Scottish Certificate of Education

Standard Grade Revised Arrangements in Science

Foundation, General and Credit Levels
in and after 1999

STANDARD GRADE ARRANGEMENTS IN SCIENCE

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Introduction

This document sets out the arrangements for examinations in Standard Grade Science which have been developed in the light of a two-stage consultation exercise carried out between November 1995 and February 1997. The consultation initially sought the views of interested bodies and presenting centres on a range of alternative models for assessment of Practical Abilities in the sciences and latterly on proposed amended arrangements.

Examinations in Science at Foundation, General and Credit Levels based on these Arrangements will be offered in and after 1999.

Section 1

Rationale

1 Rationale

1 1 The underlying philosophy of the course is the provision of opportunities for pupils to acquire knowledge and understanding of scientific facts, ideas and applications, and to develop practical abilities, all of which can be used to solve scientific problems.

1 2 The main thrust of Standard Grade Science, therefore, is not simply the acquisition of knowledge and understanding and the development of practical abilities for their own sakes: it is the use to which this knowledge and these abilities can be put in problem-solving activities. Interest and enjoyment may, on their own, provide sufficient justification for some activities.

1 3 Science is offered at Foundation, General and Credit Levels, and is designed to challenge the most able pupils as well as to provide support and allow success for pupils of lower academic attainment. The majority of pupils who study Science are unlikely to become professional scientists, but all may require in their career to have some appreciation of strategic issues related to science rather than be involved at an operational level. In particular, the target group for Credit Level consists of pupils who are principally interested in other areas of the curriculum but who do not wish to lose contact with science. The Science course allows pupils who might not wish to undertake a single science specialism an opportunity to appreciate the culture of science.

1 4 It is recognised that there is merit in having similar objectives to Standard Grade Biology, Chemistry and Physics, in that opportunities can be provided for the development of transferable skills. In consequence, therefore, the elements of Knowledge and Understanding, Problem Solving and Practical Abilities which define the key areas for assessment and profiling of attainment are the same as those employed in the discrete sciences.

Section 2

Aims and Course Objectives

2 Aims and Course Objectives

2 1 Aims

The aims of the course are, firstly, to indicate the contribution Science can make to society and to the pupils' own wellbeing and, secondly, to emphasise the importance of the process of scientific investigation as a means of solving problems in everyday life.

2 2 Course Objectives

To meet the aims of the course the following objectives have been identified.

a) Knowledge and Understanding

Pupils should be able to demonstrate knowledge and understanding of:

- some scientific facts, ideas, and techniques
- some applications of science in society.

b) Problem Solving

Pupils should be able to demonstrate scientific abilities in problem solving by:

- handling and processing information
- evaluating procedures and information
- drawing conclusions and making predictions.

c) Practical Abilities

Pupils should be able to demonstrate ability in:

- practical scientific techniques
- investigative skills.

d) Attitudes

The course should be designed and presented in such a way as to encourage pupils to:

- develop initiative, interest and motivation
- be open-minded, and cooperate with others
- be aware that they can take decisions which affect the wellbeing of themselves and others, and the quality of their environment.

Attitudes will not be assessed for certification purposes.

Section 3

Course Description

3 Course Description

3 1 Course Outline

The course consists of:

- **four** compulsory topics, a total of approximately 120 hours of teaching time being devoted to these
- **one** additional topic or **two** additional topics selected by the school, approximately 40 hours of teaching time being devoted to the single topic or to the two topics combined.

The total allocation of time over the two-year course is 160 hours.

3 2 Compulsory Topics

Topic 1 Healthy and Safe Living

Healthy lungs
Heart and blood
Fit for life

Topic 2 An Introduction to Materials

Classification, uses and properties of materials
Extending the range of materials
The shape and strength of structures
Flammability
Damage to and protection of materials
Case study

Topic 3 Energy and its uses

Energy in the home
Electrical safety in the home
Non-renewable sources of energy
Alternative sources of energy
Renewable sources of energy

Topic 4 A Study of Environments

Energy from the sun for living things
Food chains and food webs
Interdependence and populations
Production and recycling of household waste
Pollution
Adapting the environment to human needs
Conservation

Details of the content of the topics are provided in Section 4.

3 3 Additional Topic(s)

A school or group of schools may devise additional topic(s) or use topics already prepared which should be capable of meeting the Extended Grade Related Criteria at each of the Levels at which the course is to be offered.

Topics devised for Foundation and General Levels may be extended to provide adequate levels of attainment at Credit Level. This may be done by augmenting the content, but would preferably take the form of requiring a greater depth of knowledge and understanding and their application to more demanding problems or aspects of problems.

In devising additional topics, consideration could be given to the possibility of using topics from one or more of the Biology, Chemistry, Physics or Technological Studies Standard Grade courses.

It is not necessary for all pupils at a particular school to be following the same additional topic(s), nor is it necessary for the topics to be taught in any particular order. Providing the choice of topic(s) allows the course objectives to be achieved, extends the pupils' own experience and illustrates applications of science and technology, then a school is free to promote its own priorities within the curriculum, ensure the most efficient use of available resources and capitalise on the interests and expertise of individual members of staff.

A pupil's performance in the additional topic(s) may be used as evidence in support of an appeal or in the case of adverse circumstances. Teachers are expected to include the work of the additional topic(s) in coming to a decision on estimate gradings for Knowledge and Understanding and for Problem Solving, and in determining the grade for Practical Abilities.

3 4 Progression beyond Standard Grade

Although there is no examination in Science on the Higher Grade, many opportunities for curricular progression exist for pupils with a Standard Grade Science qualification. The course objectives are similar to those of Standard Grade Biology, Chemistry and Physics, although the content differs. It should be possible for pupils to achieve success in any of these subjects by following a link course, and this could lead to presentation in one or more single science subject at Higher Grade. Additional opportunities for progression are described in the Higher Still Subject Guides for Physics, Chemistry and Biology.

It is important that pupils, parents, head teachers and guidance teachers as well as science teachers are fully aware of the wide range of opportunities available to pupils who have achieved an award in Standard Grade Science.

Section 4

Compulsory Topics

4 Compulsory Topics

4 1 Introduction

There are many ways of presenting a syllabus, ranging from bald statements of factual content to detailed compilations of specific objectives or learning outcomes with lists of experiments and references. In these pages, an attempt has been made to strike a balance between the extremes.

4 2 Content

4 2 1 Knowledge and Understanding

The content statements indicate knowledge and understanding expected at the different Levels. It is these statements which, when combined with the activities listed in the Grade Related Criteria for Knowledge and Understanding, may be used to provide appropriate specific objectives. Any of the activities, eg listing, selecting, explaining, may be combined with any appropriate area of content. This allows flexibility in undertaking assessment of Knowledge and Understanding and avoids both the restrictions imposed by a limited number of specific objectives and the unwieldiness of an exhaustive list.

4 2 2 Problem Solving

The Problem Solving statements give examples of ways in which problem-solving skills may be demonstrated in a given area of content. An attempt has been made to cover a variety of problem-solving skills, but it should be clearly understood that these activities are examples only and do not form a complete set. Teachers may, however, find them a useful starting point for their own ideas.

Topic 1: Healthy and Safe Living

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
1 Healthy Lungs		
1 Position of windpipe and lungs.		8 The structure of the respiratory system related to function, to include: windpipe kept open by cartilage rings; windpipe dividing into bronchi and bronchioles; and air sacs (alveoli) surrounded by capillaries for gaseous exchange.
2 In the lungs, oxygen from the air goes into the blood and carbon dioxide leaves the blood and is breathed out.	6 Function of the diaphragm and ribcage.	9 Mechanism of breathing in terms of volume and pressure difference.
		10 Haemoglobin in red blood cells carries oxygen and carbon dioxide is released from the plasma.
3 Harmful substances in tobacco smoke are: tar, nicotine and carbon monoxide.	7 Mechanism of entry of harmful substances into the body (e.g. nicotine and carbon monoxide are breathed into the lungs, and pass into the blood.)	11 Tar coats the air-sacs so that gases cannot be exchanged properly. Nicotine is addictive. Carbon monoxide stops the haemoglobin from carrying oxygen.
4 Smoking contributes to diseases such as bronchitis, lung cancer and heart disease.		12 Self-cleaning mechanism of the lungs: sticky mucus traps dirt, and beating hairs (cilia) lining the passages move the dirty mucus out of the lungs.
5 The lungs can also be polluted by car exhaust fumes, industrial waste gases and by solvent abuse.		13 Effects of pollutants and solvents on the body (eg fumes from car exhausts and industry increase bronchitis; glue-sniffing leads to lung, heart and brain damage).

Topic 1: Healthy and Safe Living *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
2 Heart and Blood		
1 Position of the heart and its function as a muscular pump.		12 The structure of the heart in relation to its function of pumping blood, to include: auricles (atria) collect the blood, right ventricle pumps blood to the lungs, left ventricle pumps blood around the body under pressure, and so needs a thicker wall.
2 Blood flows through blood vessels.	8 Arteries, capillaries, veins and valves, and their functions.	13 Arteries are thick-walled as the blood leaving the heart is under pressure. Capillaries are very thin-walled to allow exchange of gases, food and waste with body cells. Veins are thin-walled and contain valves.
3 Pulse rate is a measure of the rate at which the heart beats.	9 The relationship of pulse rate to exercise and the effects on circulation.	
4 Recovery time is a measure of fitness.		14 Recovery time is associated with removal of accumulated waste products (carbon dioxide and lactic acid).
5 Blood carries food, heat and oxygen around the body.	10 Blood consists of plasma, white cells, red cells and blood platelets	15 Plasma carries dissolved food, carbon dioxide and heat around the body. White cells destroy bacteria. Red cells carry oxygen. Platelets seal cuts by clotting the blood.
6 Blood helps to defend the body against germs or diseases.	11 White blood cells destroy bacteria (germs) by producing antibodies, and by engulfing and digesting bacteria.	16 Immunisation helps the body to produce antibodies before bacteria are present.
7 Factors which increase the risk of heart disease, to include: smoking, poor diet, worry and inherited factors.		17 A heart attack is caused when the coronary artery gets blocked (eg by a blood clot or fat deposit). This prevents oxygen getting to the heart muscle.

