

6th Form Transition: Bridging the Gap KS4 – KS5

BTEC Applied Science

Week	Guidance / Instructions	Submitted assessed task
1	Task 1 Waves: Complete the GCSE exam questions based on waves. Task 2 Waves Continued: Read through the provided article and answer the summary questions.	Questions on Waves Questions on Waves continued
2	Task 3 Cells: Complete the GCSE questions based on cells. Task 4 Cell Structure: Research the structure of a cell using the websites provided. Label the cell diagram and fill in the table.	Questions on Cells Cell Diagram and Labels
3	Task 5 Bonding: Answer the GCSE questions on bonding to refresh your memory of GCSE Chemistry. Task 6 Molecules & Forces: Read through the relevant information and answer the questions.	Questions on Bonding Questions on Molecules and Forces
4	Task 7: Answer the questions based on chromatography Task 8: Use the websites provided to research gas chromatography and then fill in the tasks outlined.	Questions on Chromatography Tasks/worksheet on Gas Chromatography

BTEC Level 3 National Extended Certificate in Applied Science

Bridging the gap between year 11 and 12

Overview of the course:

The applied science sector

The applied science sector is diverse and wide ranging, including, for example, biomedical, forensic, physical and chemical sciences. There are approx. 5.8 million people employed in applied science occupations in the UK. This equates to approximately 20% of the workforce. The applied science sector has a crucial role to play in delivering economic growth in the UK and allowing companies to compete in a rapidly enlarging global market.

Who is this qualification for?

The Pearson BTEC Level 3 National Extended Certificate in Applied Science is intended to be an Applied General qualification for post 16 students wanting to continue their education through applied learning and who aim to progress to higher education, and ultimately to employment, possibly in the applied science sector. The qualification is equivalent in size to one A level and makes up a third of a typical study programme, normally alongside other A level or vocational qualifications at level 3.

What does the qualification cover?

The content of this qualification has been developed in consultation with academics to ensure that it supports progression to higher education. In addition, employers and professional bodies have been involved and consulted, in order to confirm that the content is also appropriate and consistent with current practice for students planning to enter employment directly in the applied science sector.

Everyone taking this qualification will study three mandatory units:

- Unit 1 Principles and Application of Science I (exam based- undertaken in Year 12)
- Unit 2 Practical Scientific Procedures and Techniques (coursework- undertaken in Year 12)
- Unit 3 Science Investigation Skills (exam based- undertaken in Year 13)

And one optional unit: Unit 8 Physiology of Biological Systems (coursework- undertaken in Year 13)

Each week you will be asked to complete a task related to content you will study in year 12. This work will build upon your knowledge learnt at GCSE, extend this knowledge into what is required in BTEC and hopefully give you an idea of what is required in the course.

The material you will be looking at will be set out like this:

Topic	Link to GCSE	Challenge
Physics	Waves questions	Article on waves and activities based on this
Biology	Cells questions	Organelle research task
Chemistry	Bonding questions	
Unit 2- Practical Scientific Procedures and Techniques (Coursework based unit)		
Chromatography	Chromatography questions	Gas chromatography research

You will be expected to hand in your Bridging work to your teacher on the first lesson, this will show the department your commitment to the programme and your suitability for the course. Please attempt each piece of work as if you were being assessed, as this gives us a clear idea as to your strengths and areas of focus.

Week One Tasks

Introduction: In the summer of year 12 you will take an exam based on content you have learnt in Unit 1- Principals and Applications of Science. The unit is split into three sections- Biology, Chemistry and Physics. Over the next three weeks you will complete tasks based on each of these sections. The first task is based on the Physics content of the unit. In this topic you will look mainly at waves- something you might remember from GCSE.

Task 1:

Complete the GCSE exam questions based on waves. This is to help refresh your memory on GCSE Physics content.

Mark: _____/21

Q1.

The diagram below shows types of waves within the electromagnetic spectrum.

Some of the types of waves are represented by letters.



(a) Which letter shows the position of ultraviolet (UV) radiation within the electromagnetic spectrum?

Tick **one** box.

P Q R S

(1)

(b) A special lamp can produce UV radiation.

Which **two** statements describe the electromagnetic waves emitted by a UV lamp?

Tick **two** boxes.

They have a higher frequency than X-rays.	<input type="checkbox"/>
They have the same wave speed as visible light.	<input type="checkbox"/>
They have a longer wavelength than microwaves.	<input type="checkbox"/>
They have a lower frequency than gamma rays.	<input type="checkbox"/>
They have a greater wave speed than radio waves.	<input type="checkbox"/>

(2)

(c) UV radiation is used to treat a vitamin D deficiency.

People should **not** use a UV lamp for long periods of time.

State **two** risks of exposure to high levels of UV radiation.

1. _____

2. _____

(2)

(d) Ionising radiation is used for some medical imaging.

Name **two** types of electromagnetic waves that are used.

