



**Coimisiún na Scrúduithe Stáit  
State Examinations Commission**

**JUNIOR CERTIFICATE EXAMINATION 2010**

**SCIENCE**

**ORDINARY LEVEL CHIEF EXAMINER'S REPORT**

**HIGHER LEVEL CHIEF EXAMINER'S REPORT**

# CONTENTS

<b>1.0</b>	<b>General Introduction</b>	<b>3</b>
1.1	The Syllabus	3
1.2	Assessment of Junior Certificate Science	3
1.3	Participation Rates in Junior Certificate Science	4
<b>2.0</b>	<b>Ordinary Level</b>	<b>6</b>
2.1	Introduction	6
2.2	Performance of Candidates	6
2.3	Analysis of Candidate Performance	8
2.4	Conclusions	16
2.5	Recommendations to Teachers and Students	17
<b>3.0</b>	<b>Higher Level</b>	<b>18</b>
3.1	Introduction	18
3.2	Performance of Candidates	18
3.3	Analysis of Candidate Performance	19
3.4	Conclusions	27
3.5	Recommendations to Teachers and Students	29

# 1. General Introduction

## 1.1 The Syllabus

The current syllabus for Junior Certificate Science, which was introduced in schools in September 2003, was examined for the first time in June 2006. The previous syllabi – Science (with Local Studies) and Science (without Local Studies) – which were introduced in 1989, and examined for the first time in 1992, ran in parallel with the new syllabus until 2008. Since 2009 only the current syllabus has been examined.

The syllabus is equally divided between the disciplines Biology, Chemistry and Physics. Most of the content matter is common at both Ordinary Level and Higher Level. A small amount of content pertains to Higher Level only.

## 1.2 Assessment of Junior Certificate Science

The assessment of the Science Syllabus involves a total mark allocation of 600 at both Higher Level and Ordinary Level, and consists of the following:

- (a) Practical Coursework
  - (i) Coursework A (60 marks / 10%)
  - (ii) Coursework B (150 marks / 25%)
- (b) Terminal Written Examination (390 marks / 65%)

**Coursework A** involves the completion, over the three years of the programme, of a course of 30 mandatory experiments/investigations which are specified in the syllabus; 10 investigations in each of the Biology, Chemistry and Physics sections. These investigations are common to both Ordinary Level and Higher Level. Each student is also required to maintain a laboratory notebook in which a record of these experiments and investigations is kept according to specified criteria. Marks are allocated by the class teacher on a pro-rata basis for satisfactory completion of the required coursework and, following authentication/sign-off by the school, the marks are submitted to the State Examinations Commission (SEC).

**Coursework B** involves the completion of and the reporting on two investigations prescribed annually by the SEC. Alternatively candidates may complete and report on one larger investigation of their own choice, that meets the required criteria.

Details of the investigations nominated by the SEC for the 2010 examinations were issued to schools in October 2009 in accordance with an agreed time-line for the coursework component. It should be noted that Coursework B has a common level brief and that discrimination of standard between Ordinary Level and Higher Level is achieved through the implementation of different marking schemes at each of the levels.

The investigations must be recorded in a pro-forma reporting booklet which is issued annually by the SEC. The booklets are submitted to the SEC for marking with the

written examination. The coursework booklets are accepted for assessment only if the school authorities have certified, on forms provided by the SEC, that the work presented is the candidates' own individual work, completed in accordance with the conditions specified in Circular S75/09. This Circular should be read in the context of Circulars S68/08 and S69/04, which set out the policy and practice of the SEC in relation to the assessment of practical coursework in the certificate examinations. Copies of these circulars are available on the SEC website, [www.examinations.ie](http://www.examinations.ie). Any incidence of suspected copying, improper assistance from another party, plagiarism or procurement of pieces prepared by another party is thoroughly investigated by the SEC.

**The Written Terminal Examination**, which candidates sit in June, takes the form of a completion-style booklet with three equally weighted sections (Biology, Chemistry and Physics). Each of the three sections consists of three questions. Candidates are expected to attempt all nine questions on the examination paper and there is no choice within the examination paper.

This report should be read in conjunction with the examination papers and the published marking schemes. These are available at [www.examinations.ie](http://www.examinations.ie) on the SEC's website.

### 1.3 Participation Rates in Junior Certificate Science

Since the introduction of the revised syllabus there has been a gradual increase in numbers presenting for Science at Junior Certificate, from the previous norm of 86%, to a participation rate of 90% in 2010. Data for the last three years are provided in Table 1.

**Table 1** Overall participation rates in Junior Certificate Science

Year	JC Candidature	Science Candidature	% of JC candidature taking Science
2008	54,652	48,691	89.1
2009	54,291	48,535	89.4
2010	54,951	49,448	90.0

Table 2 shows the number and percentage of candidates who sat the examination at Ordinary Level and Higher Level in 2010.

**Table 2** Number and % of candidates sitting each examination in 2010

Level	No. of candidates	% of Science Cohort	Candidature for course
Science – Higher	35,488	71.8	49,448
Science – Ordinary	13,960	28.2	

Of the 49,448 candidates taking Junior Certificate Science in 2010, 71.8% presented for the examination at Higher Level and 28.2% at Ordinary Level. Again, since the introduction of the current syllabus there has been a growing trend of more candidates taking the examination at Higher Level (typically 62 – 63% of candidates presented for

the Higher Level examinations of the previous syllabi). This change is thought to be attributable to the introduction of the coursework components and the fact that Science candidates who achieve high marks in these components, which are completed in non examination conditions, can achieve an overall grade D at Higher Level despite a poor performance in the written examination.

### Participation Rates in Science by Gender

Data on the participation rates in Science by gender are presented in Tables 3 and 4.

