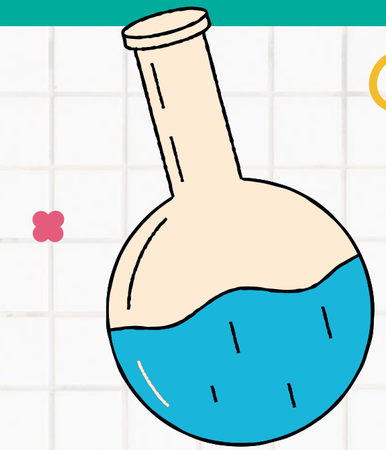
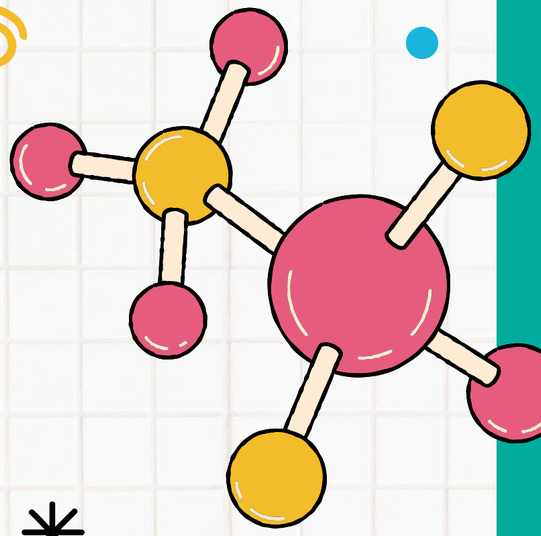
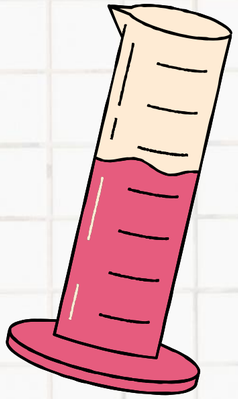
SECONDARY THREE G3 AND G2 SCIENCE COMBINATION

01

G3 SCIENCE









What are the options?

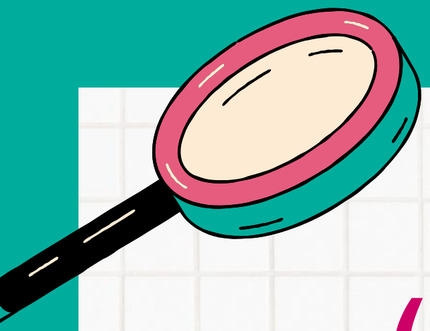
G3 Pure Sciences (Chemistry + 1 more Science)	
Subject	**Subject Code**
Chemistry	K324
Physics	K323
Biology	K325

Chemistry is the **compulsory subject** for students taking G3 Science at Upper Secondary.

What are the options?

G3 Combined Sciences [Science(Chemistry) + 1 more Science]	
Subject	**Subject Code**
Sci(Physics/Chemistry)	K326
Sci(Chemistry/Biology)	K327

Sci(Chemistry) is the **compulsory subject** for students taking G3 Science at Upper Secondary.



What are differences?

(1) Assessment Objectives

Pure Sciences	Combined Sciences
❖ **Knowledge with Understanding**, approximately 45% of the marks with approximately 15% allocated to recall. ❖ **Handling Information and Solving Problems**, approximately 55% of the marks.	❖ **Knowledge with Understanding**, approximately 50% of the marks with approximately 20% allocated to recall. ❖ **Handling Information and Solving Problems**, approximately 50% of the marks.

What are differences?
(1) Assessment Objectives

Pure Sciences	Combined Sciences
Higher % of questions will be of **higher order thinking** which require students to analyse given information and data before they can answer the questions.	Questions and the answers required are of **a less demanding level**.

What are differences?

(2) Assessment Format

Pure Sciences			
Paper	**Type of Paper**	**Duration**	**Marks (Weighting)**
1	Multiple Choice	1 hour	40 (30%)
2	Structured and Free Response	1 hr 45 min	80 (50%)
3	Practical	1 hr 50 min	40 (20%)

What are differences?
(2) Assessment Format

Combined Sciences			
Paper	**Type of Paper**	**Duration**	**Marks (Weighting)**
1	Multiple Choice	1 hour	40 (20%)
2	Structured and Free Response (Physics)	1 hr 15 min	65 (32.5%)
3	Structured and Free Response (Chemistry)	1 hr 15 min	65 (32.5%)
4	Structured and Free Response (Biology)	1 hr 15 min	65 (32.5%)
5	Practical Test	1 hr 50 min	40 (15%)

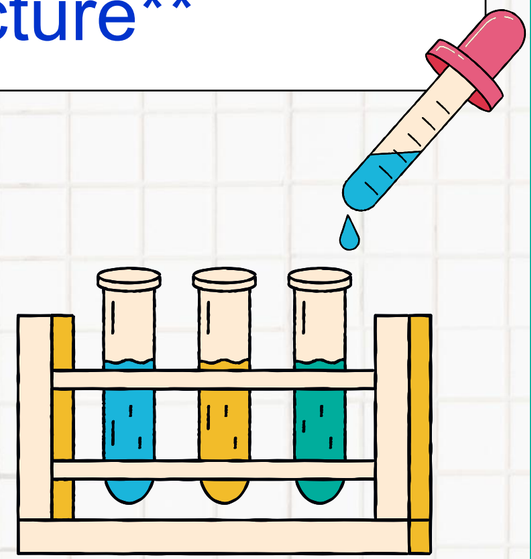
Depending on your subject combination, you will take **either** Paper 2 (for Physics) or Paper 4 (for Biology).

