St Ninian's High School

Biology Department

Multicellular Organisms

Part 3

Name: _____

Cultivating Excellence in Science

Reproduction

DNA content of Cells

Every cell in the body contains _____ chromosomes

_____ set of _____ chromosomes from mum.

_____ set of _____ chromosomes from dad.

Therefore normal body cells contain _____ of chromosomes and are called _____.

Examples of Body Cells

1.

2.

3.

Exceptions

1.

Contain _____ set of chromosomes and are called _____.

2.

_____ chromosomes as have no _____ therefore no _____.

Sex Cells

Sex Cells

Another term for a sex cell is called a _____.

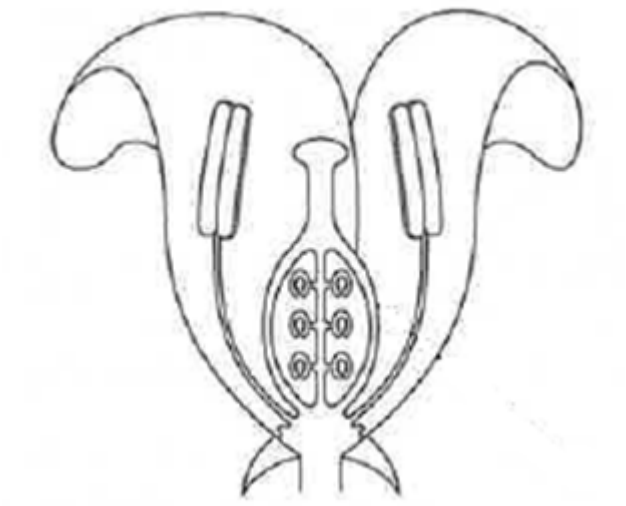
Type of organism	Male	Female

Site of Gamete Production

Flowers

Pollen gamete is made in the _____.

Ovule gametes are produced in the _____.



Sex Cells

Site of Gamete Production

Animals

Sperm gamete is made in the _____.

Egg gametes are produced in the _____.

Fertilisation

The _____ of the haploid _____ and _____ fuse to

form a _____.

Zygote

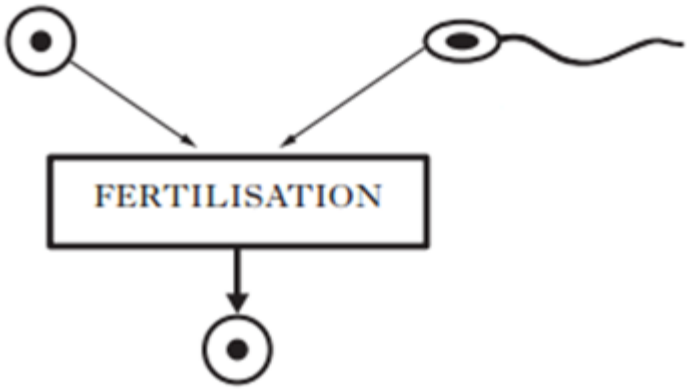
A zygote is a _____.

Why are gametes haploid?

Gametes only contain _____ of chromosomes as their _____ fuse to form

a _____ with _____ of chromosomes.

Diagram of Fertilisation



Sex Cells

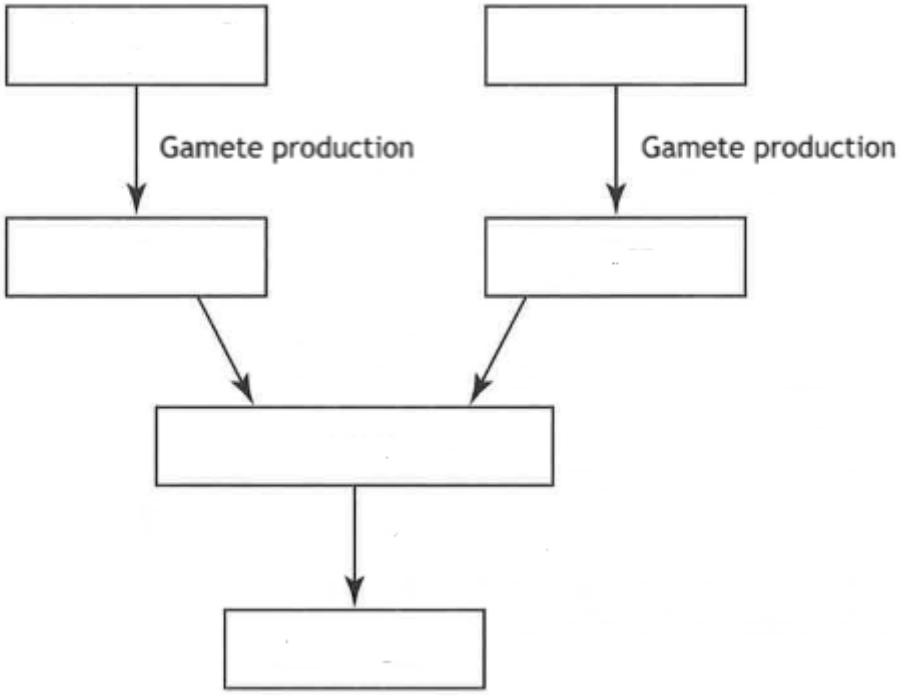
Task

State whether the cell is haploid or diploid and from an animal or plant.

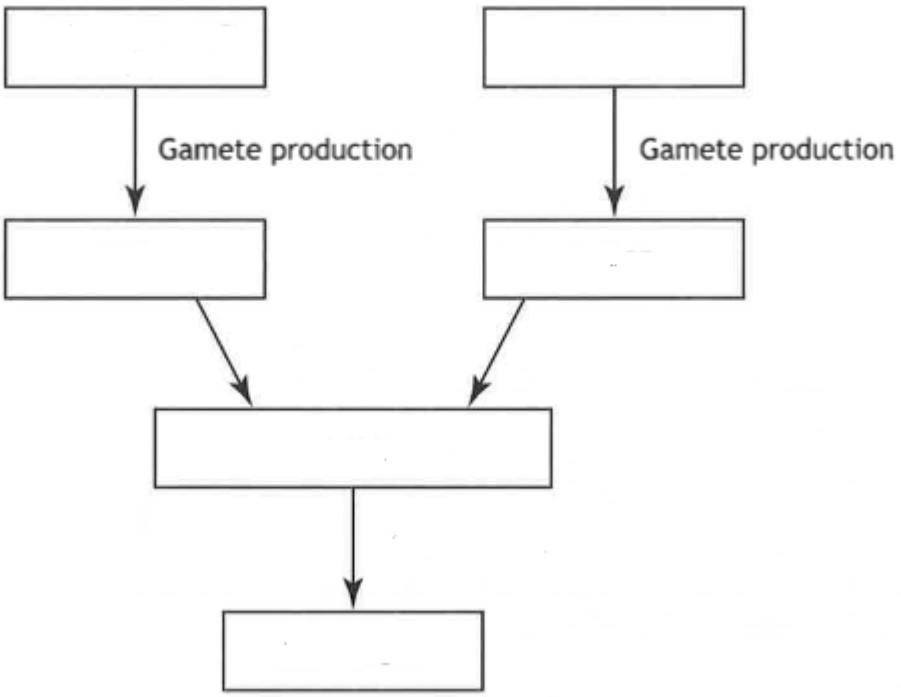
Type of cell	Haploid/diploid	Animal/plant
Testes		
Pollen		
Anther		
Sperm		
Ovule		
Ovary		
Egg		

Producing Sex Cell Diagram

Animals



Plants



Variation

Variation

Variation in the characteristics of a species are caused by _____

Mutations are _____ changes to _____.