1. _____

2. _____

(2)

(Total 7 marks)

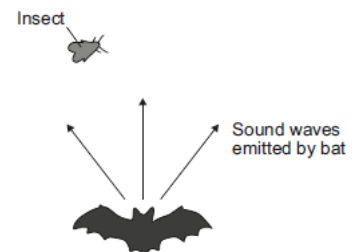
Q2.

Bats use the reflection of high pitched sound waves to determine the position of objects. The image below shows a bat and an insect flying in front of the bat.

(a) What determines the pitch of a sound wave?

Tick (✓) **one** box.

	Tick (✓)
amplitude	
frequency	
speed	



(1)

(b) State the name given to reflected sound waves.

(1)

(c) The bat emits a sound wave with a frequency of 25.0 kHz and a wavelength of 0.0136 metres.

Calculate the speed of this sound wave.

Speed = _____ m/s

(2)

(d) Sound waves are longitudinal. Describe a longitudinal sound wave.

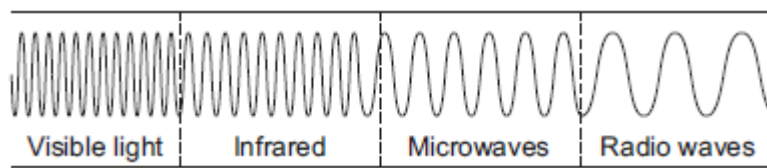
(2)

(Total 6 marks)

Q3.

Infrared and microwaves are two types of electromagnetic radiation.

The diagram below shows the positions of the two types of radiation within part of the electromagnetic spectrum.



(a) Name **one** type of electromagnetic radiation which has more energy than infrared.

(1)

(b) Use the correct answer from the box to complete each sentence.

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

greater than	less than	the same as
---------------------	------------------	--------------------

The wavelength of infrared is _____ the wavelength of microwaves.

The frequency of microwaves is _____ the frequency of infrared.

The speed of microwaves in a vacuum is _____ the speed of infrared in a vacuum.

(3)

(Total 4 marks)

Q4.

Infrared and microwaves are two types of electromagnetic radiation.

(a) State **one** example of the use of each type of radiation for communication.

Infrared: _____

Microwaves: _____

(2)

(b) Some of the properties of infrared and microwaves are the same.

State **two** of these properties.

1. _____

2. _____

(2)

(Total 4 marks)

Task 2: Read through the following article and answer the summary questions below.

Waves in Communication Article

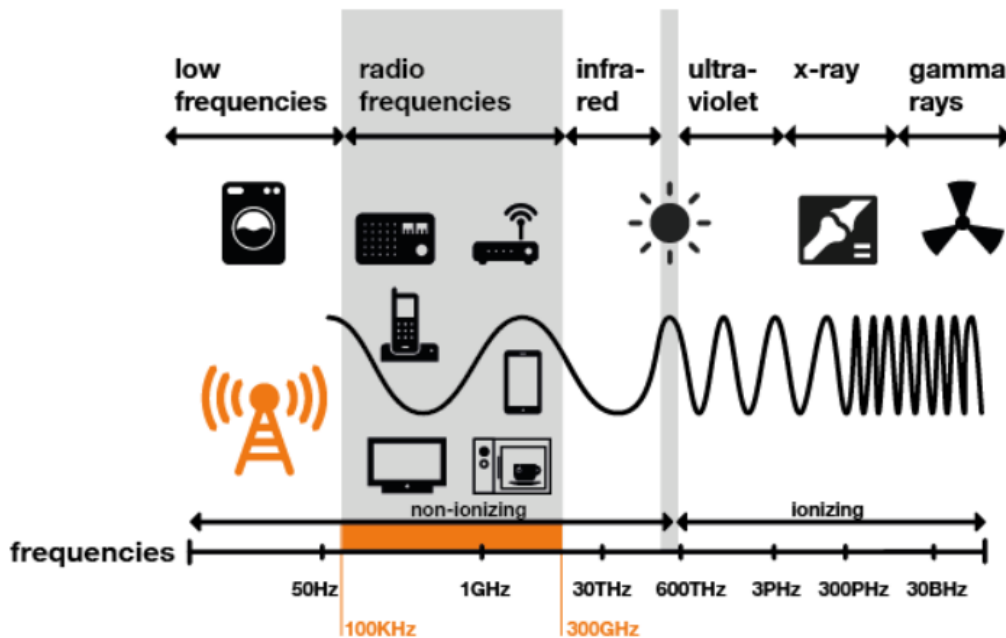
As we communicate by voice, modulating the mechanical waves emitted by our vocal cords, great physicists such as Hertz, Tesla, Branly and Marconi understood that it was possible to use electromagnetic waves to convey information through the air.

At the end of the 19th century, an understanding of electromagnetism led to the mastery of electricity, which has populated our daily lives with artificial electromagnetic field sources (or EMF). So today, at home, EMFs are present in light bulbs, microwave ovens, cordless phones, induction cookers and, of course, Wi-fi boxes and all devices connected to it.