**Table 3** Analysis of the Junior Certificate Cohort by gender in relation to participation in Science – 2010

<b>2010</b>	<b>Total Candidature</b>	<b>Number of Females</b>	<b>Number of Males</b>	<b>Percentage Female</b>	<b>Percentage Male</b>
<b>JC Cohort</b>	54,951	27,066	27,885	49.3	50.7
<b>Taking Science</b>	49,448	23,661	25,787	47.9	52.1

**Table 4** Gender breakdown of the Junior Certificate Science candidate cohort in relation to level – 2010

<b>2010</b>	<b>Total Science Candidature</b>	<b>Number of Females</b>	<b>Number of Males</b>	<b>Percentage Female</b>	<b>Percentage Male</b>
<b>Total (HL)</b>	35,488	17,831	17,657	50.3	49.8
<b>Total (OL)</b>	13,960	5,830	8,130	41.2	58.2
<b>Overall Total</b>	49,448	23,661	25,787	47.9	52.1

## 2. ORDINARY LEVEL

### 2.1 Introduction

The assessment of the Science Syllabus involves a total mark allocation of 600 at Ordinary Level, and consists of the following:

- (a) Practical Coursework
  - (i) Coursework A (60 marks / 10%)
  - (ii) Coursework B (150 marks / 25%)
- (b) Terminal Written Examination (390 marks / 65%).

### 2.2 Performance of Candidates

The results for the Ordinary Level candidature for 2010 are presented in Table 5 below.

**Table 5** Total candidature at Ordinary Level, % breakdown by grade, and cumulative % at ABC grades and EFNG grades

Year	Total	A	B	C	ABC	D	E	F	NG	EFNG
2008*	15,125	3.4	36.7	43.3	83.4	13.0	2.8	0.7	0.0	3.5
2009	14,282	2.5	33.0	44.2	79.7	15.9	3.3	1.0	0.1	4.4
2010	<b>13,960</b>	<b>1.8</b>	<b>32.6</b>	<b>45.8</b>	<b>80.2</b>	<b>15.4</b>	<b>3.2</b>	<b>1.1</b>	<b>0.2</b>	<b>4.5</b>

\* Current Science syllabus figures only; (excluding the 71 candidates presented for the 1989 syllabus - Science (without Local Studies) in 2008)

A number of observations are made in respect of these results:

- The A rate, at 1.8%, is somewhat low and has decreased on the A rates for previous years.
- The combined ABC rate of 80.2% remains high and is likely to be directly related to the high proportion of marks available for the coursework elements.
- The combined EFNG rate of 4.5% is a little higher than in recent years. It is noteworthy that a significant number of those who achieve an E, F or NG either do not present one or more of the coursework components or have made only a minimal engagement with these components.

It is generally recognised that the introduction of additional components in assessment tends to reduce the proportion of extreme grades awarded. This, however, is not the only factor that may have impacted on results at Ordinary Level. While there has been a significant decrease in the A rate, it is likely that this decrease may also be attributable, among other things, to the significant migration of candidates from Ordinary Level to Higher Level which was mentioned previously.

At the other end of the grade spectrum, the introduction of coursework seems to have had limited impact at this level on the EFNG rate. This may have been contributed to by candidates who failed to present one or both coursework components. Over the past number of years, examiners have reported that the absence of one or other coursework element, and/or the presentation of very poor or incomplete coursework, made it very difficult for some candidates to achieve a Grade D.

Details of candidates who did not present one or both of these components are provided in Table 6.

**Table 6** Numbers of candidates not presenting Coursework A or Coursework B

Level	Numbers of candidates not presenting coursework for assessment		
	Coursework A	Coursework B	Coursework A & Coursework B
Higher	257	37	36
Ordinary	781	208	197

Furthermore, at Ordinary Level, a number of candidates presented a report on only one of the two Coursework B investigations required – thus excluding themselves from any portion of 12.5% of the total available marks for the overall assessment.

### Performance by Gender at Ordinary Level

The breakdown of grades by gender for Science – Ordinary Level is shown on Table 7 below.

**Table 7** Breakdown of grades by gender for Science – Ordinary Level

Science (OL)	Grade							Total Candidature
	A	B	C	D	E	F	NG	
Female	2.1	35.1	45.5	14.0	2.6	0.7	0.1	5,830
Male	1.6	30.9	46.0	16.4	3.6	1.4	0.2	8,130
Overall	1.8	32.6	45.8	15.4	3.2	1.1	0.1	13,960

It is noted that girls perform better than boys at Ordinary Level. This can be seen at the A Grade and the B Grade in the above table.

## 2.3 Analysis of Candidate Performance

The average mark obtained by candidates in each of the three components is given in Table 8.

**Table 8** Average mark obtained for each examination component

Science (OL)	Component			Overall
	Coursework A	Coursework B	Written Paper	
<b>Mark Available</b>	60	150	390	600
<b>Average Score</b>	56	120	208	384
<b>Percentage</b>	93%	80%	53%	64%

### Written Examination

Statistical data relating to the attempting of questions and the marks awarded for questions for the Ordinary Level examination paper are given in Table 9.

**Table 9** Statistical data on the answering of the Ordinary Level examination paper

Section	Question	Marks allocated	Average Mark with (%)	Rank order in terms of popularity
A Biology	1	52	30 (58)	3
	2	39	19 (49)	5
	3	39	27 (69)	2
B Chemistry	4	52	30 (58)	3
	5	39	15 (38)	8
	6	39	15 (38)	8
C Physics	7	52	25 (48)	6
	8	39	31 (78)	1
	9	39	18 (46)	7

These statistics have been drawn from an analysis of approximately 7% of scripts which were selected at random.

With the exception of questions 5, 6, 8 and 9, all other questions had an attempt rate of over 98%. Questions 8 had an attempt rate of 97% and questions 5, 6 & 9 attempt rates of just over 96%.