Importance of Variation

Variation in a species is important for species _____

It ensures species can _____to _____.

Example—peppered moth

Types of Variation

Types of Variation

There are two types of variation in the population.

1. Discrete Variation
   Variation can be split into _____.

   Examples

2. Continuous Variation
   Variation shows a _____ of values.

   Examples

Variation

Polygenic Variation

A _____ controlled by _____.

Example

Most characteristics are polygenic and show _____ variation.

Graphs and Variation

Discrete variation
Distinct groups
Single gene/polygenic
Most/few characteristics

Continuous variation
Range of values
Single gene/polygenic
Most/few characteristics

_____ graph

_____ OR _____graph

Task
Classify the following characteristics as continuous or discrete.

Characteristic	Continuous	Discrete

Reproductive - Self Assessment

1. The diploid number of chromosomes in a cell from a kangaroo is 12.

Which line in the table below identifies the number of chromosomes for the cell type shown?

	Kangaroo Cell Type	*Number of chromosomes*
A	sperm	12
B	skin	6
C	nerve	6
D	zygote	12

2. Which of the following pairs of human cells have the same number of chromosomes?

A Liver cell and sperm cell

B Kidney cell and sperm cell

C Kidney cell and liver cell

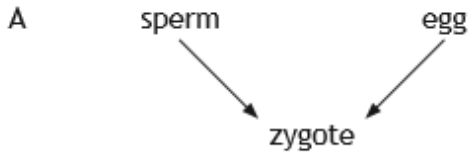
D Liver cell and egg cell

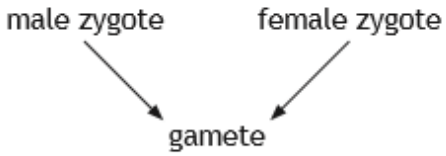
3. Variation in a characteristic can be discrete or continuous. The range of heights and weights for a group of students were measured and recorded. Ear lobe types were also examined and categorised into groups.

Which line in the table below identifies the type of variation shown by each of these human characteristics?

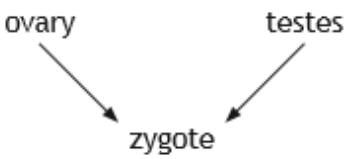
	Height	*Weight*	*Ear lobe types*
A	continuous	continuous	discrete
B	discrete	continuous	continuous
C	discrete	discrete	continuous
D	continuous	discrete	discrete

4. Which of the following diagrams represents the process of fertilisation in plants?

A


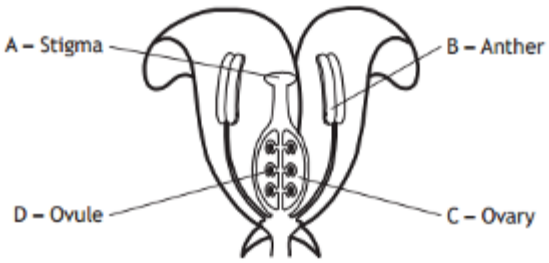
B


C


D


5. The diagram below shows the structure of a flower.

Where are the male gametes produced.



Reproduction & Variation - Self Assessment

6. Most features of an individual phenotype are

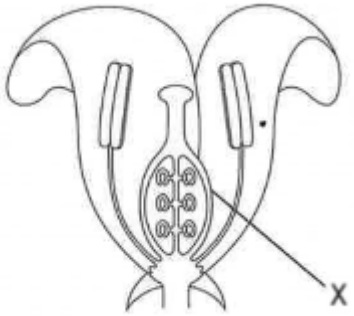
A controlled by a single gene and show continuous variation

B controlled by a single gene and show discrete variation

C polygenic and show continuous variation

D polygenic and show discrete variation.

7. The diagram below show structures in a flower.



Which line in the table represents X and the type of gamete it produces.

	Name of part X	*Type of gamete produced*
A	ovary	male
B	ovary	female
C	anther	female
D	anther	male

8. Inherited characteristics controlled by more than one gene are called

A continuous

B polygenic

C discrete

D chromosomes

9. Pollen is produced in

A testes

B Ovaries

C Zygote

D Anthers

10. A cell which is haploid is

A red blood cell

B testes cell

C ovaries cell

D egg cell

11. A fertilised egg cell is called

A gamete

B zygote

C diploid

D discrete

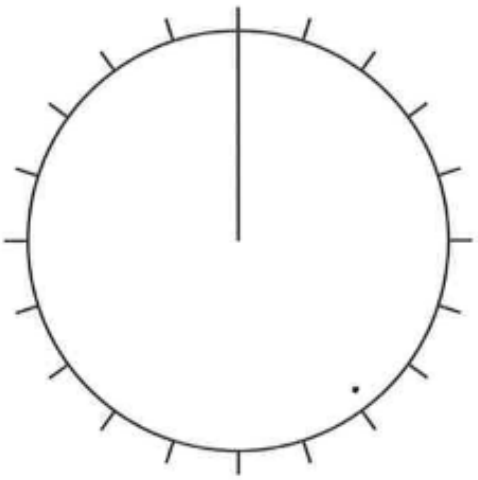
Reproduction & Variation - Self Assessment

Eye colour in humans shows discrete variation.

The eye colour of 80 school students was recorded and the results are shown in the table below.

Eye colour	*Number of school students*
Brown	36
Green	12
Blue	24
Grey	4
Hazel	4

(a) Complete the pie chart to show this information. **2**
(A spare chart, if required, can be found on page twenty-four of this paper.)



(b) Calculate the percentage of the students with blue eyes. **1**

_____ %

(c) Give the meaning of the terms continuous variation and polygenic inheritance.

