Qualification Accredited

OCR
Oxford Cambridge and RSA

LEVEL 3 CERTIFICATE

Examiners' report

CORE MATHS B (MEI)

H869

For first teaching in 2016

H869/01 Summer 2022 series

Version 1

ocr.org.uk/maths

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 1 series overview

The great majority of candidates were able to attempt all the questions, so had the opportunity to show what they could achieve.

The mean mark for this paper is statistically significantly lower than 2019's paper but not statistically significantly different from 2018's paper. By their very nature it is almost impossible to objectively compare the difficulty of these heavily contextualised questions year on year.

The mean omission rate this session is slightly higher than the 2019 session and higher than the session before that (5.7% this session compared with 4.5% and 2.7% respectively). Question 7(b)(ii) had the highest omission rate and was not attempted by just over 1 in 5 of all candidates.

Well over three quarters of candidates scored more than half of the available credit whilst about 1 in 25 gained less than a quarter of the marks available. There was no evidence of a significant number of candidates inappropriately entered or insufficiently prepared for the examination. There was no firm evidence that a significant proportion of candidates were denied credit by virtue of any literacy demands. As far as it is possible to judge, candidates made effective use of the pre-release materials.

Overall, the least successful candidates found the questions' order of difficulty, easiest first, (judged on facility) to be 1, 6, 3, 5, 2, 7 and 4. For the most successful the corresponding order was 6, 1, 3, 2, 5, 7 and 4 – but only marginal differences.

The least successful candidates found these pieces of content the most challenging:

- setting up an algebraic expression (Question 4(a)(i) and (ii)),
- following through a calculation involving different metric units (Question 4(d) and (e)),
- showing whether a relationship is proportional (Question 7(b)(ii)),
- and determining the location interval of the median for data arranged in a grouped frequency table (Question 2(b)(ii)).

This group of candidates showed competency when dealing with:

- calculating the cost of a finance-related decision in a context (Questions 1(a)(i), 1(a)(iv)),
- drawing and interpreting a line of best fit (Questions 3(a)(ii) and (iii)),
- interpreting various statistical diagrams (Questions 3(a)(i), 2(a)(i), and 6(a)(i)).

The most successful candidates found these pieces of content the most challenging:

- setting up an algebraic expression (Question 4(a)(i) and (ii)),
- interpreting numbers given in standard spreadsheet format (Question 7(b)(i) and (ii)),
- using/interpreting proportionality in a real-world situation (Question 7(b)(ii))
- and interpreting acceleration, including units from a velocity-time graph (Question 5(b)(iii)).

Competency was particularly evident when:

- carrying out financial related calculations (Question 1(a)(i) and 1(a)(iv)),
- performing foreign exchange calculations (Question 6(b)(i) and (ii)),
- and interpreting time series involving exchange rates (Question 6(a)(i)).

Overall, there are several questions where some marks could have been lost by incorrect or premature rounding. The rubric on the first page does state "Give your final answers to a degree of accuracy that is appropriate to the context". Notably, there is an expectation that money (£s) be given correct to two decimal places.

Another area which can result in or cause unnecessary credit loss is units. This was particularly noticeable in Question 1. Writing units can sometimes give candidates a brief period to ponder on their responses. In the same vein, whilst fully appreciating it is not possible that candidates' life experiences can embrace all the scenarios, a critical attitude to the magnitudes of quantities can help. Examples where wrong answers could have been picked up with a little thought include:

- Probabilities greater than 1 are impossible (Question 7(c)); 10^5 was seen on occasion.
- Times to cover the measured mile at about 300 mph are about 11 to 12 seconds, so calculated times of 3 600 000 seconds, from 3600 × 1000, to cover a mile at 1000 mph must be incorrect (Question 5(c)).
- Buying and selling back currency over a short period of time, unless there are very serious events taking place or you are a bank, cannot result in a profit (Question 6(b)(ii)).
- Given scale drawings are accurate, answers generated from them should be consistent. For example, in Question 5(d) just looking at the scale drawing should query an answer of 40 km for the track length.
- A megaton is a large unit of energy (joules) – therefore an energy in joules converted into megatons must result in a smaller number (Question 7(a)). A similar argument holds when converting between currencies.

Ideally candidates should get into the habit of always quickly looking at their answers with healthy scepticism.

The other, all too obvious, strategy is to re-read question and answer, both as a pair and individually. This should make sure that the question has in fact been answered and that the working towards it is clear and unambiguous (Question 1(b) and Question 7(b)(ii)). This is particularly important in questions of the type "Which is the better deal?" when candidates work through faultlessly but simply forget to state the better deal.

One observation, possibly subjective and a result of the situation over the last two years, are instances of less well-written numbers and working generally. This appeared to have increased on previous years.

Candidates who did well on this paper generally did the following:	**Candidates who did less well on this paper generally did the following:**
• showed clarity in their working • made sure to consider units • appeared to reflect on the question. E.g. Question 1(b) – did not rush in and change from annual to monthly payments without reason E.g. Question 2(c) – realised that the totals in the spreadsheet table can be used to estimate the mean. • recognised numbers in spreadsheet formats and equivalent.	• did not review answers critically to check units and "reasonableness" of the numbers. • gave insufficient consideration as to how their workings read and their clarity • may not have read the questions at least twice (as this tends to encourage omitting the vital decision statement or "X is the better deal" based on their previous calculations).

Question 1(a) (i)

1 Mia wants to buy an electric bike to get to work. She currently travels to work by bus.

- Electric bikes travel 80 miles on a single electric charge.
- A single electric charge costs about £0.30.
- It is a **total** distance of 10 miles to cycle to work from home and back.
- It costs £5.50 a day by bus.
- She works for 20 days each month.

(a) (i) Calculate how much Mia spends a month to get to work by bus. **[2]**

A very well answered question; almost all candidates achieved full credit, regardless of attainment level. It was one of the best answered questions on the paper. The main error was to omit the correct money units.