Content Structure for Chemistry and Sci(Chemistry)

Theme	Topics
Matter – Structures and Properties	1. Experimental Chemistry 2. The Particulate Nature of Matter** 3. Chemical Bonding and Structure**

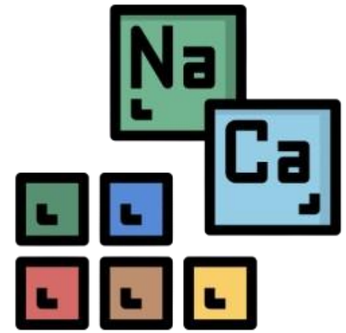
✳

** There will be **more learning outcomes** to be covered in these topics for Pure Chemistry.



Content Structure for Chemistry and Sci(Chemistry)

Theme	Topics
Chemical Reactions	4. Chemical Calculations 5. Acid – Base Chemistry** 6. Qualitative Analysis 7. Redox Chemistry 8. Patterns in the Periodic Table** 9. Chemical Energetics** 10. Rate of Reactions
Chemistry in a Sustainable World	11. Organic Chemistry** 12. Maintaining Air Quality**



Sample Questions for Pure Chemistry

Instrumental techniques in analysis

Flame tests for Group 1 elements

Flame tests were used in the 1850s. Robert Bunsen developed the Bunsen burner and used it to show that many metals give characteristic colours when they are heated in the flame. The colour comes from light emitted by individual atoms when they become very hot. For example, sodium gives a very intense yellow-orange colour. The table shows the flame colours of Group 1 elements.

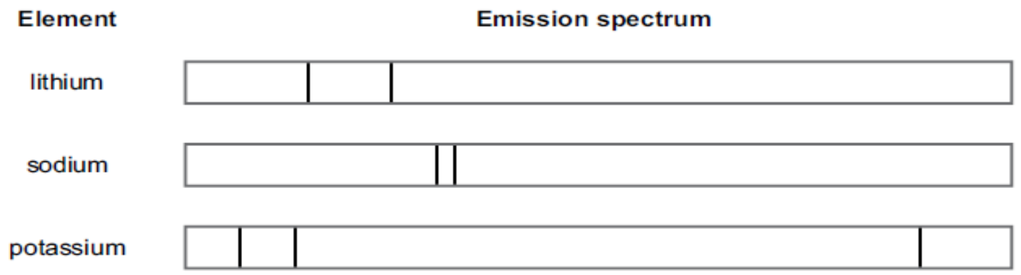
Table 8.1

element	flame colour
lithium	red
sodium	yellow-orange
potassium	pale violet
rubidium	red-violet
caesium	blue-violet

Group 1 element emission spectra

Bunsen realised that, in practice, it was difficult to use flame tests to identify elements in mixtures. In the 1860s, Bunsen worked with fellow scientist, Gustav Kirchhoff. They used a spectroscope to split the colours of the flames into individual lines. They found that atoms of an element each give a characteristic pattern of lines which is known as an emission spectrum. Fig. 8.1 shows the emission spectra of some Group 1 elements.

Emission spectra from elements can be used as a reference. They can be compared with the emission spectrum of a mixture so that individual elements in the mixture can be identified. This technique is used today to analyse light from stars to work out which elements are present in the star.



(b) This is the emission spectrum from a mixture.

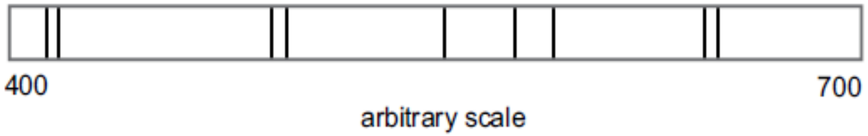


Fig. 8.4

(i) What conclusions can you make about which Group 1 elements this mixture does and does not contain?

Explain your reasoning.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) What additional information would you need so that you could use the spectrum to identify **all** of the elements in the mixture?

.....

..... [1]

Sample Questions for Sci(Chemistry)

Chlorine and iodine are in Group 17 of the Periodic Table.

(a) Name one **other** element in Group 17.

..... [1]

(b) Aqueous chlorine is an oxidising agent.

Chlorine gas is bubbled into aqueous potassium iodide.

(i) Construct the ionic equation for the reaction of chlorine gas with aqueous iodide ions.

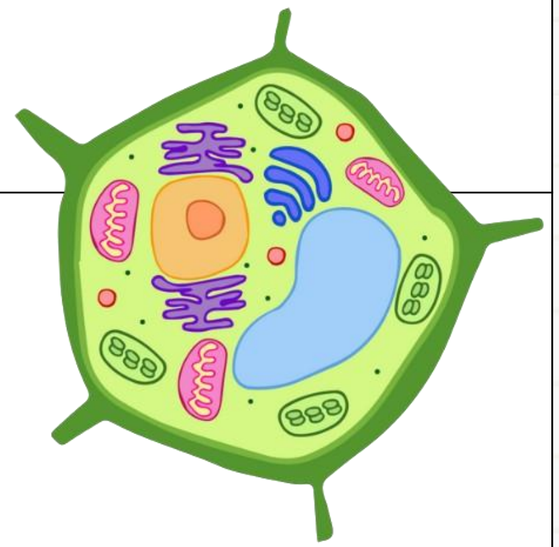
..... [1]

(ii) Describe the colour change that happens during the reaction.