Continuous variation **1**

_____

_____

Polygenic inheritance **1**

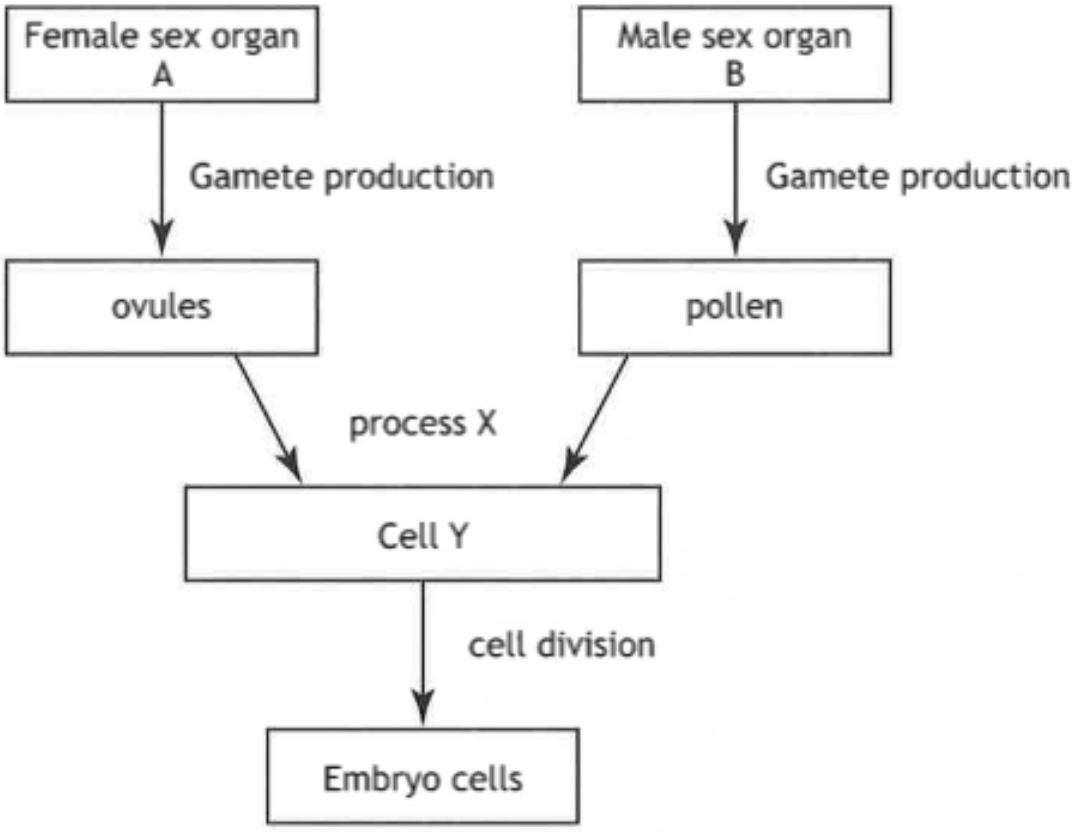
_____

_____

Reproduction & Variation - Self Assessment

MARKS

(a) The flow chart below shows a summary of events that occur during reproduction in a flowering plant.



(i) Name sex organs A and B. 2

A _____

B _____

(ii) Name process X, which involves the fusion of the gametes. 1

_____

(iii) Name cell Y. 1

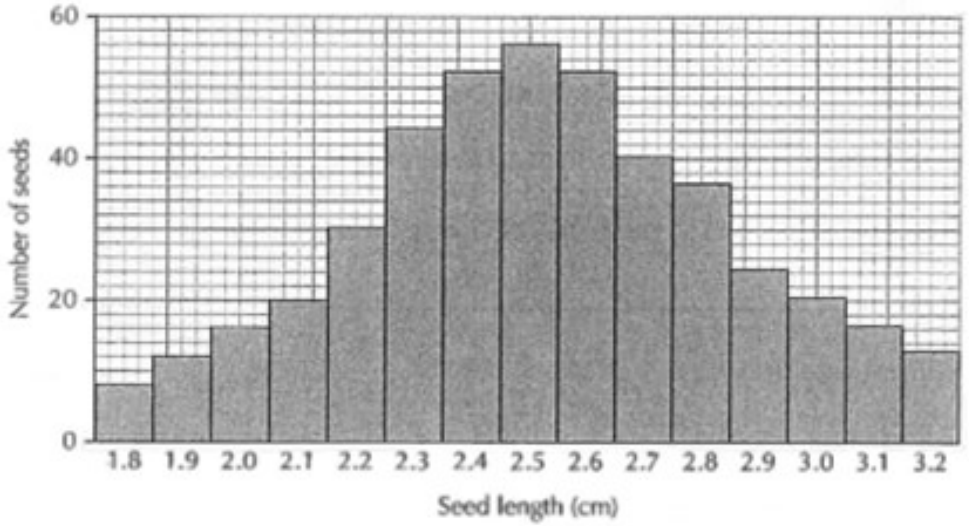
_____

(b) Complete the table below by inserting ticks (✓) into the correct boxes to show which of the cells in the diagram are haploid and which are diploid. **2**

Cell	*Haploid*	*Diploid*
Ovule		
Pollen		
Cell Y		

Variation

The bar chart shows variation in the length of seeds harvested from a broad bean plant.



a) Calculate the difference between shortest and longest seeds in the sample

_____ cm 1

b) Give evidence from the graph above to support the statement that seed length Shows continuous variation.

_____

_____ 1

c) Give one example of a characteristic that shows discrete variation.

_____ 1

Genetics

Genes & Variation

Many variations in characteristics between individuals in a population are controlled by our _____.

Genes are made up of _____ molecules and are found on

_____.

Diagram of Chromosome

Gene Alleles

Each gene contains different _____ called _____.

Gene	Allele	Allele
Dimples		
Tongue rolling		
Ear lobes		
Eye Colour		
Hair colour		

Alleles

Types of Gene Alleles

There are two types of gene allele.

1. allele (symbol—small/capital letter)

If this is present in an individual this characteristic is _____.

2. allele (symbol—small/capital letter)

This characteristic is only visible if an individual has _____ of these alleles.

Quick Questions

1. Define continuous variation.

   _____

   _____

2. Define polygenic inheritance and state whether it is always shows continuous or Discrete variation.

   _____

   _____

3. State the term given to the different versions of a gene.

   _____

Genotype & Phenotype

Phenotype & Genotype

Phenotype

_____ due to _____.

Examples

Genotype

The two _____ present.

There are three potential combinations of alleles—creating three _____.

1. 2. 3.

Homozygous

Contain two of the _____ allele

Aka

Heterozygous

Two _____ alleles

Types of Genotype

1.

Type of Genotype

2.

Family Tree Genetics

Family Tree Generations

The first generation in a family tree is called the _____ generation

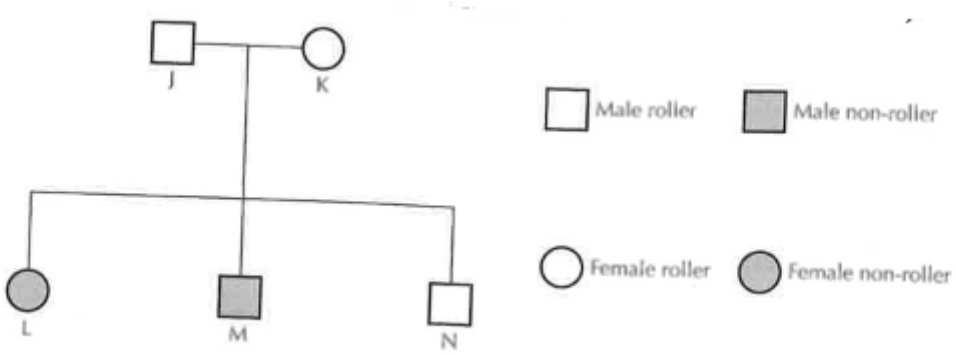
The second generation in a family tree is called the _____ generation

The third generation in a family tree is called the _____ generation

Worked Example Question

Tongue rolling is an inherited characteristic in humans.

Tongue rolling is determined by the dominant form of the gene, T and the non rolling condition is determined by the recessive t.



Rules

If individuals have a recessive phenotype their genotype is _____.

If a mum and dad are dominant but they have a child that is recessive they are _____.

Work out the Genotype of

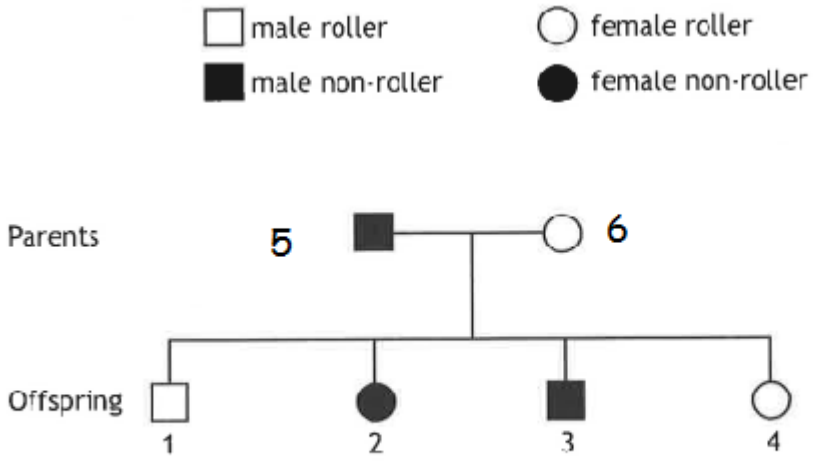
J _____ K _____ L _____ M_____ N _____

Monohybrid Cross

Tongue rolling is an inherited characteristic in humans.

