SCHOOL-BASED
SCIENCE PRACTICAL ASSESSMENT
(SPA)

Information Sheet
For School Candidates

For GCE Ordinary Level Examination conducted in 2013/2014

School-based Science Practical Assessment (SPA)

1. School-based Science Practical Assessment (SPA) assesses candidate's competence in practical skills over a period of time.

SKILLS ASSESSED

2. Candidates will be assessed in the following skill sets:

   (a) Skill Set 1 — *Performing and Observing*

   Candidates are required to

   - demonstrate their ability to perform an experiment using familiar apparatus, materials and techniques safely and methodically; and
   - make relevant and accurate observations or measurements and record results in an appropriate manner

   (b) Skill Set 2 — *Analysing*

   Candidates are required to

   - process results, identify and comment on a key source of error; and
   - draw conclusions which are consistent with obtained results

   (c) Skill Set 3 — *Planning*

   Candidates are required to

   - analyse a practical problem and produce an appropriate procedure for the investigation

ASSESSMENT REQUIREMENTS

3. Assessment is in the form of a portfolio which is a collection of assessment tasks and daily tasks.

4. Each candidate is to maintain a portfolio containing the completed and marked assessment and daily tasks. The portfolio is to provide evidence of the learning of practical skills and evidence that the prescribed range of competencies and topics have been covered.

5. Candidates are required to demonstrate mastery of the 3 skill sets and the listed competencies within a variety of topics specified for the subject over 2 years.

6. For assessment, each candidate must only be assessed **three times**, i.e. **twice** for both Skill Sets 1 and 2 and **once** for Skill Set 3.

7. All the tasks in the portfolio must be complete tasks.

8. Failure to comply with the assessment requirements may result in the candidate's results being nullified.

WEIGHTINGS AND MARKS COMPUTATION

9. The weighting and marks computation of the skill sets are as follows:

Skill Set	No. of Assessment (a)	Max Marks per Assessment (b)	Weight (c)	Sub-total (a × b × c)	Weighting
1	2	6	4	2 x 6 x 4 = 48	50%
2	2	4	3	2 x 4 x 3 = 24	25%
3	1	4	6	1 x 4 x 6 = 24	25%
Total Marks for SPA				96	

NOTICE OF ASSESSMENT

10. Candidates will be informed of the general topic and the skill(s) to be assessed at least 2 weeks in advance. Candidates are not allowed to bring any notes or reference materials to the assessments.

ABSENCE

11. Candidates who are absent from **all** SPA assessments will not be awarded a grade for the subject.

DISHONESTY

12. For dishonesty case, no mark will be given for SPA and the candidate may be disqualified from the subject or the whole examination.

GENERIC CRITERIA

Skill Set 1: Performing and Observing

Strand 1.1: Demonstrating experimental techniques & skills
Performs the experiment safely and without assistance, and demonstrates correct experimental techniques and skills
Strand 1.2: Making observations and/or readings / measurements
Makes relevant and accurate observations or readings/measurements to an appropriate degree of precision
Strand 1.3: Presenting data
Records observations or readings/measurements in an appropriate manner

Skill Set 2: Analysing

Strand 2.1: Processing data
Processes and presents relevant data in an appropriate manner
Strand 2.2: Drawing conclusions
Draws conclusions which are consistent with obtained results; identifies one key source of experimental error and explains how it affects the results

Skill Set 3: Planning

Strand 3.1: Planning an investigation
States the problem (or describes the approach) of the investigation and identifies the key variables to carry out the investigation
Strand 3.2: Producing a procedure for the investigation
Produces an appropriate procedure to carry out the investigation

COMPETENCY LISTS

The competency lists and the range of topics for the 3 subjects are not meant to be exhaustive and may be extended as and when necessary.

