Level 3 Certificate

Quantitative Reasoning (MEI)

OCR Level 3 Certificate Quantitative Reasoning (MEI) **H866**

OCR Report to Centres June 2018

About this Examiner Report to Centres

This report on the 2018 Summer assessments aims to highlight:

- areas where students were more successful
- main areas where students may need additional support and some reflection
- points of advice for future examinations

It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

The report also includes links and brief information on:

- A reminder of our **post-results services** including **reviews of results**
- Link to **grade boundaries**
- **Further support that you can expect from OCR**, such as our Active Results service and CPD programme

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OCR REPORT TO CENTRES

H866/01 Introduction to Quantitative Reasoning

1. General Comments:

This is the third year that this qualification has been examined. The candidature has steadily increased over this time, in particular showing an increase of over 25% over the previous session.

This paper is also available in the specification Quantitative Problem Solving (H867).

Candidates were well prepared and made every effort to attempt the more challenging questions. The quality of their written responses and legibility of number work overall was always at least satisfactory. Some candidates might have benefited from using bullet points or short subheadings to clarify thinking. This was clearly the case with some multi-step questions such as Q4(iv). There was no obvious indication that time was an issue for candidates. The literacy demands of the paper did not appear to have a significant effect on candidates' ability to demonstrate their knowledge. There was a suggestion, but no more, that "negative result" (Q7(iv)) and "discrete size" (Q8(v)) might have confused a very small number of candidates. However, these are legitimate pieces of vocabulary within the specification.

Areas in which candidates showed confidence and a particularly solid understanding included calculating mean values (Q1(i)), substituting into algebraic expressions and using the results (Q1(ii), Q7(i), Q7(iv) and Q7(v)), using inequalities (Q3(i)) and performing direct currency exchange calculations (Q4(i) and Q4(ii)). It was pleasing to note in passing that most candidates showed a good degree of "number sense" – answers of a magnitude not remotely possible on the basis of life-experiences were comparatively rare.

Areas which candidates found challenging included some aspects of probability and interpretation involving the Normal distribution (Q8). An over-arching area of difficulty encountered by some candidates throughout the ability range involved rates and compound units in their broader sense. This included incorrect interpretation and confusion between, for example, litres per second and seconds per litre (Q1(iii)), £ per € and € per £ (Q4(iii)/(iv)) and cost per unit area of pizza and area of pizza per £ (Q2(ii)). It was apparent that some centres had made a point of advising their candidates to attach the appropriate units to each sub-calculation thereby clarifying the "sense" of the compound unit.

It appeared that the Insert was generally used to good effect, but some misunderstandings regarding credit card commissions were observed in a number of cases. A topic, which was succinctly explained in the document.

2. Comments on Individual Questions:

Question No. 1
This, the first question on the paper, was very well done overall. The most capable tended to gain full credit, whilst the least capable achieved at least half the available credit.

Parts (i) and (ii) were, as might be expected, correctly answered by the great majority. When an error did occur in part (ii) it was usually the result of multiplying rather than dividing to

find the flow rate, instead of using the given formula. In addition, a noticeable, but small, proportion of candidates homed in on the word “estimate” in the question and gave a rounded answer.

In part (iii) a significant proportion of candidates started the question afresh, not making use of part (i) and part (ii), many of these were successful. Problems arose in a number of cases when candidates confused buckets of water flowing per second with seconds taken for a bucket to fill. Writing down the units of their calculations might have prevented this.

Question No. 2
The question taken, as a whole was one of the least well answered across all capabilities. About half of candidates were successful with part (i) but only 1 in 10 achieved full credit in part (ii), with more than a third gaining no credit. The prime source of this low success rate was a failure of the majority of candidates to appreciate that the determining factor in value for money is cost per unit area (area of pizza per £), not cost unit length of pizza radius. Some small partial credit was conditionally available in such cases.

Question No. 3
Over two thirds of all candidates gained at least half the available credit for this question. All question parts were attempted by the vast majority.

In many cases failure to achieve full credit for part (i) was the result of omitting to label all three lines, difficult not to attribute to “just” carelessness. Perhaps not unexpectedly, the most common error in part (ii) was 6 to 11 weeks – the overall range.

Question No. 4
Set against the other questions, on the whole, a moderately well answered question.