Question 1(a) (ii)

(ii) Mia reads that the cost to charge an electric bike is just over 1p per mile.
Use the above information to determine if this is true. **[2]**

A significant minority of candidates found using the correct units a challenge and omission of units was not uncommon. A minority achieved full credit, with a very small minority scoring no marks.

Question 1 (a) (iii)

(iii) How much could Mia save a month by using an electric bike to get to and from work?
For the electric bike, only consider the cost of electricity to charge it. **[2]**

Most candidates were successful with few not gaining any credit.

Question 1 (a) (iv)

(iv) The batteries for electric bikes are expensive.
Their lifetime is about 1000 charges from empty.

Mia plans to use her bike for work and visiting friends.
This is a total of 350 miles a month.

Determine whether the bike's battery is likely to last more than 4 years. **[3]**

Several different valid approaches were employed - comparing number of charges or number of miles possible. Most gained full credit. Several candidates did not give a conclusion.

Question 1 (b)

(b) In addition to paying for electricity, Mia will need to pay for a crash helmet, insurance and bike maintenance as well as paying for the bike itself.

The prices of bikes available in her local shop are shown in **Fig. 1.1**.

The shop is offering deposit-free loans. **Fig. 1.2** shows the monthly repayments.

Cost of bike

Bike	**Cost**
Electric Blue	£800
Electric Rider	£1000
Electric Comet	£1200

Fig. 1.1

Monthly loan repayments

	Loan period		
Loan	12 months	24 months	36 months
£600	£54.85	£29.79	£21.52
£800	£73.13	£39.72	£28.70
£1000	£91.41	£49.65	£35.87
£1200	£109.69	£59.58	£43.04
£1500	£137.12	£74.48	£53.81

Fig. 1.2

Crash helmet, insurance, and bike maintenance cost in total about £20 a month.
Mia needs to take out a loan.

- She wants her total monthly cost to be less than she is currently paying for bus fares, taking account of the crash helmet, insurance, bike maintenance, battery recharging and loan repayment.
- She also wants to pay off the loan in a year.

Determine which bike(s) Mia can afford. **[4]**

Less than half the candidates gained half the available marks with a very small minority not gaining any. A significant number of candidates did not take into account the cost of charging the bike's battery. In addition, a number confused stated cost with the actual cost (including interest), and made the error of assuming that £800 was to be paid back rather than £877.56 (12 × £73.13). A small proportion worked with both annual costs and monthly costs and confused the two. Some could have improved their performance by imposing a logical structure to their working, perhaps employing sub-headings to support this.

Long questions involving elements of choice

Responses to information-rich questions like this benefit from the use of bullet points or even tables – nothing too elaborate but sufficient to clarify thinking and support situations where there may be partial credit available.

Exemplar 1

1(b)	52.5 charges a year (friends + work) =
	52.5 × £0.30 = £15.75 per year
	15.75 ÷ 12 = £1.31 a month.
	helmet etc. + electricity = £21.31 per month.
	£800 loan over 12 months = 73.13 × 12 =
	£877.56.
	877.56 ÷ 12 = £73.13 per month + £21.31 = £94.44
	£1000 loan over 12 months = 91.41 + 21.31 = £112.72
	too much - more than bus fare.
	If she wants to pay loan off in 1 year:
	In order to pay for electricity, helmet, insurance,
	electricity and maintenance, she must buy the
	Electric Blue bike for £800 as the loan repayment
	~~tot~~ per month will be less than her bus fare
	(bus = £110, bike = £94.44).

A full and clear response. Note how the candidate successfully switched to monthly costings.

Question 2 (a) (i)

2 **(a)** Wave heights can be recorded using signals from floating buoys, like the one shown in **Fig. 2.1**.

Fig. 2.1

The grouped frequency charts in **Fig. 2.2** and **Fig. 2.3** show the wave heights of 400 waves under typical conditions in the North Atlantic and the Gulf of Mexico.