### Question-by-Question Commentary

While the overall standard of answering was satisfactory and, indeed, good at times, the comments offered here are aimed principally at highlighting some of the common errors made by candidates in answering the examination paper. These should be read in conjunction with the Ordinary Level examination paper and the published marking scheme.

**Question 1 [Biology – short questions]**

**Average mark: 30 (58%)**

- (a) The first part of this question was well-answered; ‘membrane’ sometimes offered. The second part was also well-answered. ‘Vacuole/cytoplasm’ were the most common incorrect answers.
- (b) Most candidates answered correctly here. Choosing carbon dioxide instead of oxygen was the most common error.
- (c) The first part of this question was very well-answered; most gave some indication of the flower changing colour. The second part elicited a good response from candidates; movement of water up the plant was slightly less well-answered.
- (d) This was generally poorly answered; many candidates gave the result of a positive test (which was given in the question). The second part of this question was also poorly answered; many of those who received marks answered ‘energy’ even though they received no marks for the first element.
- (e) The first part was very well-answered; most candidates were able to identify A. The second part was poorly answered; many candidates named the part rather than gave the function.
- (f) This was generally well-answered.
- (g) Both parts were well-answered.
- (h) A well-answered question; many candidates received full marks here.

**Overall comment:** Though different candidates lost marks across the various parts of this question, overall it was one of the best-answered questions on the examination paper. Part (d) was the only part that a large number of candidates had difficulties with.

**Question 2 [Biology]**

**Average mark: 19 (49%)**

- (a) This was well-answered. The most common mistake was to match A with ‘stigma’. Many used the letter B instead of F in the lower box. No penalty was applied in this case.
- (b) (i) Many candidates could not name the ‘pooter’ correctly but did know its use. Many candidates confused it with the apparatus used to show inhaled/exhaled air contains carbon dioxide. A common incorrect use was ‘to blow air into’.

- (ii) Few candidates were able to identify the quadrat frame and even fewer could give a use for it.
- (c) (i) Many candidates gave 'phototropoism' or 'respiration' instead of 'photosynthesis'.
- (ii) This part was very poorly answered. 'Carbon dioxide' was the most common incorrect answer.
- (iii) This part was also very poorly answered. 'Starch' was the most common incorrect answer.
- (iv) Most candidates answered 'water' or 'iodine'.
- (v) This was reasonably well-answered. Common incorrect answers included 'green chemical gone', 'plant was dead' and 'starch is not present'.

**Overall comment:** Parts (a) and (b) of this question were answered reasonably well. Part (c) was answered particularly poorly. Overall, this was the least well-answered question in the Biology section.

**Question 3 [Biology]**

**Average mark: 27 (70%)**

- (a) This part was well-answered.
- (b) (i) This was poorly answered. Many candidates gave 'oesophagus' or 'spine' or 'throat'.
- (ii) Few could give the correct function of the rings of cartilage. Many linked their answer to the oesophagus which they named in part (i). A common mistake was to offer 'to help oxygen (air) go down' or 'to help you breathe'.
- (iii) This was poorly answered with most giving 'lungs' or 'part B'. The term 'alveoli' was not well known.
- (iv) This part was well-answered.
- (c) All parts were very well-answered with most candidates scoring full marks. Healthy eating was the most common response for part (ii).

**Overall comment:** Parts (a) and (c) were well-answered. Many candidates experienced difficulties with part (b). This was the second best answered question on the paper.

**Question 4 [Chemistry – short questions]**

**Average mark: 30 (58%)**

- (a) This was generally well-answered, though a number of candidates answered the second part of this question incorrectly.
- (b) Most candidates received at least 3 marks here. Reversal of answers was common as was 'neutron' instead of 'electron', indicating poor knowledge of atomic structure.

- (c) This part was well-answered.
- (d) Many candidates identified 'water' as the base.
- (e) This part was poorly answered. Surprisingly few candidates could name 'sodium chloride'. Equally, very few could identify the 'burette'. 'Pipette' or 'thermometer' were common incorrect answers.
- (f) Most candidates gave 'dull' in colour as one property, and the opposite, 'shiny', as the other. This may suggest that guessing was involved.
- (g) This was generally not well-answered. The most common incorrect answer was 'gold' as the alloy with 'jewellery' as its function. Very often, regardless of the metal selected as the alloy, 'car wheels' was offered as the function.
- (h) The first part was well-answered. Many answered the second part correctly, though some offered 'to keep oxygen in' as the purpose of the oil. Surprisingly, the quality of answering of the third element was only fair.

**Overall comment:** Though different candidates lost marks across all parts of this question, it was still the best answered of the questions in the Chemistry section. Parts (b), (e), (g) and (h) were found to be particularly challenging.

**Question 5 [Chemistry]**

**Average mark: 15 (38%)**

- (a) This part was frequently omitted and when attempted the standard of answering was very poor. Most had difficulty in naming the gas. The most frequent incorrect answers were 'carbon dioxide' or 'oxygen'. Many of those who identified the gas produced, as hydrogen, were unable to identify a test for it.
- (b) (i) This part was quite well-answered. 'S' and 'L' were occasionally reversed. Sometimes 'U' appeared in the top box.  
(ii) This part was poorly answered. The most common incorrect answer was 'it changed colour'. Many candidates did not appear to read the question and, based on the diagram, answered 'it burns or sparks'.
- (c) This part was answered quite well. The name of the solvent was frequently omitted. Most gave 'Bunsen burner' or 'hotplate' as the source of heat. There was usually some indication of 'cooling' or 'waiting' involved in getting the crystals to form. A common incorrect answer was to 'evaporate it'. Most candidates were able to name another piece of equipment used.

**Overall comment:** Parts (a) and (b) (ii) proved particularly challenging for candidates. This question tied with Question 6 as the most poorly answered questions on the examination paper.

