Unit 2 - Multicellular organisms
1 - Cells, tissues and organs
2 - Stem cells and meristems
23. The list below refers to stages in the response of the nervous system to a stimulus.

1 Central nervous system sorts information.
2 Nerve impulses sent to muscles.
3 Nerve impulses sent to central nervous system.
4 Senses detect the stimulus.
5 Response is produced.

The correct order of the stages is

A 4 → 3 → 1 → 2 → 5
B 3 → 4 → 2 → 1 → 5
C 4 → 3 → 2 → 1 → 5
D 3 → 4 → 1 → 2 → 5.

24. The following diagram shows a human brain.

(A) receptor in eye
(B) neurone 1
(C) neurone 2
(D) Central Nervous System

25. The diagram below shows neurones connecting the eye with the central nervous system.

Which line in the table below identifies correctly the types of neurones and the direction of impulses which travel along them?

<table>
<thead>
<tr>
<th>Neurone 1</th>
<th>Neurone 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Motor</td>
<td>Sensory</td>
</tr>
<tr>
<td>B Sensory</td>
<td>Motor</td>
</tr>
<tr>
<td>C Motor</td>
<td>Sensory</td>
</tr>
<tr>
<td>D Sensory</td>
<td>Motor</td>
</tr>
</tbody>
</table>
(c) The grid below shows structures related to the nervous system.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>relay nerve cell</td>
<td>muscle</td>
<td>motor nerve cell</td>
<td>sensory nerve cell</td>
</tr>
</tbody>
</table>

Complete the sequence below, using letters from the grid, to show the order of the structures through which a nerve impulse travels in a reflex action.

stimulus → touch receptor → _____ → _____ → _____ → _____ → response  

(a) Complete the table below to show parts of the brain and their functions.

<table>
<thead>
<tr>
<th>Part of brain</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebrum</td>
<td></td>
</tr>
<tr>
<td>Cerebellum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>controls breathing and heart rate</td>
</tr>
</tbody>
</table>
(a) Different parts of the brain have different functions.
Draw one line to link each part of the brain with its correct function.
(One example has been completed for you.)

<table>
<thead>
<tr>
<th>Part of the brain</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebrum</td>
<td>control of breathing rate</td>
</tr>
<tr>
<td>Medulla</td>
<td>conscious responses</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>co-ordination of movement</td>
</tr>
</tbody>
</table>

(b) (i) The flow chart below shows the structures in a reflex arc.
Complete the chart by inserting the names of the missing neurones.

(ii) Describe a function of a reflex response.
(a) The diagram below shows the structures found in a reflex arc.

Complete the table below to identify the structures and their functions.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Letter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory neurone</td>
<td>P</td>
<td>Carries impulses from the receptor to the spinal cord</td>
</tr>
<tr>
<td>Effector</td>
<td></td>
<td>Passes impulses from the sensory neurone to the motor neurone</td>
</tr>
</tbody>
</table>
13. The diagram below shows the process of fertilisation.

Cell R is

A a zygote
B a gamete
C an ovule
D an embryo.
The diagram below represents some of the processes involved in human reproduction.

The sex chromosomes are shown in each cell.

(a) Which cell(s) are female?

**Circle the correct cell(s) below.**

Cell 1 / Cell 2 / Cell 3

(c) **Underline one** option in each set of brackets to make the following sentence about fertilisation correct.

Cell 3 is a \{body cell\} formed when the \{cytoplasm\} of the two gametes

\{divide\} or \{fuse\} at fertilisation.
11. In corn on the cob, yellow seed (G) is dominant to purple seed (g). The cob shown below shows some yellow and some purple seeds. The seeds have been counted.

![Corn cob with yellow and purple seeds](image)

125 yellow seeds  124 purple seeds

The genotypes of the parents that produced this cob were
A  GG × gg
B  Gg × gg
C  gg × gg
D  Gg × Gg.

14. A hairy stemmed pea plant is crossed with a smooth stemmed pea plant. All the F₁ plants had hairy stems.

The genotype of the F₁ plants was
A  heterozygous
B  homozygous
C  dominant
D  recessive.

