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OCR
Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

MATHEMATICS

J560

For first teaching in 2015

J560/04 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 is 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 4 series overview

This is the first of three papers taken by Higher tier candidates for the GCSE (9-1) Mathematics specification and is a calculator paper. This series shows the benefits of reading each question carefully, making sure to use all the information given and give the answer in the form requested. A number of correct attempts were seen that were crossed out and replaced by incorrect attempts, so the first thought is usually the right one. Many candidates did show their working clearly and were able to find any errors more easily than those whose working was not so clear. For example, we normally expect to see the formula written down, then with the numbers substituted and then the final result. In some questions candidates did not always choose the most efficient method and this was clear in Questions 4, 13 and 14. As in previous series, many candidates rounded or truncated partial results which led to inaccuracies creeping into final answers. Accuracy should be kept to that of the calculator for as long as possible and certainly to more than is demanded in the question.

The number work was quite good. The percentage questions were answered well providing they were straightforward and simple but many candidates could not work out reverse percentages. In angle questions, too many still made assumptions from the diagrams that were not true. All information required for these questions will be given; any information to be interpreted from a diagram will be clear and obvious. This paper had a lot of quadratic algebra. Candidates could multiply out brackets accurately except where there were negative signs involved. They could factorise quadratic expressions very well providing the coefficient of x^2 was 1. Where this coefficient was greater than 1, they found this extremely difficult. Even when a quadratic expression could be factorised, many candidates still tried to use the 'formula' or 'complete the square'.

There was strong evidence that candidates were still using trials to find answers which would otherwise need inverse methods. In Question 3 some tried to guess the cost of the painting by using trials rather than dividing the sales price by 1.05^2. In Question 4 they often used trials to find the number of sides of the third polygon. In Question 6 some tried to work out the number of days by multiplying up from their distance in one day instead of dividing the two.

Few candidates used diagrams to any great effect. In Question 5 some did not plot the two points accurately in part (a), in part (d) some did not indicate the outlier and in part (f) they did not always count the points accurately. In Question 8 (c) many candidates calculated the answers instead of reading them from the graph. In Question 12 more would have benefitted by writing the angles onto the diagrams. In Question 17 they would have benefitted by drawing a tree diagram and writing the probabilities on it.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• read each question carefully and answered each one fully • knew how to correctly use their calculators • had learned most mathematical techniques thoroughly • set their working out clearly and logically • pursued their first method and answers were easy to read.	• often did not give the answer to each question as requested or in the format requested • did not know how to use their calculators and how to find certain functions • showed working that was haphazard and could not be clearly followed • crossed out correct work and changed their method. Answers could be crossed out and replaced.

Question 1 (a)

1 **(a)** Write 6 050 000 in standard form.

(a) ..... **[1]**

This part was well answered. The common incorrect responses were either 6.05×10^4 or 605×10^4 caused mainly by counting the zeros.

Question 1 (b)

(b) Write 4.58×10^{-3} as an ordinary number.

(b) ..... **[1]**

This was usually answered correctly though some candidates counted the decimal point movements incorrectly and gave responses such as 0.0458 or 0.000 458.

Question 2

2 Calculate.

$$\frac{270}{2.5^2} - \frac{4.6 + 17.2}{8.4 - 6.8}$$

..... **[2]**

A common response was $\frac{1183}{40}$, which is correct but an unusual form given that the question is framed in terms of decimals. The most consistently successful method was to calculate each fraction separately and then subtract the results. Early rounding or truncation did cause inaccurate responses.

Assessment for learning

Know how to use your calculator, and where to find the functions and inverse functions. Learn how to estimate the answer to check that you have not made an error. Know how to change the modes, for example so that you can get the answer as a fraction or as a decimal.

Question 3

3 In January 2018, an art collector bought an antique painting.
In January 2020, he sold it for £17 640.

Assume the value of the painting increased by 5% each year.

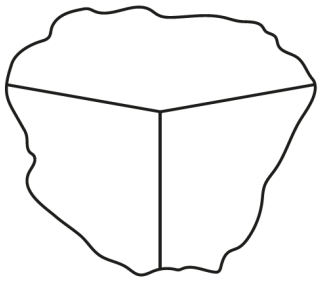
Calculate the art collector's profit.
You must show your working.