A band apart: radio waves

While many different types of EMF are used to convey information over distance, the most common are radio waves, also called radiofrequencies. This is a wide spectrum ranging from tens of kilohertz to 300 gigahertz. Within this spectrum, frequency bands are allocated to each use. This distribution is intended to ensure an efficient service for each user and avoid interference in transmissions and communications – to avoid the interruption of police or fire brigade communications by someone’s personal walkie-talkie, for example.

It was mastery of radio waves that gave birth to the “wireless telegraphy”, then radio, television and modern forms of telecommunication: radio and TV transmitters, GSM mobile networks, etc. One limitation of radio waves is that they reflect off the atmosphere; so when communicating with satellites in space microwaves are used instead.



How do radio waves carry information?

The basic principle is simple. At one end, a transmitter “encodes” or modulates messages by varying the amplitude or frequency of the wave – a bit like Morse code. At the other, a receiver tuned to the same wavelength picks up the signal and ‘decodes’ it back to the desired form: sounds, images, data, etc.

All wireless communication systems, from the home remote control up to the satellite, are based on this principle, even though increasingly complex technologies are of course used to encode these electromagnetic signals, improve their quality, increase the amount of information or make transmissions secure.

We use radio waves in almost every aspect of our daily lives. In the morning we get the latest news from an AM or FM radio, newsfeeds on our mobiles, the television; mobiles help us pay for small purchases throughout the day such as our coffee, baguette or parking meter using NFC contactless technology, they enable us to alert the authorities in case of an emergency (police, fire brigade, ambulance); and they also enable connected objects to communicate thanks to consumer devices such as Wi-Fi, Bluetooth, LORA, DECT... and of course private and professional communication. They have become indispensable.

Questions

1. Name one electromagnetic wave with a higher frequency than radio waves.
2. What is the range of frequencies for radio waves?
3. What are the units for frequency?
4. State 3 electromagnetic waves that are used for communication.
5. Give three uses of radio waves for communication.
6. Explain why microwaves are used to communicate with satellites.
7. Convert 300kHz into Hz.
8. Convert 2.5MHz into Hz.

Week Two Tasks

Introduction: This week's tasks are based on the biology content you will learn in year 12 BTEC Applied Science. Biology is split into three categories in this Unit 1- cells, specialised cells and communication within the body. You will focus on cells or this task.

Task 3: Complete the GCSE questions based on cells. Again, this is to refresh your memory on GCSE Biology. Submit the completed task by the end of the week to Ms Valentine, who will then send out the mark scheme to these questions.

Q1.

Living organisms are made of cells.

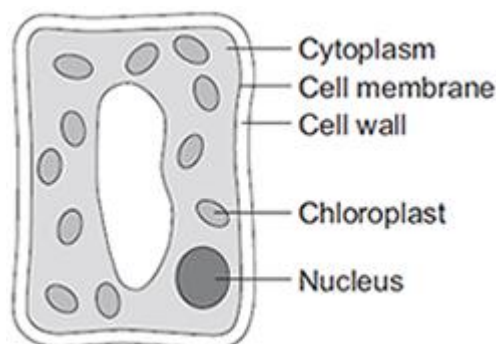
(a) Animal and plant cells have several parts. Each part has a different function.

Draw **one** line from each cell part to the correct function of that part.

Cell part	Function
Cell membrane	Where most energy is released in respiration
Mitochondria	Controls the movement of substances into and out of the cell
Nucleus	Controls the activities of the cell
	Where proteins are made

(3)

(b) The diagram below shows a cell from a plant leaf.



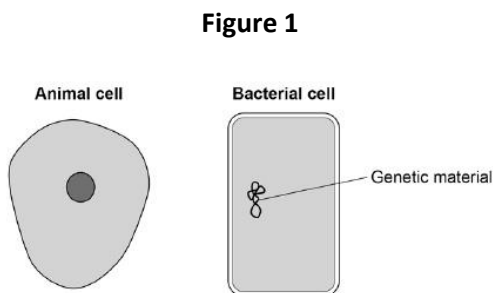
Which **two** parts in the diagram above are **not** found in an animal cell?

1. _____
2. _____

(2)

Q2.

Figure 1 shows an animal cell and a bacterial cell.



(a) Compare the structure of the cells in **Figure 1**.

Complete the sentences.

Choose the answers from the box.

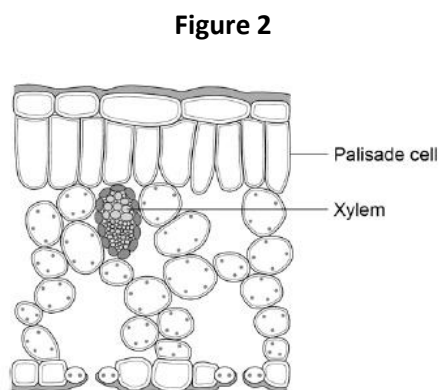
cell membrane	cell wall	chloroplast
cytoplasm		nucleus

Only the animal cell contains a _____.

Only the bacterial cell contains a _____.

(2)

Figure 2 shows a section through a leaf.



(b) The function of palisade cells is to photosynthesise.

Describe **one** way palisade cells are adapted to carry out their function.