..... [1]

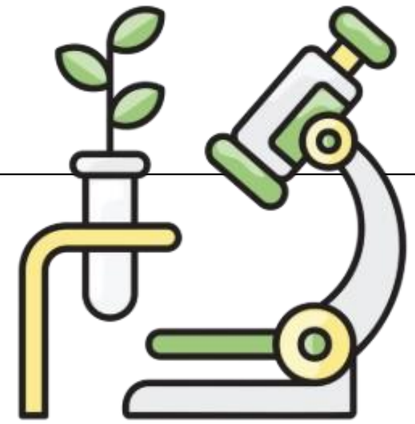
Content Structure for Biology and Sci(Biology)

Theme	Topics
Cells and The Chemistry of Life	1. Cell structure and Organisation 2. Movement of Substances 3. Biological Molecules
The Human Body – Maintaining Life	4. Nutrition in Humans 5. Transport in Humans 6. Respiration in Humans 7. Excretion in Humans** 8. Homeostasis, Co-ordination and Response in Humans** 9. Infectious Diseases in Humans



Content Structure for Biology and Sci(Biology)

Theme	Topics
Living Together – Plants, Animals and Ecosystems	10. Nutrition and Transport in Flowering Plants 11. Organisation and their Environment
Continuity of Life	12. Molecular Genetics 13. Reproduction** 14. Inheritance



Sample Questions for Pure Biology

Pneumococcal disease is caused by a bacterium called *Streptococcus pneumoniae*.

(a) Describe **two** features of a bacterial cell that are different from an animal cell.

1 .....

2 ..... [2]

(b) Fig. 9.1 shows the annual hospitalisation rate for pneumococcal disease by age group in Singapore between 1998 and 2004.

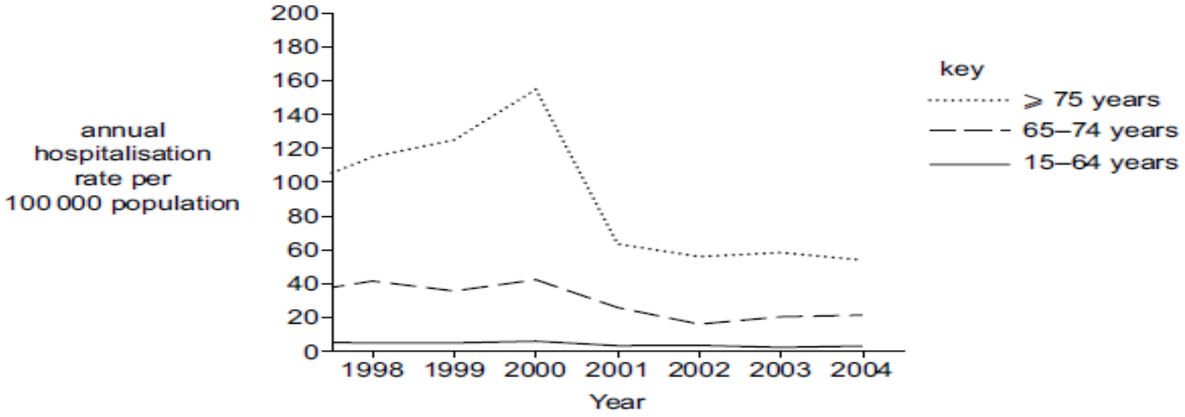


Fig. 9.1

Using Fig. 9.1, describe the differences in the hospitalisation rate for people aged 75 and above with people aged 15 to 74.

Suggest a reason for the differences.

.....

.....

.....

.....

.....

..... [3]

(c) Vaccines and antibiotics are used in different ways to reduce the number of deaths from pneumococcal disease.

Explain the different ways in which vaccines and antibiotics are used.

.....

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..... [5]

Sample Questions for Sci(Biology)

Fig. 3.1 shows the number of cases of pneumococcal disease in children in a country between 1998 and 2008.

A vaccine was introduced in the year 2000.

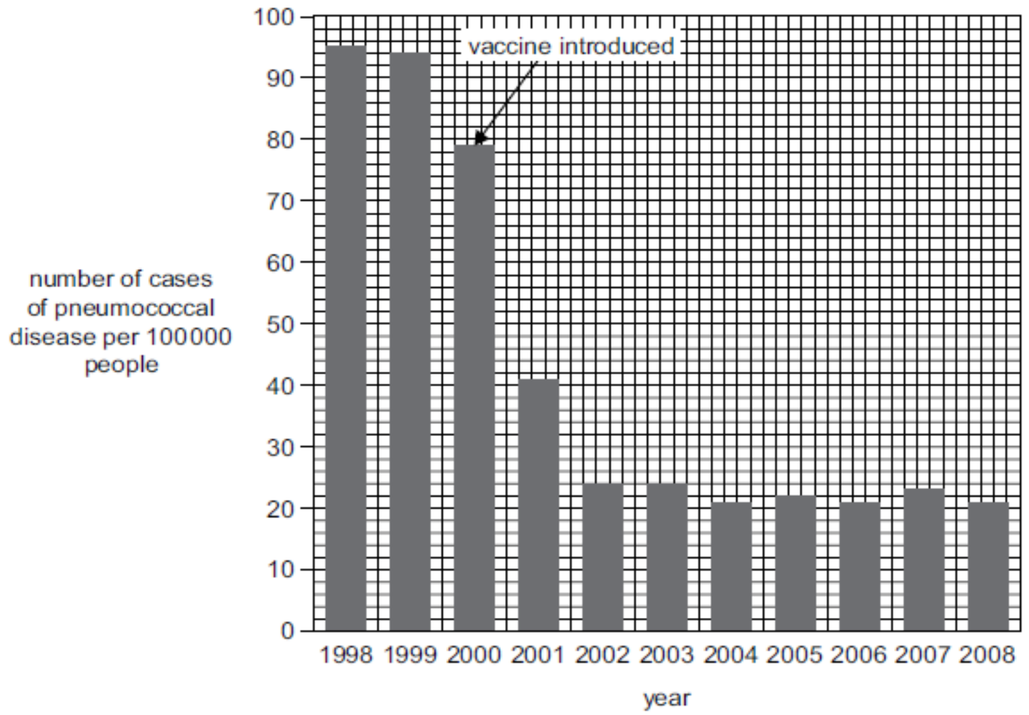


Fig. 3.1

(a) (i) Calculate the percentage decrease in cases between 2000 and 2008.

