

# BTec National Extended Diploma in Applied Science

## Summer Independent Learning

### Y11-12

#### **Part 1 – Compulsory content (pages 2-34)**

There are 3 sections to the compulsory content (**Biology**, **Physics** and **Chemistry**)

For each section.

1. Watch the videos and complete the notes – you may consider adding flashcards / condensed notes, so you can use them to test yourself (metacognition)
2. Complete the follow up application questions
3. Where available, correct and improve questions (mark scheme at the end of the document)

This will be assessed in your initial assessment

#### **Part 2 – Highly recommended content (pages 35-43)**

There are 3 sections to the highly recommended content (**Biology**, **Physics** and **Chemistry**)

Partial solutions (pages 43-63)

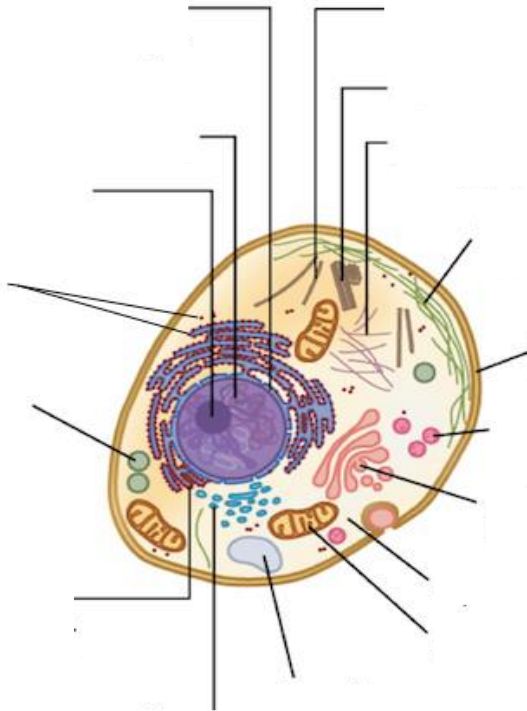
# Part 1 – Compulsory Content

## BIOLOGY

### Cells and Microscopy

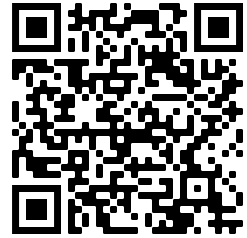
Q1. Label the cells below

#### EUKARYOTIC CELL



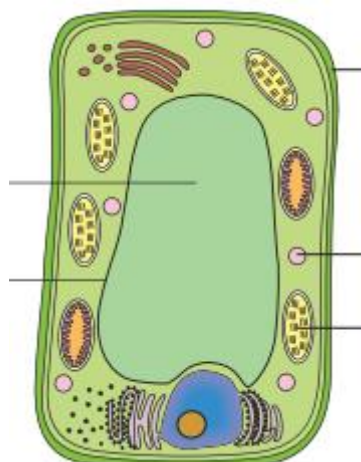
#### REVIEW

Use the resources below to support you with the questions

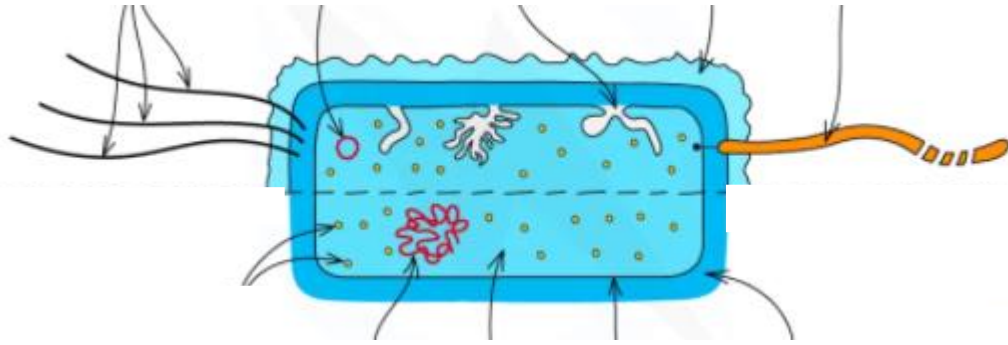


<https://www.savemyexams.co.uk/gcse-biology-aqa-new/revision-notes/>

#### PLANT CELL

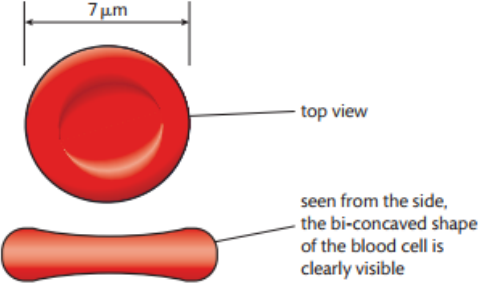
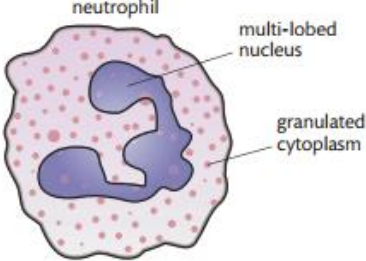


# PROKARYOTIC CELL



Q2. Fill out the table with the structures which make each specialised cell adapted to its function

Specialised Cell	Characteristics
<p><b>PLANT CELL</b></p> <p>The diagram shows a rectangular plant cell with a thick green cell wall. Inside, there is a large, clear central vacuole. The cytoplasm is filled with small green chloroplasts. A dark, oval nucleus is located near the bottom right. Labels with lines pointing to the structures include: cell membrane, cytoplasm, chloroplast, cell wall, vacuole, and nucleus.</p>	
<p><b>ROOT HAIR CELL</b></p> <p>The diagram shows a root hair cell, which is elongated and has a long, thin projection called a root hair. The cell has a thick cell wall and a large central vacuole. The cytoplasm is pushed to the periphery. A nucleus is visible at the base of the cell. Labels with lines pointing to the structures include: cell membrane, cell wall, vacuole, root hair, cytoplasm, and nucleus.</p>	
<p><b>SPERM CELLS</b></p> <p>The diagram shows a sperm cell with a distinct head, neck, and tail. The head contains a nucleus and an acrosome. The middle piece contains a mitochondrion with a spiral shape. The tail is called an undulipodium. Labels with lines pointing to the structures include: head, nucleus, mitochondrion (spiral shape), acrosome, neck, middle piece, plasma membrane, and undulipodium.</p>	
<p><b>EGG CELL</b></p> <p>The diagram shows a spherical egg cell. It has a thick outer layer called the zona pellucida, surrounded by a layer of corona radiata. Inside, there is a large nucleus and cytoplasm. Labels with lines pointing to the structures include: corona radiata, nucleus, cytoplasm, and zona pellucida.</p>	

<p><b>RED BLOOD CELL</b></p>  <p>7 <math>\mu\text{m}</math></p> <p>top view</p> <p>seen from the side, the bi-concaved shape of the blood cell is clearly visible</p>	
<p><b>WHITE BLOOD CELL</b></p>  <p>neutrophil</p> <p>multi-lobed nucleus</p> <p>granulated cytoplasm</p>	

## Microscopy

**Q3.** When a cell was viewed with a light microscope the image of the cell nucleus had a diameter of 12mm. The cell had been observed at a magnification of X 200. What was the actual size of the nucleus in  $\mu\text{m}$ ?

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**Q4.** A red blood cell has a diameter of 8  $\mu\text{m}$ . A photograph of a red blood cell was taken using an optical microscope with a magnification of X 1000. What will the diameter of the cell be on the photograph in mm?

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**Q5.** A chloroplast has a diameter of 2  $\mu\text{m}$ . The image of a chloroplast observed using an optical microscope had a diameter of 20mm. What was the magnification of the microscope used?

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**Q6.** If a measurement is given in mm how can it be converted to  $\mu\text{m}$ ?

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**Q7.** If a measurement is given in  $\mu\text{m}$  how can it be converted to mm?

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# Tissue Structure and Function

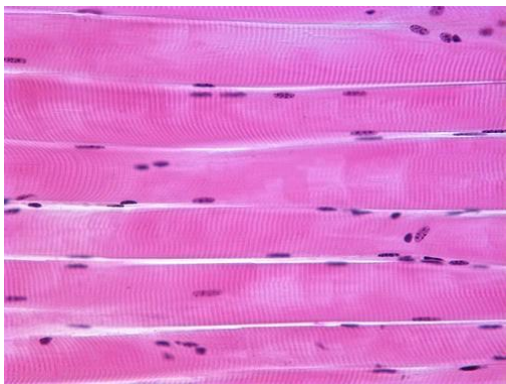
## Epithelial Tissue

Q1. Draw a diagram below of each type of epithelial tissue and label the key structures

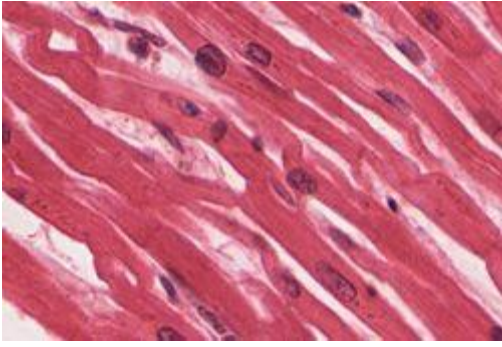
Type of epithelium	Diagram
Squamous	
Ciliated	

## Muscle Tissue

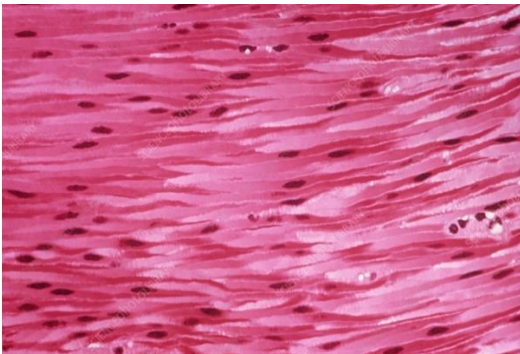
Q2. Below are the three main types of muscle tissue. Describe where each is found.

