

Mathematical Skills Working Group Report

The assessment of mathematical skills in AS/A
level business and AS/A level psychology

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Executive Summary

The reformed A levels have seen the assessment of mathematical skills formalised in Ofqual's requirements for the first time. To support the ongoing development and delivery of these assessments, we convened a meeting of subject experts from Ofqual and the exam boards to consider the assessment of mathematical skills in A levels, focussing on GCE business and psychology.

These discussions provided a rich source of evidence, and enabled us to develop some common principles for good practice in the assessment of mathematical skills, reflecting the content requirements, assessment objectives and other regulatory requirements. This report outlines these principles and the thinking behind them, and includes examples of questions to illustrate how these principles can be applied in practice.

Introduction

Many AS and A level qualifications require the use of mathematical or quantitative skills¹. In some reformed A levels this has been formalised for the first time and a specified minimum amount of mathematical skills (10% of the total marks) at a prescribed level of demand (level 2 or above) must be included in the assessments. The first group of subjects reformed for teaching in 2015, for which there is a mathematical skills requirement, includes AS/A levels in: biology, business, chemistry, computer science, economics, physics and psychology. A number of the subjects reformed in subsequent years have similar requirements, including for example AS/A levels in design and technology.

To support the ongoing development and delivery of these assessments we convened a meeting of subject experts from Ofqual and the exam boards in two subjects, business and psychology, to agree some principles for good practice in designing questions that assess mathematical skills. This report is the output of that meeting. It contains examples of questions from these two subjects which the subject experts agree illustrate an appropriate level of demand in the use of quantitative or mathematical skills in line with the principles. We intend that this report will provide a source of information for exam boards to consider when designing their assessments, but it might also be of use to those involved in teaching the subjects. We will use the report if we develop additional guidance on the assessment of mathematical skills.

The examples used in this document are provided for illustrative purposes, and the questions and mark schemes provided might not have gone through the full review process for use in live examinations. The examples have been drawn from all of the exam boards and so reflect a variety of different, legitimate approaches to assessment. The questions and mark schemes are those written by the exam

¹ The terms 'quantitative skills' and 'mathematical skills' are not used consistently between different subjects, with the content for GCE business including an annex of 'quantitative skills' and the content for GCE psychology referring to both 'quantitative skills' and 'mathematical skills'. The Ofqual conditions for both subjects refer to 'mathematical skills', and so that is the terminology used in this report. It encompasses the requirements for both 'mathematical skills' and 'quantitative skills' referred to in the content documents.

boards and are reproduced with their permission but have been anonymised in this report.

Mathematical skills requirements

In both business and psychology (and indeed in all other subjects where these requirements exist) the use of mathematical skills is an integral part of the subject, and this is reflected in the subject content and assessment objectives.

For both subjects the mathematical requirements are set out in an annex to the main content document (annex on p. 5 of the business content², and appendix 6d on p. 38 of the science content for psychology³). The introduction to these annexes states that in order for students to develop their skills, knowledge and understanding in the subject they need to have been taught, and acquired competence in, appropriate areas of mathematics. Therefore, there is an expectation that teaching and learning allows students to develop their mathematical skills in a range of appropriate subject contexts, as detailed in each specification. Ofqual does not require that the items that assess mathematical skills do so in isolation of the other course content, and the introduction to the relevant appendices in both psychology and business emphasise that the mathematical skills listed should be applied in the context of the subject. For example:

In order to be able to develop their skills, knowledge and understanding in business, students need to have acquired competence in the quantitative skills that are relevant to the subject content and which are applied in the context of a business A level.

(GCE business content, page 5)

In order to be able to develop their skills, knowledge and understanding in science, students need to have been taught, and to have acquired competence in, the appropriate areas of mathematics relevant to the subject as indicated in the table of coverage below.

The assessment of quantitative skills will include at least 10% level 2 or above mathematical skills for biology and psychology, 20% for chemistry and 40% for physics, these skills will be applied in the context of the relevant science A level.

(GCE psychology content, page 24)

Questions that did assess mathematical skills in isolation from the relevant subject content would also be unlikely to address any of the relevant assessment objectives. In both psychology and business all of the assessment objectives reference the subject context and assessing mathematical skills in isolation would be incompatible with this.

²https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/302103/A_level_business_subject_content.pdf

³

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/600863/gce-subject-level-conditions-and-requirements-for-psychology.pdf

The expectation that these skills are assessed in context is reflected in the principles outlined below and is clear from the question commentaries later on in the report.

While the published core subject content for both subjects includes an annex outlining the mathematical skills in which students are expected to be competent, exam boards can choose to add to these skills in their own specifications if they feel that is appropriate.

For each subject a specified proportion of the qualification marks must be allocated to the assessment of mathematical skills at level 2 or above. For the purposes of this work we have defined level 2 as of a standard equivalent to that found in the higher tier papers in GCSE mathematics and/or statistics (i.e. the underlined and bold content in the DfE content documents for GCSE mathematics and GCSE statistics).

Business

The subject experts were clear that mathematical skills are an important part of the decision making and problem-solving expectations of A level business qualifications. This is reflected in assessment objective 4 (AO4) which requires students to *'evaluate quantitative and qualitative information to make informed judgements and propose evidence-based solutions to business issues'*⁴. The content also includes a number of aspects which rely on mathematical skills and data handling. For example, the 'accounting and finance' area of study outlined in paragraph 9 of the business content⁵, and some aspects of the 'business analysis' area of study in paragraph 10 (e.g. data analysis and measure of financial performance).

The quantitative skills annex in business includes some generic mathematical skills, not all of which are necessarily level 2 skills. The first two bullet points, for example, refer to the use of ratios, averages, fractions and percentages. While it might be clear that these skills are essential in the context of the subject, in their simplest form they would be assessed at foundation tier GCSE mathematics, or at Key Stage 3, and as such would be regarded as level 1. This has implications for assessment design, as noted in principle 4 below.

Psychology

Assessment objective 2 (AO2) in psychology includes a strand referring specifically to mathematical skills, requiring students to *'apply knowledge and understanding of scientific ideas, processes, techniques and procedures when handling quantitative data'*⁶. In addition, assessment objective 3 (AO3) requires students to *'analyse, interpret and evaluate scientific information, ideas and evidence'*, which is also likely

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/371195/2014-04-09-gce-subject-level-conditions-and-requirements-for-business.pdf

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/302103/A_level_business_subject_content.pdf

6

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/600863/gce-subject-level-conditions-and-requirements-for-psychology.pdf

to include the use of quantitative data, particularly in the context of the research methods aspect of psychology.

References to mathematical skills permeate the psychology content⁷, including references to the collection, presentation and analysis of quantitative data and to the use of descriptive statistics including measures of central tendency and dispersion.

The required mathematical skills for psychology are laid out in an annex to the content, and this is detailed and extensive. It includes exemplification of how each identified mathematical skill may be assessed in the context of A level psychology (although it is clear that assessments will not be limited to these contexts alone). The exemplification in the annex clearly roots the mathematical skills in a subject context, but this approach could be confusing as a number of the mathematical skills listed in the annex for psychology are not necessarily at a level of demand required for a level 2 qualification, but the exemplification in the annex adds to the skill in a way that does make it level 2. For example, D1.6 in the annex is '*understand the terms mean, median and mode*', which, in itself, is not a level 2 skill; understanding these terms is a requirement of foundation tier mathematics candidates at GCSE. The exemplification of this skill suggests that students could select which of these measures was the most appropriate to use in a particular situation, which would meet the level 2 requirement.

Principles for good practice in the assessment of mathematical skills

The principles outlined below are intended as a guide for good practice, and reflect the requirements and expectations of the content, assessment objectives and regulatory requirements outlined above.

1. Where mathematical skills are required to answer a question, they should be appropriate to the subject context.
2. Where a student is required to carry out a mathematical or statistical procedure they should be expected to use and/or interpret the outcome of this procedure in the context of the question asked.
3. Where mathematical skills are rewarded in a question, marks should only be allocated to mathematical skills at level 2 or above. That is of a standard equivalent to⁸ or higher than the underlined and **bold** content as laid out in the content documents of GCSE mathematics⁹ or GCSE statistics¹⁰.

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/593849/Science_AS_and_level_formatted.pdf

⁸ Qualifications at a level equivalent to or higher than GCSE could include other general qualifications in mathematics or statistics, for example AS or A level mathematics and further mathematics, and AS or A level statistics qualifications.

⁹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/254441/GCSE_mathematics_subject_content_and_assessment_objectives.pdf

¹⁰https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/500793/Statistics_GCSE_subject_content.pdf

4. There may be occasions where it is appropriate to include mathematical skills in a question at a standard below level 2, depending on the context and requirements of the question. In these cases marks will not count towards the mathematical skills requirements.

Principles 1 and 2 reflect the fact that mathematical skills are an integral part of the subject content and should be assessed as such, and not as a 'bolt-on' or additional requirement. Mathematical skills given in the annexes would be sampled in the assessments in the same way as any other content, and usually in the context of another aspect of the subject content. In the case of psychology, this would include a research methods context. Mathematical skills should rarely (if ever) be the sole focus of a question. The subject content and context should be the main focus, and the mathematical skills used should support that context.

Principle 3 reflects the level of demand that mathematical skills questions must meet in order to address our requirements. This principle is reflected in a range of qualifications, as a number of the requirements of the business and psychology content are not found on the GCSE mathematics syllabus. GCSE, AS and A level statistics are included as a number of the mathematical requirements in business and psychology are not assessed in GCSE mathematics, but can be found in the statistics content.