(1)

(c) Complete **Table 1** to show whether each structure is a tissue, an organ or an organ system.

Tick **one** box for each structure.

Table 1

Structure	Tissue	Organ	Organ system
Leaf			
Xylem			
Roots, stem and leaves			

(2)

A student observed palisade cells using a microscope.

The microscope had four objective lenses, each with a different magnification.

(d) Which objective lens should the student use first?

Tick **one** box.

Give a reason for your answer.

×4 magnification	<input type="checkbox"/>
×10 magnification	<input type="checkbox"/>
×40 magnification	<input type="checkbox"/>
×100 magnification	<input type="checkbox"/>

Reason _____

(2)

The student measured the width of 5 different palisade cells at a total magnification of ×400

(e) Eyepiece lenses are usually ×5 or ×10 magnification.

What combination of eyepiece and objective lenses would give a total magnification of ×400?

Eyepiece lens _____

Objective lens _____

(1)

(f) **Table 2** shows the student's results.

Table 2

Cell	Width of cell image in mm
------	---------------------------

1	12
2	13
3	16
4	10
5	11

(f) Calculate the mean width of the palisade cell images.

Mean width = _____ mm

(1)

(g) Calculate the real width of a palisade cell.

Use the mean width you calculated in part (f).

Use the equation:

$$\text{real width} = \frac{\text{image width}}{\text{magnification}}$$

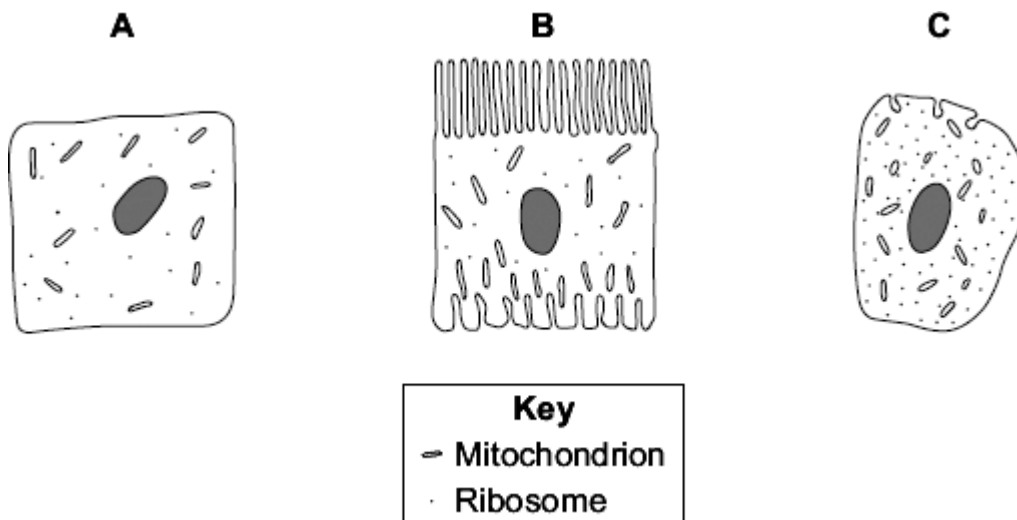
Real width = _____ mm

(2)

(Total 11 marks)

Q3.

Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



(a) Which cell, **A**, **B** or **C**, appears to have adaptations to increase diffusion into or out

of the cell?



Give **one** reason for your choice.

(1)

(b) (i) Cell **C** is found in the pancreas.

Name **one** useful substance produced by the pancreas.

(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this substance.

(2)

(Total 4 marks)

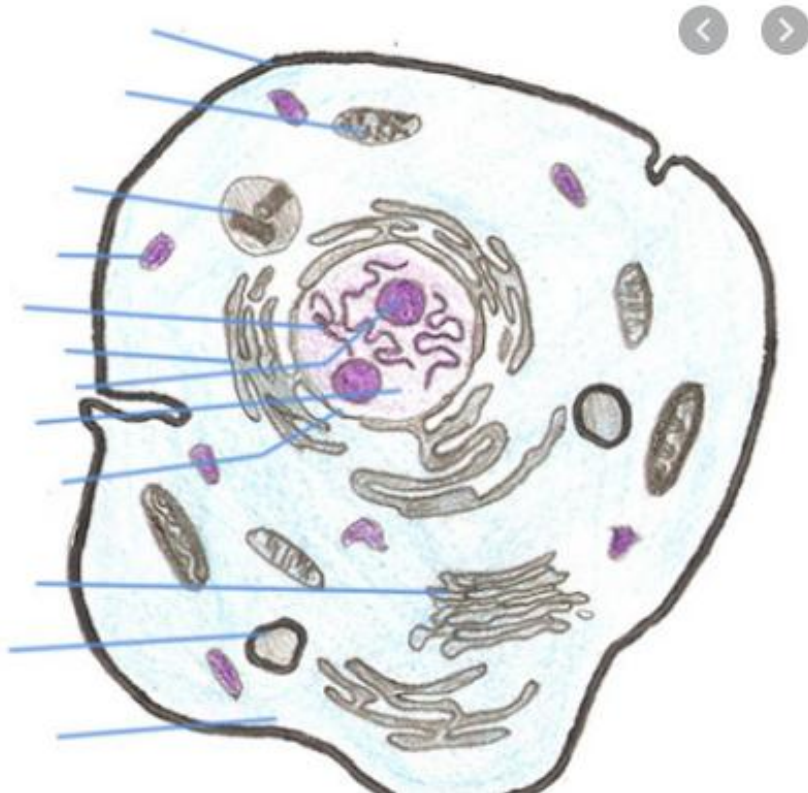
Task Four: In GCSE you will have learnt about some organelles such as mitochondria and ribosomes. In reality cells are much more complex than what you have learnt in GCSE. Your task is to research the cell using the websites below, label the cell diagram and fill in the table.