.....% [2]

(ii) Explain how the introduction of vaccines caused a percentage decrease in cases in **(a)(i)**.

.....

.....

.....

.....

..... [3]

(b) State the type of organism that causes pneumococcal disease.

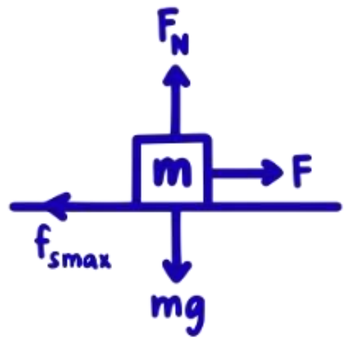
..... [1]

(c) Suggest why there are still cases of pneumococcal disease even after the introduction of the vaccine.

..... [1]

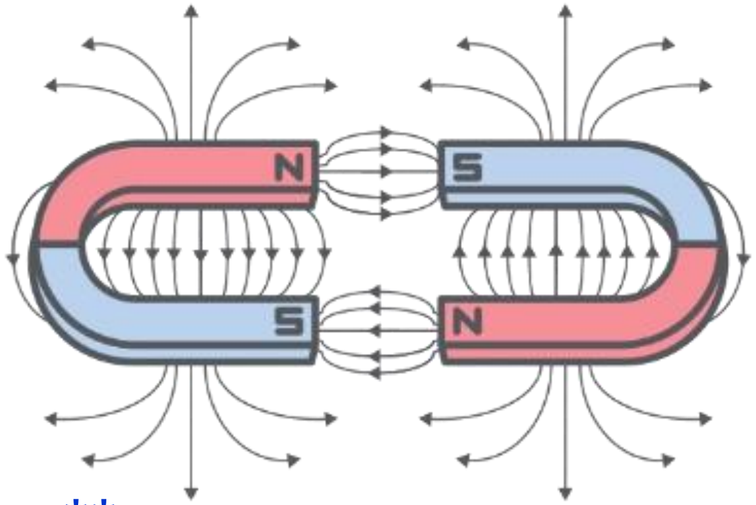
Content Structure for Physics and Sci(Physics)

Theme	Topics
Measurement	1. Physical Quantities, Units and Measurement
Newtonian Mechanics	2. Kinematics 3. Dynamics 4. Turning Effect of Forces 5. Pressure 6. Energy
Thermal Physics	7. Kinetic Particle Model of Matter 8. Thermal Processes 9. Thermal Properties of Matter**



Content Structure for Physics and Sci(Physics)

Theme	Topics
Waves	10. General Properties of Waves 11. Electromagnetic Spectrum 12. Light
Electricity and Magnetism	13. Static Electricity** 14. Current of Electricity 15. D.C. Circuits 16. Practical Electricity 17. Magnetism 18. Electromagnetism 19. Electromagnetic Induction**
Radioactivity	20. Radioactivity



Sample Questions for Pure Physics

Fig. 9.1 shows a multi-mode optical fibre made from glass of uniform refractive index.

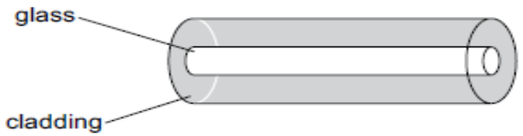


Fig. 9.1

Fig. 9.2 shows three rays of light entering the fibre from the air. Each of these rays follows one of the three possible paths through the fibre.

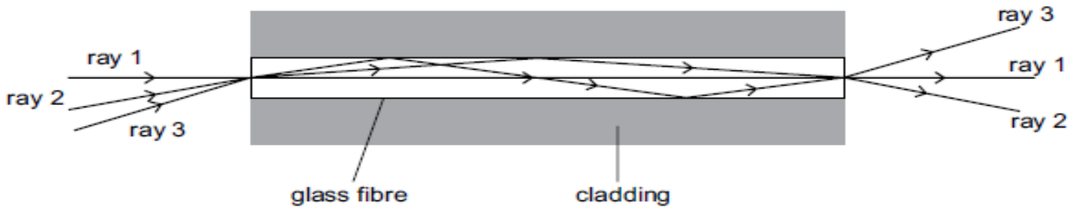


Fig. 9.2 (not to scale)

The three rays travel different distances and take different times to pass through the fibre. Fig. 9.3 gives information about the three rays and their paths in a 1 km and a 2 km cable.

	angle of incidence on entry / °	angle of refraction on entry / °	distance covered in 1 km cable / m	time spent in 1 km cable / μs	distance covered in 2 km cable / m	time spent in 2 km cable / μs
ray 1	0	0	1000	5.0	2000	10.0
ray 2	20	13	1027	5.1	2054	10.3
ray 3	35	*X*	1082	5.4	2164	10.8

Fig. 9.3

(a) Using data for ray 1 from Fig. 9.3, calculate the refractive index of the glass.

The speed of light in air is 3.0×10^8 m / s.

refractive index = ... [2]

(c) At time $t = 0$, a single pulse of light enters an optical fibre of length 2 km. The pulse lasts 0.1 μs. Fig. 9.4 shows the pulses of light that leave the fibre.

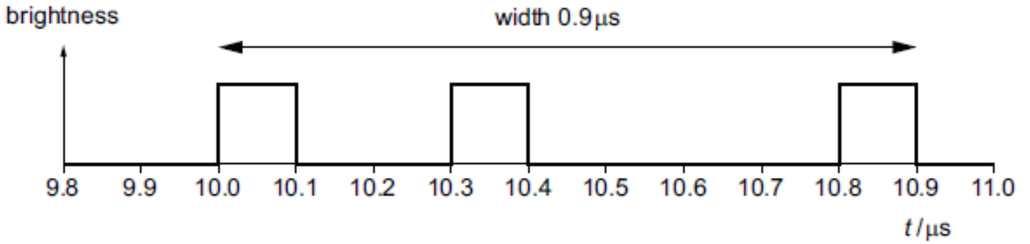


Fig. 9.4

(i) Using data from Fig. 9.3, explain Fig. 9.4.