Both GCSE mathematics and GCSE statistics have content that is differentiated into three areas of increasing demand:

Area 1: Content with regard to which it is intended that all Learners taking the qualification should be confident and competent by the end of their GCSE course. This content is shown in standard font in the Content Document and must be assessed in both higher and foundation tier assessments.

Area 2: Content with which all students taking the qualification are intended to be at least familiar by the end of their GCSE course. This content is underlined in the Content Document and must be assessed in both higher and foundation tier assessments. Students taking higher tier assessments should be expected to be confident and competent with this content by the end of their GCSE course, and those assessments must reflect that expectation.

Area 3: Content with which only the most highly attaining Learners will be expected to be confident and competent by the end of their GCSE course. This content is shown in bold font in the Content Document and must be assessed in higher tier assessments only.

(GCSE mathematics conditions and requirements, page 16)

We have defined level 2 as being that covered in area 2 and area 3. This is content that is only assessed on higher tier papers, or content with which candidates sitting the higher papers will be competent and confident.

The GCSE statistics content reflects the increase in demand that interpreting the outcomes of some mathematical procedures in context. For example, selecting an appropriate way to represent data is defined as a level 1 skill in the GCSE statistics content i.e. it is given in 'standard' type in the content document. If, however, a student has to justify their choice of representation and state why it would be the

most appropriate to use with reference to the nature of the data they are using, this raises the demand to level 2. Similarly, the calculation of averages (mode, median and arithmetic mean) is identified in both the GCSE mathematics and statistics content as being at level 1, but the GCSE statistics content goes on to say that if a Learner is able to select the most appropriate average for a situation, this would again raise the demand to level 2.

The final principle recognises that sometimes the context or content of a question will require the use of mathematical skills below level 2. Indeed, as discussed above, some of the mathematical skills outlined in the annexes are not necessarily of an appropriate level of demand to count towards the required weighting of level 2 mathematical skills marks. The use of mathematical skills at a lower level is likely to be appropriate in a number of content areas in both business and psychology, and there is no requirement for mathematical skills only to be tested at level 2 or above. However, where questions do use mathematical skills at a lower level these must not be counted toward the regulatory requirements of 10% of the marks for both of these subjects.

Implications for mark schemes

As illustrated in the commentaries above, there are challenges in both designing mark schemes and in allocating an appropriate number of mathematical skills marks in questions assessing these skills. For example, extended response questions, such as examples 1 and 2 for GCE business, where candidates may legitimately take a number of approaches or consider a variety of both quantitative and qualitative data.

Subject experts discussed this in some depth, with a number of approaches to the allocation of marks being considered, including considering how many marks a candidate could legitimately achieve in a question without the use of any mathematical skills. It is up to exam boards to decide how to allocate marks against the requirements for level 2 mathematical skills, but the approach must be applied consistently so that compliance with the requirements can be clearly demonstrated.

Conclusions

Mathematical skills are a fundamental part of business and psychology and the assessment of them in the context of the subject content was common practice in the legacy qualifications. The Subject Level Conditions and Requirements we put in place for the reformed qualifications strengthens this integrated approach.

It was recognised by the subject experts that there were challenges in meeting the regulatory requirements. Equally, it was recognised that tensions can exist between the delivery of curriculum aspirations and the delivery of reliable assessments on a national scale. The subject experts acknowledged that, when assessed in their simplest form, a number of mathematical skills included in the annexes to the subject content were not of an appropriate level of demand to be considered level 2. However, they also agreed that mathematical skills should be used as appropriate to the subject content and context, and as such there may be situations where it is

appropriate to use mathematical skills at a lower level though they do not then count towards the 10% requirement for mathematical skills at level 2 or above. This is reflected in the principles for good practice.

The principles identified in this document (page 5) demonstrate that there is agreement between the subject experts on the focus and purpose of the assessment within an examination context. The principles and examples provide some common ground for question writers. They highlight and support the need for mark schemes to be able to reliably and consistently reward candidates for demonstrating the application and understanding of mathematical skills in a manner appropriate to the focus of the question.

The approaches that exam boards take to the assessment of quantitative skills may legitimately vary while still satisfying Ofqual's regulatory requirements. The exemplar questions provided show that it is possible to design questions that meet Ofqual's requirements and complement the subject content in different ways.

Annex A: Exemplar questions and mark schemes

The exemplars have been selected from materials provided by the exam boards that offer these qualifications. Where a question includes reference to a specific company or organisation, the sources of the information are appropriately referenced and the exam board has sought permission for its use where required. The exemplars represent a sample of questions from both AS and A level assessments and cover a range of different content areas, mathematical skills and question types. Each one was agreed by the subject experts to exemplify the principles laid out above. We have provided a short commentary explaining how the question assesses mathematical skills. The commentary includes a brief overview of the question followed by a summary of how the question satisfies the principles in this report.

Business

Example B1

B1 Question	<p style="text-align: center;">KMH plc</p> <p>KMH plc is a multinational company with its headquarters in the UK. It designs, builds and maintains marine engines for ships and yachts. Revenue comes from two major sources. Around half its revenue comes from manufacturing and selling marine engines. The rest comes from providing support services for the engines, from regular checking and simple maintenance to more complex service arrangements. These services include KMH plc technicians monitoring engine performance minute by minute wherever it is in the world and making remote adjustments to the way an engine is operating.</p> <p>Two market segments account for most of its engine sales – cruise ships and luxury yachts. KMH plc's market share for cruise ship engines is over 30%. Many of its customers (major cruise ship operators) have begun placing bigger orders as mergers and takeovers reduce the number of companies in this segment of the holiday industry (see Appendix A). Larger companies operating cruise ships can negotiate better deals from engine manufacturers, but KMH plc can also gain economies of scale as it works on larger orders, negotiating better deals with its own suppliers.</p> <p>KMH plc is also market leader in the luxury yacht market – providing the engines and servicing for the vessels much loved by mega-rich company executives, notably from Russia and Middle Eastern oil-producing countries.</p> <p>With key target markets for its marine engines consisting of cruise ship operators and buyers of luxury yachts, KMH plc's marketing mix is very different to many other large multinational businesses. These customers place relatively few orders for marine engines each year, but each purchase involves millions of pounds and complex negotiations. This requires KMH plc to have a specialised and highly skilled sales team with a detailed understanding of the technical benefits of its products and services.</p> <p>Secrets of KMH plc's success</p> <p>KMH plc puts a strong focus on Research and Development, allowing it to be a technological leader in its field, holding thousands of patents for innovative technologies developed in its research centres. KMH plc has invested heavily in training its staff and considers the excellence of its staff to be a fundamental source of competitive advantage. An apprenticeship academy was opened in Hull in 2012. Meanwhile, the company spent a total of £48.5m on training staff in 2016 to keep their skills up to date. Generous salaries alongside the excellent training make KMH plc one of Britain's favourite employers, shown by its low labour turnover. KMH plc aims to reap the rewards of its investment in people through ensuring that its maintenance services are world-class, whilst staff involved in Research and Development have the skills to develop market-leading new engines.</p> <p>Much of KMH plc's success is down to the excellent fuel efficiency of its engines – a crucial selling point when oil prices are high. Its newest engine, the result of many years' Research and Development, is claimed to be 25% more efficient than those of its major rivals. In addition, KMH plc's maintenance and support contracts offer its customers peace of mind, aimed at preventing problems from occurring.</p>
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Turbulence for KMH plc

Despite its strengths, KMH plc was still vulnerable to changes in market conditions. 2015 and 2016 had been worrying times for KMH plc shareholders. In February 2015 the company was forced to issue a profit warning – advising the stock market that previous predictions of future profits might be inaccurate. Further warnings followed, each time downgrading expectations of future profits. **Appendix B** shows KMH plc's share price in 2015 and 2016. Financial data for the business can be found in **Appendix C**.

Journalists blamed KMH plc's poor financial performance in 2015 and 2016 on two major issues:

- worsening global economic conditions slowing revenue growth
- excessive costs.

Global economic growth rates have remained low and the incomes of consumers in many rich countries barely increased in real terms and are not forecast to rise for the next few years. This has had an impact on demand for cruise holidays. In addition, global oil prices have fallen. There are no clear signs that oil prices will rise again in the next couple of years.

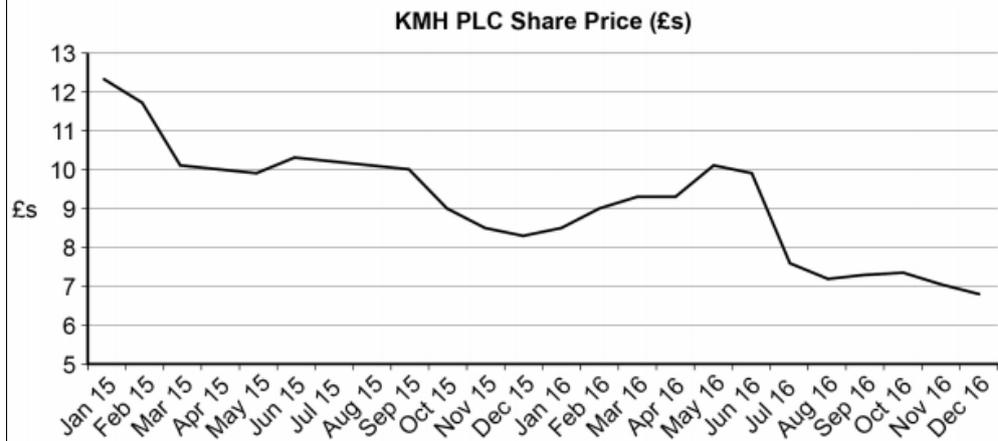
A new captain - a new strategy

In May 2016, KMH plc appointed Sir Rodney Short as its new Chief Executive. Sir Rodney was previously Chief Executive of ZQQZ plc – a British microchip manufacturer that he had turned into a world leader. Within weeks, Sir Rodney announced a major new strategy aimed at solving KMH plc's problems. One feature of the new strategy was an organisational restructuring. This was designed to reduce the size of the workforce. Most of the planned 140 job losses would be amongst senior managers (one in three senior managers would lose their jobs). Sir Rodney claimed that costs would be reduced by around £12m per year as a result after the costs of the restructuring. In addition, major investment (£50m) in new production machinery and a new factory is planned, aimed at reducing manufacturing costs and increasing total capacity. With such major changes planned, KMH plc's share price recovered slightly as the stock market gave Sir Rodney's strategy its approval, but there are plenty of details that need to be finalised, not least, how the changes are to be funded.