Use these websites for your research:

<https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article>

<https://alevelnotes.com/notes/biology/cells/cell-structure/organelle-structure-and-function>

Label the cell:



Fill in the table:

Organelle	What does it look like? (sketch it)	What does it do? (function)
Golgi apparatus		
Lysosome		
Smooth endoplasmic reticulum		
Rough endoplasmic reticulum		
Nucleolus		

Week Three Tasks

Introduction: Part of your exam at the end of year 12 will be on Chemistry. This course covers a wide range of topics but for this week you will focus on bonding.

Task 5: Answer the GCSE questions on bonding. This is to refresh your memory of GCSE chemistry.

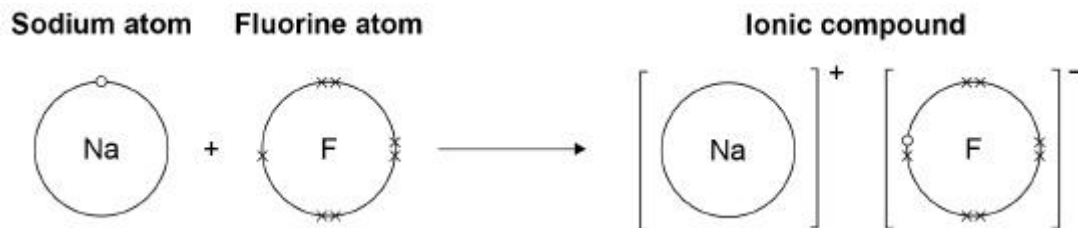
Q1.

A sodium atom and a fluorine atom react together to form an ionic compound.

Figure 1 shows the electron arrangements in the atoms and the ionic compound.

Only the outer shell electrons are shown.

Figure 1



(a) What is the name of the ionic compound shown in **Figure 1**?

Tick **one** box.

- Sodium fluorate
- Sodium fluoride
- Sodium fluorine

(1)

(b) What type of force acts between the ions in an ionic compound?

Tick **one** box.

- Electrostatic
- Frictional
- Gravitational
- Magnetic

(1)

(c) What are **two** properties of ionic compounds?

Tick **two** boxes.

- Conducts electricity when molten
- High melting point
- Low boiling point
- Small molecules
- Weak bonds between particles

(2)

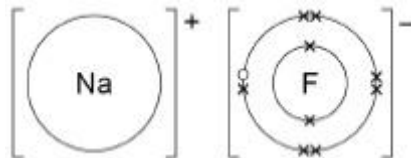
- (d) Describe what happens when a sodium atom reacts with a fluorine atom to form an ionic compound.

Use **Figure 1**.

(4)

- (e) **Figure 2** shows the structure of the ionic compound formed in the reaction.

Figure 2



Suggest **one** limitation of using **Figure 2** to show the structure of this compound.

(1)

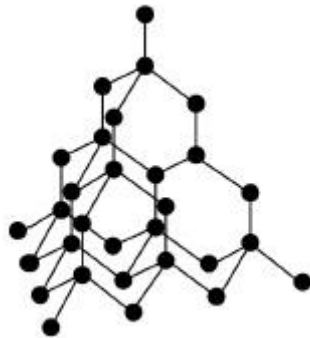
(Total 9 marks)

Q2.

This question is about diamond and graphite.

Figure 1 shows part of the structure of diamond.

Figure 1



(a) Complete the sentence.

Choose the answer from the box.

calcium	carbon	chromium	cobalt
---------	--------	----------	--------

Diamond is a form of _____.

(1)

(b) Which **two** statements about diamond are correct?

Tick **two** boxes.

Diamond has a giant structure.

Diamond has ionic bonds.

Diamond is made of layers.

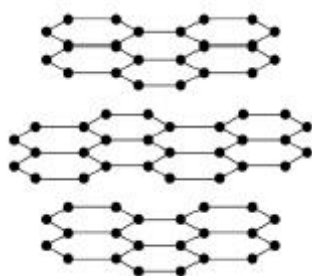
Diamond has weak bonds.

Each atom is joined to four other atoms.

(2)

Figure 2 shows part of the structure of graphite.

Figure 2



(c) Explain why graphite is soft and slippery.

Use **Figure 2** and your own knowledge.