**Question 6 [Chemistry]****Average mark: 15 (38%)**

- (a) (i) The majority of candidates correctly named oxygen but incorrectly gave 'carbon dioxide' as a second element.  
(ii) Most candidates left this section blank. The most common incorrect answer was to refer to 'litmus' or an 'acid-base indicator'.
- (b) (i) Very few candidates named a correct element, with the most common incorrect answers being 'limestone' or 'limescale'. Most candidates could describe a method for removing hardness. The most common incorrect answer was 'filtration'.  
(ii) This part was well-answered.
- (c) This part was generally well-answered
- (d) Most candidates left this blank. The majority who did attempt the question thought 'litmus' was used to measure pH. Most included a good labelled diagram.

**Overall comment:** This question tied with Question 5 as the most poorly answered question on the examination paper. In many instances no attempt was made in respect of parts (a) and (d).

**Question 7 [Physics – short questions]****Average mark: 25 (48%)**

- (a) The most common incorrect answer was to match 'T' with 'm', possibly mistaking 'm' for minutes.
- (b) Most candidates correctly identified the traffic cone as the item which does not involve a lever.  
The second part was very poorly answered with many simply stating 'it did not have a lever'.
- (c) This part was generally poorly answered. Many candidates referred to gravity or discussed the heavier demands on the downstairs due to washing machines and dishwashers or simply repeated information given in the question. A number of answers referred to gravity or weight of water.
- (d) This was generally well-answered but reversal of orange and green was not uncommon.
- (e) The first part was poorly answered with most saying 'sound' was a form of 'noise'. The second part was well-answered.
- (f) Both parts were well-answered.

- (g) The first part of this question was reasonably well-answered; common incorrect answers included ‘it heated up’ or ‘steam’.  
Most candidates answered the second part correctly.
- (h) The equation was generally well-answered but area/force was not uncommon. Candidates who got the equation correct usually got the calculation correct as well. The question part on the instrument was left blank by most candidates. Common incorrect answers were ‘scales’, ‘weighing scales’, ‘spring balance’, ‘Newton meter’, ‘meter stick’ and ‘ruler’.

**Overall comment:** Though different candidates lost marks across all the parts of this question, parts (a), (b) and (h) were particularly challenging for many candidates.

**Question 8 [Physics]**

**Average mark: 31 (78%)**

- (a) Most candidates were awarded full marks here.
- (b) All parts were very well-answered and most candidates were awarded full marks.
- (c) All parts were very well-answered.  
 (i) ‘Lamp’ was a common answer.  
 (ii) Sometimes ‘reflection’ was mentioned here.  
 (iii) ‘Light doesn’t travel through objects’ was a frequent incorrect answer.
- (d) A number of candidates seemed to have not noticed that they were asked to complete the ray diagram and omitted this. Those who did complete the ray diagram, generally got it correct. Most left the last part blank with common incorrect answers including ‘prism’, ‘solar panels’, and ‘glass’.

**Overall comment:** This was the best answered question on the examination paper. Part (d) was the only part where some candidates had difficulties.

**Question 9 [Physics]**

**Average mark: 18 (46%)**

- (a)(i) Aided by the scaled axes, most candidates achieved full marks for their graph, although a number drew bar charts. Providing labelled and scaled axes is a significant assistance to the cohort of candidates who sit Ordinary Level. However, many could not manipulate data from the graph.
- (ii) This part was generally not well-answered. Quite a number of candidates incorrectly read 0.7 on the X-axis as 0.65.
- (iii) Many stated ‘ruler’. ‘Voltmeter’ was correctly offered in a reasonable number of cases.
- (iv) How to vary the current was clearly not well known. The most common incorrect answer was ‘ammeter’.

- (v) This was generally not well-answered. Some mentioned that voltage increased with current but gave no indication of proportionality.
- (b) The first part was well-answered but the standard of answering for the rest of the question was poor. Misinterpretation of the workings of the switch was common (i.e. was it open or was it closed?) Very few had the idea of 'forward bias'.

**Overall comment:** This question gained marks for candidates but quite a number of them demonstrated somewhat poor knowledge of reading from a graph, voltmeters, rheostats and proportionality.

### **Coursework A and B**

The total marks obtained for coursework were generally high (on average 176 from the 210 marks available or 84%).

#### **Coursework A**

**Average mark: 56 (93%)**

The high return of marks here is not surprising as marks are awarded for the satisfactory completion of the mandatory experiments/investigations and the quality of performance is not assessed. The award of marks for Coursework A supports the activity-based approach to the delivery of the syllabus.

#### **Coursework B**

**Average mark: 120 (80%)**

Performance on Coursework B was generally good. Again, the high return of marks here is not entirely surprising and is consistent with that observed for coursework in other jurisdictions. It is hoped that in addition to assisting in the development of laboratory and science investigative skills, this component will serve to support an appropriate teaching and learning environment for candidates. Most candidates presented procedure and recorded data well. The principle areas of weakness observed were in the areas of analysis, conclusions and comments. The identification of variables and controls, were also sometimes less than what was required.

#### ***The Biology Investigation***

The Biology option, with an uptake of 17%, was the least popular of the SEC nominated investigations. The average mark was 56.6 (75.5%). Candidates' reports on the investigation were reasonably well presented. The most common weaknesses were in the conclusions, analysis and comments sections.

#### ***The Chemistry Investigation***

The Chemistry investigation was attempted by nearly 84% of candidates and returned an average mark of 59.8 (79.7%). A variety of methodologies were evident in candidate responses. Data collection, analysis, conclusions and comments were weak in some cases.

### ***The Physics Investigation***

The Physics option was the most popular with an attempt rate of 91%. The average mark obtained was 60.25 (80.3%). The data obtained by some candidates was poor with no definite relationship between the variables. The analysis and conclusions tended to be better for the Physics than for either the Biology or the Chemistry investigations.