Appendix A

Top 5 Cruise Ship Holiday Providers - Market share (2016)	
CCL	48.1%
RCL	23.1%
NCL	10.4%
MSC Cruises	5.2%
Disney	2.8%
Others	10.4%

Appendix B



Appendix C

Table 1 Extracts from KMH plc balance sheets

	2015 (£m)	2016 (£m)
Non-current assets	5518.0	5104.0
Current assets	5594.0	6058.0
Current liabilities	(3842.5)	(4086.5)
Non-current liabilities	(4076.0)	(4567.5)
Net assets	3193.5	2508.0
Total equity	3193.5	2508.0

Table 2 Extracts from KMH plc income statements

	2014 (£m)	2015 (£m)	2016 (£m)
Revenue	7756.5	7441.7	6862.5
Gross profit	1658.4	1562.6	1399.8
Operating expenses	903.5	906.5	910.4
Operating profit	754.9	656.1	489.4

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Analyse, using **two** financial ratios, the financial constraints faced by KMH plc in attempting to fund the new strategy.

[12 marks]

B1 Mark Scheme

Level	The student will typically demonstrate:	Marks
3	<p>A good response overall that focuses on many of the demands of the question. Provides an answer to the question set that:</p> <ul style="list-style-type: none"> • demonstrates a depth and range of knowledge and understanding of issues in the question • demonstrates analysis which is well developed, applied effectively to the context and considers a range of issues in the question 	9 – 12 marks
2	<p>A reasonable response overall that focuses on some of the demands of the question. Provides an answer to the question set that:</p> <ul style="list-style-type: none"> • demonstrates a limited knowledge and understanding of a range of issues in the question or a good knowledge and understanding of relatively few issues in the question • demonstrates analysis which is developed, applied to the context and considers some of the issues in the question 	5 – 8 marks
1	<p>A limited response overall with little focus on the demands of the question. Provides an answer to the question set that:</p> <ul style="list-style-type: none"> • demonstrates a limited range and depth of knowledge and understanding of issues in the question • demonstrates analysis with little development and mainly descriptive application to the context 	1-4 marks

The focus of the question is on:

- using the results from two appropriate ratios (only 2016 is required)
- show how KMH's current financial position limits the availability of finance for the new strategy

Indicative content:

2016 gearing = $4567.5 / (4567.5 + 2508) * 100 = 64.55\%$ (2015 was 56.07%)

Gearing with an extra £50m borrowed = $4617.5 / (4617.5 + 2508) * 100 = 64.8\%$

Borrowing to finance strategy may not be a sensible choice – though arguments could question the relative cost of loan vs share capital with interest rates still relatively low for a large borrower such as KMH plc

2016 current ratio = $6058.0 / 4086.5 = 1.48$ (2015 = 1.46)

Current ratio with £50m cash deducted = $6008.0 / 4086.5 = 1.47$

This implies the firm's liquidity, would be reduced; it may be argued that this could be low and create liquidity problems; however the ratio is still higher than in 2015

2016 ROCE = 6.9% (2015 was 9%). This relatively low level (especially the decline) suggests it may be hard to attract external equity investment. It could also be an indicator of the firm's inability to fund the investment through retained profit.

Other acceptable ratios include profitability margins used to assess either the attractiveness of KMH to external investors or their ability to use retained profit as a way of raising finance

	2015	2016
Gearing (%)	56.1	64.6
Current	1.46	1.48
ROCE (%)	9	6.9
Operating margin (%)	8.8	7.1
Gross margin (%)	21.0	20.4

Share price has fallen from a high of over £12 to under £7 – suggests financing the new strategy through sale of shares may not be a sensible option since a greater number of new shares would have to be issued at this lower price to raise the funding needed – diluting ownership further

Note – if only 2015 figures used, responses should still be credited. It is possible to argue that investment in the new strategy took place in the second half of 2015.

Exemplar B1 – Commentary	
Description	<p>A 12 mark extended response question with a level of response mark scheme containing 3 bands and indicative content. The following mathematical skills are assessed:</p> <ul style="list-style-type: none"> - Calculate, use and understand ratios, averages and fractions - Use and interpret quantitative and non-quantitative information in order to make decisions <p>6 of the 12 marks available are allocated to level 2 mathematical skills.</p>
Principles 1 and 2 (subject context)	Candidates are expected to select the ratios and make use of the outcomes of the consequent calculations to analyse the constraints.
Principles 3 and 4 (mathematical demand)	Candidates are expected to calculate, use and understand business ratios. While the use of ratios in itself may not necessarily be a level 2 skill, in this question the ratios are not provided. Candidates have to use the information provided to decide which ratios to use, and are then expected to use the outcomes of these calculations further in the question to analyse information. This selection of an appropriate ratio, and the ability to interpret the outcomes, raise the demand to an appropriate level.

Example B2

Question	<p style="text-align: center;">Read the following extracts (E to H) before answering Question 2.</p> <p style="text-align: center;">Write your answers in the spaces provided.</p> <p>Extract E</p> <p>Pure Gym founder on why he started Pure Gym</p> <p>Pure Gym, which Peter Roberts started in 2009 with four sites in the UK, now has 90 gyms from Aberdeen to Southampton.</p> <p>Roberts, who trained as a chartered surveyor and then became a leisure entrepreneur investing in nightclubs and hotels, got the idea for Pure Gym after spotting the low-cost gym trend in America, Germany and Scandinavia. At the time, the UK was dominated by the relatively expensive gym chains.</p> <p>Pure Gym opened 30 new gyms in 2014 and a further 40 the following year. It has a target of having 250 to 300 gyms in the UK by 2020. Pure Gym is now Britain's largest gym chain by membership, with 450,000 members paying between £9.99 and £25 a month. It expects to overtake Virgin Active as the operator with the largest number of sites by the end of March 2015.</p> <p>Each site contains just a gym, with no swimming pools, saunas or racquet courts. Each Pure Gym typically employs just two staff, supported by up to 12 self-employed trainers. Members join online, paying monthly with no annual contracts and use PIN codes to access the gyms 24 hours a day.</p> <p>Roberts wants Pure Gym to expand overseas in Italy, Spain, and emerging markets, such as those in Asia, South America and Africa.</p> <p style="text-align: right;"><small>(Source: adapted from http://www.telegraph.co.uk/finance/newsbysector/retailandconsumer/11337645/Pure-Gym-founder-on-how-he-built-Britains-biggest-gym-chain.html, 10 January 2015)</small></p> <p>Extract F</p> <p>Pure Gym buys rival LA Fitness</p> <p>In 2016 Pure Gym's newly appointed chief executive, Humphrey Cobbold, won the auction to buy LA Fitness, a business established for over 25 years. The LA Fitness sites will require a £20m refurbishment. Most of the gyms will be rebranded and require a change in working practices.</p> <p>Pure Gym paid between £60m and £80m for LA Fitness, a mid-market operator that consists of 43 clubs. LA Fitness was put up for sale last year and, like other more upmarket chains, it has been pressured by the challenge posed by lower priced rivals.</p> <p>The acquisition will require clearance from the Competition and Markets Authority (CMA), which last year foiled plans for a merger between Pure Gym and The Gym Group. Mr Cobbold said that many of the worries the CMA had were unlikely to be replicated by the LA Fitness acquisition.</p> <p style="text-align: right;"><small>(Source: adapted from http://www.telegraph.co.uk/finance/newsbysector/retailandconsumer/leisure/11637658/Pure-Gym-buys-rival-LA-Fitness.html, 24 January 2016)</small></p>
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Extract G**Selected information from The Gym Group's Statement of Comprehensive Income for year ending 31 December 2015**

	31 December 2015 (£'000)	31 December 2014 (£'000)
Revenue/Turnover	61 084	45 480
Cost of sales	(1 073)	(1 040)
Gross profit	60 011	44 440
Administrative expenses	62 712	42 105
Operating profit/(loss)	(2 701)	2 335

(Source: adapted from <http://www.tggplc.com/media/66640/24869-Gym-Group-AR15.pdf>)

Extract H**Selected information from The Gym Group's Statement of Financial Position as at 31 December 2015**

	31 December 2015 (£'000)	31 December 2014 (£'000)
Non-current assets	134 551	118 380
Current assets	8 636	9 933
Current liabilities	25 546	24 656
Non-current liabilities	9 198	72 072
Equity/Shareholder funds	108 443	31 585

(Source: adapted from <http://www.tggplc.com/media/66640/24869-Gym-Group-AR15.pdf>)

In 2016, had it not been for the Competition and Markets Authority, Pure Gym may have been able to reach its target growth by taking over The Gym Group, rather than LA Fitness.

(d) Using the data in Extracts G and H calculate appropriate accounting ratios for The Gym Group and, using other non-financial information, evaluate these two options.

Recommend which company it would have been better for Pure Gym to take over to achieve its growth target.