BIOLOGY PRACTICAL SKILLS CHECKLIST

TOPICS				
COMPETENCIES	Task 1	Task 2		
Using and organising techniques, apparatus and materials				
Able to set up apparatus from a diagram or written instructions				
Able to follow instructions to perform an experiment				
Able to use appropriate equipment to measure:				
volume				
temperature				
length				
time				
Able to perform experiments using the following techniques/materials:				
hydrogen carbonate indicator				
carry out a food test - starch (Iodine Test)				
carry out a food test - reducing sugars (Benedict's Test)				
carry out a food test - proteins (Biuret Test)				
carry out a food test - fats (Ethanol emulsion Test)				
use a microscope to view prepared slides				
prepare slide of temporary mounts (use the correct staining techniques where possible)				
prepare a specimen for drawing by cutting longitudinal (LS), transverse (TS) or staining				
prepare a leaf to test for the presence of starch				
Able to use instruments such as mounted needles, scalpels /razor blades, forceps, scissors				
dataloggers				
Observing, measuring and recording				
Able to make and record measurements to the correct degree of precision for the apparatus used				
Able to make clear line drawing of the specimens provided, indicate magnification and label familiar structures				
Able to make sufficient measurements or observations to reach a conclusion				
Able to record results correctly and clearly in a table				

TOPICS				
COMPETENCIES	**Task 1**	**Task 2**		
Handling experimental observations and data				
Able to draw and label a graph correctly from experimental data				
Able to perform a calculation from experimental data				
Able to draw an appropriate conclusion from experimental data or observations				
Able to identify a source of experimental error and explain how it affects results				
Planning Investigations				
Able to describe the approach of an investigation				
Able to identify key variables and/or conditions in planning an investigation				
Able to suggest a sequence of activities, including a control experiment (where applicable) that will successfully investigate a practical problem,				
Able to evaluate a plan and procedures and make modifications where appropriate with reasons				
Breadth of practical work				
There are at least 8 experiments (3 assessments & at least 5 daily tasks) carried out spanning a range of areas of Biology				

CHEMISTRY PRACTICAL SKILLS CHECKLIST

TOPICS				
COMPETENCIES	Task 1	Task 2		
Using and organising techniques, apparatus and materials				
Able to set up apparatus from a diagram or written instructions				
Able to follow instructions to perform an experiment				
Able to use appropriate equipment to measure:				
volume				
mass				
temperature				
time				
Able to perform experiments using the following techniques/materials:				
separate a solid/liquid mixture by filtration				
separate a mixture of compounds by paper chromatography				
controlled heating of substances using a Bunsen burner				
collect a gas appropriately				
carry out a test to identify a gas and/or its properties				
carry out a test to identify an anion and/or its properties				
carry out a test to identify a cation and/or its properties				
carry out a titration				
prepare a soluble/insoluble salt				
dataloggers				
Observing, measuring and recording				
Able to make and record measurements to the correct degree of precision for the apparatus used				
Able to take sufficient measurements or observations to reach a conclusion				
Able to record results correctly and clearly in a table				
Handling experimental observations and data				
Able to draw and label a graph correctly from experimental data				
Able to perform a calculation using experimental data				
Able to draw an appropriate conclusion from experimental data or observations				
Able to identify a source of experimental error and explain how it affects the results				

TOPICS				
COMPETENCIES	Task 1	Task 2		
Planning Investigations				
Able to describe the problem/approach of an investigation				
Able to identify key variables/conditions in planning an investigation				
Able to suggest a sequence of activities that will successfully investigate a practical problem				
Able to evaluate a plan and procedures and make modifications where appropriate with reasons				
Breadth of practical work				
There are least 8 experiments (3 assessments & at least 5 daily tasks) carried out spanning a range of areas of Chemistry				