.....

.....

..... [1]

(ii) At $t = 0$, a single pulse of light enters an optical fibre of length 1 km. This pulse also lasts 0.1 μs.

On Fig. 9.5, draw the pulses of light that leave the fibre.

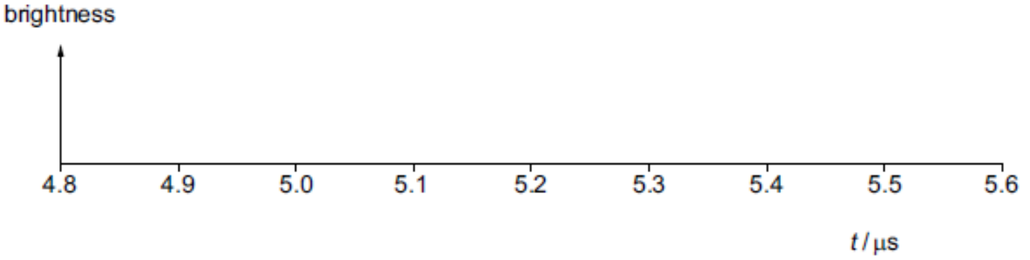


Fig. 9.5

[2]

Sample Questions for Sci(Physics)

A thin converging lens is used to project an image of an object onto a screen.

When the distance between the object and the lens (object distance) is changed, the distance between the image and the lens (image distance) also changes.

Fig. 5.1 shows how the image distance varies with the object distance for the lens.

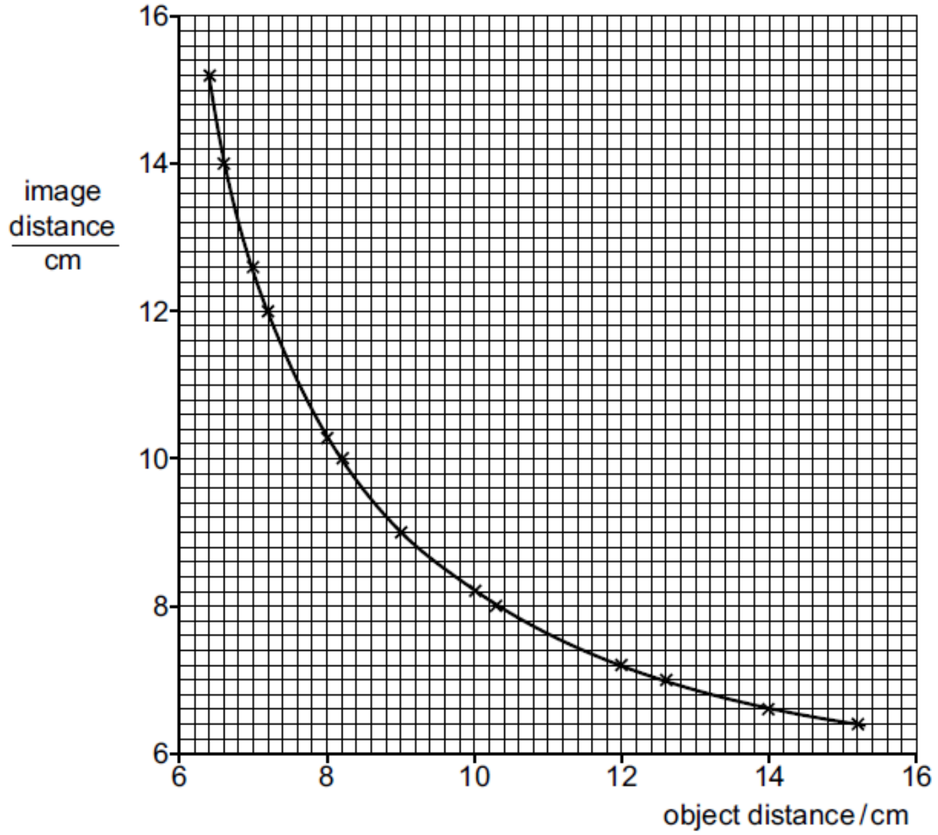


Fig. 5.1

(a) Determine the object distance for which the image distance is equal to the object distance.

object distance = ... cm [1]

(b) If the object distance is greater than the image distance, the image formed is diminished. If the object distance is less than the image distance, the imaged formed is magnified.

State **two** characteristics of the image formed when the object distance is 11.0 cm.

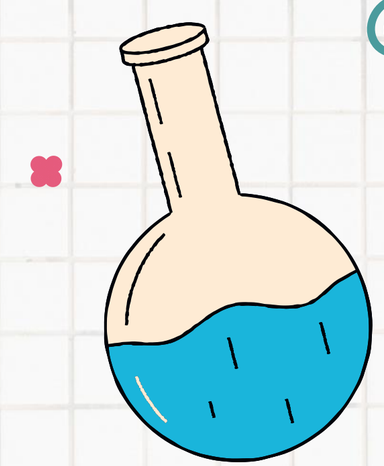
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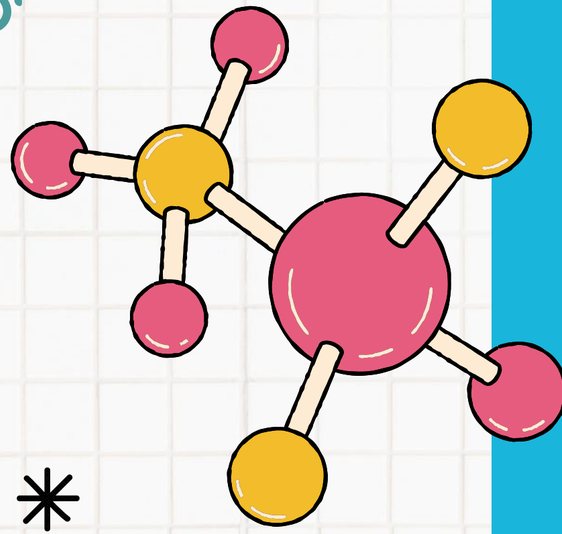
..... [2]