(20)

B2 Mark Scheme	Level	Mark	Descriptor
		0	A completely inaccurate response.
	Level 1	1-5	Isolated elements of knowledge and understanding. Weak or no relevant application of business examples. An argument may be attempted, but will be generic and fail to connect cause(s) and/or consequence(s)/effect(s).

	Level 2	6–10	<p>Elements of knowledge and understanding, which are applied to the business example. Arguments and chains of reasoning are presented, but connections between cause(s) and/or consequence(s)/ effect(s) are incomplete. Attempts to address the question. A comparison or judgement may be attempted, but it will not successfully show an awareness of the key features of business behaviour or business situation.</p>
	Level 3	11–15	<p>Accurate and thorough knowledge and understanding, supported throughout by relevant and effective use of the business behaviour/context. Uses developed chains of reasoning, so that cause(s) and/or consequence(s)/effect(s) are complete, showing an understanding of the question. Arguments are well developed. Quantitative or qualitative information is introduced in an attempt to support judgements, a partial awareness of the validity and/or significance of competing arguments and may lead to a conclusion.</p>
	Level 4	16–20	<p>Accurate and thorough knowledge and understanding, supported throughout by use of relevant and effective use of the business behaviour/context. Uses well developed and logical, coherent chains of reasoning, showing a range of cause(s) and/or effect(s). Arguments are fully developed. Quantitative and/or qualitative information is/are used well to support judgements. A full awareness of the validity and significance of competing arguments/factors, leading to balanced comparisons, judgements and an effective conclusion that proposes a solution and/or recommendations.</p>

Knowledge 4, Application 4, Analysis 6, Evaluation 6
Marks for application and analysis – include up to 8 marks
for quantitative skills

Quantitative skills assessed:

QS1: calculate, use and understand ratios, averages and fractions

QS2: calculate, use and understand percentages and percentages changes

QS8: use and interpret quantitative and non-quantitative information in order to make decisions

QS9: interpret, apply and analyse information in written, graphical and numerical forms

Indicative content (quantitative skills)

Profitability:

Expect to see two types of ratio from:

- 2015 GPM = (Gross profit/sales turnover x 100) therefore (60 011/61 084 x 100) = 98.2%
- 2014 GPM = (Gross profit/sales turnover x 100) therefore (44 440/45 480 x 100) = 97.7%
- % change = 0.5% improvement (QS2)

- 2015 OPM = (Operating profit/sales turnover x 100) therefore (2 701/61 084 x 100) = **minus** 4.42%
- 2014 OPM = (Operating profit/sales turnover x 100) therefore (2 335/45 480 x 100) = 5.13%

- 2015 ROCE = (Operating profit/Capital Employed x 100) Therefore (-2 701/117 641) x 100 = **minus** 2.3% (QS1)
- 2014 ROCE = (2 335/103 657) x 100 = 2.25% (QS1)

Gearing:

- 2015 Gearing = (Non-current liabilities/Capital employed) x 100 therefore (9 198/117 641) x 100
- = 7.82% (QS1)
- 2014 Gearing = (72 072/103 657) x 100
- = 69.5% (QS1)
- Gearing has fallen 88% (69.5-7.82)

Liquidity:

- 2015 Current Ratio = Current assets/Current liabilities
- Therefore 8 636/25 546 = 0.34:1 (QS1)
- 2014 Current Ratio = 9 933/24 656 = 0.40:1 (QS1)

- % change = 0.06 decline (QS2)

Rate of return on capital employed (ROCE) has seen a dramatic decline (QS9)

The market size is growing due to the growth in budget, low cost gyms in the UK (QS9)

Gearing is 7.82%, which could be viewed as very low, compared to 2014 when it was very high at 69.5% - QS8)

Liquidity has worsened to 0.40:1, which is extremely low.

The Gym

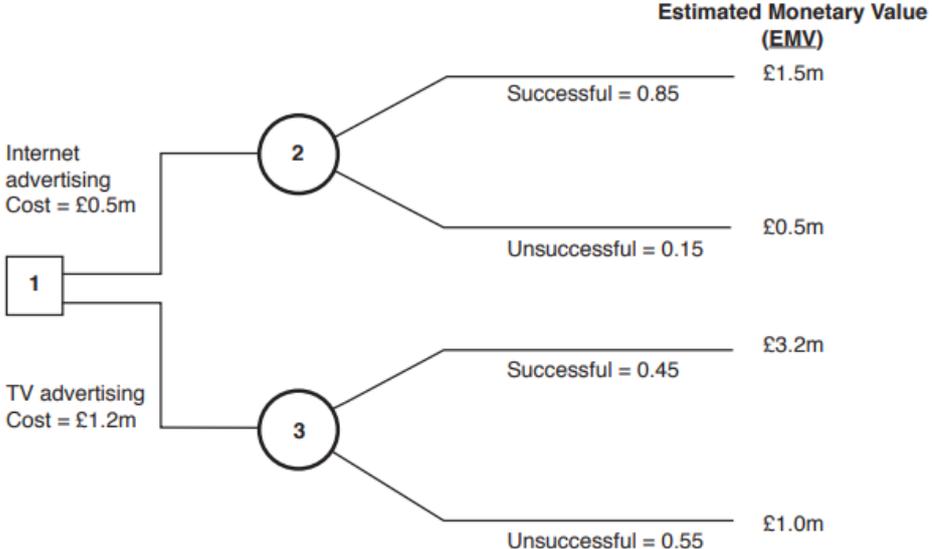
- This would have been a merger, not a takeover, which may have had both positive and negative repercussions
- Pure Gym has set a target to have 300 UK gyms by 2020 and this inorganic growth strategy would be more likely to match this ambition as the sites are similar and wouldn't require new builds
- Two discount operators coming together might have meant similar stock of fitness equipment and locker room supplies which would allow greater purchasing economies of scale and in turn higher profitability
- The Gym Group sites in the same area could be sold off to eliminate the direct competition and provide funds for staff training or any future redevelopment of Pure Gyms
- Revenue could be increased by increasing prices as the direct competition would no longer exist. This could be used to support further expansion in Italy, Spain, South America or Africa.
- Expansion through purchase of The Gym Group sites could lead to lower average total costs as administration and marketing costs could be integrated and shared over more sites. Administrative expenses for The Gym Group were 104.5% of the value of gross profits in 2015 (94.7% in 2014)

LA Fitness

- Although LA Fitness allegedly cost between £60m and £80m, the 43 sites are likely to be premium sites as they were part of an upmarket chain. Some of these could be sold to provide revenues for more of the smaller new build Pure Gyms as part of its expansion plans across the country.
- Converting LA Fitness sites to Pure Gym sites might enable Pure Gym to appeal to different market segments by offering former LA Fitness members cheaper memberships and so increase its customer base naturally, without the need for expensive marketing campaigns
- Rebranding LA Fitness sites to Pure Gyms may enable the business to offer a premium, upmarket gym to compete directly with Virgin Active and David Lloyd to take advantage of those people on higher incomes.

	<p><i>Possible recommendations</i></p> <ul style="list-style-type: none"> • The accounting ratios for profitability and liquidity are not healthy – well below industry averages. Therefore it would not be advisable to takeover The Gym Group as this could worsen Pure Gym’s cash-flow and finance investment opportunities to risk survival in a very competitive market • Gearing has fallen which may be a good thing as it would suggest that expansion could cost less to finance as lenders might see the loan as less of a risk • The low cost gym sector may experience an increase in demand as the demand from people wanting basic facilities increases as real incomes fall. In which case by taking over LA Fitness, Pure Gym would not really tap into a lucrative market by offering alternative up market sites designed for those with high real disposable incomes
Exemplar B2 – Commentary	
Description	<p>A 20 mark extended response question with a level of response mark scheme and indicative content. The following mathematical skills are assessed:</p> <ul style="list-style-type: none"> - calculate, use and understand ratios, averages and fractions - calculate, use and understand percentages and percentage changes - use and interpret quantitative and non-quantitative information in order to make decisions - interpret, apply and analyse information in written, graphical and numerical forms <p>8 of the 20 marks available are allocated to level 2 mathematical skills.</p>
Principles 1 and 2 (subject context)	<p>The question is set in a context, the growth of Pure Gym, and requires candidates to apply both quantitative and qualitative analysis. The question is an example of the business content leading the question, with the quantitative skills playing a supporting role.</p>
Principles 3 and 4 (mathematical demand)	<p>While some of the mathematics required in the question is relatively simple, candidates are expected to choose accounting ratios, interpret the outcomes of their calculations in the context of the question, and use the outcomes to make and justify their decision. The requirement that candidates have to select and interpret their findings raises the level of demand (in line with similar content in GCSE statistics for example).</p>