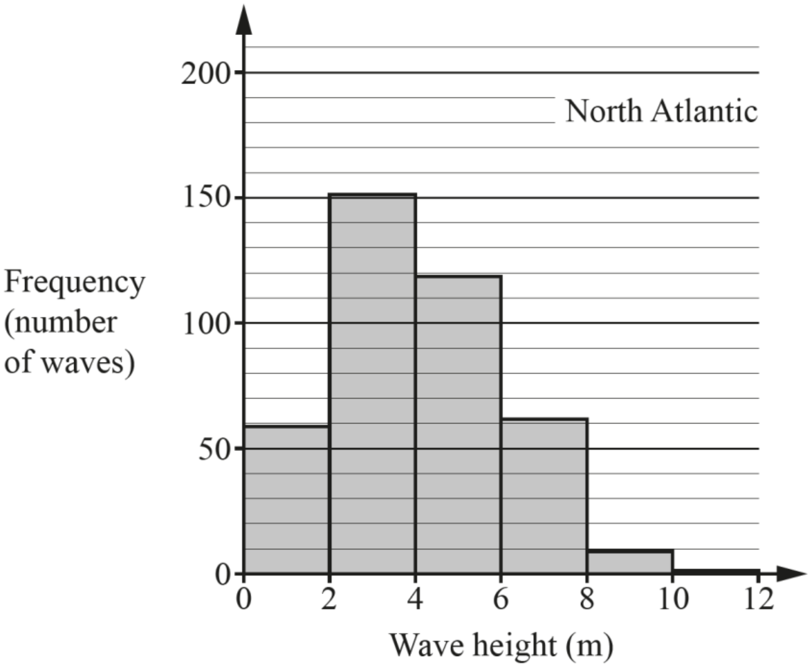

Fig. 2.2

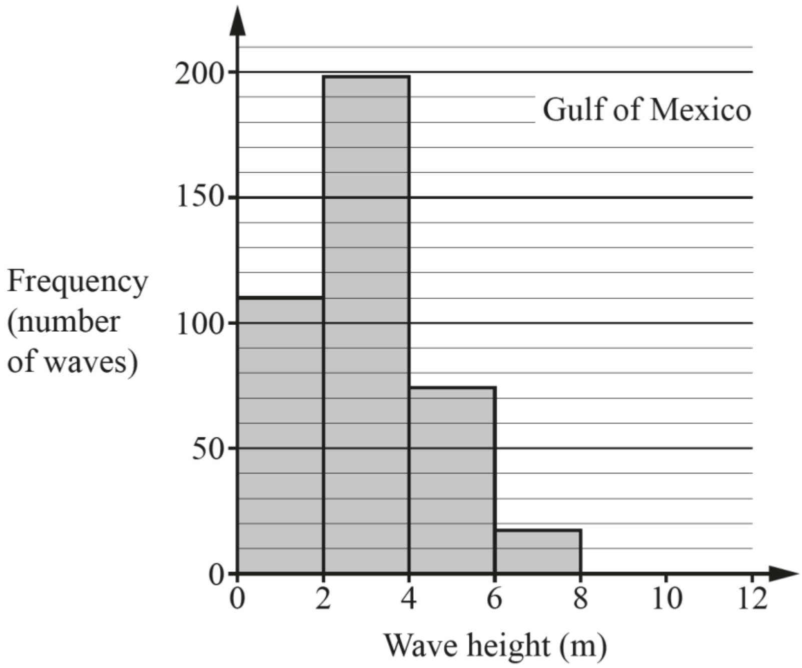

Fig. 2.3

(i) How many of the waves in the Gulf of Mexico sample were less than 2 m? **[1]**

A moderately easy first part to this question with success achieved by nearly all candidates. There was little difference between higher and lower attaining candidates. A common incorrect response was "59 waves". There were almost no instances of reading from the wrong chart.

Question 2 (a) (ii)

(ii) Write down **one** difference and **one** similarity in the distributions of wave heights in the North Atlantic and the Gulf of Mexico. **[2]**

Candidates tended to be more successful in stating similarities rather than differences; "having the same modal range" was a popular response here. Only a small minority did not gain full credit. About 4 out of 5 of the lower attaining candidates were successful.

Describing differences, similarities or overall trends

Responses to questions about differences, similarities or overall trends usually require details of the big picture or a general pattern – identifying specific points in a chart or table will not be sufficient.

Question 2 (b) (i)

(b) Wave heights are important to shipping but also to structures such as oil rigs which, unlike ships, are unable to move away from storms.

The spreadsheet in **Fig. 2.4** shows the grouped wave heights, w metres, during a particular storm in the Gulf of Mexico. The storm lasted about an hour.

	A	B	C	D	E	F
1		Interval		Mid-interval	Frequency	Mid-interval × frequency
2	0	$\leq w <$	4	2	55	110
3	4	$\leq w <$	8	6	97	582
4	8	$\leq w <$	12	10	90	900
5	12	$\leq w <$	16	14	43	602
6	16	$\leq w <$	20	18	11	198
7	20	$\leq w <$	24	22	4	88
8	24	$\leq w <$	28	26	0	0
9				Total	300	2480
10						

Fig. 2.4

(i) Find the modal interval for the wave heights. **[1]**

This was found challenging by the lower attaining candidates where only about 1 in 4 were successful. A very common error was to give "6", the mid-range of the modal interval. A very large majority of the higher attaining candidates were successful. As far as it was possible to ascertain, very few, if any, candidates used the two frequency charts rather than the tabulated data.

Question 2 (b) (ii)

(ii) Show that the median lies in the modal interval. **[1]**

This was a challenging question, particularly for lower attaining candidates. Overall, full credit was only achieved by a minority. A common error was simply to list the numbers 2, 6, 10, 14, 18, 22, 26 and select the middle number. Most appreciated the role of the 150th data point but many did not progress further in their explanation.

Question 2 (b) (iii)

(iii) Write down the formula in F2 which was copied from F2 to F8. **[1]**

Most were successful here and about one third of lower attaining candidates gained full credit. This rose to about three quarters for the higher attaining candidates. The most common errors were omitting "=" or not using the asterisk symbol for multiplication.

Using spreadsheets

It is expected that candidates will have had some practical experience of spreadsheets and understand simple formulae. Practical spreadsheet activities using the large data set Excel file from H869/02 is an effective way to check that candidates can write simple formulae.

Question 2 (c)

(c) Oil rigs need to withstand the exceptionally high waves which can very occasionally occur. Suitable modelling suggests that, at any time, the height of about 1 wave in 260 000 is at least 4 times the mean wave height in a storm.

How high is such a wave in the Gulf of Mexico? **[3]**

The majority gained at least partial credit or better. Some candidates did not make use of the relevant totals displayed in the spreadsheet to calculate an estimate of the mean wave height. These attempts from first principles were rarely successful. Partial credit was available for a calculated estimate of the mean, regardless of its correctness, if it was correctly used in the formula to calculate the height of an exceptional wave.

Question 3 (a) (i)

3 **This question refers to article A in the pre-release material, 'Leaves as thermometers'. You can find the article on the Insert accompanying this paper.**

(a) The scatter diagram in **Fig. 3.1** shows 21 observations of the percentage of species of plants with smooth-edged leaves and the mean annual temperature in various regions around the world.

(i) Coca is a region in Ecuador. The mean annual temperature there is 27 °C and 76% of plant species have smooth-edged leaves.

Plot this point with a cross on the scatter diagram in **Fig. 3.1**. **[1]**

A very well answered part, only a very small minority were unsuccessful.

