



Singapore Examinations and Assessment Board



Cambridge Assessment
International Education

**Singapore–Cambridge General Certificate of Education
Normal (Technical) Level (2022)**

Science (Syllabus 5148)

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INTRODUCTION

The syllabus is organised around contexts that students can relate to their everyday experiences and the commonly observed phenomena in nature. The contexts are presented as three Core Modules in the Upper Secondary syllabus. They are **Gadgets Work Wonders (II)**, **Food Matters** and **Wonders of My Body (II)**. These contexts have been chosen because they provide a strong link between the concepts to be learnt and their applications. The topics encompassed by each context are not to be viewed as compartmentalised blocks of knowledge, but rather as interdependent and united through that context.

AIMS¹

The Secondary Science Normal (Technical) Syllabus aims are to:

1. guide students in acquiring knowledge with understanding for **application in their daily lives** such that they
 - 1.1 are motivated to learn science through contextualised and hands-on learning
 - 1.2 are able to problem-solve and use thinking and inquiry processes
 - 1.3 can communicate effectively
 - 1.4 develop safety consciousness and safe practice
 - 1.5 become confident citizens who are able to cope with the changing and progressive nature of science and technology in the world.
2. **develop 21st century competencies**, which would
 - 2.1 enable them to acquire problem-solving skills and use thinking and inquiry processes
 - 2.2 enable them to become responsible individuals and productive citizens
 - 2.3 enable them to acquire life-long learning skills
 - 2.4 enable them to show care and concern for people and the environment
 - 2.5 allow them to use information communications technology (ICT) for communication, collaboration and as a tool for data collection and the analysis of results.
3. enable students to be suitably prepared for post-secondary courses, such that they
 - 3.1 develop abilities and skills, which would also be relevant and useful in the work place
 - 3.2 become aware of the impact of science and technology on society, industry and business.

It is hoped that, where appropriate, teachers should allow students to have the opportunities to discuss the ethical implications of science and technology.

¹ The aims are taken from the teaching syllabus.

ASSESSMENT OBJECTIVES

A Knowledge with understanding

Students should be able to demonstrate knowledge and understanding in relation to:

1. scientific phenomena, facts, laws, definitions, concepts, theories
2. scientific vocabulary, terminology and conventions (including symbols, quantities and units)
3. scientific instruments and apparatus including techniques of operation and aspects of safety
4. scientific quantities and their determination.

The subject content defines the factual knowledge that candidates may be required to recall and explain. Questions testing those objectives will often begin with one of the following words: *define, state, name, describe, explain* or *outline*. (See the *Glossary of Terms*.)

B Handling and applying information

Students should be able – in words or by using symbolic, graphical and numerical forms of presentation – to:

1. locate, select, organise and present relevant information from a variety of sources
2. transpose information from one form to another
3. process numerical and qualitative data
4. use information to identify patterns, report trends and draw inferences
5. present reasoned explanations for phenomena, patterns and relationships
6. make predictions.

These assessment objectives cannot be precisely specified in the subject content because questions testing such skills may be based on information which is unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, reasoned or deductive manner to a novel situation. Questions testing these objectives will often begin with one of the following words: *predict, suggest, calculate* or *determine*. (See the *Glossary of Terms*.)

C Experimental skills and investigations

Students should be able to:

1. select and organise techniques, apparatus and materials
2. take readings accurately
3. handle experimental data and observations
4. interpret and evaluate experimental results and suggest improvements to experimental procedures.

Scientific subjects are, by their nature, experimental. It is therefore important that the candidates carry out appropriate practical work to facilitate the learning of this subject and to meet objectives C1–C4 above.

USE OF CALCULATORS

An approved calculator may be used in all papers.

SCHEME OF ASSESSMENT

There will be two papers.

Paper	Type of paper	Duration	Marks	Weightings
1	Multiple choice ²	1 hr	40	40%
2	Short-answer or structured	1 hr 15 min	60	60%

Paper 1 (1 h, 40 marks)	Paper 1 will carry 40 marks and consist of 40 compulsory multiple choice items.
Paper 2 (1 h 15 min, 60 marks)	Paper 2 will carry 60 marks and consist of a variable number of compulsory short-answer or structured questions. One of the questions is a data-response question, requiring candidates to interpret, evaluate or solve problems using data and/or observations. This question will carry 8–12 marks.

Weighting of Assessment Objectives

Papers 1 and 2 (100 marks in total)

- A Knowledge with understanding**, approximately 60% of the marks with approximately one-third allocated to recall.
- B Handling and applying information**, approximately 40% of the marks.

