# Candidate Style Answers

# Critical Maths

# High 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 page and accessed via the following link: [<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/)

### Question 1

It is possible to drive from London to Leeds on the motorway all the way.

The distance is approximately 200 miles.

How long will it take?

Show your reasoning.

**[3]**

### Sample answer for Question 1

200 miles to drive.

Cars can drive at 70 miles per hour on the motorway.

200 ÷ 70 = 2.857

Sometimes the car might drive slower than 70mph like if it was in a traffic jam so I can round this up.

The journey will take about 3 hours.

### Commentary on the answer

This answer has been worked out correctly by dividing distance by time. The answer has been rounded appropriately with an explanation.

### Question 2

Dan wants to go on a holiday which costs £5000.

He will pay with his credit card which charges an annual interest rate (APR) of 16%.

Dan wants to pay back the money over two years.

He estimates that his monthly repayments will be £208 to the nearest pound.

**(i)** What calculation did Dan do to get £208?

**[1]**

**(ii)** Decide whether Dan’s estimate is too high, too low or about right. Give a reason for your

answer.

**[2]**

### Sample answer for Question 2

(i) 5000 ÷ 24

(ii) Dan’s estimate is too low. He didn’t take the interest rate into account and that will mean he has to pay back more than £5000.

### Commentary on the answer

Both answers are correct here, with correct working shown in (i) and a correct explanation in (ii).

### Question 3

Usain Bolt won the 100 m and the 200 m gold medals at the London 2012 Olympics.

His time for the 100 m was 9.63 seconds.

His time for the 200 m was 19.32 seconds.

Without using your calculator, decide in which race he had the greater average speed.

Justify your answer.

**[3]**

### Sample answer for Question 3

100 m in 9.63 seconds means 200 m in 9.63 × 2 = 19.26 seconds.

Bolt did the 200 m in 19.32 seconds which is more so he was running faster in the 100m.

### Commentary on the answer

This answer has correctly doubled up the time for the 100 m and compared it to the 200 m time then come to a correct conclusion regarding which race was run at the faster speed.

### Question 4

*“The new mathematics GCSE will be more demanding and we anticipate that*

*schools will want to increase the time spent teaching mathematics. On*

*average secondary schools in England spend only 116 hours per year*

*teaching mathematics, which international studies show is far less time than*

*that spent on this vital subject by our competitors. Just one extra lesson each*

*week would put England closer to countries like Australia or Singapore who*

*teach 143 and 138 hours a year of mathematics respectively.”*

Michael Gove 1 Nov 2013

Estimate the number of extra mathematics teachers needed to increase average mathematics teaching time for years 7 to 11 in England from 116 hours per year up to the kind of time taken in Australia or Singapore.

You can use the following assumptions.

**•** There are about 500 000 school students in each year group in England.

**•** A typical secondary school mathematics teacher teaches between 20 and 25 hours a week.

**•** Students are at school for 190 days a year.

Any additional assumptions you make must be clear.

**[7]**

### Sample answer for Question 4

Assumptions

* a teacher teaches 20 hours a week
* class size = 25
* target hours = 140 per year for each class

5 years and 500 000 school students in each year

so total number of school students = 500 000 × 5 = 2 500 000

Number of classes = 2 500 000 ÷ 25 = 100 000 classes

Each class get 116 hours a year

Now 100 000 × 116 = 11 600 000 hours a year

Target 100 000 × 140 = 14 000 000 hours a year

Extra hours = 14 000 000 – 11 600 000 = 2 400 000 hours a year

190 days = 38 weeks

Teacher teaches 20 × 38 = 760 hours a year

Extra number of teachers = 2 400 000 ÷ 760 = 3158

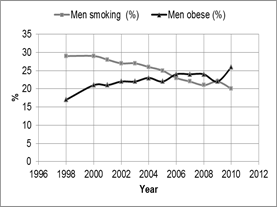
So about 3000 extra teachers needed.

### Commentary on the answer

This answer starts off with correct and clearly stated assumptions of a teacher teaching 20 hours a week, class size being 25 and the target hours being 140 per year for each mathematics class. The answer has been worked logically, first finding how many classes there are in total, then looking at how many hours per year would be needed if a class has 140 hours a year compared to 116 hours per year. The difference is worked out to suggest an extra 2 400 000 hours a year are needed. The number of teachers this would require is then calculated if each teacher teaches for 20 hours a week. The final answer is rounded appropriately to the nearest thousand since this is a rough estimate.

### Question 5

The graphs below show data for smoking and obesity for men in England.