Question 3 (a) (ii)

(ii) Draw a line of best fit by eye on the scatter diagram. **[1]**

3(a)(i)

3(a)(ii)

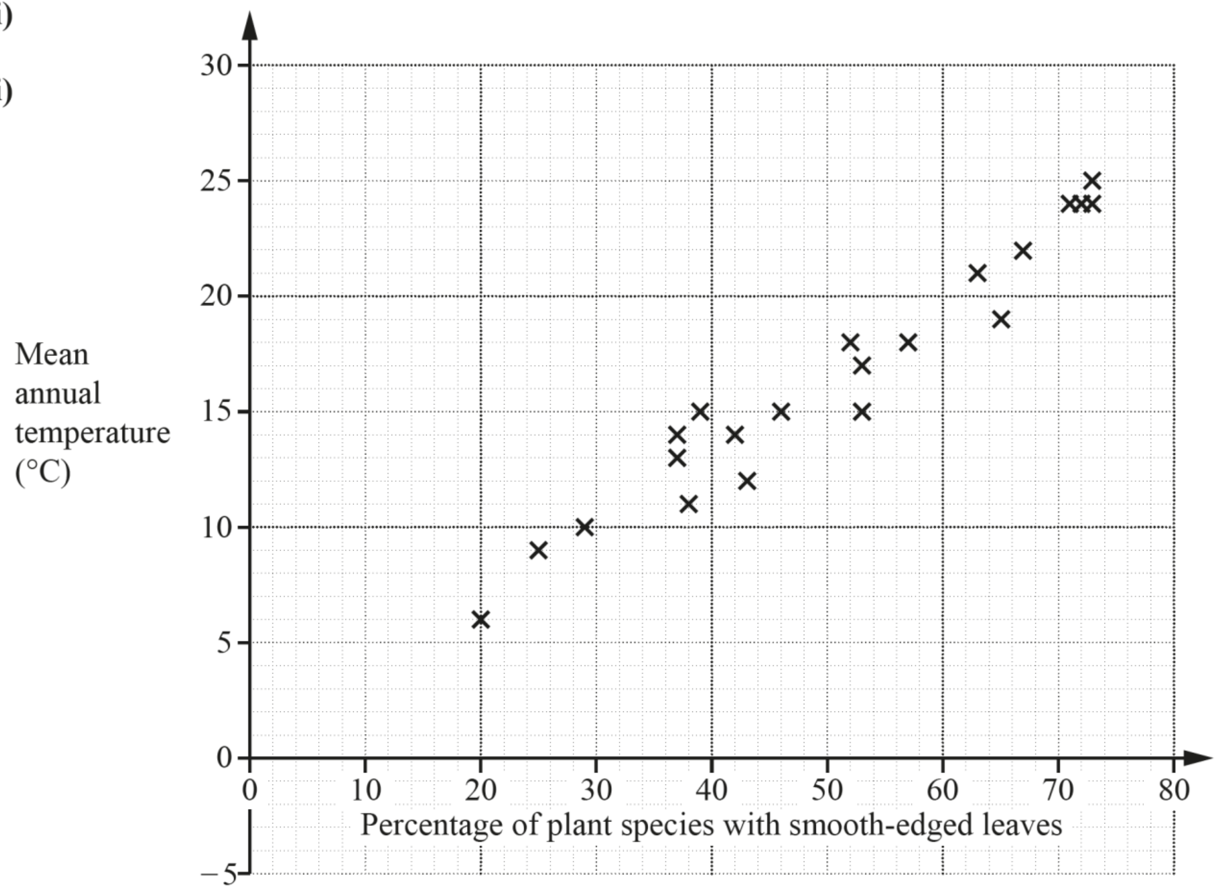

Fig. 3.1

Most successfully drew a line of best fit within tolerance and with a ruler. The prime source of credit loss was not using a ruler.

Question 3 (a) (iii)

(iii) The straight line model represented by your line of best fit can be used to estimate annual mean temperatures millions of years ago, provided fossilised leaves from that time are available.

In Wyoming, USA, there are large deposits of fossilised leaves. These can be dated using animal bone fossils.

In one site, 55.9 million years old, half of the plants had smooth-edged leaves.

The present mean annual temperature in Wyoming is 7.6 °C.

Compare this with the temperature 55.9 million years ago. **[3]**

Most candidates gained full credit, set against a very small minority who did not gain any marks. Most errors arose from considering solely the leaves with no reference to the temperature. Using the straight line presented no problems for the great majority. Almost no candidates guessed, based on global warming, that today's temperature would be greater than that millions of years ago.

Question 3 (b)

(b) Fossil dating always has some uncertainty.
It is established that dinosaurs became extinct 65.95 ± 0.04 million years ago.

A dinosaur bone has been dated as 65.3 ± 0.9 million years old.

Is this figure consistent with the extinction date for dinosaurs? **[3]**

All but a few candidates were successful in finding the error bands of at least one of the dates. However, using the error bands was found challenging and only around 2 in 5 were able to correctly say that the figures were consistent. Only a small minority used a number line to support their answer.

Question 4 (a) (i)

4 This question refers to article B in the pre-release material, 'Centre pivot irrigation'. You can find the article on the Insert accompanying this paper.

(a) Centre pivot irrigation is used in square fields. A basic system can only irrigate the circular region shown in **Fig. 4.1** (which is part of **Fig. B.3** in the pre-release material).

Fig. 4.1

A circle of radius r metres is surrounded by a square of side $2r$ metres.

(i) Find the total area of the four regions that are inside the square but outside the circle. (This is the area not irrigated.) **[1]**

Candidates were very reluctant to employ algebra in either part (i) or part (ii). In fact, most candidates did not gain credit in part (i) and almost no candidates were successful in part (ii). A common error by those attempting to use algebra was to assume "$2r \times 2r = 2r^2$" or "$(2r)^2 = 2r^2$", instead of $4r^2$.

Question 4 (a) (ii)

(ii) Show that this area is $(100 - 25\pi)\%$ of the area of the square. **[2]**

Very few candidates were successful. Partial credit was available to those who worked consistently with a specifically sized square and corresponding circle, following this through from their result in part (a)(i).

Exemplar 2

4(a)(i)

1 km radius

~~$\pi r^2 = \pi 1^2 = 9.869604401$ km~~

2r metres, 2000 metres, 1 side

$2000 \times 2000 = 4{,}000{,}000\ m^2$

$\pi (1000^2) = 3{,}141{,}592.654\ m^2$

$4000000 - 3141592.654 = 858407.3464\ m^2$

4(a)(ii)

$(100 - 25\pi)\% = 21.46\%$

$\dfrac{858407.3464}{4000000} = 0.2146\ldots$

$\times 100$

$= 21.46\%$ (2.d.p)

The candidate did not use algebra, so gained no credit for Question 4(a)(i). However, their calculated figure did follow through to the percentage calculated using the formula in Question 4(a)(ii). This resulted in a single mark being given for part (a)(ii).

