# Candidate Style Answers

# Introduction to Quantitative Reasoning

# Medium banded responses

### Introduction

This resource has been produced by a senior member of the Core Maths examining team to offer teachers an insight into how the assessment objectives are applied. It has taken questions from the sample question paper and used them to illustrate how the questions might be answered and provide some commentary on what factors contribute to overall levels.

As these responses have not been through full moderation, they are banded to give an indication of the level of each response. Please note that this resource is provided for advice and guidance only and does not in any way constitute an indication of grade boundaries or endorsed answers.

The sample assessment material for these answers and commentary can be found on the Core Maths web pages and accessed via the following links: [<https://www.ocr.org.uk/qualifications/core-maths/a-mei-level-3-certificate-h868/assessment/>/](http://www.ocr.org.uk/qualifications/core-maths-quantitative-reasoning-mei-level-3-certificate-h866/) or <https://www.ocr.org.uk/qualifications/core-maths/b-mei-level-3-certificate-h869/assessment/>

### Question 1 (i)

The following information is displayed at a bank in England.

|  |
| --- |
| Travel Bank |
| Currency | Sell at | Buy at |
| AUSTRALIAN DOLLAR | 1.48 | 1.64 |
| CANADIAN DOLLAR | 1.54 | 1.76 |
| EURO | 1.14 | 1.31 |
| TURKISH LIRA | 2.55 | 3.08 |
| US DOLLAR | 1.52 | 1.73 |

**(i)** How much will 200 Euros cost a customer in pounds?

**[3]**

### Sample answer for Question 1 (i)

1.31 Euros = £1

 = £152.6717557

### Question 1 (ii)

### Commentary on the answer

This answer uses the incorrect exchange rate for changing pounds to Euros but performs the correct calculation to do the conversion. The answer has not been rounded to the nearest 1p.

Dave is in a shop in the USA. He sees a watch priced in US dollars at $58.50. Dave wants to know roughly what the watch would cost in pounds. He remembers the exchange rates from Travel Bank.

**(ii)** Show how, **without using a calculator**, Dave can estimate the cost of the watch in pounds.

**[3]**

### Sample answer for Question 1 (ii)

£1 is about $2. The watch is about $60,

so about £120

### Commentary on the answer

The approximation £1 ≈ $2 is very rough but it is in the acceptable range. The price of the watch has been sensibly rounded but there is no working to show how the final answer has been obtained and it is wrong.

### Question 2

This question is about estimating the average speed of the earth as it travels round the sun.

The earth travels round the sun once a year.

The average distance of the earth from the sun is m.

Assume that the sun remains still and ignore the rotation of the earth about its axis.

What assumption must be made about the path of the earth to allow you to estimate its average speed?

Carry out the estimate, giving your answer in km h-1.

 **[6]**

### Sample answer for Question 2

Speed =  410 958 904 metres per day

= 410 958.904 km per day

= 410 958.904 × 24 = 9 863 014 km/hr

### Question 3 (i)

### Commentary on the answer

This answer uses a correct method to find speed and the conversion from metres per day to km per day has been correctly calculated although no workings have accompanied the answer. However, the following errors have been made:

* The answer has missed out the part about what assumption must be made (the Earth has a roughly circular orbit). The distance of 1.5 × 1011 m used in the speed calculation is the radius of the orbit, not the distance travelled.
* The method for changing from km per day to km per hour is wrong – the answer has more km being travelled in one hour than were travelled in one day; it would also be helpful to show the method – where the answer is incorrect (as here) it is the method that will gain marks.

The answer is rounded to the nearest km/h; the average distance from the earth to the sun was given to two significant figures; it would not be reasonable to expect the answer to be accurate to 7 significant figures when it is based on figures that are much less accurate than this.

Alia takes a job as a home care worker. She travels to elderly people’s homes to provide care for them. She is with a client for either 15 minutes or half an hour. This is the blog of her first day at work.

7am set off to see first client.

Journey takes half an hour.

With first client for 15 minutes, then half an hour journey to see second client for 15 minutes.

Arrive home at noon having seen a total of 6 clients; two for 15 minutes each and 4 for half an hour each.

5pm set off for evening visits.

Takes 20 minutes to get to first client.

See total of 4 clients for 15 minutes each and get home at 7pm.

**(i)** Alia is paid £7.30 an hour but she is only paid for the time she is with clients. She is not paid for travelling time. How much is she paid for her first day?