15. Differences in the mass of sunflower seeds are due to the interaction of the alleles of several genes.

This type of inheritance is called
A  dominant
B  monohybrid
C  polygenic
D  co-dominant.
13. An organism has two different alleles of a gene.

This genotype is
A dominant
B homozygous
C recessive
D heterozygous.

14. Distichiasis is a dominant characteristic in humans which causes the person to have two rows of eyelashes.

A woman who is homozygous for the condition and a man who is unaffected have children.

What proportion of their children would be expected to have Distichiasis?
A 0%
B 25%
C 50%
D 100%

15. In dogs, uniform coat colour is dominant to spotted coat.

From the family tree above, in which generation(s) are all the dogs heterozygous for coat colour?
A P only
B F₁ only
C F₂ only
D P and F₁
(a) Hair appearance in mice is controlled by a single gene. Wavy hair (H) is dominant to straight hair (h).

Two homozygous mice were crossed, one had wavy hair and one had straight hair.

(i) Complete the genotypes of the parental generation (P).

\[
\text{Wavy haired} \quad \times \quad \text{Straight haired}
\]

P genotypes \quad \underline{} \quad \times \quad \underline{} \quad 1

(ii) State the phenotype of the F\(_1\) mice.

\[\text{F}_1\ \text{phenotype} \quad \underline{} \quad 1\]

(iii) An F\(_1\) mouse was crossed with a straight haired mouse. State the genotype of the wavy haired offspring.

\[\text{Space for working}\]

\[\text{Genotype} \quad \underline{} \quad 1\]
The difference between blue and green feather colour in budgerigars (budgies) is determined by a single gene. The allele for green (G) is dominant and the allele for blue (g) is recessive.

True-breeding blue males were allowed to breed with true-breeding green females. The offspring were allowed to interbreed to produce a second generation.

(a) Explain what is meant by the term “true-breeding”, in terms of the alleles present.

(b) Give the genotype(s) and phenotype(s) of the F₁ generation.

  genotype(s)  

  phenotype(s)  

(c) In 1974, a mutation occurred in a budgie which gave rise to one chick with a speckled pattern of wing feathers never before seen. Such birds are called “spangles”. It is now 37 years since the hatching of the first chick, and the number of spangles now living is estimated to be 80,000 in a total population of 30 million captive budgies.

  (i) In which structures in the nucleus of a cell do mutations arise?

  (ii) Give an example of a factor which can influence the rate of mutation in an organism.

  (iii) Calculate the average yearly increase of spangles. Express your answer to the nearest whole number.

  \[ \text{Space for calculation} \]
(a) The diagram below shows the two ways in which hands can be clasped together.

Left thumb on top  Right thumb on top

(i) This behaviour is thought to be influenced by a single gene with two forms. What term refers to the two forms of a single gene?

(ii) The diagram below shows whether members of a family clasp their hands with the right or left thumb on top.

\( T \) represents the left thumb form of the gene.
\( t \) represents the right thumb form of the gene.

What information from parent B proves that the left thumb on top is the dominant form of the gene?

(iii) Use the information in the diagram to complete the following table.

<table>
<thead>
<tr>
<th>Person</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>
(a) (continued)

(iv) If person D has a child with a man with the same genotype, what is the chance of their first child clasping their hands with the left thumb on top?

Space for working

(v) When 1000 people were surveyed, 625 people were found to clasp their hands with the left thumb on top.

What is the simple whole number ratio of left to right thumb people?

Space for calculation

____________________

left thumb : right thumb

(b) The following table shows the stages of a selective breeding programme to produce sheep with soft wool. The stages are not in the correct order.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The selected sheep are mated.</td>
</tr>
<tr>
<td>B</td>
<td>Lambs are born.</td>
</tr>
<tr>
<td>C</td>
<td>Sheep with soft wool are selected.</td>
</tr>
<tr>
<td>D</td>
<td>The best young female sheep are used to breed more sheep.</td>
</tr>
<tr>
<td>E</td>
<td>Sheep are checked to see which have the softest wool.</td>
</tr>
</tbody>
</table>

Put the stages into the correct order by completing the boxes below. The first and last stages have been completed for you.

<table>
<thead>
<tr>
<th>Order</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>
(a) Fruit flies show variation in wing structure which can be inherited. Flies were crossed as shown below.

\[ \text{P} \quad \xrightarrow{X} \quad \text{normal winged male} \quad \text{vestigial winged female} \]

\[ \text{F}_1 \]

All \( F_1 \) flies have normal wings. \( F_1 \) flies were self-crossed.

\[ \text{F}_2 \]

Some flies have normal wings and some have vestigial wings

(i) Using "N" for the normal form and "n" for the vestigial form, give the genotypes of each of the following:

1. Parent with normal wings
2. A fly from the \( F_1 \) generation
3. An \( F_2 \) fly with vestigial wings

(ii) Which of the following flies could be described as true-breeding? Tick (✓) the correct boxes.

- Parent with normal wings
- Parent with vestigial wings
- \( F_1 \) flies
- \( F_2 \) flies with normal wings
(b) What term is used to describe the different forms of a gene?

______________________________ 1

(c) Variation in a species can be caused by mutation.

(i) What is meant by the term “mutation”?

______________________________ 1

______________________________ 1

(ii) Give an example of a factor which can increase the rate of mutation in an organism.

______________________________ 1
Sorghum is an important food crop in some parts of the world. The colour of the seed husk (coat) is controlled by a single gene. Purple husk colour (H) is dominant to tan husk colour (h).

(a) A true breeding purple husk plant is crossed with a true breeding tan husk plant.

(i) What other term is used in genetics to indicate true breeding?

Circle the correct term below.

heterozygous  polygenic  homozygous  recessive  1

(ii) Complete the genotypes of the parental (P) generation below:

P purple X tan

P genotypes  __________  __________  1

(iii) State the phenotype(s) of the F₁ plants.

F₁ phenotype(s) ____________________________________________ 1

(b) An individual from the F₁ generation is crossed with a true breeding tan husk plant.

(i) Complete the Punnett square to show the expected results of this cross.

<table>
<thead>
<tr>
<th>Genotypes of gametes from F₁ plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genotype of gametes from tan husk plant</td>
</tr>
</tbody>
</table>

(ii) State the expected phenotype ratio for the offspring of this cross.

________ purple : _________ tan  1
6 - The need for transport

19. The diagram below shows the human alimentary canal.

Which structure contains villi?

17. The diagram below shows the human alimentary canal and its associated organs.

22. The diagram below shows the heart and circulation.

Which line in the table describes correctly the types of blood in vessels X and Y?

<table>
<thead>
<tr>
<th></th>
<th>Vessel X</th>
<th>Vessel Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>deoxygenated</td>
<td>deoxygenated</td>
</tr>
<tr>
<td>B</td>
<td>oxygenated</td>
<td>deoxygenated</td>
</tr>
<tr>
<td>C</td>
<td>oxygenated</td>
<td>oxygenated</td>
</tr>
<tr>
<td>D</td>
<td>deoxygenated</td>
<td>oxygenated</td>
</tr>
</tbody>
</table>

Which numbered parts produce digestive enzymes?
A  1, 2, 4
B  3, 4, 8
C  2, 7, 8
D  1, 3, 4
19. The diagram below shows the structure of a villus.

Which food molecules are absorbed by structure Y?
A. Amino acids
B. Fatty acids
C. Glucose
D. Glycogen

21. The diagram below shows the heart and circulation.

Which labelled structure is the pulmonary artery?

25. The diagram below shows a cross section of a human heart.

Which line in the table identifies the parts of the heart correctly?

<table>
<thead>
<tr>
<th></th>
<th>Vessel X</th>
<th>Chamber Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>aorta</td>
<td>left ventricle</td>
</tr>
<tr>
<td>B</td>
<td>vena cava</td>
<td>left ventricle</td>
</tr>
<tr>
<td>C</td>
<td>vena cava</td>
<td>right ventricle</td>
</tr>
<tr>
<td>D</td>
<td>aorta</td>
<td>right ventricle</td>
</tr>
</tbody>
</table>
22. The diagram below shows the human alimentary canal.

Peristalsis occurs in
A  P only
B  P and R only
C  P, R and S only
D  P, Q, R and S.

23. The diagram below shows the structure of the lungs.

Which letter identifies a bronchiole?
(c) The diagram below represents a structure found in the small intestine. The arrows show the direction of the flow of fluids through the structure.

(i) What is the name of this structure?

______________________

(ii) Which letter identifies the position of the fluid with the highest glucose content, after the absorption of digested food?

_____ 1

(iii) Which letter identifies the position of the fluid with the highest fat content, after the absorption of digested food?

_____ 1
(a) The diagram below represents part of a cross section through a leaf.

Identify **one** example of each of the cells described below by using letters from the diagram to complete the boxes.

Each letter may be used **once, more than once** or **not at all**.

- Transparent cells
- Cells which carry out photosynthesis
- Mesophyll cells
- Guard cells

What substance in red blood cells is responsible for the transport of oxygen?
(a) The diagram below shows some cells from the lining of a human trachea.

Name the microscopic hair-like structures labelled Y and describe their function.

Name ____________________ 1

Function ____________________________________________ 1

(b) The diagram below represents an air sac in a human lung.

(i) Explain why each of the following features, shown in the diagram, are needed for the efficient diffusion of oxygen.

1 Film of moisture ________________________________________ 1

2 Thin lining of air sac ____________________________________ 1
(b) (continued)

(ii) Describe what happens to oxygen after it enters a red blood cell.
(iii) Name the chemical formed in red blood cells at high oxygen levels in the lungs.

The diagram below shows an alveolus and a capillary in the lungs where gas exchange occurs.

![Diagram of alveolus and capillary](image)

(a) Decide if each of the following statements about gas exchange is True or False, and tick (✓) the appropriate box.

If the statement is False, write the correct word(s) in the Correction box to replace the word underlined in the statement.

<table>
<thead>
<tr>
<th>Statement</th>
<th>True</th>
<th>False</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lungs have a large surface area for efficient gas exchange.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The thin walls of alveoli slow down gas exchange.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is a lower oxygen concentration in the alveoli than in the blood.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) How is oxygen carried in the red blood cells?
The diagram below shows some structures of the human lungs.

(a) Complete the following flow chart to give the pathway of air from X to the alveoli by inserting the names of the structures labelled in the diagram.

\[
\begin{array}{c}
\text{X} \\
\downarrow \\
\text{A} \\
\downarrow \\
\text{B} \\
\downarrow \\
\text{C} \\
\downarrow \\
\text{alveoli}
\end{array}
\]

(b) (i) Name the process by which oxygen moves from the lungs into the blood.

(ii) State two features of alveoli which allow efficient gas exchange.
The following diagram shows the human heart.

(a)  

(i) Name chamber Q and valve R.

- Q
- R

(ii) Describe the function of valve P.

(iii) Add an arrow to the diagram showing where blood enters the heart from the lungs.

(b) Name the blood vessel that carries blood to the lungs.

-
(a) The diagram below shows the human digestive system.

(i) Name structures X and Y.

X ________________________________

Y ________________________________ 1

(ii) Draw lines to link each structure with the enzyme(s) that it produces. Each structure may be linked to more than one enzyme.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Enzyme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salivary glands</td>
<td>Amylase</td>
</tr>
<tr>
<td>Stomach</td>
<td>Lipase</td>
</tr>
</tbody>
</table>
| Pancreas     | Pepsin   | 2
(b) Glucose is absorbed from the small intestine into blood capillaries in the villi before being transported to the liver.

(i) State **one** feature of a villus that increases the rate of absorption of glucose.

______________________________

(iii) Excess glucose is stored in the liver. Name the storage carbohydrate found in the liver.

______________________________