Type of Muscle Tissue	Location
<b>Skeletal</b> 	

## Cardiac



## Smooth

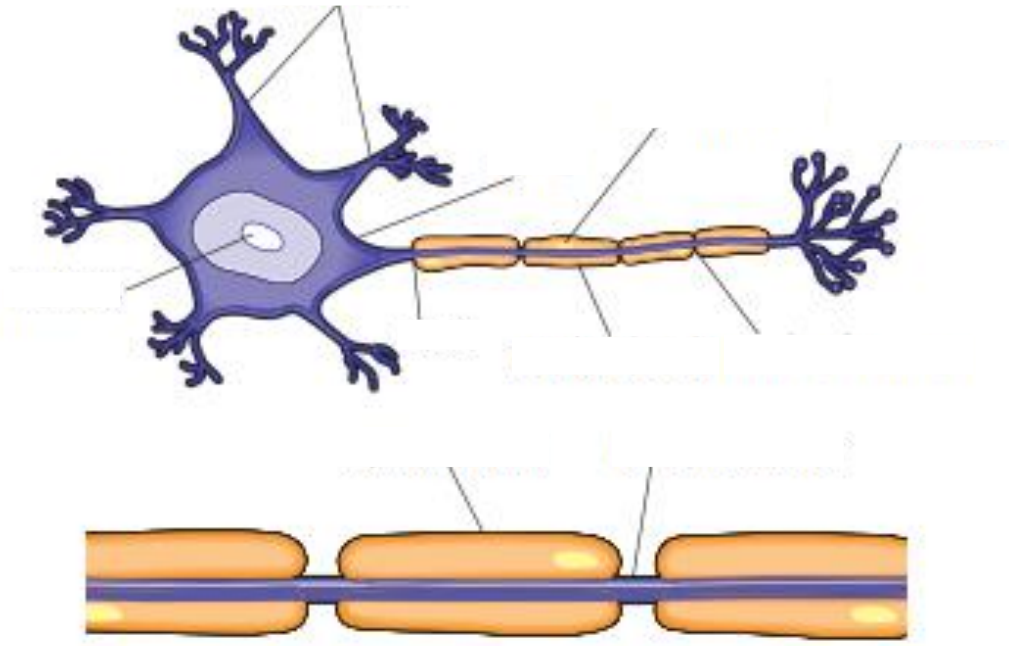


Q3. List some of the key characteristics of fast twitch and slow twitch muscle fibres

Fast Twitch	Slow Twitch

Nervous Tissue

Q4. Label the diagram of a neuron



Q5. Identify the different types of neuron shown below and describe their function

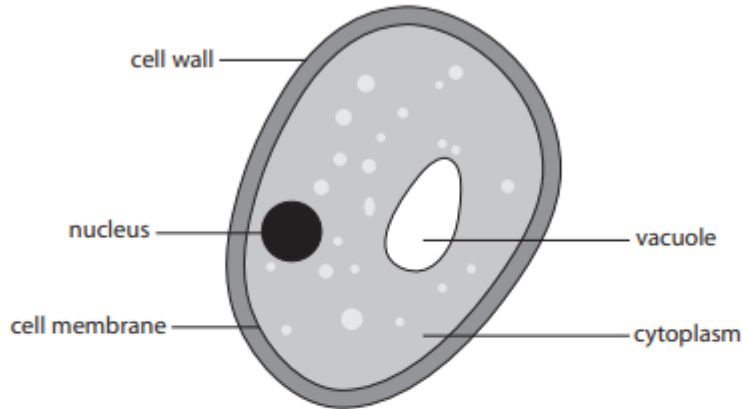
	Type of Neuron	Function
<p>A diagram of a sensory neuron. It features a cell body (soma) with a nucleus, a long axon, and a myelin sheath. The axon is labeled 'AXON', the cell body 'CELL BODY', and the myelin sheath 'MEYELIN SHEATH'. The axon terminates in a 'RECEPTOR CELL'.</p>		
<p>A diagram of a multipolar neuron. It has a central cell body (soma) with a nucleus, surrounded by cytoplasm. Several dendrites extend from the cell body. A long axon extends from the cell body. Labels include 'AXON', 'CELL BODY', and 'DENDRITE'.</p>		
<p>A diagram of a myelinated multipolar neuron. It shows a cell body (soma) with a nucleus, surrounded by cytoplasm. Several dendrites extend from the cell body. A long axon extends from the cell body, covered by a myelin sheath. The myelin sheath is composed of 'SCHWANN CELLS' and 'NODES OF RANVIER'. Labels include 'AXON', 'SCHWANN CELLS', 'NODES OF RANVIER', and 'CELL BODY'.</p>		

# APPLY

Q1.

Yeasts are microorganisms that are used in the brewing and baking industries.

The diagram shows a yeast cell.



(a) (i) State **two** ways in which the structure of this yeast cell differs from the structure of a bacterial cell.

(2)

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Q2.

Describe the functions of white blood cells.

(2)

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Person B has a low number of red blood cells compared to the healthy person.

Suggest an effect this may have on person B.

(1)

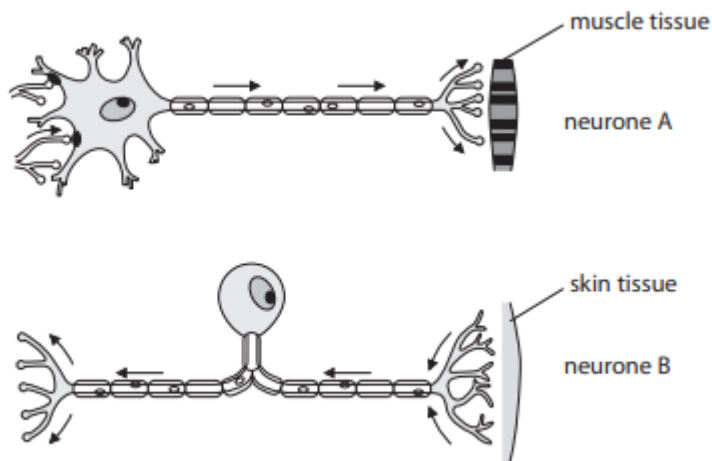
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Q3.

The diagrams show the structure of two neurones A and B.



(a) Complete the sentences by putting a cross (☒) in the box next to your answer.

(i) Neurone A is a

(1)

- A motor neurone
- B reflex neurone
- C relay neurone
- D sensory neurone

(ii) Neurone B sends information to the

(1)

- A brain and spinal cord
- B hormones which results in a response
- C muscle tissue
- D receptor cells in the skin

(b) Explain how information travels along the axon of a sensory neurone.

(2)

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(c) Describe the role of the myelin sheath.

(2)

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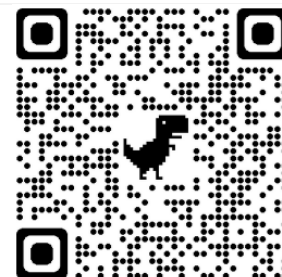
# PHYSICS –

## NOTES (recall)

Watch the following [videos](#) and complete the notes on waves:

You may also wish to refer to BBC bitesize [\(link\)](#)

You don't need to include any derivations of formulae.



### Wave basics [\(link\)](#)

1. Define a mechanical wave and provide two examples

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2. Define an electromagnetic wave and provide the names of two frequency bands

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3. Complete the sentence for the definition of waves

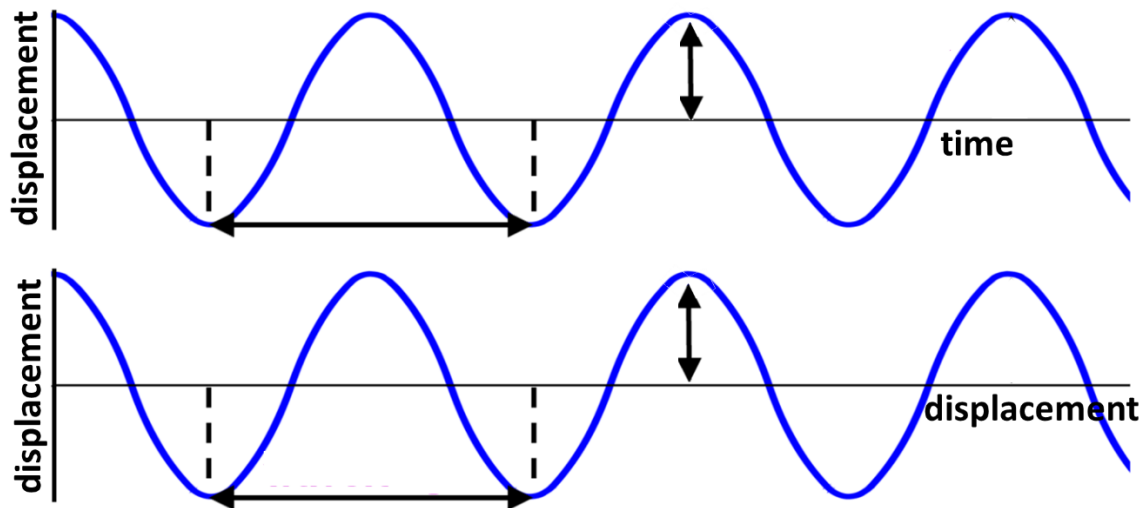
Waves transfer \_\_\_\_\_ without the transferring \_\_\_\_\_

### Wavelength, Period, Amplitude and Phase Difference [\(link\)](#)

1. a. Complete the sentence for the **transverse** waves:

The oscillations of the medium are parallel / perpendicular to the direction of energy transfer.