**[2]**

### Sample answer for Question 3 (i)

8 people for 15 mins = 120 mins = 2 hrs

and 4 for 30 mins = 2 hrs

4 hrs at £7.30 per hr = £29.20

### Commentary on the answer

This answer correctly identifies the number of people seen for 30 mins, but incorrectly identifies the number of people seen for 15 mins. Correct working is shown clearly, but the final answer is wrong due to the error in number of people seen for 15 minutes.

### Question 3 (ii) (*A*)

**(ii)** Another agency pays home care workers for time with clients and time travelling between clients but not for time travelling to or from home. That agency pays £6.31 an hour.

**(*A*)** Which of the following is the most reasonable estimate of Alia’s total time travelling to and from home on her first day?

30 minutes 50 minutes

1 hour 40 minutes 3½ hour

**[1]**

### Sample answer for Question 3 (ii) (*A*)

30 mins out plus return in the morning, 20 mins out plus a return in the evening means more than 50 mins, possibly double, so 1 hr 40 mins seems the best estimate.

### Commentary on the answer

This answer is correct and correctly explained – it is just the travelling time to and from home that is asked for.

### Question 3 (ii) (*B*)

**(*B*)** How much would Alia have been paid by the second agency for the day she describes in her blog?

**[3]**

### Sample answer for Question 3 (ii) (*B*)

7am to 12pm = 5 hrs, 5pm - 7pm = 2 hrs, 5 + 2 = 7 hrs in total

7 hrs less 1 hr 40 for travel = 5 hrs and 20 mins.

Total = £33.65

### Commentary on the answer

This answer correctly works out time with clients and time travelling between clients using an efficient method of subtracting the time Alia was travelling to and from home from the total time she was away from home. However, the answer has not been completed to calculate how much Alia is paid.

### Question 4 (i)

Geraldine is setting up a business making hats. She needs to decide how much to sell the hats for.

* Each hat costs her £3 to make.
* She can make up to 100 hats per week.

Geraldine has done market research which suggests the following.

* She can sell 100 hats per week if she charges £15 for each hat.
* She can only sell 50 hats per week if she charges £25 for each hat.

The graph below shows the demand curve modelled as a straight line.

She uses this model and a spreadsheet to work out how to make the maximum profit.

**(i)** Fill in the rest of the numbers in column B.

**[2]**

### Sample answer for Question 4 (i)

Price (£) Hats sold Cost (£) Profit (£)

15 100 300 1200

16 95 48 1520

17 90 51 1530

18 85 54 1530

19 80 57 1520

20 75 60 1500

21 70 63 1470

22 65 66 1430

23 60 69 1380

24 55 72 1320

25 50 75 1250

### Commentary on the answer

The correct numbers have been filled in for the number of hats sold, making use of the given start and end numbers and going down in equal steps. This is all that was required for part (i).

### Question 4 (ii)

**(ii)** What formula should Geraldine type in cell C2 so that she can copy it down the column to give the cost?

**[2]**

### Sample answer for Question 4 (ii)

=B2\*3

### Commentary on the answer

This answer gives a correct formula, correctly expressed in terms of spreadsheet cell references and it remembers to include the equals sign at the start.

### Question 4 (iii)

**(iii)** What formula should Geraldine type in cell D2 so that she can copy it down the column to give the profit?

**[2]**

### Sample answer for Question 4 (iii)

(A2\*B2)-C2

### Commentary on the answer

This answer gives a correct formula, correctly expressed in terms of spreadsheet cell references, but it doesn’t include the equals sign at the start.

### Question 4 (iv)

**(iv)** Geraldine wants to sell each hat for a whole number of pounds.

What price should she sell the hats for to make the maximum profit?

**[4]**

### Sample answer for Question 4 (iv)

Price (£) Hats sold Cost (£) Profit (£)

15 100 300 1200

16 95 285 1235

17 90 270 1260

18 85 255 1275

19 80 240 1280

20 75 225 1275

21 70 210 1260

22 65 195 1235

23 60 180 1200

24 55 165 1155

25 50 150 1100

£17 or £18

### Commentary on the answer

In this answer the cost has been incorrectly calculated by multiplying the first column by the £3 cost of a hat rather than the second column, revenue has also been calculated rather than profit. Consequently, it is not possible to identify the optimum price.

### Question 5 (i)

A biology student is researching how fast a cheetah can run.

* + 1. On one website, he finds the following graph of a cheetah’s motion.

Use the graph to estimate this cheetah’s maximum speed.



**[4]**

### Sample answer for Question 5 (i)

Speed = m/s

### Commentary on the answer

This answer calculates the average, rather than the maximum, speed. The maximum speed occurs at the steepest part of the graph and so the correct solution would include estimating the gradient at this point, possibly by drawing a tangent to the curve and calculating the gradient of the line.

### Question 5 (ii)

**(ii)** The student looks at two other websites.

* One website says that the maximum speed of a cheetah is 50 metres per second.
* Another website says that the maximum speed of a cheetah is 70 miles per hour.

Work out whether these two speeds are approximately the same.

[You may use the fact that 5 miles is about the same as 8 km.]

**[4]**

### Sample answer for Question 5 (ii)

70 ÷ 5 × 8 = 112 km per hour

112 km = 112 000 m

so 112 000 metres per hr is the same as: 112 000 ÷ 60 = 1866.67 m/s

No they are not the same.

### Commentary on the answer

This answer uses a correct strategy of changing the speed in miles per hour to metres per second so that they can be compared. The correct conversion from miles per hour to km per hour has been made but then the speed in metres per minute has been found, rather than metres per second (112 000 ÷ 60 ÷ 60 = 31.1 m/s).

### Question 6 (a)

Mrs Jones is planning to fly from London to Chicago. She checks the weather forecast for the day of her flight. The probability of snow for these places is as follows.

|  |  |
| --- | --- |
| London | 60% |
| Chicago | 80% |

What is the probability that there will be snow in at least one of these two places on that day? You can assume that the weather in London and the weather in Chicago are independent of each other.

**[5]**

### Sample answer for Question 6 (a)

Imagine 100 days like the one in the question; the table shows what the weather will be like on average in Chicago and London.

|  |  |  |
| --- | --- | --- |
|  |  | Chicago |
|  |  | Snow | No snow | Total |
| London | Snow | 0.6 × 0.8 × 100 = 48 | 0.6 × 0.2 × 100 = 12 | 60 |
| No snow | 0.4 × 0.8 × 100 = 32 | 0.4 × 0.2 × 100 = 8 | 40 |
| Total | 80 | 20 | 100 |

### Commentary on the answer

This answer has used a correct method and correctly identified the combinations of weather conditions for 100 typical days like the one in the question. However, the question has not been completed to give the final answer.

### Question 6 (b)

The histogram below shows the distribution of January rainfall near Royston for 98 years. A Normal distribution has the same mean and standard deviation as the rainfall data. Part of this Normal curve is shown on the diagram.



**(i)** Use the Normal curve to write down an estimate of the mean and standard deviation of the rainfall data.

**[3]**

**(ii)** Give **two** reasons to reject the Normal distribution as a model for the rainfall data.

**[2]**

### Sample answer for Question 6 (b)

(i) The mean is about 50 mm and the standard deviation is about 140 – 50 = 90 mm.

(ii) The distribution of the rainfall data is skewed.

### Commentary on the answer

(i)The answer has correctly identified the mean as being where the Normal curve has a maximum. The answer for the standard deviation is incorrect – it has used the distance from the mean value to what appears to be the maximum value but this is not the standard deviation.

(ii)The answer gives one correct reason for rejecting the Normal distribution as a model but two reasons were asked for.

### Question 7 (a) (i)

The population of the world in 1960 was 3040 million. In 1975, it was 4090 million. Two models,
A and B, for population growth are considered.

**(i)** In model A the population grows by a constant number of people each year. Show that the average increase from 1960 to 1975 is 70 million people per year.

**[2]**

### Sample answer for Question 7 (a) (i)



### Commentary on the answer

This answer correctly works out the constant annual increase in millions. It would be even better with a conclusion saying that this shows that the annual increase is 70 million.

### Question 7 (a) (ii)

**(ii)** In model B the population grows by a constant percentage each year.

What constant annual percentage growth rate from 1960 to 1975 would result in the population increasing from 3040 million to 4090 million?

**[3]**

### Sample answer for Question 7 (a) (ii)

%

### Commentary on the answer

This answer calculates what the percentage increase would be if the 1960 population increased by 70 million; this is not what was asked for. A correct answer would find the annual percentage increase, which compounded year on year would give 4090 million people in 1975.

### Question 7 (a) (iii)

**(iii)** The population of the world in 2000 was 6090 million.

Work out which of the two models is better.

**[5]**

### Sample answer for Question 7 (a) (iii)

Using model A,25 × 70 = 1750 million extra since 1975, so 4090 + 1750 = 5840 million

Using model B, 3040 × 1.02325 = 5367.406

From these figures Model A looks closer to the actual figure of 6090.

### Commentary on the answer

This answer uses model A correctly to work out an estimate of the population in the year 2000. However, for model B the incorrect percentage increase from part (ii) is used to work out an estimate of the population 25 years after 1960. The use of the incorrect percentage would still get some follow through marks.

### Question 7 (b)

The spreadsheet chart below shows the population of the United States from 1820 to 2000.

****

The vertical axis has a logarithmic scale.

What was the approximate population of the United States in 1860?

**[3]**

### Sample answer for Question 7 (b)

****

100 000 – 10 000 = 90 000

Half of this is 45 000

So the population is 45 000 + 10 000 = 55 000

### Commentary on the answer

This answer correctly identifies the point corresponding to 1860 and realises that it is approximately halfway along the scale between 10 000 and 100 000 but it does not appreciate that the scale is logarithmic. Moreover, it does not take into account that the vertical scale is in thousands, so 55 000 (thousands) is actually 55 million.

### Question 8 (i)

The chart below is from “*Combating poverty and social exclusion: A statistical portrait of the European Union 2010*”. The horizontal axis shows percentages.



**(i)** Suggest one way that the graph could have been improved to show the information more clearly.

**[1]**

### Sample answer for Question 8 (i)

Put some more marks on the scale.

### Commentary on the answer

It is not entirely clear what this answer means – it could be referring to more horizontal marks on the vertical axis or it might mean that there should be more vertical gridlines. It would be better if it stated precisely what should be done to the graph.

### Question 8 (ii)

**(ii)** Did men responding to this survey **each** choose only one reason or more than one reason?

You must justify your answer.

**[3]**

### Sample answer for Question 8 (ii)

It is possible for someone to give two reasons such as, looking after someone and they don’t want to work anymore, or illness and don’t want to work anymore. So some men may have responded with more than one reason.

### Commentary on the answer

This answer recognises that people may have more than one reason for not working more than 30 hours a week but it does not take into account whether the survey allowed them to give more than one reason so it does not answer the question. The data are given as percentages. If each person gave exactly one answer, the total for all bars should be 100%. If some people gave no answer, the total would be less than 100% but if some people gave more than one answer the total would be more than 100%.

### Question 8 (iii) (*A*)

**(iii)** There are four times as many women as men working less than 30 hours per week in the European Union.

**(*A*)** Show that approximately 5% of people surveyed (men and women combined) give the reason ‘undergoing education or training’.

**[2]**

### Sample answer for Question 8 (iii) (*A*)

The men’s 10% is  of the total percentage so 2% of the total.

The women’s 5% is  of the total percentage so 4% of the total.

Together this makes 6% of the total percentage.

### Commentary on the answer

The working and explanation in this answer is correct; it has read from the graph slightly differently to the answer in the mark scheme but it is a reasonable value given the accuracy of the graph scale. However, the answer should have been completed by saying that this is about 5% because that is what the question asked candidates to show.

### Question 8 (iii) (*B*)

**(*B*)** Find the corresponding percentage giving the reason ‘housework, looking after children or other persons’.

**[2]**

### Sample answer for Question 8 (iii) (*B*)

Women 36%, men 5%, so average is about 20%.

### Commentary on the answer

This answer correctly reads the two values from the graphs but makes no attempt to take account of the different numbers of men and women in the population.

### Question 9

A typical ant is about 5 mm long and weighs about 3 mg.

An actor is about 2 m tall and weighs about 80 kg.

A science fiction film script includes shrinking an actor to 5 mm tall.

As the actor shrinks, his weight is always directly proportional to his volume.

Compare the weight of the shrunken actor to the weight of the ant.

**[5]**

### Sample answer for Question 9

2 m = 2000 mm

2000 ÷ 5 = 400

The man is 400 times as tall as the ant; his height is divided by 400 and so is his weight.

80 ÷ 400 = 0.2

The shrunk man will weigh 0.2 kg = 200 g.

200 ÷ 3 ≈ 67

The man will weigh about 67 times as much as the ant. The actor is less than half the weight of the ant.

### Commentary on the answer

This answer correctly works out the scale factor for length between ant and man but does not use the information in the question that the weight will be directly proportional to the volume (and not the length). Consequently, the calculated weight of the shrunk man is wrong. At the end of the question when comparing weights, a weight in grams is compared to a weight in milligrams without putting them both into the same units.

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