General Certificate of Secondary Education
June 2009 to June 2010

SCIENCE CENTRE ASSESSED UNIT **4460/TN**

4461 Science A
4462 Science B
4463 Additional Science
4411 Biology
4421 Chemistry
4451 Physics

TEACHERS' NOTES

SET THREE

Investigative Skills Assignments (ISAs)

Valid for use until July 2010
Valid for Moderation in June 2009, June 2010 and June 2011

For immediate release to the teacher(s) responsible for GCSE Sciences

All Centre Assessed Unit marks to be returned to AQA by 5 May in the year in which moderation is required

Introduction

- The CD with all the Investigative Skills Assignments (ISAs) will be sent to the centre's Examinations Officer. The Examinations Officer must be alerted to the importance of this CD and the password that will be sent separately. The CD **must** be kept under secure conditions. The Examinations Officer may print out **one** copy of the ISAs for the use of the Head of Science but this copy **must** also be kept under secure conditions.
- Teachers' Notes are sent out in advance of the ISA CD so that teachers can incorporate the ISAs into their schemes of work.
- Full information about conducting the ISA can be found in the 'Teachers' Guide' and in the booklet 'Guidance and Standardising Material for ISA and PSA' distributed at the standardisation meetings. An abbreviated version of the latter will be included on the ISA CD.
- ISAs have a shelf life of **two** years. ISAs must be completed and marked within this validity period, but marks may be submitted for moderation for **one** further year. The work must be held under secure conditions for the entire period.
- **Do not use the 'live' ISAs for practice purposes.**
- Teachers should attach the Centre Assessed Unit (CAU) to a specific subject when making entries. Candidates should be entered in February for CAU moderation in the following June. A mark is not needed at the time of entry but should be submitted to AQA and the moderator by 5th May. The marks must be submitted on the Centre Mark Form (CMF). The Centre should also circle the highest and lowest non-zero mark for each subject on the Centre Mark Forms.
- The teacher should ensure that each candidate has a mark from an ISA that relates to the subject being entered and that the PSA mark has been added to make a total CAU mark.
- The following table shows the codes needed for CAU entry and the ISAs that may be used.

Subject	**Code to Enter for CAU**	**ISAs to be used**		
Science A and Science B	SCYC	B1	C1	P1
Additional Science	ASCC	B2	C2	P2
Biology	BLYC	B1	B2	B3
Chemistry	CHYC	C1	C2	C3
Physics	PHYC	P1	P2	P3

- Please refer to the Teachers' Guide/Specification for further explanation of the choices that can be made about when to certificate for each subject.
- Centres need to submit an entry code for certification for a particular subject. The codes are:

Subject	**Code**
Science A	4461
Science B	4462
Additional Science	4463
Biology	4411
Chemistry	4421
Physics	4451

Biology 1 ISA 1.4 – *Caffeine*

Teachers' Notes

This ISA relates to Unit B1: Science A (4461), Science B (4462), Biology (4411) Section 11.3.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How do we use/abuse medical and recreational drugs?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning the effect of caffeine on reaction speed/time. All candidates must be involved in the investigation. However, it is not necessary for all candidates to take drinks.

One simple way to do this would be to divide a group into two sets. Each set should have their reaction speed/time measured using a falling metre ruler method or a suitable computer program. One set should then be provided with a caffeinated drink and the other with a similar non-caffeinated drink. Ten minutes later reaction speed/time could be measured again using the same method.

The results of at least two people from each set (caffeinated and non-caffeinated) should be tabulated and graphed.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate must draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work must **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Biology 2 ISA 2.3 – *Diffusion*

Teachers' Notes

This ISA relates to Unit B2: Additional Science (4463) Section 11.2, Biology (4411) Section 12.2.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How do dissolved substances get into and out of cells?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning the effect of a factor on diffusion.

For example: agar cubes made up containing sodium hydroxide and phenolphthalein can be immersed in a beaker containing hydrochloric acid. The time taken for complete decolourisation of the pink phenolphthalein should be recorded. Cubes of at least three different sizes should be investigated. Centres may wish to carry out trial experiments to determine the best size of cube to use. Acid and alkali concentrations between 0.1 and 1.0 mol/dm^3 should be suitable.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate must draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work must **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Biology 3 ISA 3.3 – *Yeast*

Teachers' Notes

This ISA relates to Unit B3: Biology (4411) Section 13.5.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How are microorganisms used to make food and drink?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning a factor which affects the rate of respiration by yeast.

For example: a yeast suspension could be made up with a food substrate, in a boiling tube. The number of bubbles passing through a tube of water via a delivery tube, in a given time, could be measured. Suitable independent variables include: temperature, concentration of sugar or concentration of yeast.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate must draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work must **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Chemistry 1 ISA 1.5 – *Investigating Plastics*

Teachers' Notes

This ISA relates to Unit C1: Science A (4461), Science B (4462) Section 12.4,
Chemistry (4421) Section 11.4.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How are polymers and ethanol made from oil?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning the strength of the polymer used to make plastic carrier bags.