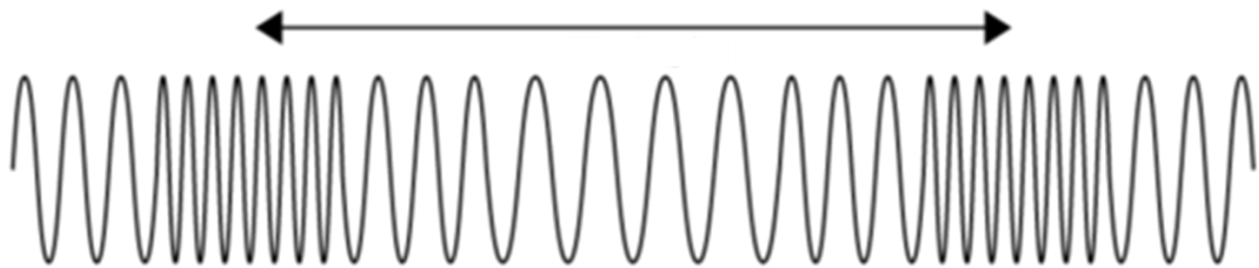
b. Add labels (wavelength, amplitude x2 and period) for the diagrams of **transverse** waves:



2. a. Complete the sentence for the **longitudinal** waves:

The oscillations of the medium are parallel / perpendicular to the direction of energy transfer.

b. Add labels (compression, rarefaction and wavelength) for the diagram of a **longitudinal** waves:



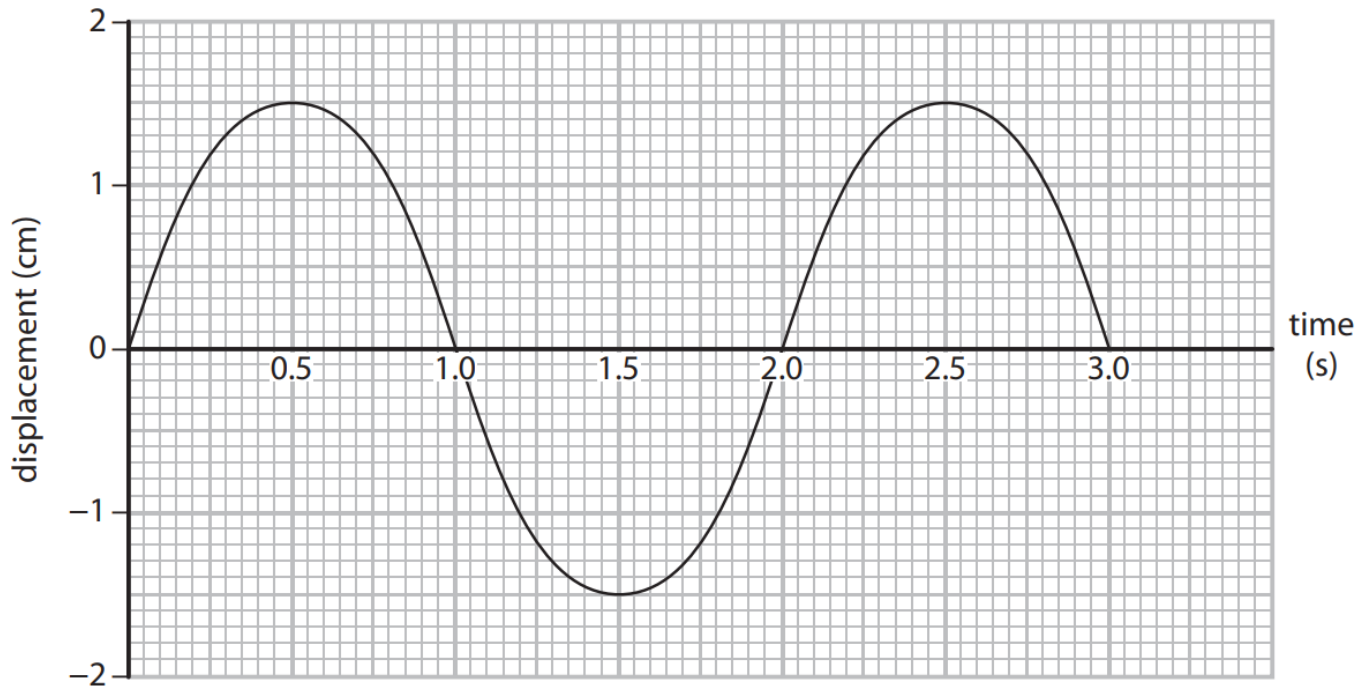
[try the simulation of a longitudinal wave <https://ophysics.com/w5.html>]

### The wave equation ([link](#))

1. State the equation linking the frequency,  $f$ , (the number of cycles per second) and the time period of a wave,  $T$  (the time taken for a complete cycle).
  
2. Provide the unit for frequency \_\_\_\_\_
  
3. State the wave equation which links the wave speed,  $v$ , the frequency of a wave,  $f$ , and the wavelength,  $\lambda$ .

PTO

## APPLY – QUESTIONS



Use the graph to answer the following questions:

1. Provide the amplitude of the wave.
2. Provide the time period of the wave.
3. Calculate the frequency of the wave.

4. Complete the missing values in the table below provided that  $f = 1/T$ :

f / Hz	T / s
	2
	5
	10
	2.8
	0.6
	36.5
	$8 \times 10^{-5}$
	0.094
	86 400

f / Hz	T / s
4	
20	
50	
7.2	
0.005	
28	
$7 \times 10^{13}$	
3200	
$6.5 \times 10^{-6}$	

5. Complete the missing values in the table below provided  $v = f \times \lambda$ :

v / m/s	f / Hz	$\lambda$ / m
	2	12
	125	20
	15	3
7		0.3
5		0.4
8		24
256	25	
330	450	
7500	350	

v / m/s	f / Hz	$\lambda$ / m
	1.2	256
	360 000	0.0004
	2.9	5.7
400		1500
$3.0 \times 10^8$		$7.5 \times 10^{-7}$
$3.8 \times 10^5$		0.25
215	525	
$3.0 \times 10^8$	$7 \times 10^{14}$	
0.036	57	

6. Provide two example calculations for the above showing your workings below.

**Q1.** (a) Which one of the following is not an electromagnetic wave?

Tick **one** box.

Gamma rays

Ultraviolet

Sound

X-rays

(b) What type of electromagnetic wave do our eyes detect?

(1)

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(c) What is a practical use for infrared waves?

(1)

Tick **one** box.

Cooking food

Medical imaging

Energy efficient lamps

Satellite communications

(1)

Scientists have detected radio waves emitted from a distant galaxy.

Some of the radio waves from the distant galaxy have a frequency of 1 200 000 000 hertz.

(d) Which is the same as 1 200 000 000 hertz?

Tick **one** box.

1.2 gigahertz

1.2 kilohertz

1.2 megahertz

1.2 millihertz

(1)

(e) Radio waves travel through space at 300 000 kilometres per second (km/s).

How is 300 000 km/s converted to metres per second (m/s)?

Tick **one** box.

$300\,000 \div 1000 = 300\text{ m/s}$

$300\,000 \times 1000 = 300\,000\,000\text{ m/s}$

$300\,000 + 1000 = 301\,000\text{ m/s}$

$300\,000 - 1000 = 299\,000\text{ m/s}$

(1)

(f) Write the equation which links frequency, wavelength and wave speed.

\_\_\_\_\_

(1)

(g) Calculate the wavelength of the radio waves emitted from the distant galaxy.

Give your answer in metres.

\_\_\_\_\_

\_\_\_\_\_

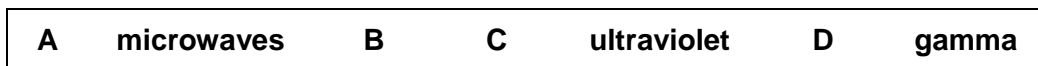
\_\_\_\_\_

wavelength = \_\_\_\_\_ m

(3)

(Total 9 marks)

**Q2.** The figure below shows an incomplete electromagnetic spectrum.



(a) What name is given to the group of waves at the position labelled **A** in the figure above?  
Tick **one** box.

infrared	<input type="checkbox"/>	visible light	<input type="checkbox"/>
radio	<input type="checkbox"/>	X-ray	<input type="checkbox"/>

(1)

(b) Electromagnetic waves have many practical uses.  
Draw **one** line from each type of electromagnetic wave to its use.