More than three quarters of all candidates were fully successful with part (i). The least capable were on average able to gain half of the available credit. The most common error was to select the wrong exchange rate. A number failed to appreciate that the selling rate at the bank was what Jamie would have to pay.

In part (ii) more than half the candidates achieved full credit. Most errors originated in calculating the percentage loss made by Jamie. The actual calculations involved in buying and selling were correctly carried out in many cases.

Part (iii) only attracted full credit for about half the candidates. Most problems arose from misunderstanding how to take into account the delivery charge. A significant number thought that if the friend bought the book in the US and took it to the UK there would be no delivery charge. However, partial credit was available, which about a quarter of candidates were able to avail themselves of.

Part (iv) was found to be very challenging, with almost a quarter failing to gain any credit. A common error was a failure to treat commission as a charge but wrongly as a payment to the holidaymaker. This was surprising as the example in the Insert was quite clear on this point. Candidates must have read this as their initial starting point was very commonly £100 or €100 as in the Insert’s example. Clarity of thought may not have been helped by muddled working – subheadings or bullet points might have supported candidates’ trains of thought. In addition, lack of displayed units sometimes made it difficult to understand the candidate’s method of working. The general concept of buying and selling currency was clearly found to be a difficult one in a number of cases.

Question No. 5
About 1 in 20 candidates failed to gain any credit for this question. Calculating and using acceleration was a challenge to a significant minority. It is difficult not to subscribe some of this to the units ms^{-2} or kilometres/$hour^2$ as there were a number of calculations clearly employing squares and square roots triggered, in all probability, by the sight of the former notation.

In part (i) a small, but noticeable, proportion of candidates worked out or attempted to work out the acceleration rather than converting the speed units. It is possible that two short questions followed by two large consecutive answer spaces may have contributed to this error. This was the one part question where poor number sense was evident as speeds of 30 000 m/s were seen (probably the result of "× 3600" rather than "÷ 3600".

Part (ii) was found difficult by the majority of candidates with more than half failing to achieve any success. A significant number multiplied by 3.2 rather than divide by 3.2 indicating problems in their understanding of the concept of acceleration as a rate of change. Another area of confusion was shown by the number of mixed unit answers based on 60 (mph) ÷ 3.2 (seconds). In addition, as mentioned above, misunderstanding over unit notation was responsible for a number of instances of squaring and taking square roots.

Part (iii) showed a very wide range of success with just under a third of all candidates failing to gain any credit but just over 1 in 10 gaining full credit. Most had some inkling that a triangle was required and that a gradient obtained from it was relevant to their answer. This strongly suggested that such content has been encountered in the past. There were many instances of carelessly or wrongly drawn tangents. It seemed that most knew how to extract values from their triangle in order to calculate a gradient, although correctly quantifying the *x*–axis scale was found difficult by some. Many only gained credit by correctly comparing their incorrectly calculated value for the acceleration with the critical value.

Question No. 6
Compared with the other questions this was a moderately well answered question with two thirds of the candidates achieving more than half the available marks.

Although most were successful with part (i) it did attract some unusual responses relating to newspaper bias. Some candidates tended to fill the space provided with explanations – but not always rational. Just under a third failed to gain any credit.

Although full credit was achieved by slightly less than half of all candidates, part (ii) showed up some candidates' insecurities regarding rates, as illustrated by them calculating injuries per participant and then choosing cycling as it resulted in the highest number. There were also instances of cavalier attitudes to place value in order to erroneously reduce the size of very large or very small numbers in calculations. However, a noticeable proportion was able to state numbers per million or the equivalent with some confidence.

Part (iii) was reasonably well done; most credit was lost because a correct response was effectively repeated for the second reason. "Protective gear" and "the weather" were common incorrect responses.

Question No. 7
This was moderately well attempted with slightly less than 1 in 20 candidates failing to achieve any credit and about three quarters getting more than half the credit.

The great majority of candidates were successful with part (i), when credit was lost; it was usually the result of some inappropriate or incorrect rounding.

Part (ii) was found to be very challenging, especially by the least capable, almost half of all candidates gained no credit. Less than 1 in 10 remembered the brackets for the index. There were a notable number of instances of the given algebraic formula simply being repeated. Correct placing of the "^" gained most credit, "=SUM" was a not uncommon error.

Part (iii) was moderately well done; by far the common error involved reading the row number rather than "number of days" column.