(3)

(d) Graphite has covalent bonds between the atoms.

How many covalent bonds does each atom form?

Tick **one** box.

1 2 3 4

(1)

(e) Explain why graphite can conduct electricity.

You should include a reference to electrons in your answer.

(2)

(Total 9 marks)

Q3.

This question is about calcium.

(a) What type of compound is calcium oxide?

Tick **one** box.

An acid

- A base
- A carbonate
- A salt

(1)

(b) Ionic compounds, such as calcium oxide, have high melting points.

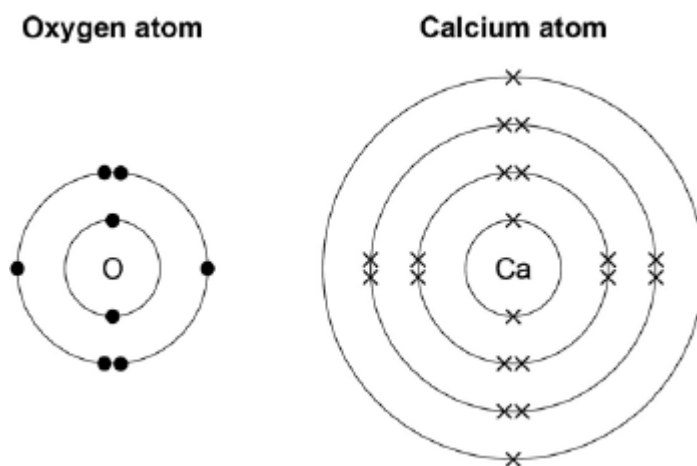
Complete the sentences. Use words from the box.

bonds forces ions layers

Calcium oxide has a giant ionic lattice in which there are strong electrostatic _____ of attraction in all directions.

(1)

(c) The figure below shows the electronic structure of an oxygen atom and a calcium atom.



Describe how the calcium atom and the oxygen atom forms calcium oxide.

You should give the charge on each ion formed.

(4)

(Total 6 marks)

Task 6: Read through the information below and answer the questions underneath

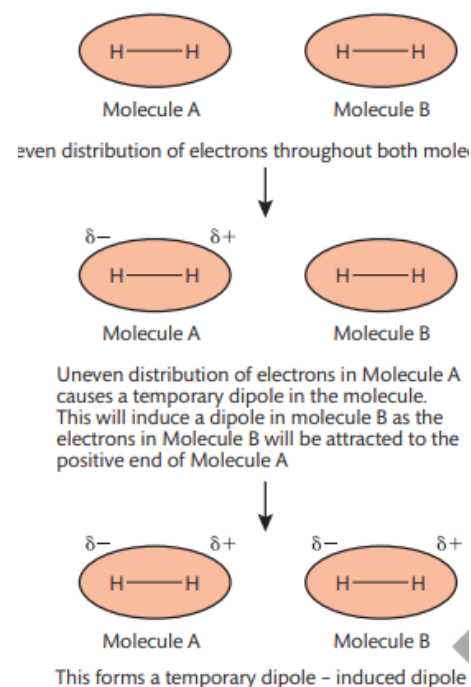
KEY WORD: Electronegativity - This is the tendency of an atom to attract a bonding pair of electrons towards itself in a covalent bond

INTERMOLECULAR FORCES:

Intermolecular forces also affect how chemical substances behave. A laboratory technician must know where these are present and understand how they will affect the behaviour and reactions of chemical substances they are working with.

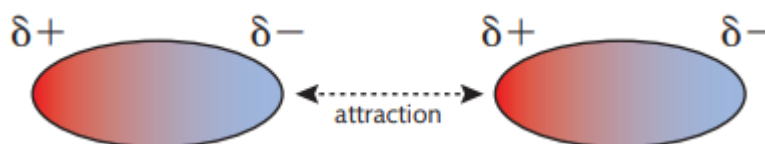
LONDON DISPERSION FORCES (VAN DER WAALS):

One type of intermolecular force is called London dispersion forces (also called temporary dipole – induced dipole forces). They are weak forces present between non-polar covalent molecules. They are less than 1% of the force of a covalent bond. When the electron distribution in a molecule becomes non-symmetrical (i.e. there are more electrons at one end of the molecule than the other) then one end of the molecule can become more positive and one end can become more negative. This causes a temporary dipole. The positive and negative charge in the dipole can disturb the electrons in a nearby molecule, repelling the electrons and so causing (inducing) a dipole in that molecule. The molecule with the temporary dipole and the molecule with the induced dipole attract each other and pull the molecules together. The forces are temporary because the electrons are constantly moving so electron density in any part of a molecule is constantly changing. Larger molecules have more electrons which can move further so more temporary dipoles can form, meaning the force is bigger.



