Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE

SCIENCE

MARKING INDICATORS

IMPORTANT – PLEASE NOTE

Each marking scheme for the State Examinations is designed specifically to ensure uniform and just marking of an individual examination in a given year. It is the product of an exhaustive process of deliberation by the Chief Examiner, the entire Advising Examiner team and the experience of marking a random sample of scripts by all Examiners. Up to that time, full knowledge of how candidates have responded to the paper is not available. Accordingly, up to the date of its publication by the State Examinations Commission, it is a draft marking scheme only.

Each marking scheme is developed for a specific paper in a given year. It follows that marking schemes will vary from year to year in such aspects as:

(i) subdivision of marks;
(ii) criteria for award of marks.

The following marking indicators were developed in relation to the sample papers, without the benefit of the process outlined above. While their aim is to provide an indication to teachers of how these particular questions might be marked, it is emphasised that the final marking scheme in 2006 or in any subsequent year may differ from these.

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1. Introduction

A new syllabus for Junior Certificate Science was introduced into schools in September 2003. This will be examined for the first time in June 2006. Sample papers were issued by the State Examinations Commission in September 2005 and were placed on the Commission's website. Hard copies of the sample papers were issued to schools in early 2006.

These sample papers were trialled in early 2006 in a small number of schools with a view to issuing additional information on assessment to teachers and students to assist them in preparing for the examinations in June. Similar trialling of sample papers has already taken place in relation to Leaving Certificate Geography and to Leaving Certificate History and additional assessment information issued also on these.

The schools selected for the trialling of the sample papers were representative of school type and the students involved were from across a wide ability range. Students sat for one of the three sections of the papers only but coverage of all sections was achieved to allow for the generating of assessment information on the written papers in their entirety. The work of the students was assessed by members of the advisory teams involved in the marking of the Junior Certificate Science examinations in the summer. This work was undertaken under the direction of the Chief Examiner for Junior Certificate Science.

The additional assessment information in this document is in the form of Marking Indicators. These indicators specify how questions on both the Ordinary Level Sample Paper and the Higher Level Sample Paper were marked. They also provide exemplar material for a number of key questions, particularly questions which test candidates in the areas of scientific method and investigative process. This exemplar material includes samples of students' answers as presented by them in the trialling process. It is accompanied by commentary which highlights significant features of particular answers. This commentary is intended to give some indication as to the standard that will be required in candidates' answering in the written examinations in June.

The Marking Indicators should be read in conjunction with the Sample Papers which were issued to schools in the autumn of 2005. They should also be read in conjunction with Circulars S67/05 and S17/06 which outlines the structure and rubrics for the assessment of the revised Junior Certificate Syllabus at both Ordinary Level and Higher Level. These documents are available on the State Examinations Commission website: www.examinations.ie

The State Examinations Commissions extends its gratitude to the principals, teachers of science, and students in the schools that participated in the trialling of the sample papers.

2. The Assessment of Junior Certificate Science

2.1 The Revised Junior Certificate Syllabus

The revised Junior Certificate Syllabus shares many of the topics and outcomes of the syllabus that it replaces**.** It is set out in three sections – biology, chemistry and physics. In each section the main topics and sub-topics are described and the associated learning outcomes are presented. The topics are designed to be delivered in a way that will involve the student in consistent experimental and investigative work. This emphasis is what marks the revised syllabus off from the one it replaces. It is this which also accounts for the fundamental changes that have occurred in relation to the manner in which Junior Certificate Science will be assessed.

From 2006 onwards the assessment of the revised Junior Certificate Science syllabus will consist of three components – Coursework A, Coursework B, and a terminal written examination. This is a significant advance on the assessment of the previous science syllabus which, for the vast majority of science students, consisted solely of a terminal written examination.

2.2 Structure of the Assessment in Junior Certificate Science

The prescribed assessment structure consists of three components:

1. Coursework A
2. Coursework
3. The Written Examination

The total marks allocated will be 600.

These 600 marks will be allocated as follows:

Coursework A will have an allocation of 60 marks (10%), Coursework B will have an allocation of 150 marks (25%), and the terminal written examination will have an allocation of 390 marks (65%).

2.3 Description of Assessment Components

Coursework A

Coursework A which involves the completion of mandatory investigations/experiments serves as a reward for participation in practical activities aimed at the development of a range of scientific skills in an enjoyable and stimulating setting. The skills developed in this way include those of dexterity and manipulation, observation, laboratory practice, safety and investigation. 10% of the total assessment mark will be awarded for the completion of the mandatory investigations/experiments (or lower on a pro rata basis for less that 100% completion).

Coursework B

Coursework B involves more open investigative work and 25% of the total assessment mark will be awarded for this component. Two options are available to candidates. Candidates are entitled to carry out and present a report on a scientific investigation of their own choice or, alternatively, carry out and present reports on two shorter investigations chosen from a list of three investigations prescribed by the State Examinations Commission. This investigative work serves to enhance the work done in Coursework A by further developing and applying the skills learned during the mandatory investigations. Coursework B presents scope for candidates to show imagination and creativity as they apply the scientific process and communication skills they have acquired in Years 1 and 2 through Coursework A.

It is clear, therefore, that Coursework A and Coursework B are designed to encourage the development and application of science process and investigative skills, and rewards them accordingly.

The Written Paper

A terminal written examination constitutes the third component of the assessment. The mark weighting allocated to the written examination is 65%. The role of the written paper is explicitly stated in the syllabus which requires that it assesses candidates' knowledge and skills in relation to learning outcomes in the areas of biology, chemistry and physics. The examination paper consists of three sections; one each for biology, chemistry and physics. Each section consists of

three questions and candidates taking the examination are expected to attempt all questions. There is no internal choice within questions.

The terminal written examination will test the full range of skills as prescribed in the revised syllabus. The decision to present an examination with no choice of any kind ensures that candidates engage with questions which assess specific learning outcomes and skills. It thus enhances the validity and reliability of the examination. For the examination to be valid and reliable, as wide a range of questions as possible is presented - testing across the range of learning outcomes presented in the syllabus. These outcomes include knowledge, understanding, ability to measure, to apply what is known, to demonstrate and to investigate.

2.4 The Structure of the Written Paper

The structure of the terminal written examination papers for both Higher Level and Ordinary Level, and the division of its allocation of 390 marks will be as follows:

The papers for both Higher Level and for Ordinary Level will take the form of 20 page completion-type booklets. The papers will have three distinct sections, each consisting of three questions. The first section of the examination paper will relate to the biology content of the syllabi, the second to the chemistry content and the third to the physics content. Each section will be allocated a total of 130 marks.

The first question in each of the three sections will be allocated 52 marks (40% of the marks allocated to the section). This question will consist of eight items. The first seven of these items will be allocated 6 marks and the last 10 marks. The content matter for these items will be drawn from across the syllabus.

The second question will have an allocation of 39 marks (30% of the marks allocated to the section) and will examine a smaller number of topics from across the syllabus in more depth. This question may also include some assessment of investigative skills and the ability of the candidate to apply scientific process.

The third question will also have an allocation of 39 marks. Again, a small number of topics from across the syllabus will be examined in more detail but this question will feature an increased emphasis on scientific process and investigative skills.

Candidates will be expected to attempt all questions on the examination paper. There will be no internal choice of questions within the examination paper.

2.5 Choice in the Written Paper

The absence of choice within the examination paper allows an appropriate balance to be achieved across the entire examination paper. Thus, the balance between specific skills or outcome types may shift from year to year across the three sections. For example in one year's examination physics and chemistry may have a slightly heavier emphasis on higher-order skills and on science process and investigative skills, with biology having a slightly heavier emphasis on knowledge or understanding. In the following year's examination biology and physics may be the ones heavier in higher-order skills and in scientific process and investigative skills with chemistry slightly heavier on knowledge or understanding. The structure of the sample papers deliberately demonstrates the flexibility that will obtain on the real examination papers into the future. It achieves this by illustrating the following:

- That there may be variation in the weightings of the assessment of lower-order skills, higher-order skills and scientific process and investigative skills between the three sections

- That one question may be largely or wholly dedicated to the assessment of knowledge/understanding or experimental/investigative skills within an overall balance as reflected in the syllabus outcomes. For example whilst Question 2 on the Higher Level sample paper concentrates on knowledge/understanding skills, Questions 8 and 9 are dominated by higher-order skills with increased emphasis on science process and investigative skills.

- That aspects of experimental/investigative skills can be assessed in the first question of each section.

3. The Marking of Junior Certificate Science

3.1 General Points regarding Marking Schemes for Junior Certificate Science

1. In many cases only key phrases are given in the marking schemes. These points contain the information and ideas that must appear in the candidate's answer in order to merit the assigned marks.

2. The descriptions, methods and definitions given in a marking scheme are not exhaustive and alternative valid answers are acceptable.

3. The detail required in any answer is determined by the context and the manner in which the question is asked and by the number of marks assigned to the answer in the examination paper. This may vary from year to year.

4. The bold text is often used to indicate the essential points required in the candidate's answer. A double solidus (//) separates points for which separate marks are allocated in a part of the question. Words, expressions or statements separated by a solidus (/) are alternatives which are equally acceptable for a particular point. A word or phrase in bold, given in brackets, is an acceptable alternative to the preceding word or phrase. Note, however, that words, expressions or phrases must be correctly used in context and not contradicted. Where there is evidence of incorrect use or contradiction, the marks may not be awarded.

5. In general, names and formulas of elements and compounds are equally acceptable except in cases where either the name or the formula is specifically asked for in the question. However, in some cases where the name is asked for, the formula may be accepted as an alternative.

6. There is a deduction of one mark for each arithmetical slip made by a candidate in a calculation.

3.2 Ordinary Level – Marking Indicators and Observations

Marking Indicators are provided to identify key words/concepts/points which would be reasonably expected to appear in any correct answer. The lists of key words/phrases/concepts are not exhaustive. Observations on each question indicate how candidates performed in the trialling exercise.