In part (iv), as in part (iii), row numbers were mistaken as "numbers of days". Nevertheless partial credit could be gained by evidence of relevant working (about 1 in 10 candidates profited by this) – a good example to illustrate the benefit of showing working. There were a small but noticeable number who interpreted a negative result as meaning literally a negative number. The meaning of positive results was made clear in the question.

The great majority of candidates were successful with part (v), as might be expected, most errors involved carelessness in the actual plotting.

In part (vi) just over half the candidates gained full credit, a small proportion failed to attempt the question. A significant minority referred to the clarity of the actual graph itself rather than the model.

Question No. 8
Overall, this was one of the most challenging questions, on par with Q2. Less than 1 in 100 candidates gained full credit and more than 1 in 10 gained no credit. Nevertheless, the majority of even the least capable candidates attempted the majority of the question parts sensibly. It was apparent that understanding of the Normal distribution was somewhat fragile for many candidates.

Part (i) was poorly answered, over three quarters of candidates assumed the chart to represent a scatter graph and the line a line of best fit.

About a quarter failed to gain any credit in part (ii). Most candidates realised the range should be centred on the mean. Many used one standard deviation as the range. There were some attempts to use *z*-values but with little real understanding.

Part (iii) A was almost either correct or wrong with hardly any instances of partial credit being gained in between. The question was omitted by some candidates.

Less than 1 in 20 were successful with part (iii)B. Most candidates erroneously focused on the standard deviation or simply gave 90% as their answer.

Less than 1 in 5 gained credit in part (iv), the question was omitted by about the same proportion. Many candidates repeated their response for part (iii)A with no working.

Part (v) was poorly answered with almost 1 in 10 failing to attempt the question. A significant number concentrated on preferences rather than the statistical data. Although there was, no unequivocal evidence “discrete” might have confused a small number of candidates, despite being a legitimate word to use within this specification.

H866/02 Critical Maths

1. General Comments:

The vast majority of candidates were well prepared for the examination, not just in terms of their knowledge and understanding but also in terms of their willingness to tackle problems in a variety of contexts.

Most candidates showed a good understanding of mathematical and statistical concepts, skills and techniques in their responses. Many were able to confidently apply mathematical and statistical thinking and reasoning to evaluate quantitative information and explain a wide range of real-life problems.

Most candidates set out their working in a way, which made it, clear what they had done. This is especially important in problem solving or in questions where candidates are asked to show that a given answer is true. However, there was still scope for improvement in this area for some candidates.

Accuracy was also an issue for some candidates; as there were questions that clearly indicated the use of rounded or approximate values and others where exact values were required throughout calculations.

2. Comments on Individual Questions:

1(i) Most candidates were successful in reading from the diagram to find reasonable estimates of the percentages. Using the fact that the two answers had to add to 100% allowed others to gain a follow through mark.

1(ii) Most candidates were familiar with the concept of a percentage point change and completed this successfully. A common wrong answer was to find the percentage change.

1(iii) Most candidates were able to use the figures in the question to calculate and compare the relevant numbers of households and to show that there were more households in "ownership" in 2011. A few candidates lost marks because they thought that 21.7 million was something other than 21 700 000. A minority attempted a qualitative argument but rarely said anything relevant to the situation – those who did were able to score one of the four marks available by providing an argument that there might have been more households in "ownership" in 2011.

1(iv) Many candidates successfully explained that each bar represented 100% and so would not change in length. Some candidates said that the bars represented percentages but did not complete the explanation of why the total bar length remained the same over the years.

2(i) Nearly all candidates were able to successfully apply the given rules to find the scores.

2(ii) Many candidates were successful in finding a possible set of scores where the "eliminate extremes" rule gave a higher score than the "average all" rule. A small number of candidates did not use whole number scores in the range 0 to 10, as specified in the question, and so lost marks. Other candidates lost marks by either not writing down their set of scores clearly or making errors in finding either of the two combined scores.

2(iii) The two most commonly used strategies for finding a set of scores where the "eliminate extremes" rule gave the same score as the "average all" rule were either to use a set of identical scores or to use a set of scores which formed an arithmetic sequence but there were other ways of finding a suitable set of scores. Some candidates rounded scores and claimed they had equal scores using both rules when this was only true to one decimal place.

2(iv) Many candidates identified the advantages correctly and succinctly.

3(i) Many candidates found it difficult to work with a percentage over 100. In addition to this, some attempted to increase the wrong value by 180%.