£ ..... **[5]**

There were a number of different incorrect methods here. Some candidates decreased the sales price by 5% twice, others increased it by the same amount. Some decided that two 5% decreases are equal to a 10% decrease and so they used that to find the purchase price. Some gave their purchase price and not the profit as requested in the question.

Question 4

4 Three **regular** polygons meet at a point.



Not to scale

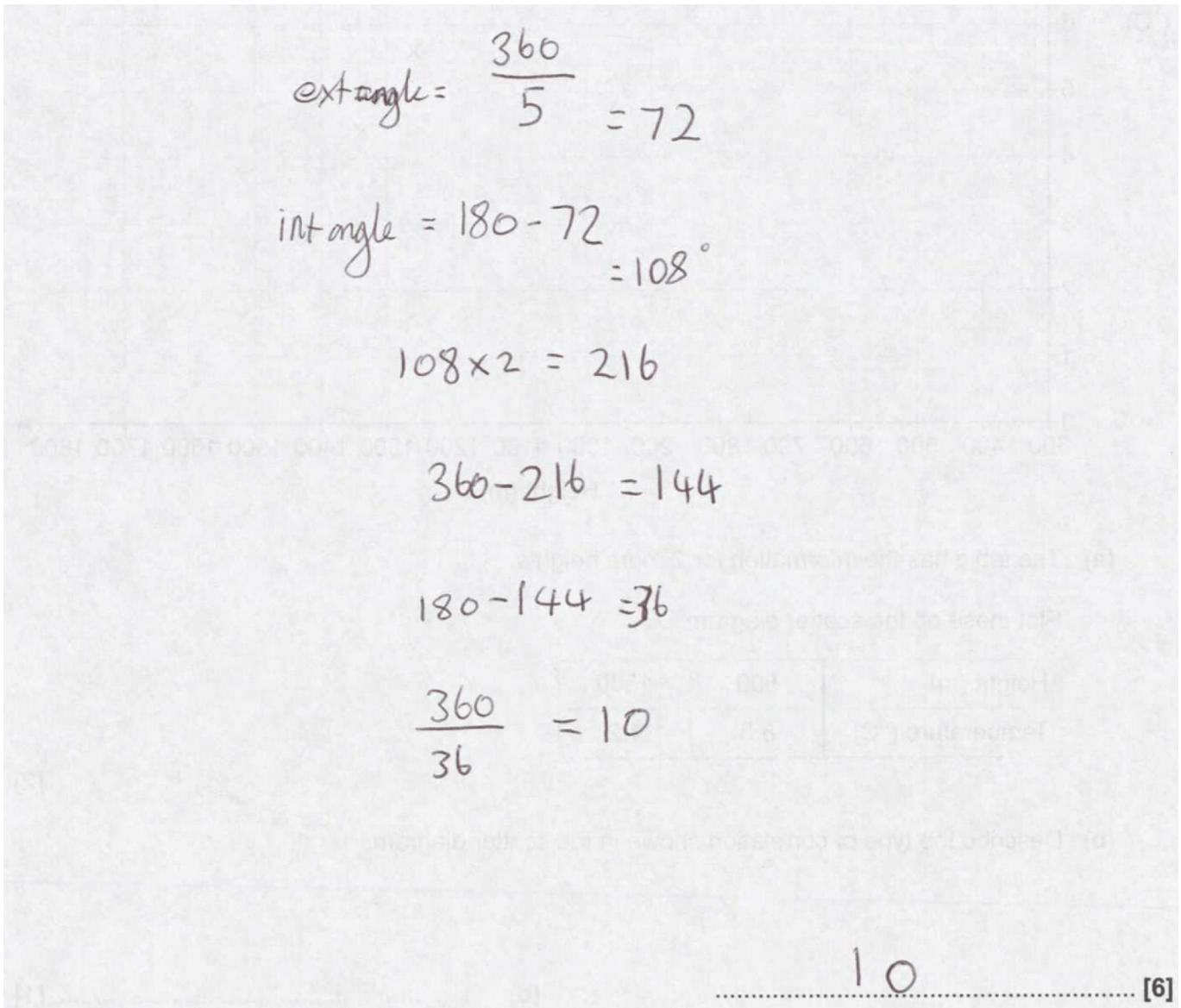
Two of the polygons are pentagons.

Find the number of sides of the third polygon.
You must show your working.

