General Certificate of Secondary Education
June 2012

Science Centre Assessed Unit 4460/TN

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

Teachers' Notes

Set Six

Investigative Skills Assignments (ISAs)

Valid for use until May 2012 only
Valid for Moderation in June 2012 only

All Centre Assessed Unit marks to be returned to AQA by 7 May 2012.

Introduction

1. The ISA papers for Set 6 will be available at the beginning of September 2011 on eAQA SKM. The EO may print out **one** copy of the ISAs for the use of the Head of Science but this copy **must** be kept under secure conditions.
2. **The ISA papers should NOT be downloaded on to the centre's intranet**. **Neither should any electronic copies be made**.
3. Teachers' Notes are sent out in advance of the ISAs so that teachers can incorporate the ISAs into their schemes of work. All the Teachers Notes can be found on our website in the subject specific areas: eg http://web.aqa.org.uk/qual/newgcses/science/new/scienceb_overview.php?id=03&prev=03
4. Full information about conducting the ISA can be found in the 'Teachers' Guide'.
5. **THIS SET OF ISAs WILL HAVE A SHELF LIFE OF ONLY ONE YEAR DUE TO THE PUBLICATION OF THE NEW SCIENCE SPECIFICATIONS**. ISAs must be **completed** and **marked** within this validity period. The work must be held under secure conditions for the entire period.
6. **Do not use the 'live' ISAs for practice purposes**. These Set 6 ISAs may not be used as practice pieces.
7. Candidates should be entered in **February** for Centre Assessed Unit (CAU) moderation in the following June. Teachers should attach the CAU to a specific subject when making entries but amendments can be made in the light of March results. A mark is not needed at the time of entry but must be submitted to AQA and the moderator by 7 May. 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 CMFs.
8. Before filling in the CMF, the teacher should ensure that the **PSA** mark has been added to the ISA mark to make a total CAU mark.
9. The following shows the codes needed for CAU entry and the ISAs that may be used with the candidates from **September 2011 to May 2012** when the present specification ends.

   Centres should be careful to ensure that candidates submit ISAs appropriate for the subject they are entering, as the inappropriate marks may be disallowed.

Subject and Cert Code		Code to Enter for CAU	ISAs to be used for CAU		
Science A	4461	SCYC	B1.6	C1.7	P1.6
Science B	4462		B1.7	C1.8	P1.7
Additional Science	4463	ASCC	B2.5	C2.5	P2.5
			B2.6	C2.6	P2.6
Biology	4411	BLYC	B1.6	B2.5	B3.5
			B1.7	B2.6	B3.6
Chemistry	4421	CHYC	C1.7	C2.5	C3.5
			C1.8	C2.6	C3.6
Physics	4451	PHYC	P1.6	P2.5	P3.5
			P1.7	P2.6	P3.6

Centres may submit marks from Set 4 ISAs in May 2012 if the ISA was completed by the candidate before 31 July 2011.

10. A separate entry is needed for each of the required units and for the overall subject before certification. Entry for Centre Assessed Unit is not automatic.

    eg for Biology GCSE (foundation level) you need to enter BLY1F, BLY2F, BLY3F **and** BLYC. Centres should also enter the certification code of 4411.

11. Please refer to the Teachers' Guide/Specification for further explanation of the choices that can be made about when to certificate for each subject.

12. **Candidates need to use information from their own investigations to answer questions in Section 2**. **Therefore, as far as possible, the centre needs to use tasks as close as possible to the ones described in the Teachers' Notes**.

13. Centres should ensure that candidates complete the practical before attempting the ISA.

Information relevant to the completion of all ISAs

14. **Risk Assessment**
    It is the responsibility of the centre to ensure that a risk assessment is carried out for each investigation.

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

    It is advisable for teachers or technicians to carry out trial experiments.
    For each different method used in an ISA undertaken by a class, the teacher **must** complete an ISA Explanation Sheet and attach it to work sent to the moderator. If more than one of the samples requires the same ISA Explanation Sheet, only one need be completed, but please make this clear when submitting the sample to the moderator. The Explanation Sheet can be found on e-AQA.