Question 1 **(52 marks)**

(a)	Microscope	(3)
	View cells / magnify image / to see small things	(3)
(b)	Skull	(3)
	Femur / thigh	(3)
(c)	Wind	(3)
	Avoid competition // spread species	(3)
(d)	Lens	(3)
	Retina / fovea	(3)
(e)	Stomach	(3)
	Large intestine / colon	(3)
(f)	Molar / accept pre-molar	(3)
	Chewing	(3)
(g)	Vegetables	(3)
	Energy	(3)
(h)	Z	(3)
	Growth towards window	(3)
	Light needed for photosynthesis (to make food)	(4)

Observations:

(a) Name was usually correct but answers in relation to the use were often vague e.g. “looking at small things” or “looking closely”.

(b) Usually answered well. Some candidates mixed up the femur with other bones.

(c) Wind was usually given but the importance of seed dispersal was not widely understood.

(d) Reasonably well answered by the majority who answered it. Some mixed up parts of eye. In most cases where marks were not awarded it was because no answer was offered.

(e) Stomach was usually answered correctly. Some gave “small intestine” or just “intestine” as the second answer.

(f) Answered well.

(g) Answered well.

(h) The most difficult item in Question 1. Even when the first two elements were answered correctly candidates struggled with the third element. Answers when offered to the third part were often vague e.g. “to make them grow”.

Parts (c) and (h) provided a high level of discrimination at the upper ability range.

Question 2 **(39 marks)**

(a)	(i)	Transport food // transport oxygen // transport waste // fight infection // maintain temperature (any 2)	(2 × 3)
(b)	(i)	Left atrium	(3)
	(ii)	Do: Exercise / healthy diet	(3)
		Don't: Smoke / poor diet	(3)
(c)	(i)	Water / carbon dioxide / salt / sweat / urine (any 2)	(2 × 3)
	(ii)	Bladder	(3)
		Kidney	(3)
		Ureter	(3)
	(iii)	Store waste / store urine	(6)
	(iv)	Skin / lungs	(3)

Observations:

(a)	(i)	Usually both were correct or incorrect. There appeared to be some vague guessing e.g. "to keep you alive" or "to keep heart going".
(b)	(i)	Usually correct. Not unexpectedly "ventricle" was given by some candidates.
	(ii)	Well answered.
(c)	(i)	Well answered. "Sweat" and "urine" were the most common correct answers. "Solid waste" was the most common incorrect answer offered.
	(ii)	Generally well answered. Sometimes mixed up parts. Uterus was the most regular incorrect answer for **C**.
	(iii)	Idea of storage was uncommon. "Making urine" was a regular incorrect answer.
	(iv)	Generally well answered.

Candidates tended to score well in this question. This was anticipated.

Question 3 **(39 marks)**

(a)	(i)	1/2: Carbon dioxide // water	(2 × 3)
		3: Chlorophyll	(3)
		4: Oxygen	(3)
(b)	(i)	Light / water / nutrients / space (any 2)	(6 + 3)
(c)	(i)	Protection of (Sensible use of) / animal (plant, environmental) resources	(3)
	(ii)	Red squirrel / red deer / any suitable example	(3)
	(iii)	Four points: Viable sampling technique // Randomness of sampling for fairness // Recording results // Supporting diagram	(4 × 3)

Observations:

(a) Most answered two parts correctly. Very few got all four parts correct.

(b) (i) Mostly well answered. Competing for "height" sometimes given.

(c) (i) Only a minority answered this element well.

(ii) Some offered foreign animals e.g. lion. Interestingly, no plants were offered.

(iii) Attempts were variable. A number of candidates made no attempt at this element.
A small proportion of answers were very good.
Many lacked some vital element. The requirement of randomness in the sampling technique and its link to fairness was the most common omission.
Attempts included both plant and animal species. Quadrat frames and pit-fall traps were most common pieces of equipment cited.

Part (c) of this question was highly discriminating. It was clear from the answers observed that some candidates had carried out field work. The question provided clear reward for those who understood scientific process and developed investigative skills. However, it must be noted that more open-ended questions of this type often suffer from a significant number of non-attempts at Ordinary Level.

Question 4 **(52 marks)**

(a)	Graduated (measuring) cylinder	(3)
	Measure (volume) of liquids	(3)
(b)	Coal / gas / oil / accept turf or peat	(3)
	Hydrogen	(3)
(c)	Solid	(3)
	Gas	(3)
(d)	Use cobalt chloride paper / anhydrous copper sulphate	(3)
	Blue to pale pink (purple) / white to blue (colour change must be matched)	(3)
(e)	Negative	(3)
	Inside	(3)
(f)	Prevent (fight) tooth decay	(3)
	Chlorination / use of ozone / disinfecting	(3)
(g)	Unsightly / damage birds (wildlife) [Accept pollution for half marks]	(6)
(h)	Turns blue	(3)
	Alkaline / basic	(3)
	Less oxygen in air	(4)

Observations:

(a) Generally answered well.

(b) Virtually all were able to give an example. A surprisingly significant proportion did not know that hydrogen was the second element.

(c) Most identified the solid. A significant number struggled with the second element.

(d) Candidates found this element difficult. They struggled both with the test and the observation. Only the better candidates scored marks here.

(e) Most got both “negative” and “inside”. A small number offered “positive”.

(f) Generally good but quite a few candidates seem to think that “fluoride is used to kill bacteria”.

(g) Well answered. Candidates gave a wide variety of answers – most of which were acceptable.

(h) Poorly answered. Only the very good candidates scored here.
Better candidates understood that oxygen supported the combustion.
A significant proportion did not attempt this element.

Parts (c), (d) and (h) provided a high level of discrimination with only the better candidates getting full marks in these elements.

Question 5 **(39 marks)**

(a)	(i)	Filtration	(3)
	(ii)	Any liquid and insoluble solid	(3)
	(iii)	Distillation	(3)
(b)		Solder / brass / bronze / pewter (any suitable example)	(3)
		Matched use	(3)
(c)	(i)	A	(3)
	(ii)	Uses (wastes) more soap / blocks pipes	(3)
	(iii)	Deionising / distillation / (accept boiling)	(3)
(d)	(i)	Ignite //	(3)
		Burns //	(3)
		With a “pop”	(3)
	(ii)	Zinc chloride	(3)
	(iii)	Lower	(3)

Observations:

(a) (i) Well answered.
(ii) Most were able to identify an example.
(iii) A significant proportion of candidates were unable to identify the technique.

(b) Example of an alloy was not well answered.
Most were able to identify a use of alloys – usually in car wheels.

(c) (i) Usually correct if attempted. Candidates showed a good ability to interpret the data.
(ii) Generally good if attempted.
(iii) Boiling was regularly offered.

(d) (i) Attempted rarely and only by the better candidates.
Only some of these answered correctly.
(ii) Almost no correct answers.
(iii) Usually correct when attempted.
There were however, fewer responses than might be expected.

Parts (c) (i) and (d) provided a high level of discrimination.

Question 6 **(39 marks)**

(a) (2 × 3)

Substance	Element	Compound
Carbon dioxide		√
Water		√
Carbon	√	

(b) (i) Hydrochloric acid (6)
Calcium carbonate / any carbonate or hydrogen carbonate / marble chips (6)
(ii) Quenches (3)
(iii) Doesn't support combustion (3)
(iv) Fire extinguishers (3)

(c) Four points: (4 × 3)
Lime water //
Method of drawing air through it //
Observation //
Conclusion //
Absence of diagram – deduct marks

Observations:

(a) This part yielded a surprisingly high number of incorrect answers.
Water being offered as an element was common.

(b) (i) Only about half of candidates were able to identify a suitable X and Y.
(ii) Answered well though some mixed up the gas with hydrogen.
(iii) Many unable to make a deduction.
(iv) Usually correct if answered. Not attempted by a significant number of candidates.

(c) Usually not attempted and attempts were often poor.

Candidates found this question difficult. Part (b), in particular, was quite discriminating. Part (c) showed the reluctance on the part of all but the best candidates to engage with descriptive questions. This has been observed when similar demands have been placed on candidates in examining the "old" syllabus.

Question 7 **(52 marks)**

(a)	8	(3)
	m^3	(3)
(b)	Acceleration / change of speed / change in velocity / change in shape / move an object (any 2)	(2 × 3)
(c)	Reflected ray drawn	(3)
	Reflection	(3)
(d)	Becomes faint / Can't be heard	(3)
	Sound requires a medium travel	(3)
(e)	Repels	(3)
	Any use of magnets	(3)
(f)	Thermometer	(3)
	Increases b.p.	(3)
(g)	Coal // oil	(2 × 3)
(h)	Wear ear (hearing) protection	(3)
	Decibel	(3)
	Insulation / double glazing	(4)

Observations:

(a) Answer usually correct.
Units often incorrect with cm^3 the most common incorrect answer.

(b) Answers ranged from good to poor. Examples of forces rather than effects of forces were often given.

(c) Answered by most and usually correct.

(d) Usually correct.
Some found difficulty in expressing the conclusion.

(e) Was well answered.
Examples were mostly acceptable. Some candidates probably knew a valid example but presented answers which were not specific and, therefore, would not get marks in an examination e.g. "fridge".

(f) Thermometer was given by virtually all candidates.
Answers were rare and very few of these were correct.

(g) Nearly always answered and correct.

(h) Well answered.
Often not attempted. There were very few correct answers.
Well answered.

Parts (a), (b), (f) and (h) provided a high level of discrimination.

Question 8 **(39 marks)**

(a) (i) Mass // Volume (3)

(ii) Electric balance / spring balance (6)

(iii) Three points: (3 × 3)
Method of displacing water – either graduated cylinder with water in it or overflow can //
Measure displaced water by rise in level or decanting to graduated cylinder //
Supporting diagram

(iv) 3 g cm^{-3} (6)

(b) (i) Four points: (4 × 3)
Metal rod (strip) / ball and ring apparatus //
Heated //
Method of showing expansion //
Supporting diagram

(ii) Expansion joints (3)

Observations:

(a) (i) Surprisingly a significant number of candidates offered incorrect answers.

(ii) Usually acceptable answers. Candidates should be discouraged from using the term "weighing scales".

(iii) This was the best answered of the experimental procedures on the examination paper. The most common point omitted was indicating how the volume is deduced.