..... **[6]**

The first error was that some candidates thought that a pentagon had either 6 or 8 sides. There are two distinct methods to find the internal angle of a polygon. The first method involves using the formula for the angle sum, $\frac{(n-2)\times 180}{n}$. However this is very cumbersome to use when you have the angle and you need to find the number of sides. The other method involves finding the external angle first and in one step it is $180-\frac{360}{n}$. Most candidates, using either method, found the internal angle of their pentagon correctly and most of these found the third angle round the point. However some candidates did not know how to find the number of sides from the internal angle of the third polygon. In this question the working was not always easy to follow.

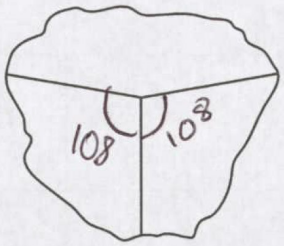
Exemplar 1



The method is logical and easy to follow. The first two steps are labelled "ext. angle" and "int. angle". They find the number of sides by reversing the first two steps. This demonstrates that, in this question, this method proved to be easier than the other method as demonstrated in Exemplar 2.

Exemplar 2

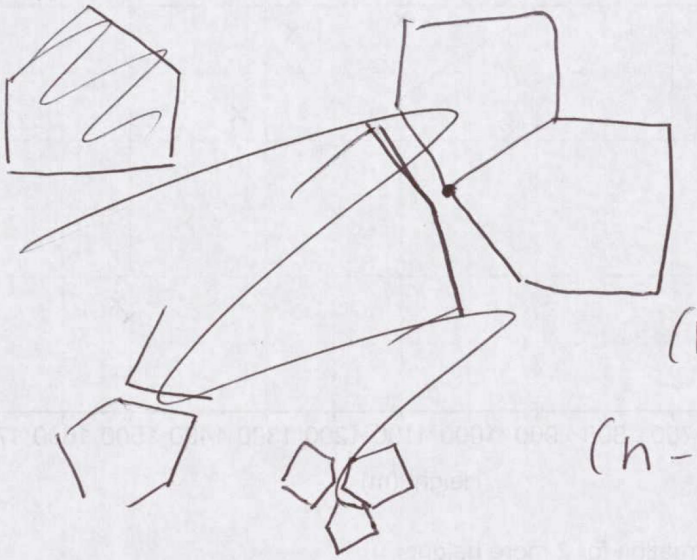
4 Three **regular** polygons meet at a point.



Not to scale

Two of the polygons are pentagons.

Find the number of sides of the third polygon.
You must show your working.