Data: Copyright © 2013, Re-used with the permission of the Health and Social Care Information Centre. All rights reserved.

Do these graphs show that giving up smoking causes obesity? Justify your answer by making three comments about the data.

**[3]**

### Sample answer for Question 5

It looks like there is negative correlation – as obesity goes up then smoking seems to go down. However, there isn’t any evidence that giving up smoking caused obesity as there might be another factor like people who stop smoking sometimes give up because they have bad health and this also means they don’t exercise much. This is only about men so you can’t say anything about women.

### Commentary on the answer

This answer correctly identifies that there is negative correlation between obesity and smoking. It considers an alternative explanation for causation and also comments on the data only being for men.

### Question 6

Two statements from different news websites about the same story are given below.

*70% of parents were fined for taking their children out of school for a holiday in*

*term time.*

*The number of parents fined for taking their children out of school for a holiday*

*in term time rose by 70% from the previous year.*

Explain what each of these statements means and decide whether they mean the same thing.

**[5]**

### Sample answer for Question 6

1 = 70% of all parents who take their children for a holiday in term time were fined.

2 = Say last year 100 parents got fined, this year 170 parents got fined.

They are not the same thing because the first statement says most parents got fined but the second one we don’t know the percentage that got fined only the number - it might only be a small percentage.

Total = £33.65

### Commentary on the answer

In this answer, the two statements are explained correctly. A comparison has been made between the two statements and they have shown that they are not the same.

### Question 7

The male to female sex ratio at birth is the number of males that are born for every female born. The table below shows the countries with the two highest male to female sex ratios at birth in 2013.

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Male to female sex ratio at birth** | **Population (thousands)** | **Births per 1000**  **of population** |
| Liechtenstein | 1.26 | 37 | 10.67 |
| Azerbaijan | 1.13 | 9590 | 17.17 |

Data: CIA World Factbook

**(i)** Use the information in the table to show that the total number of births in 2013 in Liechtenstein can be estimated as 395. Show that approximately 175 are girls and approximately 220 are boys.

**[4]**

A researcher is investigating whether the number of boys born in some countries is distinctly different from the number of girls.

Her initial model is that the long-term probability of a new baby being a boy is 0.5.

**(ii)**

1. For Liechtenstein investigate whether the figures of 175 girls and 220 boys provide strong evidence that the initial model is incorrect.

Explain your reasoning and show your working clearly.

**[7]**

1. In 2013 in Azerbaijan 77 305 girls and 87 355 boys were born. Do these figures provide strong evidence that the initial model is incorrect?

**[4]**

### Sample answer for Question 7

(i) 37 × 10.67 = 394.79 which is about 395

The ratio means for every 1 girl there are 1.26 boys.

1 + 1.26 = 2.26

395 ÷ 2.26 = 174.77 which is about 175

So there are about 175 girls and 175 × 1.26 = 220 boys

(ii) *A*. 395 ÷ 2 = 197.5 girls and 197.5 boys

Standard deviation = .

197.5 + 3 × 9.94 = 227.32

197.5 – 3 × 9.94 = 167.68

So 220 and 175 are within 3 sd of the mean so the data can be considered not that unusual.

*B*. 77 305 girls and 87 355 boys

mean = (77 305 + 87 355) ÷ 2 = 164 660 ÷ 2 = 82 330

standard deviation =  202.9

For boys the number of sd from the mean 

This is much more than 3 sd so there is strong evidence to suggest the probability

is not 0.5.

### Commentary on the answer

1. This first calculation of 37 × 10.67 is correct. The second calculation correctly works out the total numbers of males and females using the ratio of 1.26 and 395 births.
2. (*A*) This calculation correctly works out that if the probability is 0.5 then the expected number of boys and girls is 197.5. The answer has also correctly used the standard deviation to identify whether the numbers of boys and girls given are outliers.

(*B*) In this part the mean is worked out correctly. As with part *(A)*, the working for standard deviation is correct and the last statement addresses the idea of strong evidence by finding how many standard deviations from the mean the number of boys is. (It would have been just as good to consider how many sd from the mean the number of girls is.)

### Question 8

A sign in a pay and display car park has the following information about charges for parking.

**Car park charges**

**Monday to Friday 9am to 5pm**

£3 for up to 8 hours

**Other times**

Free

**£40 daily fine for parking without**

**displaying a valid parking ticket**

Drivers who pay get a ticket to display in their cars. A warden checks the cars from time to time. If the warden finds any cars which are not displaying a ticket, their drivers are fined £40 for that day.