    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. If a worksheet has been used, please attach it to the ISA Explanation Sheet as this will help the moderator.

16. **Data Processing**

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

    Candidates need to produce a table for the results. **This should be marked prior to the practical session**.

    During the practical session, each candidate must complete his or her own table of results and should process the data in an appropriate way, eg charts, graphs, diagrams, line of best fit 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 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.

    Please note that Set 4 ISAs can still be sat until they reach their final date of July 2011.

Biology 1 ISA 1.7 – *Acid Rain*

Teachers' Notes

This ISA relates to Unit B1: Science A (4461), Science B (4462), Biology (4411) Section 11.8.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How do humans affect the environment?

- More waste is being produced which unless properly handled may pollute air with smoke and gases, such as sulfur dioxide, which contribute to acid rain.

Risk Assessment
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. **Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below**.

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

A simple method would involve the use of seeds such as cress. These should be germinated in Petri dishes on filter paper dampened with weak acidic buffered solutions. Other requirements for germination are supplied.

Candidates should determine how many seeds have germinated after a suitable time interval. At least three pH values of **acidic** solutions should be investigated, along with a solution at pH7. Candidates should measure the pH of each solution they use.

Before candidates carry out their investigation teachers or technicians may wish to carry out trial experiments to determine a suitable range of buffers to use along with a suitable time interval between setting up the dishes and collecting results.

Notes from CLEAPSS
We have tried this and found that lemon juice in various dilutions affects germination of cress and alfalfa much as might be anticipated. The buffer solutions we have here also inhibit germination at all sorts of pHs and we believe this is the phosphate in the buffer we used which is causing the problem. Schools are probably best advised to use various (dilute) concentrations of sulfuric acid rather than buffer solutions.

Please read notes 14–16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'.

Biology 2 ISA 2.6 – *Osmosis*

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?

- Water often moves across boundaries by osmosis. Osmosis is the diffusion of water from a dilute to a more concentrated solution through a partially permeable membrane that allows the passage of water molecules.
- Differences in the concentrations of the solutions inside and outside a cell cause water to move into or out of the cell by osmosis.

Risk Assessment
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below.

Candidates should be given the opportunity to carry out an investigation concerning the effect on the mass of pieces of plant material when the concentration of sucrose solution in which they are immersed is changed.

A simple method would involve immersing weighed pieces of potato tuber in sucrose solutions of varying concentration, including pure water. After a minimum of half an hour the potato pieces should be carefully removed and surface-dried before reweighing.

At least three different sucrose solution concentrations should be used, along with pure water. It is **not** necessary to calculate percentage change of mass.

Teachers or technicians may wish to carry out trial experiments to determine a suitable range of concentrations to use before candidates carry out their investigation.

Notes from CLEAPSS
There are no particular health and safety issues, and works pretty well as long as school trial the concentration of sucrose solutions needed.

Please read notes 14–16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'.

Biology 3 ISA 3.6 – *Fatigue*

Teachers' Notes

This ISA relates to Unit B3: Biology (4411) Section 13.3.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How does exercise affect the exchanges taking place within the body?

- If muscles are subjected to long periods of vigorous activity they become fatigued, ie they stop contracting efficiently.

Risk Assessment
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. **Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below**.

Candidates should be given the opportunity to carry out an investigation concerning the effect of exercise on fatigue.

A simple method would involve clasping and unclasping the hand at the rate of two times per second until: it begins to hurt a little or a lot or the rate falls or it becomes too painful to continue.

Candidates should collect data from at least six different people and might, for example, compare left and right hands, gender or athletic build.

Alternatively, a candidate could measure the time for which different people can hold the same masses at arm's length: in which case, results from a minimum of six people should be collected to allow comparison of left and right hand, gender or athletic build.

Or, a candidate could measure the time for which different masses can be held at arm's length by the same person: in which case, a minimum of four different masses should be used.

