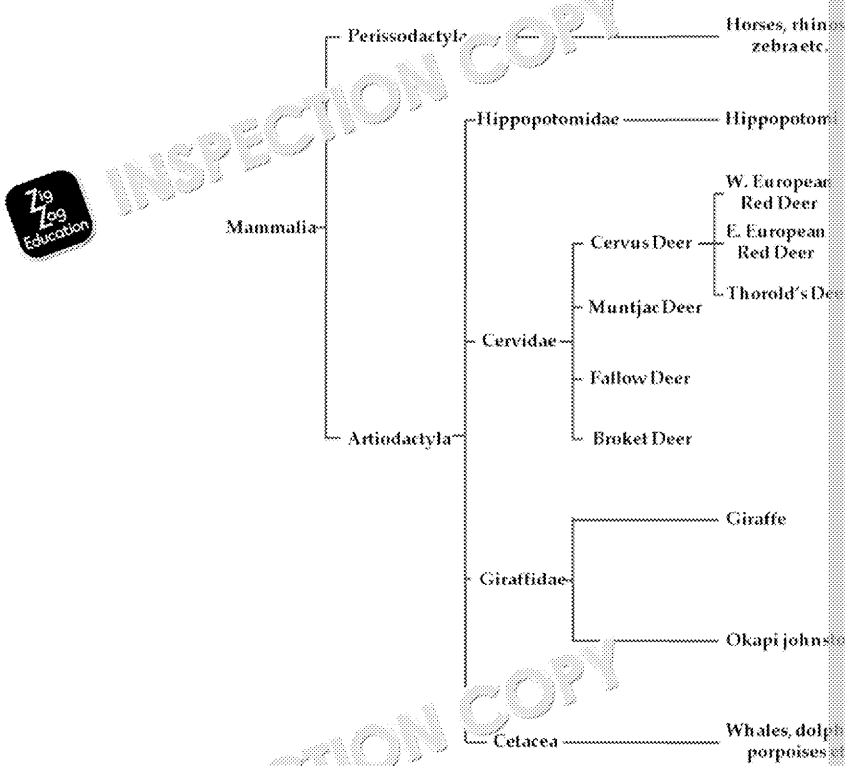
2. a) Give two practical reasons why scientists m[illegible]ave difficulty ass[illegible] found to a species.
   b) Aside from using observable ch[illegible]teristics such as appearance a[illegible] else can species classification be achieved?

3. Copy [illegible]mplete the hierarchy below, using the taxa provided in th[illegible]

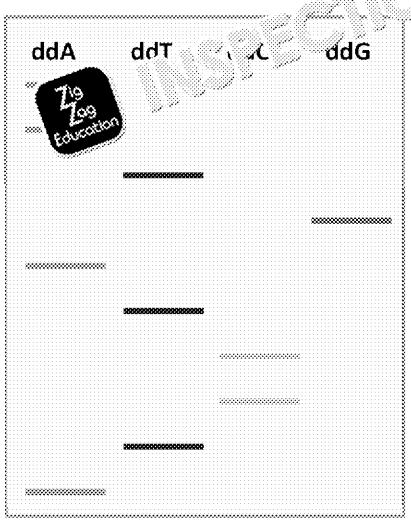
Highest – Domain ⟶ _____ _____ _____ _____ _____

Family	Class	Genus	Phylum	

4. Use the classification tree below to answer the following questions:
   a) What is the closest related order to Artiodactyla?
   b) Whales, dolphins and porpoises all belong to one family. Identify
   c) What genus do red deer belong to?
   d) What is the closest related species to the giraffe?
   e) What is a binomial name? Why is it useful for every species to ha[illegible]



5. The following diagram shows a plate with the DNA sequencing of a s
   a) What is the sequence of the DNA fragment?
   b) Copy the following stages of DNA sequencing and fill in the miss the stages in order.



1	The DNA fragment is b ngle strands.
	The distance travelled s terminator nucleotide v known as _____ se
	The DNA strands are p _____, labelled wit unstable isotopes).
	A photographic film sh of the label. Shorter DN _____ distance.
	The strands are then se DNA fragments move a a _____ is applied.
	A _____ is attached strand.
	_____ attaches the assembling a double str when it hits a labelled n

6. An inv tion is written up which proposes a new evolutionary tre the journal carry out before publishing the results of the investigation followed were rigorous, that the results are reproducible, and that the supported by the investigation?

7. Copy and fill in the missing information in the table on the three dom

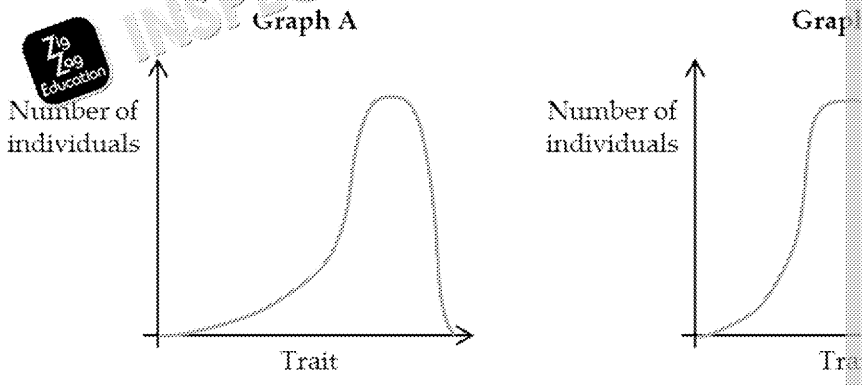
Domain:	Bacteria		
Kingdom:	Prokaryotes		
Features:	Single-celled prokaryotes		
		al s ribosomes	
		Non-murein cell walls	

Topic Test 13: Natural Selection and Biodive

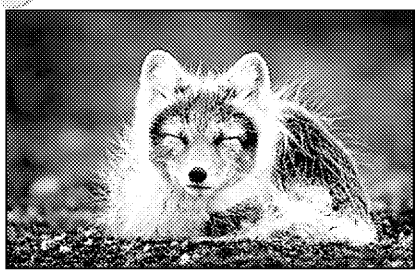
1. What is meant by genetic diversity?

2. Identify the three types of adaptation that allow animals to become ad

3. The two graphs below show selection cu ves
   What types of selection are sh n graphs A and B?



4. A period of longer winters caused mortality among arctic foxes. Adu
   long enough to give birth and could more successfully rear their youn
   a) What term describes the foxes that managed to produce more livi
   b) What type of selection is acting on the arctic fo es?
   c) Sketch a graph showing this selectio ac ing on arctic foxes.
   d) How do you expect allele fr qu es for short and long hair to ch



5. a) What is the difference between allopatric and sympatric speciatio
   b) Suggest two mechanisms for sympatric speciation.

6. How do drug-resistant pathogens evolve and what are their implicati

Topic Test 14: Natural Selection and Biodiver

1. Define the following terms:
   a) Biodiversity
   b) Species richness

2. Simpson's Index allows calculation of a h abi at s diversity.
   The formula for Simpson's Ind e is g n below:

$$D = \frac{N(N-1)}{\Sigma n(n-1)}$$

   a) Calculate the diversity of the two habitats using the species data b
   b) Explain which habitat is agricultural land and which is ancient fo
   c) What species is the farmer growing?
   d) What species has become locally extinct on the farm?

Habitat A		
Species	**n**	**n(n–1)**
B	63	
C	49	
D	86	
E	45	
F	31	

Species	
A	
B	
C	
E	
F	

3. The al xa e shows that farming reduces biodiversity, and farm
   the far needs with conservation.
   How can intensive farming negatively affect wildlife?

4. An experiment was set up to investigate the effect of introducing alter
   farmland. Farms in Group A featured artificial habitats such as bird b
   farms in Group B were left without alternative habitats. After five yea
   was surveyed to assess whether wildlife was recolonising farmland.

   The table below shows the results obtained from the experiment:

Farm	Number of pollinators	
	Group A	Group B
1	[illegible]	192
2	213	196
[illegible]	205	190
4	211	186
5	202	197
6	199	200
Mean:	**a**	**b**

   a) Calculate the mean for group A and group B above.

b) What statistical test is used to find whether the means are significantly
c) Use the data on the previous page, the statistical test named in b, and t
   i) if there is a significant effect of the alternative habitats on pollinat
   ii) the approximate probability that the results are due to chance

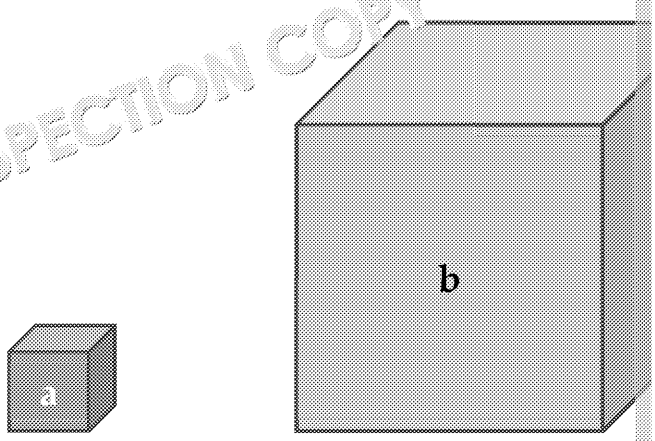
Degree of Freedom	P-value		
	0.001	0.01	0.05
5	[illegible]	3.36	2.02
6	5.21	3.14	1.94

5. Descr[illegible] difference between in situ and ex situ conservation and g

6. Many different arguments are made in favour of preserving biodivers
   i) an ethical argument
   ii) an economic argument

Topic Test 15: Surface Area : Volume R

1. Calculate which of the cubes shown below has a higher surface area : v
drawn to scale).



2. As organisms increase in size…
   a) … does their surface area or volume increase at a faster rate?
   b) … does their surface area : volume ratio increase or decrease?