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
3 Fit for Life		
1 Normal body temperature is constant at 37 ^{O}C and usually higher than the surroundings. Variations from normal body temperature indicate illness.	9 Hypothermia is the inability to maintain core body temperature.	
2 Sweating decreases body temperature and shivering increases body temperature.		
3 Under normal conditions the body continuously loses heat to the surroundings. Clothing helps to retain heat. Energy must be supplied in the form of food to maintain body temperature.		
4 A varied nutrition (balanced diet) normally consists of milk and its products, bread or cereal, meat or alternative, fruit and vegetables.		
5 Problems associated with unhealthy eating habits include heart disease and anorexia.		
6 Alcohol affects behaviour (eg slow reactions, violence, sleepiness).	10 Alcohol abuse affects health and society (eg drink-related accidents, broken marriages, financial problems).	12 Physiological effects of alcohol on the body (eg damage to the liver and kidneys).
7 Equivalent alcohol content of common drinks: half a pint of beer, a small whisky, and a glass of wine all contain one standard unit of alcohol.		

Topic 1: Healthy and Safe Living *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
3 Fit for Life *(continued)*		
8 The different aspects of fitness are strength, suppleness, and stamina. Fitness can be improved by regular exercise.	11 The differences between the different aspects of fitness; strength (eg being able to lift heavy objects with ease), suppleness (eg being able to bend the body in many ways without feeling stiff and sore), stamina (eg being able to continue exercise without getting out of breath).	

Topic 1: Healthy and Safe Living *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
Select pages related to alcohol and its effect as a drug from part of the index of a book.	Select information from a medium length passage to give the advantage of using less salt in the diet.	Select information from a long passage to explain why two blood group O people may not be able to receive blood from each other.
Complete a key about the three types of blood vessels, from given information.	Select information from a key about immunisation.	Select information from graphs relating the duration of an expedition, the altitude climbed and the number of red blood cells in a member of an expedition.
Complete a bar graph to show the alcohol content of different drinks.	Construct a line graph to show the target heart rates required for a person to keep fit at various ages.	Construct a line graph to show the effect of temperature on the clotting time of blood.
Use percentages to calculate how many patients out of 200 are in blood group A.	Calculate the percentage of champagne in a cocktail.	Calculate the percentage increase in red blood cells from information shown on a graph.
Calculate the daily energy requirement given that 98,000kJ are used in seven days.	Calculate a person's average daily intake of alcohol.	Calculate the average increase in red blood cells from information shown on a graph.
Select an appropriate procedure to measure tar content of cigarette smoke.	Comment on a procedure to measure tar content of cigarette smoke.	Make critical comment on results of an experiment measuring tar content of cigarette smoke.
Put into correct order the steps for finding out how long it takes for a pulse rate to return to normal after playing tennis.	Describe a fair experiment, using given apparatus, to compare the energy in different types of peanuts.	Suggest improvements to a given method investigating the saltiness of peanuts.
Draw a valid conclusion from a table showing the average number of red blood cells in the people living at different heights above sea level.	Draw valid conclusions from a table showing the daily energy requirement of different groups of people.	Draw valid conclusions from a table showing the reaction times of people before, and after, drinking alcohol.

Note: Problem Solving skills should be developed, where appropriate, in the context of practical activities.

Topic 2: An Introduction to Materials

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
1 Classification, Uses and Properties of Materials		
1 Materials can be grouped under given headings, to include: natural and man-made; metals and non-metals; solids, liquids and gases.	5 Criteria for classification of materials. Materials can be grouped according to their origin, use and properties.	
2 The same material can have a number of different uses, to include: steel; copper; nylon and polystyrene.	6 Different materials can be used for the same purpose, to include: clothes, cooking vessels, building materials, containers and packaging.	
3 Materials have many different properties associated with their use, to include: strength; resistance to corrosion; thermal and electrical conductivity.	7 Materials have many different properties associated with their use, to include: flexibility; wear resistance; flamm-ability; heat resistance and elasticity.	8 Meaning of terms, to include: strength (the ability to support heavy loads without breaking); hardness (the ability to resist impact damage); wear resistance; thermal and electrical conductivity, by exemplification if appropriate.
4 Physical properties, cost, appearance, and health and safety implications are factors affecting the choice of a material for a particular use.		

Topic 2: An Introduction to Materials *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
2 Extending the Range of Materials		
		4 The importance of developing new materials with specific properties for particular applications, including new technologies (eg new materials for replacement hip-joints).
1 By changing the composition of a material, its range of properties and uses can be extended, to include: different mixes of sand, cement and aggregate in concrete; mixing metals to form alloys such as brass and solder; mixing man-made and natural fibres.	2 The properties of steel are affected by the elements which are added to iron. Carbon increases its hardness. Chromium and nickel increase resistance to corrosion. Tungsten increases resistance to wear.	
	3 Properties of materials may be affected by physical treatment. (eg steel is heated and quenched to make it harder; polystyrene is expanded to make it less dense and a better heat insulator; fibres are crimped to increase insulation).	

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
3 The Shape and Strength of Structures		
1 The strength of a structure depends on its shape. Arched bridges are stronger than beam bridges of the same span. The use of triangles in a structure strengthens it (eg electricity pylons, cross bracing in scaffolding).	2 The advantages of using tubes, girders (T and H) and corrugations in structures.	
4 Flammability		
1 Some materials catch fire easily eg paper, wood, cotton, petrol. 2 Materials such as curtains, soft furnishings and clothes may be treated with flame-proofing chemicals to stop them catching fire easily. 3 When clothes are laundered the flame-proofing chemical is often washed out.	4 Some materials produce toxic fumes on burning (eg all carbon-containing materials may produce carbon monoxide; poly-urethane produces hydrogen cyanide fumes; and polyvinyl chloride (PVC) produces hydrogen chloride fumes).	5 Carbon monoxide combines with haemoglobin in red blood cells and stops it carrying oxygen. Hydrogen cyanide affects the nervous system. Hydrogen chloride forms hydrochloric acid, when breathed in, and 'burns' the lining of the lungs.

Topic 2: An Introduction to Materials *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
5 Damage to and Protection of Materials		
1 Materials can be damaged by weather, corrosion, pests, heat or impact.	3 Corrosion is the gradual breakdown of a metal due to a chemical reaction at its surface.	5 The economic consequences of corrosion, to include: cost of replacing corroded parts; loss of production; additional labour costs; and costs of protection.
2 Methods of protection of materials, to include: water-proofing, painting; metal-plating; packaging, pesticide treatment; galvanising; electroplating; and anodising.	4 Electroplating is covering a metal with a layer of another metal using electricity. Galvanising is covering iron (or steel) with a layer of zinc. Anodising is using electricity to thicken the oxide layer on aluminium.	6 Appropriateness of type of protection for particular applications.

Topic 2: An Introduction to Materials *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
Select information from a pie chart giving information about the amount of plastic used in Europe.	Select information from a flow diagram showing how iron is produced in a blast furnace.	Select information from a flow diagram and table showing information on different types of rocks.
Complete a table, given the headings, from a passage about the colours of tempered steel.	Construct a headed table from a passage about metals and their properties.	Complete a table on copper production using information from two sources.
Complete a bar graph from a passage about the colours of tempered steel.	Draw a graph to show how a strip of wood, with a load hanging from it, bends as the length of the wood is increased.	Draw a graph to show how the thickness of paint on the hull of a ship changes over 36 months.
	Calculate the mass of a material given mass = volume x density.	Rearrange the energy of impact equation: E = mgh, to calculate the height (h) from which an object has been dropped.
Calculate how much copper sulphate would be in each of 6 beakers, if 90 g was divided out equally.	Calculate the mass of copper in 50 g of brass, given the percentage composition of brass.	
Select, from given diagrams, an appropriate procedure which would make a fair comparison of the flexibility of carbon fibre rod with that of split cane.	Outline an experiment to show how the stretch of elastic bands depends on their width.	Suggest improvements to a fair experiment in which detergents were used to remove fruit juice stains from cloth.
Use a table to draw a valid conclusion about the shape of the exhaust end of a jet engine and the noise level it produces.	Make valid predictions about the sag in the middle of a plank, supported at either end, when a load is placed in the middle.	Draw valid conclusions about the effects of oil and the effects of magnesium on the rusting of iron nails.

Note: Problem Solving skills should be developed, where appropriate, in the context of practical activities.

Case Study

A brief but detailed study of a chosen material or set of materials should be undertaken. The case study provides scope for both library and laboratory work and for the application of knowledge and understanding gained in the preceding sub-topics. While, therefore, there is no new examinable content to be overtaken, the case study provides an enhanced opportunity for reinforcement of the knowledge and understanding of the topic and at the same time permits further development of the pupils' skills in handling information, problem solving and practical work. Depending on the choice of case study, it may more appropriately be undertaken at the end of a different topic.

One suggested approach is that the pupil should, for a chosen material or set of materials:

- carry out a practical investigation of some properties
- obtain and present information about, for example, sources, properties, cost, uses, possible damage or hazards, means of protection, social and economic implications.

Suitable materials for a case study include: metals and alloys, glass, paper, dyestuffs, rubber, wood, fibres, plastics, detergents, photographic materials, insulators, rocks and minerals, fertilisers.