$(n-2) \times 180$

Pentagon Interior angle = 108

$108 \times 2 = 216$

$360 - 216 =$

144

$(10-2) \times 180 \div 10 = 144$

5-2

$(n-2) \times 180 \div n = 144$

÷180 −36

+2

$(n-2) \times 180 = 144$
n

$(n-2) \times 180 \div n = 144$

+2 +2

$n \times 180 \div n = 146$

÷180

$\frac{(n-2)}{n} = 0.8$ or $\frac{4}{5}$

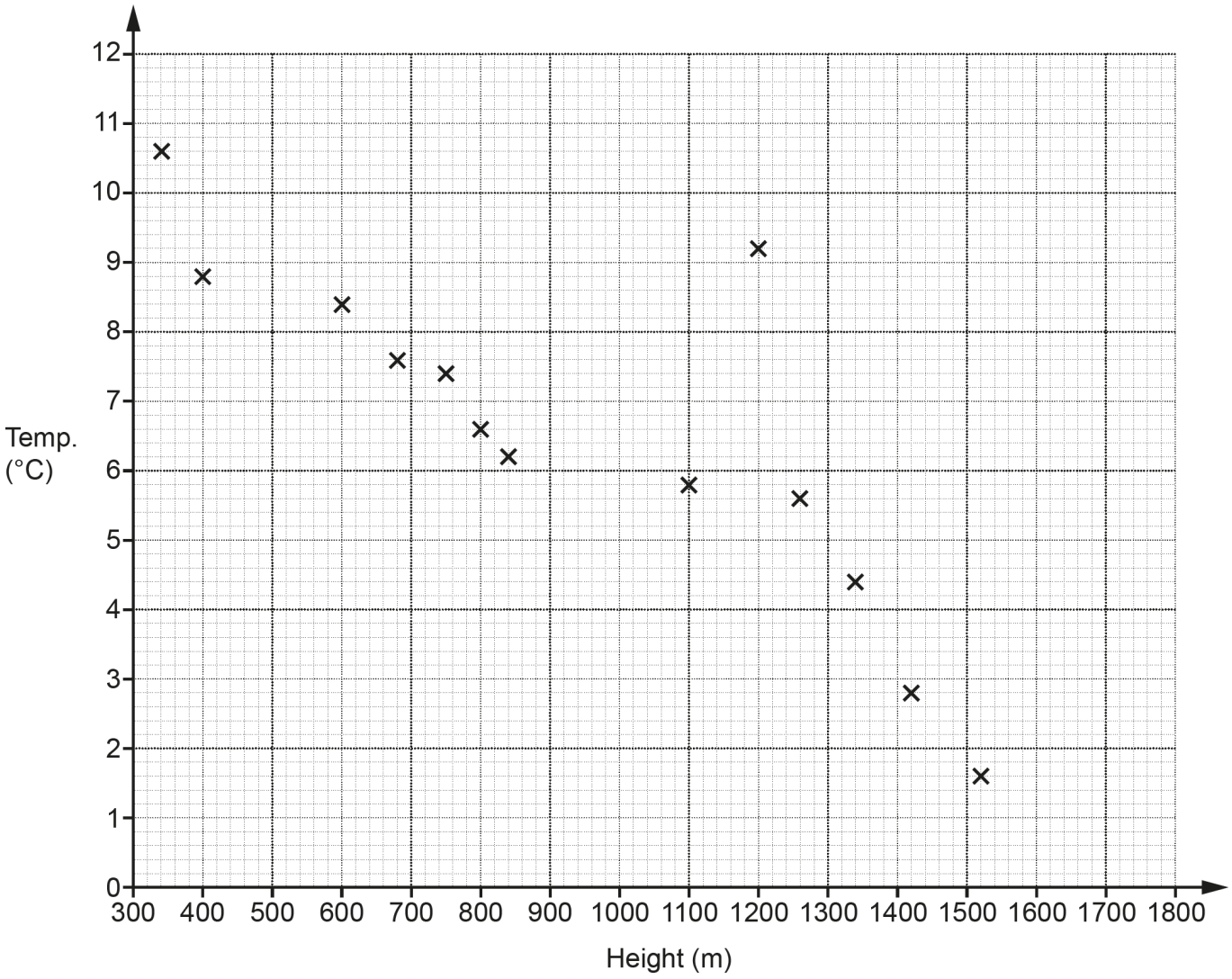
10

..... [6]

This response uses the formula to find the internal angle from the angle sum and it is more difficult to follow. Top right is the angle sum formula and to the left is 5 – 2 which shows substitution of $n = 5$. Just below top right is the internal angle of a regular pentagon and below that the third angle round the point. They find it difficult to use this formula to find the number of sides and, in the middle right, they appear to guess $n = 10$ and they check it. However this is sufficient working to gain full marks and we can just follow it.

Question 5 (a)

5 The scatter diagram shows the midday temperature at 13 different heights on a mountain.



(a) The table has the information for 2 more heights.

Plot these on the scatter diagram.

Height (m)	500	1580
Temperature (°C)	8.8	1.2

[2]

These two points were almost always plotted correctly. A few candidates misread the scale and plotted the second point at (1580, 1.4) or at (1560, 1.2).

Question 5 (b)

(b) Describe the type of correlation shown in the scatter diagram.

(b) ..... **[1]**

This part was almost always answered 'negative' though a few candidates stated 'positive' and some used the term 'decreasing'.

Question 5 (c)

(c) By drawing a line of best fit, estimate the temperature at 1000 m.

(c) ..... °C **[2]**

This was usually ruled and within the acceptable limits. A few candidates joined the points with a series of zigzag lines or curves.

Question 5 (d)

(d) Circle the outlier on the scatter diagram. **[1]**

The outlier was almost always indicated correctly. A few candidates, however, did not answer this part at all. It is possible they may not have read it or they may not have known the term 'outlier'.

Question 5 (e)

(e) Explain why using the scatter diagram to estimate the temperature at 1800 m may be unreliable.

.....

..... **[1]**

Most candidates stated that it was beyond the available information or that it would be off the graph. Some did not communicate these ideas clearly or correctly or they suggested that at that height there may be other factors involved.

Question 5 (f)

(f) Find the percentage of the 15 temperatures which are below 6 °C.