Question 4 (b)

(b) The radius of the irrigated circle in a centre pivot irrigation system is 400 m.

Calculate the area which is irrigated.
Give your answer in m^2 correct to **2** sf. **[3]**

A large majority of candidates were successful in calculating the irrigated area. Most problems arose in rounding these areas correct to 2 sf. A very common wrong response was "502 000" – the result of not understanding that a trapped zero is a significant figure. Only a minority gained full credit for this part. A very small minority mistakenly used the formula for the circumference of a circle.

Question 4 (c)

(c) 1 mm of rain falls evenly onto 1 m^2 of ground (see **Fig. 4.2**).

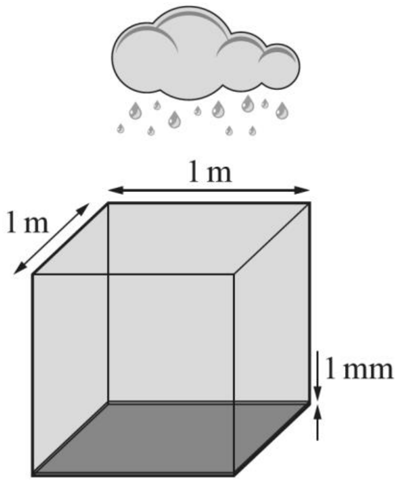

Fig. 4.2

Show that this is 1 litre of water (1 litre = 1000 cm^3). **[1]**

Just under half the candidates were successful. This ranged from about a quarter of lower attaining candidates to just over three quarters of higher attaining candidates. It was clear that a significant minority were not secure converting between the various metric measures of both length and volume. There were a few muddled calculations which in the final step were divided by a number such that the result was 1000, but with no obvious rationale.

Question 4 (d)

(d) 1 mm of rainfall falls uniformly over a circle of radius 400 m.

Calculate the volume of water involved. Give your answer in m^3, using the results from parts **(b)** and **(c)** ($1\ m^3 = 1000$ litres). **[2]**

Most candidates did not gain credit. Almost 1 in 5 candidates did not attempt to answer the question. This was despite the instruction to use the results from parts(b) and (c). A lack of understanding of units was shown in a significant minority of cases. Some of these could perhaps have been reduced had candidates put the relevant units after each calculation thereby guiding them to focus on what the results meant in terms of the problem asked.

Question 4 (e)

Centre pivot irrigation allows farming in deserts, providing water wells can be drilled. The tables in **Fig. 4.3** show how many millimetres of water are needed each day in the desert conditions, during peak growth for some popular crops.

Crop	Water needed (mm per day)
Bananas	12
Beans	11
Eggplant	11
Grapes	7
Melon	10

Crop	Water needed (mm per day)
Nuts	10
Peppers	10
Potatoes	11
Squash	9
Tomatoes	11

Fig. 4.3

(e) How many m^3 of water would be needed per day to grow potatoes during peak growth on a single 400 m radius irrigated circle? **[2]**

Most candidates gained no marks for this part and only about a quarter gained full marks. Partial credit was available but it was sometimes impossible to give due to the unordered presentation of working. A small minority divided by 11 instead of multiplying by 11, indicative of misunderstanding the situation.

Question 5 (a) (i)

5 This question refers to article C in the pre-release material, 'Land speed record'. You can find the article on the Insert accompanying this paper.

(a) In 1935 the car Bluebird took a **total** of 23.91 seconds to cover the measured mile in both run directions. This gave a mean speed of 301.129 mph for the 2 miles, making it the first car to achieve an average speed of over 300 mph.

- The mean speed, V mph, needed to cover 1 mile in T seconds is given by

  $V = \frac{3600N}{T}$ with $N = 1$.
- The first run took 11.83 seconds, giving a mean speed of 304.311 mph.
- The second run took 12.08 seconds.

(i) Calculate the mean speed for the second run. **[2]**

A large majority were successful, and most were able to substitute into the given formula. However, many truncated or rounded their answers prematurely, despite the pre-release stating that speeds in world land speed records are correct to 3 dp.

Question 5 (a) (ii)

(ii) Determine whether the official mean speed of 301.129 mph corresponds to the mean of run 1's speed and run 2's speed.
(You will need your answer to part **(i)**.) **[2]**

A minority were successful. A very small but significant minority did not realise that they needed to calculate the mean and tried to compare the mean given by the first and second times separately. There was some evident confusion in a few cases as to what was meant by "corresponds to".

Question 5 (b) (i)

(b) The chart in **Fig. 5.1** shows the first 30 seconds of a journey from a standing start by the high-speed Bloodhound SSC based on an actual test run.