(iii) A significant number of candidates got the number "3" but very few got the units correct.

(b) (i) The experiment using a ball and ring was most commonly offered. A good number of candidates answered the question very well.
A few neglected to label the diagram.

(ii) Most offered acceptable answers.

Part (a) (i) proved more discriminating than might be expected. Parts (a) (iii), (b) (i) provided a good level of discrimination.

Question 9 **(39 marks)**

(a)	(i)	Green and yellow	(3)
		Blue	(3)
	(ii)	Safety / to prevent overload	(3)
(b)	(i)	1	(3)
		$7 \times 10 = 70c$	(6)
(c)	(i)	Voltmeter in parallel	(3)
		Ammeter in series	(3)
	(ii)	Label switch	(3)
	(iii)	$I \alpha V / V = RI$	(6)
(d)	Static		(3)
	Earthing		(3)

Observations:

(a)	(i)	Mostly correct. A few candidates got the colours mixed up.
	(ii)	Mostly correct answers.
(b)	(i)	60 was a common incorrect answer. Very few correct answers.
(c)	(i)	Voltmeter and ammeter placed correctly by very many candidates.
	(ii)	The switch was usually correctly identified.
	(iii)	Very few correct answers.
(d)	Most were able to identify the type of electricity as static. Only a few candidates were able to give a way of preventing the problem.	

Parts (b) and (c) (iii) and (d) were highly discriminating.

3.3 General Observations arising from the trialling of the Ordinary Level Sample Paper

The type and standard of question offered allowed the vast majority of candidates the opportunity to engage with the assessment. There were still a sufficient number of more testing elements to provide adequate discrimination for the ability range of this cohort.

At Ordinary Level a number of general observations can be made.

- The single biggest problem remains one of candidates writing little or nothing in response to some elements of questions. This is a particular problem where more open response questions, such as "describe how you would carry out an experiment/investigation", are asked.

- The level of knowledge and understanding observed did not appear to be significantly different to that seen over recent years for the old syllabus.

- It did appear that the absence of choice within the examination made the test significantly more demanding, particularly for those candidates whose knowledge and understanding was somewhat patchy.

- There may be an improvement in performance when it comes to the June examinations for two reasons:
  - Some candidates entered at Higher Level may have relocated to Ordinary Level by that time
  - A significant number of candidates tend to become more focussed as the examinations come closer.

- Candidates tended to show weakness at drawing inferences from information.

- Where candidates showed reasonable ability to draw inferences or conclusions they also generally tended to have a better concept of validity when it came to describing investigations. There is likely to be a strong link between teaching and learning through experiment and investigation and the ease with which candidates excel in the examination.

- Whilst the allocation of a significant proportion of marks to Coursework elements is expected to reduce significantly the numbers achieving very low grades such as E, F and N.G., the structure of the written examination, with its absence of choice in particular, makes the new examination a more searching test than the written examination which was used to assess the previous syllabus.

3.4 Higher Level – Marking Indicators and Observations

Marking Indicators are provided to identify key words/concepts/points which would be reasonably expected to appear in any correct answer. The lists of key words/phrases/concepts given are not exhaustive. Observations on each question indicate how candidates performed in the trialling exercise

Question 1

(a)	Microscope	(3)
	Focus	(3)
(b)	Humerus	(3)
	Femur // thigh	(3)
(c)	Wind	(3)
	Avoid competition // spread species // prevent overcrowding	(3)
(d)	Lens	(3)
	Focus image on retina (fovea)	(3)
(e)	Liver	(3)
	Produce bile	(3)
(f)	Carry messages from sense organs // carry messages to central nervous system	(3)
	Carry messages from central nervous system // carry messages to muscles	(3)
(g)	Vegetables	(3)
	Gives a blue-black colour when tested with iodine	(3)
(h)	Z	(3)
	Phototropism	(3)
	Light needed for photosynthesis (to make food)	(4)

Observations:

(a) Mostly correct. Few gave "focus knob" – possibly due to the lay-out of the question.
Mostly correct.

(b) Answered well. Some gave tibia in place of femur.

(c) Wind was identified by most candidates.
Some vague and incorrect answers were presented in relation to why seed dispersal was important. Among the more common incorrect answers were "to grow" or "to reproduce".

(d) Mostly correct. Some gave iris or pupil.
Most candidates correct gave the correct function.

(e) Most candidates answered correctly. Production of bile was the most common correct answer to the function. A few candidates gave the "stomach and a matched function as an answer.

(f) The brain was given in stead of the central nervous system in most cases.

(g) Vegetables most commonly given as an answer. A few candidates offered cheese as an answer. Most were able to identify the test. A few candidates, however, just mentioned iodine solution without details.

(h) The first two elements were answered well. A few incorrectly identified the growth response as geotropism. Many had difficulty with the last element. Very few made a connection between light and photosynthesis.

Parts (c) and (h) gave a high level of discrimination.

Question 2

(a)	(i)	Transport food // transport oxygen // transport waste // fight infection // maintain temperature (any one)	(3)
	(ii)	Veins carry blood towards the heart // veins have valves // veins have thinner walls // converse of each true for arteries	(3)
(b)	(i)	X: Lungs	(3)
		Y: Aorta	(3)
	(ii)	Alveolus // alveoli	(3)
		Oxygen exchanged for carbon dioxide and water	(3)
		Smoking	(3)
(c)	(i)	A: Kidney	(3)
		B: Ureter	(3)
		C: Bladder	(3)
	(ii)	Removes waste of metabolism from blood // accept “filters blood”	(3)
	(iii)	Skin // lungs	(2 × 3)

Observations:

(a)	(i)	Well answered.
	(ii)	Well answered.
(b)	(i)	Well answered. Generally well answered. Some simply stated “main artery”.
	(ii)	Generally well answered. Some simply stated “bronchioles”. Most knew the gases involved but some mixed up the exchange. Well answered. Smoking most commonly given.
(c)	(i)	A: Well answered. B: Poorly answered. Either not attempted or urethra given by a significant number of candidates. C: Well answered.
	(ii)	Generally well answered. Some simply stated “storage” as the function.
	(iii)	Well answered.

As expected this was the best answered question on the examination paper. Where weaknesses were identified it was attributed to “course coverage” rather than test item difficulty.

Question 3

(a)	(i)	Carbon dioxide // water	(3)
		Oxygen	(3)
		Chlorophyll	(3)
	(ii)	Food transport	(3)
(b)	(i)	7.6 ± 0.1 m	(3)
	(ii)	Competition for light // water // nutrients // space (any 2)	(2 × 3)
(c)	(i)	Protection (wise use) of animal // (plant, environmental) resources	(3)
	(ii)	Red squirrel // red deer // any suitable example	(3)
	(iv)	Four points: Viable sampling technique // Randomness of sampling for fairness // Recording results // Supporting diagram	(4 × 3)

Observations:

(a)	(i)	This question was surprisingly poorly answered. Candidates had particular difficulty in identifying chlorophyll as the necessary substance.
	(ii)	Well answered.
(b)	(i)	Well answered.
	(ii)	Usually well answered.
(c)	(i)	Answers were sometimes a bit vague but mostly satisfactory.
	(ii)	Mostly acceptable answers but a significant number chose non-indigenous animals e.g. lions, pandas, etc. Usually well answered. The need for randomness was included by most of the better candidates. It would appear that the need for "fairness" controls in this kind of field study is being stressed in teaching.

Part (a), surprisingly, and part (c) (iii) were the more strongly discriminating parts.

Question 4

(a) Burette (3)
Measure (volume) of liquids (3)

(b) Reacts with air (oxygen) (3)
Hydrogen + sodium hydroxide (3)

(c) Acid rain // erosion of stonework // damage plants (3)
Burning fossil fuels (3)

(d) Water (3)
Cobalt chloride paper, blue to pink (purple) // anhydrous copper sulphate, white to blue (colour changes must be matched) (3)

(e) Atoms of the same element with different numbers of neutrons in their nuclei. (6)

(f) Prevent (fight) tooth decay // harden teeth (3)
Chlorination // use of ozone // disinfecting (3)

(g) Unsightly // damage birds (wildlife) [Allow 3 marks for "pollution"] (3)

(h) $H_2O_2 \rightarrow H_2O + \frac{1}{2}O_2$ // $2H_2O_2 \rightarrow 2H_2O + O_2$ // (3)
Turns blue (3)
Alkaline // basic (4)

Observations:

(a) Mostly well answered. A few candidates gave "pipette".
Mostly correct though, interestingly, the word "volume" was rarely seen.

(b) Understanding why sodium is stored in oil was well answered.
The completion of the equation was very poorly answered.

(c) Identifying the problem was well answered but a few candidates gave the "ozone problem" as an answer. A few candidates did not know how the problem arose.

(d) Water was generally given.
Many identified a test but some of these got the colour changes mixed up.

(e) This element was very poorly answered. Only a small number of the better candidates were able to answer it.

(f) Mostly well answered. Some candidates thought fluoride is used to kill bacteria.
Most choose chlorination. However, unfortunately, some candidates wrote "add chloride".

(g) Generally well answered. Some, unfortunately, simply restated the information given i.e. "they are non-biodegradable".

(h) The vast majority of candidates did not balance the equation.
Observations were often poor.
The conclusion was regularly incorrect.

Parts (b), (c), (e), (f) and (h) of this question all contributed to making the question highly discriminating. Particular weaknesses of some candidates in the area of observations and deductions were identified.

Question 5

(a) Hydrogen (3)
Burns with a "pop" (3)

(b) (i) Four points: (4 × 3)
Marble chips / suitable carbonate (hydrogen carbonate) //
Hydrochloric acid / suitable acid //
Collection by displacement of air //
Supporting labelled diagram

(ii) Candle quenches (3)
Gas is heavier (more dense) than air (3)
Gas doesn't support combustion (3)

(c) (i) Four points: (4 × 3)
Piece of iron with access to air and water //
Observation: it rusts //
Piece of iron with access to air but not water (drying agent needed) //
The latter doesn't rust so water must be necessary

Observations:

(a) Oxygen was incorrectly offered by a significant number of candidates.
A correctly matched test was almost invariably given even if it were for the wrong gas.