Tongue rolling is determined by the dominant form of the gene, T and the non-rolling condition is determined by the recessive t.

The family tree diagram below shows the pattern of inheritance in one family.



Tasks

Add the P and F1 generation to the family tree above

Fill in the symbols for

A) Parent 5 _____ Parent 6_____

Offspring 1 _____ 2_____ 3_____ 4 _____

b) State the number of a homozygous individual.

_____

c) State the number of a female roller.

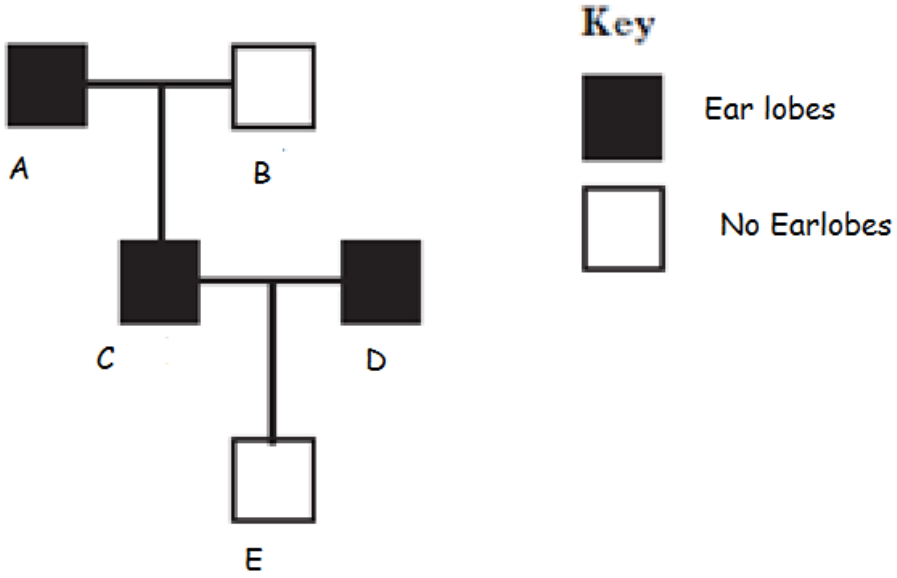
_____

Monohybrid Cross

Worked Example 2

Having earlobes is an inherited characteristic.

Having earlobes is a dominant (E) condition and not having earlobes is recessive.



Task

Add P, F1 and F2 to the following family tree.

Work out the genotype of

a) C_____ D_____ E_____ 3

b) B_____ A _____ 2

b) Which individuals are definitely heterozygous.

_____ 1

Working out Dominant/Recessive alleles.

Handy Hints for Questions

If only one phenotype is present in F1 then it is the dominant characteristic.

If ALL the F1 are the same this suggests the P Dominant parent is _____

Example

P generation Brown x Red

F1 generation All Brown

The dominant phenotype is _____.

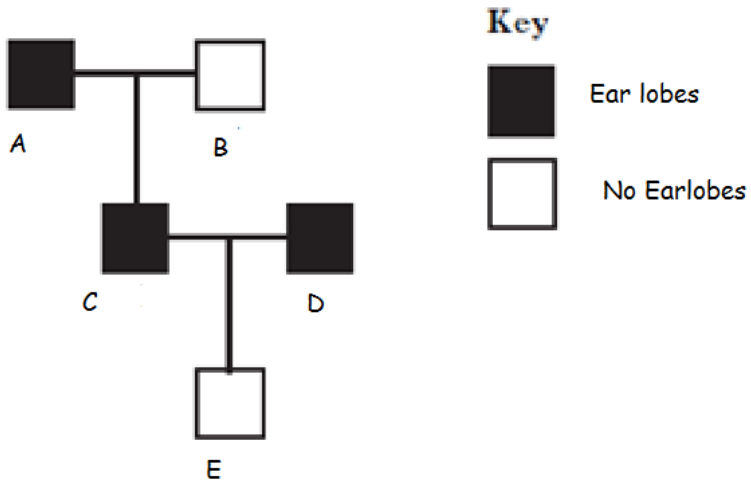
The red parent's genotype is _____ and the brown's genotype is _____

Worked Example 1

A red flower was crossed with a white flower. All of the F1 had white flowers.
The dominant characteristic was _____ flowers.

Worked Example 2

From this family tree which phenotype is the dominant allele.



Working out Dominant/Recessive alleles.

Worked Example 3

A pea plant with yellow seeds was crossed with a pea plant with green seeds.
All of the F1 generation has yellow seeds.

The genotype of the parent plant with green seeds could be described as

A heterozygous and recessive
B heterozygous and dominant
C homozygous and recessive
D homozygous and dominant

The genotype of the parent plant with yellow seeds could be described as

A heterozygous and recessive
B heterozygous and dominant
C homozygous and recessive
D homozygous and dominant

Monohybrid Cross

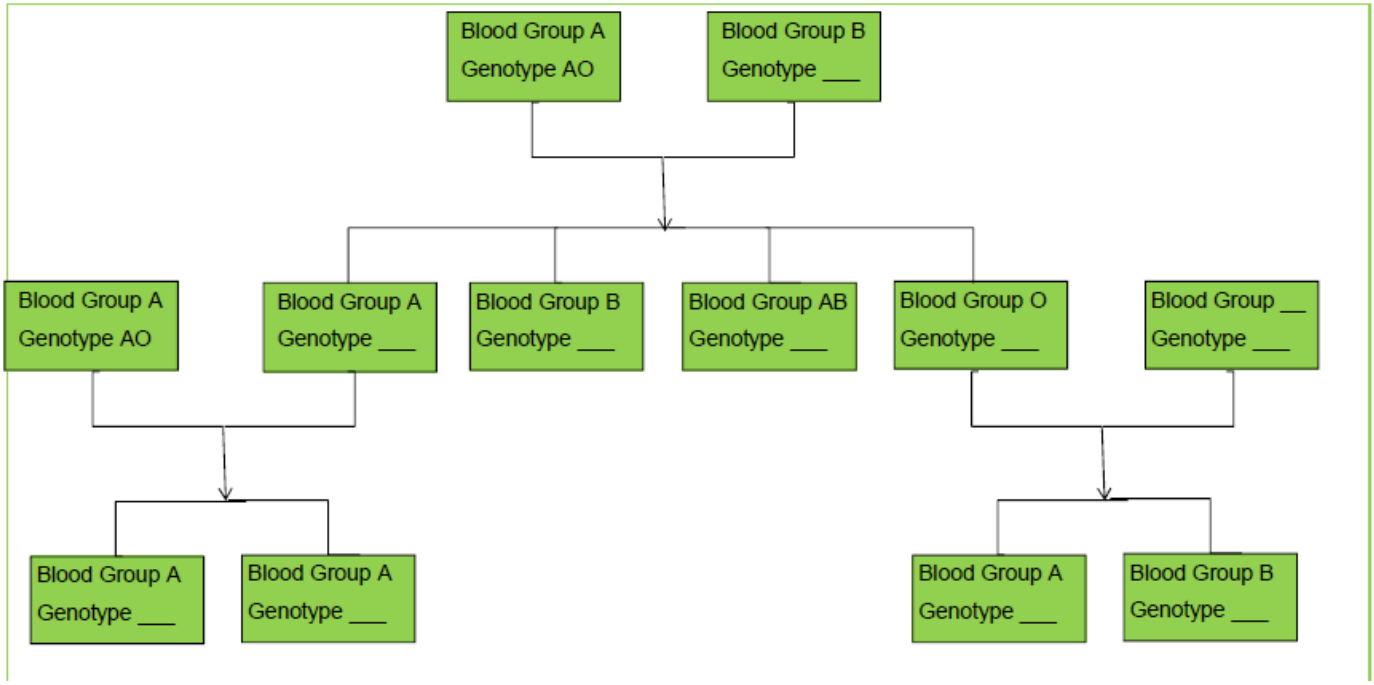
Everyone has one of four blood types, A, B, AB or O. The genetic information for the blood types is shown in the table below. Both A and B are dominant over O which is recessive.