PHYSICS PRACTICAL SKILLS CHECKLIST

TOPICS				
COMPETENCIES	Task 1	Task 2		
Using and organising techniques, apparatus and materials				
Able to set up apparatus from a diagram or written instructions				
Able to follow instructions to perform an experiment				
Able to perform experiments using the following apparatus with the proper techniques and skills:				
stand, boss and clamp				
ruler, graph paper*, vernier calipers*, micrometer screw gauge*				
stopwatch (analogue or digital)				
pivot (e.g. knife edge)				
plumbline*, pointer*				
weighing device (e.g. electronic or analogue, Newton-meter)				
measuring cylinder*, burette*				
protractor				
lenses				
glass blocks/prisms				
mirrors				
thermometer (liquid-in-glass)				
power supply (or accumulators, dry cells)				
ammeter (analogue)				
voltmeter (analogue)				
jockey (moving contact)				
switch				
variable resistor (e.g. rheostat)				
dataloggers				
* *where possible*				
Observing, measuring and recording				
Able to make and record measurements to the correct degree of precision for the apparatus used				
Able to take sufficient measurements or observations to enable a conclusion to be reached				
Able to record results correctly and clearly in a table				

TOPICS				
COMPETENCIES	Task 1	Task 2		
Handling experimental observations and data				
Able to draw and label a graph correctly from experimental data				
Able to perform a calculation using experimental data				
Able to draw an appropriate conclusion from experimental data or observations				
Able to identify a source of experimental error and explain how it affects the results				
Planning investigations				
Able to state the problem of an investigation				
Able to identify key variables in planning an investigation.				
Able to suggest a sequence of activities that will successfully investigate a practical problem				
Able to evaluate a plan and procedures and make modifications where appropriate with reasons				
Breadth of practical work				
There are at least 8 experiments (3 assessments & at least 5 daily tasks) carried out spanning a range of areas of Physics				

PRACTICAL NOTES

School-based Science Practical Assessment (SPA) assesses candidate's competence in the practical skill sets as detailed on page 2 over a period of time. The best preparation for SPA is for candidates to pursue a comprehensive course in practical work throughout the time during which they are being taught the theoretical content in the subject. It is not expected that all the experiments and exercises will follow the style of the Assessment Tasks but they must be complete work requiring the conducting of experiment to gather data or make observations to analysing the data/observations made to reach a conclusion.

The following subject specific notes are intended to give schools and candidates an indication of the scope and areas specific to the subject that can be assessed in SPA.

BIOLOGY

Over the course of study, candidates could be exposed to the following range of experiments/techniques/skills:

(a) recognise and observe features of familiar and unfamiliar biological specimens, record their observations and make deductions about functions of whole specimens or their parts;

(b) make clear line drawings of the specimens provided, indicate magnification and label familiar structures;

(c) employ manipulative skills in assembling apparatus, in using chemical reagents and in using such instruments as mounted needles, scalpels and razor blades, forceps and scissors;

(d) observe reactions, read simple measuring instruments and perform simple arithmetical calculations.

This is not intended to be an exhaustive list.

Candidates may be asked to carry out simple physiological experiments, involving tests for food substances, enzyme reactions, hydrogen carbonate indicator solution, cobalt(II) chloride paper etc. It is expected that glassware and instruments normally found in a laboratory e.g. beakers, test-tube racks, funnels, thermometers, droppers and so on, should be available for these experiments.

Candidates may be asked to carry out simple physiological experiments, involving the use of sharp instruments on plant or animal materials. Accurate observations of these specimens will need a hand lens of not less than x6 magnification for each candidate.

CHEMISTRY

Over the course of study, candidates could be exposed to the following range of exercises based on:

(a) quantitative experiments involving the use of a pipette, burette and an indicator such as methyl orange or screened methyl orange; if titrations other than acid/alkali are set, full instructions and other necessary information will be given;

(b) speeds of reaction that may involve the determination of some quantity, e.g. a temperature change or the rate of a reaction or change in mass or measuring of quantities, e.g. volume, length mass or time measurements;

(c) measurements of temperature;

(d) problems of an investigatory nature, possibly including suitable organic compounds;

(e) experiments involving separation techniques such as simple paper chromatography, filtration;

(f) salt preparation;

(g) collection of gas by downward delivery or any appropriate method;

(h) tests for oxidising and reducing agents and identification of ions and gases.

This is not intended to be an exhaustive list.