3. State three things that need to be exchanged with an organism's envir

4. Why do worms have a limited maxim m bo y size?

5. Why do small mam [illegible] to eat a large percentage of their body w

6. Why d s adapted to hot environments have large ears, while tho
environments have small ears?

7. An experiment was set up to investigate marram grass response to te
humidity. The researcher recorded the length of time a marram grass
The results are shown in the table below:

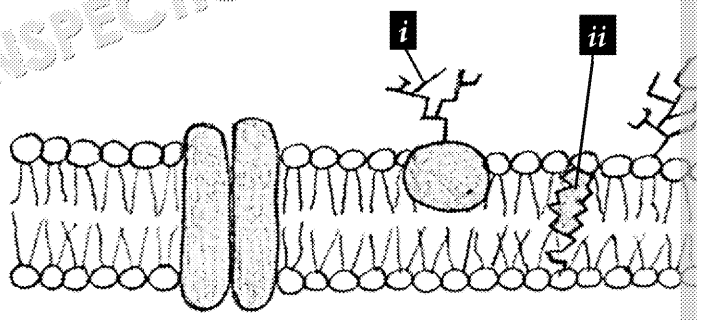
		Temperature (	
		10	20
Total time with leaves rolled (min)	Dry	277	331
	Humid	42	109

   a) Plot a graph of the results.
   b) Give a conclusion for the experimen an suggest an explanation
   c) Suggest two ways the res h could have improved the experi
   increase the validi the results.
   d) Calc late percentage error for the measurements of time

Topic Test 16: Cell Transport Mechan

1. State two locations of membranes within eukaryotic cells.

2. a) Give the specific names of components ***i*** to ***iii*** within the phospho
   diagram below.
   b) State two roles of structures ***i*** and ***iii***
   c) State the role of structure ***ii***



3. What name is given to the common model used to describe the structu

4. Describe the properties of molecules that can freely diffuse through th

5. How does facilitated diffusion differ from simple diffusion across the

6. Define osmosis.

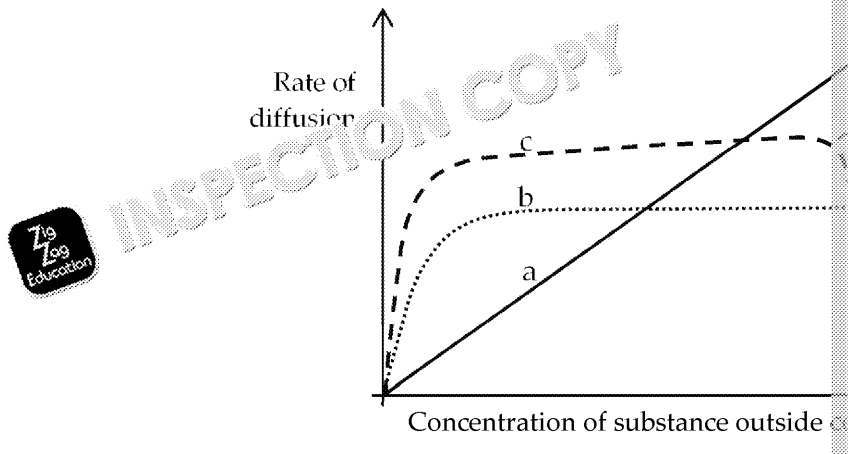
7. Copy the text and fill in the missing words in the following descriptio
   Pure w as a water potential of _____ kPa. In a solution, wate
   solute molecules and has a _____ water potential. Water moves f
   _____ water potential.

8. State the word equation with symbols to calculate water potential of a

9. Describe active transport.

10. What methods involving vesicles can be used to transport large amou
    into and out of the cell?

11. The way in which substances enter the cell is dictated by their charact
graph below, line **a** represents water molecules while line **b** represent
a) Explain what lines a, b and c represent.
b) At point ***x***, the cell's respiration is limited. Explain why this affec

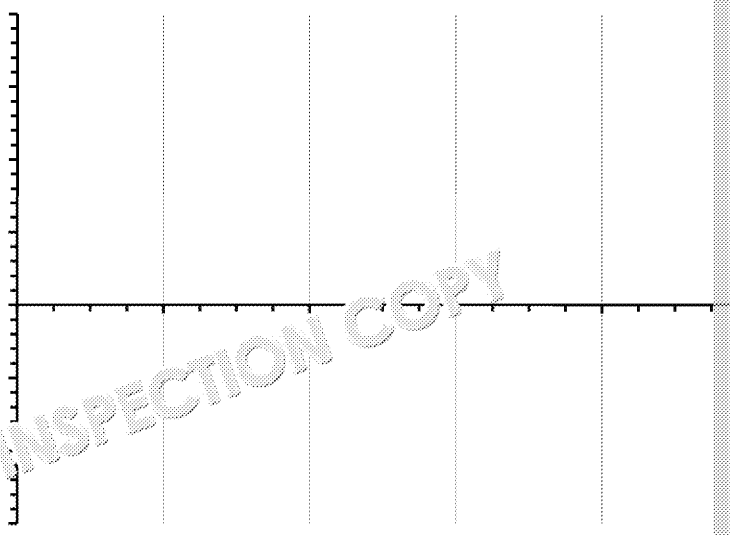


12. A student set up an experiment to determine the water potential of po
weighed samples of the tissue then placed them in different sucrose s
which was set to 30 °C. After 90 minutes the student removed the sam

The table shows the final mass at different sucrose concentrations.

	Sucrose concentration (mol d				
	0.0	0.2	0.4	0.6	
Initial mass (g)	2.43	2.57	2.56	2.14	2
Final mass (g)	4.00	3.43	3.18	2.24	2
Mass change (g)					

a) Explain why a water bath was used in the experiment.
b) Use the table above and a piece of graph paper to plot a graph sh
tuber mass.



c) Estimate the sucrose concentration of the potato tuber and explai

13. Beetroot cells contain a water-soluble red pigment within their centra
cannot pass through intact membranes. Six equal slices of beetroot co
containing 15 cm^3 of water. Each tube was placed in a water bath at d
30 °C, 35 °C, 40 °C, 45 °C and 50 °C respectively. After 15 minutes the
water baths and samples of the remaining fluid were placed in a colori
intensity of the red colouration.

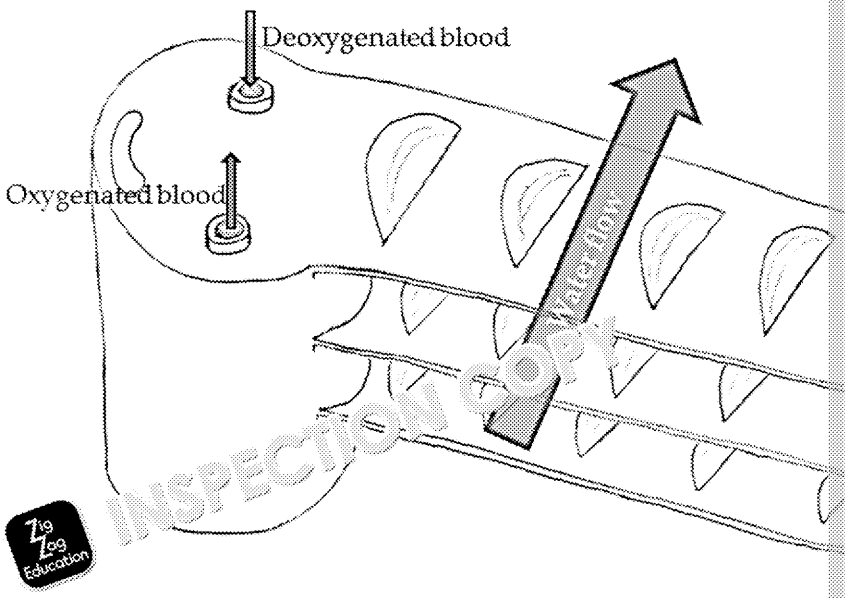
a) As temperature increased, the colour int y (redness) of the su
Suggest why this occurred.

b) State the independent ... this experiment.

Topic Test 17: Gaseous Exchange (

1. Insects have to compromise gas exchange so that they do not lose too
   a) Describe the structures insects have to allow gas exchange.
   b) How do gases move through these structures?
   c) Give two adaptations insects have to reduce [illegible]er loss.

2. Fish provide a large surface area for gas exchange with their gills.
   a) i) Label the missing parts of the gill below.
   ii) Draw the flow of blood through the gill filaments.
   b) What phrase is used to describe the movement of fluids in opposite directions across a gas exchange surface such as fish gills?
   c) Explain why the above process allows more oxygen to enter the blood. Include the flow of water and blood.



3. Describe how gas exchange for photosynthesis and respiration takes p

4. During dissections, strict laboratory procedures need to be followed t
   a) What safety precaution would you recommend for a person with [illegible] carry about a dissection?
   b) State a safety action undertaken after completion of dissection.

Topic Test 18: Gaseous Exchange (i

1. a) Copy the table below and draw a line between the boxes for each t
features and its function.

Bronchi	Minute air sacs lined w[illegible]stic fibres
Alveoli	Smalle[illegible] airways lined with smooth muscle fibres
Trache[illegible]	Large, flexible airway supported by cartilage
B[illegible]oles	Two branches supported by cartilage

b) What are the roles of goblet cells and cilia? Where are they found?

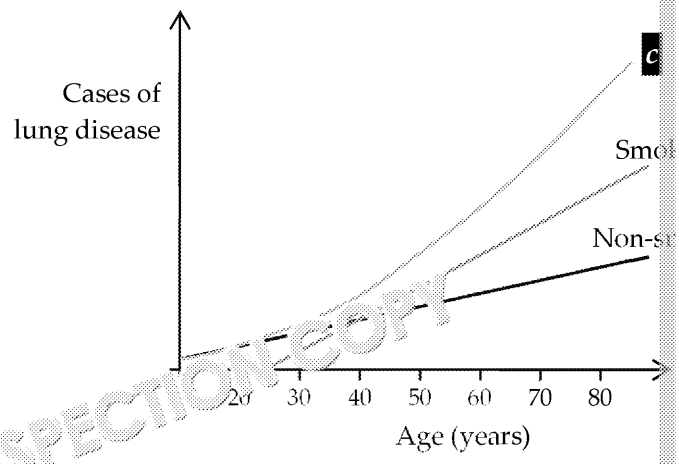
2. State and explain one characteristic of the lungs which increases gaseo

3. a) What is meant by maximum pulmonary ventilation?
b) Give the equation to calculate pulmonary ventilation rate.