(f) ..... % **[3]**

Most responses were correct, although a few were convinced that there were only 14 points, possibly they were not counting the outlier. However it does state this figure clearly in the question.

Question 6 (a)

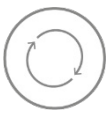
6 A machine can dig, on average, 2 cm of tunnel each minute.
It operates 24 hours each day.

(a) Work out how many days it should take to dig a tunnel of length 3.5 km.
Give your answer to the nearest day.

(a) ..... days **[4]**

The major issue for many candidates was converting kilometres to centimetres as many used 1000 centimetres in a metre. Some candidates merely multiplied the 3.5 by 1000 and wrote that as centimetres. The other issue was converting the rate in minutes into days, some just multiplied by 24 and others multiplied by 60^2 and 24. The intention was to finally divide a distance by a rate but many tried this by using trials which was a long and often unsuccessful method.

Assessment for learning



You should know how to convert numbers between different units for either distance, area or volume. You will need to be able to multiply and divide a decimal number by powers of ten.

Question 6 (b)

(b) The machine actually digs an average of 2.5 cm of tunnel each minute for most of the time and an average of 1.5 cm each minute for the rest of the time.

How would this affect your answer to part **(a)**?

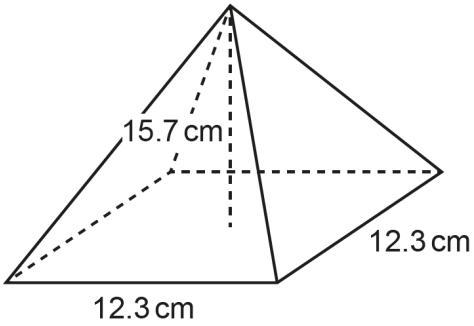
.....

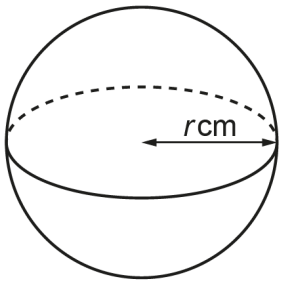
..... **[1]**

Many candidates stated that it would have no effect on their answer while others did say that it would increase the time taken. It looked like many missed the word 'most' in the question.

Question 7

7 The diagram shows a square-based pyramid and a sphere.





The pyramid has base length 12.3 cm and perpendicular height 15.7 cm.
The sphere has radius r cm.

The pyramid and the sphere have the same volume.

Work out the radius of the sphere.
You must show your working.

[The volume of a pyramid is $\frac{1}{3} \times$ area of base $\times$ perpendicular height.

The volume V of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... cm **[5]**

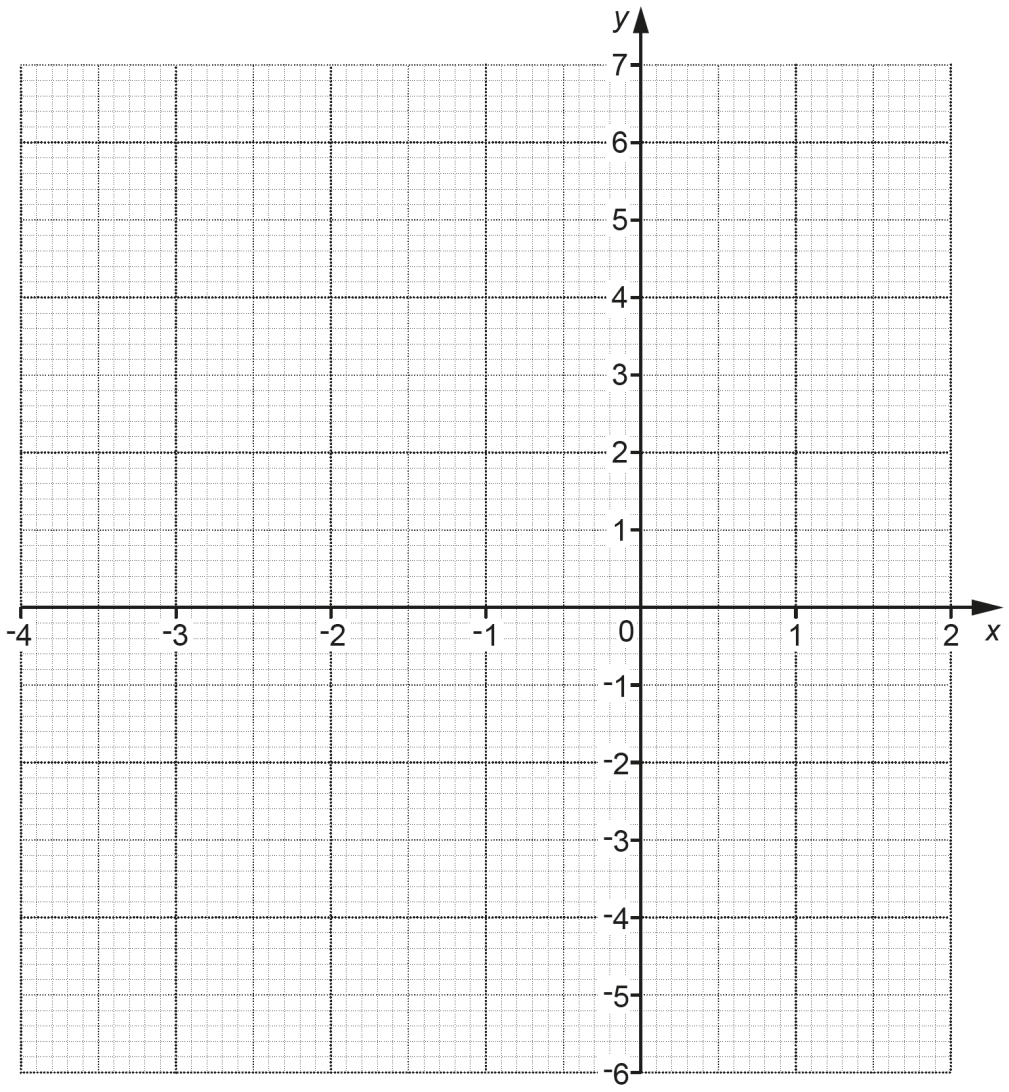
The first part of this problem was to calculate the volume of the pyramid whose formula was given in the question. Some candidates did not use this formula or they did not use the correct formula. The main issue was that some candidates did not use the $\frac{1}{3}$ and either they just worked out area of base × perpendicular height or they used 12.3 for the area of the base. In trying to calculate the radius of the sphere many candidates attempted the inverse operations in the wrong order - usually the cube root came first or second and before at least one of the divisions. Division by $\frac{4}{3}$ did cause some issues when using the calculator, some actually used 1.3 in place of it. The best attempts multiplied by 3 and divided by 4 separately. Some intermediate results were not shown.

Question 8 (a)

8 Here is a table of values for $y = x^2 + 2x - 2$.

x	-4	-3	-2	-1	0	1	2
y	6	1	-2	-3	-2	1	6

(a) Draw the graph of $y = x^2 + 2x - 2$ for $-4 \leqslant x \leqslant 2$.



[3]

The plotting was usually very accurate with the exception that the point (1, 1) was often plotted at (1, 0). Some curves were drawn very inaccurately. When marking, particular attention is given to check that the curve goes through the correctly plotted points. A few candidates used a ruler but the expectation is that curves are to be drawn by hand.

Question 8 (b)

(b) Write down the equation of the line of symmetry of the graph.

(b) ..... **[1]**

This was usually answered well with $y = -1$ as a very common incorrect answer. Some candidates tried to use $y = mx + c$ which made this part very tricky.

Question 8 (c)

(c) Use the graph to solve the equation $x^2 + 2x - 2 = 0$.
Give your answers to **1** decimal place.

(c) $x =$ ..... or $x =$ ..... **[2]**

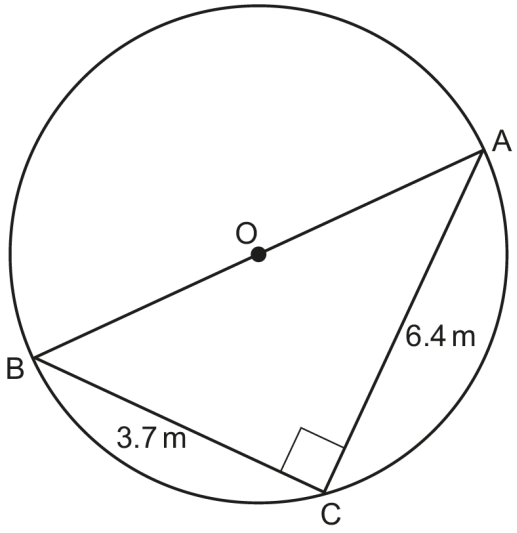
Many candidates tried to calculate the answers from the equation and completely ignored the instruction to 'use the graph'. Many gave the answer to more than 1 decimal place despite the request in the question.

Assessment for learning

Read each question very carefully and give the answer(s) in the form requested.

Question 9

9 Points A, B and C lie on the circumference of a circle, centre O.



Not to scale

Angle ACB = 90°, AC = 6.4 m and BC = 3.7 m.

Work out the circumference of the circle.
You must show your working.

..... m **[5]**

This question was well answered. Most candidates used Pythagoras' theorem to find length BA. A few attempted trigonometry and they were usually unsuccessful. In calculating the circumference there were some who used the formula for the area. Many did round values too early in their calculations, for example the diameter should have been given to at least three figures such as 7.39… .

Question 10 (a)

10 A student is researching the difference in how much exercise adults and children do.
To collect their data, the student interviews the first 25 people found in the High Street at 11 am on one Monday morning.

(a) Make **three** different criticisms of the student's method of collecting data.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

[3]

The question was quite clear about criticising the method of data collection but many candidates included comments about the truth of the answers given by the subjects and about where and how people exercised. Question 10 is not about what questions were asked but the people who were asked these questions. However most candidates gave at least one acceptable response and many gave at least two acceptable criticisms. Many repeated a point and this prevented them from gaining all the marks.

Question 10 (b)

(b) Here is the data collection table that the student used.

Hours exercised in a week (h)	Adult tally	Child tally
$0 \leqslant h \leqslant 2$		
$2 \leqslant h \leqslant 4$		
$4 \leqslant h \leqslant 8$		
$8 \leqslant h \leqslant 12$		
$12 \leqslant h \leqslant 20$		

Make **one** criticism of the student's table.

.....

.....

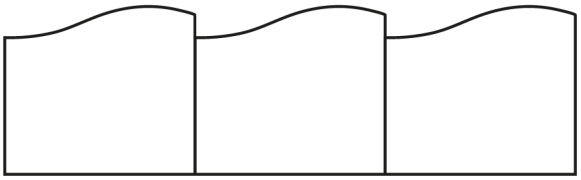
..... **[1]**

Some candidates were concerned about the table being empty or that there were no totals rather than the limit to the hours in a week or the overlapping nature of the classes.

Question 11

11 Jamie buys fence panels that fit tightly together.

Not to scale



Each panel has a length of 1.8 m, correct to 1 decimal place.
Jamie measures the length of a garden as 42 m, correct to the nearest metre.

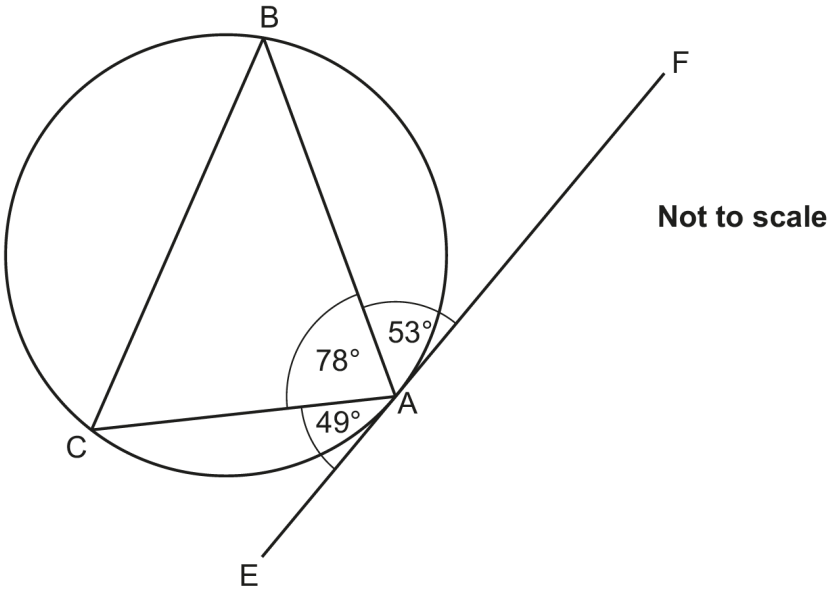
Work out the minimum number of panels Jamie should buy in order to be certain that there are enough panels for the length of the garden.
Show how you decide.