Blood Type	Genotype
A	AA or AO
B	BB or BO
AB	AB
O	OO

a) Is blood group an example of discrete or continuous variation.

_____

b) Complete the family tree information below with blood type and genotype.

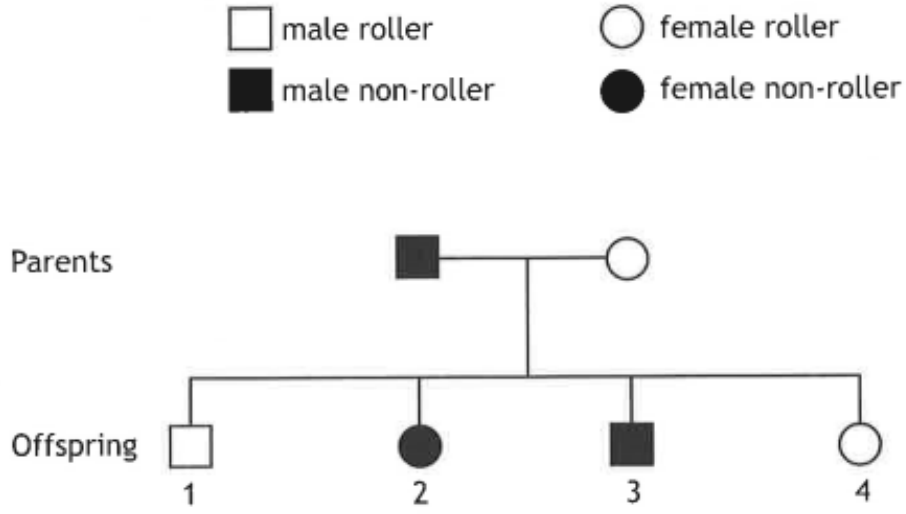


Monohybrid Cross Family Trees

Tongue rolling is an inherited characteristic in humans.

Tongue rolling is determined by the dominant form of the gene, T and the non-rolling condition is determined by the recessive t.

The family tree diagram below shows the pattern of inheritance in one family.



(a) (i) State the genotypes of the following individuals. **2**

Male 1

_____

Female 2

_____

Female 4

_____

(ii) Identify which of the parents is homozygous. **1**

Tick (✓) the correct box.

Male parent ☐

Female parent ☐

Both parents ☐

Neither parent ☐

(b) Give the term used for different forms of the same gene. **1**

_____

(c) Tongue rolling is an example of a discrete variation.

Describe what is meant by the term discrete variation. 1

Family Tree Worked Example

Monohybrid Crosses

Monohybrid Cross

A monohybrid cross aka _____ can be used to work out the _____ of having a child with a certain characteristic.

The usual style of question is:

1. Two homozygous individuals in P generation of differing phenotype

2. The F1 generation produces heterozygous individuals

3. The F2 generation produces a specific ratio of

   _____ dominant individuals : _____ recessive individual.

Observed & Expected Ratios

However the expected ratio of _____ is not always the

_____ ratio

Why?

_____ is a _____ process

Monohybrid worked example

P generation Mother Father

Phenotype

Genotype

F1 generation

Phenotype

Genotype

F2 generation

Phenotype

Genotype

Monohybrid worked example

P generation Mother Father

Phenotype

Genotype

F1 generation

Phenotype

Genotype

F2 generation

Phenotype

Genotype

Monohybrid worked example

Punnet Square Examples

Cross a homozygous dominant individual with a recessive individual.
What percentage show a recessive phenotype.

_____% recessive

Punnet Square Examples

Cross a heterozygous individual with a recessive individual.
What percentage show a dominant phenotype.

_____% dominant

Monohybrid worked example

Punnet Square Examples

Cross a two heterozygous individuals together.
What percentage show a recessive phenotype.

_____% recessive

Punnet Square Examples

Cross two recessive individual.
What percentage show a dominant phenotype.

_____% dominant

Monohybrid Probability Questions

1) In mice, white fur is dominant to grey. Calculate the ratio you would you expect from a cross between a heterozygous individual and one with grey fur?

_____ white fur: _____ grey fur

2) In cats black hair is dominant to white hair. If 2 heterozygous black haired cats are mated, what is the chance of producing a white haired kitten?

_____% dominant

Monohybrid Probability Questions

3. In mice Y is the dominant gene for yellow fur and y is the recessive gene for grey fur. Y is lethal if it is present as a homozygous trait. Calculate the percentage of mice that would survive if a grey fur mouse was crossed with a heterozygous mouse.

_____% survival

4. A homozygous long-tailed cat is crossed with a homozygous short-tailed cat and produces a litter of 9 long-tailed kittens. Show the probable offspring which would be produced if two of these kittens were mated and describe the characteristics of the offspring.

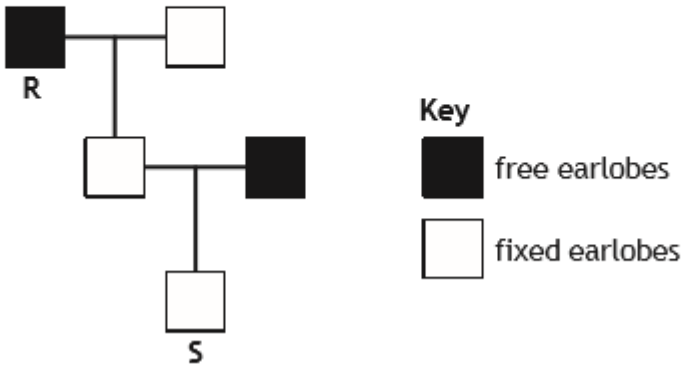
Hint: work out the kitten's genotype first before carrying out monohybrid cross.

5. Wrinkled peas are recessive and round peas are dominant. If 80 peas were produced from a cross between two heterozygous individuals, how many peas were round.

_____ round peas.

Genetics Self Assessment

In humans the inheritance of earlobe type is an example of discrete variation. The allele for free earlobes (E) is dominant to the allele for fixed earlobes (e). The diagram below shows the inheritance of this characteristic.



Which line in the table below correctly identifies the genotypes of individuals **R** and **S**?

	Genotype	
	R	**S**
A	EE	ee
B	Ee	ee
C	Ee	Ee
D	ee	EE

The following diagram shows the inheritance of coat colour in guinea pigs.