Topic 3: Energy and its Uses

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
1 Energy in the Home		
1 Energy is required in the home for heating, lighting and the operation of appliances. Energy for the home can come from electricity, gas and solid fuels.		6 The cost of home heating depends on the fuel used and other factors such as tariffs, installation charges and the period of use.
2 Heating is more expensive than lighting or using appliances. Energy use can be calculated from the difference between two meter readings.	5 The energy consumption (kWh, J) and cost of running an electrical appliance depends on the power rating (W, kW) and the period of use.	
3 Energy losses from the home cost money. Heat loss can be reduced by draught-proofing and by using an insulating layer (eg double glazing, loft insulation, lagging, carpets or cavity wall insulation). Energy waste can be eliminated by using showers instead of the bath, switching off lighting and heating when not needed, and appropriately setting the thermostat.		7 Energy is lost by conduction, convection and radiation. Most insulating materials trap a static layer of air. 8 Factors affecting the cost-effectiveness of remedies for energy loss/waste, to include: running costs, installation charges and the period of use.
4 Many appliances, such as heaters, ovens and irons, use a thermostat to maintain a steady temperature.		9 A thermostat operates at a selected temperature. When the temperature of the appliance rises above this pre-set point, the thermostat switches the heater off. When the temperature falls below the pre-set point the thermostat switches the heater on again.

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
2 Electrical Safety in the Home		
1 The electrical insulation on the wires for a plug is colour coded – brown for live, blue for neutral, yellow and green for earth.		
2 Fuses and earth wires are safety devices.		3 The correct fuse value depends on the power rating of the appliance (eg power ratings up to 720W need a 3A fuse; power ratings of 720W to 3000W need a 13A fuse). 4 The fuse and switch must be in the live wire to prevent the appliance from remaining "live" when the fuse wire melts or the appliance is switched off. 5 The earth wire is a safety device which is connected to the metal parts of the appliance. This provides a path for the electrical current if the metal parts become "live". A large current in the earth wire will melt the fuse, cutting off the electricity.
3 Non-renewable Sources of Energy		
1 Fossil fuels (coal, oil, natural gas and peat) are the main energy sources. Their supply is finite and requires conservation.	4 If the demand for fossil fuels outstrips supply there will be an energy crisis.	
	5 Fossil fuels are formed by the gradual compression of organic remains over millions of years. Solid fossil fuels form seams. Oil and natural gas seep upwards through the permeable layers of rock until they are trapped in anticlines and fault traps, capped by a non-permeable rock layer.	11 Oil and gas bearing rocks are detected by aerial photography, anomalies of gravity, geological survey, seismic survey and test drilling. 12 Coal has to be mined, while oil and natural gas are easier to extract as they are under pressure.

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
3 Non-renewable Sources of Energy *(continued)*		
2 Examples of products from crude oil (eg petrol, paraffin and diesel fuels; plastics and man-made fibres; bottled gases and lubricating oils).	6 The different fractions (refinery gas, petrol, naphtha, paraffin, diesel and bitumen) have increasing: darkness of colour, boiling points, viscosity; and decreasing flammability.	13 Crude oil can be separated into its constituent parts (fractions) by fractional distillation. Fractions can be separated from each other as they boil and condense at different temperatures.
	7 Refinery gas is used to make bottled gas (eg butane for caravans). Petrol is a car fuel. Naphtha is used to make plastics and other chemicals. Paraffin is used for heating and in aviation fuel. Diesel is a fuel for cars, trains and lorries. Bitumen is used for road surfacing.	
3 When fuels burn they use up oxygen.	8 The burning of fossil fuels is an oxidation process which produces carbon dioxide, water vapour and sulphur dioxide.	14 Insufficient oxygen results in incomplete combustion and the formation of carbon monoxide. Oxides of nitrogen may also be formed if high temperatures are reached.
		15 There are possible problems associated with industrial combustion, to include: acid rain from sulphur dioxide and oxides of nitrogen, "greenhouse effect" from carbon dioxide, "arctic winter" from smoke particles.
	9 The range of fire extinguishers relates to the variety of fires, to include: water or fire blanket for burning solids like wood or plastic; foam, carbon dioxide or fire blanket for burning liquids like petrol or oil; powder or carbon dioxide for electrical fires.	

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
3 Non-renewable Sources of Energy *(continued)*		
	10 Power stations can be fuelled by any fossil fuel. The fuel is used to boil water and produce steam. The steam turns the blades of a turbine and this drives a generator which produces the electricity.	16 In an electrical generator a magnet rotates, and produces current inside coils of wire. The current depends on both the strength of the magnet and the speed at which it is turning.
4 Alternative Sources of Energy		
1 Nuclear fuels produce heat energy.	3 The heat from nuclear fuels is used to boil water and produce steam. The steam turns the blades of a turbine and this drives a generator which produces the electricity.	
2 A nuclear power station produces waste which is radioactive and dangerous.	4 Radioactive waste must be stored safely to prevent pollution of the environment and prevent harm to people (eg it can be buried deep underground and stored for a long time in leak-proof containers).	5 Half-life is the time taken for radioactive material to lose half of its radioactivity. The longer the half-life, the longer the material must be stored before it becomes safe.
5 Renewable Sources of Energy		
1 Fossil fuels and nuclear fuels are non-renewable, but waves, wind, hydroelectricity and the sun are renewable sources of energy.		3 Other renewable sources of energy include sugar alcohol and geothermal heat. In sugar-growing countries, sugar can be fermented into alcohol which can be used as a fuel. To obtain geothermal energy, cold water is pumped down to a hot rock layer. The water is heated and forms steam which can be extracted and used to produce electricity or heat houses.

Topic 3: Energy and its Uses *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
5 Renewable Sources of Energy *(continued)*		
2 As the stocks of fossil fuels are depleted these alternative sources of energy will become more important.		4 There are advantages and disadvantages in the use of each alternative or renewable energy source, to include: cost, the technology involved, visual pollution, and reliability of the energy source.

Topic 3: Energy and its Uses *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
Use information to label a diagram showing how a solar panel works.	Select information from a graph of radioactive decay.	Select information from a passage about hydroelectric turbines.
Select the main theme of a passage describing different kinds of biofuel.	Use information in a passage to complete a table about sources of radiation and their annual dose.	Select information from a world map showing how long the coal and oil reserves of the world will last.
Complete a line graph showing crude oil production over the last five years.		Construct a single bar graph to show the initial cost and annual saving for three methods of saving energy at home.
From two meter readings, calculate the number of units of electricity used.	Calculate, using multiple operations, the total amount of radiation from various sources.	Rearrange the formula E=VIt to calculate the current used by a kettle.
Select an appropriate procedure to find out if loft insulation reduces the rate of heat loss from a house.	Suggest an appropriate procedure to find the optimum thickness of loft insulation needed in a house.	Make critical comment on the procedure used to calculate the optimum thickness of loft insulation needed in a house.
Draw valid conclusions from a table showing the temperature change in a model house related to the type and thickness of material used for insulation.	Draw valid conclusions from a table showing the amount of radiation escaping from nuclear waste drums made of different materials and with different wall thicknesses.	Draw valid conclusions from a graph showing the heat loss from pipes of different diameters containing water at different temperatures.
Use a graph showing the cooling of two differently shaped cups, to predict the cooling of another cup.	Predict and explain the results of experiments using various containers of different shapes to heat up water.	Draw valid conclusions and explain results from tables and graphs showing the cooling effects of liquids which easily evaporate.

Note: Problem Solving skills should be developed, where appropriate, in the context of practical activities.

Topic 4: A Study of Environments

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
1 Energy from the Sun for Living Things		
1 All energy for living things comes from the sun.		
2 Green plants use the sun's energy to make food.	3 Green plants use the light energy from the sun to make food which is stored as starch.	
2 Food Chains and Food Webs		
1 Producers are green plants which produce food. Consumers are animals which eat plants or other animals.		
2 Animals have to consume food as they cannot make their own food.		
3 Predators are animals which hunt or trap other animals for food. Prey are the animals which are hunted or trapped by predators.		
4 A food chain from a familiar natural environment.		
5 A food chain within a given food web.	8 A food web including at least five organisms.	
6 Energy is transferred from producers to consumers.		
7 Energy is lost at each step in a food chain.	9 More energy is available to the final consumer (eg human beings) through shorter food chains.	11 Energy may be lost between feeding levels by movement, respiration, heat and waste material.
	10 The removal of one species has an effect on the remaining organisms in a food web.	12 The greater the number of links in a food web, the more stable is the environment.
		13 Decomposers (eg bacteria and fungi) get their energy by decaying natural waste, releasing materials which can be used again by producers.

Topic 4: A Study of Environments *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
3 Interdependence and Populations		
1 Environmental factors influence where either an animal or plant may be found (eg temperature, humidity, pH, light intensity, flow rate).	2 Factors which control the number of living things of one particular kind in an environment, to include: predators, competitition for space, and competitition for food.	3 A population is the number of organisms of one type which are living in a habitat. 4 Other factors can limit population growth (eg disease, migration, climatic change, natural disasters, habitat interference).
4 Production and Recycling of Household Waste		
1 Types of waste produced by a typical household, (eg plastic, metal, glass, paper, ashes, rags, animal/ vegetable materials). 2 Metal, glass, paper and plastics can be easily recycled.	3 Recycling saves energy, resources, money and protects the environment.	
5 Pollution		
1 Air can become polluted (eg by smoke, car exhaust fumes, CFCs and sulphur dioxide).	4 Air pollution causes lung diseases such as asthma and bronchitis. 5 Lichens can be used to indicate the level of pollution. In areas of low pollution there are more types of lichens, and in greater number.	9 CFCs cause the break-down of the ozone layer which shields the Earth from solar radiation. 10 Increased carbon dioxide from burning fossil fuels produces a "greenhouse effect". Less heat escapes from the Earth resulting in environmental changes (eg polar ice-caps melt, sea level rises, changes in climate and vegetation). 11 Air pollution can be reduced (eg using alternatives to fossil fuels, scrubbing discharged gases).