Objectives A and B may be assessed through questions which involve experimental skills and investigations. These questions, when set, are also intended to meet appropriate aspects of objectives C1–C4.

Questions on experimental skills and investigations will normally be set within the bounds of the syllabus. If questions are based on apparatus or topics beyond the syllabus, candidates will not be assessed on knowledge of the apparatus or topics. They will be assessed on knowledge or general skills (e.g. reading of scales, data handling), which are required by the syllabus. Questions may be set requiring the candidates to:

- select appropriate experimental techniques
- select and organise apparatus and materials
- draw, complete or label diagrams of apparatus
- record readings from diagrams of apparatus
- read, complete or draw tables of data
- take readings from or plot graphs
- determine a gradient, intercept or intersection on a graph
- interpret or draw conclusions from observations and experimental data
- suggest a needed modification to a step in an experiment
- recognise or comment on possible sources of error from experimental data
- comment on the safety or suggest safety procedures when using apparatus, materials and techniques.

² The paper may be delivered on ICT when the platform for ICT in assessment is ready and appropriate.

CONTENT STRUCTURE

Module	Topics
I. Gadgets Work Wonders (II)	1.1 Energy and its Uses 1.2 Energy transfer through Waves 1.3 Effects of Forces 1.4 Electricity 1.5 Sources of Electricity
II. Food Matters	2.1 Sources of Food 2.2 Food Chemistry 2.3 Food Health and Safety
III. Wonders of My Body (II)	3.1 Digestion 3.2 Breathing 3.3 Fitness and Cardiac Health 3.4 Staying Healthy

SYLLABUS CONTENT

MODULE I: GADGETS WORK WONDERS (II)

1.1 Energy and its Uses

Content

- energy may be converted to different forms

Learning Outcomes

Candidates should be able to:

- show understanding that kinetic energy, elastic potential energy, gravitational potential energy, chemical potential energy and thermal energy are examples of different forms of energy
- show understanding that thermal energy is transferred from a region of higher temperature to a region of lower temperature
- understand and apply the principle of the conservation of energy to daily situations
- relate power to energy transferred and time taken, using appropriate examples and the equation:
 $power = energy / time$ in simple systems

1.2 Energy transfer through Waves

Content

- waves transfer energy
- types of waves used for communications

Learning Outcomes

Candidates should be able to:

- describe what is meant by wave motion as illustrated by vibrations in ropes and springs (the terms transverse and longitudinal are not required)
- show understanding that waves transfer energy
- understand the terms *frequency*, *wavelength* and *amplitude* of a wave
- state how the following types of waves are used for daily situations:
 - radiowave (e.g. radio and television communications)
 - microwave (e.g. microwave oven and satellite communication)
 - infra-red (e.g. remote control devices)
 - light (e.g. optical fibres for telecommunication)
 - ultra-violet (e.g. sunbeds and sterilisation)
 - X-ray (e.g. radiological and engineering applications)

1.3 Effects of Forces

Content

- a force can change the motion of a body
- a force can cause a body to turn

Learning Outcomes

Candidates should be able to:

- use the following instruments for measuring length: rulers and measuring tape
- use digital stopwatches for measuring time intervals
- explain what is meant by *speed* and *acceleration*
- calculate the average speed and acceleration
- plot and interpret a distance-time graph of real situations
- understand that a force can change the state of rest and motion of a body
- predict changes in speed and direction when a force acts on an object
- understand what is meant by *moment of a force* and apply this to everyday examples (calculations are **not** required)

1.4 Electricity

Content

- electrical components can be connected in series or parallel circuits
- electricity consumption can be reduced in many ways
- electrical safety precautions must be observed when using electricity

Learning Outcomes

Candidates should be able to:

- measure current, voltage and resistance using a multimeter
- draw simple series and parallel circuits for daily applications (e.g. table lamps use series circuits, ceiling lamps use parallel circuits)
- label and interpret circuit diagrams which include cells, switches, resistors (fixed and variable), voltmeters, ammeters, bells, bulbs, lamps and fuses
- state that current is the same at every point of a series circuit
- state that the total current is equal to the sum of the currents of the individual branches in a parallel circuit
- state that a voltage is required to cause a current flow
- state that the effective resistance increases when in series circuit
- state that the effective resistance decreases when in parallel circuit
- identify situations in which series and parallel circuits are used in daily electrical circuitry systems
- use information on a label of an electrical appliance to determine its power consumption
- give examples of ways to reduce electrical energy wastage at home
- use the equations: Power, $P = V \times I$; Energy, $E = P \times t$
- calculate the cost of using an electrical appliance where the energy unit is kW h
- understand and use information in electricity bills
- identify the potential dangers in the use of electricity at home, such as:
 - damaged insulation
 - overheating of cables
 - poor or loose connections
- state precautions to be taken for safe electricity use at home, such as:
 - use of fuses
 - earthing metal casings
 - double insulating wires
 - use of circuit breakers