It will be assumed that candidates will be familiar with the reactions of the following cations with aqueous sodium hydroxide and aqueous ammonia (aluminium, ammonium, calcium, copper(II), iron(II), iron(III), lead(II) and zinc), and with the tests for the anions (carbonate, chloride, iodide, nitrate, and sulphate) and gases (ammonia, carbon dioxide, chlorine, hydrogen, oxygen and sulphur dioxide) as detailed in the *Notes for Use in Qualitative Analysis* that will be included with the assessment task for the use of candidates during the assessment.

Exercises involving organic substances and ions and other reagents not on the list above may be set but candidates will only be required to record observations and to draw general conclusions.

In qualitative exercises candidates should use approximately 1 cm depth of a solution (1-2 cm^3) for each test and add reagents slowly, ensuring good mixing, until no further change is seen. Candidates should indicate at what stage a change occurs. Observations made should include details of colour changes and precipitates formed and the names and chemical tests for any gases evolved.

PHYSICS

Over the course of study, candidates could be exposed to the following range of exercises based on:

(a) measurements of lengths with appropriate accuracy by means of tapes, rules, micrometers and calipers, using a vernier as necessary;

(b) measurements of time intervals by means of clocks and stopwatches, including the period of a pendulum;

(c) measurements of temperature by using appropriate thermometers;

(d) measurements of mass and weight by using appropriate balances;

(e) measurements of the volume of a liquid or solid by using a measuring cylinder;

(f) determination of the density of a liquid, or of a regularly or irregularly shaped solid which sinks in water;

(g) the principle of moments;

(h) determination of the position of the centre of gravity of a plane lamina;

(i) the law of reflection;

(j) determination of the position and characteristics of an optical image formed by a plane mirror;

(k) the refraction of light through glass blocks;

(l) the principle of total internal reflection;

(m) the focal length of lenses;

(n) measurements of current and voltage by using appropriate ammeters and voltmeters;

(o) determination of the resistance of a metallic conductor by using a voltmeter and an ammeter.

This is not intended to be an exhaustive list.

TAKING READINGS

During the course of SPA, candidates should be taught to observe the following points of good practice, which often feature in the mark scheme. A measuring instrument should be used to its full precision. Thermometers are often marked with intervals of 1°C. It is appropriate to record a reading which coincides exactly with a mark as, for example, 22.0°C, rather than as a bald 22°C. Interpolation between scale divisions should be within one half of a division. For example, consider a thermometer with scale divisions of 1°C. A reading of 22.3°C might best be recorded as 22.5°C, since ‘0.3’ is nearer ‘0.5’ than '0'. That is, where a reading lies between two scale marks, an attempt should be made to interpolate between those two marks, rather than simply rounding to the nearest mark. The length of an object measured on a rule with a centimetre and millimetre scale should be recorded as 12.0 cm rather than a bald 12 cm, if the ends of the object coincide exactly with the 0 and 12 cm marks. A measurement or calculated quantity must be accompanied by a correct unit, where appropriate.

RECORDING READINGS

A table of results should include, in the heading of each column, the name or symbol of the measured or calculated quantity, together with the appropriate unit. Solidus notation is expected for Physics. Each reading should be repeated, if possible, and recorded. The number of significant figures given for calculated quantities should be the same as the least number of significant figures in the raw data used. A ratio should be calculated as a decimal number, to two or three significant figures.

DRAWING GRAPHS

A graph should be drawn with a sharp pencil. The axes should be labelled with quantity and unit. The scales for the axes should allow the majority of the graph paper to be used in both directions and be based on sensible ratios, e.g. 2 cm on the graph paper representing 1 or 2 or 5 units of the variable (or 10, 20 or 50 etc.). Each data point should be plotted to an accuracy of at least one half of one of the smallest squares on the grid. Points should be indicated by a small cross or a fine dot with a circle drawn around it. Where a straight line is required to be drawn through the data points, there should be about an equal number of points either side of the line over its entire length. That is, points should not be seen to lie all above the line at one end, and all below the line at the other end. The gradient of a straight line should be taken by using a triangle with a hypotenuse that extends over at least half the length of the candidate's line. Data values should be read from the line to an accuracy within one half of one of the smallest squares on the grid. The same accuracy should be used in reading off an intercept. Calculation of the gradient should be to two or three significant figures.