Topic 4: A Study of Environments *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
5 Pollution *(continued)*		
2 Water can become polluted (eg by oil, sewage and industrial waste).	6 Water pollution decreases the oxygen level in the water, killing some animals and plants.	12 Relationship between the level of pollution with organic waste, and each of bacterial numbers, oxygen concentration and number of species.
	7 Freshwater invertebrates can be used to indicate the level of water pollution. In areas of low pollution there are more types of invertebrates, and in greater number.	
3 Land can become polluted (eg by coal bings, in-fill sites, lead mine workings, pesticides).	8 Land pollution prevents plants from growing properly and gradually poisons animals.	13 Pollutants accumulate along a food chain.
6 Adapting the Environment to Human Needs		
1 The five basic needs of human beings are shelter, water, warmth, food, and air.	2 Human beings adapt the environment to meet their basic needs to include: building houses for shelter; making dams and reservoirs for storing water; constructing coal mines and power stations to provide energy for warmth; clearing away natural forests and grasslands for farming.	
7 Conservation		
1 Conservation is a way of meeting our basic needs without destroying the environment.		
2 Examples of conservation (eg replanting areas after timber extraction; maintaining hedges and trees around fields; protecting endangered species).		

Topic 4: A Study of Environments *(continued)*

Knowledge and Understanding: Content Statements		
Foundation Level	General Level	Credit Level
Extract information from the index of a nature book.	Use the information in a passage to label a diagram of a compost bin.	Select information from a technical passage about the habitat of a plant.
Complete a key about leaves from simple text.	Construct a table with suitable headings based on a passage about three types of ladybird.	Complete a key from given information about the germination requirements of four types of primula seed.
Construct a food chain from simple text.	Construct a food web from four food chains.	Construct a food web from two tables: one of producers and their consumers, the other of predators and their prey.
Complete a table, given the headings, from a passage about the effect of air temperature on the light produced by fireflies.	Draw a bar graph from a table showing the amounts of different kinds of litter found in a hedgerow.	Draw a line graph showing the relative numbers of a woodland predator and its prey, over several years.
Calculate the volume of water retained in different soils, given the volume of water put in and the volume of water coming out.	Calculate the percentage of a lion's food energy which is used for growth and repair.	Rearrange the recapture formula: $\frac{X}{N} = \frac{Z}{Y}$ used to estimate the number of pheasants in a wood.
From four given factors, identify the one which might affect the fairness of an experiment on the germination of seeds.	From six diagrams of pond weed growing in beakers of fertiliser- containing water, identify the pair which would give a fair comparison of two fertilisers.	Suggest improvements to an investigation to study the effect of a fertiliser on the growth of pond weed.
Draw valid conclusions from the results of food chain experiments using seaweed, limpets, whelks and crabs.	Draw valid conclusions from a diagram showing how water speed in a river affects the type and number of caddis fly larvae.	Draw valid conclusions from a table about sewage outfall and its effect upon water quality and wildlife.
Predict the types of lichen found in an area, given information about the level of pollution and its effect upon varied lichen types.	Explain the shape of a graph showing the effect of light intensity on oxygen production by a green plant.	Use graphs and diagrams to explain the effects of pH and minerals on plant growth.

Note: Problem Solving skills should be developed, where appropriate, in the context of practical activities.

Section 5

Assessment for Certification

5 Assessment for Certification

5 1 Assessable Elements

The assessable elements for the course, based on the course objectives identified in Section 2, are:

- Knowledge and Understanding
- Problem Solving
- Practical Abilities.

These elements will be used as the basis for assessment and profiling of candidate performance.

5 2 Certification

Candidates will be assessed by a system common to all Levels.

The Certificate will record an overall award on a 7-point scale of grades, Grade 1 being the highest. The Certificate will also record attainment in each assessable element. The overall award will be derived from the mean of the element grades with a weighting of 2:2:1 in favour of the externally assessed elements.

5 3 Grade 7 and No Overall Award

For any element, Grade 7 will indicate that the candidate has, in the element concerned, completed the course but has not demonstrated achievement of any specified level of performance as defined by the Grade Related Criteria. Grade 7 in an element will not be available to external candidates.

The Scottish Qualifications Authority (SQA) will regard the submission of an estimate grade for an externally assessed element as evidence that the course has been completed in that element.

Candidates who have not complied with the assessment requirements in any element (eg due to unauthorised absence from the external examination) will be deemed not to have completed the course, in that element. Such candidates **will not receive a grade** for that element and hence **will not receive an overall award** for the subject. In such cases, however, if a grade is gained for any other element, that grade will be recorded on the Certificate.

It should be noted that since external candidates will not be assessed in the element Practical Abilities, they will be unable to obtain an overall award in Science.

5 4 External Assessment

The external examination papers, each assessing Knowledge and Understanding, and Problem Solving, will be as follows:

Foundation Level (Grades 6, 5): 1 hour

General Level (Grades 4, 3): 1¼ hours

Credit Level (Grades 2, 1): 1½ hours

The questions in each paper will relate to the compulsory topics as illustrated by the content statements for the course (see Section 4). A variety of question types may be used and candidates will be expected to attempt all questions.

Marks will be allocated to each question and a total mark obtained for each element. The two grades associated with each Level will be distinguished by setting two cut-off scores. The lower score (in the region of 40-50%) will reflect a satisfactory overall standard of performance, the upper score (in the region of 70-80%) a high overall standard of performance.

Candidates who attempt papers at two Levels will be given the better of the two grades achieved on these papers. Performance at one Level will **not be** taken into account in grading at the other Level.

5 5 Internal Assessment: Estimates for Knowledge and Understanding and Problem Solving

Presenting centres must submit to the SQA, by 31 March of the year of the examination, an estimate grade for each candidate for Knowledge and Understanding and for Problem Solving.

In the light of their overall performance in an element, candidates should be assigned in the first instance to one of the three Levels, Foundation, General or Credit, and then to the upper or lower of the grades within the Level (see also 6 2).

In general terms, Standard Grade certification is a portrayal of the attainment level reached at the end of the course. Internal assessments submitted to the SQA should accordingly indicate the position reached at the time of submission. It will nevertheless be desirable to have periodic internal assessments at intermediate stages during the course in order to provide a sound basis for final judgement and, where appropriate, to record achievement in areas where content coverage (eg end-of-topic tests in Knowledge and Understanding) or skill development is not to be taken any further as well as illustrating the candidate's achievement in Science.

Presenting centres should retain suitable evidence in support of estimates submitted. This should not be submitted to the SQA, but should be available for use in connection with the SQA's internal procedures, including such cases as absence from the external examinations, adverse circumstances and appeal. The evidence must be sufficient to support the estimates submitted and should therefore represent an adequate sample of the Extended Grade Related Criteria for these elements.

5 5 *(continued)*

The internal estimates should relate to performance in both the compulsory and the additional topic(s).

Teachers may choose to encourage pupils to collect work in a folio for reasons such as increasing motivation and developing a sense of achievement and of progression through the course. In such cases, there is no need to submit the complete folio if evidence is required by the SQA; the evidence submitted should be drawn from both the compulsory and the additional topic(s) and might for example include tests on different topics and a sample or samples of written work.

In any event, it is important that some of the evidence is drawn from a case study or investigative work in the laboratory.

5 6 Internal Assessment of Practical Abilities

5 6 1 Introduction

Assessment of Practical Abilities is the responsibility of the teacher concerned. Candidates will be awarded a grade on the 7-point scale based on performance in relation to the assessment scheme set out below and the Grade Related Criteria stated in paragraph 6 10.

Within Standard Grade Science, there are two components of Practical Abilities, namely, Techniques and Investigations.

5 6 2 Techniques

The specified techniques and the related criteria for assessment, together with a note of opportunities within the course to practise each technique, are set out in the following table.

5 6 2 *(continued)*

TECHNIQUE	CRITERIA FOR ASSESSMENT	OPPORTUNITIES TO PRACTISE TECHNIQUE
	To achieve success in this technique the candidate must:	
1 Measuring the pH of soil or water samples	1 demonstrate the correct use of pH paper or liquid or pH meter, including moistening of paper/sample if necessary; 2 correctly measure pH to ± two pH units for at least three samples. *The measurements should be made in context. Preferably the technique should be carried out on samples the candidates have collected. If not, then candidates should be provided with samples suitably labelled as, "river water", "polluted water", "forest soil", "peaty soil", etc.*	A Study of Environments Interdependence and populations Pollution Energy and its Uses Non-renewable sources of energy (acid rain)
2 Wiring a plug	1 given a length of cable with part of the sheath removed, cut each of the three wires to the required length; 2 connect all 3 wires to the correct terminals so that the plug would work safely (ie no damage to wires, no possibility of shorting and fuse correctly fitted); 3 ensure that the cable is in the cord grip; 4 tighten all screws so that the wires cannot be pulled loose.	Energy and its Uses Electrical safety in the home
3 Testing for electrical conductivity	1 set up a simple circuit consisting of a battery (or power pack), bulb (or meter) and connecting wires, by reference to a simple circuit diagram. The diagram may be in pictorial form rather than in circuit notation;	An Introduction to Materials Classification, uses and properties of materials

TECHNIQUE	CRITERIA FOR ASSESSMENT	OPPORTUNITIES TO PRACTISE TECHNIQUE
3 Testing for electrical conductivity (continued)	2 test a minimum of five solids and correctly classify each one as either a conductor or insulator	
4 Measuring temperature changes	1 demonstrate the correct use of the thermometer (eg bulb immersed, left to come to a steady temperature, not removed to read); 2 make two correct readings to an accuracy of $\pm$ 1^0C and subtract to find the temperature change.	Any point in the course where temperature differences are measured, eg Healthy and Safe Living Fit for life An Introduction to Materials Classification, uses and properties of materials Energy and its Uses Energy in the home
5 Measuring light intensity using a meter in three different locations	1 use the apparatus correctly; 2 read the correct scale; 3 take the correct readings in three different locations.	A Study of Environments Energy from the sun for living things
6 Using a microscope	1 adjust the microscope so that there is enough light; 2 adjust the microscope so that the specimen/prepared slide is in focus.	Healthy and Safe Living Healthy lungs Heart and blood An Introduction to Materials Classification, uses and properties of materials
7 Measuring pulse rate	1 demonstrate how to measure pulse rate; 2 listen to an audio-tape of heart beats; 3 count the number of heart beats on the tape in a given time interval; 4 calculate the equivalent pulse rate.	Healthy and Safe Living Heart and blood

TECHNIQUE	CRITERIA FOR ASSESSMENT	OPPORTUNITIES TO PRACTISE TECHNIQUE
8 Making estimates of weight, time, volume and length	To achieve success in this technique the candidate must achieve success in any **three** of the following. 1 given four objects differing in mass by approximately 250g, identify the one which is approximately 1 kilogram; 2 estimate a short time interval of 30 seconds to an accuracy of ± 5 seconds; 3 given four commonly used containers differing in capacity by approximately 250 ml, identify the one which has a capacity of approximately 1 litre; 4 estimate a length of 1 metre, eg by marking or cutting material, to an accuracy of ± 10%.	Any point in the course where weight, time, volume or length is measured.