P Phenotype Black guinea pig X White guinea pig

P Genotype: BB bb

F1 Genotype: Bb

F2 Genotypes: BB and Bb and bb

Which of the following generations contain heterozygous individuals?

A P and F1

B P and F2

C F1 and F2

D P, F1 and F2

Genetics Self Assessment

MARKS

Coat colour in Labrador dogs is an inherited characteristic. Black coat (**B**) colour is dominant to chocolate coat colour (**b**).

(a) A homozygous black Labrador was crossed with a Labrador with a chocolate coloured coat.

Complete the diagram below to show the genotypes of each of the parents and the F_1 phenotype. **2**

Parents:	black coat	X	chocolate coat
Genotypes:			
F_1 genotype:		All Bb	
F_1 phenotype:			

(b) (i) Explain what is meant by polygenic inheritance. **1**

_____

_____

(ii) State the type of variation shown by polygenic inheritance. **1**

_____

Genetics Self Assessment

MARKS

Hair type in humans is controlled by a single gene. The dominant form is curly hair (H). The recessive form (h) produces straight hair.

Both parents of this curly-haired child have the genotype Hh.

(a) What term is used to describe the genotype of both parents? **1**

_____

(b) Complete the Punnet square to show the possible genotypes of their offspring. **1**

		Male gametes	
		H	h
Female gametes	H		
	h		

(c) State the possible genotype(s) of the girl in the picture. **1**

_____

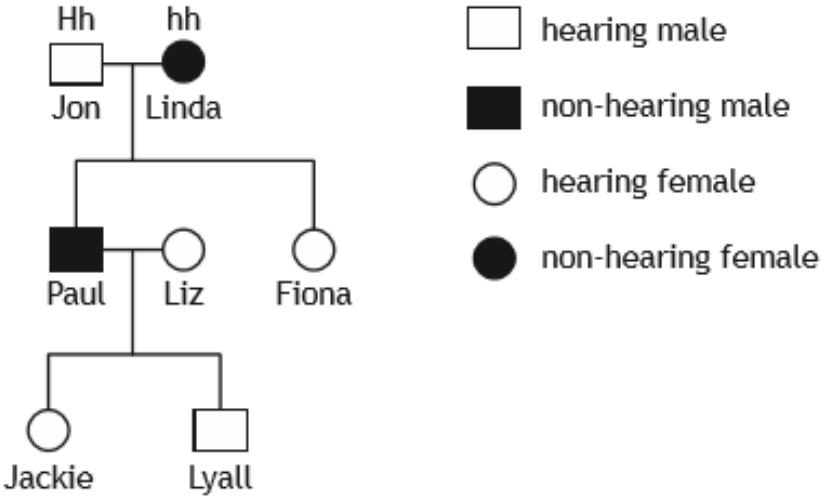
Total marks 3

MARKS

(a) One type of deafness in humans is caused by a single gene.

The diagram below shows the pattern of inheritance in one family.

H represents the hearing form of the gene.
h represents the non-hearing form of the gene.



(i) Using Jon as an example, explain how it is known that the hearing form of the gene is dominant. **1**

_____

_____

(ii) Use information in the family tree to complete the following table to show the genotype and phenotype of each individual. **2**

Individual	*Genotype*	*Phenotype*
Paul		
Lyall		

(iii) Fiona has a child with a man who has the same genotype as her. State the chance of their child being able to hear. **1**

Space for calculation

_____

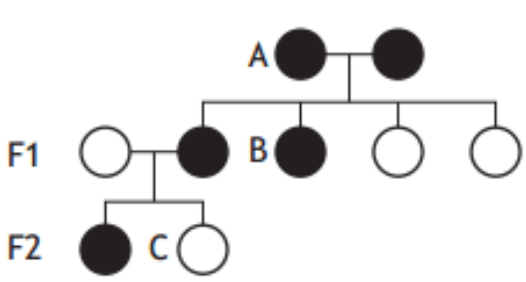
(b) Most features of an individual's phenotype are controlled by more than one gene.

Name this type of inheritance. **1**

_____

Genetics Self Assessment

The following diagram represents part of a family tree showing the inheritance of hitchhiker's thumb, where the thumb can bend back as shown below.



Key

● straight thumb

○ hitchhiker's thumb

(a) Complete the table below for individuals A and C. **2**

Individual	*Possible Genotype(s)*	*Phenotype*
A		straight thumb
B	TT or Tt	straight thumb
C	tt	

(b) In a survey of 90 students it was found that 25 of them had hitchhiker's thumb.

(i) Calculate the number of students with straight thumb to hitchhiker's thumb as a simple, whole number ratio. **1**

Space for calculation

_____ : _____

straight thumb : hitchhiker's thumb

(ii) The predicted ratio was 3 straight thumb : 1 hitchhiker's thumb.

Explain why the predicted ratio was different to the actual ratio. **1**

_____

_____

Reproductive System & Variation—Where am I in my learning?

Where am I in my learning?

Review 1

State that gametes are also called sex cells.	
State the meaning of the terms haploid and diploid and give examples of each type of cell in animals and plants.	
Explain why gametes are haploid.	
Define a zygote.	
Explain what causes variation in populations and why it is necessary for survival.	
Define continuous and discrete variation and be able to give examples.	
Explain what is meant by polygenic inheritance.	

My next steps are:

_____

_____

Review 2

State that gametes are also called sex cells.	
State the meaning of the terms haploid and diploid and give examples of each type of cell in animals and plants.	
Explain why gametes are haploid.	
Define a zygote.	
Explain what causes variation in populations and why it is necessary for survival.	
Define continuous and discrete variation and be able to give examples.	
Explain what is meant by polygenic inheritance.	

My next steps are:

_____

_____

Plant Transport

Plants transport the following molecules up or down the plant.

1.

2.

Plant Transport Vessels

1. Phloem

transports _____ _____ plant.

2. Xylem

1. transports _____ _____ plant.

2. _____ plant via rings of _____.

Xylem diagram

Phloem diagram

Plant Transport

Characteristic of tube	Xylem	Phloem
Dead/Alive		
Water/sugar		
Up/down plant		
Rings of lignin		
Sieve tubes & sieve plates		
Companion cells		

Diagram Xylem and Phloem

Transpiration

Transpiration Stream.

Three stage process to move water up plant through the three plant _____

i.e.

Stages of transpiration

1.

Water moves from _____ into _____by _____

The _____ surface area maximises water absorption from soil.

2.

Water moves up stem through _____ vessels by _____.

3.

Tiny _____ on bottom of _____

_____of water from _____ by _____.

Transpiration Summary Diagram

Transpiration Summary Diagram

Importance of Transpiration stream

1.

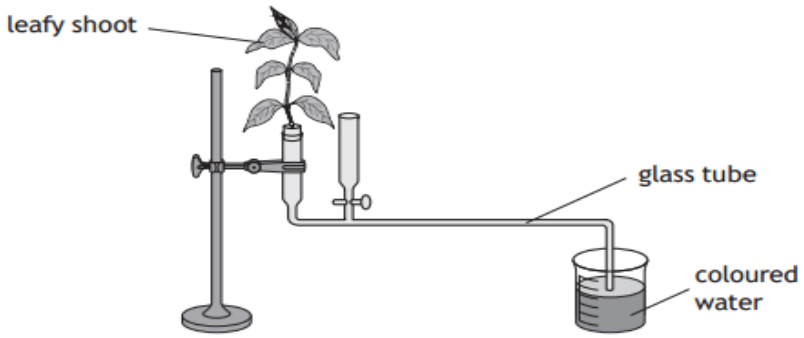
2.