(b) (i) Standard of diagrams was very variable.
Chemicals required were usually correct though some gave the requirements to make oxygen.
A significant number of candidates collected the gas over water.
Most labelled the diagram.

(iii) The observation was almost always correct.
Weaker candidates were only to draw one conclusion (i.e. "gas doesn't support combustion").

(c) (i) Responses were mixed.
A high proportion of candidates did not present a means of excluding water i.e. no drying agent. Where an attempt to identify a drying agent was made, sodium chloride and calcium carbonate were regular incorrect answers.
Occasionally the conclusion was omitted.

This was a highly discriminating question. Parts (b) and (c) clearly rewarded those who had a clear understanding of experimentation, investigation and scientific process.

Question 6

(a)	(i)	2, 8, 1 arrangement for sodium drawn	(3)
		2, 8, 7 arrangement for chlorine drawn	(3)
	(ii)	Describe (show) electron transfer	(3)
		Formation of Na^+ and Cl^- ions	(3)
	(iii)	Ionic	(3)
(b)	(i)	Points plotted correctly	(6)
		Linear plot (should not be extended to origin)	(3)
	(ii)	Solubility increases with temperature // solubility α temperature	(3)
	(iii)	74 g per 100 cm^3	(3)
	(iv)	Three points: 100 cm^3 of water heated to certain temperature // Add salt 'till no more will dissolve // Method for knowing mass dissolved (added)	(3 × 3)

Observations:

(a) (i) Most candidates were able to describe the electronic configurations of sodium and chlorine. Where errors were made it most commonly involved the sodium atom.

(ii) Most showed an electron being transferred but many made no reference to ion formation.

(iii) Most gave ionic but a small number incorrectly gave covalent.

(b) (i) Points were usually plotted correctly.
Candidates regularly and incorrectly extrapolated the plot incorrectly to include the origin.

(ii) Most interpreted the graph correctly making the correct observation.

(iii) Most answered correctly. Candidates should be encouraged to take care to read data/information from graphs accurately.

(iv) This part was not well answered.
Only the better candidates referred to the important details of fixing the amount of water, and having some method of knowing how much salt was added.

Again this question was highly discriminating. Part (b) in particular clearly identified which candidates had an understanding of how to set up a fair investigation.

Question 7

(a)	Light travels faster than sound	(6)
(b)	Green and yellow	(3)
	Safety / to blow if overloaded	(3)
(c)	Barometer	(3)
	Less atmosphere above	(3)
(d)	Becomes faint / Can't be heard	(3)
	Sound requires a medium travel	(3)
(e)	Hot water rises / hot water less dense	(3)
	Convection	(3)
(f)	Light to electrical (chemical)	(3)
	Needs direct sunlight / open space	(3)
(g)	2	(3)
	$m\ s^{-2}$	(3)
(h)	Charging of trolly by friction	(4)
	Dry air is an insulator / in damp air the charge leaks (can't build up)	(6)

Observations:

(a) Well answered.

(b) Colours generally known.
Poorly answered. Phrases like "control current" were common.

(c) Barometer was generally known.
Explanations were often poor and incorrect. There was evidence of confusion in relation to the reason, and answers like "atmospheric pressure varies with height (depth)" or "air thinner were common".

(d) Both elements were well answered.

(e) This part was well answered though a small number failed to produce the word "convection".

(f) Mostly well answered. Interestingly, the energy change seemed to present slightly more difficulty than the factor.

(g) Mostly got the number correct but many offered $m\ s^{-1}$ in place $m\ s^{-2}$ of as the units.
A small number of candidates produced curious answers of no obvious origin.
Candidates should be encouraged to show calculations so that is clear what they are attempting to do.

(h) The idea of charging by friction was regularly and acceptably demonstrated without mention of the word friction. Attempts to explain why static electricity only builds up in dry weather were varied and often poor.

This question was quite discriminating. Parts (b), (c) and (h) were strongly discriminating.

Question 8

(a)	(i)	6 (kg m^{-3})	(6)
	(ii)	1800	(3)
		Newtons // N	(3)
	(iii)	120 (Pa) (N m^{-2})	(3)
(b)	(i)	Three points:	(3 × 3)
		Bar magnet and iron filings / plotting compases //	
		Shake / plot //	
		Pattern produced //	
		No diagram – deduct marks	
(c)	(i)	Ammeter	(3)
		Voltmeter	(3)
	(ii)	To keep temperature constant	(3)
	(iii)	0.5	(3)
		Ohm // Ω	(3)

Observations:

(a) (i) Mostly correct. Where incorrect there was no indication as to where the error occurred.
(ii) Poorly answered. Units were often incorrect e.g. kg.
(iii) Regularly incorrect.

(b) An indication of the final pattern emerging was often omitted.

(c) (i) The majority of candidates identified the meters correctly.
(ii) Most had no idea as to why the resistor was placed in water.
(iii) The majority got the correct answer but a significant number offered either 2 or 0.25. Nearly all knew the correct units.

The question as a whole was strongly discriminating. Candidates had particular difficulty with elements (ii) and (iii) of part (a), and with (c) (ii).

Question 9

(a) (i) Three reflected rays (3)

(ii) Show converging rays (3)

(iii) Four points: (4 × 3)
Glass block and incident ray //
Ray tracked through block //
Exiting ray tracked //
Supporting diagram

(iv) Four points: (4 × 3)

Glass block and incident red and blue rays at same angle // Ray tracked through block // Exiting ray tracked // Supporting diagram	Glass prism and incident red and blue rays at same angle // Ray tracked through block // Exiting ray tracked // Supporting diagram

(b) (i) Four points: (3 × 3)
Hot gas in vessel //
Cooling //
Method for noting volume reduction (contraction) //
Supporting diagram required – no diagram – marks deducted

Observations:

(a) (i) Well answered.

(ii) Well answered.

(iii) Generally well answered. A significant number of candidates failed to track the emerging ray correctly.

(iv) Many made the link to the previous part but often failed to develop the procedure fully.
Interestingly, only a small minority of the candidates tested made a link to the dispersion of a beam of light shown by a prism.

(b) (i) A significant proportion of candidates were unable to adapt the experiment to show that gases expand when heated to show that gases contract when cooled.

The question was highly discriminating. Candidates who, for what ever reason, had not developed the flexibility to adapt information and apply it in an investigation setting had difficulty with parts (a) (iv) and (b) (i).

3.5 General Observations arising from the trialling of the Higher Level Sample Paper

The type and standard of question offered allowed the vast majority of candidates the opportunity to engage with the assessment. There were a sufficient number of more testing elements to provide adequate discrimination for the ability range of this cohort. The absence of choice makes the examination extremely searching in terms of course coverage, and in the range of skills assessed.

At Higher Level a number of general observations can be made

- Candidates at Higher Level are more likely to attempt questions than their counterparts at Ordinary Level even in instances where they are clearly hazy as to the answer.

- In questions which involve more open responses such as “describe an experiment/ investigation”, etc., candidates should be encouraged to present information in clear points. These should cover relevant aspects of the experiment/investigation such as how a test is made to be fair, etc. even if such is not explicitly stated in the question. Such considerations are often an absolute requirement of an investigation and therefore required for full marks to be awarded in the examination.

- The level of knowledge and understanding observed did not appear to be significantly different to that seen over recent years for the previous syllabus. Very few candidates were awarded full marks in the first question of each section. This contrasts with the scoring pattern observed amongst candidates for Section A of the examination for the previous syllabus.

- It did appear that the absence of choice within the examination and the inclusion of more demanding items in the first question in each section made the test significantly more discriminating. Even the best of candidates seemed to find the examination more searching than has been observed in examinations involving the previous syllabus which had substantial choice.

- Some candidates tended to show weakness at drawing inferences from information.

- Where candidates showed reasonable ability to draw inferences or conclusions they also generally tended to have a better concept of validity when it came to describing investigations. There is likely to be a strong link between teaching and learning through experiment and investigation, and the ease with which candidates excel in the examination.

- The allocation of a significant proportion of marks to Coursework elements is expected to reduce significantly the numbers achieving very low grades such as E, F and N.G. However, the observations made above in relation to the more searching nature of the written examination may counteract this and may reduce somewhat the numbers of candidates receiving very high grades.

It was clear from the trialling exercise that simple recall will not secure a high grade in the examination paper. Candidates will need not only to recall information or experiments/investigations but also to have internalised the finer points of the material they have covered so that they can select relevant information and also be able to understand and explain why certain elements of a process were necessary for the validity of an exercise.

4 Exemplar Material

4.1 Ordinary Level

Exemplar material included here is drawn directly from the responses of candidates who participated in the trialling of the Ordinary Level Sample Paper. These responses are reproduced in italics exactly as candidates had written them. Observations are made following each exemplar as appropriate.

Question 1

(*c*) The diagram shows the fruit and the seed of the dandelion.

How are dandelion seeds dispersed?

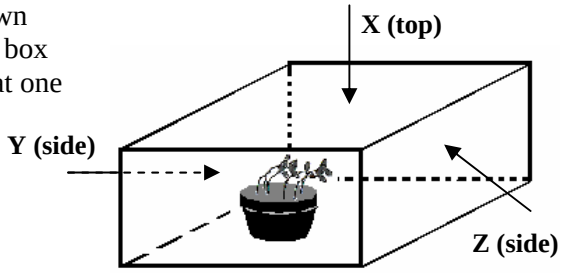
How? *Wind*

Why is seed dispersal important?

Why? *So that they can spread over a wider area.*

Observation: The method of dispersal and a reason why it is important are both correct. Full marks were awarded.

(*h*) The seedlings in the flower pot drawn on the right were grown in a closed box which had a window to let light in at one of the points **X**, **Y** or **Z**.



Was the window at **X**, **Y** or **Z**?

Z

Give a reason for your answer.

Because the seedlings grow towards the light

Why is this growth response helpful to the plants?

Because they need light to make food

Observation: The location of the window is correct. The reason why this deduction can be made is correct and the reason why this growth response is helpful to plants is also correct. The candidate has shown an ability to make an observation, to link this to knowledge and to link this in turn to an understanding of the growth requirements of plants. All 10 marks were awarded.