Each candidate should be assessed on **all** of the eight techniques listed above, the assessment being carried out during ongoing classwork or in specific practical tests. Candidates who on a particular occasion are unable to carry out a technique successfully may be given further opportunities to practise the technique and then be assessed again on another occasion.

A score of one mark should be awarded by the teacher for each technique successfully demonstrated by the candidate. Where the candidate is unsuccessful in demonstrating a technique, zero marks should be awarded.

5 6 3 Investigations

This component is assessed in terms of the extent to which Investigative Skills objectives are achieved by a candidate in the course of carrying out each of his/her best two investigations. During the course, candidates should be given opportunities to undertake a number of investigations, each of which involves demonstration of the thirteen specified Investigative Skills objectives.

The objectives are grouped under four headings, as follows:

i Generative Skills (G)

ii Experimentation Skills (E)

iii Evaluation Skills (Ev)

iv Recording and Reporting Skills (RR).

Two investigations, each covering all of the Investigative Skills objectives, should be submitted for the purpose of assessment for certification. At least one of the investigations must involve a continuous independent variable.

The Investigative Skills objectives to be assessed, together with the related assessment criteria and mark allocations for Standard Grade Science, are set out in paragraph 5 6 6 below.

5 6 4 Structure of Investigations

Investigations carried out for certification purposes should provide opportunities for candidates to demonstrate **all** thirteen of the Investigative Skills objectives. They should be of a suitable standard and should not be repeats of classwork experiments or investigations which have already been attempted either during practice or previous assessment. It is important that a candidate's "report" of an investigation (ie the candidate's written response to an investigation) is structured in a way which allows the teacher and an external moderator readily to identify in the evidence generated those parts which relate to the individual objectives. It is equally important that the degree of structuring of the Investigation is not so great that the candidate receives an excessive amount of support. The Investigation Booklet issued by the SQA must be used for all investigations conducted for the purposes of assessment for certification.

5 6 5 Conduct of Investigations

The following comments give guidance on the permissible limits of support which may be offered by teachers during an investigation which is being assessed for certification purposes.

It is expected that, at the outset of the investigation, teachers will stimulate class or group discussion. Subsequent to the discussion, candidates must work individually throughout the remainder of the investigation. However, if the candidate is unable to meet the criterion for G1, the teacher should give assistance to enable the candidate to proceed but will not award the mark allocated to this Objective. In the case of a candidate who identifies a relevant investigable aspect which cannot be investigated within the constraints of the school situation, the candidate should be directed to other alternatives without penalty. Should a candidate fail to meet a criterion associated with Objective G2, G3 or G4, it is permissible for the teacher to intervene and give sufficient support to enable the candidate to proceed, but the mark allocated **to the relevant criterion** will not be awarded.

After the generative phase (Objectives G1, G2, G3 and G4) candidates must be left to pursue the investigation **independently**. Teacher intervention in the post-generative phase is permitted only when the candidate fails to adopt standard, safe laboratory practice. In such a case, the mark allocated to the criterion for Objective E1 is forfeited.

Investigations for certification purposes must be carried out and written up by the candidate in class time.

5 6 6 Assessment Scheme for Investigations

Assessment of achievement of Investigative Skills objectives is undertaken by applying the following assessment scheme to a candidate's investigation. The scheme identifies the criteria which must be satisfied for the purposes of assessment for certification. For each of the criteria, one mark should be awarded where the requirements of the criterion are satisfied. If a criterion is not satisfied, zero marks should be awarded. The total mark allocation for an investigation is 24.

For certification purposes, the final mark should be the sum of the scores for the candidate's **two** best investigations to give a score out of 48.

5 6 6 *(continued)*

Investigative Skills Objective The candidate should be able to:	**Assessment Criteria and available marks**	**Marks Total**
G1 demonstrate understanding of the problem posed;	Following group discussion, the candidate individually identifies and records an investigable aspect of the problem (1,0)	1
G2 state the aim of the investigation;	Clearly identifies the aim of the investigation in terms of the two relevant variables (1,0)	1
G3 articulate a testable hypothesis;	Articulates a testable hypothesis in terms of the two relevant variables; this should be directional if a continuous variable is chosen (1,0)	1
G4 suggest a broad strategy to adopt;	The strategy gives sufficient detail by description and/or diagram to indicate: *a)* how the chosen independent variable will be altered (1,0) *b)* that the candidate has considered what will have to be measured (1,0)	2
E1 adopt appropriate and safe procedures;	Adopts appropriate and safe procedures (1,0)	1
E2 identify the independent variable to be used and alter it over a suitable range;	*a)* Provides a working definition of the independent variable (1,0) *b)* Alters the independent variable over an appropriate range taking account of a suitable number of types or values (1,0)	2
E3 control all relevant variables as necessary;	*a)* Makes a written statement of the variables which need to be actively controlled by the candidate (1,0) *b)* Controls these variables in practice (1,0)	2
E4 make valid, reliable measurement of the dependent variable;	*a)* Uses a valid method of measuring the dependent variable (1,0) *b)* Evidence is provided of a form of repeat/replicate testing which improves the reliability of the results **or** a valid written justification is given for not repeating/replicating measurements (1,0)	2
RR1 tabulate results with appropriate headings and units of measurement;	*a)* Values (or types) with appropriate headings for independent, dependent (and any derived) variable are entered in the table (1,0) *b)* Appropriate units or their correct abbreviations are entered in the table (1,0)	2

Investigative Skills Objective The candidate should be able to:	**Assessment Criteria and available marks**	**Marks Total**
RR2 present the results on a graph or chart;	*a)* A graph or chart of a suitable size and scale is produced (1,0) *b)* Both axes have appropriate labels and units (1,0) *c)* Plots all the points/bars accurately (1,0) *d)* Draws line/curve of best fit or joins up the points as appropriate when the independent variable is continuous **or** draws a bar chart when independent variable is not continuous (1,0)	4
Ev1 draw a valid conclusion inter-relating the appropriate variables;	Draws a conclusion which interrelates the appropriate variables or states that no firm conclusion can be drawn (1,0)	1
Ev2 use results to evaluate the original hypothesis;	Confirms hypothesis if appropriate or refutes hypothesis and replaces it with appropriate substitute **or** states that no conclusion can be drawn (1,0)	1
RR3 describe how the investigation was carried out.	The description includes: *a)* a labelled diagram and/or statement of the apparatus used; (1,0) *b)* an account of the procedure adopted to measure the dependent variable; (1,0) *c)* an account of how the independent variable was altered; (1,0) *d)* an indication of how variables which were the investigator's responsibility to control were kept constant (1,0)	4

5 6 7 Use of Inference Item Sets

a) As a teaching aid

The Inference Skills identified by the Techniques for the Assessment of Practical Skills in Science research group (TAPS) relate closely to some of the Investigative Skills objectives and consequently the TAPS inference item sets can provide a useful teaching aid to help candidates develop some of the skills required to carry out investigations.

b) As an alternative approach to the assessment of Investigations for awards at Grades 5, 6 and 7

Performance in Inference Skills provides evidence of attainment of some skills of investigating and offers an alternative approach to the assessment of Investigations which may be appropriate for a candidate who achieves only very limited success in carrying out investigations. It is, however, recommended that all candidates are given opportunities to undertake investigations even if these are not assessed for certification. (A **combination of scores** obtained by this approach and that using the thirteen Investigative Skills objectives identified in paragraph 5 6 6 above is not permitted.)

The relevant Inference Skills which could be assessed for certification purposes are:

- make plausible generalisations from observations
- use generalisations and observations to draw valid conclusions
- make deductions from hypotheses
- use observations to confirm or refute existing hypotheses.

Note: While the inference item sets produced by TAPS provide a means of assessing these skills, it may be necessary to simplify the language used in these sets for some candidates. Care should be taken to ensure that this does not alter the assessment of the skill(s).

One mark is allotted to each of the four Inference Skills listed above and performance in each skill marked on a 1 or 0 basis.

Each candidate for whom this alternative approach is adopted should be assessed on **all** of the four Inference Skills listed above. Candidates who on a particular occasion are unsuccessful may be assessed again on another occasion. The mark for an Inference Skill should be awarded once the teacher has clear evidence of the candidate's proficiency in this.

This approach, combined with the assessment of Techniques, enables an award to be made at Grades 5, 6 and 7 only (see Appendix).

5 6 8 Recording of Assessment of Practical Abilities

For each candidate, a summary record should be kept of the outcome of the assessment of the two components of Practical Abilities, Techniques and Investigations.