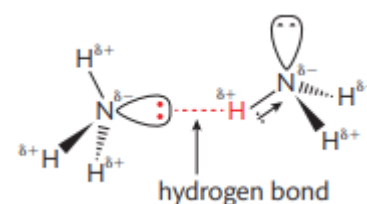
DIPOLE-DIPOLE FORCES

Another form of van der Waals forces are dipole-dipole forces. These are permanent forces between polar molecules. Polar molecules have a permanent negative end and a permanent positive end. These oppositely charged ends attract each other. Dipole-dipole forces are slightly stronger than London dispersion forces but are still weak in comparison to a covalent bond. The force is about 1% the strength of a covalent bond. Molecules that have permanent dipole-dipole forces include hydrogen chloride, HCl, and iodine monochloride, ICl. In both cases, the chlorine atom in the molecule is slightly negative. The hydrogen and iodine atoms are slightly positive.



HYDROGEN BONDING

The strongest form of intermolecular force is a hydrogen bond. These are a special type of dipole-dipole bond and are forces that are about 10% the strength of a covalent bond. Hydrogen bonds will form when compounds have hydrogen directly bonded to fluorine, oxygen or nitrogen. This is because there is a large difference in electronegativity between hydrogen and one of these three atoms. This large difference means that very polar bonds are formed so the molecules have permanent dipoles. When two of these molecules are close together, there will be an attraction between the positive end of one and the lone pair of electrons of the other. This is a hydrogen bond. This is different to other dipole-dipole forces because there are inner bonding electrons. The single electron in the hydrogen atom is drawn to



the nitrogen, oxygen or fluorine atom. There are no non-bonding electrons shielding the nucleus of the hydrogen. The hydrogen proton is strongly attracted to the lone pair of electrons on the nitrogen atom of another molecule.

QUESTIONS:

1. Draw a table showing the different types of intermolecular bonding and their properties.
2. Explain how each type of intermolecular bond affects the properties of the molecules.
3. Hydrogen bonding in water is the reason why water has such unusual properties, e.g. solid water is less dense than liquid water, it has a higher boiling point than expected, it is a good solvent for many chemical substances. **Research** how hydrogen bonding is caused in a water molecule. List properties of water due to the hydrogen bonding, Explain the properties.

Week Four Tasks

Introduction: You will also complete a coursework based unit in year 12. This unit is based into four different topics- three of which are based on practical's (Titrations, Chromatography and cooling curves). The last piece of coursework is a summary of the skills you have learnt from these three practical's. In this week you will focus on chromatography.

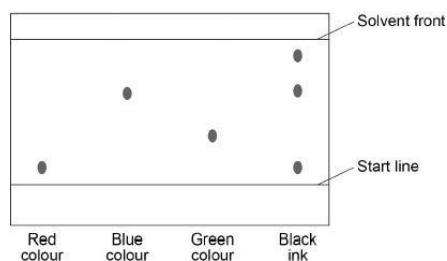
Task 7: Answer these questions based on chromatography.

Mark: _____/21

Q1.

A student used paper chromatography to identify the colours in a black ink.

The diagram below shows the student's results.



(a) What colours are in the black ink?

(2)

(b) Suggest which colour is least soluble in the solvent.

Give a reason for your answer.

Colour _____

Reason _____

(2)

(c) Use the diagram above to complete the table below.

Distance in mm

Distance moved by green colour	
Distance moved by solvent	

Calculate the R_f value for the green colour.

Use the equation:

$$R_f = \frac{\text{distance moved by green colour}}{\text{distance moved by solvent}}$$

R_f value = _____

(4)

(Total 8 marks)

Q2.

Race horses may be given drugs to improve their performance in races.

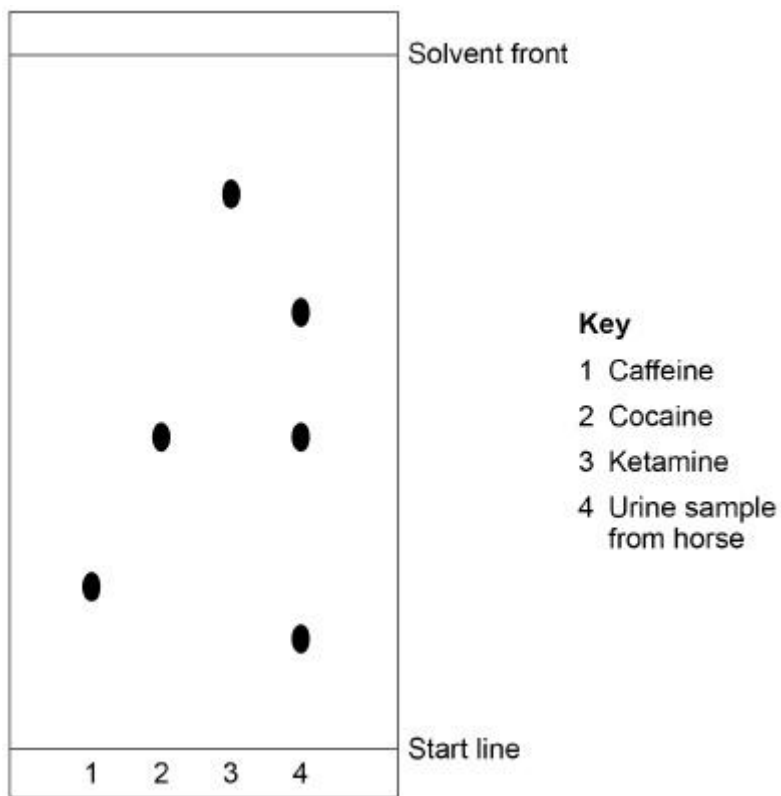
This is illegal in the UK.