PRECISION OF INSTRUMENT

A measuring instrument is a device with a scale or read-out mechanism that allows measurement of a physical quantity to be read off. In general, the scale or read-out mechanism has a smallest division or unit and all other readings can be expressed as an integer multiple of this smallest unit. The smallest division determines the instrumental precision of the instrument. However, when taking the readings, interpolation between two scale divisions should be made to one half of the smallest division.

The following tables summarise the precision of some equipment and apparatus (not exhaustive) for the three sciences. In some cases the context of the experiment may dictate the precision of the recorded data.

(a) Biology

No	Apparatus	Smallest Division	Uncertainty	Examples of recording
1	Burette	0.1 cm^3	0.05 cm^3	25.0 cm^3 25.00 cm^3, 25.05 cm^3
2	Electronic balance	0.1g	0.1 g	120.0 g, 121.1 g
		0.01 g	0.01 g	121.00 g, 121.10 g
3	Ruler	0.1 cm	0.1 cm	12.0 cm, 12.1 cm
4	Measuring cylinder (100 cm^3)	1 cm^3	0.5 cm^3	18.0 cm^3, 18.5 cm^3
5	Stopwatch (analogue)	0.1 s	0.1 s	36.0 s, 36.1 s
6	Stopwatch (digital)	0.1 s	0.1 s	28.1 s
		0.01 s	0.01 s	28.00 s, 28.11 s
7	Thermometer (–10 °C to 110 °C)	1 °C	0.5 °C	23.0 °C, 23.5 °C

(b) Chemistry

No	Apparatus	Smallest Division	Uncertainty	Examples of recording
1	Burette	0.1 cm^3	0.05 cm^3	23.5 cm^3 23.50 cm^3, 23.55 cm^3
2	Electronic Balance	0.1 g	0.1 g	2.2 g
		0.01 g	0.01 g	2.25 g
3	Measuring cylinder (50 cm^3)	1 cm^3	0.5 cm^3	20.0 cm^3, 20.5 cm^3
4	Pipette	-	-	10.0 cm^3, 20.0 cm^3 25.0 cm^3
5	Stopwatch (analogue)	0.1 s	0.1 s	36.0 s, 36.1 s
6	Stopwatch (digital)	0.1 s	0.1 s	28.1 s
		0.01 s	0.01 s	28.00 s, 28.11 s
7	Thermometer (–10 °C to 110 °C)	1 °C	0.5 °C	23.0 °C, 23.5 °C

(c) Physics

No	Apparatus	Smallest Division	Uncertainty	Examples of recording
1	Ammeter (0 - 1 A)	0.02 A	0.01 A	0.20 A, 0.21 A
2	Electronic balance	0.1 g	0.1 g	121.0 g, 121.1 g
		0.01 g	0.01 g	121.10 g, 121.11 g
3	Half metre rule or metre rule	0.1 cm	0.1 cm	12.0 cm, 12.1 cm
4	Measuring cylinder (100 cm^3)	1 cm^3	0.5 cm^3	18.0 cm^3, 18.5 cm^3
5	Micrometer	0.01 mm	0.01 mm	2.10 mm, 2.11 mm
6	Milliammeter (0 - 100 mA)	2 mA	1 mA	20 mA, 21 mA
7	Spring balance (0 - 10 N)	0.1 N	0.05 N	3.65 N, 3.70 N
8	Stopwatch (analogue)	0.1 s	0.1 s	36.0 s, 36.1 s
9	Stopwatch (digital)	0.1 s	0.1 s	28.1 s
		0.01 s	0.01 s	28.11 s
10	Thermometer (–10 °C to 110 °C)	1°C	0.5 °C	23.0 °C, 23.5 °C
11	Voltmeter (0 - 5 V)	0.1 V	0.05 V	2.50 V, 2.55 V