For Techniques a record should be kept of the mark (1 or 0) achieved for each of the eight techniques and thereafter the total of these marks.

5 6 8 *(continued)*

For Investigations the record should state clearly whether assessment is based on:

i the total mark of two Investigations assessed using the thirteen Investigative Skills objectives;

or

ii the assessment of Inference Skills.

In the first case, the total mark obtained for each of the Investigations should be recorded. In the second case, the mark (1 or 0) achieved for each of the four Inference Skills should be recorded, and thereafter the total of these marks.

Form Ex5 (Flyleaf) will be issued to presenting centres, annually, for use in connection with the submission of materials at the moderation stage. The reverse side should be used to record the above details of a candidate's performance in Practical Abilities. A sample of the reverse side of Form Ex5 (Flyleaf) is appended. Presenting centres will also be provided on an annual basis with details of the arrangements for the submission of internal assessments of Practical Abilities for all candidates.

5 6 9 Evidence of Attainment of Practical Abilities

Evidence of a candidate's attainment of Practical Abilities should comprise a summary record, as described in paragraph 5 6 8 above, and, as appropriate, evidence of the candidate's work in Inference Skills or in producing his/her best two investigations. In the latter case the evidence should be in the form of an investigation booklet for each of the two investigations. Each of these investigation booklets must give a clear indication of the mark awarded for each of the Investigative Skills objectives and of the total mark awarded.

5 6 10 Grade for Practical Abilities

For each candidate, **a total score for Practical Abilities should be determined by multiplying the mark awarded for Techniques by 2 and adding it to the mark awarded for Investigations**. The grade for the element should then be determined by reference to the following table.

Marks range	Grade
64-55	1
54-46	2
45-39	3
38-30	4
29-19	5
18-12	6

5 6 10 *(continued)*

Candidates for whom there is evidence in support of at least one technique or investigation and who achieve an overall total score of less than 12 marks should be awarded a Grade 7 for Practical Abilities.

Alternatively, if inference item sets were used to assess a candidate's skills of investigating, the grade should be determined by multiplying the mark awarded for Techniques by 2, multiplying the mark awarded for Inference Skills by 2 and adding these two marks. The grade for the element should then be determined by applying the cut-off scores for Grades 5 and 6 given in the table above. **The highest award possible by this method would be Grade 5.** For a Grade 7, evidence would be required for at least one technique or inference item set (see Appendix).

5 6 11 Moderation of Internal Assessments

To ensure the uniform application of the Extended Grade Related Criteria for Practical Abilities, each year a sample of presenting centres will be required to submit to the SQA evidence in support of internal assessments of Practical Abilities for a sample of candidates. Where a centre's internal assessments cannot be confirmed, the centre will be required to carry out re-assessment as necessary.

Section 6

Grade Related Criteria

6 Grade Related Criteria

6 1 Definition

Grade Related Criteria (GRC) are positive descriptions of performance against which a candidate's achievement is measured. Direct comparisons are not made between the performance of one candidate and that of another.

6 2 Application of GRC

GRC are defined at three Levels of performance: Foundation, General and Credit.

Awards will be reported on six grades, two grades being distinguished at each Level. The upper of the two grades at a given Level will be awarded to candidates who meet the stated criteria demonstrating a high standard of performance; the lower grade to those who demonstrate a lower, but still satisfactory standard of performance.

There will be a seventh grade for candidates who complete the course but fail to meet the criteria for any Level.

6 3 Types of GRC

Summary GRC are broad descriptions of performance. They are published as an aid to the interpretation of the profile of attainment by candidates, parents, employers and other users of the Certificate.

Extended GRC are more detailed descriptions of performance. They are intended to assist teachers in making their assessments for each element and in identifying targets for course construction, and by examiners when conducting external assessment.

6 4 Knowledge and Understanding – Summary GRC

Foundation Level (Grades 6, 5)

In relation to the course topics* the candidate has demonstrated basic knowledge and understanding of scientific facts and ideas, and their application in society.

General Level (Grades 4, 3)

In relation to the course topics* the candidate has demonstrated knowledge and understanding of scientific facts and ideas, and their application in society.

Credit Level (Grades 2, 1)

In relation to the course topics* the candidate has demonstrated detailed knowledge and thorough understanding of scientific facts and ideas, and their application in society.

* including Healthy and Safe Living; An Introduction to Materials; Energy and its Uses; A Study of Environments.

6 5 Problem Solving – Summary GRC

Foundation Level (Grades 6, 5)

The candidate has demonstrated ability to select and present information; to carry out simple calculations; to select from a list of alternatives an appropriate problem-solving procedure, identifying which given factors might affect its fairness; and to draw conclusions, explain results and make predictions.

General Level (Grades 4, 3)

The candidate has demonstrated ability to select and present information using correct scientific terminology; to carry out calculations; to suggest an appropriate problem-solving procedure, identifying the factors which might affect its fairness, and possible improvements; and to draw conclusions, explain results and make predictions.

Credit Level (Grades 2, 1)

The candidate has demonstrated ability to select and present information precisely and concisely using correct scientific terminology; to carry out calculations; to suggest an appropriate problem-solving procedure, discussing the limitations of the equipment, sources of error and possible improvements; and to draw conclusions, explain results and make predictions.

6 6 Practical Abilities – Summary GRC

Foundation Level (Grades 6, 5)

The candidate has demonstrated ability to carry out a range of practical scientific techniques and competence in some investigative skills.

General Level (Grades 4, 3)

The candidate has demonstrated ability to carry out a wide range of practical scientific techniques and to carry out scientific investigations with a degree of competence.

Credit Level (Grades 2, 1)

The candidate has demonstrated ability to carry out a wide range of practical scientific techniques and to carry out scientific investigations with a high degree of competence.

6 7 Descriptions of Grades

These describe performance within Levels and apply to each element.

Grade 6 The candidate has met the criteria for Foundation Level, demonstrating a satisfactory overall standard of performance.

Grade 5 The candidate has met the criteria for Foundation Level, demonstrating a high overall standard of performance.

Grade 4 The candidate has met the criteria for General Level, demonstrating a satisfactory overall standard of performance.

6 7 *(continued)*

Grade 3 The candidate has met the criteria for General Level, demonstrating a high overall standard of performance.

Grade 2 The candidate has met the criteria for Credit Level, demonstrating a satisfactory overall standard of performance.

Grade 1 The candidate has met the criteria for Credit Level, demonstrating a high overall standard of performance.

6 8 Knowledge and Understanding – Extended GRC

In demonstrating Knowledge and Understanding, candidates will be required to undertake tasks which involve the following activities:

- stating
- giving examples
- identifying
- labelling
- listing
- matching
- naming
- selecting
- describing
- explaining
- distinguishing
- summarising
- putting in sequence.

Foundation Level (Grades 6, 5)	General Level (Grades 4, 3)	Credit Level (Grades 2, 1)
The candidate can demonstrate knowledge and understanding of scientific facts, ideas and their application in society as illustrated by the content statements at Foundation Level (see Section 4).	The candidate can demonstrate knowledge and understanding of scientific facts, ideas and their application in society as illustrated by the content statements at General Level (see Section 4).	The candidate can demonstrate knowledge and understanding of scientific facts, ideas and their application in society as illustrated by the content statements at Credit Level (see Section 4).

Note: Some overlap between Levels may occur. For example, content at General Level may be used, with appropriate guidance, to assess whether the Foundation statement has been fully understood.

6 9 Problem Solving – Extended GRC

Foundation Level (Grades 6, 5)	General Level (Grades 4, 3)	Credit Level (Grades 2, 1)
The candidate can:	In addition, the candidate can:	In addition, the candidate can:
***select relevant information from sources related to the course, eg index, passage of writing, key, flow chart, diagram, table, bar graph, line graph, pie chart;**	——————————›	
present information in a written +or graphic form, eg write reports, summarise given information, accurately label a diagram, order information with appropriate headings, construct line and bar graphs when provided with ordered data, scales and axes, construct simple pie charts;	present information in written or graphic form using correct scientific terminology;	present information precisely and concisely in written or graphic form using correct scientific terminology;
process information by carrying out science-based calculations involving +, –, ×, ÷, and use simple given percentages in science-based situations;	***process information by carrying out science-based calculations involving multiple operations including percentages and averages or applying a relationship in science-based situations;**	——————›
select an appropriate procedure to solve a problem from several suggestions and identify which given factors might affect the fairness of the procedure;	suggest an appropriate procedure or comment on a given procedure to solve a problem eg identify the factors which might affect the fairness of the procedure and suggest possible improvements;	suggest an appropriate procedure or comment on a given procedure to solve a problem, eg discuss the limitations of equipment, sources of error and possible improvements;
draw valid conclusions, explain results and make valid predictions from information related to the course at Foundation Level.	draw valid conclusions, explain results and make valid predictions from information related to the course at General Level.	draw valid conclusions, explain results and make valid predictions from information related to the course at Credit Level.

* Differentiation depends on the degree of difficulty of the task performed.

6 9 *(continued)*

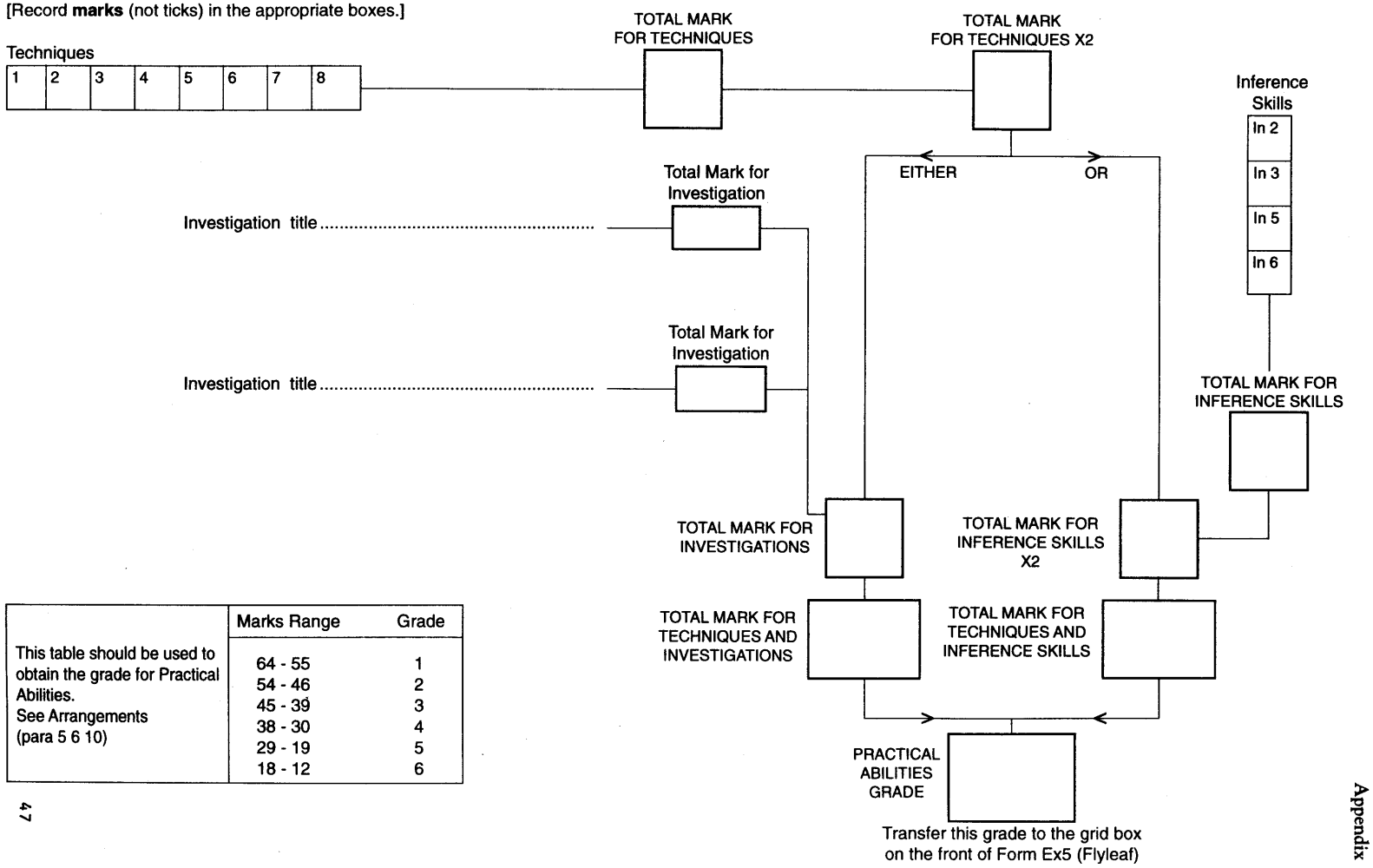
	Foundation Level (Grades 6, 5)	General Level (Grades 4, 3)	Credit Level (Grades 2, 1)
	The candidate can:	The candidate can:	The candidate can:
Techniques	demonstrate competence in carrying out some practical scientific techniques;	demonstrate competence in carrying out a high proportion of practical scientific techniques;	demonstrate competence in carrying out a high proportion of practical scientific techniques;
Investigations	demonstrate competence in some investigative skills.	demonstrate competence in a proportion of investigative skills in carrying out scientific investigations.	demonstrate competence in a high proportion of investigative skills in carrying out scientific investigations.

Note: It is expected that candidates will perform well in Techniques as compared to Investigations. A good performance in Investigations may outweigh a poor performance in Techniques.

Appendices

Science Standard Grade
Practical Abilities Assessment Record

[Record **marks** (not ticks) in the appropriate boxes.]



This table should be used to obtain the grade for Practical Abilities. See Arrangements (para 5 6 10)	Marks Range	Grade
	64 - 55	1
	54 - 46	2
	45 - 39	3
	38 - 30	4
	29 - 19	5
	18 - 12	6

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Appendix

Appendix II

(append to Arrangements issued August 1997)

Assessment of Practical Abilities

Standard Grade Biology, Chemistry, Physics and Science

In August 1997 SQA issued revised arrangements for the assessment of Practical Abilities in all of the science subjects specified above. These revised arrangements were implemented for the first time in 1999.

Following central moderation of the internal assessment of these subjects, SQA has decided that the following additional guidance should be provided to centres. **This additional guidance does not change any requirements of the published Arrangements documents and should be read in conjunction with these documents.**

General Comments

1 The assessment of candidate performance is carried out with reference to the Extended Grade Related Criteria (EGRC) that are included in Arrangements documents. Across the science subjects, the EGRC for Practical Abilities at Foundation, General and Credit Levels detail requirements for *both* techniques and investigations. In addition, the Summary GRC for Practical Abilities confirm that both techniques *and* investigations are required at all levels.

To be awarded any grade other than 7 in Practical Abilities, candidate evidence must be consistent with the EGRC and so must cover **both techniques and investigations**. For example, to be awarded any grade between 1 and 6 for Practical Abilities in Standard Grade Science, in achieving the minimum mark specified in the Arrangements document, candidates must:

- carry out at least one practical technique
  and
- achieve at least one Investigative Skill objective.

All of the Arrangements documents for science Standard Grades include statements of the type:

> "Candidates for whom there is evidence in support of at least one technique or investigation and who achieve an overall total of less than X marks should be awarded a Grade 7 for Practical Abilities."

These statements apply only to the award of Grade 7. A small number of schools have inferred, incorrectly, that these statements also apply to the award of grades other than 7. As indicated above, this inference is consistent neither with the EGRC nor the Summary GRC.

A candidate who attempts neither techniques nor investigations will be deemed not to have completed the course in the Practical Abilities element. Such a candidate will not receive a grade for this element and hence will not receive an overall grade for the subject.

2 **To comply with the EGRC**, investigations undertaken by candidates **must** be relevant to the subject eg investigation of:

- the period of a pendulum is inappropriate for Chemistry or Biology candidates
- lathering is inappropriate for Physics candidates.

Science candidates may undertake an investigation in any science subject. All candidates should have a clear understanding of the science content of their investigations.

3 Investigations carried out for certification purposes **must** provide opportunities for candidates to demonstrate **all** of the thirteen skills objectives. During the generative phase it is in order for the teacher to direct candidates away from trivial or other investigations that will not permit candidates to demonstrate particular skills. For example a candidate might want to investigate the rate of reaction of copper with dilute acids. This would result in a graph where all of the points would be on one of the axes. This investigation is not appropriate for certification purposes as it would not permit the candidate to demonstrate skills in relation to criteria *a*, *c* and *d* of objective *RR2*. The candidate should be directed to alternatives **without penalty**.

4 The booklets supplied by SQA must be used. No change is permitted to the text of the booklets, or to the sequence. The following modifications **are permitted**:

- addition of school or class details to the front page
- reproduction in A4 or other format
- alteration of font size
- highlighting the boxes for marks awarded by direct observation
- photocopying graph paper into the booklet.

5 To facilitate assessment and moderation, candidates should provide evidence in the appropriate places in the Investigation Booklet. For example, evidence relevant to criterion *G1* should normally be written in the space following instruction number 1. Where marks are awarded for evidence written elsewhere in the booklet, this must be clearly recorded by the assessor.

6 Candidates should be encouraged to avoid the use of the term 'amount' where other terms, eg mass, volume, weight, are more appropriate. Use of 'amount' usually results in loss of marks, as responses are misleading and/or ambiguous.

7 At least one investigation must have a continuous independent variable to ensure that all candidates have the opportunity to draw a line graph.

8 To aid moderation, the teacher should indicate briefly in the booklet why a candidate has not been awarded marks for one or more of the criteria *G1*, *G2*, *G3* or *G4*. Similarly, the teacher should indicate briefly why marks dependent on direct observation (criteria *E1*, *E3b* and *E4a*) have not been awarded.

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
G1	demonstrate understanding of the problem posed;	Following group discussion, the candidate individually identifies and records an investigable aspect of the problem.	1 Having thought about the problem and talked about it with others in your class, write down the factor which you are going to investigate.	Where the dependent variable is given, the candidate must give an independent variable that is to be investigated. Where neither variable is given, the candidate could give **either** an independent or a dependent variable eg: • concentration of acid or rate of reaction • light intensity or number of seeds germinating • length of pendulum or period. A list of variables is not required. Candidates who make a list must indicate the variable they have chosen to investigate. If the candidate is *unable to meet this criterion*, the teacher should give assistance to enable the candidate to proceed but should *not award the mark* allocated to this objective. In the case of a candidate who identifies a relevant investigable aspect *that cannot be investigated within the constraints of the school situation* the candidate should be directed to alternatives **without penalty**. **Note:** The term 'constraints of the school situation' applies to any circumstance that would prevent the candidate from completing the investigation eg necessary equipment is not available, equipment that is available is insufficiently sensitive, length of school period is too short etc…

Investigative Skills Objective		Criterion	Wording in Investigation Booklet		Additional Guidance
The candidate should be able to:					
G2	state the aim of the investigation;	Clearly identifies the aim of the investigation in terms of the two relevant variables.	2	What is the aim of your investigation?	**Both** the independent and dependent variables must be mentioned eg to find out how: • *light intensity* affects the *germination* of seeds • the *length* of pendulum affects the *period* • the *concentration* of an acid affects *rate of reaction.* Candidates can use their own words – ie they do not have to use precise scientific terms to meet this criterion.
G3	articulate a testable hypothesis;	Articulates a testable hypothesis in terms of the two relevant variables; this should be directional if a continuous variable is chosen.	3	What is your hypothesis? (What do you expect to happen?)	Where a discontinuous variable is used, candidates should not be penalised for using the word 'change' eg the following are acceptable: • I expect voltage to change when I use electrodes made of different metals. • I expect height of rebound to change when I use different surfaces. When a continuous variable is used the direction of change **must** be mentioned eg I expect: • *more* seeds to germinate as temperature rises • current to *increase* as voltage increases. If the candidate is *unable to meet this criterion*, the teacher should give assistance to enable the candidate to proceed but should *not award the mark* allocated to this objective.