1.5 Sources of Electricity

Content

- electricity is generated at power stations
- batteries are portable sources of energy

Learning Outcomes

Candidates should be able to:

- (a) outline the processes that produce electricity from fossil fuels, transmit electricity to homes and consume electricity in common household electrical appliances (in terms of conversions of energy)
- (b) understand that electricity is transmitted from a power station through a grid of high voltage transmission lines
- (c) describe a transformer as two coils of wire wound onto a core of iron
- (d) understand the use of step-up and step-down transformers and give examples of their use (including high voltage transmission of electricity)
- (e) state the importance of batteries as a source of electricity, giving some examples of their use

MODULE II: FOOD MATTERS**2.1 Sources of Food****Content**

- growing food
- the need to produce food

Learning Outcomes

Candidates should be able to:

- (a) state that sunlight, air, water and good soil (containing nutrients and appropriate pH) are required for plants to grow and produce food
- (b) measure the pH of soil using litmus paper, universal indicator or a pH meter
- (c) understand that fertilisers provide nutrients for the plant to grow faster and bigger
- (d) understand that the use of fertilisers can be beneficial (increase food supply) and also cause problems
- (e) state the effects of 'slash and burn' methods of agriculture on soil fertility and the environment
- (f) understand that pesticides and herbicides can be used to protect crops against pests and weeds and their use has effects on the environment (soil and water contamination) leading to effects on the food chain
- (g) describe and explain the use of biological control to reduce the need for pesticides (limited to the control of prey organisms by their predators)
- (h) understand that there is a need to improve the methods of food production:
 - (i) as the world population increases
 - (ii) with limitations in space to grow food
- (i) describe how food production can be improved by:
 - (i) improving plant and animal varieties
 - (ii) intensive production methods for crops, fish and farm animals
(details of technologies are **not** required)
- (j) understand that plant hormones are used as weedkillers and in regulating growth and ripening of fruits

2.2 Food Chemistry

Content

- separation techniques
- chemical changes produce new products
- the acids in some foods exhibit typical properties

Learning Outcomes

Candidates should be able to:

- (a) explain that substances can be extracted and separated through the following techniques:
 - (i) dissolving
 - (ii) filtration
 - (iii) evaporation
 - (iv) distillation
 - (v) paper chromatography
- (b) describe the applications of the various separation techniques in homes and food industries
- (c) use a measuring cylinder to measure volume of liquids / solids
- (d) describe a chemical reaction as a process that leads to the formation of new products
- (e) give examples of everyday changes that involve chemical reactions:
 - (i) decaying of food
 - (ii) cooking of food
 - (iii) burning
 - (iv) rusting
- (f) give examples of everyday situations in slowing down / preventing chemical reactions (e.g. preserving food, reducing amount of heat, fuel and air supply for burning, tin-plating against rusting)
- (g) describe the properties of acids by their taste and effects on litmus paper and universal indicator
- (h) describe acidity, neutrality and alkalinity in terms of the pH scale (whole numbers only)
- (i) measure the pH of various common household substances and food using homemade pH indicator, litmus paper, universal indicator and a pH meter
- (j) relate pH within the mouth to its effect on dental health
- (k) describe the characteristic properties of food acids on the following items that are commonly found at home :
 - (i) metals (e.g. cooking utensils)
 - (ii) bases (e.g. antacids)
 - (iii) carbonates (e.g. baking soda, effervescent vitamin C tablets)
 (chemical equations are **not** required)
- (l) state that neutralisation takes place when an acid reacts with a base and the products are salt and water only (chemical equations are **not** required)

- (m) state some applications of neutralisation (e.g. action of toothpaste, fabric softener and hair conditioner, controlling pH in soil, neutralising industrial wastes)
- (n) state some of the effects of phosphate detergents (e.g. increase growth of algae and water weeds) and acidic waste water on the rivers and seas
- (o) understand the use of microbes in sewage plants to treat the waste water before it is released to the rivers and seas