After races, urine samples are collected from the horses.

These samples are tested for drugs.

Chromatography is one of the tests used to identify drugs in urine.

The diagram shows a chromatogram.



(a) How do we know that sample 1 was a **pure** sample of caffeine?

(1)

(b) Calculate the R_f value for cocaine.

Give your answer to 2 significant figures.

Use information from the diagram.

Use the equation:

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

R_f value of cocaine = _____

(4)

(c) Give **three** conclusions about the urine sample from the horse.

Use information from the diagram.

1. _____

2. _____

3. _____

(3)
(Total 8 marks)

Q3.

Read the article.

Problem food colourings

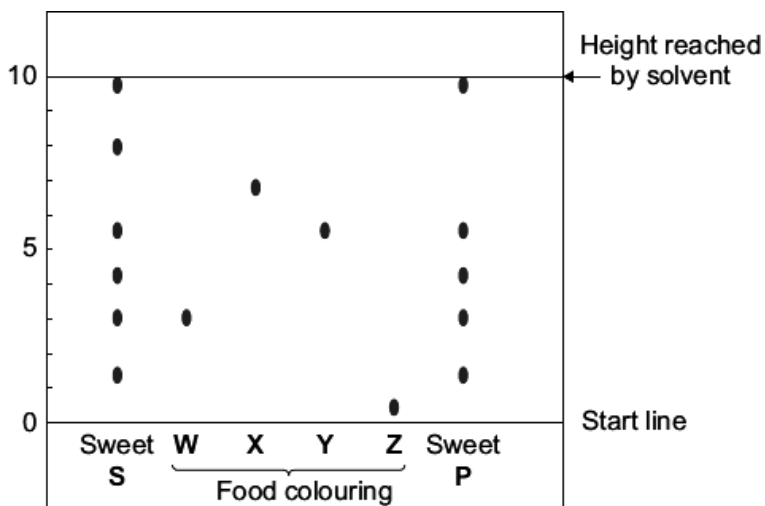
Scientists say they have evidence that some food colourings cause hyperactive behaviour in young children.

These food colourings are added to some sweets.

W, X, Y and **Z** are food colourings that may cause hyperactive behaviour in young children.

A scientist used chromatography to see if these food colourings were used in two sweets, **S** and **P**.

The results are shown on the chromatogram.



(a) Food colourings, such as **W, X, Y** and **Z**, are added to some sweets.

Suggest **one** reason why.

(1)

distance moved by the colouring

(b) In chromatography, the R_f value = distance moved by the solvent

Use the scale on the chromatogram to help you to answer this question.

Which food colouring, **W**, **X**, **Y** or **Z**, has an R_f value of 0.7?

(1)

(c) From the chromatogram, what conclusions can the scientist make about the colourings in sweets **S** and **P**?

(3)

(Total 5 marks)

Name:

Gas Chromatography

Class:

Date:

Key Terms

- Chromatography
- Gas
- Separation
- Mass
- Spectrometry
- Instrumental
- Method
- Column
- Identification
- Molecular Mass
- Small Quantities

What is chromatography?



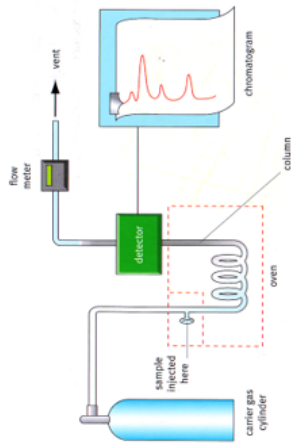
What is gas chromatography?

In gas chromatography, abbreviated as (GC), a mixture of compounds are vaporised so they are in the gaseous state. This gas is then pumped through a column, that is heated to speed up the rate at which the compounds are separated.

Gas chromatography can be used to separate compounds in a mixture. But another technique is required to help identify the compounds.

Order the steps of gas chromatography

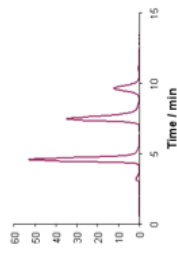
Order	Description of step
1	Sample injected into heating column where it turns to gas
2	The detector records the arrival of each chemical from the column.
3	The substance is carried by the carrier gas through the tube
4	The carrier gas carries the sample through the stationary phase (the liquid)
5	Each arrival registers as a peak of the chromatogram.



I can:

- Recall the purpose of chromatography.
- Compare the similarities and differences between paper and gas chromatography.
- Explain how mass spectrometry can be used with gas chromatography to identify compounds.
- Evaluate the advantages and disadvantages of instrumental techniques.

a) How many compounds are present in this gas chromatograph?



b) which compound is the most abundant? How do you know?