3(ii) There were some good clear explanations which generally either explained that it was not possible to decrease a value by over 100% or that a percentage increase and the reverse percentage decrease have different percentage values because they refer to different numerical starting values. Some candidates claimed that percentages over 100 are not possible showing a lack of familiarity with large percentages. Others claimed that probability depends on the individual – this suggestion is not consistent with the context of the question, which is about an average cohort of people.

3(iii) Most candidates got this correct. The most common wrong answer was 95% which suggests that they were focussed on mutually exclusive outcomes rather than reading the question carefully to understand the question.

3(iv) Many candidates did this correctly showing clear working. Some added on extra 5%, showing that they had not fully understood the context but they got some of the marks for the question. A few candidates showed long, detailed non-calculator methods for calculating 25% of 125 000. Those who worked more efficiently either used a calculator to find 25% or divided by 4.

3(v) Most candidates described the negative correlation, for example, "as the percentage of households with internet access goes up the percentage of adult smokers goes down"; this was a correct answer so got the mark. A minority said there was no relationship and so did not score.

3(vi) Many candidates scored here by saying that there could have been other factors involved or by saying that the internet could have helped reduce smoking due to wider availability of information about the risks of smoking. Fewer candidates scored by simply saying that correlation does not imply causation, which was sufficient. Others referred to percentage decrease in smoking, claiming that this was evidence for causation but this is not the case.

4(i) Most candidates knew the approximate size of the UK population but a sizeable minority had no idea – suggested wrong answers ranged from hundreds of thousands to billions. Nearly all candidates wrote down a figure for the total UK population and so were able to gain follow through marks for method. Some candidates either assumed that the whole population was adults or did not notice the distinction between the total population and the adult population – this reduced the number of marks they had access to. It was pleasing to see some candidates making good estimates of the proportion of adults in the population and showing their reasoning

but a few had over half the population being children – this is not realistic for the UK. Virtually all candidates gained some marks for this part question, only stronger candidates scored full marks.

4(ii) Candidates who had an answer for part (i) were able to gain full marks for follow through in this part and some did so. Marks were lost by candidates who were content to find the average number of selfies per person who admitted to taking them but did not address the "how often" which the question asked.

4(iii) Only the strongest candidates got this mark. Most candidates who attempted this part divided one number by another number, which is not a suitable method for finding the median. It was pleasing to see that a very small number of candidates not only got this right but were able to explain their reasoning clearly.

5(i) Most candidates took the approach of estimating the length of ribbon needed for one medal then multiplying by 30 with most of them getting full marks. The main errors were either not having a ribbon long enough to go over the head or finding the length for one ribbon and stopping there. A few candidates did not know how many cm were in a metre – leaving the final answer in cm was accepted.

5(ii) There were two methods of tackling this question – both were seen and most candidates gained at least one mark with many gaining two or three. The main sources of error were using an incorrect formula for area of a circle, incorrect rounding or assuming that an equal number of turns of ribbon implied equal total length.

6(i) Candidates who had a good understanding of the pre-release article and were able to use it to answer the given question usually gained full marks – with some slips in calculation leading to 2 out of 3. Other candidates did not seem to be able to relate the information in the passage to the question asked and gained no marks.

6(ii) A small number of candidates gained full marks; they had usually produced a fully labelled tree diagram using representative frequencies with labels on appropriate branches including "pass" or "fail" – this enabled them to use the information in the tree diagram correctly to produce the answers to parts (A) and (B). Other candidates gained the marks for producing a correct tree diagram but were not able to find the probabilities asked for. There were some rounding errors caused by assuming that $\frac{1}{3}$ is 33% - candidates who worked with the given values of $\frac{1}{3}$ and $\frac{2}{3}$ found that this gave easier numbers to work with. It was rare for candidates who did not use either a labelled tree diagram or a labelled table to score more than 2 marks.

6(iii) Nearly all candidates were able to find the correct mean but fewer were successful with the standard deviation. Some candidates were able to relate their mean and standard deviation to the Normal curve in part (C) and so score full marks for this part, but others numbered the axis so it ran from 0 to 400.

6(iv) Only the strongest candidates scored full marks here but some picked up one of the two available marks. Some candidates did not realise the relevance of the mean and standard deviation in this part of the question and so said that John was fairly close when, according to their calculated values of mean and standard deviation, the value was well over 10 standard deviations from the mean.

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