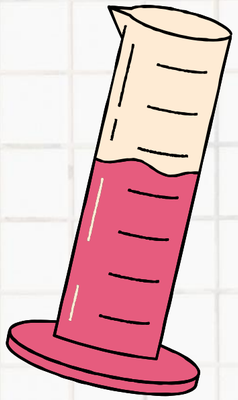
[Total: 3]

02

G2 SCIENCE







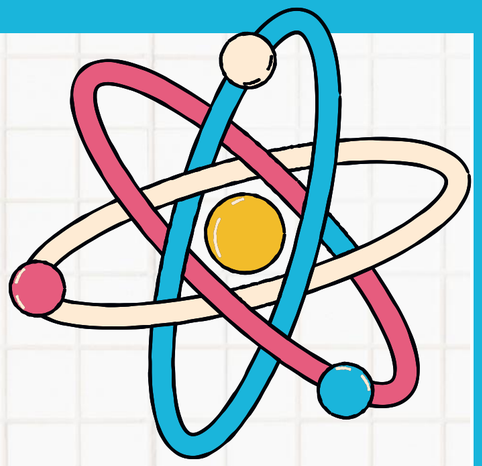


What are the options?

G2 Combined Sciences [Sci(Chemistry) + 1 more Science]	
Subject	**Subject Code**
Sci(Physics/Chemistry)	K223
Sci(Chemistry/Biology)	K225

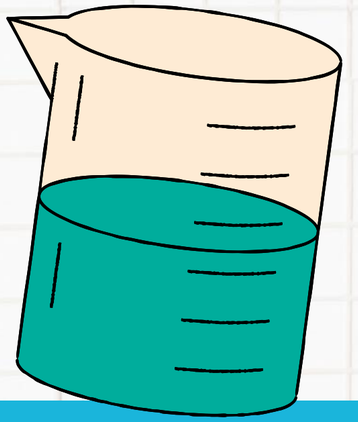
Sci(Chemistry) is the **compulsory subject** for students taking G3 Science at Upper Secondary.

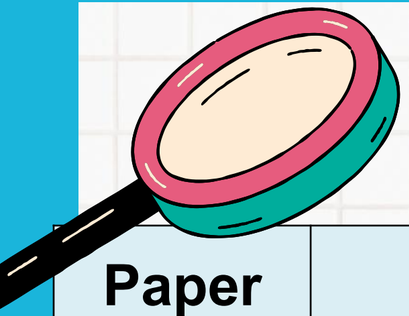
(1) Assessment Objectives



G2 Combined Sciences

- **Knowledge with Understanding**, approximately 45% of the marks with approximately 20% allocated to recall.
- **Handling Information and Solving Problems**, approximately 45% of the marks.
- **Experimental Skills and Investigation**, approximately 10% of the marks.





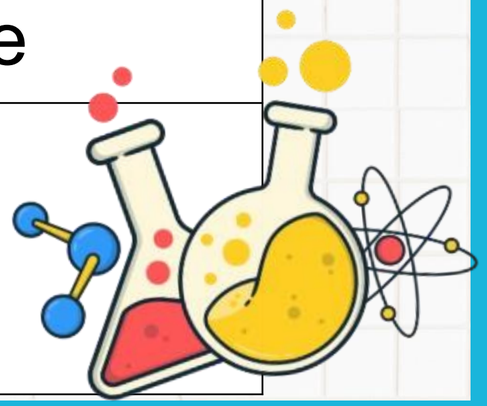
(2) Assessment Format

Paper	Type of Paper	Duration	Marks (Weighting)
1	Multiple Choice (Physics)	1 hr 15 min	20 (20%)
2	Structured and Free Response (Physics)		30 (30%)
3	Multiple Choice (Chemistry)	1 hr 15 min	20 (20%)
4	Structured and Free Response (Chemistry)		30 (30%)
5	Multiple Choice (Biology)	1 hr 15 min	20 (20%)
6	Structured and Free Response (Biology)		30 (30%)

All students will have to take **Paper 3 and 4**.
Depending on your subject combination, you will take either Paper 1 & 2 or Paper 5 & 6.

Content Structure for Sci(Chemistry)

Theme	Topics
Matter – Structures and Properties	1. Experimental Chemistry 2. The Particulate Nature of Matter 3. Chemical Bonding and Structure
Chemical Reactions	4. Chemical Calculations 5. Acid – Base Chemistry 6. Qualitative Analysis 7. Patterns in the Periodic Table
Chemistry in a Sustainable World	8. Organic Chemistry 9. Maintaining Air Quality



Sample Questions

G2 Science (Chemistry)

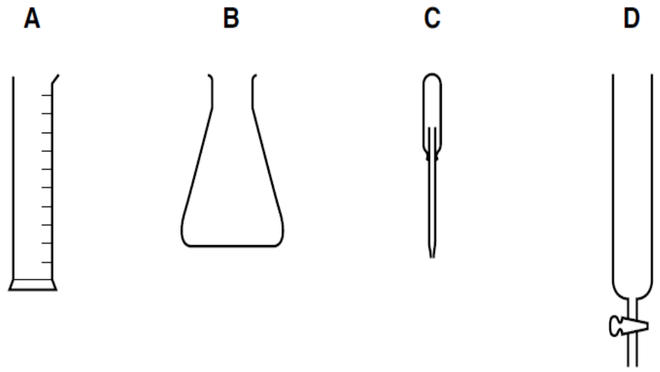
(a) A student wants to separate the coloured pigments in a plant leaf by chromatography. The student grinds the plant leaf and separates the solids from the green solution.