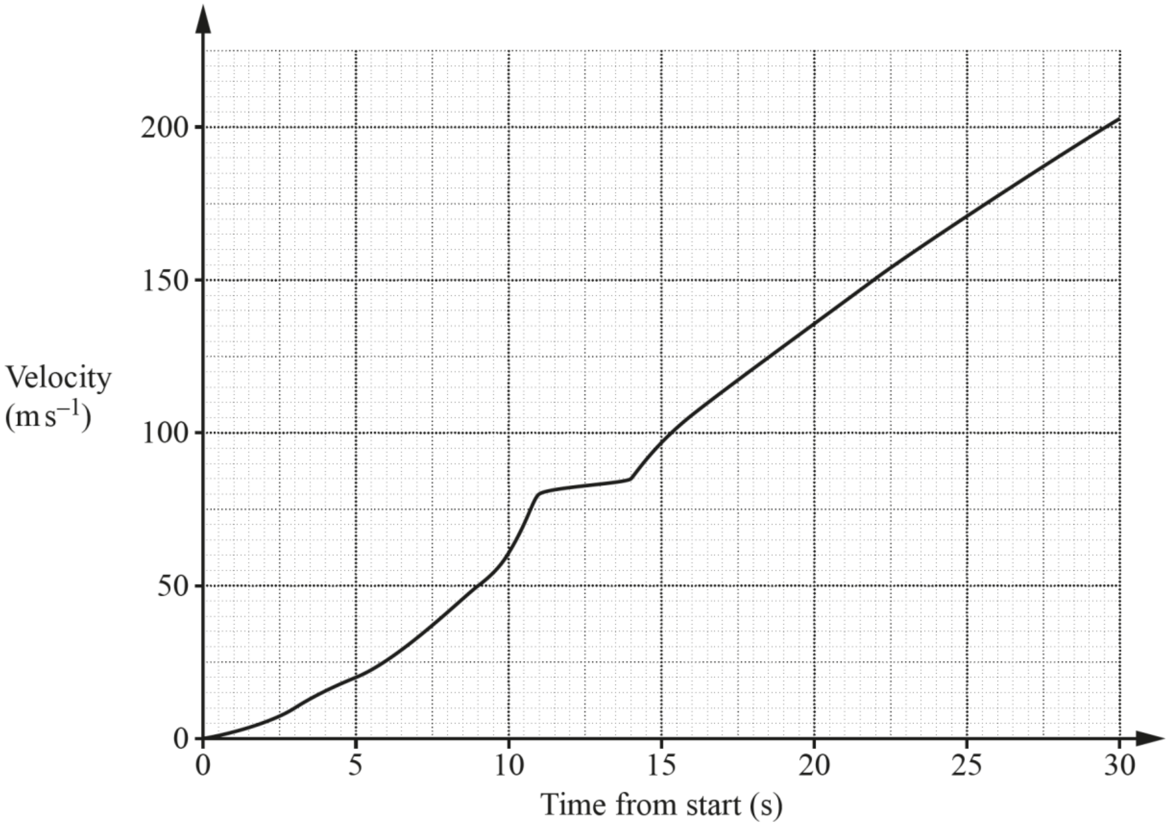

Fig. 5.1

(i) Write down the velocity of Bloodhound SSC, in $\mathrm{m\,s^{-1}}$, after 10 seconds. **[1]**

A large majority were successful. Incorrect answers included "61 $\mathrm{ms^{-1}}$" and "62 $\mathrm{ms^{-1}}$" as might be expected but also some others which appeared not to have a logical explanation.

Question 5 (b) (ii)

(ii) State whether the acceleration of the Bloodhound SSC is constant over the first 10 seconds. Explain your answer. **[2]**

About half of the candidates were successful and responded with at least "no, not a straight line". Many others got involved with calculations which were rarely correct. There were also instances of insecurity as to the actual meaning of acceleration.

Question 5 (b) (iii)

(iii) Calculate Bloodhound's acceleration between 10 and 11 seconds after starting. **[2]**

Only a very small minority of candidates gained full credit, however a larger proportion gained some partial credit, usually as a result of a correct numerical response with incorrect units, usually ms^{-1}.

Question 5 (c)

(c) Calculate the time taken on a single run of 1 mile to give an average speed of 1000 mph.

Use the formula $V = \frac{3600N}{T}$ with $N = 1$

where V is the average speed, in mph, needed to cover 1 mile in T seconds. **[2]**

Full credit was achieved by most candidates, with a very small minority not gaining any credit.

Question 5 (d)

(d) The measured mile (1.6 km) together with the track used by Bloodhound SSC is illustrated in the scale drawing in **Fig. 5.2**.

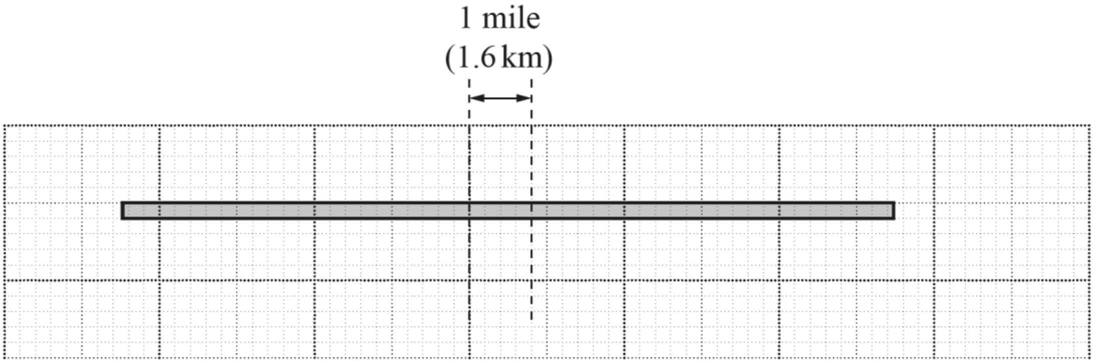

Fig. 5.2

Work out the length of the track.
Give your answer in kilometres and assume that 1 mile is exactly 1.6 kilometres. **[2]**

The majority gained full credit, with a small minority not gaining any credit. A common error was to assume the grid to be a centimetre grid. It was possible that partial credit may, on occasion, have been lost because of lack of working to provide evidence.

Question 6 (a) (i)

6 The zloty is the Polish unit of currency. Like all currencies its value, or exchange rate, compared with other currencies is changing all the time.

(a) The graph in **Fig. 6.1** shows how many zloty could be bought from a supermarket for £1 for each day in April 2021.