<b>Electromagnetic wave</b>	<b>Use</b>
Gamma rays	For fibre optic communications
Microwaves	For communicating with a satellite
Ultraviolet	To see security markings
	To sterilise surgical instruments

(3)

(c) Complete the sentence.  
Use an answer from the box.



X-rays can be dangerous to people because X-rays are  
\_\_\_\_\_ radiation.

(1) (Total 5 marks)

## WAVES ON A STRING UNDER TENSION

1. Wave pulses are sent along two wires subjected to the same tension. One wire is a thin nylon wire, the other is a thick rope. On which rope do you think pulses will move fastest?



The equation for the speed,  $v$ , of a wave on a string on mass per unit length,  $\mu$ , under a tension,  $T$ , is:

$$v = \sqrt{\frac{T}{\mu}}$$

2. Calculate the mass per unit length  $\mu = m/l$ , where,  $m$ , is the string mass and,  $l$ , is a given length for the two wires.

	$m/\text{kg}$	$l/\text{m}$	$\mu/\text{kg/m}$
<b>nylon wire</b>	0.00080	2.0	
<b>rope</b>	0.0040	1.0	

3. Both strings are held with a tension of 4.0 N. Calculate the wave speed of:
- Pulses on the nylon wire.

b. Pulses on the rope.

- 4 Did you answer agree with your prediction?

5. The tension is increased to 8.0 N calculate the new wave speed for.

a. Pulses on the nylon wire.

b. Pulses on the rope.

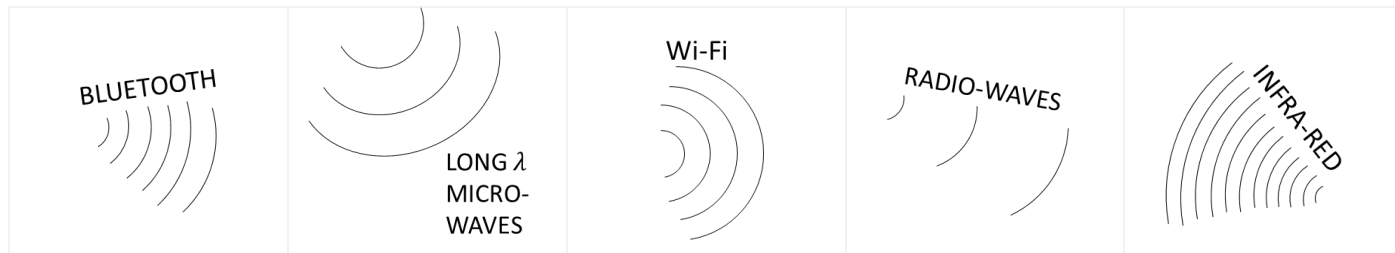
6. Describe how increasing the tension changes the speed of a wave on a string.



## WAVES IN COMMUNICATION

Electromagnetic waves enable devices to be connected and are the bedrock of modern communication. These wireless connections occur over multiple frequency bands.

Some methods of wireless information transfer are listed below



Using your existing knowledge, which of the frequency bands:

1. Communicate between a remote control and a television?

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2. Communicate between two mobile phones?

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3. Communicate between a satellite and a satellite dish?

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4. Communicate between a radio tower and an FM radio?

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5. Communicate between a wireless router and a laptop?

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6. Communicate between a mobile phone and some wireless earbuds?

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7. Has the longest wavelength?<sup>1</sup>

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8. Has the shortest wavelength?

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9. Is reflected by the ionosphere?

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<sup>1</sup> See more information



## NOTES (preview)

Watch the following [videos](#) and complete the notes on waves:



### Optical fibres

Watch the video on refraction ([link](#)) optical fibres ([link1](#), [link2](#)) and answer the following questions:

1. Link the correct term to the correct description:

<b>Refraction</b>		The spreading of a wave as it passes through a gap or a past an obstacle.
<b>Reflection</b>		The change in direction of a wave as it passes through the interface between two different materials.
<b>Diffraction</b>		The change in direction of a wavefront at an interface between two different media so that the wavefront returns into the medium from which it originated.

2. Describe total internal reflection

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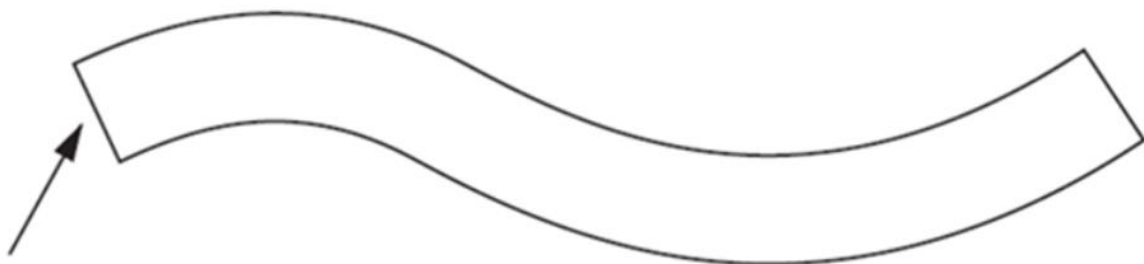
3. Describe how total internal reflection is used in optical fibres.

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4. Sketch the path of one light ray as it propagates along an optical fibre.



# CHEMISTRY

## Unit 1: Principles and Applications of Science I

Answer all the questions. There are links to websites which you may find helpful. You will be given a test on these concepts at the start of the term.

This unit covers some of the key science concepts in biology, chemistry and physics.

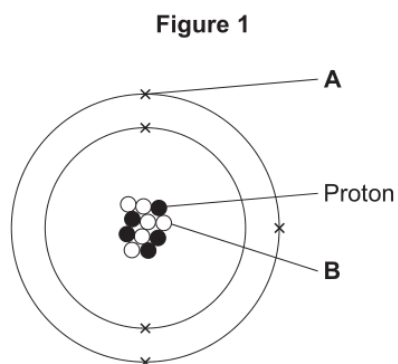
This section looks at some of the chemistry concepts you have covered at GCSE and will cover in more depth in Unit 1.

### Periodicity and properties of elements

#### □ Atomic Structure

<https://www.bbc.co.uk/bitesize/guides/zwn8b82/revision/3> (pages 3,4 and 5)  
[https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom\\_en.html](https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html)

**Q1.** Figure 1 shows an atom of element **G**.



Draw a ring around the correct answer to complete each sentence.

(a) Label **A** shows

**an electron**      **an ion**      **a nucleus**      (1)

(b) Label **B** shows

**an isotope**      **a molecule**      **a neutron**      (1)

(c) The atomic number of element **G** is

(d) The mass number of element **G** is

**5**      **6**      **10**      **11**      **16**

(1)

#### □ Periodic Table

<https://www.bbc.co.uk/bitesize/guides/ztv797h/revision/2> (pages 2-8)  
<https://www.rsc.org/periodic-table/>

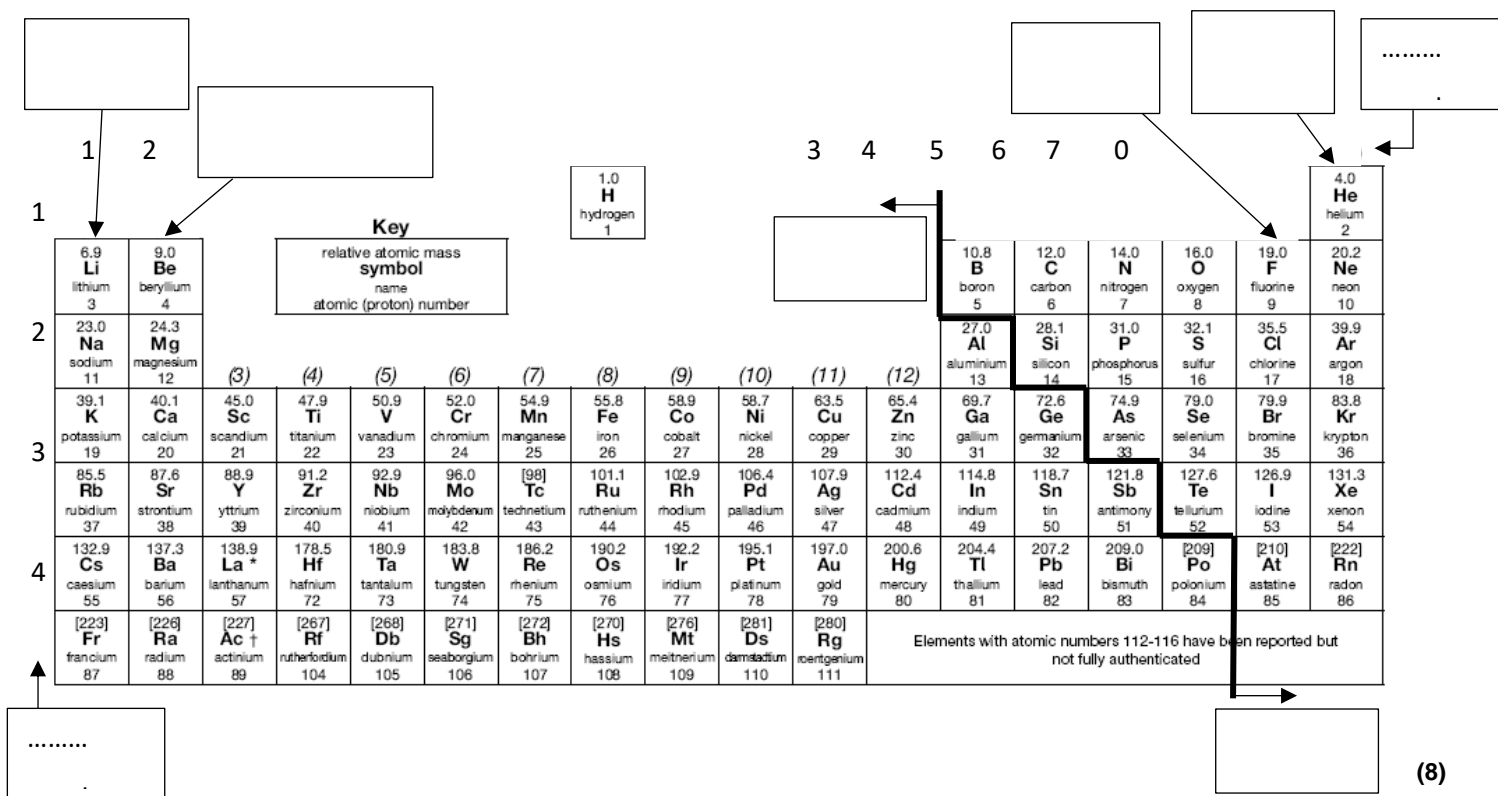
**Q2.** The Periodic table below contains **six** errors. Highlight these.