(i) Identify the method used to separate the solids from the green solution.

..... [1]

(ii) The student takes a drop of the green solution and puts a spot of it onto a piece of chromatography paper.

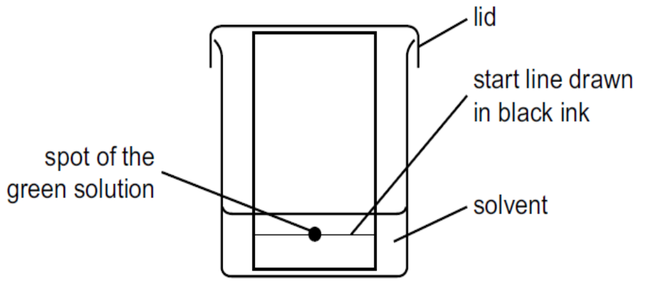
From the diagrams below choose the letter for the most suitable piece of apparatus for this task.



apparatus ..... [1]

(b) The student sets up the chromatography apparatus shown.

The student made two mistakes.



One mistake was to add too much solvent so that the start line was in the solvent.

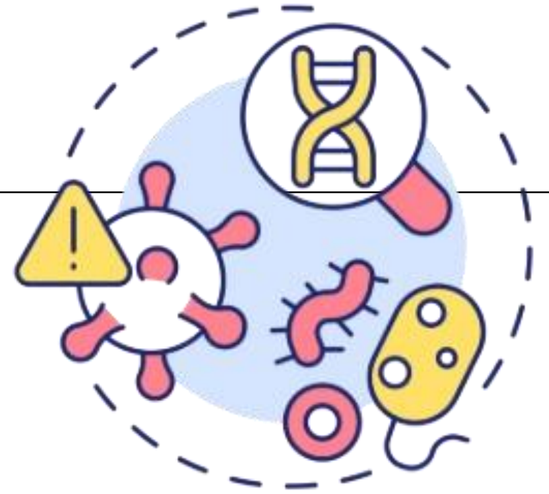
(i) Explain why this mistake would not lead to the separation of coloured pigments.

.....

..... [1]

Content Structure for Sci(Biology)

Theme	Topics
Cells and The Chemistry of Life	1. Cell structure and Organisation 2. Movement of Substances 3. Biological Molecules
The Human Body – Maintaining Life	4. Nutrition in Humans 5. Transport in Humans 6. Respiration in Humans 7. Infectious Diseases in Humans
Living Together – Plants and Animals	8. Nutrition and Transport in Flowering Plants



Sample Questions

G2 Science (Biology)

The duodenum is labelled on Fig. 6.1 which shows part of the human digestive system.

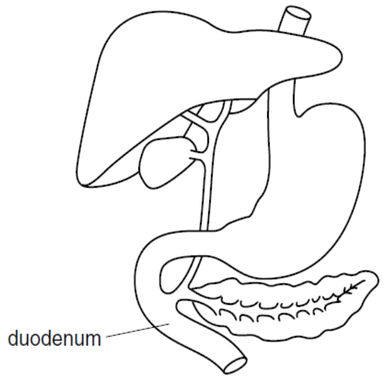


Fig. 6.1

(a) (i) On Fig. 6.1 label the gall bladder, the oesophagus and the pancreas. [2]

(ii) Describe the function of the gall bladder.

.....

..... [1]

(b) The graph in Fig. 6.2 shows the activity of three digestive enzymes in solutions of different pH.

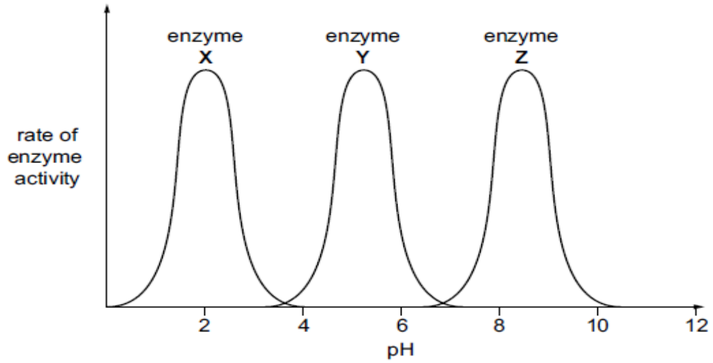


Fig. 6.2

(i) Identify and explain which one of the three enzymes, **X**, **Y** or **Z**, is most likely to be active in the stomach.

.....

.....

..... [2]

(ii) Each enzyme has a similarly shaped graph.

Use ideas of the 'lock and key' hypothesis to explain why the graphs have this shape.

.....

.....

.....

..... [3]

Sample Questions

G2 Science (Biology)

4 Infectious diseases can be spread from person to person.

(a) Antibiotics are sometimes used to treat an infection caused by a pathogen.

(i) State the type of pathogen that antibiotics are used to kill.

..... [1]

(ii) Many antibiotics have been developed. Some of these antibiotics are not used anymore because of the emergence of antibiotic resistant pathogens.

Table 4.1 gives information about three of these antibiotics, R, S and T.

Table 4.1

antibiotic	year antibiotic was developed	year antibiotic resistant pathogens were first observed
R	1962	1973
S	2000	2003
T	2004	2005

Use the data in the table to compare the antibiotics.

.....

.....

.....

..... [2]

(iii) State **one** cause of antibiotic resistance.

..... [1]

(b) Vaccines are used to prevent infectious diseases.

(i) Explain how vaccines prevent infectious diseases.

.....

.....

..... [2]

(ii) A vaccine was introduced into a small country in 1968 to prevent measles, an infectious disease. The graph in Fig. 4.1 shows the effect of introducing this vaccine.

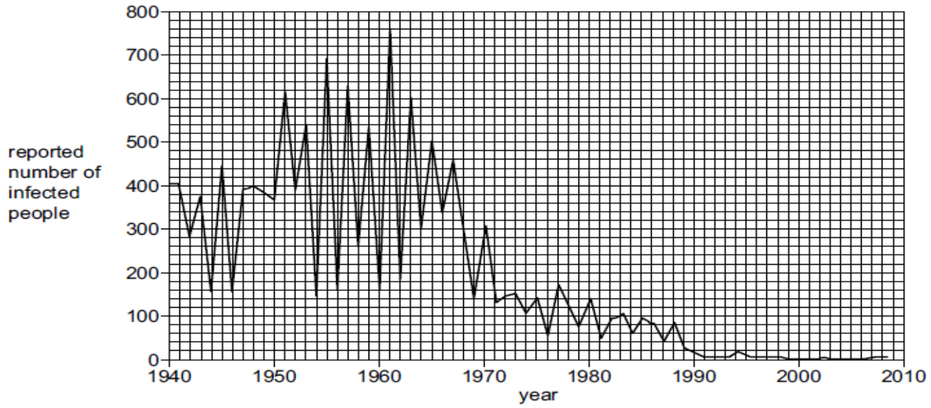


Fig. 4.1

Explain what this data shows about the effect of introducing this vaccine and suggest a possible source of error in this data.

explanation .....

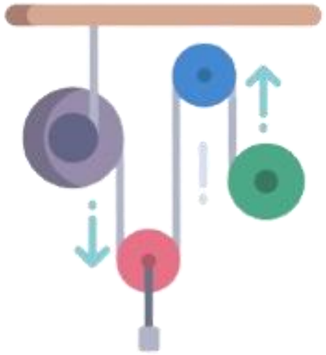
.....

source of error .....

.....

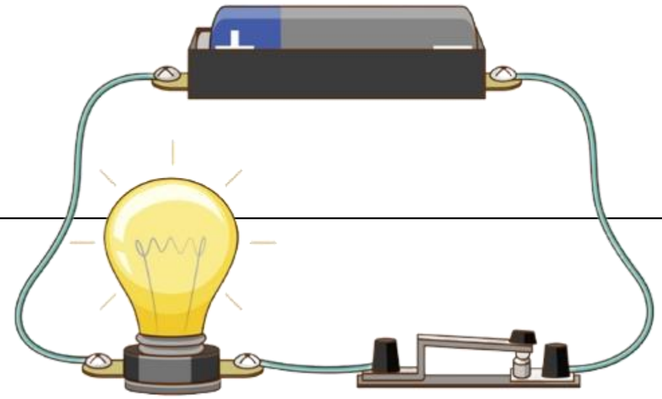
Content Structure for Sci(Physics)

Theme	Topics
Measurement	1. Physical Quantities, Units and Measurement
Newtonian Mechanics	2. Kinematics 3. Force and Pressure 4. Dynamics 5. Energy
Thermal Physics	6. Kinetic Particle Model of Matter 7. Thermal Processes



Content Structure for Sci(Physics)

Theme	Topics
Waves	8. General Properties of Waves 9. Electromagnetic Spectrum
Electricity and Magnetism	10. Electric Charges and Current of Electricity 11. D.C. Circuits 12. Practical Electricity
Radioactivity	13. Radioactivity



Sample Questions

G2 Science (Physics)

A student investigates how changing the potential difference (p.d.) across a light-emitting diode (LED) affects the current in it.

She uses connecting wires and the components represented by these symbols.



(a) Using the correct symbols, draw a circuit diagram of a suitable circuit for the student to use to carry out her investigation.

[3]

(b) The student's table of results is shown.

p.d. / V	current / mA
0.0	0
0.5	0
1.0	0
1.5	2
2.0	4
2.5	12
3.0	22

The student states that the results show that the resistance of the LED is constant.

Explain whether you agree with the student.

.....

..... [1]

[Total: 4]

Sample Questions

G2 Science (Physics)

1 A diver, working underwater at a depth of 40 m, wears a diving helmet with a plastic window.

The area of the plastic window is 100 cm^2. The pressure of the air inside the helmet is 50 N/cm^2.

(a) Calculate the force exerted by the air on the plastic window.

force = ... N [2]

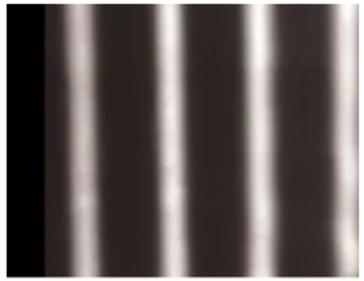
(b) State the change in arrangement of molecules when water evaporates to form water vapour.

.....

..... [1]

[Total: 3]

4 The photograph shows the image observed as a water wave passes across a ripple tank.



to scale

(a) Determine an accurate value for the wavelength of the wave, in cm.

wavelength = ... cm [2]

(b) The wave travels at a speed of 42 cm/s. Using your answer to **(a)**, calculate the frequency of the wave.

frequency = ... Hz [2]

[Total: 4]

Which Science Combination to choose?

Sci(Physics / Chemistry)	Sci(Chemistry/Biology)
❖ Involves the use of more formulae and calculations ❖ Students are required to see the relationships between quantities. For example : How changing the speed will affect the time taken for a car to reach its destination?	❖ Involves the more memorisation of scientific terms ad accurate spelling of the terms ❖ Students would need to be strong in English Language as the question usually requires them to organise and describe their answers / explanations.

G3 and G2 Sciences

Which Science Combination to choose?

Aptitude and Attitude

Passion / Interest

Post Secondary Pathways

Career Prospect


THANK YOU