



COIMISIÚN NA SCRÚDUITHE STÁIT ***STATE EXAMINATIONS COMMISSION***

Report on Errors in the 2013 State Certificate Examination Papers

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Review of errors on the 2013 Leaving and Junior Certificate Papers

1 Introduction

In the course of the 2013 State certificate examinations, a number of errors came to light in Leaving Certificate and Junior Certificate examination papers during or after the sitting of the examination which had the potential to impact on candidate answering.

A number of these errors occurred in Junior Certificate and Leaving Certificate Mathematics papers.¹ These errors were the subject of significant media commentary. Error in one question in the Leaving Certificate Mathematics, Higher Level Paper 2, (Phase 2 and Phase 3), was the focus of particular attention because of the high stakes status of Leaving Certificate Mathematics and the nature of error involved.

Errors also occurred in a number of other examinations, including Junior Certificate CSPE, Junior Certificate Science and Leaving Certificate Irish. These errors were largely typographical in nature.

The SEC deeply regrets all of the errors in the 2013 papers and apologises to the candidates affected. Specific measures have been implemented in the marking process by the SEC so that candidates have not been disadvantaged as a result of these errors.

Assertions were also made in the media that there were a number of other errors, including an error in a Leaving Certificate History of Art paper, a grammatical error in Leaving Certificate Irish and three further errors on various Mathematics papers. These assertions were incorrect.

The purpose of this document is to report on the outcome of the SEC's review of errors in the 2013 examination papers and to explain how the errors were dealt with so that candidates have not been disadvantaged.

Section 2 of the document describes the scope of the SEC's work in providing the state certificate examinations, the process involved in preparing examination papers and the strategies employed for addressing errors. Section 3 deals with the errors that occurred in the 2013 papers generally including the conclusions reached regarding the cause of the errors and recommendations to mitigate the possibility of such errors recurring. Appendix 1 focuses specifically on the error in the Leaving Certificate Higher Level Mathematics Paper 2 examination paper. Appendix 2 focuses on the other errors.

¹ In 2013, as part of the *Project Maths* initiative the SEC produced 48 different Mathematics papers at Leaving Certificate and 40 at Junior Certificate.

2 Background

2.1 General Context

The SEC is responsible for the development, assessment, accreditation and certification of the second-level examinations of the Irish State. These include the Junior Certificate and the Leaving Certificate examinations. The SEC is a non-departmental public body under the aegis of the Department of Education and Skills. In common with all public bodies, the SEC must manage its allocated resources effectively. In delivering the State certificate examination service, it must find an appropriate balance between conflicting imperatives, such as quality, efficiency, security, openness, wide accessibility, equity, timeliness and value for money.

The conduct of the State Examinations each year is a significant logistical operation and relies greatly on multiple human interactions and transactions by both the internal and external staff of the SEC. These include the SEC's administrative and professional assessment staff; contract staff (such as drafters, setters, examiners and superintendents); school staff; and external contractors, including confidential printers. It is estimated that, in all, over 23,000 individuals have a direct involvement in performing specific functions each year in the running of the examinations. Each of the interactions by the personnel involved is governed by established operating frameworks and protocols which are subject to regular ongoing review and refinement in light of changing circumstances.

2.2 Test Instruments

The SEC arranges for examinations in 90 curricular and 15 non-curricular subjects each year. It generates some 477 different examination papers and other test instruments. These include, for example, oral tests, aural recordings, practical briefs, project briefs, portfolio and coursework items, as well as the written examination papers.

Written and practical examination papers are produced in both English and Irish versions (with the exception of the subjects English, Irish, and non-curricular languages). Where required, modified and Braille versions of examination papers are also produced. In addition, the SEC prepares a full set of Leaving Certificate and Junior Certificate contingency papers, which are developed under similar principles and protocols as the live papers. Delivering the State Examinations involves the production of approximately 4 million individual examination papers annually, equating to some 47.7 million A4 pages.

2.3 The Paper Preparation Process

The process of creating an examination paper encompasses a number of stages. These stages span an 18 month timeframe and include drafting, setting, translating, proofing, pre-press scrutiny and post-press scrutiny stages.

The principles that underpin the preparation of examination papers have been clearly identified and articulated by the SEC and are published in the document, *The Preparation of*

Test Items – Principles and Protocol, available on its website at www.examinations.ie.

Detailed guidelines and protocols emanating from these key principles have also been developed to guide the work of the personnel involved in the development of the examination papers. These principles and protocols are outlined in the *Manual for Drafters, Setters and Assistant Setters*, 2007, which is also available on the SEC website.

The SEC has a range of quality assurance measures in place to help ensure that the examination papers are error free.

The preparation of each examination paper is managed by an Examinations and Assessment Manager (EAM), who is a fulltime employee of the SEC, and who as Chief Examiner for the relevant subject is responsible for the preparation of examination papers and their marking schemes, and has overall responsibility for the content, standard and quality of examination papers. Contract personnel with relevant subject expertise and experience are appointed and trained to draft and set the examination papers, under the supervision of the Chief Examiner.

At each stage of the drafting/setting process the examination paper is proofread by the setting team in accordance with the Commission's procedures. The proofing process involves the review, revision and processing of edits of the draft material. Irish versions of the examination papers are produced by trained translators and reviewed by Irish Editors in order to check the accuracy of the translations and to minimise error. A further quality assurance review of Irish versions is provided by the SEC's Translation Service Manager.

In addition to the foregoing, the SEC's protocols require marking schemes and, where appropriate, worked solutions to be prepared in tandem with examination papers. Assessment grids are also prepared by the setting team to ensure that the material on the examination paper is within the published syllabus and is a balanced and fair reflection of the content and objectives of that syllabus.

One of the key objectives of the SEC is the provision of an examinations system of the highest possible quality. The aspiration of any examining body, including the SEC, is to preside over a system that is completely error free. However, it is recognised in examining circles that this will always be an aspiration rather than a completely achievable goal. Despite the procedures the SEC has in place to enhance reliability and to minimise error in advance of papers going to press, it is an unfortunate fact that errors can and do occur on examination papers from time to time. Consequently, the SEC has a formal process in place for scrutinising examination papers after they have been printed.

In order to address issues requiring correction which are identified through this scrutiny process, the SEC produces a *List of Corrections*, which is the international standard mechanism for alerting candidates to issues requiring correction in examination papers that have not been detected during the proofing process prior to printing. The *List of Corrections* is issued to all examination Superintendents who are instructed to read out any relevant corrections before the start of each examination so that candidates can make the necessary correction on the examination paper.

In some instances, such as when an issue is unlikely to impact on candidate answering and where a correction is likely to cause confusion, a decision may be made not to include a correction. This occurred in relation to an issue detected in advance by the SEC in the 2013 Leaving Certificate Foundation Level Mathematics Paper 2, for example. In other instances, where the issue is likely to impact adversely on candidates but where a correction would be too complex, the examination paper may be reprinted. In each of these situations, the interests of candidates are paramount in deciding on the most appropriate course of action. Such decisions are made by a senior manager of the SEC.

In exceptional circumstances, such as where an unusual level of error comes to light in the course of the examinations, an additional scrutiny process is undertaken on all remaining examination papers. This process may lead to the issue of a supplementary *List of Corrections* to superintendents or to a reprint of a paper. In 2013, the SEC decided on Wednesday 12th of June to carry out such an additional scrutiny of all remaining examination papers. Three further issues requiring correction were discovered leading to a reprint of the Irish version of the Leaving Certificate Ordinary Level Classical Studies paper, taken by one candidate, and the issue of corrections in respect of Leaving Certificate Ordinary Level Accounting and the Irish version of Leaving Certificate Ordinary Level Design and Communication Graphics.

2.4 Dealing with error

Notwithstanding the quality assurance measures described earlier, it is nonetheless possible that an error will come to light on an examination paper during or after the sitting of the examination. Such errors are usually brought to the attention of the SEC by schools, candidates, parents or the media, either during or shortly after the examination. When an error is discovered during an examination, the school personnel or superintendents that contact the SEC are instructed to advise candidates to proceed with the examination as scheduled. They are also asked to assure candidates that if there is an error on the paper, it will be taken into account by the Chief Examiner in the development of the marking scheme.

On receipt of a report of an error the relevant Chief Examiner is asked to verify whether or not an error has occurred. Where an error is confirmed, the first and immediate priority for the SEC is to assess the potential impact of the error and take whatever steps are necessary, through the marking process, so that candidates are not disadvantaged as a result of the error. At the same time, care must also be taken to ensure that the marking strategies adopted for dealing with error do not unfairly advantage any candidates. The impact of the error and effectiveness of the strategy for dealing with it are monitored and reported on by the Chief Examiner at the end of the marking process.

In addition, the marking schemes used in all examinations are published on the SEC's website and, in the case of the Leaving Certificate, candidates have an opportunity to view their marked scripts. In the case of an examination affected by an error, the manner in which the error was dealt with in the marking is clearly indicated in the marking scheme.

2.5 System Review – lessons learned

Each year, following on from the marking process, the SEC undertakes a review of its existing operating systems both in relation to

- a) the structures and systems themselves, and
- b) staff interaction and engagement with the structures and systems.

Issues, such as errors on examination papers, are dealt with through this review process.

The review at b) above is undertaken as an integral part of the personal performance reviews that apply in the SEC each year.

By taking this approach the SEC aims to provide a comprehensive review which enables the organisation to focus on both the robustness of its processes at a structural/systems level, and the thoroughness and effectiveness of its staff in delivering the final product, with a view to system improvement and minimising the possibility of a recurrence of an error.

3. Errors in the 2013 examination papers

In the 2013 State certificate examinations, a number of Leaving Certificate and Junior Certificate examination papers contained undetected errors which had not come to light before the examination and which had the potential to impact on candidate answering. The level of error was higher than normal.

3.1 Errors in Mathematics papers

A number of the errors occurred in Mathematics papers as follows:

Leaving Certificate Mathematics, Higher Level, Paper 2; (Phase 2 and Phase 3). This paper contained two errors in one question. Because of the nature of the errors on this paper and the potential variation in impact on candidates, the investigation and management of these errors and the management of the marking of this examination were subject to a special protocol, which included significant additional QA measures and senior management oversight. This protocol is outlined in Appendix 1 of this report.

Leaving Certificate Mathematics, Ordinary Level – Paper 1 (Phase 3)

Under the *Project Maths* initiative, candidates in the 23 initial schools sat a different Leaving Certificate Mathematics Paper 1 from all other candidates. Question 5 on the Ordinary Level Paper 1 examination for these candidates contained an error, in that it asked candidates to complete some tasks that are no longer on the syllabus for these 23 schools.

Junior Certificate Mathematics – Higher Level Paper 1 (Phase 3)

Question 5 b (ii) asks for two values for ‘p’ whereas there is in fact only one such value. The **Irish version** of this paper also contained a translation error in that the phrase “even number”, in Question 3(b) (ii), was incorrectly translated as “whole number”.

3.2 Errors in other examination papers

Errors also occurred in a number of other examinations, viz.:

- A spelling error in Leaving Certificate Irish where the word ‘buaileadh’ was misspelt as ‘bualadh’
- The inclusion of outdated information regarding the Referendum Commission in Junior Certificate Civic, Social and Political Education (CSPE)
- A typographical error in Junior Certificate Science, Ordinary Level, where an item was referred to as **S** in a diagram and **B** in the text of the question
- A typographical error in Leaving Certificate History, Higher Level, where the word ‘of’ was omitted in a question
- A typographical error in the Leaving Certificate Biology, Higher Level, modified version for visually impaired candidates
- A typographical error in Leaving Certificate Higher Level Chemistry, where an incorrect unit of days rather than years was given for the half-life of an isotope. This error did not affect the workings of the question

- A typographical error in the Leaving Certificate Higher Level Arabic, where the first three lines of an extract of a poem were repeated at the end of the extract
- An error in the Leaving Certificate Ordinary Level Arabic where the title of the poem printed in Arabic was incorrect.

3.3 Reports of errors which were unfounded

In the course of the media commentary on the 2013 examinations, assertions were also made about a number of other errors across a range of papers. These assertions proved to be incorrect. They included a report of an error in the Leaving Certificate History of Art Higher Level paper, a report of a grammatical error in Leaving Certificate Irish and assertions that there were three further errors on various Mathematics papers. The SEC is satisfied that in each of these instances there was no error and the questions were fully correct and appropriate.

3.4 Actions taken

In keeping with the SEC's strategies for dealing with error, account was taken of each of the errors in the marking process so that candidates were not disadvantaged as a result of the error. The special protocol implemented in the case of Leaving Certificate Mathematics, Higher Level, Paper 2 is outlined in Appendix 1, while the strategies used in relation to the other errors are summarised in Appendix 2.

In that regard, the SEC is satisfied that, through the application of these strategies, there have been no adverse effects on candidate outcomes.

3.5 Conclusions

- The SEC, having reviewed the circumstances of the issues involved, has concluded that the mistakes in this year's examinations resulted from human error
- The level of error in the 2013 examination papers was unacceptably high
- A small number of errors made it difficult for some candidates to answer the relevant question
- The remaining errors were minor and had little or no impact on candidate answering
- The strategies implemented by the SEC to address any disadvantage to candidates were effective
- Assertions that were made about a number of other errors across a range of papers were incorrect
- Significant and unplanned rapid change in staffing in the last 12 months, with a consequential loss of corporate memory and critical experience, together with other context factors, such as the immutable deadlines for examinations, the existence in the case of most subjects of only one EAM and, in the case of Mathematics, the particular demands of the *Project Maths* initiative, all served to increase risk significantly in 2013. (Background is detailed at Sections 3.6 and 3.7 below)
- The generic protocols used by the SEC for the preparation of examination papers are considered to be robust and fit for purpose. However the unique circumstances of this

year have demonstrated a need to augment these in the case of certain subjects to provide for situations where there is a break in the continuity of subject expertise. (See Sections 3.6 and 3.7 below).

3.6 Factors which contributed to an increased level of error in 2013

In considering why the level of error which occurred in 2013 was unusually high, the SEC concludes that, while its systems for examination paper preparation are substantially robust, the contexts in which the preparation of examination papers, including the QA measures, took place this year were particularly challenging. Over the last three years, the Examination and Assessment Division of the SEC, which is responsible for developing examination papers, has experienced significant and unplanned rapid change. Much of this is attributable to recent public service reform initiatives as a result of the crisis in the public finances, including a number of incentivised retirement schemes, which contributed to the departure of over 40% of the Division's staff.

The rapid and unplanned departure of so many of the Division's most senior and experienced subject specialists (Examination and Assessment Managers, EAMs in short) resulted in a situation where over 30% of the current EAMs have been recruited in the last 12 months, with a significant consequential loss of corporate memory and critical experience. In addition, the moratorium on recruitment and restrictions imposed on the SEC along with all other public service bodies as a consequence of Government policy has resulted in a reduction of 15% in the Division's staffing complement. As a consequence, there were fewer EAMs to carry an increasing workload, and the number of remaining EAMs with experience, who might have provided support and advice to new staff, was, proportionately, greatly reduced.

Managing these changes has been a challenge for the SEC as it has for other public service organisations. However, the reduction in staff numbers and, even more crucially, the loss of experienced personnel with subject-specific examination expertise, together with other context factors, such as the immutable deadlines for examinations, the existence in the case of most subjects of only one EAM, all served to increase risk significantly in 2013. Furthermore, with fewer experienced staff and increased workload, the capacity to support and mentor new colleagues was limited.

The challenges associated with the changes in staffing had been identified in advance of this year's examinations and strategies to mitigate risk were put in place. However, the unprecedented level of change made it difficult to ensure that risk was fully eliminated.

3.7 Factors pertaining specifically to Mathematics

In addition to the staffing issues outlined above, the following specific context factors contributed to risk of error in the case of Mathematics in 2013.

The Mathematics syllabi at all three levels for both Junior Certificate and Leaving Certificate are currently undergoing substantial change under the Government's *Project Maths* initiative. This reform project has a number of features that, in combination, have complex and

unprecedented implications for the examinations in mathematics over the transitional period, which commenced in 2010 and will conclude in 2015:

- The syllabi are being changed on a phased basis over three years
- A group of initial schools are undertaking the change two years in advance of all other schools
- Junior and Leaving Certificate are changing simultaneously
- The changes involve a substantial re-imagining of the nature of the subject.

The effects of these changes on the examination system are substantial. These include:

- A very large increase in the number of examination papers to be produced during the transition phase
- Each examination paper being substantially more time-consuming to prepare than heretofore
- A shortage of available contract staff with sufficient understanding of the revised syllabi and their implications
- A constantly changing syllabus, leaving people less confident about what is examinable for a particular group in a particular year
- Significant logistical difficulties in planning and managing the marking processes.

When *Project Maths* was first proposed, an internal SEC working group identified a number of risks associated with the project and identified resource implications and critical success factors. Some of these risks and critical success factors were within the control of the SEC while others were not.

The working group identified a need for the intensive and undivided attention of the two existing and experienced EAMs for Mathematics, along with the secondment of two further full-time subject experts to assist in managing all of the mathematics examinations over the transitional phase. Since then, unplanned staff changes, along with difficulties related to recruitment of fulltime and contract staff, have meant that for the majority of the relevant period, staffing has fallen short of the level identified as necessary.

In 2013, the sole EAM for Mathematics and one fulltime Deputy Chief Examiner (DCE) were between them responsible for signing off on 92 examination papers², with the assistance of a number of setters. Throughout the 2012/2013 year, the EAM was also responsible for representing the SEC on all *Project-Maths* related committees and for handling all correspondence to the SEC related to Mathematics and *Project Maths*.

In contrast, for example, in 2007, before *Project Maths* was introduced, the two full-time experienced EAMs for Mathematics were handling, between them, an average of 31 examination papers, all of which were well established and stable, and with the benefit of experienced and knowledgeable drafters and setters.

² **Leaving Cert:** 12 live EV; 12 live IV; 12 contingency EV; 12 contingency IV. **Junior Cert:** 10 live EV; 10 live IV; 10 contingency EV; 10 contingency IV. **LCA:** 1 live EV; 1 live IV; 1 contingency EV; 1 contingency IV.

3.8 Recommendations

The particular set of circumstances which applied to 2013 is unlikely to be repeated in that the extent of unplanned staff change should not re-occur and the roll-out of *Project Maths* is stabilising with a reducing number of examination papers required as full implementation takes place at Leaving Certificate in 2014 and Junior Certificate in 2015. However, further retirements and other staff changes are nevertheless envisaged over the coming years. It is also clear that restrictions on public service recruitment and employment will continue for the foreseeable future.

Recognising that it continues to be the role and responsibility of the SEC to deliver a high quality examination service, it is essential that robust systems are in place to buttress the examination system against these changes. It is recommended therefore that:

- The SEC takes a more formalised approach to strategic work-force planning which will include an assessment of the risks associated with the loss of subject-specific examination expertise
- Using a risk based approach the personnel structures and protocols for paper preparation be reviewed for each subject so as to ensure that they are fit for purpose in the context of staffing and other available resources.

Furthermore, given that some of the errors which occurred in 2013 did not relate directly to staffing changes it is recommended that:

- All post print errors, including the detected errors highlighted by the SEC on the *List of Corrections*, be analysed with a view to identifying patterns and underlying causes
- The information arising from this review to be used to identify where procedures and protocols might be strengthened and/or the training needs of staff e.g. in areas such as proof reading and version control.

This further review will be completed by end of October 2013.

Appendix 1

Leaving Certificate Higher Level Mathematics Paper 2 Question 8

1 Issue

The Leaving Certificate Higher Level Mathematics examination comprises two written examination papers. The mark allocation for each paper is 300 marks. The examination papers are provided as a combined question-and-answer booklet. Candidates are instructed to write their answers into the spaces provided in the booklet. If they run out of space, or need to cancel an answer and repeat it, they are free to continue their work either in the additional space at the back of the booklet, or on supplementary four-page answer-books.

The 2013 Paper 1 examination took place on the afternoon of Friday June 7th while the Paper 2 examination took place on Monday, June 10th from 09.30 to 12.00. Paper 2 comprised nine questions and candidates were required to attempt all questions.

Difficulties with Question 8 on the Higher Level Paper 2 were brought to the attention of SEC Management late in the afternoon of June 10th when a number of phone calls were received. Following review by the Chief Examiner, the SEC confirmed that Question 8 contained two errors. The question included more pieces of information than were required to solve the problem. Taken in their entirety these pieces of information were not all mutually reconcilable. While it was possible to work through the question satisfactorily without realising that it contained error, depending on the combinations of data used different solutions would have been arrived at. In addition, there was a potential ambiguity in interpreting the text of the question concerned, in that it could be interpreted in a way that is different from the information presented in the diagram.

2 How the Error Occurred and Went Unidentified

The question concerned was not on the original draft submitted by the drafter. At their first panel meeting, the recently-appointed Chief Examiner (EAM) and the Setter determined that the drafter's original question on this topic was unsuitable. The original question was worth 75 marks. They considered whether it could be rendered suitable with appropriate re-working, but agreed that it could not. Accordingly, they decided to replace it with two fresh questions worth 30 marks and 45 marks. These two replacement questions are Questions 8 and 9 on Paper 2.

The fresh questions were reviewed and refined over the remaining period of paper preparation. The Chief Examiner and Setter each produced solutions to the question on a number of occasions over this period and it seems clear that the flaw in the question was there from the start, i.e., extra information was not introduced later in order to make the question more approachable, as is sometimes the case with such errors as this. The faulty question was present in the version of the paper that was reviewed as part of the University

Observation process of reviewing papers to assess their suitability for matriculation purposes. In addition, the former Chief Examiner for Leaving Certificate Mathematics also reviewed these papers. This was intended as a support to the new Chief Examiner to assist in ensuring that the questions were appropriate in standard and content in the context of the revised syllabus.

As already stated, it is possible to work through the question satisfactorily without realising that it contains error. Accordingly, the continued presence of error is not inconsistent with the fact that solutions were produced at several times by the setting team.

It had been suggested in some quarters that the Irish Version of the paper, as printed, had the correct version of the question, which was then rendered incorrect by the reading out of a correction to candidates. This is not the case. The omission of the “36 degrees”, while rendering the question mathematically sound, would make it much more difficult than intended, and also logically suspect, in that the work required for part (a)(ii) would need to be done before or in the course of answering part (a)(i).

All of the SEC’s formal protocols for the preparation of papers were adhered to in the preparation of the Higher Level Mathematics Paper 2, including the production of solutions, marking schemes, assessment grids, and the adherence to the SEC’s proof-reading guidelines. The SEC is satisfied that the errors in this question should have been detected by the setting team during the paper preparation process.

3 Action Taken

In accordance with the SEC’s commitment to ensuring that candidates are not disadvantaged by error on examination papers, a strategy was put in place to (i) identify the extent and nature of the impact of the errors in Question 8, on candidate answering in the examination and (ii) to deal with any potential disadvantage identified while at the same time being cognisant of the need for fairness to all candidates.

The strategy involved: developing criteria to assist examiners to identify affected scripts (see 3.1 below); the application of a specific marking scheme to the affected scripts (see 3.2 below); scrutiny of all affected scripts by a senior member of the examining team to monitor the effectiveness of the criteria and marking strategy; recording of detailed item by item outcomes of the affected scripts for comparison with similar information on various comparator groups and monitoring of the process by a management group.

To quality assure the effectiveness of the methodology used to identify and deal with the impact of the errors, the SEC conducted a number of comparative exercises. These exercises included a statistical analysis of the outcomes of the affected group³ on individual questions, and various combinations of questions, on Paper 2 against those of a comparator group. They also included an analysis of overall marks on Paper 2 for the affected group, using established

³ The ‘affected group’ refers to the group of candidates whose scripts showed evidence of impact as per criteria

statistical models of expected performance in Paper 2 based on performance on Paper 1. As a final QA step, the entire unaffected cohort⁴ was analysed to identify candidates who showed unexpected significant differences in performance on Paper 2 compared to their performance on Paper 1. On foot of this analysis, ten additional scripts were reviewed. The review confirmed that none of the ten candidates showed any evidence of having been affected by the error in Question 8.

The implementation of the strategy and the outcomes were monitored throughout by a management group comprising the Chief Examiner and two senior managers in the Examination and Assessment Division.

Over the course of the marking it transpired that the scripts of approximately 4% of candidates showed evidence of having been impacted as a consequence of error in Question 8. The SEC is satisfied that the strategies used were effective in addressing disadvantage caused to those candidates who were affected by the errors, and this is further referred to in Appendix 2.

3.1 Criteria for identifying impact of error

The following table shows the criteria used by examiners to identify possible impact of error in question 8:

<p>The candidate</p> <ul style="list-style-type: none"> Attempts a part more than once and gets different values for the same length. For example: <ul style="list-style-type: none"> In part (a)(i), calculates d as $80 \sin 36^\circ = 47 \cdot 02$ and as $110 \sin 20^\circ = 37 \cdot 62$. Calculates HP using the cosine rule and the sine rule (or other method), getting different values. Calculates HR as $110 \frac{\sin 20^\circ}{\sin 36^\circ} = 64$, contradicting an identified value of 80 for HR Correctly generates a value for any angle that conflicts with an already calculated or identified value for the same angle. Values correctly obtained lead to a value of cosine or sine that is outside the range $[-1, 1]$. Attempts to construct an accurate scaled diagram and encounters difficulty. Any explicit statement suggesting awareness of conflicting data. <p>If you encounter any other evidence of potential impact, not covered by the above, please notify your Advising Examiner immediately.</p>

⁴ The 'unaffected cohort' refers to the group of candidates whose scripts did not show evidence of impact as per criteria

3.2 Marking Scheme for Question 8

The following are the parts of the Marking Scheme pertaining to Question 8

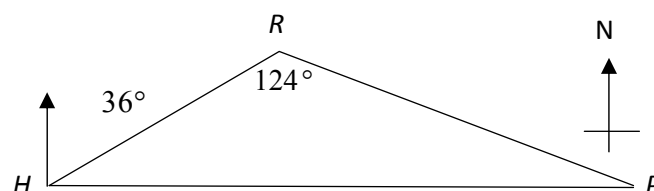
Model Solutions

Question 8

(30 marks)

Errors in this question mean that different valid approaches can result in different values for certain quantities. This will have caused difficulty for some candidates. See marking notes.

- a) A port P is directly East of a port H .
To sail from H to P , a ship first sails 80 km, in the direction shown in the diagram, to the point R before turning through an angle of 124° and sailing 110 km directly to P .



- (i) Find the distance from R to HP .

Some possible solutions:

$$\sin 36^\circ = \frac{d}{80} \Rightarrow d = 80 \sin 36^\circ = 47.02 \text{ km}$$

OR

$$\sin 20^\circ = \frac{d}{110} \Rightarrow d = 110 \sin 20^\circ = 37.62 \text{ km}$$

- (ii) Calculate $|HP|$.

Some possible solutions:

$$\begin{aligned} |HP|^2 &= 80^2 + 110^2 - 2(80)(110)\cos 124^\circ \\ &= 6400 + 12100 + 9841.79 = 28341.79 \\ |HP| &= 168.35 \text{ km} \end{aligned}$$

OR

$$\frac{|HP|}{\sin 124^\circ} = \frac{110}{\sin 36^\circ} \Rightarrow |HP| = 155.148 \text{ km}$$

OR

$$\frac{|HP|}{\sin 124^\circ} = \frac{80}{\sin 20^\circ} \Rightarrow |HP| = 193.915 \text{ km}$$

OR

$$|HP| = 80 \cos 36^\circ + 110 \cos 20^\circ = 64.72 + 103.366 = 168.087 \text{ km}$$

OR

$$\frac{1}{2}|HP|(47.02) = \frac{1}{2}(80)(110)\text{Sine}124^{\circ}$$

$$\Rightarrow |HP| = \frac{(80)(110)(0.8290)}{47.02} = 155.15\text{km}$$

OR

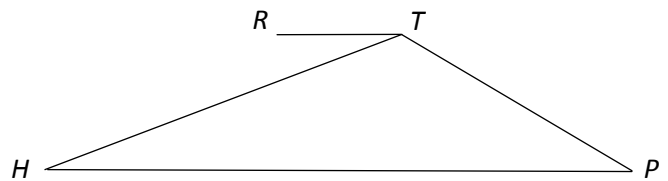
$$|HP| = \frac{47.02}{\tan 36^{\circ}} + \frac{47.02}{\tan 20^{\circ}} = 64.721 + 129.186 = 193.9\text{km}$$

OR

$$|HP| = 47.02 \tan 54^{\circ} + 47.02 \tan 70^{\circ} = 193.9\text{km}$$

- (b) The point T is directly East of the point R .

$$|HT| = 110 \text{ km and } |TP| = 80 \text{ km.}$$



Find $|RT|$.

Some possible solutions:

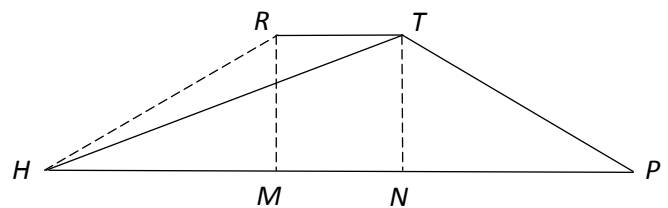
$$\cos 36^{\circ} = \frac{|HM|}{80}$$

$$\Rightarrow |HM| = 80 \cos 36^{\circ}$$

$$= 64.72 \text{ km}$$

$$|NP| = 64.72$$

$$|RT| = |MN| = 168 - 2(64.72) = 38.56\text{km}.$$



OR

Taking ΔHTP

$$80^2 = 110^2 + 168.35^2 - 2(110)(168.35)\text{Cos}THP$$

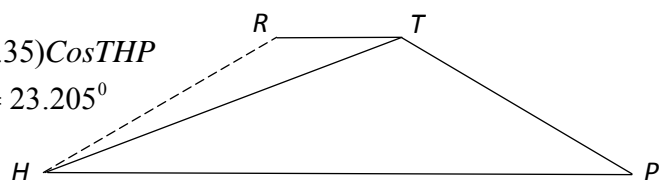
$$\Rightarrow \text{Cos} \angle THP = .9191 \Rightarrow \angle THP = 23.205^{\circ}$$

$$\Rightarrow \angle RHT = 12.795^{\circ}$$

Taking ΔHRT

$$|RT|^2 = 110^2 + 80^2 - 2(110)(80)\text{Cos}12.795^{\circ}$$

$$|RT|^2 = 1337.0 \Rightarrow |RT| = 36.56\text{km}$$



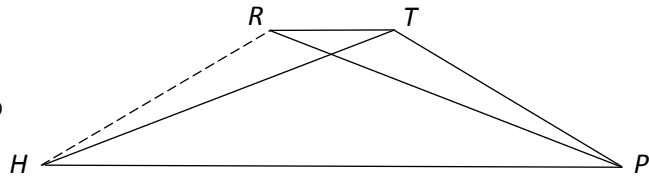
OR

$$|\angle RPH| = |\angle THP| = 20^\circ$$

$$\Rightarrow |\angle RHT| = 16^\circ$$

$$|RT|^2 = 110^2 + 80^2 - 2(110)(80)\cos 16^\circ$$

$$|RT|^2 = 1581.824 \Rightarrow |RT| = 39.77 \text{ km}$$



Detailed Marking Notes

Question 8

(a)(i) Scale 10C*(0, 3, 8, 10)

Low Partial Credit

- Identifies a relevant right angle
- $\sin 36^\circ = \frac{\text{opp}}{\text{hyp}}$ or equivalent

High Partial Credit

- $\sin 36^\circ = \frac{d}{80}$ or equivalent (e.g. $\sin 20^\circ = \frac{d}{110}$)

Note:

- Accept candidate answer from this section if and when used in later sections
- Units - apply penalty once only in question
- Do not penalise candidates for rounding off answers in **(a)(i)** and **(a)(ii)**.

(a)(ii) Scale 10C*(0, 3, 8, 10)

Low Partial Credit

- Identifies Cosine Rule
- $\cos 36^\circ = \frac{\text{adj}}{\text{hyp}}$ or $\cos 20^\circ = \frac{\text{adj}}{110}$ or $\tan 36^\circ = \frac{d}{\text{adj}}$ or equivalent statements

High Partial Credit

- $|HP|^2$ calculated and stops
- Substantially correct work with one error

(b) Scale 10B*(0, 5, 10)

Partial Credit

- Some relevant work

Note: Where there is no evidence of impact of error, mark according to candidate's work. There are several possible correct approaches. Track candidate's data throughout, accepting any valid approach to each part.

Where there is evidence of impact of the error, award full marks in the part in which the impact occurs and subsequent part(s). Ensure that all such scripts are forwarded for review.

Criteria for identifying impact of error:

- Attempts a part more than once and gets different values for the same length.
For example:
 - In part **(a)(i)**, calculates d as $80 \sin 36^\circ = 47.02$ **and as** $110 \sin 20^\circ = 37.62$.
 - Calculates $|HP|$ using the cosine rule and the sine rule (or other method), getting different values.
- Calculates $|HR|$ as $110 \frac{\sin 20^\circ}{\sin 36^\circ} = 64$, contradicting an identified value of 80 for $|HR|$
- Correctly generates a value for any angle that conflicts with an already calculated or identified value for the same angle.
- Values correctly obtained lead to a value of cosine or sine that is outside the range $[-1, 1]$.
- Attempts to construct an accurate scaled diagram and encounters difficulty.
- Any explicit statement suggesting awareness of conflicting data.

If you encounter any other evidence of potential impact, not covered by the above, please notify your Advising Examiner immediately.

APPENDIX 2

	ERRORs -that emerged in the course of the 2013 examinations	Marking Strategy	Impact
1	<p>Leaving Certificate Mathematics, Higher Level, Paper 2 (Phase 2 and Phase 3) Q 8 contained two errors. The question included more pieces of information than were required to solve the problem. Taken in their entirety these pieces of information were not all mutually reconcilable. Depending on the combinations of data used different solutions would have been arrived at. In addition, there was a potential ambiguity in interpreting the text of the question concerned, in that it could be interpreted in a way that is different from the information presented in the diagram.</p> <p>The mark allocation to this question is 30, apportioned in three lots of 10. This represents 10 % of the total mark in this paper (5% of the overall total mark in the examination).</p>	<p><i>A detailed strategy (Appendix 1) was put in place to deal with the consequences of this error. The question was initially marked according to normal procedures. If a candidate encountered a contradiction (an outcome of using the excess incompatible information) marks were awarded for all parts beyond that point. Evidence for impact of the error beyond Question 8 was also looked for and scripts from such candidates were reviewed.</i></p>	<p>Approximately 4% of candidates' scripts showed evidence of impact resulting from the errors in Question 8. These were addressed through the implementation of the marking strategy</p>
2	<p>Leaving Certificate Mathematics, Ordinary Level – Paper 1 (Phase 3) Q 5 contained an error, in that it asked candidates to complete some tasks that are no longer on the syllabus for these 23 schools. The tasks involved the product rule for differentiation and the quotient rule for differentiation neither of which are on the syllabus for these students.</p> <p>The total marks for the parts affected are 15 marks, representing 5% of the total mark in this paper (2.5% of the overall total mark in the examination).</p>	<p>The marking scheme took account of the errors as follows: <i>The 25 marks for this question will not be subdivided between parts (a),(b),(c). The marks will be awarded for the skills that are on the syllabus only.</i></p>	<p>The marks were awarded for the relevant skills as demonstrated by candidates so as to address disadvantage.</p>
3	<p>Leaving Certificate Mathematics, Foundation Level Paper 1 (Phase 2) Q 10 contained a typographical error. This error had been detected by the SEC after the paper had been printed, but before the examination. In considering whether a correction ought to be read out on the day of the examination, a judgment was made that the error was unlikely to negatively affect candidates, and that reading a correction was likely to cause unwarranted confusion.</p>	<p>No change to the marking scheme envisaged Attention was drawn to this at the marking conference. Examiners asked to be vigilant for any possible unexpected impact.</p>	<p>No impact was reported. There was no feedback from any examiner that any candidate was in any way impacted by this. This is understandable as they would be familiar with a number of ways of presenting functions from their textbooks and previous examinations.</p>
4	<p>Leaving Certificate Gaeilge, Ordinary Level Paper 2 Q 1 (A), paragraph 3, the word 'bualadh' in line 7 of the third paragraph is incorrect and should read "buaileadh". It is highly unlikely that this spelling error will cause difficulty for candidates in answering this question. The mark allocation for Léamhthuisctint A is 50 marks and Ceist 3(a) carries 5 marks, representing 2.5% of the total mark in this paper (0.8% of the overall total mark in the examination).</p>	<p>Candidates who use the word "bualadh" in their response to this question will not be penalised. This misspelling is not penalised in the 0-5 mharc a bhaintear den Ghaeilge ar fud na bhfreagraí mar aonad ar Léamhthuisctint A.</p>	<p>Having analysed the Sample Marking Sheets at Post Conference and asked Advising team for feedback in relation to this answer, it was very evident that the error had no impact on candidates accessing the correct information / sentence for this question.</p>

5	<p>Junior Certificate Mathematics - Higher Level Paper 1 (schools other than 23 initial schools) Question 5 b (ii) asks for two values for 'p' whereas there is in fact only one such value.</p> <p>Candidates were asked to find two solutions to the equation $p = 3\sqrt{p} + 2$. Using solutions from b (i) or otherwise, two values of p can be found. However one of these is valid only when a negative value of \sqrt{p} is used, which is not consistent with the correct modern interpretation of the square root symbol.</p> <p>Part (b) (ii) carries a mark allocation of 5 marks out of a total of 300 marks for this paper, which represents 1.7% of the total mark in this paper (0.8% of the overall total mark in the examination).</p>	<p>Marking Scheme took account of the error as follows:</p> <p><i>12.7 is the only valid solution to $p = 3\sqrt{p} + 2$.</i></p> <p><i>As two solutions were asked for do not penalise candidates if both solutions are offered.</i></p>	<p>No examiners reported any evidence of impact. Candidates who completed the task invariably offered the two solutions found.</p>
6	<p>Junior Certificate Mathematics - Higher Level Paper 1 (schools other than 23 initial schools)</p> <p>Q3(b) (ii): Translation error - The Irish version of the paper contained an error in that the phrase "even number" was incorrectly translated as "whole number". This error meant that (b) (ii) of the question could not be answered correctly. Although (b) (iii) did not depend on (ii) being answered (correctly or otherwise), the repeat of the mistranslation in this part would have caused confusion.</p> <p>Part (b)(ii) carries a mark allocation of 5 marks and (b)(iii) also carries a mark allocation of 5 marks out of a total of 300 marks for this paper. This represents 3.3% of the total mark for this paper (1.7% of the overall total mark in the examination).</p>	<p>Marking scheme took account of the error as follows:</p> <p><i>For candidates answering through the medium of Irish: There is an error in the translation of "even number" in the Irish version of the paper. Therefore any candidate who has difficulty with part (ii) or part (iii) because of this error should be awarded full marks.</i></p>	<p>The relevant marks were awarded to the small number of candidates affected. Examiners reported no ill effects on the remaining work of any candidate.</p>
7	<p>Junior Certificate Science, Ordinary Level</p> <p>Typographical error in Question 5 (c) of the Ordinary Level paper. The question involves a Solid and a Liquid. The Solid is referred to using the letter 'S' in the diagram, while in the text of part (iii) it is referred to using the letter 'B'. As there is only one Solid shown in the diagram it is likely that candidates will have interpreted the question correctly.</p> <p>Part (iii) of question 5(c) is worth 3 marks out of a total of 390 marks for the written paper, which represents 0.8% of the total mark in this component (0.5% of the overall total mark in the examination).</p>	<p>Marking scheme took account of the error as follows:</p> <p><i>As some candidates who didn't answer this element or answered the element incorrectly may have done so due to confusion resulting from error, amend marking scheme to award the 3 available marks to all candidates regardless of their response.</i></p>	<p>Examiners reported no evidence of candidates being negatively affected by the presence of this error.</p>

8	<p>Junior Cert – Civic, Social and Political Education (CSPE) The information provided in the opening statement in Section 3, Question 3 regarding the Referendum Commission contained outdated information on which a series of questions were based.</p> <p>As this information was not required to answer the questions, it is expected that the great majority of candidates were not adversely affected. However, it could conceivably affect candidates' answering in part (b). This part is worth 8 marks out of a total of 80 marks for the paper, which represents 10% of the total mark in this component (4% of the overall total mark in the examination).</p>	<p>The Marking Scheme was firstly framed in the context of candidates who were unaffected by the information provided and, otherwise, took account of the error as follows: <i>In instances where candidates' work clearly indicates that they knew that presenting arguments for and/or against a proposal is not the function of a Referendum Commission, then award up to 8 marks for the quality of information given.</i></p>	<p>Examiners noted that there was no evidence of any disadvantage in any candidate's work. There were no reported instances of the alternative element to the marking scheme needing to be applied.</p>
9	<p>Leaving Certificate Biology, Higher Level - modified version for visually impaired candidates. In part (c) (ii) of Q 15 of the paper, visually impaired candidates were erroneously asked to explain the graph they had <i>drawn</i> in part (c) (i) whereas they had actually been asked in part (c) (i) to <i>describe</i> how a second, dependent, graph would vary from the given graph. Part (c) (ii) carries a mark allocation of 6 marks which represents 1.5% of the total mark in this examination.</p>	<p>The error was taken into account in the modified Marking scheme. The allocation of marks to part (c) (ii) is 6 marks. All visually impaired candidates who attempted part (c) (i) will automatically be awarded the marks allocated to part (c) (ii).</p>	<p>The relevant marks were awarded to the candidates affected so that no candidate was disadvantaged.</p>
10	<p>Leaving Certificate History, Higher Level, Later Modern Field of Study Section 2, Topic 4 -The Irish Diaspora, 1840-1966', Q4. Typographical error the word 'of' was omitted from the question.</p> <p>The mark allocation to this question is 100 marks out of a total of 400 marks for the written paper, which represents 25% of the total mark for this component (20% of the overall total mark in the examination).</p>	<p>Attention was drawn to this typographical error at the conference, examiners were asked to be vigilant for any unexpected impact.</p>	<p>There is very wide choice on this paper. In Section 2 there are 24 questions over 6 topics. Candidates are required to answer 1 question from 2 topics. Virtually no candidates attempt questions on this period of history. No impact was reported.</p>
	ERRORS DISCOVERED after the examination but before the marking		
	<p>Leaving Certificate Chemistry, Higher Level Q10 (c) stated that Caesium-137 decays by beta-particle emission with a half-life of 30 days. Should have been with a half life of 30 Years. This error would not have affected the question unless the candidate knew that it should have been years not days.</p>	<p>The marking scheme was adjusted to accommodate answers based on a 30 year half-life without penalty. Examiners at conference instructed to be vigilant for any attempt based on a 30 year half-life and to</p>	<p>No instance of a candidate using the 30 year period was reported. There was no evidence of any candidate being disadvantaged.</p>

		mark accordingly.	
	Leaving Certificate Arabic, Ordinary Level The title of the poem that was printed in Arabic on the examination paper was not the correct title for the poem.	Attention was drawn to this at the marking conference.	The examiners reported that this error presented no difficulty to candidates. No candidate was affected by this error
	Leaving Certificate Arabic, Higher Level The first three lines of the extract of the poem printed on the examination paper were repeated at the end of the extract.	Attention was drawn to this at the marking conference.	The examiners reported that this error presented no difficulty to candidates. No candidate was affected by this error.