4. Copy the text and fill in the missing words in the process below:

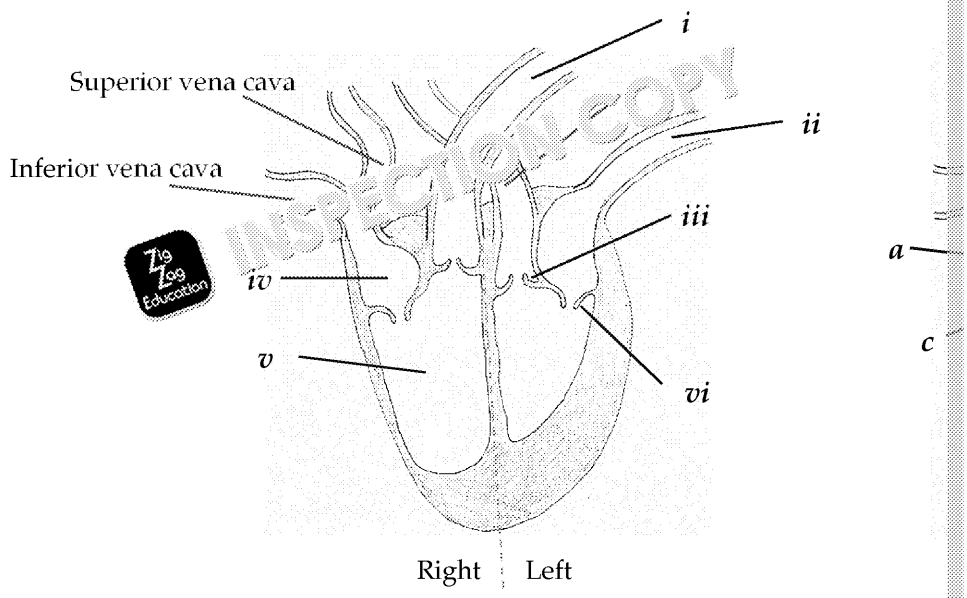
During inspiration the _____ intercostal muscles contract and the _
and pull down. This increases the volume, thereby decreasing the pre
causing air to enter the lungs. At rest, expiration and inspiration are re
requiring little energy to complete. _____ expiration during exe
intercostal muscles and the diaphragm relax.

5. Altho[illegible]nc[illegible]g is a large risk factor for lung cancer, it isn't the onl
develo[illegible]he disease. The graph below shows cases of lung disease
a) Give two reasons for some non-smokers having lung disease.
b) Explain the possible factors associated with the people represente



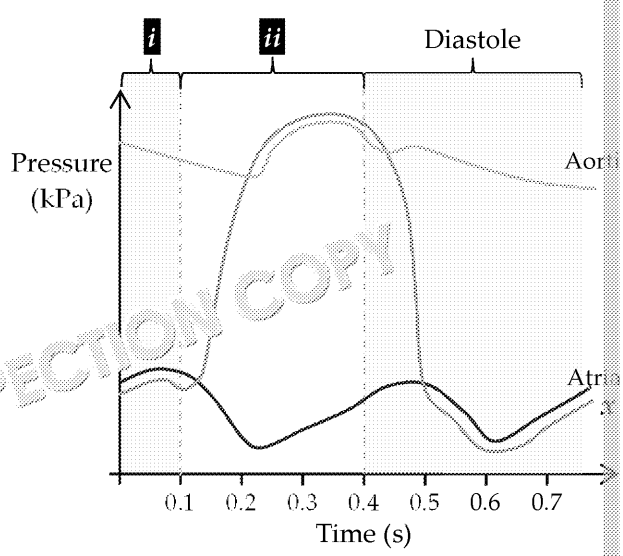
Topic Test 19: Circulation *(4.4)*

Diagram A



1. The diagrams above show the human heart.
   a) For each of the labels i–vi in Diagram A, name the indicated comp valves and blood vessels.
   b) Draw and label two arrows showing the movement of oxygenate
   c) How do the valves work and why are they necessary?
   d) Why is the cardiac muscle of the ventricle thicker on the left side?
   e) Using Diagram B, fill in the missing labels *a* to *c*.

2. The graph below shows pressure changes within the heart and aorta.
   a) Name the two missing stages of contraction *i* and *ii*.
   b) What does line *x* represent?
   c) On the graph below, label where the semilunar valves and atriov

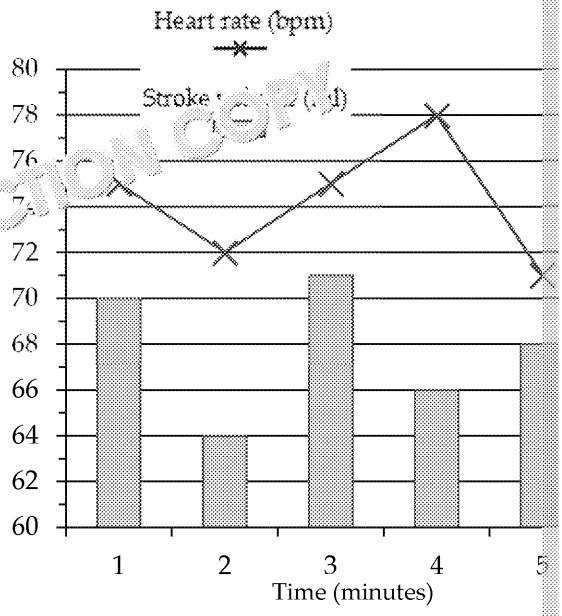


3. Fill in the table below with the missing names, features and roles of d

Vessel	Muscle layer	Elastic layer	Overall wall thickness	Valves	
		Thick		None	
	None		[illegible] thin		
Veins					Ta

4. Explai[illegible]eason for the difference in thickness of artery and vein w

5. Cardiac output of the heart can increase up to five times during vigor[illegible] cardiovascular diseases weaken the heart and reduce cardiac output.
   a) Define cardiac output.
   b) The graph below shows heart rate and stroke volume over five m[illegible] at rest.
   Calculate the mean heart rate and stroke volume over this period the cardiac output (in $dm^3 min^{-1}$ to 2 dp).



   c) The same individual is then studied for five minutes after intense [illegible] mean cardiac output increases to 13.42 dm^3 mi[illegible], while mean str[illegible]
   Calculate the mean heart rate of the [illegible]idu[illegible]ual over the five minu[illegible]
   Give your answer to the n[illegible]es[illegible]ole number.

6. a) Des[illegible]s of cell found in the blood plasma.
   b) S[illegible]ee essential roles of the blood.

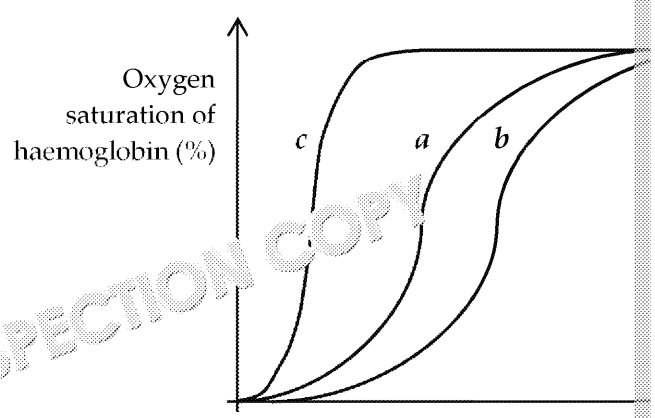
7. Describe the process that occurs when the body responds to a wound.

8. Summarise how atherosclerosis forms and state a risk factor that cont[illegible]

Topic Test 20: Transport of Gases in Blood, Tra between Circulatory System and Cells and Tra (4.5, 4.6, 4.7)

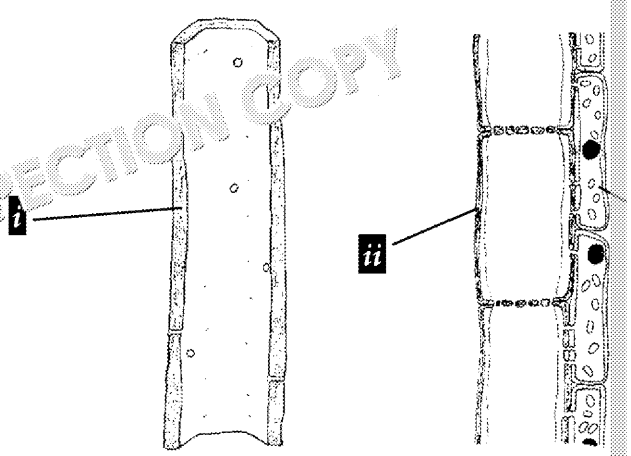
1. Haemoglobin carries oxygen around the body.
   a) What protein structure does haemoglobin have?
   b) Describe how haemoglobin changes when it becomes oxyhaemoglobin.

2. The graph below shows three oxygen dissociation curves. Curve *a* is a Curve shows the dissociation curve in high CO_2. Curve *c* shows the myoglobin.
   a) Name the effect shown in curve *b*.
   b) Why is this effect necessary in muscles during exercise?
   c) Myoglobin has a very high oxygen affinity unaffected by the part How does this feature aid its function?
   d) Copy the graph below, and add a labelled curve on the graph to re in fetal haemoglobin.



3. Cells are bathed in tissue fluid, which acts as an exchange medium be
   a) How is tissue fluid formed?
   b) Give two components found in tissue fluid.
   c) Describe two ways tissue fluid re-enters the blood.

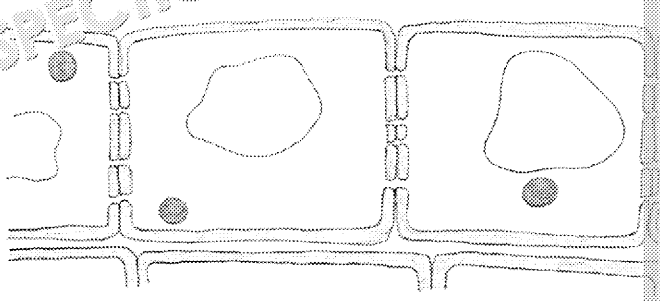
4. a) Copy the diagram below, labelling cells *i* to *iii*.
   b) Give two differences between xylem and phloem.



5. Copy the text and fill in the missing words in the process below:

   The _____ theory of water movement in the xylem depends on __
   Water evaporates out the _____ into an area of more _____ w
   molecules are held together by _____ bonds, a continual stream o
   upwards.

6. Copy the diagram below. Draw and label your diagram the three p
   through plant cells.



7. Oak trees can grow in different climatic conditions. Observational re
   conditions grow larger than those in drier conditions. Researchers hy
   growth is due to a higher rate of transpiration causing water loss that

   They set up potometer experiments with cuttings of the oak in humid
   recorded the rate of bubble movement:

	Rate in humid conditions ( )	Rate
	0.1	
	97	
	0.136	
	0.225	
	0.098	
	0.149	
Mean:		

   a) Copy and fill in the table above and plot a graph of mean rate (to
   b) Calculate the 95 % confidence limits (to 4 dp) for each condition a
      table below.