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
G4	suggest a broad strategy to adopt;	The strategy gives sufficient detail by description and/or diagram to indicate:	4 Describe briefly how you are going to carry out your investigation.	
		a) how the chosen independent variable will be altered.		*a)* It is not sufficient for candidates to say what they are going to change; they **must** state how they are going to effect the change eg I will change: • the voltage … by adding more batteries/by turning the voltage control on the power supply. ('by using a power supply' on its own is insufficient as many common power supplies have a single output voltage) • the temperature … by heating with a bunsen burner/water bath • light intensity … by putting one seed tray in a cupboard, one beside a window and one in a shaded part of the room. In each case the text after the ellipsis is essential. For investigations where candidates are provided with prepared samples of the independent variable (eg acids of different concentrations), they should indicate that they are using a different sample for each test.
		b) that the candidate has considered what will have to be measured.		*b)* Candidates do not require to state how they intend to measure the dependent variable. It is sufficient for candidates to state that they intend to measure it eg I will: • measure the volume of gas given off • measure the current • count the number of seeds that germinate. Where the independent variable requires to be measured, candidates should also state that they intend to measure this variable.

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
E1	adopt appropriate and safe procedures;	*Adopts appropriate and safe procedures. (Mark awarded by teacher observation)*	7 You should now carry out your investigation in a safe way.	**Both** appropriateness and safety are essential. Thus the mark allocated to this objective should not be awarded if the procedures followed by candidates: • do not allow successful completion of the investigation eg inappropriate method of measuring either variable • put themselves or anyone else at risk.
E2	identify the independent variable to be used and alter it over a suitable range;	*a)* Provides a working definition of the independent variable. *b)* Alters the independent variable over an appropriate range taking account of a suitable number of types or values.	5 State clearly what you are going to change. 8 Make a table of your results.	*a)* The candidate must refer to the **independent** variable. *b)* The minimum number of types of values must be **appropriate to the investigation.** While a minimum of three values will be appropriate in many investigations, this number would be insufficient for others. For example, the three pairs of values below could be obtained by candidates investigating *either* the variation of range with angle of projection (smooth curve with maximum at 45°) *or* variation of current with voltage (straight line through the origin for ohmic circuit). *Variable 1* 10 20 30 *Variable 2* 3.2 6.4 8.8 These three points on their own are insufficient to establish the relationship between these variables.

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
E3	control all the relevant variables as necessary;	*a)* Makes a written statement of the variables which need to be actively controlled by the candidate. *b)* *Controls these variables in practice.*	6 What variables are you going to keep the same?	*a)* The statement should include all variables that **must** be controlled by the candidate to ensure that the results of the investigation are valid. For example, if maintaining a constant temperature is crucial to the investigation, temperature must be included in the statement. However, if small variations in laboratory temperature do not have a significant effect on the measurements made, the candidate need not include temperature in the list. A candidate who omits any variable that must be controlled should not be awarded this mark. *b)* Candidates must **actively** control all of the variables included in their lists.
E4	make valid, reliable measurement of the dependent variable;	*a)* *Uses a valid method of measuring the dependent variable.*	7 You should now carry out your investigation in a safe way. Use the space below to note results or for rough notes.	*a)* Candidates must use a valid method to measure the dependent variable. (The method used by the candidate to measure the independent variable is irrelevant to this criterion. However, a candidate using an invalid method for measuring the independent variable would not be awarded the mark allocated to objective *E1*.)

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
E4 *(cont)*		*b)* Evidence is provided of a form of repeat/ replicate testing which improves the reliability of the results **or** a valid written justification is given for not repeating/ replicating measurements.	8 Make a table of your results.	*b)* In addition to taking more than one reading of the same measurement, repetition/replication may involve: • simultaneous experiments eg planting many seeds at the same time • measuring multiples eg the time for 10 swings of a pendulum. Pooling of results is not permitted. The purpose of replication is to **improve the reliability** of the results. Thus a candidate who calculates an average incorrectly should not be awarded the mark allocated to this criterion. Normal constraints of the school situation, eg insufficient apparatus, cost, length of period etc. are **not** valid justifications for repeat/replicate testing not being carried out. Candidates should have been directed to other investigable aspects without penalty (see comments for objective *G1*).
RR1	tabulate results with appropriate headings and units of measurement;	*a)* Values (or types) with appropriate headings for inde-pendent, dependent (and any derived) variable are entered in the table. *b)* Appropriate units or their correct abbreviations are entered in the table.	8 Make a table of your results.	*a)* Data must be presented in clearly discernible rows and columns. Headings should be clear and appropriate. Candidates should be encouraged to use a ruler when drawing tables. However, candidates should not be penalised for omitting table lines. Data errors, should be penalised, eg where it is apparent that the candidate has recorded incorrect readings for either variable. *b)* Units are required for **both** the independent and dependent variables. The units may appear in the table headings or in the body of the table. Where a table includes repeated measurements and an average value the units do not need to be repeated for each heading or entry eg: *Reading 1 Reading 2 Reading 3 Average reading (units)* would be acceptable for one variable.

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
RR2	present the results on a graph or chart;		9 On square ruled paper or graph paper draw a graph or a chart based on your results. Staple the square ruled paper or graph paper to your booklet.	During the generative phase it is in order for the teacher to direct candidates away from investigations that will not permit the candidates to demonstrate these skills (see general comment 3 on page 60).
		a) A graph or chart of suitable size and scale is produced.		*a)* The decision about *suitability* of size of a graph should relate to the quality of the communication, ie does the graph communicate findings clearly? A graph that is difficult to read or interpret does not meet this criterion. Numerical scales must rise in equal increments (eg 0, 2, 4, 6, 8 ... **not** 0, 2, 5, 11, 23 ...).
		b) Both axes have appropriate labels and units.		*b)* Any error in labelling or units should be penalised *unless* the candidate has already been penalised for the error under criterion *RR1a* or *RR1b*. Line graph scales do not need to begin at zero. However, candidates using such scales will have to exercise great care when drawing conclusions. For bar charts, the y-axis should begin at zero.
		c) Plots all the points/bars accurately.		*c)* Plotting either average values or all replicates is acceptable. The points plotted should be consistent with the data in the table produced by the candidate. Incorrect data (penalised under criterion *RR1a*) plotted correctly should not be penalised again here.

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
RR2 *(cont)*		*d)* Draws line/curve of best fit or joins up the points as appropriate when the independent variable is continuous **or** draws a bar chart when independent variable is not continuous.		*d)* A line/curve of best fit must be drawn where this is appropriate eg in physics investigations. Joining of points with a series of straight lines should be accepted only if this is appropriate to the investigation. Inappropriate extrapolation should be penalised eg straight line extended well beyond highest/lowest values without supporting data. Vertical solid lines (spikes) should be penalised in line graphs. In a bar chart adjacent bars may be separate or touching. Candidates should be encouraged to use bars of equal width and to avoid using spikes.
Ev1	draw a valid conclusion inter-relating the appropriate variables;	Draws a conclusion which inter-relates the appropriate variables or states that no firm conclusion can be drawn.	10 What conclusion can you draw from your results?	The conclusion should relate to the aim of the investigation (*G2*) and should reflect the findings. It should be more than a simple restatement of the results. acceptable: "The higher the temperature the more seeds germinated." not acceptable: "Half the seeds germinated at 5°C and all the seeds germinated at 25°C." Where a valid conclusion can be made that is directional, the direction of change must be included in the candidate's conclusion. acceptable: "The longer the pendulum string the greater the period." unacceptable: "The period of the pendulum changes as the string gets longer." Candidates do not have to use precise scientific terms to meet this criterion ie candidates may answer in their own words.

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
Ev2	use results to evaluate the original hypothesis;	Confirms the hypothesis if appropriate **or** refutes hypothesis and replaces it with appropriate substitute **or** states that no conclusion can be drawn.	11 What can you say about your hypothesis? (Circle A or B or C below. If your circle B complete the sentence.) A My hypothesis in part 3 is correct. B My hypothesis in part 3 should be changed to … C My results do not allow me to choose A or B.	If the candidate is unable to meet the criterion for skill objective *G3*, the teacher should give assistance so that the candidate has an opportunity to gain the mark for objective *Ev2*. Where this is the case the teacher should record an appropriate comment on page 2 in the candidate's investigation booklet.

Investigative Skills Objective		Criterion	Wording in Investigation Booklet	Additional Guidance
The candidate should be able to:				
RR3	describe how the investigation was carried out.	The description includes: *a)* a labelled diagram and/or statement of the apparatus used; *b)* an account of the procedure adopted to measure the dependent variable; *c)* an account of how the independent variable was altered; *d)* an indication of how variables which were the investigator's responsibility to control were kept constant.	12 Describe clearly how you set up and carried out your investigation.	*a)* Key apparatus must appear in the text or in a labelled diagram. A list of apparatus is not required. *b)* This account should describe the procedure actually used by the candidate. *c)* This account should describe the procedure actually used by the candidate. The procedure used may be different from the procedure indicated for objective *G4* eg a candidate may have planned to change temperature using a bunsen burner but may actually have used an immersion heater. *d)* Candidates should indicate how they controlled **all** of the variables specified in their statement for criterion *E3a*. Some of the information required may be communicated by a clearly labelled diagram eg diagram could show that temperature was controlled by immersion of apparatus in crushed ice.