H																He	
Li	Be											B	C	N	O	Fl	Ne
Na	Mg											Al	Si	P	S	CL	Ar
K	Ca	Sc	Ti	V	Cr	Mn	fe	CO	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	pD	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg							

(6)

Q3. Complete the labels on the diagram below using the following terms:

metals                      non-metals                      group                      period  
Noble gases   Alkaline-Earth metals                      Halogens                      Alkali metals



Q4. Read the information below on element X carefully. Use this to help you answer the questions which follow.

Element X has two different isotopes, both of which contain 17 protons. The least abundant isotope contains 20 neutrons. The second isotope is three times more abundant and contains 2 more neutrons. All the atoms contain 2 electrons in the first shell, 8 electrons in the second shell and 7 electrons in the third.

(a) Where in the Periodic Table is element X found:

Group: ..... Period: .....

(2)

(b) Use the Periodic Table in Q3, the key and your answer to Q4.(a) to complete Figure 2, for element X

Key

Ar
Symbol
name

.....
.....
.....

(4)

(c) Is element X a metal or non-metal? .....

(1)

(d) Identify an element, in the same group as X, which has a lower boiling point than X.

.....

(1)

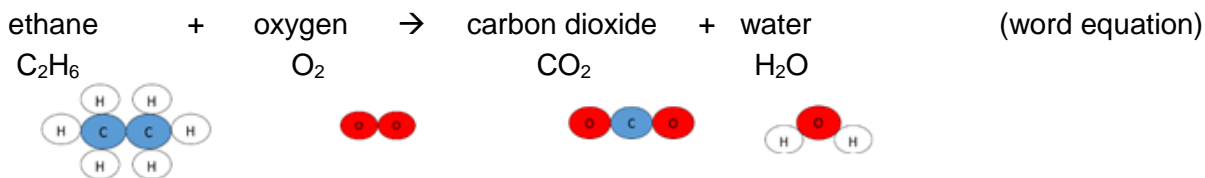
□ **Chemical reactions and equations**

<https://www.bbc.co.uk/bitesize/guides/zy4pmsg/revision/1> (pages 1-6)  
<https://www.bbc.co.uk/bitesize/guides/z2bfxf/revision/1> (pages 1,2)

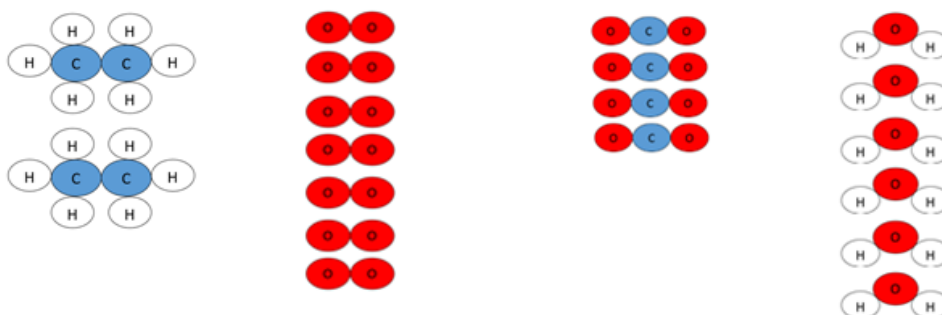
Equations are used to show chemical reactions.

Reactants are written on the left of the arrow and products are written on the right.

For example:



Atoms cannot be created or destroyed. They are simply rearranged. Therefore, the equation with formulae needs balancing. (You can only add more of the same molecules. You cannot change the formula of any.)



The relative formula mass of a molecule/compound ( $M_r$ ) can be calculated by adding the  $A_r$  of all the atoms it contains. The  $A_r$  value for all elements can be found in the Periodic Table.

$A_r$  of C is 12.0,  $A_r$  of H is 1.0 and  $A_r$  of O is 16.0

$M_r$  of  $C_2H_6$  =  $(2 \times 12.0) + (6 \times 1.0) = 30.0$

$M_r$  of  $O_2$  =  $(2 \times 16.0) = 32.0$

$M_r$  of  $CO_2$  =  $12.0 + (2 \times 16.0) = 44.0$

$M_r$  of  $H_2O$  =  $(2 \times 1.0) + 16.0 = 18.0$

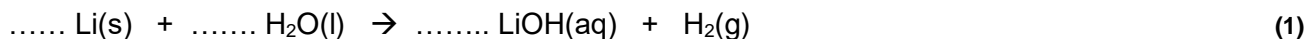
The total mass of the reactants = the total mass of the products

Mass of reactants =  $(2 \times M_r C_2H_6) + (7 \times M_r O_2) = (2 \times 30.0) + (7 \times 32.0) = 284.0$

Mass of products =  $(4 \times M_r CO_2) + (6 \times M_r H_2O) = (4 \times 44.0) + (6 \times 18.0) = 284.0$

**Q5.** Lithium reacts with water to form lithium hydroxide and hydrogen.

(a) Balance the symbol equation for this reaction



(b) (i) Complete the table below for this reaction

(8)

	Reactant or product	State	$M_r$
Lithium			
Water	reactant	liquid	18.0
Lithium hydroxide			
Hydrogen			

(ii) Calculate the total mass of the reactants. Are these the same as the total mass of the products? Show your workings.

.....

..... (2)

## □ Bonding

Chemical reactions involve the breaking and making of bonds. This involves electrons being transferred or shared between atoms.

The total number of electrons at the end of the reaction must be the same as at the start.

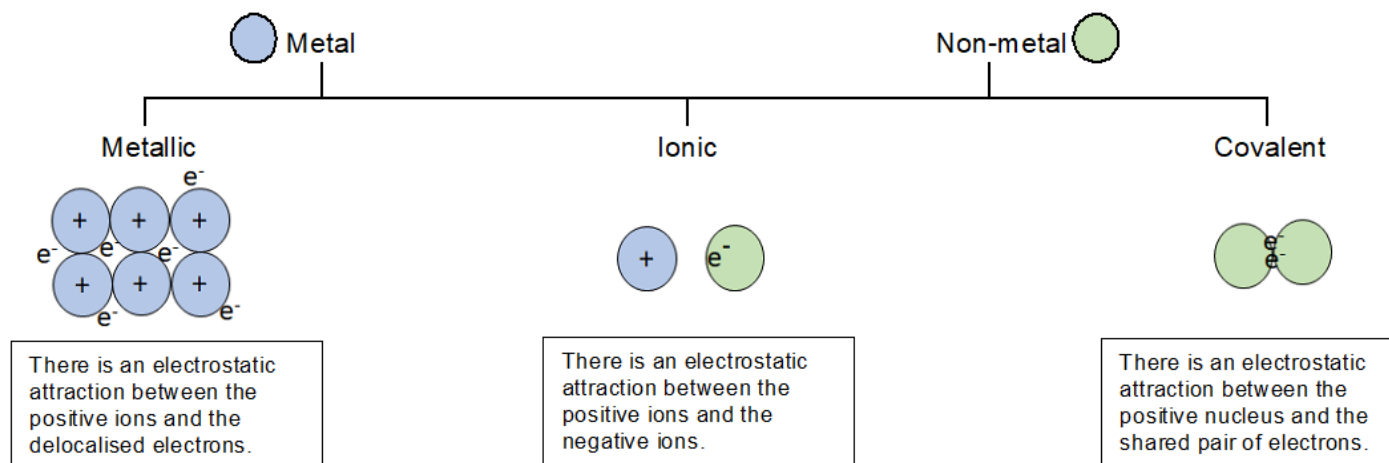
**Metal** atoms **lose** electrons and form **positively charged ions**.