### ***Candidates own Investigation***

The number of candidates who presented an investigation of their own choice was very small, at 0.6%. The average mark obtained was low at 89.3 (59.5%). Examiners reported that some candidates repeated or did slight variations on investigations previously set by the SEC and appeared to use the marking schemes that were used by the SEC as a template for completing them. Such practices are contrary to the spirit of the programme and should not be encouraged.

### ***Authentication Issues at Ordinary Level***

This year at Ordinary Level a number of candidates across a number of examination centres produced coursework reports that raised concerns regarding their authenticity. Marks for this coursework were withheld pending a satisfactory explanation from schools. Teachers and students are reminded that the coursework presented and the reports thereof should be the individual work of the candidate only.

## 2.4 Conclusions

- The Ordinary Level examination paper was considered a fair but testing assessment of candidates' ability in Science and reflected the change in emphasis of the course.
- In general, candidates followed the instructions on the examination paper correctly and attempted to answer the question that was being asked.
- In the vast majority of cases the manner in which candidates presented material was satisfactory. Space provided on the paper to complete answers was found to be adequate and very few candidates needed to avail of the extra space provided at the back of the answer-booklet.
- Candidates engaged reasonably well with most items on the paper but experienced some difficulty with more open-ended questions.
- Knowledge of simple facts, and information was frequently poor. Even more able candidates often lost marks for not knowing very basic information.
- Most candidates presented procedure and recorded data well in their coursework investigations. Identification of variables and controls, however, was sometimes less than what was required.
- Coursework presented by a small number of candidates was very similar. A number of candidates wrote identical or very similar entries for analysis, conclusion and comment, or simply left these sections blank. These sections were frequently the weakest parts of the report.
- Examiners found that some self-nominated investigations presented for Coursework B were too short in terms of what was undertaken, presented insufficient detail under the prescribed headings, and lacked scientific basis, data, results or conclusions. In a small number of instances candidates presented investigations previously set by the SEC in the guise of their own investigation and appeared to use the published marking scheme as a guide to carrying out and presenting the investigation. This practice is contrary to what was envisaged in allowing candidates select their own investigations and should not be encouraged.

## 2.5 Recommendations for Teachers and Students

- Completion of both Coursework A and Coursework B by candidates is of paramount importance, as the combined coursework elements comprise 35% of the marks available for assessment. Some candidates will find it virtually impossible to achieve a Grade D if they do not present the coursework elements.
- Candidates should adhere to the guidelines and obey the regulations relating to the completion and submission of coursework.
- Teachers and students are reminded that the coursework presented, and the reports thereof, should be the work of the candidate only and that marks will be withheld if it is deemed that inappropriate assistance has been given to candidates.
- Course completion is essential as preparation for the examination. This is particularly the case in Science as there is no choice on the paper.
- Candidates should be encouraged to attempt all questions. This includes questions where candidates are asked to describe investigations or experiments. The inclusion of labelled diagrams to support descriptions should be encouraged.
- Where questions require the description of an investigation or experiment candidates should use the “equipment”, “procedure”, “results”, “conclusions” type headings, which they have become familiar with through the coursework A & B, as a guide to answering.
- Candidates should use past examination papers as a guide to the type of questions they are likely to be asked.

### 3. Higher Level

#### 3.1 Introduction

The assessment of the Science Syllabus at Higher Level involves a total mark allocation of 600 and consists of the following:

- (a) Practical Coursework
  - (i) Coursework A (60 marks / 10%)
  - (ii) Coursework B (150 marks / 25%)
- (b) Terminal Written Examination (390 marks / 65%).

#### 3.2 Performance at Higher Level

The results for the Higher Level candidature for 2010 are presented in Table 10.

**Table 10** Total candidature at Higher Level, % breakdown by grade, and cumulative % at ABC grades and EFNG grades

Year	Total	A	B	C	ABC	D	E	F	NG	EFNG
2008*	33,566	8.1	29.9	41.3	79.3	19.5	1.0	0.2	0.0	1.2
2009	34,246	9.2	30.4	37.7	77.3	20.9	1.7	0.2	0.0	1.9
2010	<b>35,488</b>	<b>10.4</b>	<b>34.9</b>	<b>38.0</b>	<b>83.3</b>	<b>15.7</b>	<b>0.8</b>	<b>0.2</b>	<b>0.0</b>	<b>2.5</b>

\* Current Science syllabus figures only; (excluding the 188 candidates presented for the 1989 syllabus - Science (without Local Studies) in 2008)

The overall performance of candidates at Higher Level in recent years has remained satisfactory with a good standard being maintained. This year's outcomes show a significant improvement at the higher grades which is thought to be attributable to candidates and teachers becoming more accustomed to the demands of the examination and the requirements of the coursework elements.

A number of observations are made in respect of these results:

- The A rate shows a slight increase to 10.4%. It remains significantly lower than the 14.5% that was typically observed for the previous syllabi.
- The combined ABC rate at 83.3% is quite high and well above what was achieved in the previous syllabi (typically 72%).
- The EFNG rate at 2.5%, though up on recent years, remains quite low and is predominately related to candidates who either did not present one or both coursework components or presented very poor attempts at them.

It is generally recognised that the introduction of additional components in assessment tends to reduce the proportion of extreme grades awarded. This is manifest in the results achieved at Higher Level. While the % achieving a grade C, or higher, has increased significantly, the number of candidates achieving a Grade A as compared with

the previous syllabi has reduced. At the other end of the grade spectrum the EFNG rate has fallen significantly.

Examiners expressed the opinion that the absence of choice in the written examination paper combined together with an increased number of questions requiring candidates to engage with and to utilise higher-order skills have, however, made the terminal examination a particularly challenging and discriminating assessment instrument.