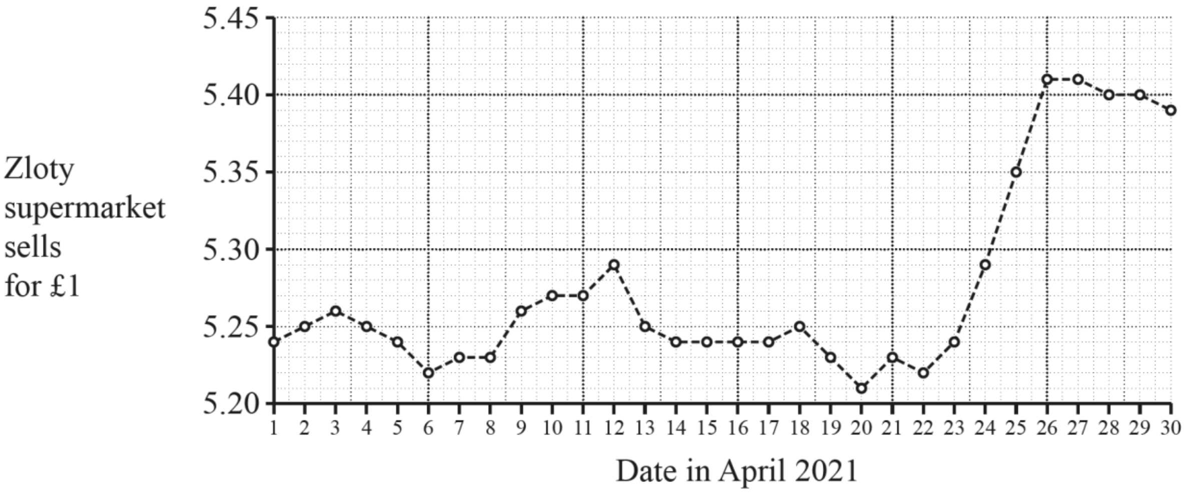

Fig. 6.1

(i) How many zloty was the supermarket selling for £1 on 10 April 2021? **[1]**

This was answered with confidence by most candidates of all attainment levels. Popular errors were "5.25" or "5.26", originating from in accurate reading of the scale.

Question 6 (a) (ii)

(ii) For how many days was the supermarket selling more than 5.30 zloty for £1? **[1]**

Only a very small minority were unsuccessful. A relatively common error was "24 days", most likely the result of misinterpreting the question as meaning "less than 5.30 zloty for £1".

Question 6 (a) (iii)

(iii) On which day in April was it most expensive to buy zloty? **[1]**

A minority of candidates found this part a challenge. A common error was "April 26", the result of not considering the difference between selling and buying currency. Nevertheless, most candidates were successful.

?

Candidates' responses to questions on buying and selling currency suggest this is an area of uncertainty. Further practice is needed in selecting the rate, deciding on the operation (multiplication or division) and appreciating the magnitude of their answer.

Question 6 (b) (i)

(b) A family is to visit friends in Warsaw, Poland.
They decide to change £1000 into zloty all at once at their bank.

(i) **Fig. 6.2** shows the buying and selling rates in their bank on that day.

Currency	We sell at	We buy at
Euro	1.11	1.32
US dollar	1.34	1.57
Zloty (Poland)	5.27	5.46

Fig. 6.2

How many zloty do the family get for £1000? **[2]**

Most candidates gained credit – a common error was to calculate "1000 ÷ 5.46" or, less frequently, "1000 ÷ 5.27" rather than "1000 × 5.27" suggesting a tighter grasp of currency conversion is needed.

Question 6 (b) (ii)

(ii) The airline company flying to Warsaw ceases trading a month later, so the trip is cancelled. The family changes all their zloty back into £s. **Fig. 6.3** shows the new rates in their bank.

Currency	We sell at	We buy at
Euro	1.15	1.37
US dollar	1.42	1.66
Zloty (Poland)	5.31	5.44

Fig. 6.3

How much do the family lose of their original £1000? **[3]**

A large majority gained full credit. A number were able to gain partial credit. A noticeable error was to calculate the correct money received after changing the zloty back into £s but omitting to use this to calculate the financial loss to the family.

Question 7 (a)

7 This question refers to article D in the pre-release material, 'Near-Earth Objects'. You can find the article on the Insert accompanying this paper.

(a) A megaton (Mt) is equivalent to 4.2×10^{15} J (joules) of energy.

Just over two billion years ago the Earth was hit by a very large asteroid.
It is estimated that the energy of the impact was 2×10^{25} J.

Convert 2×10^{25} J to megatons (Mt).
Give your answer in standard form correct to **1** sf. **[2]**

Over two thirds gained at least partial credit. There were instances of candidates working through the whole calculation in normal number format correctly but not gaining the final mark which asked for the answer in standard form correct to 1 sf. Rounding incorrectly to 1 sf was not uncommon with "4.8×10^9" or "4.9×10^9" among the most common errors.

Question 7 (b) (i)

(b) The risk from an NEO can be assessed by calculations based on observation and modelling. Details of four NEOs are given in **Fig. 7.1**.

NEO name	Year of nearest approach	Probability of impact	Diameter (m)	Impact energy (Mt)
2007 DX40	2030	6.2E–05	40	3.9E+00
2012 QD8	2042	6.5E–06	80	4.8E+01
2017 WT28	2083	1.5E–04	8	1.3E–02
1950 DA	2880	1.0E–04	1600	1.0E+04

Fig. 7.1

(i) Which NEO in **Fig. 7.1** has the greatest chance of impacting the Earth? **[1]**

Most candidates found this too challenging, and few were successful. The most common incorrect response was "1950DA", although most of the NEOs were represented. There was a strong impression that candidates were not familiar with numbers expressed in standard form in the format of spreadsheets (or some scientific calculators).

Assessment for learning

It may be helpful for candidates to have an experience of using standard form in spreadsheet format – perhaps to check calculations. Ranking them would also be a useful exercise.

Question 7 (b) (ii)

(ii) Use the figures in **Fig. 7.1** to determine whether the impact energy of an NEO is proportional to its diameter. **[3]**

This was a challenging question with over a quarter of candidates not making an attempt (the highest amount for any of the questions on the paper). A large majority of candidates did not get any marks. Some attempted conclusions without providing supporting calculations. When attempts were made to use ratio in any form it was not always used consistently. As in part (b)(i), it appeared there were problems working with standard form in the format used in the question.