**Non-metal** atoms **gain** electrons and form **negatively charged ions**

**OR** by **sharing** them (in pairs) with another non-metal atom

<https://www.bbc.co.uk/bitesize/topics/z33rwx> (ionic compounds, small molecules, metals and alloys)

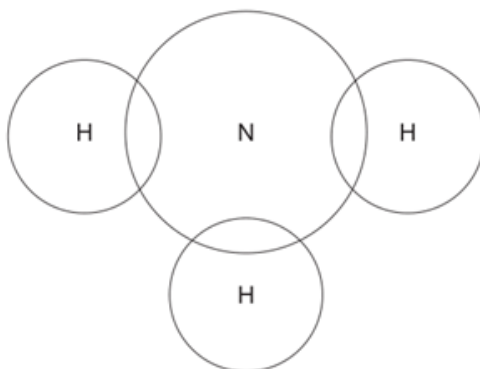
How do you know which type of bonding is present in an element or compound? Consider the type of element(s) it contains:



**Q6.** The electronic structure of a potassium atom is 2,8,8,1

Draw a diagram to show the electronic structure of a potassium ion. Show the charge on the ion.

**Q7.** Complete the dot and cross diagram to show the electrons in the outer shells of ammonia, NH<sub>3</sub>. Use the periodic table to help you.



(2)

(2)



## Unit 2: Practical Scientific Procedures and Techniques

In this unit you will be required to complete a lot of practical procedures and so it is important that you know about laboratory safety.

### □ Laboratory Safety

- Watch the video on safety in the laboratory:  
<https://www.youtube.com/watch?v=RhIOYhOvCsQ>

Use this to complete a list of safety rules to follow when completing any experiment.

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....














(8)





You will be using a number of different chemicals and apparatus when completing these experiments.

- Follow the instructions provided to complete the table below on hazard symbols
  - Match the old hazard symbol to the new symbol.
  - Match the new hazard symbol to the hazard name.  
<https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/acs-secondary-safety-guidelines.pdf> (page 22 and 23)
  - List the precautions which should be taken (in addition to wearing a labcoat and safety glasses) when handling chemicals with these hazards to minimise the chance of an accident occurring.  
<https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/acs-secondary-safety-guidelines.pdf> (pages 38-40)

Old	New	Name	Precautions
		harmful / irritant	
		oxidising agent	
		flammable	
		harmful to the environment	
		corrosive	
		toxic	
			

(19)

**Practical techniques**

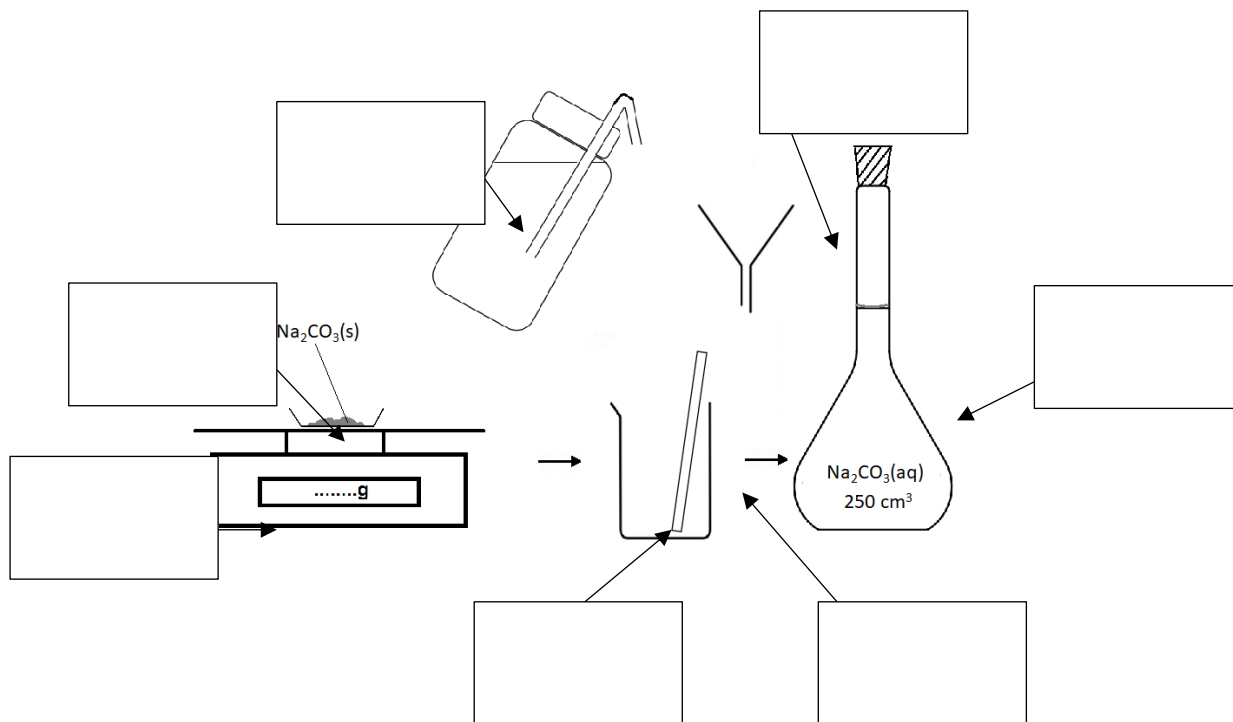
One of the practical techniques you will need to complete is the preparation of a standard solution and performing a titration to test the solution you have prepared.

- Watch these videos to help you answer the questions

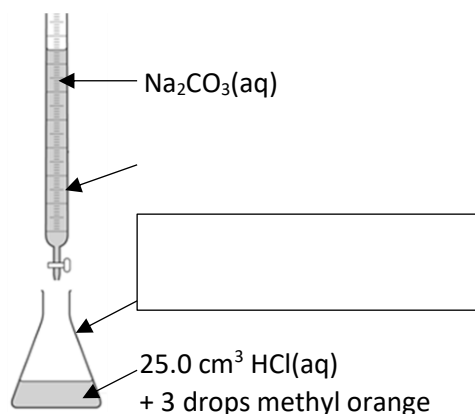
<https://www.youtube.com/watch?v=xBKyjXUhJy0>  
<https://www.youtube.com/watch?v=rLc148UCT2w>  
[https://www.youtube.com/watch?v=gzvzvDv\\_BnA](https://www.youtube.com/watch?v=gzvzvDv_BnA)

**Q1. (a)** What is a standard solution? .....(1)

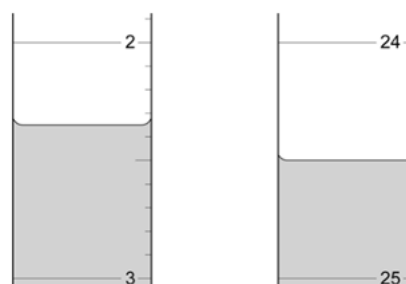
**(b)** The diagram below shows the apparatus used to make a standard solution of sodium carbonate. Complete the labels. (7)



**(c)** The standard solution prepared can be used to find the concentration of a solution of hydrochloric acid.



**Figure 2.**

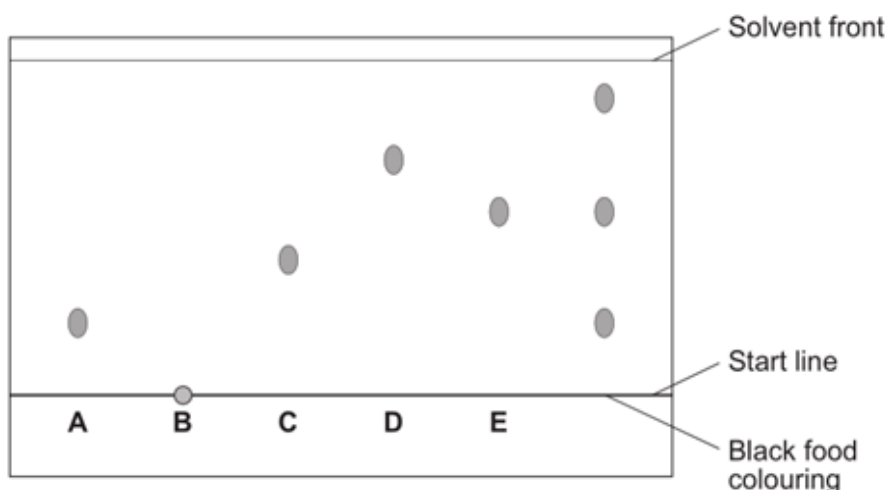


- (i)** Complete the label to show name of the apparatus in which the acid is placed. (1)
- (ii)** What is the name given to this procedure? ..... (1)
- (iii)** **Figure 2.** shows the level of the sodium carbonate solution in the burette at the start and the end of one titration. Use these to work out the volume of sodium carbonate added in the titration. Give your answer to 2 d.p:

Volume  $\text{Na}_2\text{CO}_3(\text{aq})$  added = .....  $\text{cm}^3$  (1)



Diagram 2



(i) What do the results tell you about the composition of the black food colouring?

.....  
 .....

.....(2)  
 (ii) Use **Diagram 2.** to complete **Table 1.** (2)

Table 1.

	<b>Distance in mm</b>
Distance from start line to solvent front	
Distance moved by food colour <b>C</b>	

(iii) Use your answers in (c)(ii) to calculate the  $R_f$  value for food colour **C**. Show your workings.

$R_f$  value = ..... (1)

(iv) **Table 2.** gives the results of chromatography experiments that were carried out on some known food colours, using the same solvent as the students.