	Humid conditions	
+ (95 % limit above mean):		
Mean transpiration rate:		
– (95 % limit below mean):		

   c) Writ c a for the experiment, referring to the probability
      a enced by chance and whether the hypothesis is supporte

8. Suggest two other environmental factors that increase water moveme

9. Describe the process of mass flow in the phloem.

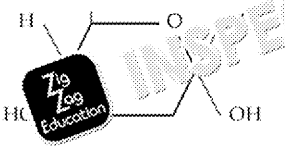
Mark Scheme

Topic Test 1

1.1, 1.2, 1.3 Carbohydrates, Lipids and Proteins (i)

1. Monosaccharide [accept glucose] (1)

2. a) β-glucose [1 mark for β, 1 mark for glucose]
   b) In the isomer the OH and H molecules are swapped on the first carbon (1



[1 mark for drawing, ensure correct orientation]

3. A *condensation* (1) reaction causes two glucose monosaccharides to form an α-[1,4] *glycosidic*] bond between them, creating a disaccharide called *maltose* (1). If many are a *polysaccharide* (1) is formed.

4. Glycogen is used for storage; cellulose is used structurally (1)
   Glycogen is formed from α-glucose; cellulose is formed from β-glucose (1)
   Glycogen has a heavily branched structure; cellulose forms long, stable straight chains that make a mesh / long fibres) (1)

5. [Any two from:]
   - Cell membranes
   - Waterproofing
   - Insulation
   - Protection
   - Energy storage

6. Triglyceride (1)

7. Condensation reaction (1) which produces an ester bond (1)

8. Phospholipid A is a saturated (1) phospholipid with no carbon–carbon double bonds; phospholipid B is a polyunsaturated (1) phospholipid with multiple carbon–carbon double bonds

9. One of the R-groups / fatty acids of the triglyceride is replaced with / substituted for a

10. The head of the phospholipid is polar / negatively charged (1)
    The head of the phospholipid is hydrophilic (1)
    The tail of the phospholipid is non-polar / not charged (1)
    The tail of the phospholipid is hydrophobic (1)
    Therefore, they form a bilayer in water (1)

Topic Test 2

1.1, 1.2, 1.3 Carbohydrates, Lipids and Proteins (ii)

1. a) Amino group (1)
   b) R group (1)
   c) Acid group / Carboxyl group (1)

2. A *dipeptide* (1) is formed from two amino acids. A [illegible] 1) bond is created [illegible] reaction.

3. a) [Any two from:]
   Fibrous proteins [illegible]d to be long, while globular proteins are spherical a[illegible] a[illegible] [illegible]ub[illegible] in water, while most globular proteins are soluble (1); fibro[illegible] wh[illegible]bular proteins have metabolic roles (1)
   b) [Fibrous – any from:]
      - Collagen
      - Keratin
      - Elastin

      [Globular – any from:]
      - Haemoglobin
      - [Accept any named enzyme, e.g.] Amylase
      - [Accept any named hormone, e.g.] Insulin

4. a) Disulfide bonds (1), Ionic bonds (1), Hydrogen bonds (1)
   b) Hydrogen bonds (weakest), Ionic bonds, Disulfide bonds (strongest) (1)
   c) A quaternary structure is formed from multiple polypeptide chains (1)
   d) Any appropriate answer, e.g. haemoglobin/colla[illegible] 1)

5. [Any three from:]
   - Collagen is a fibrous pr[illegible] [illegible]oglobin is a globular protein
   - Collagen has st[illegible] [illegible]ctions, haemoglobin has metabolic functions
   - Co[illegible]n i[illegible] [illegible]ised of three long proteins/polypeptides, haemoglobin fo[illegible]oteins
   - Co[illegible]gen provides strength, haemoglobin carries oxygen

6. [1 mark for correct calculation of R_f, e.g.]
   R_f = distance travelled by substance / distance travelled by solvent front
   $R_f = 35.5\text{ mm} / 52.0\text{ mm}$
   [Answer =] 0.68 (1)
   Amino acid is tryptophan (1)

Topic Test 3

1.4 DNA and Protein Synthesis (i)

1. Deoxyribonucleic acid (1)

2. a) A = nucleotide/m[illegible] [illegible]de (1)
   b) B = [illegible]tos[illegible] [illegible]bose (1)
      C [illegible]ph[illegible] group (1)
      D = [illegible]anic/nitrogenous base (1) [Do not accept base pair]
   c) E = phosphodiester bond (1)

3. a) TTCGCAGA [1 mark for A-T pairing; 1 mark for C-G pairing]
b) [1 mark for two bonds between A-T pairs; 1 mark for three bonds betwe

4. The enzyme *DNA helicase* unwinds the DNA strand and breaks the *hydrogen* b
Free nucleotides are attracted to and bond with their exposed complementary b
Phosphodiester bonds are formed when the enzyme *DNA polymerase* initiates c
deoxyribose phosphate backbone together.
Half of the original DNA is now part of the ne[illegible]agment. This process i
[1 mark for each]

5. The code can be exp[illegible]ed over generations (1)

Topic Test 4

1.4 DNA and Protein Synthesis (ii)

1. The triplet code of DNA codes for specific *amino acids* (1). The code is *univers*
overlapping and *degenerate* (1), which means that most amino acids have mo

2. Introns are non-coding (1), consist of multiple base repeats (1), can act as 'sta
separate genes within a chromosome (1) and exons within genes (1)

3. *i*: Homologous chromosomes (1)
ii: Chromatids (1)
iii: Allele (1)
iv: Intron (1)
v: Exon (1)
vi: Triplet code (1)

4. mRNA forms a long helix; tRNA [illegible] a short clover-leaf shape (1)
mRNA just contains [illegible]uanine, guanine, cytosine / the four bases; tRNA
amino [illegible])

5. In *transcription* (1) the DNA strands are separated and free nucleotides are at
polymerase (1) to form *messenger* (1) RNA.
The mRNA leaves the nucleus and binds to a *ribosome* for *translation* (1)

6. a) Ribosomes hold the mRNA and tRNA in place (1)
b) tRNA bonds to the mRNA with its complementary anticodon (1) and ho
c) ATP provides energy to create a peptide bond between the amino acids

7. mRNA: GCUUAG (1)
Amino acids: Alanine, (stop) (1)
i = Transcription (1)
ii = Translation (1)

8. Substitution involves replacement of a [illegible] (1)
Deletion involves a base being completely removed (1)

9. [Accep[illegible]oth[illegible]rrect example] Sickle-cell anaemia (1)

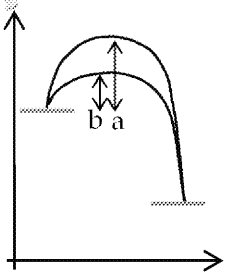
Topic Test 5

1.5 Enzymes

1. Tertiary structure provides a 3D active site (1)
   Spherical shape allows easy transport out of cells (1)

2. Increase the chemical reaction (1) without being consumed / permanently ch

3. a) The minimum energy required to trigger a chemical reaction (1)
   b) [1 mark for both arrows:]



   c) Line b (1)

4) a) The induced fit model suggests that when an enzyme binds to a substra
   shape slightly to fit the substrate (1)

5. A different sequence of amino acids could cause the overall structure of the e
   the (specific) substrate can no longer reach the active site (1)

6. Competitive inhibitors bind to active site and block the substrate from bindi
   competitive inhibitors bind elsewhere and alter shape of active site (1)

7. End-product inhibition (1)

8. a: Not enough subst[illegible] available enzyme active sites [And] substra
   b: Most [illegible] becoming occupied, reducing excess substrate (1)
   c: All a[illegible]tes filled; therefore, excess substrate cannot increase rate of rea

9. a: Increased kinetic energy increases encounters between enzyme and substra
   b: Enzymes start to denature (1); therefore, active site changes and substrate d
   c: Enzymes are fully denatured (1)

10. a) $3.59 = \frac{3.59 + 3.62 + 3.57 + y}{4}$ (1)

    $(3.59 \times 4) = 3.59 + 3.62 + 3.57 + y$ (1)

    $14.36 - 3.59 - 3.62 - 3.57 = y$

    $y = 3.58$ g min^{-1} (1)

    b) The water bath being turned off lowered the temperature (1), which dec
    therefore, the rate of reaction (1), so the value for the rate of reaction is a

    c) [1 mark for use of equation:]

    $\text{Rate} = \frac{\text{change in y}}{\text{change in x}}$

    [1 mark for co[illegible]s from graph: example shown below]

    R[illegible]
    Rate = 0.0667 g sec^{-1}

    [1 mark for correct conversion to g min^{-1} and answer to 2 dp:]

    Rate = 4.00 g min^{-1} (worked answer in range 3.50–4.50 g min^{-1} scores 3 m

d) Enzyme catalyses reaction of substrate better/faster at pH 8.2 than it doe
e) Small intestine (1)
f) pH in the stomach is acidic / pH 2–3 (accept 1.5–3.5) (1); experiment sho
slower at pH 3.0 for this enzyme (1)
g) Change in pH breaks bonds / denatures enzyme (1); therefore, active sit
enzyme would no longer function / substrate would no longer fit (1)

Topic Test 6

1.6, 1.7 Water and Inorga[illegible] ions

1. a) Inorganic m[illegible] es not contain carbon (allow does not come from liv
Ic[illegible]ns may have a net positive or negative charge (1)
b) i) [illegible] (1)
ii) NO_3^- (1)

2. Their positive or negative charge (1) [Accept charge]

3.

Inorganic ion	Role
Nitrate ions	Structure of DNA and *amino acids* (1)
Phosphate ions (1)	Backbone of DNA; used to convert AD
Calcium ions (1)	For the formation of the middle lamell
Magnesium ions	For the production of *chlorophyll* (1)

4. Dipolar / contains a dipole (1)

5. [Accept any two pairs:]
Hydrogen bonds form [illegible] cohesion (1); allows transport of water through
Large latent heat [illegible] ation (1) means effective cooling with little water loss
Water [illegible] ly effective solvent (1) which means it can transport many substan

6. Water is a good *solvent* (1); therefore, substances can dissolve and move freel
place. It is also a *metabolite* (1) [Accept reactant] in hydrolysis and *condensatio*
for producing large *polymer* (1) chains from repeating monomer subunits.

7. a) Water has a high heat capacity (1) meaning the water film acts as a tempe
b) Freezing of surface water (1) insulates water beneath, meaning it is less

8. [Any three from:]
- Surface tension (1) adhesion helps water transport by sticking to other m
- Incompressibility (1) allows water to be in hydraulic transport mechanis
- Maximum density at 4 °C (1) meaning frozen water floats and insulates
- Hydrogen bonds form strong cohesion (1); allow[illegible]nsport of water thr
- Large latent heat of vaporisation (1) mea[illegible]ve cooling with little w
through leaves (1)

Topic Test 7

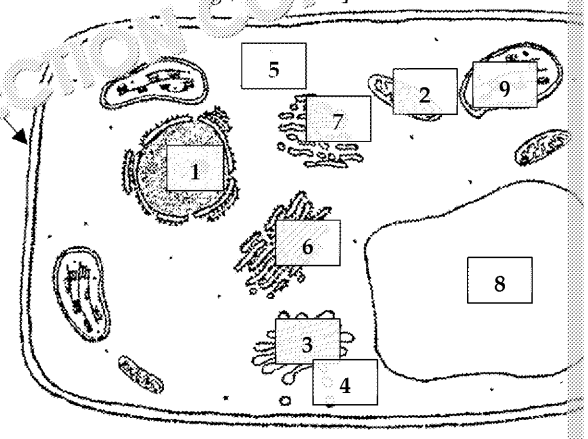
2.1 Eukaryotic and Prokaryotic Cell Structure and Function

1. *Organelles* (1) ⟶ Cells ⟶ *Tissues* (1) ⟶ *Organs* (1) ⟶ S

2. a) [1 mark for each correct grouping of organelle, feature and function:]

1. Nucleus	→	b) Double membr[illegible]ith pores	→	x) C
2. Mitochondria	→	f[illegible]d inner cristae	→	ix) R
3. Golgi appa[illegible]	→	a) Flattened sacs that bud into vesicles	→	iii) M f
[illegible]osomes	→	c) Small vesicles	→	vi) C c
5. Ribosomes	→	i) Structures made partly of proteins; can be 70S or 80S	→	ii) P
6. Rough ER	→	g) Thin tubes coated in ribosomes	→	i) L s
7. Smooth ER	→	e) Thin tubes with many vesicles	→	v) S s
8. Vacuole	→	h) Large sac of liquid	→	vii) S n
9. Chloroplasts	→	d) Double membrane, free DNA	→	iv) C P
10. Cell wall	→	j) Rigid cellulose/chitin polymers	→	viii) P

b) [1 mark for correct placement of following [illegible]rs:]



3. a) Plasmid (1)
   b) Single circular DNA [Accept DNA] (1)
   c) Capsule (1)
   d) Cell wall (1)
   e) Cell membrane (1)
   f) Flagellum [Accept flagella even thou[illegible]h plu[illegible]] (1)

4. Organelle a – the plasmid [illegible]a s[illegible] piece of circular DNA that can replicat independently of t[illegible]omosome (1)
   Organ[illegible]th [illegible]agellum – allows the cell to move (1)

5. Gram positive bacterial cell walls have a thick peptidoglycan layer containin negative bacterial cell walls have a thin peptidoglycan layer without teichoic bacteria by affecting the cell wall (1); therefore, need to know the type of bac that best affects their cell wall (1).

6. a) A and B are scanning electron microscopy [SEM] (1)
C and D are transmission electron microscopy [TEM] (1)
b) SEM involves scattering/bouncing the electron beam off the surface of th
TEM involves the electrons passing through the sample (1)

7. a) 1 micrometer unit = 2.7 graticule units (1)
Therefore, 1 micrometer unit = $\frac{10}{2.7}$ = 3.7 μm (1)
b) [1 mark for calculation:] Length = 20 830 × 3.7
= 77 071 μm

[1 mark for correct conversion to 3 sf:]
= 77.1 mm

8. Magnification increases how big an object seems (1), resolution describes the must be to be distinguished from one another (1)

9. Many organelles are colourless (1), so detail cannot be seen unless stained (1)

Topic Test 8

2.2 Viruses

1. a) *i* RNA (1) [Accept genetic material or DNA as some viruses contain DN
ii Capsid / protein coat (1)
iii Lipid membrane / phospholipid bilayer (1)
b) [Accept any correct examples] One group has DNA (1), e.g. adenovirus
has RNA (1), e.g. tobacco mosaic virus / influenza / Ebola / measles (1); o
that codes for reverse transcriptase enzymes (1), e.g. HIV/leukaemia (1)

2. 'A harmless, *non-virulent/non-pathogenic* virus inserts its genetic material i
become incorporated into a host cell's *DNA/genome* (1) and is replicated wh
lysogenic (1) pathway. Alternatively, the material can replicate independentl
pathway, *lytic* produces new viruses and causes the host cell to *burst* (1).'

3. Viruses do not feed (1) or respire (1) and can only reproduce when in a host c

4. RNA / genetic material enters a host cell and is converted to DNA (1)
Virus DNA activates and takes over host cell's processes (1)
Host cell metabolism is manipulated to create new viruses (1)

5. a) [Any three from:]
- Skin contact
- Mucous membrane contact
- Airborne droplets
- Blood/urine/faeces
- Contaminated surfaces

b) Antivirals work by reducing the virus's ability to reproduce (1), either b
recognise host cell (1) mechanism to maintain virus's protein coat (1)
replicate genetic material within the host cell (1). They are limited becau
every virus (1) [Do not accept kill]
c) Limit spread of infection (1), [Any two from:] rapid identification/rea
isolation, personal hygiene, medical sterilisation, safe disposal of an infe
of a fatality's body

6. [1 mark for good tangent placed at 8.25 months]
[1 mark for equation:]

$$Rate = \frac{\text{change in y}}{\text{change in x}}$$

[1 mark for calculation, e.g.]

$$Rate = \frac{13250 - 8600}{9.5 - 7}$$

$$Rate = 1860 \text{ incidences/month}$$

7. [For: any two fr...]
- C... ve...ns of thousands of lives if they do work
- M... other treatments ready
- People who are dying have nothing to lose

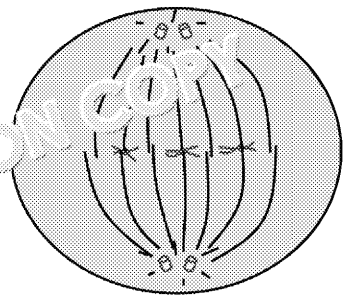
[Against: any two from:]
- Could have unexpected side effects
- People may feel like guinea pigs / as if being experimented upon
- Relatives could blame the treatment if the person still died
- May provide false hope / false sense of security if does not work

Topic Test 9
2.3 Eukaryotic Cell Cycle and Division (i)

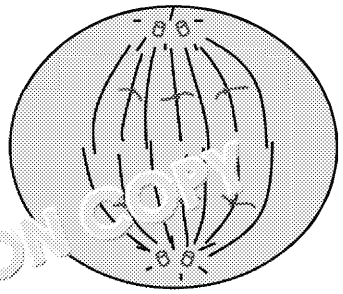
1. No (1)

2. a) Mitosis (1)
b) [Any three of:]
- organism growth
- tissue repair
- cell turn... p...cement
- ...u... reproduction

3. *Interphase* involves *DNA* replication and the organelles duplicate.
In *prophase* the chromosomes become visible and the *nuclear envelope* disinteg...
During *metaphase* the chromosomes line up on the cell's equator.
In anaphase the *chromatids* are split and pulled to opposite poles of the cell.
During *telophase* the nuclear envelope reforms around the separated chromat...
Cytokinesis completes division when the *cytoplasm* divides. [Do not accept c...
[1 mark for each]
[Drawing for metaphase – 1 mark for including spindle fibres and centrioles, aligned along centre:]



[Drawing for anaphase – 1 mark for including spindle fibres and centrioles, 1
pulled away from centre:]



4. a) M
   b) Sp bres attach to the centromeres (1), separate the chromatids (1)
   centrioles (1)

5. Growth (1), examples include the development from childhood to adulthood
   life (1)
   Repair (1), production of new cells such as red blood cells from stem cells (to
   dysfunctional cells), regenerating damaged tissues/organs such as broken sk
   Asexual reproduction (1), to produce colonies in single-celled organisms (e.g

6. [1 mark for estimation of mitotic and non-mitotic cells, ±1:]
   6 mitotic, 21 non-mitotic
   [1 mark for ratio of mitotic : total:]
   6:27

Topic Test 10

2.3 Eukaryotic Cell Cycle and Division (ii)

1. a) Somatic and ge
   b) M ns ned from a spontaneous change in the base sequence

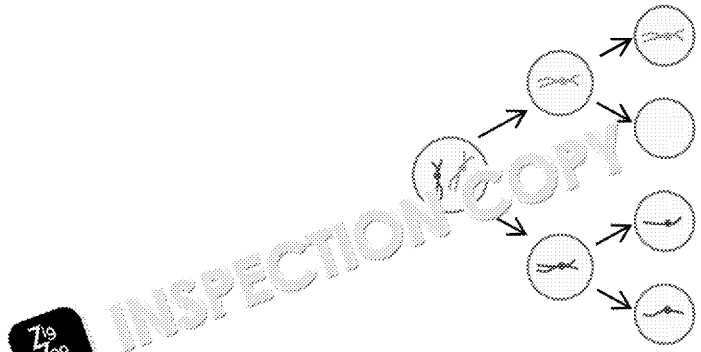
2. When tw non-homologous chromosomes exchange material (1)

3. a) Silent mutation (1)
   b) Nonsense mutation (1)

4. a) The diploid parent cell divides and homologous chromosomes split (1),
   divide again (1) forming four haploid gametes (1)
   b) Mitosis produces two identical daughter cells, meiosis forms four non-id
   produces diploid/2*n* cells (with the same number of chromosomes as the
   haploid/*n* cells (with half the number of chromosomes that the parent ce
   c) Diagram A is Anaphase I, diagram B is Anaphase II [1 mark for anapha

5. Crossing over / Recombination between homol ou hromosomes (1) wher
   exchange DNA and recombine (1)
   Independent segregation/ass omologous chromosomes (1) where
   independently (1)
   Random ilis)

6. a) [1 mark for top chromosome failing to separate and lower separating, o
1 mark for final gametes with joined chromosome and empty cell]



b) Non-disjunction of chromosomes (1)

Topic Test 11

2.4, 2.5 Sexual Reproduction in Plants and Mammals

1. a) Females: Oogenesis (1); Males: Spermatogenesis (1)
   b) a: Primordial germ cell (1)
   b: Primary oocyte (1)
   c: Secondary oocyte (1)
   d: First polar body (1)
   e: Spermatogonia (1)
   f: Primary spermatocyte (1)
   c) *i*: Diploid (1), *ii*: Haploid (1)

2. Sperm cells contain an *acrosome* (1) t[illegible] enzymes to penetrate the *zo* *oocyte* (1). Sperm cell pene[illegible] formation of a *fertilisation* (1) memb from entering. Sp[illegible]ation also causes the cell to complete *meiosis II* ((1) and *[illegible]* [illegible]ature ovum. When the *nuclei/DNA* (1) of both gametes fertilise

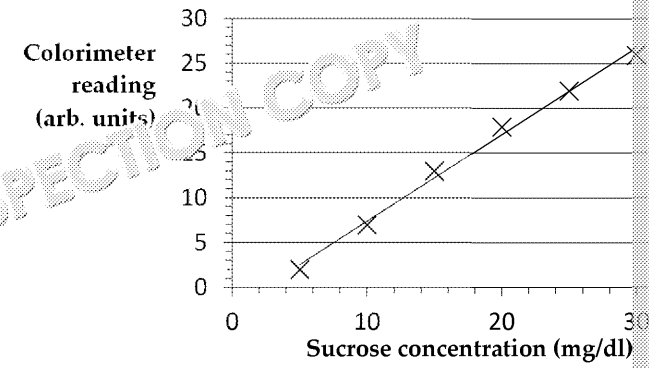
3. Blastocyst cells have undergone mitosis without interphase (1), called cleava totipotent/unspecialised/undifferentiated (1)

4. a: Anther (1)
   b: Stigma (1)
   c: Style (1)
   d: Ovule (1)
   e: Embryo sac (1)

5. a) 'The pollen *mother* (1) cell, which is *diploid* (1), divides by *meiosis* (1) to fo
   These divide by *mitosis* (1) to form *microgametes* (1) [illegible]d one cell envelop
   with two nuclei.'
   b) One becomes the tube nucleus (1) [illegible] controls the growth of the pollen
   generative nucleus (1). [illegible]ative nucleus produces the two male g
   nucleus of the [illegible] double fertilisation event) (1).

6. a) Pollen tube produces enzymes (1), grows down the style to the ovary (1)
   b) One fuses with the polar nuclei (1) to form the triploid endosperm (1), th
   to form the diploid zygote (1)

7. a) [1 mark for axes, 1 mark for correctly plotting all points, 1 mark for line



   b) Plant food sucrose levels between 22 and 23 mg/dl; therefore, level is to
   and germination (1)
   This may be due to high sugar levels disrupting osmosis (1) [Accept any

Topic Test 12

3.1 Classification

1. a) Two individuals that can interbreed to produce fertile offspring / can in
   b) Some different but closely related species can occasionally produce ferti
   the process of speciation (1) [Or] some microorg ms do not reproduc
   applied to them [1]

2. a) Any two from: organis o different species may have very sim
   two organisms e same species may appear very different due to
   ma pa ay not be known [1]; setting up a breeding program (
   ex e/ difficult [1]
   b) DN technology / bioinformatics [1]

3. **Domain** – Kingdom – Phylum – Class – Order – Family – Genus – **Species** [½

4. a) Perissodactyla (1)
   b) Hippopotamidae (1) [Or] Cervidae (1) [Or] Giraffidae (1)
   c) Cervus (1)
   d) Okapi (1)
   e) Binomial name consists of genus and species name (1); it is universal, a
   communication between scientists (1)

5. a) AATGATCCTA (1)
b) [1 mark for each missing word up to 10, 1 mark for correct overall order

1	The DNA fragment is broken into short single strands.
7	The distance travelled shows the position of the termina… the DNA. This process is known as *Sanger* (1) sequencing.
3	The DNA fragments are put in solutions of separated *nucle…* … *radioactive* (1) markers (using unstable isotopes).
6	A photographic film shows fragment location because o… DNA fragments travel a *larger/longer* (1) distance.
5	The strands are then separated by *gel electrophoresis* (1). T… move across the *agarose* (1) gel when a *current / electric cu…*
2	A *primer* (1) is attached to the first part of each single stra…
4	*DNA polymerase* (1) attaches the complementary nucleoti… double strand. The strand is *terminated* (1) when it hits a …

6. Submit the article for peer review by other experts (in the field of investigati…

7. [1 mark for each box:]

Domain:	**Bacteria**	*Archaea* (1)	
Kingdom:	**Prokaryotes**		
Feat…	Single-celled prokaryotes	*Single-celled prokaryotes* (1)	*S…*
	Small 70s ribosomes (1)	Small 70s ribosomes	
	Murein cell walls (1)	Non-murein cell walls	

Topic Test 13
3.2, 3.3 Natural Selection and Biodiversity (i)

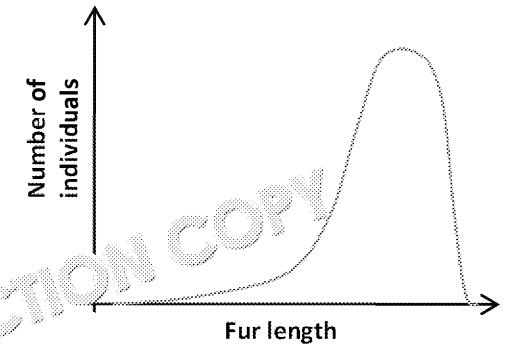
1. The number of different alleles in a population (1)

2. Anatomically/physically (1), physiologically (1) and behaviourally (1) [Do no…

3. Graph A shows directional selection (1)
Graph B shows stabilising selection (1)

4. a) They had increa… … reproductive success (1)
b) Dir… na…

c) [Need both line and axes labels for mark:]



d) A… quency for short hair will decrease (1); allele frequency for long…

5. a) Allopatric speciation occurs when a population is separated by a geogra… sympatric speciation occurs in the same space, but the population is sep…

b) [Any two from:]
- Ecological (1)
- Temporal (1)
- Mechanical (1)
- Behavioural (1)

6. Specific drugs will kill all individuals in a pathogen population, apart from t… chance (1). These individuals will then pass on their resistant characteristics … population of pathogens will be drug-resistant (1). This means new drugs n… disease (1).

Topic Test 14

3.2, 3.3 Natural Selection and Biodiversity (ii)

1. a) Th… variety of living organisms (1) across a range of habita…

b) Th… ber of different species within a community (1)

2. a) [1 mark each for completed tables:]

Habitat A		
Species	n	n(n–1)
B	63	*3906*
C	49	*2352*
D	86	*7310*
E	45	*1980*
F	31	*930*

Species
A
B
C
E
F

$\frac{274(273)}{16478} = 4.5395$

Habitat B:

$\frac{33}{7}$ …1.4398

[1 mark for each correct answer]
Habitat A = 4.54 (2 dp) (1)
Habitat B = 1.44 (2 dp) (1)

b) Habitat B is agricultural land as one species dominates (1), while habita
have a good population (1)
c) Species A (1)
d) Species D (1)

3. Intensive farming can damage habitats by decreasing the amount of food ava
of habitats available (1) and introducing poisonous/h ul/dangerous mach

4. a) [1 mark for correct means:]
Group A = 204.3, Grou = 9
b) Student's t-test
c) i) [1 mark for correct calculation of variances using the correct e
e that s^2 is calculated here. If student calculates s rather than s^2
hand side equation needs to be calculated. Answer is correct in bo

$$s^2 = \frac{\sum(x - \bar{x})^2}{n - 1}$$

$$s_A^2 = \frac{223.3334}{5}$$

$$s_A^2 = 44.66668$$

$$s_B^2 = \frac{131.5}{5}$$

$$s_B^2 = 26.3$$

[1 mark for correct calculation of t to 2 dp using the correct equatio

$$t = \frac{\bar{x}_A - \bar{x}_B}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}}$$

$$t = \frac{204.[illegible] - [illegible]}{\sqrt{\frac{44.66668}{6} + \frac{26.3}{6}}}$$

$$t = \frac{10.83}{\sqrt{7.444446667 + 4.38333}}$$

$$t = \frac{10.83}{\sqrt{11.82777667}}$$

$$t = \frac{10.83}{3.439153481}$$

$$t = 3.149030731$$

$$t = 3.15 \text{ (2 dp)}$$

[1 mark for correct calculation of degrees of fr dom:]

$$df = n - 1$$

$$df = 5$$

[1 mar ion:]
<0. herefore, there is a significant effect of artificial habitats on
s (1)
c) ii) There is less than 5 % probability the results are due to chance (1)

5. In situ conservation maintains biodiversity in their habitat (1), e.g. wildlife re
maintains biodiversity in a separate area / away from original habitat (1), e.g.
any correct example]

6. i) Any from: iImportant to preserve biodiversity so that future generations aesthetic experiences / we have a duty to protect species on Earth becau to exist (1)
   ii) Any from: rare species may produce new medicines / many endangered quality (and hence crop yields) may depend on high biodiversity / cont purification or waste decomposition / contribution to the process of nut

Topic 15

4.1 Surface Area : Volum[illegible]

1. $Surface\ area = 2(\ldots - 2(ac) + 2(bc)$

   [1 mar[illegible]culation of cube *a* surface area:]
   $Surface\ area = 2(1.1 \times 1.1) + 2(1.1 \times 1.1) + 2(1.1 \times 1.1)$

   $Surface\ area = 7.26\ cm^2$

   [1 mark for calculation of cube *b* surface area:]
   $Surface\ area = 2(4.1 \times 4.1) + 2(4.1 \times 4.1) + 2(4.1 \times 4.1)$

   $Surface\ area = 100.86\ cm^2$

   $Volume = a \times b \times c$

   [1 mark for calculation of cube *a* volume:]
   $Volume = 1.1 \times 1.1 \times 1.1$

   $Volume = 1.331\ cm^3$

   [1 mark for calculation of cube *b* volume:]
   $Volume = 4.1 \times 4.1 \times 4.1$

   $Volume = 68\ 921\ cm^3$

   [1 mark for calculation [illegible] ratio to 1 dp:]
   $\frac{7.26}{1.331}$ [illegible]

   Surface area to volume = 5.5:1

   [1 mark for calculation of cube *b* ratio to 1 dp:]
   $\frac{100.86}{68.921} = 1.\dot{4}634 = 1.5$

   Surface area to volume = 1.5:1

   Cube *a* has a higher surface area to volume ratio than cube *b*

2. a) Volume (1)
   b) Decrease (1)

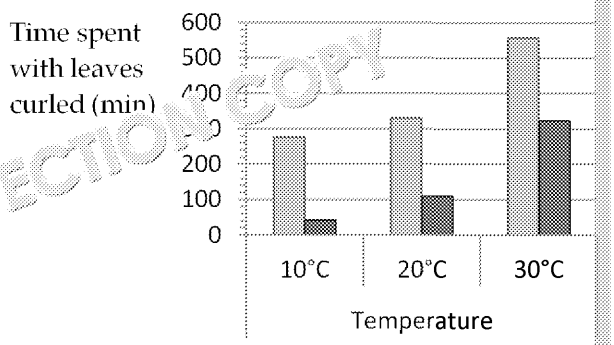
3. [Any three from:]
   - Gases within respiration
   - Nutrients
   - Heat
   - Excretion p[illegible]

4. Worms [illegible] diffusion (1); therefore, need a large surface area : volume rat surface area would be too small and its volume too large to allow effective di

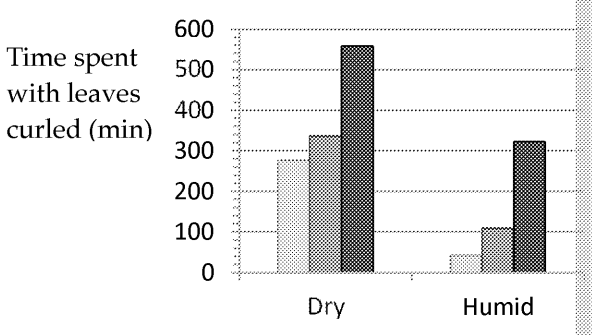
5. Because they have a large surface area : volume ratio (1) they lose a lot of hea therefore, need to consume a lot of energy to maintain body temperature / fa

6. In hot environments foxes would need to lose heat (1); therefore, have a larger s
cold environments foxes would need to retain heat (1); therefore, have a smalle

7. a) [1 mark for correct layout of x-axis in either layout, half mark for each c
[Either:]



[Or:]



b) Conclude that marram grass rolls its leav[illegible] in drier conditions and
will not lose water (1). They ha[illegible] rolling in humid conditions a
they are not in danger o[illegible] much water as the water potential g

c) [Accept any cor[illegible]ion, e.g.] Repeated with more plants (1), reco

d) [1 [illegible] fo[illegible]on:]

$$\% = \frac{maximum\ error}{measured\ value\ recorded} \times 100$$

[1 mark for calculation of maximum error as ±1 second:]

$$Maximum\ error = \frac{1}{60}$$

$$Maximum\ error = 0.0167$$

[1 mark for each correct calculation of % error for time:]

$$10\ °C\ Dry: \%\ error\ time = \frac{0.0167}{277} \times 100 = 0.00603$$

$$10\ °C\ Humid: \%\ error\ time = \frac{0.0167}{42} \times 100 = 0.03976$$

$$20\ °C\ Dry: \%\ error\ time = \frac{0.0167}{331} \times 100 = 0.00505$$

$$20\ °C\ Humid: \%\ error\ time = \frac{0.0167}{[illegible]} \times [illegible] = 0.01532$$

$$30\ °C\ Dry: \%\ error\ time = \frac{0.0167}{558} \times 100 = 0.00299$$

$$30\ [illegible]mid: \%\ error\ time = \frac{0.0167}{323} \times 100 = 0.00517$$

[1 mark for calculation of total error to 3 sf:]

$$Total\ \%\ error = 0.00603 + 0.03976 + 0.00505 + 0.01532 + 0.00299 + 0$$

$$Total\ \%\ error = 0.074$$

Topic Test 16
4.2 Cell Transport Mechanisms

1. Award up to two marks from: Cell surface membrane (1), chloroplast membr membrane (1), Rough ER (1), Golgi apparatus (1), Smooth ER (1), vesicles (1)

2. a) *i*: Glycoprotein (1)
   ii: Cholesterol (1)
   iii: Glycolipid (1)
   b) Receptors for hormones (1) cell signalling (1)
   c) Adds strength/rigidity to membrane by holding surrounding molecules

3. Fluid mosaic model (1)

4. Small (1), uncharged/non-polar (1), lipid soluble (1)

5. Unlike simple diffusion, facilitated diffusion requires carrier/channel protein through the membrane which are too large / polar to pass through by diffusi

6. Osmosis is the movement of water molecules (1) across a partially permeable potential to low water potential (1)

7. Pure water has a water potential of 0 kPa (1). In a solution, water surrounds and has a negative (1) water potential. Water moves from the higher / less negative (water potential.
   [1 mark for each]

8. [1 mark for word equation, 1 mark for each symbol:
   $Water\ Potential\ (\Psi) = Turgor\ Pressure\ (\Psi_p) + Osmotic\ Potential\ (\pi)$

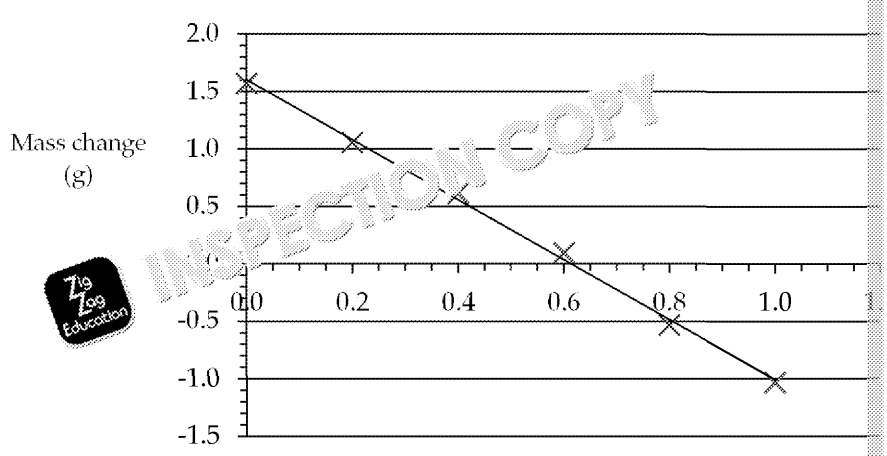
9. Active transport occurs when carrier/channel protein binds with ATP (1). A the shape of the protein (1) so the carrier protein moves the substance / chan substance across the membrane (1) against the concentration gradient (1)

10. Into the cell is endocytosis (1), out of the cell is exocytosis (1).

11. a) Line a represents simple diffusion (1) as there is no limitation on diffusi facilitated diffusion (1) which is limited by number of carrier/channel pr (1). Line c represents active transport (1) with the maximum rate of diff
    b) Respiration produces ATP (1), ATP is required by the membrane protei

12. a) To maintain a constant temperature and to increase rate of movement / d
increasing the rate of osmosis (1)

b) [½ mark for each point, 1 mark for line of best fit:]



c) Sucrose concentration is approximately 0.62 mol dm^{-3} (1); there should l
concentration; therefore, the water potential of the solution and potato t

13. a) As temperature increases, the vacuole and cell membranes become mor
rate across them increases (1); as the temperature increases further, the p
become denatured, and allow the pigment to pass through more easily (1

b) Temperature (1)

Topic Test 17

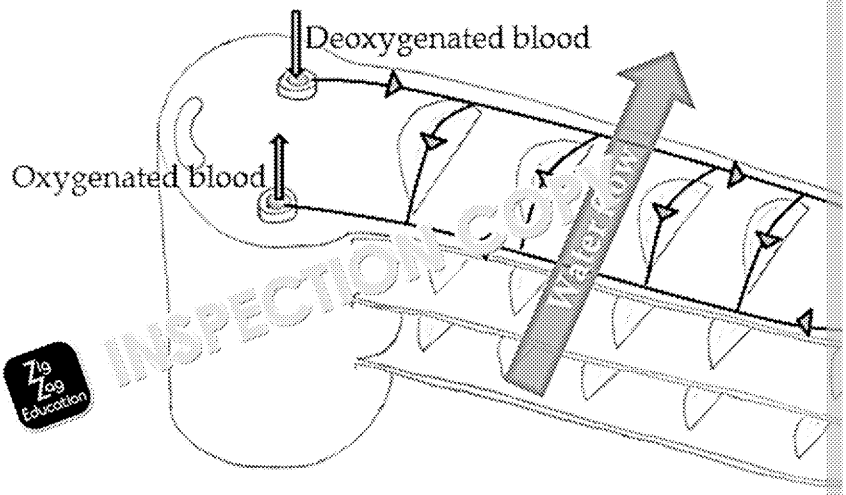
4.3 Gaseous Exchang

1. a) Tr e a tubes (1), tracheoles are small tubes to the tissues (1), s
to cheae (1)

b) Gas move along a diffusion gradient (1)

c) Thick waterproof cuticle (1) and can close spiracles (1)

2. a) *i* = gill lamellae (1)
ii = gill filaments (1)
[1 mark for line: must be correct direction and contain at least one flow



b) Counter-current exchange/flow/principle (1)

c) Blood and water flow in opposite directions (1); therefore, high oxygena blood (1) and low oxygenated water is in contact with low oxygenated b concentration gradient (1) so have diffusion along entire length of blood blood flow in the same direction (1) so oxygen levels equalise and limit d

3. Gases diffuse (1) through the stomata (1) into air spa the leaf (1), diffus gradient (1) with CO_2 diffusing in and O_2 diff for photosynthesis (1) diffusing out for respiration (1)

4. a) Recommend t gloves (1) so do not get an infection from tissue (1)

b) A fi disposal of tissue (1), sterilisation of equipment (1),

Topic Test 18

4.3 Gaseous Exchange (ii)

1. a) [1 mark for each correct grouping of structure, feature and function:]

Bronchi	→	Two branches supported by cartilage	→	
Alveoli	→	Minute air sacs lined with elastic fibres	→	
Trachea	→	Large, flexible airway supported by cartilage	→	
Bronchioles	→	Smaller, branching airway ned with smooth muscle fib	→	

b) Goblet cells produce mu ich traps dirt and pathogens (1), the c oesophagus/thr y are found in the trachea and bronchi (1).