Example B3

<p>Question</p>	<p>13 The managers at Virgin Trains are considering how to increase demand on the London to Edinburgh route. They have two options for a promotional campaign; either Internet advertising or TV advertising, and have decided to use a decision tree to help identify the best option.</p> <p>Using the diagram below, calculate the expected value (EV) at node 1.</p> <div style="text-align: right; margin-bottom: 10px;"> Estimated Monetary Value (EMV) </div>  <p style="text-align: right; margin-top: 20px;">Answer = [4]</p>		
<p>B3 Mark Scheme</p>	<p>Calculate the expected value (EV) at node 1.</p> <p>4 marks for correct answer (with or without correct working)</p> <p>3 marks for correct answer but with incorrect units/accuracy of answer</p> <p>3 marks for correctly deducting the costs from both node 2 & node 3 values</p> <p>1 mark each for correctly calculating nodes 2 and 3</p> <p>No marks for identifying Internet advertising as the best option, as that is not the question.</p>	<p>4 (AO1 2) (AO2 2)</p>	<p>Node 2 = $(0.85 \times £1.5m) + (0.15 \times £0.5m) = \underline{£1.35m}$</p> <p>Node 3 = $(0.45 \times £3.2m) + (0.55 \times £1.0m) = \underline{£1.99m}$</p> <p>EV at node 1 is the largest of:</p> <p>EV for Internet advertising = $£1.35m - £0.5m = £0.85m$</p> <p>EV for TV advertising = $£1.99m - £1.2m = £0.79m$</p> <p>EV at node 1 = £0.85m (£850,000)</p> <p><i>[£0.79m may be rewarded as the answer (OFR) if a mistake is made when calculating node 2]</i></p> <p style="text-align: right;">OFR</p>
<p>Exemplar B3 – Commentary</p>			
<p>Description</p>	<p>A 4 mark question where the calculations involved require the handling of multiple sets of data and probabilities. It involves the use of a tree diagram to calculate probability and the appropriate expected value in each case.</p> <p>All 4 marks are allocated to the level 2 mathematical skills requirements.</p>		
<p>Principles 1 and 2</p>	<p>Candidates are expected to carry out a set of calculations, which involves understanding how to identify multiple expected values (EVs). This requires</p>		

(subject context)	the integration of mathematical skills with the context of identifying the best option monetarily for the business based on this data.
Principles 3 and 4 (mathematical demand)	Multiple-stage calculations are required to achieve full marks. The use of tree diagrams to calculate probability can be clearly identified as level 2 mathematics, as it is an underlined (i.e. higher tier) point in the Probability section of GCSE mathematics subject content.

Example B4

B4 Question	<p style="text-align: center;">2</p> <p style="text-align: center;">Will's Fish and Chips (WFC)</p> <p>"It all started because I had a relative who owned a fish and chip shop and he asked me to help him out when he was ill. I was interested in the nature of the business and the interaction with the customers. I took a job in a local fish and chip shop and enjoyed it but felt that I could do better in terms of product and service." So said Will Stevenson, the entrepreneur who opened an award-winning fish and chip shop in Middleton, close to central Milton Keynes.</p> <p>Will's Fish and Chips (WFC) was started in 2007 and finding the right location was a challenge. Will looked at the plans available from the council, including the plans for house construction that was to take place. He knew the vast majority of his customers would be local; most likely living within one or two miles of the shop. Fish and chips is a product that is best eaten fresh; once out of the shop it does not 'travel' well and customers are unlikely to drive for miles, especially as there are so many other fast-food outlets nearby. Location was therefore a crucial factor in the business' success. WFC is currently open six days a week, Monday to Saturday from 11.30 am until 2.00 pm and from 4.30 pm until 10.00 pm.</p> <p>The 'start up' process for WFC was lengthy. Will chose to establish WFC as a sole trader and raising the finance was not easy. Despite a very detailed business plan, several banks said that the venture was too risky and that they would not provide the necessary funding. As well as purchasing the shop there was a large amount of capital equipment involved; freezers and fryers are expensive with the typical cost for the equipment between £40,000 and £50,000. Some of the frying equipment has to be replaced on a regular basis, for example a 'deep frying pan' can cost around £5,000.</p> <p>However, the finance was eventually raised via a bank loan and some personal savings. To raise the funds it was necessary for Will to construct a business plan and while doing so he had to consider a number of legal factors.</p> <p>Once established, it was obvious that WFC faced a lot of competition and the years following the 2008 recession were difficult, although the Bank of England's decision to keep the UK interest rate very low certainly helped WFC. The combination of the downturn in the economy and plenty of local competition for trade meant it was clear that a unique selling point (USP) was going to be of key importance. The shop has a website, although WFC's marketing has always reflected the local nature of the business.</p> <p>WFC's USP is the product and the way it is served. Although other products are on sale, such as pies and pasties, WFC offers what Will considers to be 'the traditional fish and chip experience'. To ensure this, both the fish and the batter are prepared in small batches and the frying oil is cleaned twice a day, in order to ensure freshness and good taste. He is very critical of other fish and chip shops that sell poorly cooked, greasy fish served with a 'here you are approach' rather than a smile and some conversation. Will's aim is to offer a local service for local customers. This approach is distinctive because the large fast-food national chains do not do this. If a customer wants to stand and chat, Will and his staff are happy to do so. This means that, when recruiting, Will looks for potential employees who are outgoing and friendly.</p> <p>All staff are trained in customer service and health and safety issues. Will ensures that his staff are fully aware of his business philosophy and WFC has developed a loyal customer base that comes mainly from repeat local customers who, knowing that they will get a freshly cooked meal with some conversation, come back time and again.</p> <p>WFC has won a number of awards over the past few years, most recently the 'Regional Takeaway Fish and Chip Shop of the Year'. WFC also has a 5-star hygiene 'scores on the doors' rating.</p>
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There is some discussion in the industry as to whether fish and chips is a 'luxury' or 'a value for money meal'. The products on sale at WFC are aimed at those of all income levels. The average price of a meal is £6 and most customers pay in cash. Demand is considerably higher on a Friday and Saturday night. On a payday, at the end of the month, the shop is also much busier.

On average, two weeks' stock is held in the freezers. WFC's costs can change quite rapidly, since fish and vegetable prices can vary according to national supply and demand. Will does not like to continually alter prices but he recognises that WFC has to react to cost and demand factors, to a greater or lesser extent. Based on past experience and trends, Will has come up with the data shown in **Table 1**. At the current average price of £6, WFC sells on average 3,100 meals per month.

Predicted sales data for WFC

Average price of a meal (£)	Predicted number of sales
7.00	2000
6.50	2700
5.50	3500
5.00	3700

Table 1

WFC is operated in an environmentally responsible manner. Fish is sourced from sustainable stocks. As many other ingredients as possible are sourced locally to support local trade and to reduce the carbon footprint. Will believes that sustainability is good for everyone, from the fishermen to those transporting the fish once they have been caught. He recognises that the success of one business in the supply chain is dependent on another. All packaging (glass, tin and cardboard) as well as oil from the shop is recycled.

Within the local community, the business supports several schools through the donation of raffle prizes, in the form of vouchers to use in the shop. There are collection tins in the shop for various charities, such as Help for Heroes and for people with Down's syndrome.

Operating close to the town centre means there is a lot of competition which has intensified over the years. However, while competition has increased so have the opportunities for growth. Milton Keynes Development Partnership (MKDP), which is wholly owned by Milton Keynes Council, is an organisation which exists to help Milton Keynes' continued growth and economic success. It plans to release land for development in two areas near WFC in the near future (see **Fig. 1 & Table 2**).

MKDP statements about proposed development sites

The Atterbury Development site	Initial consultation indicated that surrounding residents would prefer residential uses rather than employment uses which would tend to be more noisy and an incompatible use so close to existing housing.
The Campbell Park Development site	This plan includes a proposed mixed development comprising mainly residences as well as shops, small businesses, restaurants/cafes, hotels and leisure/non-leisure facilities.

There comes a point where a sole trader operating from a single shop cannot grow any more, given the local nature of its customer base and the product it sells. Will is not at that point yet and, even after 10 years, the shop is still operating below full capacity which Will considers to be 5,000 meals a month, with the shop's current opening hours. Will's strategic objective is to increase the number of meals sold in the shop so that its capacity can be fully utilised by 2020. He has recently been considering ways to achieve this. One way may be via local advertising including:

- A local newspaper, the MK Citizen. This is also published online and readers are able to access an archive to find past articles and advertisements.
- A local radio station, MKFM which broadcasts across Milton Keynes and Buckinghamshire as well as three adjoining counties, with a potential audience of two million listeners.

Will has gathered some basic cost data about both of these (see Tables 3 & 4).

Advertising costs in the local newspaper (MK Citizen)

Small single column advertisement to appear for four weeks	£27.80 per week
Small double column advertisement to appear for four weeks	£33.36 per week

Table 3

Advertising costs on local radio (MKFM)

8 × 30-second commercials each day for 30 days and social media support	£595 per month
4 × 30-second commercials each day for a year and social media support	£1995 per year

Table 4

(b)* Using quantitative and qualitative evidence, evaluate a strategy for Will to reach his objective of increasing sales so that the shop's capacity can be fully utilised by 2020. **[15]**

B4 Mark Scheme	20*	(b)	<p>Using quantitative and qualitative evidence, discuss a strategy for Will to reach his objective of increasing sales so that the shops capacity can be fully utilised by 2020. Justify your view.</p> <p>Level 3 (15-11 marks) – Candidate shows strong knowledge and understanding, analysis and evaluation of a strategy for Will to reach his objective of</p>	<p>15 (AO1 2) (AO2 2) (AO3 4) (AO4 7)</p>	<p>The most common approach to answering the question considers WFC’s marketing:</p> <ul style="list-style-type: none"> • Appropriate advertising – i.e. in terms of the shop’s customer/potential customer base and its philosophy. Reference to the data from MK Citizen and MKFM. Use the website and any promotional material to stress awards. • Is there any point in advertising the business more widely
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SECTION B			
Question	Answer	Marks	Guidance
	<p>increasing the turnover of the shop so that its capacity can be fully utilised by 2020. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (10-6 marks) – Candidate shows good knowledge and understanding, analysis and evaluation of a strategy for Will to reach his objective of increasing the turnover of the shop so that its capacity can be fully utilised by 2020. <i>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</i></p> <p>Level 1 (5-1 marks) – Candidate shows limited knowledge and understanding of a strategy for Will to reach his objective of increasing the turnover of the shop so that its capacity can be fully utilised by 2020.</p> <p>NB – award maximum of two marks for non-contextualised impacts.</p> <p>0 marks no response or no response worthy of credit.</p> <p><i>The answer asks for the use of both types of data. If only quantitative or only qualitative data is used, then reward the answer towards the bottom of the appropriate level.</i></p>		<p>across the whole town, given that the product does not ‘travel’ well? It could be argued that he could consider extending the ‘catchment area’ a little but not for many miles. Hence suggestions such as TV advertising would be inappropriate.</p> <ul style="list-style-type: none"> • More appropriate possibilities are local radio MKFM – especially if the ‘awards won’ were stressed. • Leaflet drops to houses within a certain radius of the shop. • Also, it is possible to have leaflets distributed <i>with local papers</i> in the target addresses; the local paper will accommodate local businesses by delivering different promotional leaflets to different target areas. • Increased use of social media. No mention of Will using it. How appropriate would (say) Facebook or Twitter be in this context? • Another issue is the likely funds that he has available to undertake the marketing. • A wider product range may be a possibility but there are some issues with this. Crucially, any new food would also have to be able to be cooked using the existing capital equipment – the objective is to utilise existing capital more fully not install new equipment at an additional cost (the case makes reference to how expensive it is). Secondly, any new food would have to fit the existing product portfolio: ‘fish and chips’ is the core product – to sell spring rolls may be ‘OK’ but to diversify and suddenly