Question 3

(*c*) (*i*) In ecology what is meant by *conservation*? (3)

Conservation is the looking after and protection of plant, animal and environmental resources so that they won't get used up or destroyed

Certain animal and plant species are described as "threatened".

(*ii*) Give an example of an Irish animal or plant species that is on the threatened list. (3)

Red deer

Exemplar 1

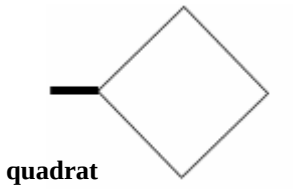
(*iii*) Many species of plant are protected in National Parks. The manager of one of these parks is asked to measure the frequency with which a protected species occurs in a habitat within the park.

Describe how this might be carried out. Include a diagram of any equipment that might be used. (12)

Throw a quadrat frame over your shoulder

Write down the plants you find inside the quadrat

Labelled diagram



quadrat

Observation: The basic method described is a valid one. However, the candidate does not adequately make allowances to make the sampling both fair and valid. The exercise is not repeated several times, is not repeated in different locations, and there is no averaging of results. Only 6 of the 12 marks were awarded.

Exemplar 2

(*iii*) Many species of plant are protected in National Parks. The manager of one of these parks is asked to measure the frequency with which a protected species occurs in a habitat within the park.

Describe how this might be carried out. Include a diagram of any equipment that might be used. (12)

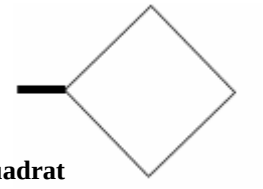
Throw a quadrat frame over your shoulder

Write down the plants you find in the quadrat

Do this a number of times around the park. Average the results

Keep the results you got for each part of the park

Labelled diagram



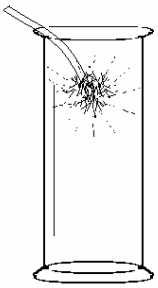
Observation: The method described is a valid one. The candidate includes the elements required to make the sampling fair without using the word "random". All 12 marks were awarded.

[Indeed at Ordinary Level words like "random" were not seen regularly but the procedure described by the better candidates often had randomness built in. Repeating the process a number of times and at different locations was the most common omission.]

Question 4

Exemplar 1

(*h*) A piece of magnesium burns very brightly in a gas jar of oxygen and produces a white powder.



What is observed when this white powder is added to water and litmus paper added?

Blue litmus turns red.

What does this result tell you about the product?

It is a acid.

Why does a piece of magnesium burn even **more brightly in oxygen**

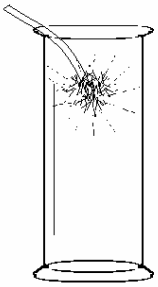
than it does in air? *Because there is less oxygen in the air*

Observation: The candidate makes the incorrect observation. The deduction is incorrect, though consistent with the incorrect observation. The candidate has demonstrated a understanding of the difference between burning in an atmosphere of air and oxygen. Only 4 of the 10 marks were awarded.

Exemplar 2

(*h*) A piece of magnesium burns very brightly

in a gas jar of oxygen and produces a white powder.



What is observed when this white powder is added to water and litmus paper added?

Red litmus turns blue.

What does this result tell you about the product?

It is a base.

Why does a piece of magnesium burn even **more brightly in oxygen**

than it does in air? *Because there is less oxygen in air*

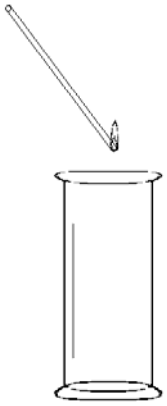
Observation: The candidate makes the correct observation, deduction and has demonstrated and understood the difference between burning in an atmosphere of air and oxygen. Full marks were awarded.

Question 6

(*b*)

Exemplar 1

The diagram shows a lighting taper and a gas jar of carbon dioxide gas.



(*ii*) What happens to the lighting taper when it is placed into the gas jar?

What? *burns out* (3)

(*iii*) What does this tell us about carbon dioxide gas? (3)

What? *That it is less dense than air.*

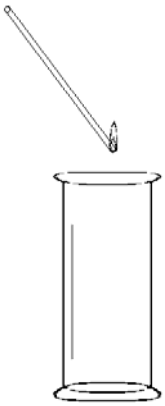
(*iv*) Name **one item** commonly found in public buildings that contains carbon dioxide and makes use of the property demonstrated in the test described above. (3)

Fire extinguishers

Observation: "Burns out" was interpreted as quenching. The deduction in the second element is incorrect. And the use is correct. Only 6 of the 9 marks were awarded.

Exemplar 2

The diagram shows a lighting taper and a gas jar of carbon dioxide gas.



(*ii*) What happens to the lighting taper when it is placed into the gas jar?

What? *The taper outs* (3)

(*iii*) What does this tell us about carbon dioxide gas? (3)

What? *Things don't burn in carbon dioxide.*

(*iv*) Name **one item** commonly found in public buildings that contains carbon dioxide and makes use of the property demonstrated in the test described above. (3)

Fire extinguishers

Observation: A clear and correct understanding of the implications of the observation is made. All 9 marks were awarded.

Exemplar 1

(*c*) Air is a mixture.

Describe, using a labelled diagram, how you might carry out an investigation / experiment to show that carbon dioxide is present in air. (12)

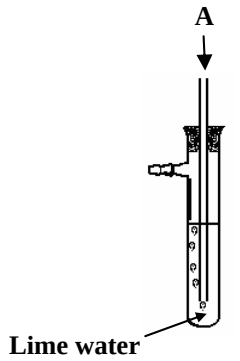
Set up a test tube as shown in the diagram.

*Breathe out through **A**.*

After a while the lime water turns milky.

This shows that there was carbon dioxide in the air.

Labelled diagram



Observation: The candidate has really in fact described an investigation to show that exhaled air contains carbon dioxide. Only the 6 marks – those for identifying the test for carbon dioxide and the observation in that test were awarded.

Exemplar 1

(*c*) Air is a mixture.

Describe, using a labelled diagram, how you might carry out an investigation / experiment to show that carbon dioxide is present in air. (12)

Set up a test tube as shown in the diagram.

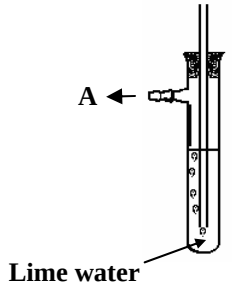
*Breathe in through **A**.*

The air is pulled in through the limewater.

After a while the lime water turns milky.

This shows that there was carbon dioxide in the air.

Labelled diagram

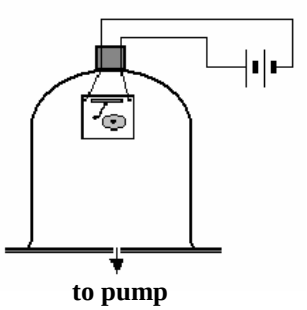


Observation: The candidate describes an investigation to show that inhaled air contains carbon dioxide. This is a valid response to the question asked. The procedure, observations and conclusion are all clear. All 12 marks were awarded.

Question 7

Exemplar 1

(*d*) The diagram shows an electric bell ringing inside a bell-jar. A pump was used to remove the air from inside the bell-jar.



What **change** would you expect to notice in the sound coming from the bell when the air was removed from inside the bell-jar?

The bell gets harder to hear.

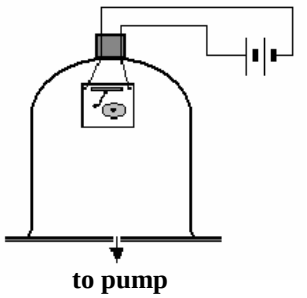
What does this experiment tell you about sound?

You need air to make sound

Observation: The first observation is correct, however, the incorrect conclusion was drawn though and only 3 marks were awarded.

Exemplar 2

(*d*) The diagram shows an electric bell ringing inside a bell-jar. A pump was used to remove the air from inside the bell-jar.



What **change** would you expect to notice in the sound coming from the bell when the air was removed from inside the bell-jar?

You can't hear the bell.

What does this experiment tell you about sound?

Sound needs the air to travel through

Observation: The first observation is correct, however, the correct conclusion was drawn and all 6 marks were awarded.

Exemplar 1

(*h*) If you were visiting a factory and saw the **sign** shown in the diagram, what precaution should you take?

Cover your ears because of noise

What is the **scale** in which sound levels are measured?

[Note: The word decibel was only very rarely seen for the second element.]

Sound levels in a house often arise from noises that come from outside the house. Mention **one** simple method of reducing the level of these noises inside the house.

Put in double glazed windows

Observation: The correct understanding was given for the first element. There was no response to the middle item and a suitable action was identified for the third element. Only 7 of the 10 marks were awarded.

Question 8

Exemplar 1

(a)

(*iii*) Describe, using a labelled diagram, how the **volume** of the stone could have been measured. (9)

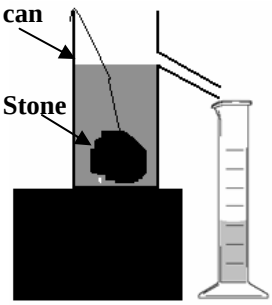
Half fill an overflow can with water.

Drop the stone into the overflow can.

The water that spills out into the measuring cylinder is the volume of the stone.

Observation: The method described is correct except for the fact that the overflow can should have been filled and allowed overflow prior to placing the graduated cylinder in place and lowering the stone in. Only 6 of the 9 marks were awarded. In many cases it is much a lack of attention to detail and accuracy in describing a process or procedure that results in loss of marks as a lack of knowledge. The importance of clarity and accuracy in scientific process is important and should be stressed.

Labelled diagram



Exemplar 2

(a)

(*iii*) Describe, using a labelled diagram, how the **volume** of the stone could have been measured. (9)

Put water in a measuring cylinder.

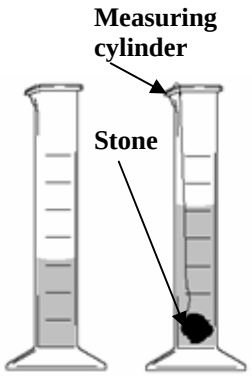
Read the volume.

Place the stone into the measuring cylinder.

The increase in volume is the volume of the stone.

Observation: The candidate has described fully a suitable method for measuring the volume of a small stone.
Full marks were awarded.

Labelled diagram



Exemplar 1

(*b*) Metals **expand** when heated.

(*i*) Describe, using a labelled diagram, an experiment you could carry out to demonstrate this. (12)

Use a ball and ring.

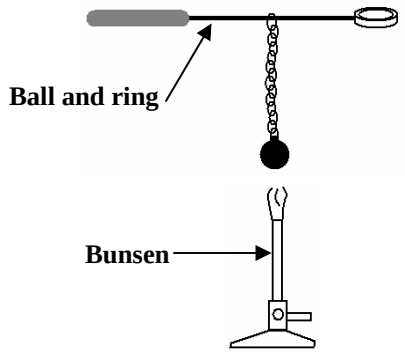
When the ball is cold it will go through the ring.

Heat the ball using a bunsen burner.

When the ball is hot it won't go through the ring.

This shows that the metal ball expanded when it was heated.

Labelled diagram



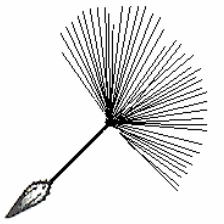
Observation: This particular experiment was regularly answered both clearly and well. Full marks were awarded in this case.

4.2 Higher Level

Exemplar material included here is drawn directly from the responses of candidates who participated in the trialling of the Higher Level Sample Paper. These responses are reproduced in italics exactly as candidates had written them. Observations are made following each exemplar as appropriate.

Question 1

Exemplar 1



(*c*) The diagram shows the fruit and seed of the dandelion.

How are dandelion seeds dispersed?

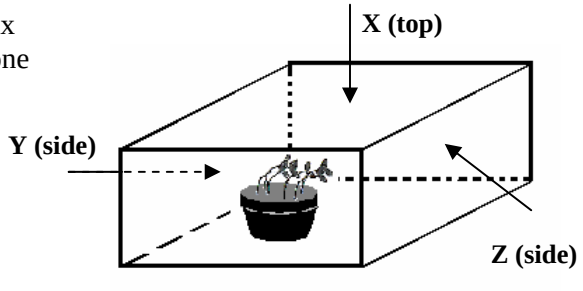
Why is seed dispersal important?

How? *By the wind*

Why? *To avoid competition for light, minerals, water, space, etc.*

Observation: Full marks awarded; clear knowledge and understanding.

(*h*) The seedlings in the flower pot drawn on the right were grown in a closed box which had a window to let light in at one of the points **X**, **Y** or **Z**.



Was the window at **X**, **Y** or **Z**?

Location of window *Z*

What is the correct name of the **growth response** of the seedlings

observed in this investigation? *Phototropism*

Explain why this growth response is helpful to plants.

Because it reacts to the light stimuli and they then grow in the direction of the sun and this helps them get more sunlight for photosynthesis.

Observation: Full marks awarded. The clear connection between position and ability to access more light for photosynthesis was made.

Question 2
Exemplar 1

(*a*) Blood consists of white blood cells, red blood cells and platelets in a liquid called plasma. Blood is carried around the body in arteries, veins and capillaries.

(*i*) Give **one function** of blood. (3)

It transports substances such as glucose, oxygen, hormones, wastes, carbon dioxide, the blood cells, etc.

(*ii*) Give **one difference** between veins and arteries. (3)

Veins have valves to prevent blood backflow. Arteries don't.

Observation: Both elements were answered clearly and correctly.
All 6 marks were awarded.

Question 3
Exemplar 1

(*ii*) Give **two** reasons why the growth of the planted trees may have been influenced by the big tree. (6)

Reason 1 *They were in competition for light, minerals, water, space, etc.*

Reason 2 *They had more space, the further away they are.*

Observation: The case of competition for several esentials for successful growth was clearly made and the full 6 marks were awarded.

(*c*) (*i*) In ecology what is meant by *conservation*? (3)

Protection, preservation and careful use of our natural resources.

Certain animal and plant species are described as "threatened".

(*ii*) Give an example of an Irish animal or plant species that is on the threatened list. (3)

Red deer

(*iii*) Many species of plant are protected in National Parks. The manager of one of these parks is asked to measure the frequency with which a protected species occurs in a habitat within the park.

Describe how this might be carried out. Include a diagram of any equipment that might be used. (12)

Step 1: Through a quadrat over your shoulder in a large open space.

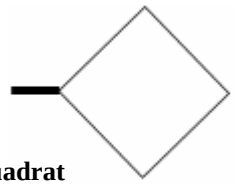
Step 2: Record how many times a certain plant appears inside the quadrat

Step 3: Write this down on some paper

Step 4: Repeat a few times to get the average number a plants occurs.

Result: The plant that occurred the most frequently inside the quadrat is the most frequently occurring plant.

Labelled diagram



Quadrat

Observation: Parts (i) and (ii) were answered clearly and correctly. In part (iii) the candidate covered the required details of an acceptable method, a method for making the process random (though it would have been better if this had been explicitly stated), the need to record and average results and to provide a supporting diagram. The candidate could have improved on the answer by explicitly stating the need for "throwing the quadrat over one's shoulder" but it was taken as an "inferred" point in the context of the total marks available. The full 12 marks were awarded.

Exemplar 2

(*iii*) Many species of plant are protected in National Parks. The manager of one of these parks is asked to measure the frequency with which a protected species occurs in a habitat within the park.

Describe how this might be carried out. Include a diagram of any equipment that might be used. (12)

This may be carried out using a pooter(small insects) beating tray (insects in trees), quadrat (plants). Rope with regular intervals (plants). Sweepnet (insects in tall lgrass) A empty jar burried in the soil will collect insects. Small insects may be sucked up from rocks/tree bark, etc. by using a pooter. The quadrat can be trown spontaneously on a field 10 times to measure the frequency of plant species.

Labelled diagram
Diagrams of all the techniques were drawn in and around the space provided.

Observation: Despite the candidates display of clear knowledge of a range of relevant sampling techniques, there was no clear indication of how the surveying was made random and fair and also no reference to the need to record results. Only 6 of the 12 marks were awarded.

Question 4

Exemplar 1

(*g*) Give **one** negative impact on the environment

of the use of non-biodegradable plastics for packaging.

Negative impact *They cause a litter problem because they don't rot.*

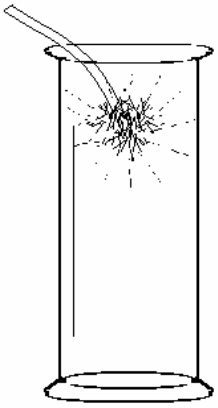
Observation: the connection between their non-biodegradability and their persistence in the environment has been made.

(*h*) A gas jar of oxygen was prepared by decomposing hydrogen peroxide using a suitable catalyst. This preparation may be described as follows:

$$\mathbf{H_2O_2 \rightarrow H_2O + O_2}$$

Balance the above equation.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$



A piece of magnesium burns very brightly in a gas jar of oxygen and produces a white powder.

What is observed when this white powder is added to water and litmus paper added?

It turns red litmus blue

What **conclusion** can be drawn from this observation?

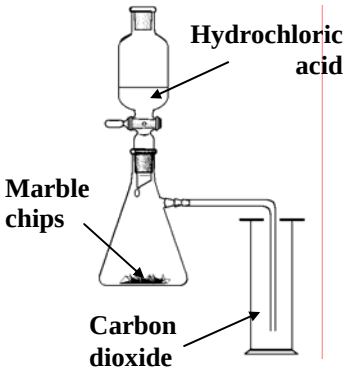
It is basic

Observation: Balancing, observation and conclusion are clearly stated and correct. All 10 marks awarded. Unfortunately, occurrences of candidates giving the balanced equation were rare.

Question 5

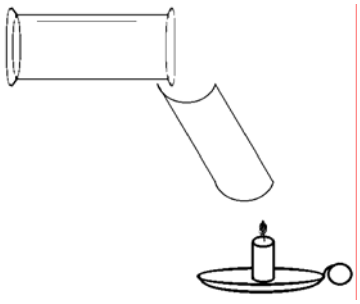
(*b*) Carbon dioxide gas may be prepared in a school laboratory.

(*i*) Illustrate using a labelled diagram, in the space provided, how a sample of carbon dioxide gas could be prepared and collected in the school laboratory. (12)



Observation: The diagram was clear and all labels were correct. All 12 marks were awarded. Interestingly, some candidates from the same class group collected the gas over water which is possible but inappropriate practice. These candidates were awarded 9 marks.

(*ii*) A gas jar full of carbon dioxide is poured onto a chute which is held over a lighting candle as shown in the diagram.



What **observation** would you expect to make? (3)

What **two** properties of carbon dioxide does this test demonstrate? (6)

Observation *It will out the candle*

Property 1 *Carbon dioxide is denser than air*

Property 2 *Carbon dioxide does not support combustion*

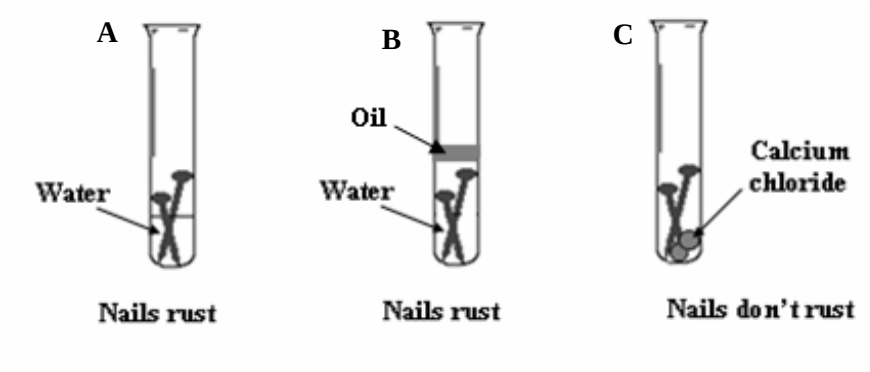
Observation: Observation and conclusions are clearly stated. All 10 marks were awarded.

(*c*) The corrugated iron on the roof of this barn was damaged by rusting.

Picture of barn with a rusting corrugated iron roof

(*i*) Describe, with the aid of a labelled diagram, how you might carry out an investigation / experiment to show that water is necessary for rusting to occur. (12)

Get 6 iron nails and 3 test tubes. Put 2 iron nails into each test tube. In test tube A add water to the nails. In test tube B add calcium chloride to the nails and in test tube C add boiling water and a layer of oil to the nails. Leave them for a dew days. A's nails rust, test tube B's nails don't rust because the calcium chloride gets rid of any water present and test tube C's nails don't rust because the boiled water gets rid of oxygen and the oil keeps it out.



Observations: The description went beyond the requirements of the question but covered all the points required to show that water was necessary. All 12 marks were awarded.

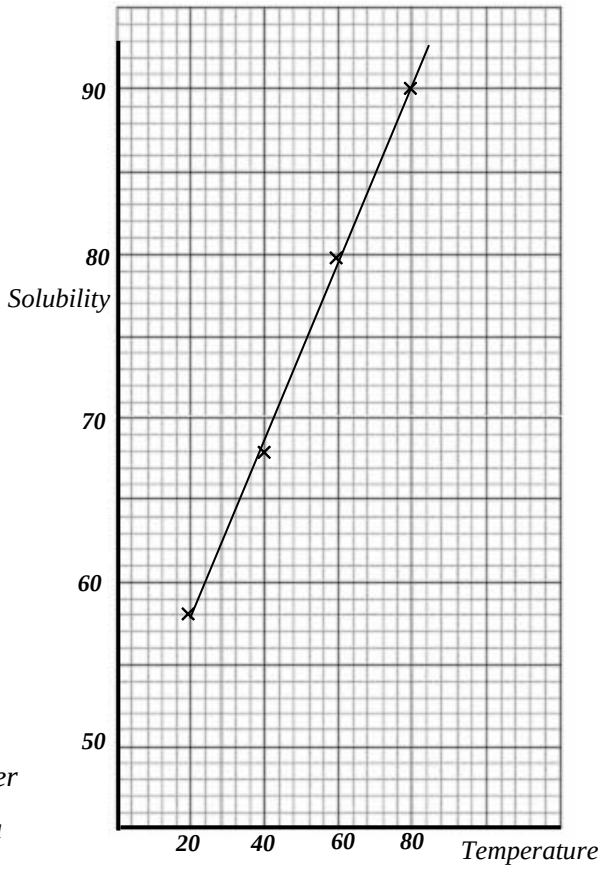
Question 5

Exemplar 1

(*c*) The solubility of a salt, potassium bromide (KBr) was investigated. The data in the table on the right was collected.

Temperature (°C)	**Solubility grams per 100 cm^3 of water**
20	58
40	68
60	80
80	90

(*i*) Plot a graph in the space provided of solubility (*y*-axis) against temperature (*x*-axis). (9)



(*ii*) What can you conclude about the solubility of the salt from the graph? (3)

The higher the temperature the more will dissolve.

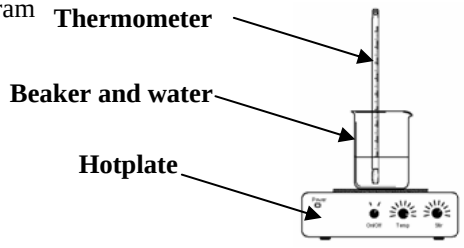
(*iii*) Use the graph to estimate the solubility at 50 °C.

Solubility *74 g/100 cm^3* (3)

(*iv*) In this investigation the solubility of the salt was measured at several temperatures. Describe, using a labelled diagram, how one of these measurements could have been made. (9)

Weigh out 100 g of salt. Heat100 cm^3 of water in a beaker to a temperature is 60 ℃. Use a thermometer to measure the temperature. Add some of the salt. As the salt will dissolves add more. Keep adding salt until no more will dissolve. Weigh the amount of salt left over. Take this mass from 100 g to get the solubility at 60 ℃.

Labelled diagram



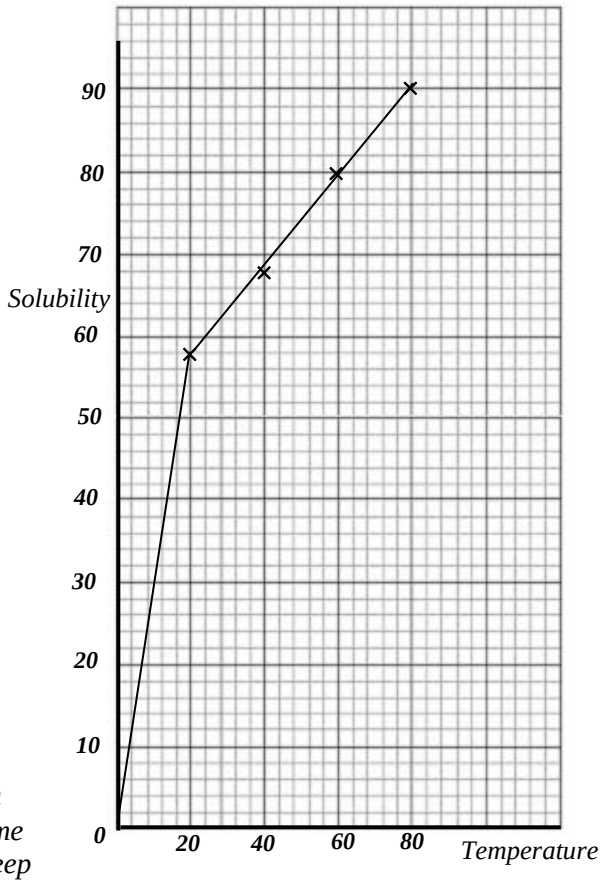
Observations: The method clearly indicates how the solubility at a particular temperature can be measured. All steps to ensure the testing is fair and accurate are made. All 9 marks were awarded.

Exemplar 2

(*c*) The solubility of a salt, potassium bromide (KBr) was investigated. The data in the table on the right was collected.

Temperature (°C)	**Solubility grams per 100 cm^3 of water**
20	58
40	68
60	80
80	90

(*i*) Plot a graph in the space provided of solubility (*y*-axis) against temperature (*x*-axis). (9)



(*ii*) What can you conclude about the solubility of the salt from the graph? (3)

The solubility increases

with temperature.

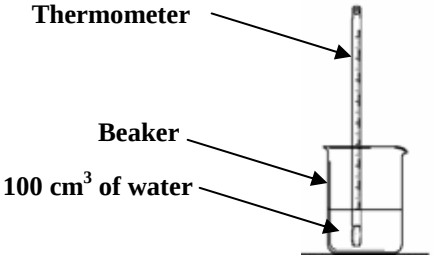
(*iii*) Use the graph to estimate the solubility at 50 °C.

Solubility *74 g/100 cm^3* (3)

(*iv*) In this investigation the solubility of the salt was measured at several temperatures. Describe, using a labelled diagram, how one of these measurements could have been made. (9)

Boil a kettle of water. Pour 100 cm^3 of water into a beaker and put a thermometer in. When the temperature is 60 °C put some salt in. The salt will dissolve. Keep adding salt until no more will dissolve. This is the solubility of the salt in 100 cm^3 of water at 60 °C.

Labelled diagram



Observations: The plot was incorrectly extended to the point (0, 0). Only 6 of the 9 marks were awarded for part (i). Parts (ii) and (iii) were answered correctly and were awarded 3 marks each. The answer to part (iii) was incomplete. How the amount of salt dissolved at that temperature was measured was not elucidated. Only 6 of the 9 marks were awarded for part (iii).

Question 8

Exemplar 1

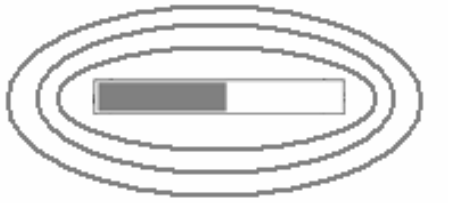
(*b*) You are given a bar magnet and asked to investigate the pattern of the magnetic field around the bar magnet. Describe, with the aid of a labelled diagram, how you could carry out this investigation. (9)

1 Place a magnet under a sheet of paper.

2 Scatter iron filings on the paper and shake gently. A pattern forms.

3 *The pattern formed shows the magnetic field lines of the bar magnet.*

Labelled diagram



Observation: The method described by the candidate was correct, however, the candidate did not know the outcome of the investigation and the pattern drawn in the diagram was incorrect. Only 6 of the 9 marks were awarded.

Exemplar 2

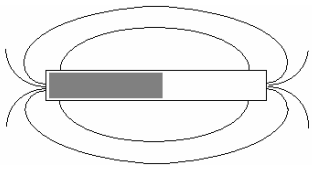
(*b*) You are given a bar magnet and asked to investigate the pattern of the magnetic field around the bar magnet. Describe, with the aid of a labelled diagram, how you could carry out this investigation. (9)

1 First of all you would place a bar magnet underneath a sheet of paper.

2 Draw around the outline of the magnet.

3 Now sprinkle the iron filings around the sheet. Note the pattern the filings make on the page and around the magnet. The filings should move from one pole to the other and many of the filings should be at either poles of the magnet.

Labelled diagram



Observation: The method described by the candidate was correct. The candidate did know the outcome of the investigation and the pattern drawn in the diagram was correct. All 9 marks were awarded.