Table 2.

Name of food colour	Distance from start line to solvent front in mm	Distance moved by food colour in mm	$R_f$ value
Ponceau 4R	62	59	0.95
Carmoisine	74	45	0.61
Fast red	67	27	0.40
Erythrosine	58	17	0.29

Which of the food colours in **Table 2.** could be food colour **C** from the chromatogram? Give the reason for your answer.

.....  
 .....

..... (2)

**❑ Obtaining and analysing results obtained in an experiment**

It is important to keep a record of all data whilst carrying out practical work. It is good practice to draw a table before starting the experiment and then enter results straight into the table.

Tables should have clear headings with units.

Time / min	Temperature / °C
0	27.6
1	27.4
2	27.2

The independent variable is the left-hand column in a table, with the following columns showing the dependent variables. All measurements should be written to the same number of decimal places (matching the precision of the measuring instrument).

<https://www.bbc.co.uk/bitesize/guides/zcxp6yc/revision/1>  
<https://www.bbc.co.uk/bitesize/guides/zcxp6yc/revision/6>

**Q3.** A student was told to complete a practical to investigate how temperature affects the rate of a reaction. The student carried out the reaction at five different temperatures and recorded the time taken for each.

The student then calculated the rate of reaction, in s<sup>-1</sup> for each experiment using the equation:

$$\text{rate of reaction} = \frac{1}{\text{time}} \quad \text{_____}$$

The student's results and calculations are shown below:

at 24.5 °C the experiment took 340 seconds	$1/340 = 0.0029 \text{ s}^{-1}$
at 39.0 °C it took 256 sec	$1/256 = 0.0039 \text{ s}^{-1}$
at 58.0 °C the experiment took 124 s	$1/124 = 0.0081 \text{ s}^{-1}$
80.5 °C 62 s	$1/62 = 0.0161$
51 °C 186 s	$1/186 = 0.0054$

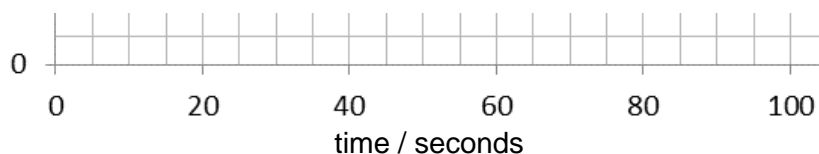
**(a)** What is the independent variable in this experiment? Circle the correct answer

**rate of reaction**                      **time**                      **temperature**                      **(1)**

**(b)** Tabulate the student's data in an appropriate manner. **(4)**

..... / .....	..... / .....	..... / .....

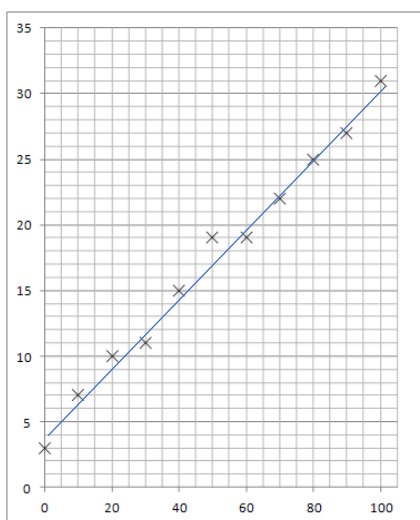
Drawing a graph of the results obtained usually makes it easier to interpret the data and draw conclusions. The independent variable is shown on the x-axis and the dependent variable is shown on the y-axis. Axes should always be labelled with the quantity being measured and the units.



Data points should be marked with a cross, x.

When choosing the scales consider:

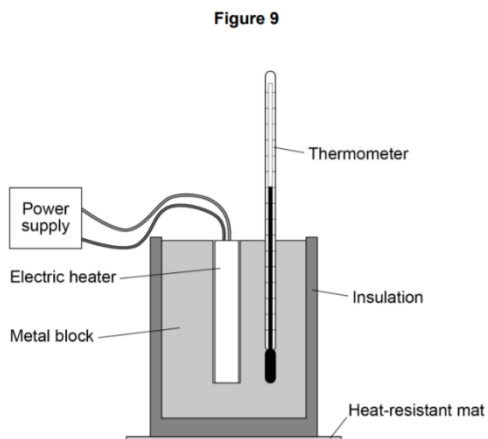
- the maximum and minimum values of each variable.
- whether 0,0 should be included as a data point.
- how to draw the axes without using difficult scale markings (e.g. multiples of 3, 7, etc)
- the data points should cover at **least half** of the grid supplied for the graph.



Consider the following when deciding where to draw a line of best fit:

- the line can be straight or curved
- the line should pass through, or very close to, the majority of plotted points (ignoring any anomalous points)
- for points not on the line make sure that there are as many points on one side of the line as the other
- the line should be continuous and drawn with a sharp pencil (use a rule for a straight line)
- the line will go through the origin (0,0) if a value of 0 for the independent variable would produce a value of 0 for the dependent variable

**Q4.** A student investigated how the temperature of a metal block changed with time.  
 An electric heater was used to increase the temperature of the block.  
 The heater was placed in a hole drilled in the block as shown in **Figure 1**.



The student measured the temperature of the metal block every 60 seconds. **Table 3.** shows the student's results.

**Table 3.**

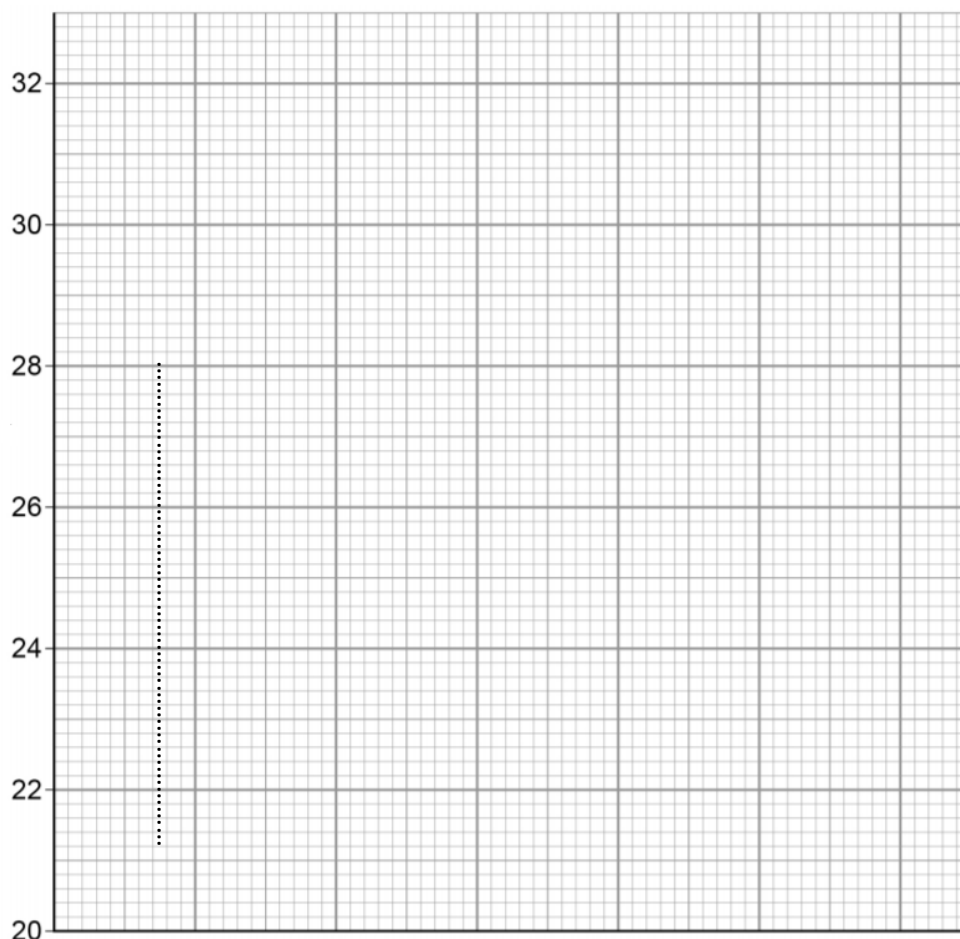
Time in s	Temperature in °C
0	20.0
60	24.5
120	29.0
180	31.0
240	31.5

**(a)** Complete the graph of the data from **Table 3.** on **Figure 2.**

- Choose a suitable scale for the x-axis.
- Label the x-axis and label the y-axis.
- Plot the student's results.
- Draw a line of best fit.

(5)

**Figure 2.**



(b) Use the graph to find the temperature of the metal block at time 100 s.