Candidates can investigate how the strength of plastic carrier bags varies with thickness in a similar way to a Hooke's Law experiment. A strip of the plastic is cut from the carrier bag. Masses are attached to the strip until it breaks. The results can be processed by plotting the length of the plastic strip against mass added or by plotting the (%) increase in length against mass. Centres should carry out preliminary work to find out the best combination of length, width and thickness of plastic strip. Centres should also be aware that strips cut at right angles to each other may have different properties. A simpler investigation would be to compare the masses needed to break different supermarket carrier bags.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate must draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work must **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Chemistry 2 ISA 2.3 – *Investigating Catalysts*

Teachers' Notes

This ISA relates to Unit C2: Additional Science (4463), Chemistry (4421) Section 12.4.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How can we control the rates of chemical reactions?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out. The teacher's attention is drawn particularly to the corrosive nature of hydrogen peroxide. Eye protection should be worn and skin contact should be avoided.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning the effect of catalysts on the rate of reactions.

Candidates should investigate the effect that a catalyst has on the decomposition of a solution of hydrogen peroxide using a continuous independent variable. The independent variable could be the concentration of the hydrogen peroxide solution, the temperature of the hydrogen peroxide solution or the mass/surface area of the catalyst. Candidates could investigate the effect that a catalyst has on the decomposition of a solution of hydrogen peroxide using manganese(IV) oxide.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate must draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work must **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Chemistry 3 ISA 3.3 – *Investigating Acidity*

Teachers' Notes

This ISA relates to Unit C3: Chemistry (4421) Section 13.2.

Area of investigation
This work should be carried out during the teaching of the section relating to:
What are strong and weak acids and alkalis? How can we find the amounts of acids and alkalis in solutions?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out. The teacher's attention is drawn particularly to the corrosive nature of acids and alkalis. Eye protection should be worn and skin contact should be avoided.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning the concentration of an acid using a titration method.

Candidates could carry out titrations involving three or more acids of the same concentration. The acids investigated could have different basicities or strengths. The candidates could investigate the concentration of acids in vinegars or soft drinks eg colas. The candidates could investigate different concentrations of a single acid.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate must draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work should **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Physics 1 ISA 1.4 – *Keeping Warm*

Teachers' Notes

This ISA relates to Unit P1: Science A (4461), Science B (4462) Section 13.1, Physics (4451) Section 11.1.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How is heat (thermal energy) transferred and what factors affect the rate at which heat is transferred?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out. The teacher's attention is drawn particularly to the dangers associated with using hot water.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning the rate of loss of heat from a container.

The simplest method would be to fill a container with hot water and record the temperature at the start and at suitable intervals for, say, 10 minutes. Any independent variable may be investigated, eg shape or colour of container, surface area, lagging, initial temperature, volume, double glazing with small beaker inside a large beaker.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate must draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work must **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Physics 2 ISA 2.3 – *Momentum*

Teachers' Notes

This ISA relates to Unit P2: Additional Science (4463) Section 13.4, Physics (4451) Section 12.4.

Area of investigation
This work should be carried out during the teaching of the section relating to:
What is momentum?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning the momentum of a vehicle on an air track or running down a slope.

Candidates should measure the mass and velocity of a moving vehicle and hence calculate its momentum. The velocity may be measured in a number of different ways, eg with light gates, ticker tape or ruler and stopwatch.

Candidates should measure the independent variable eg the mass of the vehicle or the gradient of the slope and measure the consequent change in momentum. Alternatively they may wish to give the vehicle momentum by catapulting it from a spring or piece of elastic, in which case the independent variable would be the distance that the spring or elastic is pulled back.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work must **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Physics 3 ISA 3.3 – *Electromagnets*

Teachers' Notes

This ISA relates to Unit P3: Physics (4451) Section 13.7.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How can electricity be used to make things move?

RISK ASSESSMENT
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical Work
For this part of the investigation candidates may work individually or in groups.

A suggested method is described below, but centres may adapt this method to suit their own needs.

For each ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to each piece of work sent to the moderator. Instructions of a general nature may be given to the candidates, but these must not be so prescriptive as to preclude candidates from making their own decisions.

Candidates should be given the opportunity to carry out an investigation concerning the strength of an electromagnet.

The independent variable may be chosen from the number of turns on the coil, the current through the coils or the cross sectional area of the core. Candidates should use a continuous variable. The dependent variable (the strength of the electromagnet) may be assessed in a number of different ways, eg the number of paper clips picked up, the effect that it has on a top-pan balance, or by using a magnetic field sensor.

Candidates need to produce a table for the results and draw a graph or bar chart to show their results. They will need to have collected sufficient data to display in such a format. (Refer to the Teachers' Guide for further clarification.)

The Data Processing
For this part of the investigation candidates must work individually under direct supervision.

Each candidate must draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit.

The candidates' work should be collected by the teacher at the end of this session and returned to the candidates only when they undertake the subsequent ISA.

Candidates' work must **not** be annotated with additional information, by either the teacher or the candidate, which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

ISA Explanation Sheet

to accompany each ISA
(You will need to fill in more than one of these sheets if different students have carried out different methods)

Centre Number						Date Practical Carried Out	
ISA Code						ISA Title	
Name of Teacher							
Independent variable						Dependent variable	

Did you make any changes to the suggested method?
YES / NO

If YES give details of any changes you made to the suggested method, the equipment, the chemicals etc. for this investigation.

Any other information:

Teacher Signature:

Please attach any experimental worksheet or outline used by the candidates to carry out the investigation if available.