Question 9

(*a*)

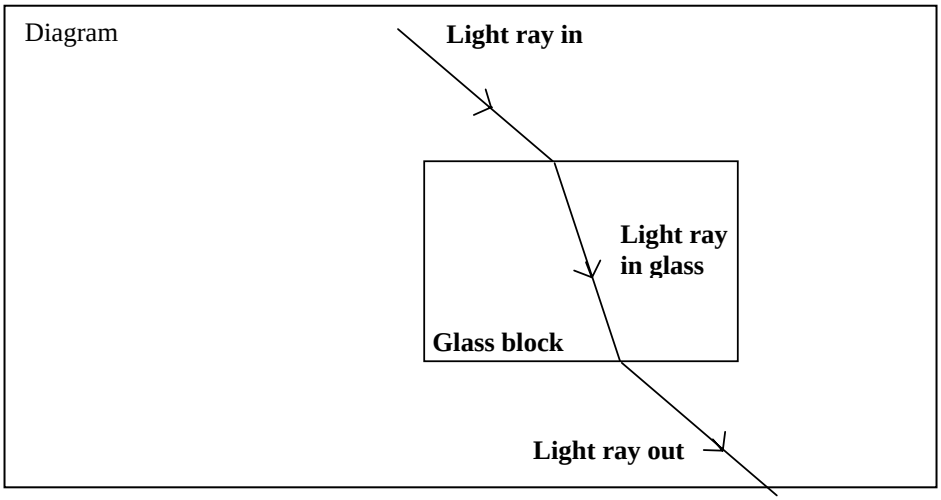
Exemplar 1

(*iii*) Describe, with the aid of diagrams, how you could investigate the refraction of light as it passes from air into a rectangular block of glass and exits the other side? (12)

Shine a ray of light from, using a ray box, through the glass block.

Note how the ray enters and exits the other side of the block.

The light should bend as it enters the block and bend back in the same direction as it comes back out of the block as shown in the diagram.



Observation: The method described by the candidate is suitable. The supporting diagram illustrates the correct result. All 12 marks were awarded.

Exemplar 1

(*iv*) You have been told that red light is refracted less than blue light when it passes from air to glass.

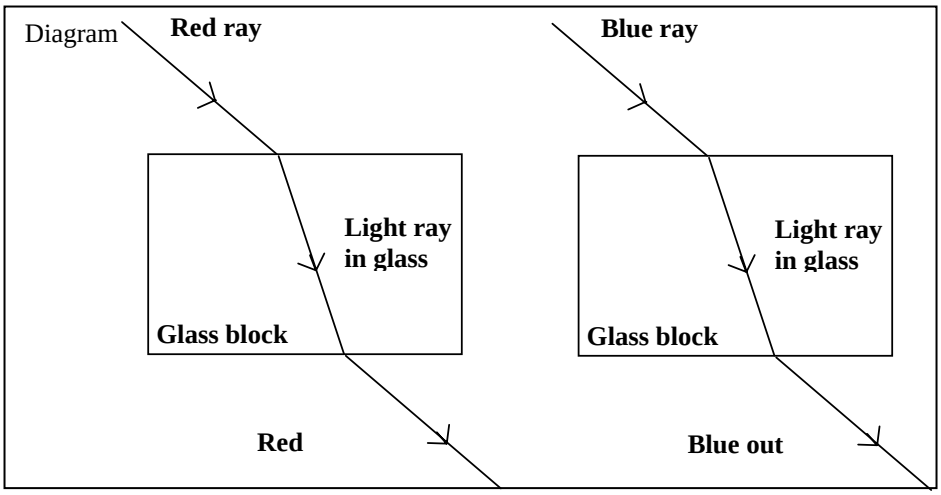
Describe, with the aid of a labelled diagram, how you could investigate this in the laboratory. (12)

Shine a ray of red light from, using a ray box, through the glass block.

Note how the ray enters and exits the block of glass.

Repeat this experiment using a ray of blue light.

The results shows that the blue light is refracted more than the red light.



Observation: The method suggested is a plausible extension of the previous experiment. However, the need to keep the test fair and valid by having both rays enter the block at the same angle os omitted. Only 9 of the 12 marks were awarded.

Exemplar 2

(*iv*) You have been told that red light is refracted less than blue light when it passes from air to glass.

Describe, with the aid of a labelled diagram, how you could investigate this in the laboratory. (12)

Shine a ray of red light from, using a ray box, through the glass block.

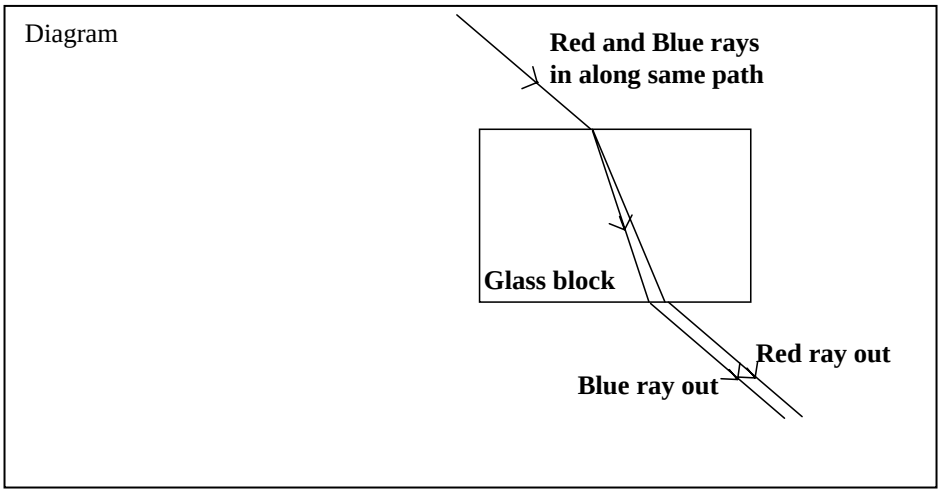
Note how the ray enters and exits the othr side of the block.

The red light should bend as it enters the block and bend back in

the same direction as it exits the block as shown in the diagram.

Now shine a ray of blue light at the same angle from the ray box on the block.

The blue ray bends slightly less than the red one as drawn in the diagram.



Observation: The method suggested is a plausible extension of the previous experiment. The test was kept fair and valid and full marks were awarded.

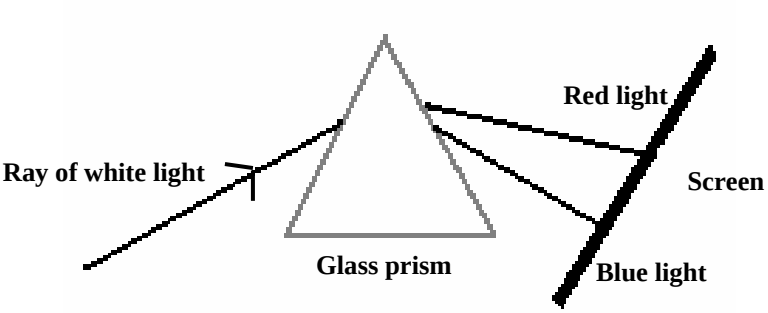
Exemplar 2

(*iii*) You have been told that red light is refracted less than blue light when it passes from air to glass.

Describe, with the aid of a labelled diagram, how you could investigate this in the laboratory. (12)

Shine a ray of white light from, using a ray box, through the glass prism. The spectrum produced shows that the red light is refracted less than the blue light.

Diagram



Observation: The method suggested will work well. It represents the transfer of information from an other investigation. The diagram is clear and supports the observations described. Full marks were awarded.

Exemplar 1

(*b*) In general solids, liquids and gases contract when cooled.

(*i*) Describe with the aid of a labelled diagram an experiment to demonstrate that gases contract when cooled. (9)

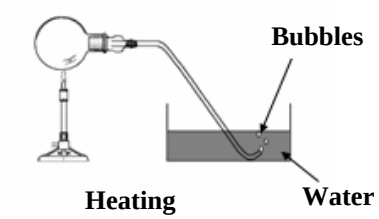
1 *Set up the apparatus shown in the diagram.*

2 *Heat the flask with a bunsen burner.*

3 *As this is done bubbles can be sen n the water. This is the air expanding in the flask.*

4 *This shows that the gas inside the flask expands when it is heated.*

Labelled diagram



Observations: The candidate has described the wrong (or reverse) experiment. Only 3 of the 12 marks were awarded - the apparatus (less the bunsen) is basically correct.

Exemplar 2

(*b*) In general solids, liquids and gases contract when cooled.

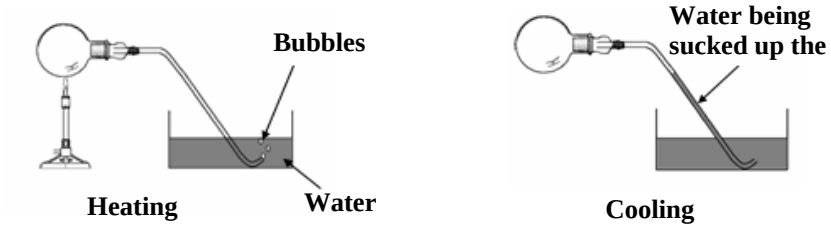
(*i*) Describe with the aid of a labelled diagram an experiment to demonstrate that gases contract when cooled. (9)

5 *Set up the apparatus shown in the diagram.*

6 *Heat the empty flask. As this is done bubbles can be seen in the water. This is due to the air in the expanding flask when it is heated. Stop the heating.*

7 *Pour cold water over the flask. This causes the air to contract and move up back down the glass tubing. This can be observed because as it does it pulls water from the basin down the tube with it.*

Labelled diagram



Observations: The experiment as described shows that the gas in the flask contracts when cooled. Full marks were awarded.

5. Concluding Remarks

The trial exercise has shown that the range and nature of the test items utilised are sufficiently varied and demanding to discriminate between the differing levels of achievement. Specific observations were made throughout this report in relation to particular questions and question types. A number of general points are made here in the interest of the preparation of candidates for the examinations.

- Candidates need a detailed knowledge and understanding of the material described in the syllabus.

- Candidates need to be able to manipulate and interpret data.

- Candidates need to understand and be able to apply an understanding of the importance of ensuring that tests or experiments are fair and valid.

- Candidates need to be able to connect the scientific knowledge and understanding gained though their study with everyday phenomena.

- The absence of choice makes the test more demanding than may be at first apparent in terms of the level of course-coverage required and the detailed knowledge, understanding and application required to score highly.

- A teaching and learning environment where students are exposed to ongoing activity-based learning through experimentation and investigation, where the students' knowledge, understanding and application of scientific process and investigative skills are developed, provides the best platform for meeting the syllabus objectives, and for preparing candidates for its assessment.