Overall, the results achieved at Higher Level, particularly the significantly higher ABC rate and the equally significant lower EGNG rate, have to be read as a very positive outcome for this examination.

### Performance by Gender at Higher Level

The breakdown of grades by gender for Science – Higher Level - is shown on Table 11 below.

**Table 11** Breakdown of grades by gender for Science – Higher Level

Science (HL)	Grade							Total Candidature
	A	B	C	D	E	F	NG	
Female	11.3	36.1	37.3	14.6	0.6	0.1	0.0	17,831
Male	9.6	33.7	38.7	16.7	1.0	0.3	0.0	14,950
Overall	10.4	34.9	38.0	15.7	0.8	0.2	0.0	35,448

It is observed that the take-up for females was greater than for males and that females also out-performed males at Higher Level.

### 3.3 Analysis of Candidate Performance

The average mark obtained by candidates in each of the three components is given in Table 12.

**Table 12** Average mark obtained for each examination component

Science (HL)	Component			Overall
	Coursework A	Coursework B	Written Paper	
<b>Mark Available</b>	60	150	390	600
<b>Average Score</b>	59	117	233	409
<b>Percentage</b>	98	78	60	68

## The Written Examination

Statistical data relating to the attempting of questions and the marks awarded for questions for the Higher Level examination paper are given in Table 13.

**Table 13** Statistical data on the answering of the Higher Level examination paper

Section	Question	Marks allocated	Average Mark with (%)	Rank order in terms of Popularity
A Biology	1	52	35 (67%)	2
	2	39	29 (74%)	1
	3	39	22 (56%)	6
B Chemistry	4	52	32 (62%)	5
	5	39	26 (67%)	2
	6	39	21 (54%)	8
C Physics	7	52	23 (44%)	9
	8	39	22 (56%)	6
	9	39	26 (67%)	2

\*These statistics have been drawn from an analysis of approximately 7% of scripts that were selected at random.

The attempt rate of all questions was in excess of 99%.

The best-answered part of the paper was the Biology section, followed by the Chemistry section on this occasion. The Physics section was the lowest scoring section of the examination paper with two quite low scoring questions on the examination paper coming from this section.

### Question-by-Question Commentary

While the overall standard of answering was good and, indeed, excellent at times, the comments offered here are aimed principally at highlighting some of the common errors made by candidates in answering the examination paper. These comments should be read in conjunction with the examination paper and the published marking scheme.

#### Question 1 [Biology – short questions]

**Average mark: 36 (67%)**

(a), (b), and (c) These parts were well-answered

(d) This part was reasonably well-answered. Some gave ‘membrane’ for cell wall; ‘chloroplast’, ‘DNA’, & ‘vacuole’ were given by some candidates for nucleus.

(e) A good response from candidates in this part. ‘baking’, ‘brewing’ appeared on some scripts (confusion with fungi).

(f) This was generally well-answered. However, ‘genes’ appeared on some scripts.

- (g) In part (i) the term ‘phototropism’ was not known by some candidates. ‘Photosynthesis’/ ‘geotropism’ appeared on some scripts. In part (ii) the word ‘more’ was omitted in some answers.
- (h) The names and/or formulas of the gases were given by most candidates. ‘Good air’ and ‘bad air’ was given by some candidates. Many candidates did not give the correct direction of movement of gases while some candidates had O<sub>2</sub> changing into CO<sub>2</sub> in the alveoli.

**Overall comment:** Though different candidates lost marks across all parts of this question, parts (f), (g) and (h) were seen as the more discriminating parts.

**Question 2 [Biology]**

**Average mark: 29 (74%)**

- (a) (i) Some candidates appeared to confuse digestion with respiration, e.g. ‘produces/ releases energy’.
- (ii) A number of candidates gave ‘to prevent choking’.
- (iii) ‘Kidney’ appeared on some scripts for A/B.
- (iv) This was well-answered
- (v) This was generally not well answered. Some candidates appeared to confuse the large and small intestines, and excretion with egestion.
- (b) (i) Some line graphs appeared.
- (ii) Some candidates appeared not to understand the word ‘constituent’.
- (iii) ‘Transparent’ and ‘see through’ appeared on some scripts.

**Overall comment:** Part (b) was the more discriminating element of this question.

**Question 3 [Biology]**

**Average mark: 22 (56%)**

- (a) (i) Role of darkness to rid leaves of starch was given correctly by the higher achieving candidates only; ‘to remove chlorophyll’ appeared on some scripts.
- (ii) The correct answer was given only by the higher achieving candidates.
- (iii) Diagrams were only of average quality; many showed a test tube of alcohol being heated directly over Bunsen burner. ‘Iodine’ was commonly given as the named liquid.
- (iv) ‘Benedict’s solution appeared on some scripts.
- (v) Some candidates found this part difficult.
- (b) (i) The range of answers offered suggested that some ‘guesswork’ may have been at play: ‘ovule’, ‘stigma’, ‘style’ were regularly cited. The role of the ovary was often confused with that of the anther.
- (ii) Correct name given only by higher achieving candidates. ‘Filament’ was common. The role of anther was often confused with role of ovary.

- (iii) There seems to have been some confusion of the transfer of pollen with seed dispersal.
- (iv) 'Embryo' and 'seed' were common wrong answers.
- (v) 'Flower', 'bud', 'foetus', 'baby' appeared on many scripts.

**Overall comment:** This was the most discriminating of the three Biology questions. Only higher achieving candidates scored steadily across all parts of this question. Almost all other candidates showed uneven knowledge and understanding.