2.3 Food Health and Safety

Content

- food contains carbohydrates, proteins and fats
- the need for a balanced diet
- food labels help us make nutritional decisions
- action of microbes
- preserving food
- pros and cons of food additives

Learning Outcomes

Candidates should be able to:

- (a) understand the concept of a balanced diet as a diet supplying sufficient quantities of carbohydrates, proteins, fats, vitamins, mineral salts, fibre and water to sustain a healthy life
- (b) list the principal sources of carbohydrates, proteins, fats, vitamin C, vitamin D, mineral salts (calcium and iron only), fibre and water
- (c) state the dietary importance of carbohydrates, proteins, fats, vitamin C, vitamin D, mineral salts (calcium and iron only), fibre and water
- (d) understand the use of simple food tests on:
 - (i) starch (iodine test)
 - (ii) protein (biuret's test)
 - (iii) oil (blot test)
 (knowledge of detailed procedures of tests is **not** required)
- (e) identify the basic information found on a food / nutrition label such as carbohydrate, protein, fat and sodium content, serving sizes, % daily values and energy content (in kilojoules and kilocalories)
- (f) understand and calculate percentages and total amount of a nutrient based on serving sizes and % daily values (the conversion between kilojoules and kilocalories is **not** required)
- (g) state how some food with high fat, salt and sugar content can cause health conditions such as obesity, high blood pressure and diabetes
- (h) state what microbes are
- (i) describe the action of microbes on food (e.g. mould on bread and bacteria on milk)
- (j) state that to preserve food there is a need to stop or reduce microbial activity

- (k) describe briefly the following methods of preventing food from getting spoilt:
 - (i) using high temperature (e.g. sterilisation, pasteurisation, canning)
 - (ii) using low temperature (e.g. freezing)
 - (iii) reducing the water content (e.g. freezing, dehydration, use of chemical preservatives)
 - (iv) lowering the pH (e.g. pickling)
 - (v) reducing the oxygen supply (e.g. bottling, packaging)
- (l) describe why some food additives are necessary
- (m) give examples of common food additives:
 - (i) preservatives (e.g. vinegar, salt, sugar, sulfur dioxide)
 - (ii) nutrient supplements (e.g. vitamins, mineral salts)
 - (iii) texture and appearance modifiers (e.g. starch, food colourings)
- (n) describe the dangers of using non-permitted additives (e.g. carcinogens, heavy-metal poisons) or adding excessive levels of permitted additives in food production (knowledge of specific non-permitted additives or permitted additives is **not** required)

MODULE III: WONDERS OF MY BODY (II)**3.1 Digestion****Content**

- food must be digested before our body can make use of it

Learning Outcomes

Candidates should be able to:

- explain why digestion is necessary for most food in order for our body to use food for energy, growth and repair
- identify the main organs and the associated organs of the digestive system (mouth, gullet, stomach, small intestine, large intestine, rectum, anus, salivary glands, pancreas, gall bladder and liver) and state their functions
- show an understanding that digestive enzymes are important in helping to speed up the rate of digestion, and that they require optimum temperature and pH to work efficiently
- interpret data on the effect of pH and temperature on the rate of protein digestion by enzymes
- describe the effects of excessive alcohol consumption on the liver (e.g. damaged liver, liver cancer)
- outline how constipation may occur and suggest how to prevent it
- state how the diet and activity level of a diabetic person can be changed to control his / her blood glucose level

3.2 Breathing**Content**

- parts of the respiratory system
- composition of inhaled and exhaled air
- effects of smoking on the respiratory system

Learning Outcomes

Candidates should be able to:

- describe why oxygen is important to us (to help break down food molecules in order to release the energy trapped in them)
- explain why breathing is important to us (brings oxygen into the body and gets rid of carbon dioxide from the body)
- identify parts of the respiratory system (windpipe, bronchi, lungs, ribcage, diaphragm) on a diagram and state their functions
- show an awareness of how choking can lead to death
- explain the differences in the composition of inhaled and exhaled air
- infer that exhaled air has a higher concentration of carbon dioxide than inhaled air, using the limewater test

- (g) infer that exhaled air has a higher concentration of water vapour than inhaled air, using cobalt chloride paper test
- (h) discuss the effects of smoking / passive smoking on the respiratory system, e.g. bronchitis and lung cancer

3.3 Fitness and Cardiac Health

Content

- how fitness is related to our cardiac health
- health conditions related to the circulatory and skeletal system

Learning Outcomes

Candidates should be able to:

- (a) distinguish between fitness (ability to do physical activity) and health (free from disease)
- (b) understand the purpose of blood: carrying oxygen and glucose to, and carrying carbon dioxide and wastes away from, all parts of the body
- (c) list the components of blood as red blood cells, white blood cells, platelets, plasma
- (d) state the functions of the components of blood:
 - (i) red blood cells – transport oxygen
 - (ii) white blood cells – to destroy bacteria and other foreign bodies, antibody formation and tissue rejection
 - (iii) platelets – blood clotting
 - (iv) plasma – transport of food substances, carbon dioxide
- (e) outline the path of blood flow through the heart and the lungs to replenish the oxygen content of the blood
- (f) state the structure of arteries, veins and capillaries and relate it to their functions
- (g) describe how cholesterol can restrict or block blood flow in arteries by forming plaques, hence affecting one's fitness and health (e.g. stroke and heart attack)
- (h) state that the flow of blood through the body is observed in the form of pulses, heart beat and blood pressure
 - (i) relate pulse rate to heart beat
 - (j) measure pulse rate and explain that exercise has an effect on pulse rate and breathing rate, because of the need for more oxygen to be carried to the exercising muscles
- (k) interpret data that shows correlation between incidence of heart disease and several factors (including blood pressure, lifestyle habits, consumption levels of salt and saturated fats)
- (l) understand the structure of a joint and describe briefly some common problems related to the joints (including sprains, dislocation, arthritis)
- (m) describe briefly some common problems related to bones (including fracture and osteoporosis)

3.4 Staying Healthy

Content

- maintaining good health

Learning Outcomes

Candidates should be able to:

- (a) state the importance of regular exercise, sufficient rest, and eating regular, balanced meals in maintaining good physical and mental health
- (b) give examples of how a modern lifestyle can cause harm to our health (e.g. eating fast food and convenience foods, prolonged use of the computer without break, prolonged listening to loud music using personal music devices)
- (c) infer if an individual's weight is in the healthy range by calculating his / her BMI = mass (kg) / [height(m) × height (m)]
- (d) describe some risks associated with over-dieting and over-exercising in an attempt to lose weight
- (e) understand that diseases can be caused by viruses and bacteria (detail of structure is **not** required)
- (f) investigate the effects of anti-microbial agents (e.g. antiseptics, disinfectants) on the population growth of micro-organisms (e.g. bacteria, fungi)
- (g) understand that vaccination gives protection from certain viruses
- (h) understand the importance of completing a prescribed course of antibiotics
- (i) state that some diseases / conditions are hereditary by nature, i.e. passed through the parents' genes (e.g. thalassemia and colour blindness)
- (j) understand the use and limitations of technology in replacing malfunctioning organs (e.g. organ transplant, kidney dialysis)

SUMMARY OF KEY QUANTITIES, SYMBOLS AND UNITS

Candidates should show familiarity with the following physical quantities and their symbols. They should be able to state the units in which these quantities are measured.

Quantity	Symbol	Unit
length	$l, h \dots$	km, m, cm, mm
area	A	m^2, cm^2
volume	V	m^3, dm^3, cm^3
weight	W	l, L, ml, mL ($1l = 1000 cm^3 = 1 dm^3$) N
mass	m, M	kg, g, mg tonne ($1 t = 1000 kg$)
time	t	h, min, s, ms
concentration	c	g / dm^3
speed	u, v	km / h, m / s, cm / s
acceleration	a	m / s^2
force	F, f	N
moment of force		N m
energy	E	J, kJ, kW h
power	P	W, kW
temperature	θ, T	$^{\circ}C, K$
speed of rotation		rev / min, rev / s
frequency	f	Hz
wavelength	λ	m, cm
potential difference	V	V, mV
voltage	V	V, mV
current	I	A, mA
resistance	R	$\Omega, k\Omega$

CHEMICAL NAMES, SYMBOLS AND FORMULAE

Candidates should show familiarity with the following chemical names and chemical symbols / formulae of the following elements and compounds. (Note: They will not be assessed on the symbols / formulae.)