Notes from CLEAPSS
We suggest that students, particularly competitive ones, may try to hold too heavy masses for too long a time. We suggest that the maximum mass used ought to be no more than 2 kg. Set up the testing space so that there is no chance of a mass being dropped on another pupil's foot – perhaps by having one or more cardboard boxes filled with screwed up newspaper placed at the point where the mass would fall.

Please read notes 14–16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'.

Chemistry 1 ISA 1.8 – *Emulsions*

Teachers' Notes

This ISA relates to Unit C1: Science A (4461), Science B (4462), Section 12.5, Chemistry (4421) Section 11.5.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How can plant oils be used?

- Oils do not dissolve in water. They can be used to produce emulsions. Emulsions are thicker than oil or water and have many uses that depend on their special properties.

Risk Assessment
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. **Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below**.

Candidates should be given the opportunity to carry out an investigation concerning the effect of varying the amount of emulsifier on an oil and water mixture.

Candidates should mix equal volumes of vegetable oil and water with varying amounts of emulsifier, such as egg yolk, dilute washing-up liquid or lecithin, to determine either how long it takes for the mixture to separate or the height of the aqueous layer after the mixture has stood for a set length of time.

Notes from CLEAPSS
CLEAPSS has trialled this investigation, and has supplied the notes below.

Please read notes 14–16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'.

Stability of Emulsions

The effectiveness of emulsifiers in making a stable emulsion using vegetable oil and water are investigated. Preliminary testing needs to be carried out by the teacher/technician to establish volumes of oil and water to use and to find suitable emulsifiers.

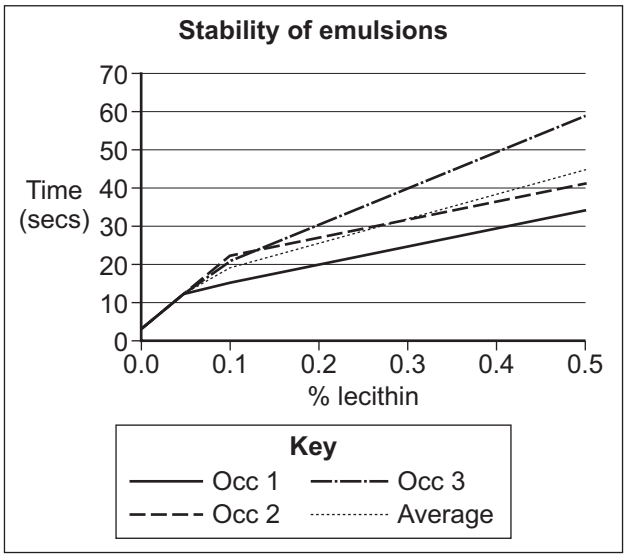
This guidance leaflet details methods using lecithin and egg yolk. Lecithin is a naturally occurring emulsifier; the principal source for commercial use is soybean. This is readily available from Health Food shops where it is sold as a food supplement to help in the breakdown of fats. Egg yolk is also a natural source of lecithin.

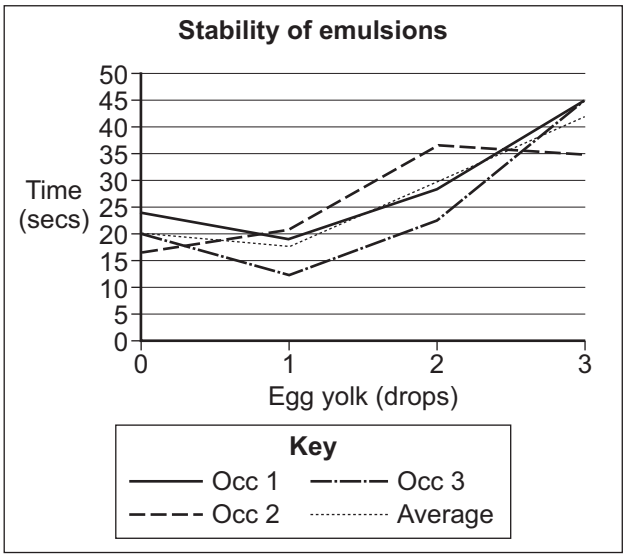
Method using lecithin

- mark 4 boiling tubes with a line approximately 2 cm from base
- put 10 cm^3 vegetable oil in each tube
- add 10 cm^3 water to the first tube
- place bung in tube and invert gently 15 times
- place boiling tube in rack and time how long clear water takes to reach mark
- repeat using solutions of lecithin up to 1% instead of the water.

The granular lecithin 'Lecigran' which was used at CLEAPSS dissolved a lot quicker in warm water and after it had been ground up using a pestle and mortar. Leaving it to mix on a hot plate/stirrer was the most effective way of dissolving it. The higher the percentage of lecithin solution the more difficult it was to differentiate between the oil and water layers. The addition of food dye to the water made it much easier to differentiate between the water and oil layers.

The results produced in the CLEAPSS lab are shown below.





Method using egg yolks

- mark 4 boiling tubes with a line approximately 2 cm from base
- put 15 cm^3 water and 25 cm^3 vegetable oil in each tube
- add 0 drops egg yolk to the first tube
- place bung in tube and invert gently 15 times
- place boiling tube in rack and time how long clear water takes to reach mark
- repeat using 1, 2 or 3 drops egg yolk.

Chemistry 2 ISA 2.6 – *Temperatures and Rates*

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?

- Increasing the temperature increases the speed of the reacting particles so that they collide more frequently and more energetically. This increases the rate of reaction.

Risk Assessment
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. **Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below**.

Candidates should be given the opportunity to carry out an investigation into the effect of temperature on the rate of a reaction.

One method would be to investigate five or six different temperatures using a 'clock' or 'disappearing' cross reaction, eg iodine or sulfur. They may use one temperature below room temperature. Candidates should plot a graph of time to react against temperature of solutions. If using data-logging equipment, candidates should hand draw their own graph, rather than rely on computer generated graphs.

Notes from CLEAPSS
Thiosulphate/acid reaction works when sulfur masks a cross on a piece of paper. One of the products of this reaction is sulfur dioxide which at higher temperatures becomes even more prevalent in the laboratory atmosphere. The Workplace Exposure Limit for sulfur dioxide was withdrawn because there is no safe lower limit.
Temperatures should be kept between room temperature and 50 °C. Warming should be carried out using water baths and avoid Bunsen burners.
Once a reading has been taken, the reactants should be poured into a beaker containing sodium carbonate to
a) stop the reaction producing more sulfur dioxide and
b) to neutralise the acidic gas sulfur dioxide and prevent it entering the atmosphere.
Avoid using conical flasks. The depth of liquid is important, not overall volume. CLEAPSS can carry out a run with 10 ml of 0.05 M sodium thiosulphate and 1 ml of 2 M hydrochloric or 0.5 M sulfuric(V1) acid in a specimen tube or vial.
Any readings below 10 seconds are very poor.

The hydrogen peroxide/iodide in acid solution reaction using starch as the indicator can be rather complicated to set up. Use water baths, not Bunsen burners to avoid over heating. Details for a convenient mix can be found on CLEAPSS recipe card 18.

Please read notes 14 – 16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'.

Chemistry 3 ISA 3.6 – *Energy from Plants*

Teachers' Notes

This ISA relates to Unit C3: Chemistry (4421) Section 13.4.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How much energy is involved in chemical reactions?

- The relative amounts of energy released when substances burn can be measured by simple calorimetry, eg by heating water in a glass or metal container. This method can be used to compare the amount of energy produced by fuels and foods.

Risk Assessment
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below.

Candidates should be given the opportunity to carry out an investigation into the temperature rise of water, by burning different alcohols.

Candidates should either burn each alcohol for a set time and record the temperature rise of water or burn the alcohol until a set temperature rise is achieved and determine the mass of alcohol burnt.

Candidates should plot a bar chart of named alcohol against temperature rise of water, or named alcohol against mass of alcohol. Alternatively, candidates can plot a line graph of number of carbon atoms in the alcohol against either temperature rise or mass of alcohol burnt.

Notes from CLEAPSS
Accidents have occurred with pupils filling their own spirit burner near a flame. The burners should be filled by a teacher or technician.
Methanol, although toxic, can be used as the pupils are not drinking it, inhaling the vapour or putting it on their skin for any length of time. Methanol is enclosed in the spirit burner. Organisation is important. Offer a number of pre-filled burners with the same alcohol in from the range methanol, ethanol, propan-1-ol, butan-1-ol, etc up to about heptan-1-ol.
Rooms will need to be well ventilated as the higher alcohols produce carbon particles.

Please read notes 14–16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'.

Physics 1 ISA 1.7 – *Cooling*

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?

- To evaluate ways in which heat is transferred in and out of bodies and ways in which the rates of these transfers can be reduced.

Risk Assessment
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. **Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below**.

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

Candidates could do this by putting insulation around a beaker. The beaker can then be filled with hot water. The top of the beaker should be covered by a cardboard lid, with a hole in the lid for a thermometer to be put through.

Candidates can then measure the initial temperature of the water and the temperature after a suitable time in order to determine the temperature drop. Candidates could investigate changing either the type of insulation or the thickness of the insulation.

It is not necessary for each candidate to carry out a large number of such investigations, as the results of the class may be pooled. However, if class results are to be pooled, it is essential that different groups must have conducted the experiment in the same way.

Notes from CLEAPSS
Attention is drawn to the dangers associated with using hot water.

Please read notes 14 –16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'.

Physics 2 ISA 2.6 – *Resistance*

Teachers' Notes

This ISA relates to Unit P2: Additional Science (4463) Section 13.6, Physics (4451) Section 12.6.

Area of investigation
This work should be carried out during the teaching of the section relating to:
What does the current through an electrical circuit depend on?

- The resistance of a component can be found by measuring the current through and potential difference across the component.

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 fact that if the current is too high the wire can get very hot, especially when short lengths are used.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. **Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below**.

Candidates should be given the opportunity to carry out an investigation concerning how the length of a wire affects the resistance.

Candidates could use a length of 36 SWG constantan wire. They could either measure the resistance directly by using a multimeter set to resistance or use an ammeter in series and a voltmeter in parallel and then calculate the resistance.

Notes from CLEAPSS
There are no particular health and safety issues.

Please read notes 14–16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'.

Physics 3 ISA 3.6 – S*tability*

Teachers' Notes

This ISA relates to Unit P3: Physics (4451) Section 13.1.

Area of investigation
This work should be carried out during the teaching of the section relating to:
How do forces have a turning effect?

- If the line of action of the weight of a body lies outside the base of the body, there will be a resultant moment and the body will tend to topple.

Risk Assessment
It is the responsibility of the centre to ensure that a risk assessment is carried out.

The Practical work
Candidates need to use information from their own investigation to answer questions in Section 2. **Therefore, as far as possible, the centre needs to use a task as close as possible to the one described below**.

Candidates should be given the opportunity to carry out an investigation concerning the angle from the vertical at which an object can be tilted before falling over.

Candidates may use a container such as a plastic milk bottle (ideally square section). This could be filled with sand to different heights. The centre of mass of the object may be taken as being the centre of the mass of sand.

The bottle can then be tilted so that candidates can investigate the link between height of the centre of mass and the angle from the vertical at which it topples over.

Alternatively, candidates could use wooden blocks of the same cross-sectional area but different heights, or could construct such blocks out of Lego.

Notes from CLEAPSS
This ISA suggests, as a possibility, using a sand-filled bottle. Sand is unstable in such bottles and the angle at which the bottle falls over may be affected by a sudden and unpredictable flow of sand. The results could become hard to justify or interpret. We think a more solid filler or wooden or a Lego block would be better.
There are no particular health and safety issues.

Please read notes 14–16 at the front of this booklet for more information about how the ISA is conducted.

Full information about conducting the ISA can be found in the 'Teachers' Guide'

END OF TEACHERS' NOTES

There are no Teachers' Notes printed on this page