3.

Transpiration Summary Diagram

Measuring Transpiration Method 1 aka

As the plant transpires, _____ is drawn up the glass tube and its _____measured, over a set period of time e.g _____.



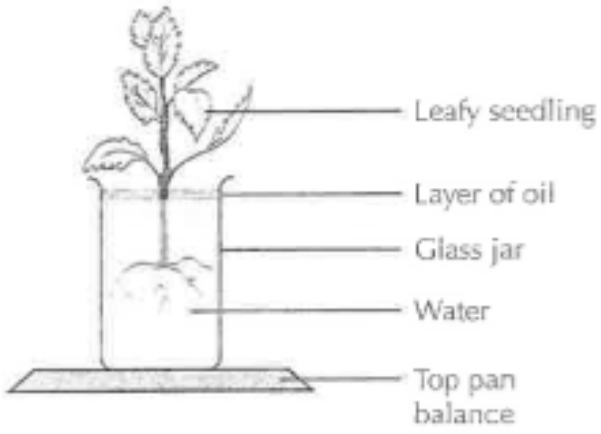
Light intensity	Volume taken up in 10 minutes (ml)

Temperature	Volume taken up in 10 minutes (ml)

Humidity	Volume taken up in 10 minutes (ml)

Transpiration Summary Diagram

Measuring Transpiration method 2



Measurements taken

Start

End

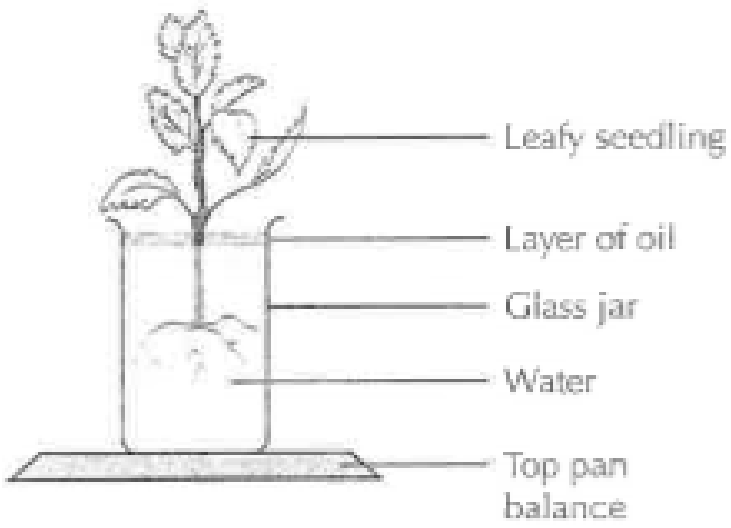
<u>Why oil is necessary?</u>

As plants weigh different masses the results are usually worked out per g

Calculation

Transpiration Summary Diagram

Environmental Factors affecting transpiration



Environmental Factor	Increasing transpiration	Decreasing transpiration
Increasing light intensity		
Increasing wind speed		
Increasing surface area of leaf		
Increasing temperature		
Increasing humidity (water in air)		

Structure of a leaf in Photosynthesis

The following cells make up a leaf and are used in the process of

_____.

Structure of a leaf diagram

Structure of a leaf

Cell	Function
Cuticle	
Upper/lower epidermis	
Palisade mesophyll	
Spongy mesophyll	
Guard cell	
Stomata	
Vein	

Stomata & Gas Exchange

Stomata

Tiny _____ on _____ of leaves.

Function: _____

Similar to _____ in lungs.

Gas Exchange Process in Stomata

Photosynthesis

Respiration

Stomata/Guard Cells

Guard Cells & Stomata

The stomata is controlled by _____ cells that open/close stomata according to _____.

Stomata diagram

Feature	Day	Night
High/low light intensity		
Guard cells turgid/ plasmolysed		
Stomata open/close		
Photosynthesis high/low		
Preventing unnecessary water loss		

Transpiration Summary Diagram

Structure of a leaf Summary

Structure of a leaf Extra notes

Plant Transport

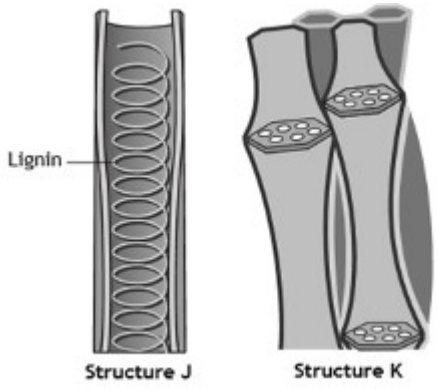
1. Transpiration is the

A evaporation of water through stomata
B uptake of water by root hair cells
C transport of water through xylem
D transport of sugars through phloem.

2. Which environmental condition would produce the greatest transpiration stream.

A warm and still air
B cold and still air
C warm and windy
D cold and windy

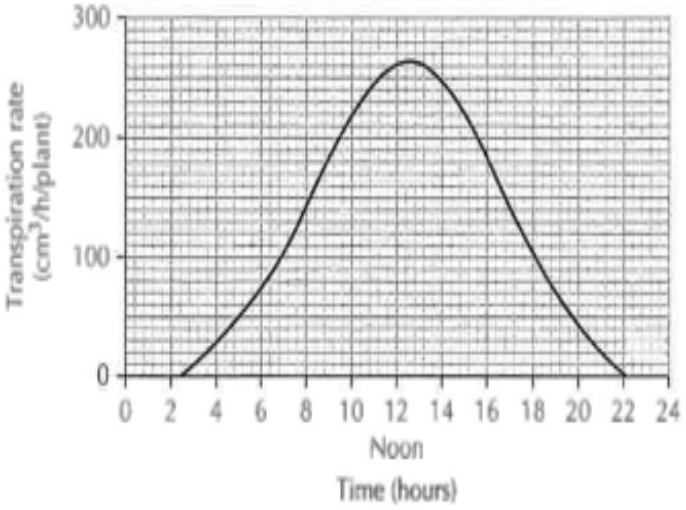
3. The diagram below shows some of the structures involved in transport of plants.



Which line in the table below identifies correctly J and K and the substances supported by them

	Structure J		Structure K	
	Name	*Substance transported*	*Name*	*Substance transported*
A	Xylem	Water	Phloem	Sugar
B	Xylem	Sugar	Phloem	Water
C	Phloem	Water	Xylem	Sugar
D	Phloem	Sugar	Xylem	Water

4. The graph below shows the average transpiration rate of barley plants in an open field over a 24-hour period during summer in Scotland.



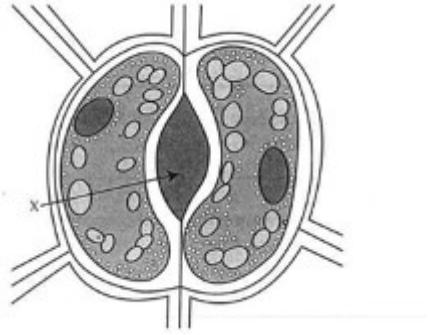
a) State the time period during which the average transpiration rate is greater than 100 cm^3 per hour per plant.

_____ cm^3 per hour per plant. 1

b) Name an environmental factors that if increased might be responsible for the transpiration rate after 12 noon.

_____ 1

c) The diagram below shows cells in the lower epidermis of a barley leaf.



Name structure X through which water evaporates through the leaves during transpiration.

_____ 1

(ii) State the conditions of the guard cells that maximise photosynthesis during the day.