**Question 4 [Chemistry – short questions]**

**Average mark: 32 (62%)**

- (a) The term 'properties' seems to have been poorly understood. Many gave the definition of an element and a compound. There was evidence of some confusion with compounds and mixtures. Many candidates thought MgO was a gas.
- (b) The first part of this was well-answered. The second part was poorly answered.
- (c) In a number of responses 'residue' was offered for A, as was 'filtrate' for B
- (d) This was generally well-answered
- (e) The first part of this question was well-answered – 'soft' was given by most. Only higher achieving candidates managed to give the correct reason.
- (f) The most common error here was citing the terms 'fluorination' and 'chloridation'.
- (g) This was generally well-answered
- (h) Most candidates did well on this part.

**Overall comment:** Though generally well-answered, Parts (a), (b), (e) and (f) were particularly discriminating.

**Question 5 [Chemistry]**

**Average mark: 26.2 (67%)**

- (a)
  - (i) This part was well-answered.
  - (ii) This part was also well-answered.
  - (iii) Some candidates appear to have misread the question. Most of these began by dissolving the crystals. They went on to describe how to make a saturated solution only. Some candidates gave no method for collecting the crystals. It was also observed that some candidates did not attempt this part of the question.
- (b) (i) General understanding of pH/ pH scale was weak. '0 – 14' was rarely cited.

- Litmus paper was given by many candidates.
- (ii) This part was generally poorly answered.

**Overall comment:** The most surprising observation here was the poor knowledge and understanding of pH and the pH scale by some candidates.

**Question 6 [Chemistry]**

**Average mark: 21 (54%)**

- (a) Some candidates scored well here, often achieving full marks for part (a).
- (i) This was known only by higher achieving candidates but often misspelt.
- (ii) & (iii) These parts were generally well-answered. Some mix-up with O<sub>2</sub> and H<sub>2</sub>, – names and tests. CO<sub>2</sub> for B was not uncommon.
- (iv) This part was well-answered.
- (b) Higher achieving candidates scored well; however, others often only achieved the 3 marks for item (vi). A number of candidates appeared not to have read the question. Some candidates made references to metals not given in the question.
- (i) to (iv) were answered correctly only by higher achieving candidates.
- (v) Answers to this part were frequently incorrect.
- (vi) In many cases this was the only element of part (b) where candidates scored marks.

**Overall comment:** This was one of the lowest scoring questions and was the least well-answered in the Chemistry section. A significant number of candidates made no attempt at one or more parts of this question. The question covers two of the more conceptually demanding areas of the syllabus and this is probably the reason for the poor response.

**Question 7 [Physics – short questions]**

**Average mark 23 (44%)**

- (a) ‘Latent heat’ and ‘change of state’ were the most common answers.
- (b) This part of the question was quite well-answered.
- (c) Most candidates got one ray correct. Some gave one converging and one diverging ray.
- (d) The unit was not known by many candidates. ‘kW/h’ was given frequently as an answer. Some candidates had difficulty with the calculation.
- (e) Very few candidates did the calculation correctly – units were frequently not given.
- (f) There were many confused answers given in response to this question – ‘temperature is a measure of heat’ and ‘heat is how hot’ being regularly cited.

- (g) This part was not answered very well by many candidates.
- (h) This was a good testing question for candidates who knew about LEDs. Many candidates, however, appeared to be totally unfamiliar with this topic. Some thought that the resistor was a fuse even though it was clearly labelled 'resistor R' on the examination paper.

**Overall comment:** This was one of the least well-answered questions in the Physics section and on the examination paper as a whole. It proved discriminating across most elements.

### Question 8 [Physics]

**Average mark 21.6 (55%)**

- (a)
  - (i) This part was answered correctly only by higher achieving candidates
  - (ii) Candidates seemed to be well able to plot points.
  - (iii) Most candidates achieved 6 marks, as any 'correctly' determined value from any graph was awarded the marks.
  - (iv) A number of candidates lost 3 marks for omitting 'directly'.
- (b) Some candidates, who did not appear to be familiar with this experiment, tried to answer the question with an expanding and contracting flask, even though the 'gas' was specifically mentioned in the question. Many confused observations with explanations while some left this page blank.
- (c) This part of the question was answered quite well.

**Overall comment:** Many candidates appeared to be unfamiliar with this experiment. Some candidates, having failed to complete the table in any comprehensible way, still went on to draw a reasonable graph. More than anything else this question seemed to highlight the importance of doing the mandatory experiments/investigations. Those who appeared to be familiar with the investigation tended to score well. Those who appeared to have not seen/carried out these experiments/investigations performed badly.

### Question 9 [Physics]

**Average mark 26.1 (67%)**

- (a)
  - (i) 'Water' was commonly cited as an answer to this part.
  - (ii) This part was quite well-answered.
- (b)
  - (i) Some candidates only drew one ray.
  - (ii) 'Submarines' was the most common response to this part.
- (c)
  - (i) There was some incorrect labelling here.
  - (ii) This part was answered correctly by higher achieving candidates only.

- (iii) Some candidates did not provide a diagram. Electrostatic experiments were incorrectly cited by other candidates.
- (iv) This part was answered correctly by higher achieving candidates only.
- (v) Some candidates confused magnetic with gravitational forces.

**Overall comment:** This was one of the better-answered questions on the examination paper. The ability of a large number of candidates to apply their knowledge in part (a) was encouraging. Parts (c) and (d) and, to a lesser extent (c), were discriminating.

### **Coursework A and B**

The total marks obtained for coursework were generally high (on average 176 from 210 available or 84%).

#### **Coursework A**

**The average mark: 59 (98%).**

The high return of marks here is not surprising as marks are awarded for the satisfactory completion of the mandatory experiments/investigations and the quality of performance is not assessed. The award of marks for Coursework A supports the activity-based approach to the delivery of the syllabus. It is hoped that in addition to assisting in the development of laboratory and science investigative skills, this component will serve to support an appropriate teaching and learning environment for candidates.