The warden is paid to check the cars so the more often they are checked, the more it will cost the car park owner.

Many drivers use the car park every day from 9 am till 5 pm. Assume that some drivers always pay to park and some drivers never pay to park. Assume that all drivers who get a fine will pay it.

How often, on average, should the warden visit the car park to ensure that drivers who always pay end up better off than drivers who never pay?

**[3]**

### Sample answer for Question 8

40 ÷ 3 = 13.333

So it takes 14 days at £3 a day for it to cost more than the fine of £40.

The warden should check at least every 13 days.

### Commentary on the answer

This answer correctly identifies the need to see how many times 3 goes into 40 and then answers the question that was asked.

### Question 9

Athletes are tested to see if they have used performance enhancing drugs. Drug tests are not completely accurate. One drug test will show a positive result for 95% of people who have taken performance enhancing drugs and a negative result for 90% of those who have not.

Assume that 5% of athletes use performance enhancing drugs.

**(i)** What proportion of those who test positive in this test have actually used performance enhancing drugs?

**[6]**

**(ii)** What percentage of those who are tested will test positive for use of performance enhancing drugs?

**[2]**

### Sample answer for Question 9

475

positive

95%

Use drugs

5%

500

25

negative

5%

950

positive

10 000

10%

Don’t use drugs

95%

negative

8550

9500

90%

1. 
2. Percentage 

### Commentary on the answer

The tree diagram is set up correctly. The representative frequency at the start and on both sets of branches is also correctly done. The first answer correctly finds 475 as a proportion of the people who had positive results (475 + 950 = 1425).

The answer in part (ii) correctly works out a percentage; taking the positive results from those athletes who use drugs and adding on those who don’t (475 + 950 = 1425) and then dividing by the total of 10 000.

### Question 10

There are five competitors in a dancing competition.

Each dancer is judged by six judges who each give a score out of 20.

Design a method to decide which dancers should take first, second and third places.

Give your method as a set of rules that can be used for other similar competitions.

Explain why your design is fair.

The scores for the dancers in one such competition are shown below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Dancer** | **Judge 1** | **Judge 2** | **Judge 3** | **Judge 4** | **Judge 5** | **Judge 6** |
| Aretha | 19 | 19 | 15 | 20 | 20 | 14 |
| Esther | 12 | 7 | 4 | 4 | 7 | 8 |
| Mo | 10 | 8 | 11 | 5 | 5 | 2 |
| Vince | 16 | 19 | 20 | 19 | 17 | 16 |
| Yuri | 15 | 6 | 12 | 15 | 6 | 9 |

Use your method to work out which dancers come first, second and third.

**[10]**

### Sample answer for Question 10

Total points for each dancer was Aretha 107, Esther 42, Mo 41, Vince 107, Yuri 63.

However, some judges might have been more generous than others so you have to look at the rankings to make it fair.

Judge 1 order: Aretha, Vince, Yuri, Esther, Mo

Judge 2 order: Aretha+Vince, Mo, Esther, Yuri

Judge 3 order: Vince, Aretha, Yuri, Mo, Esther

Judge 4 order: Aretha, Vince, Yuri, Mo, Esther

Judge 5 order: Aretha, Vince, Esther, Yuri, Mo

Judge 6 order: Vince, Aretha, Yuri, Esther, Mo

Give 1 point for first, 2 for second, 3 for 3rd, 4 for 4th and 5 for 5th and split the points if there is a tie. Aretha and Vince tied for first for Judge 2 so they get 1.5 points each for that judge.

Aretha = 1 + 1.5 + 2 + 1 + 1 + 2 = 8.5

Vince = 2 + 1.5 + 1 + 2 + 2 + 1 = 9.5

Yuri = 3 + 5 + 3 + 3 + 4 + 3 = 21

Mo = 5 + 3 + 4 + 4 + 5 + 5 = 26

Esther = 4 + 4 + 5 +5 + 3 + 4 = 25

The person that gets the fewest points wins. If two people get the same number of points, the one with more first places is better. If they have the same number of first places then the one with more second places is better. If they have the same number of first and second places, then look at third places and so on. If they have the same number of all places (i.e. an identical set of rankings) then if there is time they should compete against each other. If not, a coin should be tossed to decide.

First is Aretha, Second is Vince and third is Yuri.

### Commentary on the answer

This answer comes to a conclusion based on evidence. It is detailed and includes a description of the method. There is an explanation of why simple totalling of the marks is not valid. There is also a clear explanation of what to do in the case of a tie for an individual judge and if there is a tie overall. All the information has been used in an appropriate way.

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