Exemplar 3

7(b)(ii)	~~$\frac{3.9}{40} \approx 0.0975$~~ ~~$\frac{4.8}{80} = 0.06$~~ ~~$\frac{1.3}{8} = 0.1625$~~ ~~$\frac{1}{1600} = 0.000625$~~	~~Yes~~ ~~two~~ No as 1950 DA has the largest diameter but the least impact energy. ~~and 2017 WT28 has the least impact energy but smallest diameter.~~

This candidate shows clear insecurity handling numbers given in spreadsheet format. They appear to have adopted the strategy of ignoring the exponential and using just the mantissa. However, the top calculation of the ratio of impact energy to diameter is correct. This results in the crediting of a single mark. The crossing out was considered as it does not contradict the clear text (in fact it supports it, albeit incorrectly).

Question 7 (b) (iii)

(iii) Use **Fig. 7.2** to find the Torino scale number for NEO 1950 DA. **[1]**

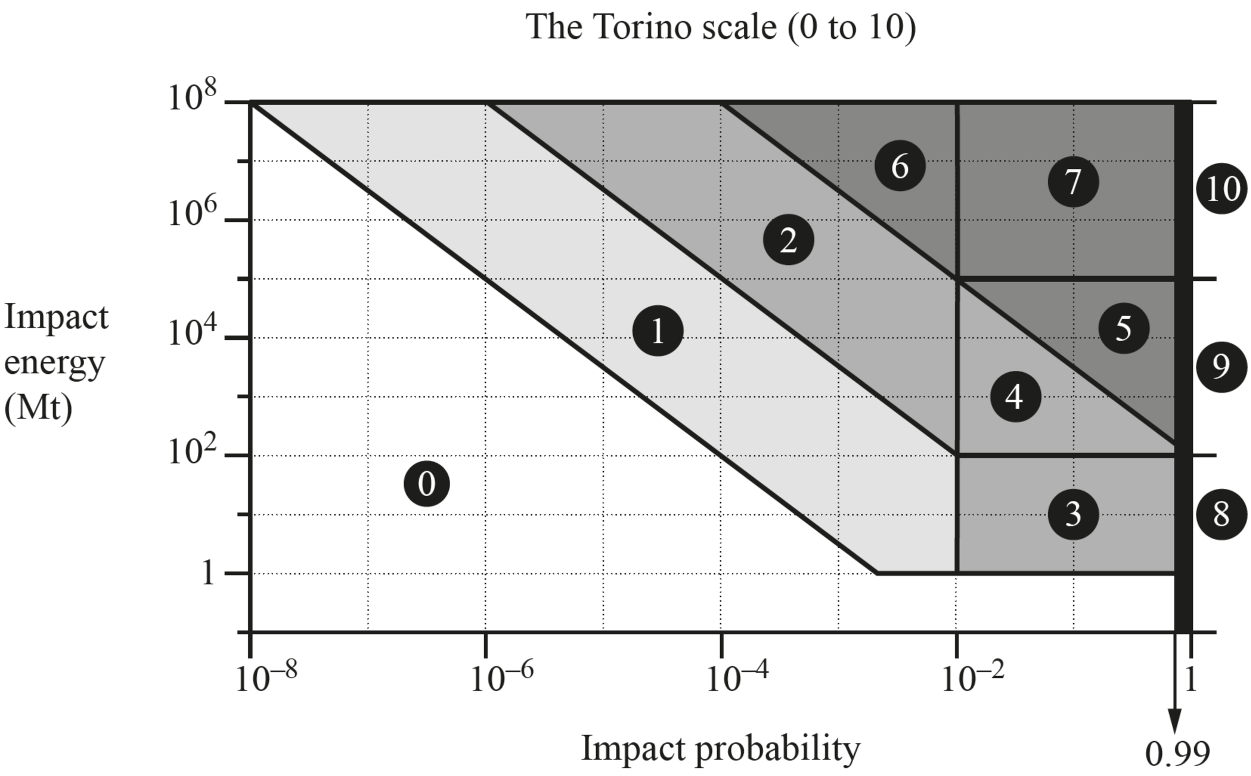

Fig. 7.2

A large majority were successful.

Non-linear scales – especially logarithmic ones

This topic has proved challenging in the past. The one presented here is probably the simplest possible, but candidates need experience with scales involving non-integer powers.

Question 7 (c)

(c) Geologists can date the craters resulting from NEOs impacting Earth.
They estimate that an impact by a 1 km or greater diameter NEO occurs about once every 100 000 years.

Use this figure to give the probability, as a decimal, of such an event in a year. **[1]**

Most candidates were successful. However, a small but noticeable minority did not gain credit as a result of expressing the answer with % added, i.e., 0.00001%.

Question 7 (d)

(d) Estimate the value of this calculation which models the impact energy, in Mt, of a 950 m diameter NEO. Do **not** use a calculator.

$$\frac{\pi \times 1.01 \times 10^5 \times 0.95^3}{3}$$

Show all the approximations in your working. **[2]**

Over a third of candidates gained full credit with just under another third gaining partial credit. A small minority attempted the full calculation rather than an estimation. Of the numbers that needed to be approximated π was the greatest challenge by some margin.

Practice with approximate calculations

Making approximations and checking numerical calculations is a useful skill in real-life. Candidates need to realise that other numbers can be approximated such as π or even π^2. Getting a sense for appropriate approximations can only come from practice.

Copyright information

Supporting you

Post-results services

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Keep up-to-date

We send a weekly roundup to tell you about important updates. You can also sign up for your subject specific updates.
If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular CPD courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses on the relevant subject page on our website or visit OCR professional development.

Signed up for ExamBuilder?

ExamBuilder is the question builder platform for a range of our GCSE, A Level, Cambridge Nationals and Cambridge Technicals qualifications. Find out more.

ExamBuilder is **free for all OCR centres** with an Interchange account and gives you unlimited users per centre. We need an Interchange username to validate the identity of your centre's first user account for ExamBuilder.

If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
01223 553998

Alternatively, you can email us on
support@ocr.org.uk

For more information visit
- **ocr.org.uk/qualifications/resource-finder**
- **ocr.org.uk**
- **/ocrexams**
- **/ocrexams**
- **/company/ocr**
- **/ocrexams**

We really value your feedback

Click to send us an autogenerated email about this resource. Add comments if you want to.
Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

I like this **I dislike this**

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation's website for a direct search.

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT