GRADE 8 SKILLS BOOKLET

THE SCIENTIFIC METHOD

Steps of the scientific method

Ask a question: The scientific method starts with a question about something that you observe: How, Why, When, What or Where?

Construct a hypothesis: A hypothesis is an educated guess about the outcome of the experiment:
If _____ (I do this) _____, then _____(this) ____will happen.
You must state your hypothesis in a way that you can easily measure or test. Include both the dependent and independent variable and the relationship between the variables in the hypothesis.
Test your hypothesis by doing an experiment: your experiment tests whether your hypothesis is true or false. It is important for your experiment to be a fair test. You conduct a fair test by making sure that you change only one factor at a time while keeping all the other conditions the same.
You should also repeat your experiments several times to make sure that the first results were not just an accident (if possible).

Variables

Independent variable : a variable/factor that you choose to control in the experiment.

Dependent variable: a variable/factor that you measure in an experiment.

Fixed variables: Variables/factors that stay the same throughout the experiment.
Begin with the word same…

Aim

To determine / To investigate …. . The aim must include the 2 variables.

Apparatus

List all apparatus/ chemicals/equipment you will use in the experiment. You may be asked to draw the apparatus as it should be set up.

Method

The method is written in steps and is numbered. It is short and simple and written in third person, as a set of instructions.

Results/Observation

A table is best used to record results. The observation can include what you have seen, heard or smelt. You may be asked to draw a graph in the results.

Discussion

State the results. Discuss the results. Why it happened and what caused it to occur? Was the hypothesis true or false? Was it a fair test? How could you have improved the experiment?

Conclusion

Refer back to aim. It is a short statement.

EXAMPLE OF A SCIENTIFIC WRITE-UP

Investigative question
Do plants on a window sill grow towards light?

Hypothesis
If plants are placed on a window sill, then plants will grow towards light.

Aim
To investigate if plants on a window sill grow towards light.

Dependent variable: growth of a plant

Independent variable: amount of light

Fixed variables: same size pot plant, same amount of water, same amount of soil, same time intervals, same type of plant, same temperature.

Apparatus
- 2 pot plants (same size and type, same amount of soil and water)
- window sill near light
- dark cupboard

Method
1. Collect 2 pot plants.
2. Place one pot plant on a window sill.
3. Place the other pot plant in a dark cupboard.
4. Leave for 2 weeks.
5. Record the observations.

Observation
A table of the growth (direction) of 2 pot plants in the dark and on the window sill (different amount of light)

Pot plant in dark	Pot plant on window sill
No change	Entire plant grew towards light

Discussion
The pot plant on the window sill grows towards light. Plants need light for photosynthesis. The hypothesis is supported.
How could you have improved the experiment?

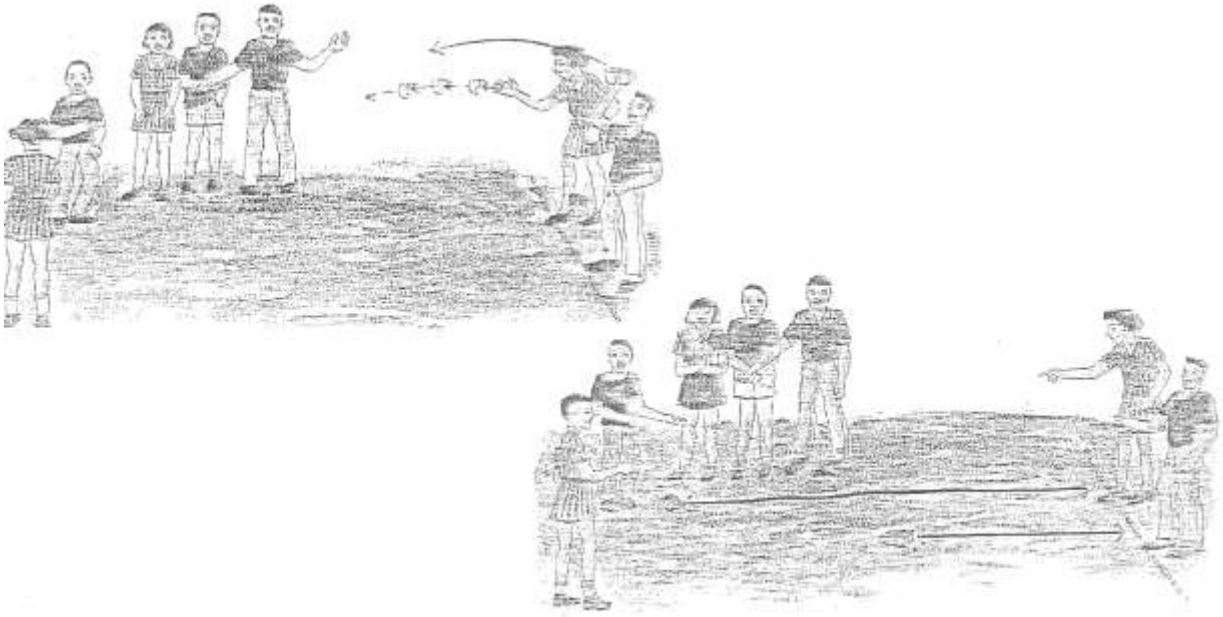
Evaluation
The experiment is not a fair test as I could have used many plants and could have increased the sample group.

Conclusion
Plants on a window sill do grow towards light.

EXERCISE: DESIGNING AN EXPERIMENT USING THE SCIENTIFIC METHOD:

PRACTICE EXERCISE:

Your teacher put forward the **hypothesis** that males are stronger than females. To test this she takes her class into the playground where they decide **to test her hypothesis** by finding out who can throw an object the furthest. Study the pictures below showing how they complete the test and what the result shows.



Result: ……
Conclusion: ……
Was the teacher's hypothesis correct? ……
Do you agree with the outcome of this experiment? ……
Give reasons for your answer above: ……
……
……
Is this a **fair test**? ……..
How could you change this experiment to make it a fair test?
(Hint: variables)…….
……
……
Name the **independent variable**(s) in this experiment: ……
……
Name the **dependent variables**(s): ……

Write down the experiment to test this hypothesis.
Do this on a separate sheet of paper.

HOMEWORK EXERCISE: DESIGNING AN INVESTIGATION USING SCIENTIFIC METHOD:

Observation: Mrs Ntuli has two different kinds of pots in her kitchen. The food always seems to cook quicker when she uses the aluminium pots than when she uses the enamel pots.

Write a scientific report with the following headings:

- Hypothesis
- Aim
- Apparatus
- Variables
- Method
- Results (including a suitable graph)
- Conclusion
- Evaluation

Graphs

GRAPHS

Graphs are a way of recording the relationship between two things / factors that can change in picture form. These factors that change in relation to each other are called **variables.**
Graphs are therefore a way of recording large amounts of information in a simple form that can easily be understood. Graphs make it easier to interpret trends.

Depending on the information we want to record, we can use different types of graphs. The most common graph is the (**jagged) line graph**; we will also deal with **bar graphs, histograms and pie graphs.**

Before we start, we need to learn the terminology linked to graphs. The following terms are common to most graphs:

Axis (pl. axes): The vertical axis is the y-axis
The horizontal axis is the x-axis

Origin: The point where the x- and y-axis cross meet.
THERE MUST BE A ZERO AT THE ORIGIN.

Independent variable: **always goes on the x-axis**.
This is the variable that we can **control** / change so that we can see what happens.

Dependent variable: **always goes on the y-axis.**
This is the variable that depends on the independent variable i.e. it changes as we change the independent variable / the variable that is **measured**.

Scale: This is the way we determine how to plot the information on the graph and we have to take readings from the graph and carefully consider it before we start the graph. We need to make sure that our scale covers all the figures that we have to plot. The scale starts at 0 and must be kept constant e.g. 5, 10, 15, 20 or 10, 20, 30 etc. The scale must also be clearly marked on the axes.

Heading: All graphs must have a heading that includes the information on both axes i.e. both variables. The question will guide you to write the heading. The heading must say what type of graph it is. The heading must not have the units. The heading must be underlined.

Labels: Each axis must be correctly labelled – always include units (if there are any)

Plotting points: Plot the points and clearly mark them on the graph with a dot.
Use **a ruler to join the plotted points.**

1. JAGGED-LINE GRAPHS:

Line graphs are used when we compare two different <u>number</u> values.

1.1. Draw two graphs on the same set of axes showing the changes in heart rate of two boys, John and Thabo, as they run over a certain distance.

Distance run (m)	John's heart rate (beats per minute)	Thabo's heart rate (beats per minute)
0	60	70
100	75	80
200	85	90
400	100	110
800	120	115
1500	120	130

1.2. What is the relationship between exercise (running further and further) and heart rate (heart beats per minute)?

_____

_____

1.3. Translate the information in the table into a line graph on the same set of axes. It gives the % male and female cigarette smokers aged 16 and over from 1972 until 1982.

Year	Percentage cigarette smokers	
	Males aged 16 & over	Females aged 16 & over
1972	52	41
1974	51	41
1976	46	38
1978	45	37
1980	42	37
1982	38	33

<u>What trend can you infer from the two graphs</u>:

(i) about smoking in general and

(ii) comparing smoking in males and smoking in females?

_____

_____

_____

2. BAR GRAPHS / CHARTS:

Bar graphs are used when one of the variables is given in numbers.
Remember:

- bar graphs have separate bars like the bars in a prison
- bars are always the same size (width) – measure and draw with a ruler
- spaces between the bars are always the same size
- do not draw bars against the y-axis
- scale must be clearly marked and the number written next to the mark
- it is strongly advised that a key be used. eg. A, B, C or 1, 2, 3.
- Do not write in the bars.

2.1. Translate the information in the table below showing the number of learners in a class of 35 who like different types of sports, into a bar graph.

Types of sports	Number of learners who like the sport
Soccer	8
Rugby	5
Basketball	6
Netball	10
Volleyball	2
Cricket	4

2.2. Which sport is liked the least? _____
2.3. Which sport is liked the most? _____

3. HISTOGRAMS:

Histograms are used when information is presented in continuous groups. These are similar to bar graphs BUT THERE ARE NO SPACES BETWEEN THE BARS.

Remember:

- bars are always the same size (width) – measure and draw with a ruler
- draw bars against the y-axis
- scale must be clearly marked and the number written next to the mark
- it is strongly advised that a key be used. eg. A, B, C or 1, 2, 3.
- Do not write in the bars.

3.1. Translate the following information showing the rainfall (mm) per month for Tshwane in 2004 into a histogram.

Month of the year	Rainfall (mm)
January	200
February	350
March	210
April	100
May	50
June	10
July	0
August	0
September	10
October	150
November	200
December	280

4. PIE GRAPHS / CHARTS:

How to draw a pie chart:

1. Add the numbers to get a total.
2. Convert to %.
3. Convert % to degrees.

Example.
Convert the following table to a pie chart.

Different food types	No. of portions
Lipids	10
Proteins	20
carbohydrates	40

Step 1 – Add number of portions together to get a total
10 + 20 + 40 = 70

Step 2 – Convert each food type to %.

Lipids – $\frac{10}{70} \times \frac{100}{1} =$ 14%

Proteins – $\frac{20 \times 100}{70 \quad 1}$ = 29%

Carbohydrates – $\frac{40 \times 100}{70 \quad 1}$ = 57%

14 + 29 + 57 = 100%

Make sure you round off correctly till you get 100% then proceed to next step.

Step 3 - Convert the % to degrees by multiplying by 3, 6 OR 360/100.

Lipids - 14 % X 3,6 = 50 degrees

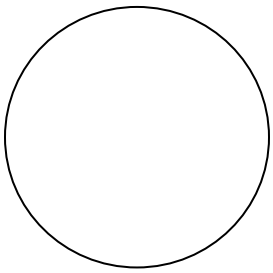
Proteins – 29 % X 3,6 = 105 degrees

Carbohydrates – 57 X 3,6 = 205 degrees

50 + 105 + 205 = 360

Add all degrees and once you have 360 degrees then you may proceed to draw the circle.

Remember to use a key for the pie chart.
Do not write any numbers in the pie chart.



4.1. Draw a pie chart above to show the proportion of carbon, hydrogen and oxygen in a carbohydrate. The proportion of C:H:O is 1:2:1.

4.2. Translate the information showing the number of learners who like different type of fruits into a pie graph.

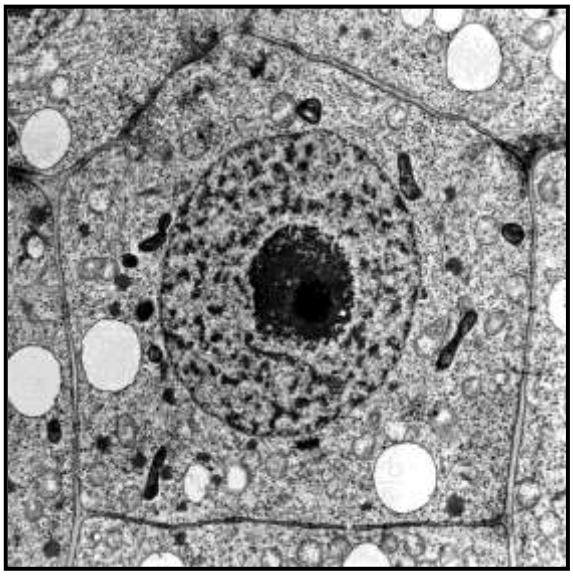
Types of fruits	**No. of learners who like the fruits**
Kiwi	10
Apples	5
Pears	15
Oranges	10

SCIENTIFIC DIAGRAMS:

Remember:

1. Diagrams must be drawn with a pencil.
2. Draw sharp, clear and solid lines.
3. No shading or colour.
4. Diagrams must be **10 lines big or a third of the page big**.
5. Labels should be printed in lowercase unless a structure is the name of a person e.g. Golgi apparatus.
6. Labels must be one below each other.
7. Label lines should be drawn with a ruler and should be parallel.
8. Heading should include: Drawing of …… what it is ……. which view i.e. L/S or a C/S …….. fresh material / seen under a microscope ……. with magnification e.g. A line diagram of a cross section of a dicot root as seen under a microscope X200. (Section of diagram and magnification must be include only if relevant to diagram)
9. Heading must be underlined.
10. You may be asked to draw ***annotated diagrams***. These are diagrams with labels and functions or labels and descriptions of the structures.

Study the micrograph below. Draw a C/S of this nucleus on the next page. DO NOT TRACE THE DRAWING!! Label it.



TABLES

1. A table must have a heading which includes the variables that are in the table .ie. A table of ….
2. The heading must be underlined.
3. A table must have columns and rows. (horizontal and vertical lines)
4. Each column must have a heading and units. (if applicable).
5. Table must have a frame or border **(drawn in pencil and with a ruler)**

How to tabulate:

1. Write the heading of the table.

Differences between plant cells and animal cells

2. Draw the table.

Differences between plant cells and animal cells

3. Give a heading to each of the columns.

Differences between plant cells and animal cells

Plant cells	Animal cells

4. When comparing, use the SAME idea, e.g. the vacuoles:

Differences between plant cells and animal cells.

Plant cell	Animal cell
One large **vacuole.**	Many small **vacuoles** or **vacuole** absent.

ESSAYS:

Remember:

1. An essay is a series of paragraphs with facts managed correctly and in an order.
2. There is **NO** introduction and conclusion.
3. Write in third person. (Do not use I and me in the essay)
4. The use of scientific terminology, ability to select relevant information and link it to the theme of the essay is tested.
5. No diagrams or flow charts may be included in the essay.
6. Facts must be organized in a logical way.
7. Stick to the topic and do not give irrelevant information.
8. Do not write more than 1 and half pages.

The cell is the basic structure of life. Discuss the statement by referring to the structure and function of the nucleus and the mitochondria.

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

An essay is only for 17 marks so should not be more than one a half pages.

Include paragraphs which flow form one idea to the next idea.

The 3 marks for synthesis is for:

Relevance – only answer what is asked in the topic. **NO extra** information.

Logical sequence- One idea must flow with another and make sure you write a statement and a reason.

Comprehensive- may be based on marks or the number of correctly linked statements and reasons.

PLANNING STEPS

4.3. ***(Nov 2010 Paper 1)***

The blood bank wants to carry out an investigation to determine the distribution of blood groups of 1 200 learners in a high school. They decide to use a sample to do their investigation in order to save costs and time. They also want to get a reliable result.

4.3.1. State any FOUR planning steps that the blood bank should put in place to do this investigation, before they draw blood from the learners, using a syringe. (4)

4.3.2. State THREE precautions that the blood bank should take when drawing blood from the learners. (3) **(7)**

Answer

4.3.1.

- Determine sample size✓
- Determine the venue✓
- Take random samples✓
- Arrange necessary equipment✓
- Arrange trained personnel ✓
- Inform school of day and time research will take place✓
- Draw up a table to record information✓ (4)

4.3.2.

- Personnel should wear gloves✓
- Sterilise the learners arms✓
- Use new sterile syringes for every learner that is tested✓
- Apply pressure to stop the bleeding✓
- Monitor the learners after drawing the blood✓ (3) **(7)**

RELIABILITY

- Repeat the investigation.
- Increase the sample size.

VALIDITY

Validity questions how the investigation or experiment or method was carried out. It is important to be sure that all the factors or variables have been controlled except the one variable that is being tested. To ensure validity the samples must be chosen randomly.

LONG QUESTIONS

ALWAYS REMEMBER TO: WRITE A STATEMENT WITH A REASON!!!!!

CALCULATIONS

(1) AVERAGES

To calculate the average: Add together the set of quantities and then divide by the number of quantities that were added.

Example. The average of 2, 4, 6 and 8
2+4+6+8 = 20
20 ÷ 4 = 5 is the average.

(2) PERCENTAGE INCREASE AND DECREASE

$$\% \text{ increase or decrease} = \frac{\text{difference}}{\text{first}} \times 100$$

You must know and write the formula in any problem.

Example 1. Pretoria High School for Girls had 200 girls in 2004. The numbers have increased to 350.

Calculate the percentage increase of girls in the school.

$$\% \text{ increase} = \frac{\text{difference}}{\text{first}} \times 100$$

$$\frac{150}{200} \times 100 = 75 \% \text{ increase}$$

Example 2. Nadine weighed 55 kg when she was 16 years old. At 21 years she weighs 49 kg.

What is the percentage decrease in her mass?

$$\% \text{ decrease} = \frac{\text{difference}}{\text{first}} \times 100$$

$$\frac{6}{55} \times 100 = 11\ \% \text{ decrease}$$

Example 3.

Mass of different materials recycled for the years 2004 and 2010

Type of material	Mass (in millions of tons)	
	2004	2010
Paper	2,5	3,0
Glass	1,0	1,7
Plastic	0,4	0,6
Wood	0,8	0,9

1.1.1. Calculate the percentage increase in the mass of paper recycled from 2004 to 2010. (2)

Answer

1.1.1.

$$\text{Percentage increase} = \frac{\text{Difference}}{\text{First}} \times 100$$

$$\frac{3,0 - 2,5}{2,5} \times \frac{100}{1} \checkmark \quad \textbf{OR} \quad \frac{0,5}{2,5} \times \frac{100}{1}$$

= 20 %✓ (2)

(3) RATIOS

Simplify the numbers to its simplest form.
Remember the order of the ratio is given in the question.

Example 1 14 boys and 16 girls

7: 8

Example 2 Morgan has 9 cows, 3 dogs and 27 cats on her farm. What is the ratio of animals in her farm?

3: 1: 9

(4) TRENDS

As the one variable increases or decreases so too does the other variable increase/ decrease/ no change.

(From T. Isaac study guide)

Year	Total amount of solid waste (millions of tons)	Amount of recyclable material in solid waste (millions of tons)
2003	1,49	0,78
2004	1,59	0,82
2005	1,80	1,20
2006	1,93	1,30

1.1.1. Describe the general trend in the total amount of waste produced and the amount of recyclable materials dumped from 2003 to 2006. (5)

Answer

1.1.1. The total amount of solid waste produced increased✓ from 1, 49 to 1, 93 ✓ in 2003 to 2006 and the amount of recyclable material increased ✓ from 0, 78 to 1,30✓ in 2003 to 2006. ✓ (5)

May mention words like increase, decrease, becomes constant or stable.
Describe the increase or decrease by using the words: steady, slow or drastic.
Use the numbers as well to show the increase or decrease.

(5) RELATIONSHIPS

As the one variable increases or decreases so too does the other variable increase or decrease.

***Do not use words such as directly and indirectly proportional*.**

(From T. Isaac study guide)

Amount of nitrate fertiliser added to crop (kg/hectare)	Yield of grass (100 kg/hectare)
0	8
225	14
425	18
650	20
700	20
750	19

1.1.1 Describe the relationship between the amount of fertiliser added and the yield of grass. (3)

Answer

1.1.1. As the amount of nitrate fertiliser increases✓ so too does the yield of grass increase✓ up to a certain point. ✓ (3)

2. MAGNIFICATION: Using a microscope

Total magnification = eyepiece magnification X objective lens magnification

= 10 X 40

= 400X

Question

QUESTION TYPES IN NATURAL SCIENCES

SECTION A

THE KEY TO ANSWERING ANY QUESTION TYPE IN NATURAL SCIENCES IS FOR THE LEARNER TO BE ABLE TO UNDERSTAND THE LANGUAGE USED IN THE QUESTIONS. VOCABULARY IS THE KEY FACTOR. IF LEARNERS ARE ABLE TO MASTER THE TERMINOLOGY, THEY ARE MORE LIKELY TO ANALYSE QUESTIONS AND FORMULATE RESPONSES.

HOW TO ANSWER MULTIPLE-CHOICE QUESTIONS

1. Try to work out the answer without looking at the possibilities.
2. Read through the statement and all the options.
3. Underline the key words in the statement.
4. Cross out the options that are definitely wrong.
5. Read through the statement again and select the most appropriate option from the options remaining.
6. Write down your answer and move to the next question.
7. Don't guess your answers; go back to the questions you were not sure of at the end of the paper if there is time left.
8. Always attempt to answer a question. Never leave an open space!

THE KEY TO ANSWERING MULTIPLE CHOICE QUESTIONS IS BEING ABLE TO UNDERSTAND THE LANGUAGE USED IN THESE QUESTIONS.

HOW TO ANSWER MATCH THE COLUMN QUESTIONS

1. Read through the entire list of statements in Column A and all the descriptions in Column B.
2. Read through each statement in Column A and find the best match in Column B.
3. Tick off the answers in Column B in pencil so that you know that one has already been chosen
4. Cross out the options that are definitely wrong or do not match any statement.
5. First, do the ones you are sure of then go back to the ones that you are not sure of and choose an answer from the remaining options.
6. Don't guess your answers. Go back to the questions you were not sure of at the end of the paper if there is time left.

SECTION B

HOW TO ANSWER LONGER QUESTIONS

1. Read through the question, more than once if time allows it.
2. Underline the verb/action word. Make sure you identify the core of the question.
3. Use the Fact, Explanation and Example Formula.
4. **Fact:** write down the fact.
5. **Explanation:** explain the fact in your own words.
6. **Example:** give your own practical example.
7. Look at the mark allocation as a guide of how many facts should be included in your answer. Use scientific language and correct terminology.

HOW TO ANSWER QUESTIONS THAT INVOLVES COMPREHENSION AND EXTRACTING DATA FROM MATERIAL

These types of questions involve understanding or comprehending the information that is provided in the extracts from other textbooks, scientific journals, newspapers and magazine articles. The extracts that are given in the questions are relevant to Natural Sciences and its application in everyday life situations. The questions that are set on these extracts assess how well you understand the information in the extract and how to interpret any data that the extract contains.

These are the important points to note when you are answering a comprehension question:

1. Look at the heading and the pictures to get an idea of what the case study/extract is about.
2. Read through the case study/extract carefully and slowly with understanding before you look at any questions.
3. Read each question and underline the keyword/verb. All the information that you will need to answer the questions will be in the extract!
4. Take each question in turn and go back through the extract to find the answer. You can use the wording in the extract to help you put the answer together. Remember the answer to the questions must be based on the information that is in the extract that you have been given.
4. Read the case study/extract again and underline each of the keywords in the case study/extract.
5. Now answer the questions. Pay special attention to action verbs.
6. Look at the mark allocation as a guide of how many facts should be included in your answer.

HOW TO ANSWER DATA RESPONSE QUESTIONS

1. Look at the whole picture, table, graph or diagram. What do you see?
2. Look at the heading and the pictures, table, graph or diagram to get an idea of the topic.
3. Look at any other symbols that may be important.
4. Read any text that is provided.
5. Read each question and underline the keyword/verb.
6. Read the graphs/diagram again and select the needed information.
7. Write down the answer and provide reasons for your answer.
8. Look at the mark allocation as a guide of how many facts should be included in your answer.

HOW TO TACKLE QUESTIONS IN NATURAL SCIENCES!

1. Unpack the question that is asked. Underline the action verbs such as outline, analyse, evaluate, apply, calculate, etc.
2. **Know** your key words of all topics.
3. Know how to use formulas for calculations and show all your workings. (For e.g. when you have to draw a pie chart, etc.)
4. **KNOW ALL YOUR CONTENT!**
5. **THINK about your answer, don't just write down everything.**

ACTION VERBS / KEYWORDS USED IN NATURAL SCIENCES QUESTIONS

Action verb/ Keyword	What is required of you
Analyse	Separate, examine and interpret
Calculate	Used when a numerical answer is required. In general, you should show your working, especially where two or more steps are involved
Classify	Group things based on common characteristics
Compare	Point out or show both similarities and differences between things, concepts or phenomena
Comment	Give your personal opinion but make sure to support it with relevant subject matter.
Define	Give a clear meaning
Describe	State in words (using diagrams where appropriate) the main points of a structure / process / phenomenon / investigation
Determine	To calculate something, or to discover the answer by examining evidence
Differentiate	Use differences to qualify categories; alternative keyword: distinguish
Discuss	Consider all information and reach a conclusion

Explain	Make clear; interpret and spell out
Identify	Name the essential characteristics
Label	Identify on a diagram or drawing
List	Write a list of items, with no elaboration OR give facts in point form
Mention	Refer to relevant points
Name	State something; alternative keywords: give, identify, mention
State	Write down information without discussion
Suggest	Offer an explanation or a solution
Tabulate	Draw a table and indicate the answers as direct pairs

HOW TO ATTEMPT THE QUESTIONS:

- Read the instructions carefully and take notes.
- Read through the question carefully before you start answering.
- In multiple-choice questions, read each question and think carefully before you answer. DO NOT GUESS!
- Read short answer and structured questions carefully. Arrange your answers clearly and logically, using notes if you prefer. Do not make vague and unclear statements. MAKE SURE THAT YOU ANSWER THE QUESTION WHICH IS ASKED.
- In questions that allow your free response or a short essay, take the time to note down the main points that you need to cover. This helps you to remember the material and allows you to organize your thoughts so that you can put your answer down clearly.
- Draw diagrams and graphs clearly and label them correctly. Make them a size that the examiner is going to be able to mark easily.

BEFORE ATTEMPTING THE QUESTIONS KNOW ALL YOUR CONTENT!