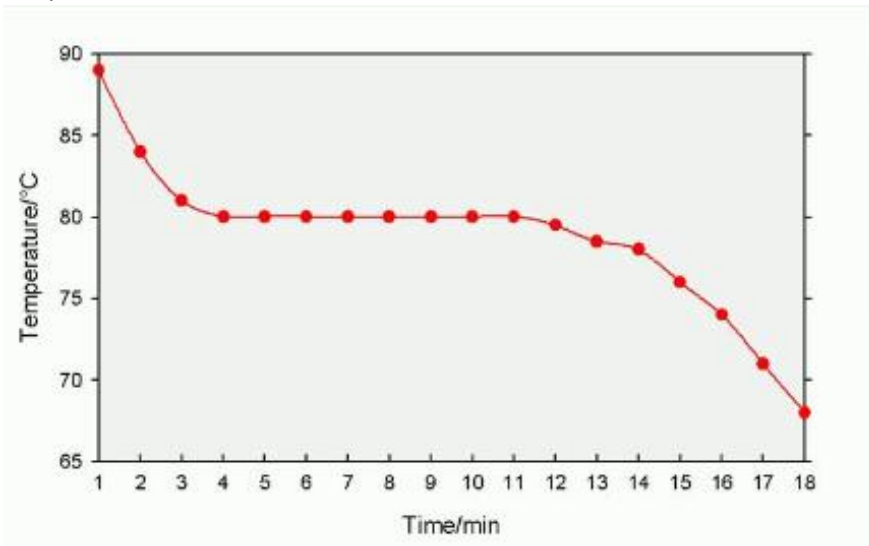
Temperature at 100s = ..... °C (1)

(c) The rate of change of temperature of the block is given by the gradient of the graph. Determine the gradient of the graph over the first 60 seconds.

.....  
 .....  
 .....  
 .....

Gradient = ..... °C / s (2)

Q5. A student measured the temperature of a substance cooling and solidifying over 18 minutes. Below is the cooling curve plotted by the student.



(a) Identify the state of the substance between 1 and 3 minutes? .....(1)

(b) Identify the state of the substance between 12 and 18 minutes? .....(1)

(c) Identify the melting point of the substance? .....°C (1)

(d) Describe in terms of particles, energy transfer and intermolecular forces, what happens to a substance during change of state from a liquid to solid.

.....  
 .....  
 .....  
 ..... (4)



## Key terminology – Command words

**Rationale:** During your assignment you will come across command words.

**Definition:** Command words are the words and phrases used in exams and other assessment tasks that tell students how they should answer the question

**Reference:-** <https://www.aqa.org.uk/resources/science/as-and-a-level/biology-7401-7402/teach/command-words#:~:text=Command%20words%20are%20the%20words,they%20should%20answer%20the%20question.>

**Task:-**

1. Complete the definitions of each word and use them in scientific sentence
2. An example has been done for you

Command Word	Definition	Use it in a sentence
Analyse	Separate information into components and identify their characteristics	Analyse the differences in the storage and communication of scientific information in different workplace laboratories.
Understand		
Draw Conclusions		
Demonstrate		
Determine		
Define		
Describe		

Prepare		
Express		
Perform		
Discuss		
Assess		
Outline		
Evaluate		
Justify		
Compare		
Eliminate		

# Part 2 – Highly recommended

## BIOLOGY –

Use the resources below to support you in answering the questions



Cell Structure and Function



Muscle Contraction



Nerve Transmission

### Cell Structure and Function

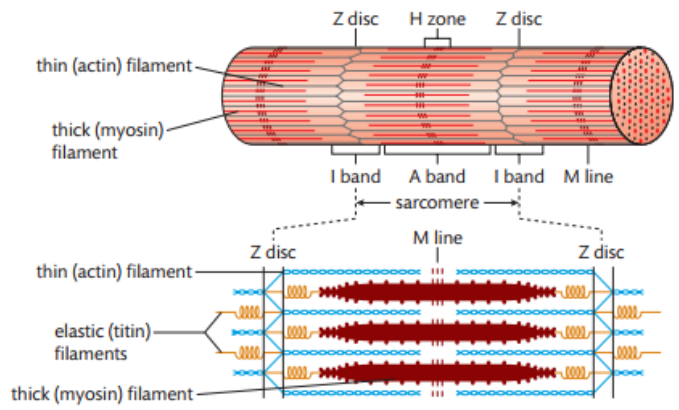
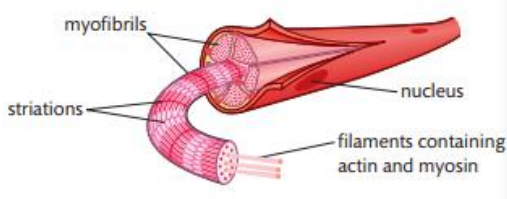
Q1. Complete the table below with the functions of each structure in the eukaryotic cell

Structure	Function
Plasma Membrane	
Cytoplasm	
Nucleus	
Nucleolus	
Rough Endoplasmic Reticulum	

Smooth Endoplasmic Reticulum	
Golgi Apparatus	
Vesicles	
Lysosomes	
Ribosomes	
Mitochondria	
Centrioles	

# Tissue Structure and Function

Q2. With the aid of the diagram below, describe the process of muscle contraction



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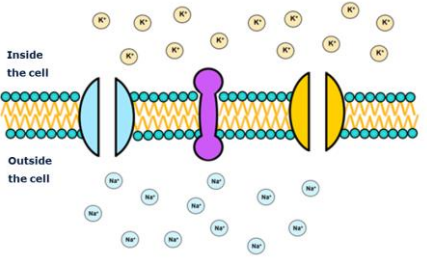
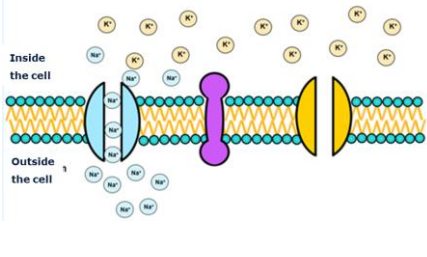
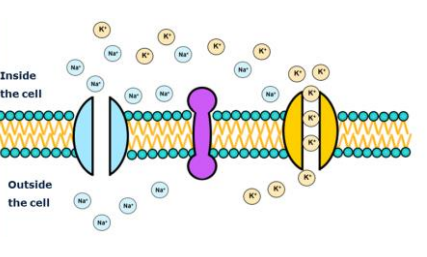
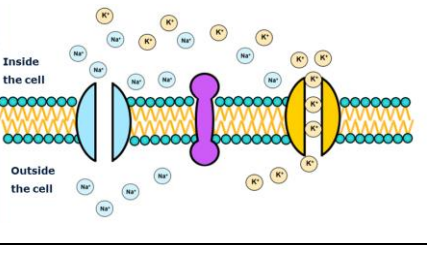
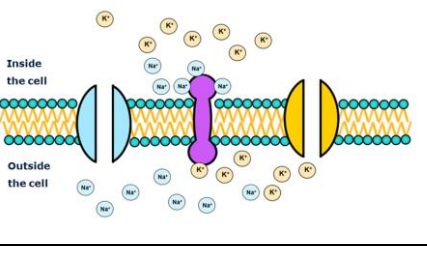
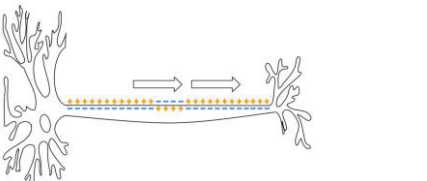
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Q3. Complete the flowchart with descriptions of each stage of nerve signal transmission

Stage		Description
Resting Potential		
Depolarisation		
Action Potential		
Repolarisation		
Hyperpolarisation		
Nerve Transmission		

# PHYSICS –

## RESEARCH (preview)

Research the use of optical fibres in medicine with endoscopes:

Use the following resources to help you:



How an endoscope works. An outline of things you can include in your description is below:

- A diagram of an endoscope
- Two uses of endoscopes in medicine or other applications
- How total internal reflection is used in endoscopy
- How the object is illuminated with the endoscope
- How the image from the object is propagates to the detector
- How bundles of fibres are used in endoscopy
- How the design of an endoscope affects the resolution of the image

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# CHEMISTRY –

Make notes from the following resources, then have a go at completing the questions

## Titration and mole calculations

<https://www.bbc.co.uk/bitesize/guides/zx98pbk/revision/3>



<https://www.youtube.com/watch?v=wPGVQu3UXpw>



<https://www.youtube.com/watch?v=ovx-Sro4NXM>



**Q1.** This question is about acids and alkalis.

(a) Dilute hydrochloric acid is a strong acid.

Explain why an acid can be described as both strong and dilute.

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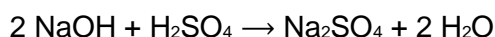
(2)

A student titrated 25.0 cm<sup>3</sup> portions of dilute sulfuric acid with a 0.105 mol/dm<sup>3</sup> sodium hydroxide solution.

(c) The table below shows the student's results.

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Volume of sodium hydroxide solution in cm <sup>3</sup>	23.50	21.10	22.10	22.15	22.15

The equation for the reaction is:





**Q2.** A student investigated the reactions of copper carbonate and copper oxide with dilute hydrochloric acid.

In both reactions one of the products is copper chloride.

(a) Describe how a sample of copper chloride crystals could be made from copper carbonate and dilute hydrochloric acid.

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(4)

(b) A student wanted to make 11.0 g of copper chloride.

The equation for the reaction is:



Relative atomic masses,  $A_r$ : H = 1; C = 12; O = 16; Cl = 35.5; Cu = 63.5

Calculate the mass of copper carbonate the student should react with dilute hydrochloric acid to make 11.0 g of copper chloride.

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Mass of copper carbonate = \_\_\_\_\_ g

(4)

(c) The percentage yield of copper chloride was 79.1 %.

Calculate the mass of copper chloride the student actually produced.

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Actual mass of copper chloride produced = \_\_\_\_\_ g

(2)