SECTION B																																										
Question		Answer				Marks	Guidance																																			
							<p>start selling (the full range of) 'Chinese' or 'Indian' would be at odds with the image of the shop which is 'the traditional fish and chip experience'.</p> <ul style="list-style-type: none"> There could be issues with supply. How reliable would a new supplier be? How long might it take to establish a 'stakeholder relationship' with mutual trust? New products would also have to fit in with the business' philosophy - sourced locally and sustainably if possible etc. <p>Price changes Candidates do NOT have to produce a table of figures but any calculations would be valid.</p> <p>On this data, Will should cut prices to £5.50 per average meal which would raise sales by 400 meals and profit by £1500 thus helping to reach his objective of increasing the number of meals sold and moving towards capacity. <i>But how big a step forward (towards the objective) is an additional 400 meals (if price is £5.50) and an extra profit of just over £1500 per month?</i> Cutting price down to £5 certainly sells more meals and moves towards the target of 5000, but barely causes a rise in profit either (up £1431 from £4124). How accurate is the data anyway especially given that Will is dealing with averages? It could well be argued therefore that cutting prices (especially as this may be at odds with the image of 'a quality product/experience') is not the way forward to reaching the objective – or at best is only part of it.</p> <p>Other suggestions may include:</p>																																			
		<table border="1"> <thead> <tr> <th>Average Price of a meal</th> <th>Predicted number of sales per month</th> <th>Total Revenue (£) per month</th> <th>Level of sales above B/E at that price</th> <th>Contribution (Average price – VC of £2.75)</th> <th>Profit (Level of sales above B/E x Contribution) per month</th> </tr> </thead> <tbody> <tr> <td>7</td> <td>2000</td> <td>14 000</td> <td>1059 (BE=941)</td> <td>4.25</td> <td>1059 x £4.25 =£4501</td> </tr> <tr> <td>6.5</td> <td>2700</td> <td>17 550</td> <td>1333 (BE=1067)</td> <td>3.75</td> <td>1333 x £3.75 =£4999</td> </tr> <tr> <td>6.0 (CURRENT PRICE)</td> <td>3100</td> <td>18 600</td> <td>1869 (BE=1231)</td> <td>3.25</td> <td>1869 x £3.25 =£4124</td> </tr> <tr> <td>5.5</td> <td>3500</td> <td>19250</td> <td>2045 (BE=1455)</td> <td>2.75</td> <td>2045 x £2.75 =£5624</td> </tr> <tr> <td>5.0</td> <td>3700</td> <td>18 500</td> <td>1922 (BE=1778)</td> <td>2.25</td> <td>1922 x £2.25 =£5555</td> </tr> </tbody> </table>	Average Price of a meal	Predicted number of sales per month	Total Revenue (£) per month	Level of sales above B/E at that price	Contribution (Average price – VC of £2.75)	Profit (Level of sales above B/E x Contribution) per month	7	2000	14 000	1059 (BE=941)	4.25	1059 x £4.25 =£4501	6.5	2700	17 550	1333 (BE=1067)	3.75	1333 x £3.75 =£4999	6.0 (CURRENT PRICE)	3100	18 600	1869 (BE=1231)	3.25	1869 x £3.25 =£4124	5.5	3500	19250	2045 (BE=1455)	2.75	2045 x £2.75 =£5624	5.0	3700	18 500	1922 (BE=1778)	2.25	1922 x £2.25 =£5555				
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SECTION B				
Question		Answer	Marks	Guidance
				<ul style="list-style-type: none"> • Price discrimination e.g. cheaper meals at lunchtime. This could tempt new customers (or existing ones) to buy. Would reduce the contribution per meal. Could be quite easily factored into the break-even model. However, might customers just buy the cheaper lunchtime meal for the more expensive evening one? • Loyalty scheme? How easy would this be to set up and run? Is this sort of promotion for ‘the big players’ in food retailing? What would the loyalty bonus be? Need to make it attractive enough to be worthwhile – a voucher for £5 off a meal (after a certain number of purchases) is rather more appealing than a free bag of chips. • Targeting the new developments at Campbell Park and Atterbury. Will would need to find out exactly when the developments are scheduled for completion and plan accordingly. The Campbell Park Development in Table 2 refers to “mixed development comprising mainly residences supported by shops, small businesses restaurants/cafes, hotels and leisure/non-leisure facilities”. Does this mean it will be ‘saturated’ with food outlets that Will will need to (and find it hard to?) compete with? <p>An alternative route into the question is to consider the sorts of actions that Will could take in terms of business tools’ and market research. Again, for higher marks, this needs to be in the explicit context of WFC. Tools could include a SWOT analysis. Other possibilities include Boston Matrix, Ansoff’s matrix, Forecasting, Product life cycle</p>

SECTION B				
Question		Answer	Marks	Guidance
				<p>analysis. Stronger answers may consider how appropriate these are likely to be for WFC.</p> <p style="text-align: right;">ARA</p>

Exemplar B4 – Commentary	
Description	A 15 mark extended response question with a level of response mark scheme and indicative content. 7 of the 15 marks available can be allocated to level 2 mathematical skills.
Principles 1 and 2 (subject context)	The question's context requires candidates to use both quantitative and qualitative analysis. This is an example of the business content leading the question, with the quantitative skills playing a supporting role. As the mark scheme makes clear, the use of mathematics is required to access the upper half of marks at each level.
Principles 3 and 4 (mathematical demand)	While some of the mathematics that could be used to answer the question is, in isolation, relatively simple, candidates obtaining higher marks on this question are expected to know how to calculate contribution and profit (integrating the level of sales above break-even multiplied by the contribution rate), selecting appropriate data and information from the unseen resource booklet and to interpret the outcomes of their quantitative calculations in the context of the question. This raises the level of demand to level 2.

Example B5

B5 Question

Extracts from JD Sports Fashion Plc, Trading, Profit and Loss account (Income Statement) for the 52 weeks ended 31 January:

	2015 £m	2014 £m
Sales Revenue	1552	1216
Less Cost of Sales	813	624
Gross Profit	739	592
Less Expenses	647	514
Net (operating) Profit	92	78

JD Sports Fashion Plc Balance Sheet as at 31st January:

	2015 £m	2014 £m
Fixed Assets	282	270
Current Assets	400 (including stock of 225)	330 (including stock of 186)
Current Liabilities	327	286
Long-term Liabilities	45	41
Total Shareholders' Funds	310	273

Calculate the net profit margin, acid test and gearing ratios for 2014 and 2015 and use them to assess the financial performance of JD Sports Fashion Plc. [10]

B5 Mark Scheme

Calculate the net profit margin, acid test and gearing ratios for 2014 and 2015 and use them to assess the financial performance of JD Sport's Fashion Plc. [10]				
Band	AO1	AO2	AO3	AO4
	2 marks	2 marks	2 marks	4 marks
3				4 marks Excellent evaluation of all the 3 financial ratios Both sides of the argument are evaluated Clear judgements are made with supporting statements
2	2 marks Good understanding of all 3 financial ratios	2 marks Good application of financial ratios to JD Sports - all 3 ratios calculated correctly	2 marks Good analysis of all three financial ratios The analysis is uneven, with some well-developed points and some where the development is more limited	2-3 marks Good evaluation of at least 2 financial ratios The evaluation is reasonably well balanced with some development on both sides of the argument Valid judgements are made with some supporting comments
1	1 mark Limited understanding of financial ratios Understanding of 1 or 2 ratios	1 mark Limited application of financial ratios to JD Sports – 1 or 2 ratios calculated correctly	1 mark Limited analysis of 1 or 2 of the financial ratios Superficial analysis with undeveloped points	1 mark Limited evaluation of 1 or 2 of the financial ratios Judgements are superficial and unsupported
0	0 marks No understanding of financial ratios	0 marks No correct calculation of the financial ratios	0 marks No analysis of the financial ratios	0 marks No evaluation of the financial ratios

Indicative content:

	2015	2014
	£m	£m
NPM	5.93%	6.41%
Acid Test	0.54:1	0.50:1
Gearing	12.68%	13.06%

Allow for correct variations in rounding to 1 decimal place. E.g. 12.7% for gearing in 2015

- The company's net profit margin is perhaps a little lower than might be expected and has also fallen slightly. On the other hand sales revenue has increased considerably from £1216 million to £1552 million and the actual figure for net profit is up by nearly 18%. This is a good performance.
- The acid test, at half of the ideal ratio of 1:1, is low. This could indicate a potential liquidity problem. If all of the suppliers were to

	<p>ask for repayment immediately the company would struggle to find the finance. It might also indicate that stock levels are too high. This could be due to seasonal factors, although the accounts are as at 31 January so the peak season has already passed.</p> <ul style="list-style-type: none"> • The gearing ratio is low. The company does not depend greatly on loans and has plenty of potential to borrow more in the future to help its expansion plans. • Overall the company seems to be performing well, apart from the possibility that it is holding too much stock. Sales and profits are up and the shareholders are getting a satisfactory return for their investment. Candidates may offer an overall conclusion. • OFR in marking AO3 and AO4 • Credit any other valid point.
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Exemplar B5 – Commentary

Description	<p>This is one part of a longer question, with all parts related to a business context set by the exam board. Part (b) is allocated 10 marks in total, of which 6 are allocated to the assessment of level 2 mathematical skills.</p> <p>The two marks for AO1 are awarded for recalling the required ratios and so are not allocated to the mathematical skills requirements.</p> <p>Answers in the 'limited' band (band 1) for AO3 and AO4 would show only superficial responses, which were not supported by any quantitative evidence. All of the remaining bands for AO2, AO3 and AO4 require the appropriate calculations to be carried out and then used in the justification of any decisions made. As such 6 of the marks available rely on the correct application of quantitative skills.</p>
Principles 1 and 2 (subject context)	<p>The question requires candidates to calculate 3 different types of financial ratios by selecting the correct data from the tables given and then use their calculations to assess the performance of the business.</p>
Principles 3 and 4 (mathematical demand)	<p>While the calculations required in this question are not in themselves complex enough to be considered level 2, candidates are expected to use the outcomes of these calculations further in the question to analyse and evaluate information. This raises the level of demand to an appropriate level.</p>

Psychology

Example Ps1

Ps1 Question

A psychologist wanted to test whether listening to music improves running performance.

The psychologist conducted a study using 10 volunteers from a local gym. The psychologist used a repeated measures design. Half of the participants were assigned to condition A (without music) and half to condition B (with music).

All participants were asked to run 400 metres as fast as they could on a treadmill in the psychology department. All participants were given standardised instructions. All participants wore headphones in both conditions. The psychologist recorded their running times in seconds. The participants returned to the psychology department the following week and repeated the test in the other condition.

The results of the study are given in **Table 1** below.

Table 1 Mean number of seconds taken to complete the 400m run and the standard deviation for both conditions

	Condition A (without music)	Condition B (with music)
Mean 400m time (s)	123	117
Standard deviation	9.97	14.5

What do the mean and standard deviation values in **Table 1** suggest about the participants' performances with and without music? Justify your answer.

[4 marks]

Ps1 Mark Scheme	<p>Marks for this question: AO2 = 2 and AO3 = 2</p> <p>Mean:</p> <p>1 mark for interpreting what the mean times suggest about the effect of music on the participants' 400m performance - participants run faster with music (take less time to run 400 metres) or participants run more slowly without music (take more time to run 400 metres). Accept alternative wording.</p> <p>Plus</p> <p>1 mark for an accurate justification about the difference in the mean scores in each condition – mean time is greater in condition A than condition B (or mean time is lower in condition B than condition A).</p> <p>Standard deviation:</p> <p>1 mark for an accurate comment about what the standard deviations suggest about the spread of scores in each condition – performance is more consistent in condition A than condition B (or performance is less consistent in condition B than condition A). Accept alternative wording.</p> <p>Plus</p> <p>1 mark for a justification about the difference between the standard deviations in each condition – standard deviation is smaller in condition A than in condition B (or standard deviation is greater in condition B than condition A).</p> <p>Note: 0 marks for just stating the data from the table, eg the mean time with music is 117 whereas it is 123 without music.</p>
Exemplar Ps1 – Commentary	
Description	<p>This is a 4 mark question in the research methods section of the paper (section C). All of the questions in section C are in the context of a research project investigating whether listening to music improves running performance.</p> <p>The question covers D1.14, D1.6 in Appendix 6 to the Content document.</p> <p>4 marks are awarded for mathematical skills: 2 marks for interpretation of a mean and 2 for interpretation of standard deviation with justification.</p>
Principles 1 and 2 (subject context)	<p>Candidates are asked to interpret mean and standard deviation values from a table of given values. They are expected to interpret what these values represent in the context of the research project described in this section of the paper.</p>
Principles 3 and 4 (mathematical demand)	<p>Candidates are not asked to calculate the values of mean and standard deviation and these are given. Calculation of the mean would not, in any event, meet the requirements for level 2 mathematics as it is expected of foundation tier (level 1) GCSE candidates in mathematics and statistics.</p> <p>The mathematical demand in the question comes from the requirement to interpret these values and say what they mean in the context of the data given. This is in line with the requirements of higher tier GCSE statistics, and so is at level 2.</p>

Example Ps2

<p>Ps2 Question</p>	<p>Rafiq carried out a correlational study to investigate whether there was a relationship between age and number of hours of sleep per night.</p> <p>(a) Complete Table 2 and calculate the Spearman's rank correlation coefficient for Rafiq's study. (4)</p> <table border="1" data-bbox="435 409 1430 949"> <thead> <tr> <th>Age</th> <th>Rank 1</th> <th>Number of hours sleep</th> <th>Rank 2</th> <th>d</th> <th>d²</th> </tr> </thead> <tbody> <tr><td>17</td><td>2.5</td><td>10</td><td>6</td><td></td><td></td></tr> <tr><td>17</td><td>2.5</td><td>11</td><td>7</td><td></td><td></td></tr> <tr><td>20</td><td>4</td><td>6</td><td>2.5</td><td></td><td></td></tr> <tr><td>24</td><td>6</td><td>7</td><td>4</td><td></td><td></td></tr> <tr><td>21</td><td>5</td><td>4</td><td>1</td><td></td><td></td></tr> <tr><td>16</td><td>1</td><td>9</td><td>5</td><td></td><td></td></tr> <tr><td>40</td><td>7</td><td>6</td><td>2.5</td><td></td><td></td></tr> <tr> <td colspan="5" style="text-align: right;">Total:</td> <td></td> </tr> </tbody> </table> <p>(b) Rafiq used a non-directional (two-tailed) hypothesis.</p> <p>Explain whether Rafiq's data were significant at $p < 0.05$ and if the research hypothesis should be accepted. (2)</p>	Age	Rank 1	Number of hours sleep	Rank 2	d	d ²	17	2.5	10	6			17	2.5	11	7			20	4	6	2.5			24	6	7	4			21	5	4	1			16	1	9	5			40	7	6	2.5			Total:					
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<p>Ps2 Mark Scheme</p>	<p style="text-align: center;">AO2 (4 marks)</p> <table border="1" data-bbox="435 1249 1299 1805"> <thead> <tr> <th>Age</th> <th>Rank 1</th> <th>Number of hours sleep</th> <th>Rank 2</th> <th>d</th> <th>d²</th> </tr> </thead> <tbody> <tr><td>17</td><td>2.5</td><td>10</td><td>6</td><td>-3.5</td><td>12.25</td></tr> <tr><td>17</td><td>2.5</td><td>11</td><td>7</td><td>-4.5</td><td>20.25</td></tr> <tr><td>20</td><td>4</td><td>6</td><td>2.5</td><td>1.5</td><td>2.25</td></tr> <tr><td>24</td><td>6</td><td>7</td><td>4</td><td>2</td><td>4</td></tr> <tr><td>21</td><td>5</td><td>4</td><td>1</td><td>4</td><td>16</td></tr> <tr><td>16</td><td>1</td><td>9</td><td>5</td><td>-4</td><td>16</td></tr> <tr><td>40</td><td>7</td><td>6</td><td>2.5</td><td>4.5</td><td>20.25</td></tr> <tr> <td colspan="5" style="text-align: right;">Total:</td> <td>91</td> </tr> </tbody> </table> <p>One mark for calculating column d One mark for calculating column d² One mark for substituting into equation $1 - \frac{6 \times 91}{7 \times (49 - 1)}$ One mark for calculating Spearman's rank correlation coefficient -0.625</p>	Age	Rank 1	Number of hours sleep	Rank 2	d	d ²	17	2.5	10	6	-3.5	12.25	17	2.5	11	7	-4.5	20.25	20	4	6	2.5	1.5	2.25	24	6	7	4	2	4	21	5	4	1	4	16	16	1	9	5	-4	16	40	7	6	2.5	4.5	20.25	Total:					91
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	<p style="text-align: center;">A02 (1 mark), A03 (1 mark)</p> <p>One mark for identifying the correct critical value (A02) One mark for accurate judgement of relationship (A03)</p> <p>For example:</p> <ul style="list-style-type: none"> The critical value is (0.786) at 0.05 for a two-tailed test when $n=7$ which more than the calculated value (of 0.625) (1) so there is no significant relationship between age and number of hours of sleep and the null hypothesis should be accepted (1). <p>Look for other reasonable marking points.</p> <p>Answers must relate to the scenario.</p>
Exemplar Ps2 – Commentary	
Description	<p>A 6 mark question addressing both mathematical skills requirements and research methods, and requiring candidates to calculate a Spearman's rank coefficient and then interpret the result of the calculation in the context of the question.</p> <p>All 6 marks count toward the mathematical skills requirements.</p> <p>This question addresses D1.8 in Appendix 6 to the Content document.</p>
Principles 1 and 2 (subject context)	<p>If part (a) was the only question, it would be mathematics for mathematics sake and have no relevance to the subject content. However, further parts of the question go on to require interpretation of the outcome of the calculation in a subject context, and as such it fulfils the requirements of principle 2.</p>
Principles 3 and 4 (mathematical demand)	<p>The level is appropriate as calculation of Spearman's rank coefficient is included in higher tier GCSE statistics content.</p>

Example Ps3

Ps3 Question	<p>Furry friends. Some research suggests that animals can help people feel less lonely. To investigate this further a psychologist wants to conduct an experiment to study the effect of caring for pets on elderly people living in one large residential home called 'The Oaklands' which has a total of 125 men and women aged between 60 and 95.</p>																		
<p>17. a) Describe how random sampling could be used to obtain participants for this study.</p>																			
Ps3 Mark scheme	<table border="1"> <thead> <tr> <th data-bbox="448 629 1034 656">Answer</th> <th data-bbox="1040 629 1150 656">Marks</th> <th data-bbox="1157 629 1428 656">Guidance</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 660 1034 775">Random sampling could be used by getting all the names of the 125 elderly residents who live in <u>The Oaklands</u> residential home and putting them in to a hat and then selecting names from it.</td> <td data-bbox="1040 660 1150 775">Max 3</td> <td data-bbox="1157 660 1428 719">Context = residents, elderly people</td> </tr> <tr> <td data-bbox="448 779 1034 837">Clear description of how random sampling could be used in context.</td> <td data-bbox="1040 779 1150 837">3</td> <td data-bbox="1157 745 1428 891" rowspan="4">Must include some reference to all members of the target population being involved in the selection process.</td> </tr> <tr> <td data-bbox="448 842 738 922">Clear description of how random sampling could be used but not in context.</td> <td data-bbox="745 842 1034 922">OR Attempt in context.</td> <td data-bbox="1040 842 1150 922">2</td> </tr> <tr> <td data-bbox="448 927 1034 985">Brief and/or unclear description of random sampling (whether in context or not).</td> <td data-bbox="1040 927 1150 985">1</td> </tr> <tr> <td data-bbox="448 990 1034 1016">No creditworthy response</td> <td data-bbox="1040 990 1150 1016">0</td> </tr> </tbody> </table>			Answer	Marks	Guidance	Random sampling could be used by getting all the names of the 125 elderly residents who live in <u>The Oaklands</u> residential home and putting them in to a hat and then selecting names from it.	Max 3	Context = residents, elderly people	Clear description of how random sampling could be used in context.	3	Must include some reference to all members of the target population being involved in the selection process.	Clear description of how random sampling could be used but not in context.	OR Attempt in context.	2	Brief and/or unclear description of random sampling (whether in context or not).	1	No creditworthy response	0
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Exemplar Ps3 – Commentary																			
Description	<p>This is an example of a question that addresses both mathematical skills and research methods.</p> <p>It covers section D1.5 of the mathematical skills requirements laid out in Appendix 6 to the DfE Subject Content.</p> <p>All 3 marks for this part question are allocated to the mathematical skills requirements.</p>																		
Principles 1 and 2 (subject context)	<p>The context of the question addresses both mathematical skills requirements and research methods. It is part of a longer question that builds from the initial question on sampling and places part a) in a wider experimental and subject context.</p>																		
Principles 3 and 4 (mathematical demand)	<p>The question requires candidates to show an understanding of sampling techniques in an applied context.</p> <p>The application of random sampling techniques is included in the underlined content of section B3 in the GCSE statistics content and as such meets the requirements for level 2.</p>																		

Example Ps4

Ps4 Question

6. A professor chose to investigate the following hypothesis, 'There will be a difference in the attractiveness ratings of men when they wear aftershave and when they don't wear aftershave'. The professor conducted his research at a bar. The researcher invited 40 of his female students to attend the event in order to celebrate his 50th birthday. 20 female students were randomly allocated to attend the event at 18.30 and the remaining 20 female students were asked to arrive at 20.00. 25 male students (who were paid by the professor) socialised with the first group of female students, wearing no aftershave. After one hour the first group of female students left. The male students then applied aftershave and socialised with the second group of female students. As they were leaving, female students were asked to give some feedback using a questionnaire. One of the questions was:

The University professor found that the mean 'attractiveness' rating for the

Using the following scale, rate the attractiveness of the male students you met at the event:

0 Not attractive at all

1 Weak levels of attraction

2 Reasonably attractive

3 Very attractive

Your rating: _____

male students when they did not wear aftershave was 1.8, whereas the mean 'attractiveness' rating for the male students when they wore aftershave was 2.1.

(e) The professor used a Mann-Whitney U test. Justify why this test is appropriate for analysing the data collected in his research. [4]

(f) Using the critical values table below, select a suitable critical value that the professor should use in his analysis and explain your selection. [2]

Table of Critical Values of U ($p=0.05$), for a two-tailed test

		N_1		
		18	19	20
N_2	18	99	106	112
	19	108	113	119
	20	112	119	127

The observed (calculated) value must be equal to or less than the critical value in this table for the result to be significant at the given level.

(g) The professor found the calculated (observed value) was 123. Explain if the professor should accept or reject his null hypothesis. [2]

6. (e)

Credit **could** be given for:

- Test of difference: Looking for a difference in attractiveness ratings from female students who were exposed to male students wearing aftershave and to male students not wearing aftershave.
- Independent data: The attractiveness scores are from participants who were either a exposed to male students wearing aftershave or participants who were exposed to male students not wearing aftershave, so is only part of one condition.
- Data is at least ordinal or data is ratio: the attractiveness rating is at least ordinal data or above.

Marks	AO2
4	<ul style="list-style-type: none"> • Answer contains all three elements to justify the use of a Mann Whitney U test and is linked to the data collected in this research.
3	<ul style="list-style-type: none"> • Answer contains two of the three elements to justify the use of a Mann Whitney U test and is linked to the data collected in this research.
2	<ul style="list-style-type: none"> • Answer contains one of the three elements to justify the use of a Mann Whitney U test and is linked to the data collected in this research.
1	<ul style="list-style-type: none"> • Answer contains all of the three elements to justify the use of a Mann Whitney U test but there is no link to the data collected in this research.
0	<ul style="list-style-type: none"> • Inappropriate answer given. • No response.

6. (f)

Exemplar answers:

- 127 as the number of participants in each group of female students was 20 and this value intersects the N1 and N2 at 20. [2 marks]
- 127 as N1 and N2 are both 20. [2 marks]
- 127. [1 mark]
- Any other appropriate content.

Marks	AO2
2	<ul style="list-style-type: none"> • Correct critical value (127) identified and explained.
1	<ul style="list-style-type: none"> • Correct critical value (127) identified and not explained.
0	<ul style="list-style-type: none"> • Inappropriate answer given. • No response attempted.

	<p>6. (g)</p> <table border="1" data-bbox="443 259 1410 831"> <tr> <td colspan="2" data-bbox="443 259 1410 293">Exemplar answers:</td> </tr> <tr> <td colspan="2" data-bbox="443 293 1410 389"> <ul style="list-style-type: none"> The professor can reject his null hypothesis as the observed value 123 is less than the critical value of 127, which mean the difference is significant at $p=0.05$. [2 marks] </td> </tr> <tr> <td colspan="2" data-bbox="443 389 1410 427"> <ul style="list-style-type: none"> He can reject the null. [1 mark] </td> </tr> <tr> <td colspan="2" data-bbox="443 427 1410 510"> <ul style="list-style-type: none"> Any other appropriate content. </td> </tr> <tr> <th data-bbox="443 521 576 566">Marks</th> <th data-bbox="576 521 1410 566">AO3</th> </tr> <tr> <td data-bbox="443 566 576 667">2</td> <td data-bbox="576 566 1410 667"> <ul style="list-style-type: none"> Correctly identified that the null hypothesis can be rejected and explained why with reference to both observed and critical values. </td> </tr> <tr> <td data-bbox="443 667 576 763">1</td> <td data-bbox="576 667 1410 763"> <ul style="list-style-type: none"> Correctly identified that the null hypothesis can be rejected but has not explained why with reference to both observed and critical values. </td> </tr> <tr> <td data-bbox="443 763 576 831">0</td> <td data-bbox="576 763 1410 831"> <ul style="list-style-type: none"> Inappropriate answer given. No response attempted. </td> </tr> </table>	Exemplar answers:		<ul style="list-style-type: none"> The professor can reject his null hypothesis as the observed value 123 is less than the critical value of 127, which mean the difference is significant at $p=0.05$. [2 marks] 		<ul style="list-style-type: none"> He can reject the null. [1 mark] 		<ul style="list-style-type: none"> Any other appropriate content. 		Marks	AO3	2	<ul style="list-style-type: none"> Correctly identified that the null hypothesis can be rejected and explained why with reference to both observed and critical values. 	1	<ul style="list-style-type: none"> Correctly identified that the null hypothesis can be rejected but has not explained why with reference to both observed and critical values. 	0	<ul style="list-style-type: none"> Inappropriate answer given. No response attempted.
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Exemplar Ps4 – Commentary																	
Description	<p>This is an example of a multi-part question that addresses both the mathematical skills and research methods requirements.</p> <p>It covers sections D1.12, D1.13 of the mathematical skills requirements laid out in Appendix 6 to the DfE Subject Content.</p> <p>The 8 marks available for parts e), f) and g) of the question are all allocated to the mathematical skills requirements.</p>																
Principles 1 and 2 (subject context)	<p>These are parts of an extended question and are all set in a relevant research context. They require students to carry out statistical procedures and to interpret the outcome of those procedures in the context of the given research scenario.</p>																
Principles 3 and 4 (mathematical demand)	<p>Statistical tests of this type, and the interpretation of these in a given context, are found in the content of A level mathematics and statistics (level 3). This clearly meets the requirements for mathematics at level 2 or above.</p>																



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