#### **Coursework B**

**The average mark: 117 (78%)**

Again, the high return of marks here is not entirely surprising, the performance of candidates was generally good and the outcomes are consistent with that observed for coursework in other jurisdictions. It is hoped that in addition to assisting in the development of laboratory and science investigative skills, this component will serve to support an appropriate teaching and learning environment for candidates. Most candidates presented procedures and recorded data excellently. Identification of variables and controls was quite good. However, conclusions, analysis and comments were sometimes less than what was required.

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### ***The Biology Investigation***

The Biology option was the least popular of the SEC nominated investigations with an uptake of 14%. The average mark was 57.3 (77.1%). Candidates' reports on the investigation were generally well presented. Where there were weaknesses in candidate responses they were usually in the conclusions, analysis and comments sections.

### ***The Chemistry Investigation***

The Chemistry investigation was attempted by nearly 90% of candidates and returned an average mark of 58.9 (78.5%). A variety of methodologies were evident in candidate responses. Data collection, analysis, conclusions and comments were weak in some cases, with a significant number of candidates who added acid to the remedy wrongly associating 'less acid used' with 'the better the mixture'.

### ***The Physics Investigation***

The Physics option was the most popular of the investigations with an attempt rate of 95%. The average mark achieved was 58.3 (77.7%). The data obtained by some candidates was poor with no definite relationship between the variables. In most of these cases the data was carelessly presented with poor labelling of tables. The analysis and conclusions tended to be much better for the Physics than for either the Biology or Chemistry investigations.

### ***Candidates own Investigation***

The number of candidates who presented an investigation of their own choice was small, at just under 0.7%. The average mark obtained was 130 (86.6%). This contrasts very favourably with the marks obtained by candidates at Ordinary Level. A number of candidates repeated or did slight variations on investigations previously set by the SEC and appeared to use the marking schemes that were used by the SEC as a template for completing them. Such practices are contrary to the spirit of the programme and should not be encouraged.

### ***Authentication Issues at Higher Level***

This year at Higher Level a number of candidates across a number of examination centres produced coursework reports that raised concerns regarding their authenticity. Marks for this coursework were withheld pending a satisfactory explanation from schools. Teachers and students are reminded that the coursework presented and the reports thereof should be the individual work of the candidate only.

### 3.4 Conclusions

- The examination paper at Higher Level was considered a fair test of candidates' ability in Science at this level and reflected the change in emphasis of the syllabus.
- Candidates followed the instructions on the examination paper correctly and attempted to answer the questions being asked.
- In the vast majority of cases the manner in which candidates presented material was satisfactory. Space provided on the paper to complete answers was found to be adequate and very few candidates needed to avail of the extra space provided at the back of the answer-booklet.
- A combination of factors was identified as contributing to the lower incidence of A grades as compared with examinations based on the old syllabi. The change in the distribution of the overall cohort, with a higher proportion of candidates taking the Higher Level examination, is suggested as one of these factors. The written examination paper containing more questions that assessed higher order skills, and the absence of choice within the paper were also cited as contributory factors. However, the introduction of coursework, particularly since it carries a heavy weighting, compresses the grade distribution from both ends of the grade spectrum and this is likely to be the most significant contributor to the grade profile observed.
- Candidates who received E, F and NG grades generally fell into two categories: those who did not submit coursework and those who fell well short on the knowledge, detail and accuracy required to reach a grade D. Both categories are a cause for concern.
- Some candidates who achieved a Grade D did so principally on the basis of their coursework mark and scored very poorly in the written examination.
- Knowledge of simple facts, and overall scientific information was generally good. However, some candidates lost marks for not knowing very basic information.
- Most candidates engaged well with the higher-order questions, though these items frequently proved very challenging for some candidates. The fact that such items cannot be avoided in an examination paper without choice, increases the demand of the test on candidates.
- Candidates appeared to enjoy doing the coursework element of the assessment and learned a lot from the experience. This was clearly evident from the work in their booklets. In their reports most candidates presented procedures and recorded data excellently. Identification of variables and controls seems to be good. However, conclusions, analysis and comments were sometimes less than what was required.

- Some candidates wrote identical or very similar entries for analysis, conclusion and comment. These sections were frequently the weakest parts of the report.
- The presentation of similar coursework by a number of candidates is a cause of some concern.
- Some self-nominated investigations in coursework were too short in terms of what was undertaken, presented insufficient detail under the prescribed headings, and lacked scientific basis, data, results or conclusions. Another issue that has arisen here is the presentation of investigations previously set by the SEC in the guise of candidate's own investigation and an apparent use of the published marking as a guide to carrying out and presenting the investigation.

### 3.5 Recommendations to Teachers and Students

- Completion of both Coursework A and Coursework B by candidates is of paramount importance. It should be remembered that the combined coursework elements comprise 35% of the marks available for assessment. Some candidates will find it virtually impossible to achieve a Grade D if they do not present the coursework elements.
- Candidates should adhere to the guidelines and obey the regulations relating to the completion and submission of coursework.
- Teachers and students are reminded that the coursework presented and the reports thereof should be the work of the candidate only and that marks may be withheld if it is deemed that inappropriate assistance has been given to candidates.
- Candidates should not repeat investigations previously set by the SEC as investigations of their own choice.
- Course completion is essential as preparation for the examination. This is particularly the case in Science as there is no choice on the paper.
- Candidates should be encouraged to attempt all questions. This includes questions where candidates are asked to describe investigations or experiments. The inclusion of labelled diagrams to support descriptions should be encouraged.
- Where questions require the description of an investigation or experiment, candidates should use the “equipment”, “procedure”, “results”, “conclusions” type headings, which they have become familiar with through coursework A and B, as a guide to answering.
- In preparation for the Higher Level examination in particular, candidates should practise questions that not only require knowledge but also scientific reasoning skills including deductive reasoning.