<u>Elements / Compounds</u>	<u>Chemical Symbols / Formulae</u>
Hydrogen	H
Oxygen	O
Nitrogen	N
Aluminium	Al
Carbon	C
Chlorine	Cl
Chromium	Cr
Copper	Cu
Iron	Fe
Lead	Pb
Nickel	Ni
Tin	Sn
Hydrochloric acid	HCl
Nitric acid	HNO ₃
Sulfuric acid	H ₂ SO ₄
Calcium carbonate	CaCO ₃
Calcium hydroxide	Ca(OH) ₂
Potassium hydroxide	KOH
Sodium hydroxide	NaOH
Water	H ₂ O
Ammonia	NH ₃
Carbon dioxide	CO ₂
Carbon monoxide	CO
Hydrogen gas	H ₂
Oxygen gas	O ₂
Nitrogen gas	N ₂

GLOSSARY OF TERMS USED IN SCIENCE PAPERS

It is hoped that the glossary (which is relevant only to science papers) will prove helpful to candidates as a guide, i.e. it is neither exhaustive nor definitive. The glossary has been deliberately kept brief not only with respect to the number of terms included but also to the descriptions of their meanings.

Candidates should appreciate that the meaning of a term must depend in part on its context.

1. *Calculate* is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
2. *Classify* requires candidates to group things based on common characteristics.
3. *Comment* is intended as an open-ended instruction, inviting candidates to recall or infer points of interest relevant to the context of the question, taking account of the number of marks available.
4. *Compare* requires candidates to provide both similarities and differences between things or concepts.
5. *Define* (the term(s)...) is intended literally, only a formal statement or equivalent paraphrase being required.
6. *Describe* requires candidates to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena. In the latter instance the answer may often follow a standard pattern, e.g. Apparatus, Method, Measurement, Results and Precautions.
In other contexts, *describe and give an account of* should be interpreted more generally, i.e. the candidate has greater discretion about the nature and the organisation of the material to be included in the answer. *Describe and explain* may be coupled in a similar way to *state and explain*.
7. *Determine* often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula.
8. *Estimate* implies a reasoned order of magnitude statement or calculation of the quantity concerned, making such simplifying assumptions as may be necessary about the points of principle and about values of quantities not otherwise included in the question.
9. *Explain* may imply reasoning or some reference to theory, depending on the context.
10. *Find* is a general term that may be variously interpreted as calculate, measure, determine, etc.
11. *List* requires a number of points, generally each of one word, with no elaboration. Where a given number of points is specified, this should not be exceeded.
12. *Measure* implies that the quantity concerned can be directly obtained from a suitable measuring instrument, e.g. length, using a rule, or angle, using a protractor.
13. *Outline* implies brevity, i.e. restricting the answer to giving essentials.
14. *Predict* or *deduce* implies that the candidate is not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted from an earlier part of the question. *Predict* also implies a concise answer with no supporting statement required.
15. *Sketch*, when applied to graph work, implies that the shape and / or position of the curve need only be qualitatively correct, but candidates should be aware that, depending on the context, some quantitative aspects may be looked for, e.g. passing through the origin, having the intercept, asymptote or discontinuity at a particular value.

In diagrams, sketch implies that a simple, freehand drawing is acceptable; nevertheless, care should be taken over proportions and the clear exposition of important details.

16. *State* implies a concise answer with little or no supporting argument, e.g. a numerical answer that can be obtained 'by inspection'.
17. *Suggest* is used in two main contexts, i.e. either to imply that there is no unique answer, or to imply that candidates are expected to apply their general knowledge to a 'novel' situation, one that may be formally 'not in the syllabus'.
18. *What do you understand by / What is meant by* (the term(s)...) normally implies that a definition should be given, together with some relevant comment on the significance or context of the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in light of the indicated mark value.

PRACTICAL GUIDELINES

Scientific subjects are, by their nature, experimental. It is therefore important that the candidates carry out appropriate practical work to facilitate the learning of this subject. An outline of some practical activities that support learning for N(T) Science is shown below; the details of these activities can be found in the teaching resources.

The list of practical activities is not intended to be exhaustive. Candidates should show familiarity with the techniques used in these experiments. Reference may be made to the techniques used in these experiments in the theory papers but no detailed description of the experimental procedures will be required.

- Measurements of length without a common unit of measure
 - palm to measure height
- Measurements of length, volume, temperature, mass and weight using appropriate instruments
 - ruler, measuring cylinder, laboratory thermometer, beam balance, spring balance
- Measurements of current, voltage and resistance in series and parallel circuits
- Separation of food colourings using paper chromatography
- Extraction of a natural pH indicator (e.g. from red cabbage) using techniques of dissolving and filtration
- Determination of pH of household items
 - Measurements of average pulse rate
 - at rest
 - after different physical activities
- Investigation of the effect of anti-microbial agents (e.g. antiseptics, disinfectants) on the growth of micro-organisms (e.g. bacteria, fungi)