2. [Must ired feature and reason for 2 marks. Any one from:]
   - Alv epithelia are very thin (1); therefore, short diffusion pathway (1)
   - Moist exchange surface allows oxygen to diffuse into moisture (1); there
   - Very good blood supply to the tissues (1), with maintenance of a concen
   - Large surface area (1) for maximum exchange (1)

3. a) The total volume of air that passes through the lungs in a given time (1)

b) Pulmonary ventilation rate = Tidal volume × Breathing rate (1)

4. During inspiration the *external* (1) intercostal muscles contract and the *diaphr* increases the volume, thereby decreasing the pressure in the *thoracic cavity* (1 At rest, expiration and inspiration are relatively *passive* (1) processes, requiri *active* (1) expiration during exercise, only the *external* (1) ntercostal muscles a [1 mark for each]

5. a) Genetic condition (1) an upation (1)

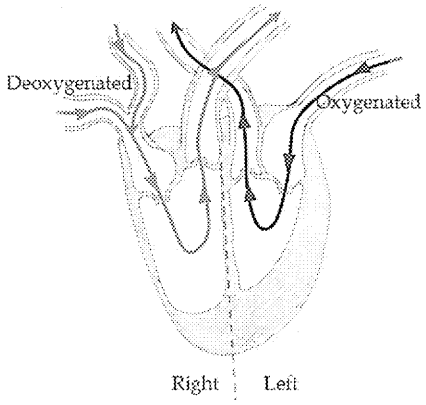
b) Effect of genetic and smoking (1) [Or] Effect of genetic conditi

Topic Test 19
4.4 Circulation

1. a)

Label	Anatomical Feat
i	Pulmonary arte
ii	Pulmonary vei
iii	Semilunar valv
iv	Right atrium
	Right ventricl
vi	Atrioventricular v

b) [1 for correct directions and correct labels]



c) Pressure behind a valve causes it to open, then pressure in front of the v
stops blood being forced backwards / keeps blood flowing in the sa

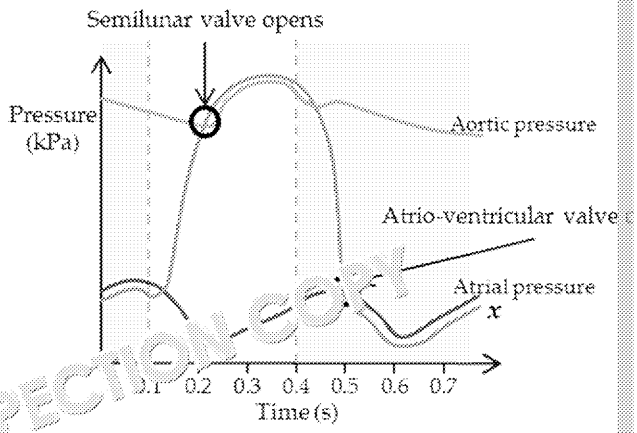
d) It needs to create more pressure as the blood has to travel around the en

e) *a* = Sinoatrial node (1) [Do not accept SAN]
b = Bundle of His (1)
c = Atrioventricular node (1) [Do not accept AVN]

2. a) i = Atrial systole (1)
ii = Ventricular systole (1)

b) Ventricular pressure (1)

c) [1 mark for each valve:]



3. [1 mark for each correct row:]

Vessel	Muscle layer	Elastic layer	Overall wall thickness	Valves	
Arteries	*Thick*	Thick	*Thick*	None	*C*
Capillaries	None	*Non*	*Or* *el* thin	*None*	*I*
Veins	*T*	*Thin*	*Thin*	*Yes/ present*	

4. Arteries have thicker walls than veins to prevent bursting (1) because they ar pressure / have to deal with regular pressure changes (1)

5. a) Cardiac output is the volume of blood pumped by one ventricle in a set
   b) [1 mark each for all correct means:]
   Mean heart rate = $\frac{75+72+75+78+71}{5} = 74.2$, Average stroke volume = $\frac{70+64+}{}$

   $Cardiac\ output = Heart\ rate \times Stroke\ volume$

   [1 mark for correct answer in ml:]

   $Cardiac\ output = 74.2 \times 67.8$

   $Cardiac\ output = 5030.76\ ml\ min^{-1}$

   [1 mark for correct answer to 2 dp with cor ts]

   $Cardiac\ output = \frac{5030.76}{100}$

   $Cardiac\ ou 0.5\ dm^3\ min^{-1}$

   c) [1 or correct calculation of stroke volume in dm^3:]

   $Exercise\ stroke\ volume = 67.8 + \frac{67.8}{10}$

   $Exercise\ stroke\ volume = 74.58\ ml$

   $Exercise\ stroke\ volume = 0.07458\ dm^3$

   [1 mark for correct arrangement of equation:]

   $\text{Exercise heart rate} = \frac{\text{Cardiac output}}{\text{Stroke volume}}$

   [1 mark for correct answer after rearrangement of equation:]

   $\text{Exercise heart rate} = \frac{13.42}{0.07458}$

   Exercise heart rate = 180 b

6. a) [Any two from:]
   - Erythrocytes carry oxygen
   - Neutrophils part of the non-specific immune system / perform pha
   - Eosinophils are part of the non-specific immune system / respond t
   - Basophils part of the non-specific immune system / produce histam
   - Monocytes part of the specific immune system
   - Lymphocytes part of the specific immune r[illegible]se
   - Platelets involved in clotting

   b) [Any three from:]
   - Transport of subst[illegible]nd the body (1)
   - Recogniti[illegible]thogens and defence against infection (1)
   - m[illegible] lymph and tissue fluid (1)
   - [illegible]ibution of heat energy around the body (1)

7. Platelets break apart and release serotonin, which narrows blood vessels (1), a triggers clotting (1). Thromboplastin converts prothrombin to thrombin (1) i Thrombin converts soluble fibrinogen to insoluble fibrin (1), which forms a n Cells and platelets are trapped in the mesh and form a clot (1).

8. Damage to the endothelium of blood vessels (1) causes white blood cells and which builds up and hardens, causing loss of elasticity and narrow lumen (1 [Risk factors, any one of:] fatty diet, smoking, stress, high blood pressure, litt diabetes (1)

Topic Test 20

4.5, 4.6, 4.7 Transport of Gases in Blood, T[illegible]r of Material betw and Cells and Transport in Plant

1. a) Quaternary structure (1)
   b) The first oxy[illegible]le changes the shape of the haemoglobin (1) wh bi[illegible]m[illegible]g it easier for the subsequent three molecules to attach (1)

2. a) Bohr effect (1)
   b) If the curve is more to the right, the oxyhaemoglobin will dissociate wit pressures (1), thereby providing more oxygen to the respiring muscles (
   c) Myoglobin does not give up oxygen easily, so acts as an oxygen store (1). very low (and carbon dioxide is high) it releases this oxygen when it is m
   d) [1 mark for correct placement of curve with label]

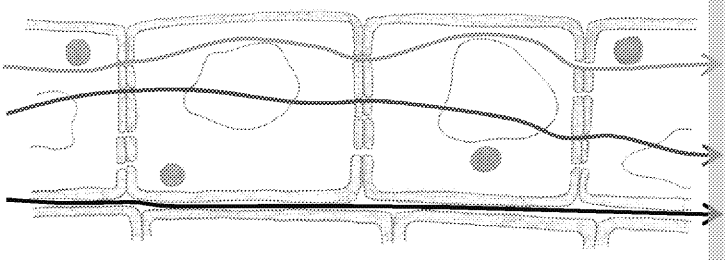
3. a) The hydrostatic pressure acting outwards on the vessel is stronger than inwards on the vessel (1), and this causes water and other components i respiratory gases to be squeezed out of the capillaries (1)
   b) [Any two from:]
   - Oxygen (1)
   - Sugar (1)
   - Amino acids (1)
   - White blood cells (1)

   c) Large protein[illegible]cules stay in the blood (1); therefore, blood has a is[illegible]ated with solutes (1) so tissue fluid re-enters because th in[illegible]n the vessel becomes greater than hydrostatic pressure pushin lymph vessels return tissue fluid to the blood (1).

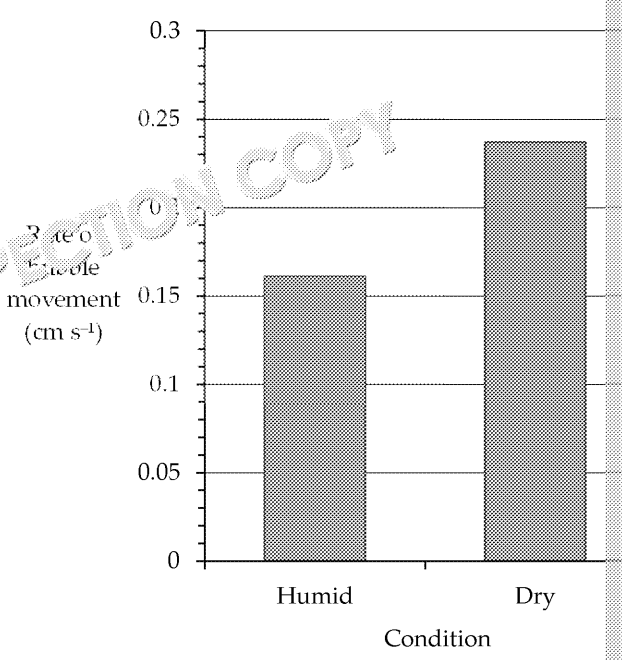
4. a) *i*: Xylem vessel (1)
ii: Sieve tube element (1)
iii: Companion cells (1)
b) Xylem transports water; phloem transports organic material / sugars (1)
[And one from:]
- Xylem provides unidirectional transport; phloem provides bidirect
- Xylem tissue is dead; phloem is made up o[illegible]g cells (1)

5. The *cohesion-tension* (1) theory of wa[illegible]ent in the xylem depends on *t*
Water evaporates out the *sto[illegible]* to an area of more *negative* (1) water p
are held together b[illegible] bonds, a continual stream of water molecul
[1 mark for each]

6. [1 mark for each correctly labelled line:]



7. a)



[1 mark for corrects mean to 3 dp:]

$Humid\ mean = 0.161\ cm\ s^{-1}$

$Dry\ mean = 0.237\ cm\ s^{-1}$

[1 mark for axes, ½ mark for ea[illegible]ectly plotted bar]

b) [1 mark for standard error equation:]

$$SE = \frac{s}{\sqrt{n}}$$

[1 mark for 95 % confidence limit equation:]

$$95\ \%\ Confidence\ limit = 2 \times SE \pm mean$$

[1 mark for calculation of standard errors and 95 % confidence limits for

$$SE_H = \frac{0.0450199}{\sqrt{6}}$$

$$SE_H = 0.0183792$$

$$95\ \%\ Confidence\ limit_H = \pm 0.0368$$

$$SE_D = \frac{0.0397768}{\sqrt{6}}$$

$$SE_D = 0.0162388$$

$$95\ \%\ Confidence\ limit_D = \pm 0.0325$$

1 mark for calculating correct ± values for each condition:]

	Humid conditions	
+ (95 % limit above mean):	*0.198*	
Mean transpiration rate:	0.161	
– (95 % limit below mean):	*0.124*	

c) Since the 95 % confidence limits for the two conditions do not overlap (1) significantly faster in dry conditions (1) with less than 5 % probability (1); therefore, the hypothesis that plants transpire more in dry conditions

8. Increased temperature (1), and increased air movement / wind (1)

9. Sugars are created by photosynthesis and enter the phloem (1), this creates a water enters from the xylem by osmosis (1), the increase in water forms pres water and sugars are transported down the phloem (1) to a sugar sink where insoluble starch (1)