_____ 1

d) Give one advantage to the plant of carrying out the transpiration stream.

_____

_____ 1

e) Xylem vessels are also necessary for transpiration.

(i) State the name of the process for the transport of water through Xylem vessels.

_____ 1

(ii) Give one function of xylem vessels other than transport of water.

_____

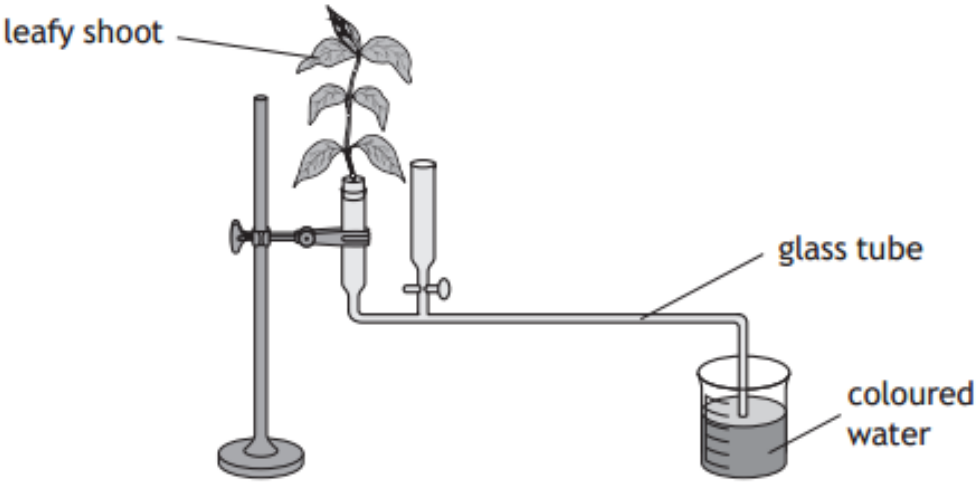
_____ 1

(iii) State whether xylem is alive or dead.

_____ 1

(a) The rate of transpiration in plants can be measured using the apparatus shown below.

As the plant transpires, coloured water is drawn up the glass tube and its volume measured, over a set period of time, to give the rate of transpiration.



Changes in the surrounding environment can have an effect on the rate of transpiration.

(i) Select **one** of the environmental changes listed below by circling it.

increase in humidity	increase in temperature	increase in wind speed

State the effect of this change on the rate of transpiration. **1**

_____

(ii) Choose any of the environmental changes listed above and describe an addition to the apparatus shown, which would allow an investigation into its effect. **1**

Environmental change _____

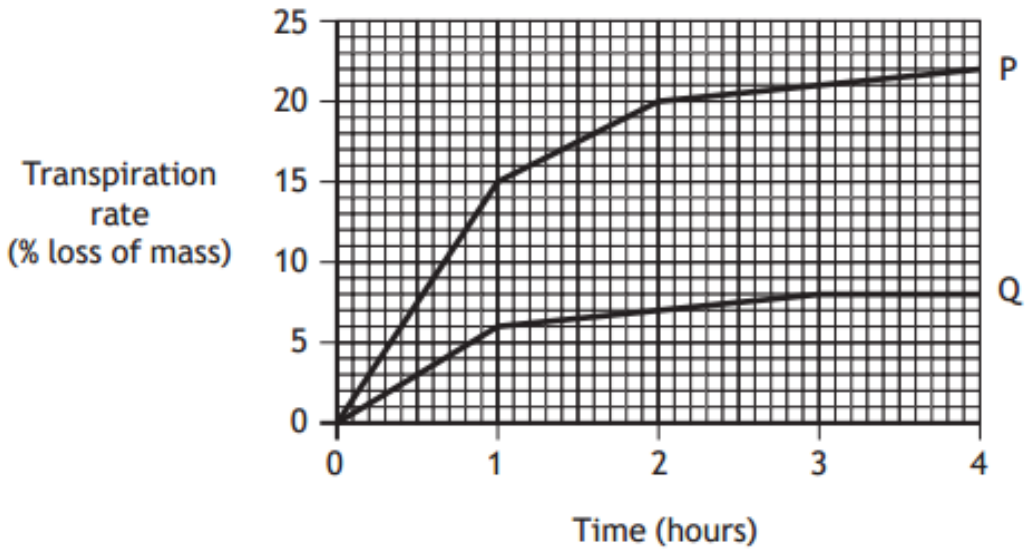
Description of addition _____

_____

_____

_____

(b) The graph below shows transpiration rates of two plants, P and Q.

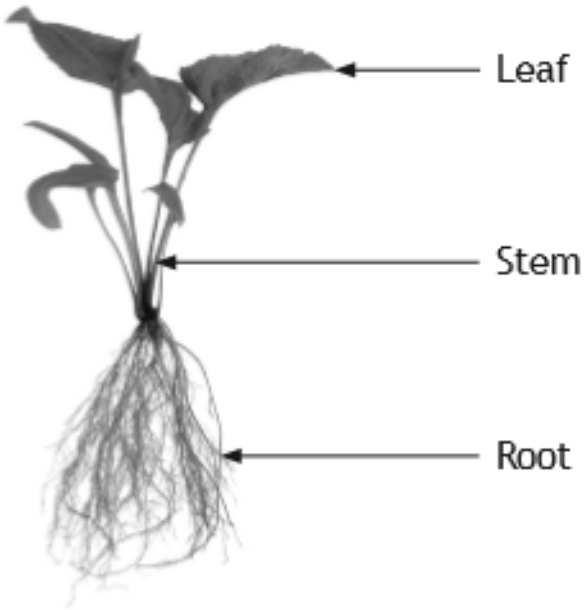


(i) With reference to the number of stomata, suggest a reason for the different transpiration rates of plants P and Q. **1**

(ii) Name the type of cells which control the opening and closing of stomata. **1**

Plant Transport

The diagram below shows three parts of a plant.



Describe the structures and processes involved as water moves through the plant from the soil to the air. **3**

Plant Transport—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

Draw a diagram of xylem and phloem and label its specialisations and its respective functions.	
Explain why plants require lignin on xylem.	
State whether xylem moves molecules up or down plant and whether the vessel is alive or dead.	
State what stomata are, where they are found and their two functions.	
Describe the state of guard cells and stomata during the day and night and explain why this is necessary.	
Describe the cells and processes involved in the 3 stages of the transpiration stream.	
Explain why the transpiration stream is necessary.	
Describe how to measure the transpiration rate of plants.	
List some environmental factors that increase and decrease the transpiration rate of plants.	
Label the key cells involved in the structure of a leaf and state their functions which include: cuticle, epidermis, palisade/spongy mesophyll, stomata and guard cells.	

My next steps are:

_____

_____

Plant Transport—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

Draw a diagram of xylem and phloem and label its specialisations and its respective functions.	
Explain why plants require lignin on xylem.	
State whether xylem moves molecules up or down plant and whether the vessel is alive or dead.	
State what stomata are, where they are found and their two functions.	
Describe the state of guard cells and stomata during the day and night and explain why this is necessary.	
Describe the cells and processes involved in the 3 stages of the transpiration stream.	
Explain why the transpiration stream is necessary.	
Describe how to measure the transpiration rate of plants.	
List some environmental factors that increase and decrease the transpiration rate of plants.	
Label the key cells involved in the structure of a leaf and state their functions which include: cuticle, epidermis, palisade/spongy mesophyll, stomata and guard cells.	

My next steps are:

_____

_____