..... **[4]**

Many candidates did not write down the upper and lower bounds for each of the two numbers first. Instead they tried a number of calculations before selecting one of them for their answer. In many cases very little working was shown and it was not always clear how they found their answer.

Question 12 (a)

12 (a) Points A, B and C lie on the circumference of a circle.
EAF is a tangent to the circle.



Write down the value of angle BCA giving a reason for your answer.

Angle BCA = ……° because .....

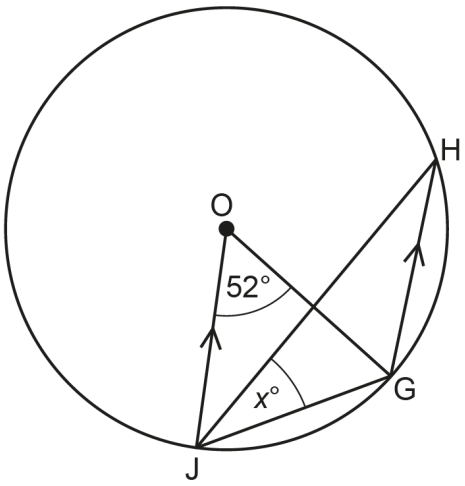
.....

..... **[2]**

The correct answer of 53 was seen quite regularly, the alternative answer often seen was 49. Many candidates did not know the reason and a common response was 'alternating angles'.

Question 12 (b)

(b) Points G, H and J lie on the circumference of a circle, centre O.



Not to scale

Angle GOJ = 52° and angle GJH = x°.
Lines JO and GH are parallel.

Find the value of x.
You must show your working.

(b) $x =$ ..... **[5]**

Many candidates gave the answer of 38 which came from 90 – 52 but this was only correct if they drew the tangent at G. Many assumed the angles where line JH intersects the line OG were right angles and also assumed angle OGJ was 52°. The other incorrect assumption was that triangle GHJ was isosceles and angle JGH was 104 from which they worked out $\frac{180-104}{2}$. Many correctly stated that angle OGH was 52° and some noticed that triangle OJG was isosceles and that angle OGJ was therefore 64°. The most difficult angle to see was that angle GHJ was half of 52.

Misconception

Angles that look like right angles were assumed to be right angles. Triangles that look isosceles may not be isosceles.

Question 13 (a)

13 Here is a restaurant's menu.

Starter	Main	Dessert
Prawn Cocktail	Hunter's Chicken	Trifle
Duck Spring Rolls	Beef Curry	Ice Cream
Lamb Meatballs	Steak	Cheesecake
Leaf Salad (V)	Fish Pie	Chocolate Cake
Mushroom Soup (V)	Lasagne	Bakewell Tart
	Egg Salad (V)	Fruit Salad (V)
	Vegetable Hot Pot (V)	Cherry Pie (V)
	Macaroni Cheese (V)	

(V) denotes vegetarian

(a) A 3-course meal consists of one starter, one main and one dessert.

Work out how many different 3-course meals can be chosen from the menu.

(a) ..... **[2]**

Those candidates who used the product rule gave the correct answer. Some attempted to work out the number from first principles and make a list and this was usually unsuccessful. There were some who included the '(V) denotes vegetarian' as one choice and the mark scheme did award some credit in both parts for this misunderstanding.

Question 13 (b)

(b) Find the fraction of the 3-course meals which are completely vegetarian (V).

(b) ..... **[2]**

Those candidates who answered part (a) correctly usually answered this part correctly. Some added the possibilities, there are 7 vegetarian courses and 20 choices altogether, so they gave $\frac{7}{20}$ as their answer.

Question 14

14 $(x+2)(3x+a)(bx+3) = 6x^3 + 11x^2 - 17x - 30$

Find the value of a and the value of b.

$a =$ .....

$b =$ ..... **[2]**

The working space was small to try to indicate to candidates that there was a quick method to find the answers from the coefficient of x^3, by $1 \times 3 \times b = 6$ and by using the constant term to find the value of a. Those who tried to multiply all the brackets out usually did not find the correct answers because they made at least one error in the bracket expansions.

Question 15

15 Use algebra to prove that an odd number multiplied by a different odd number always gives an answer that is an odd number. **[4]**

This question was well answered. Many candidates used expressions such as $2n + 1$ to represent an odd number and from there they would multiply together their two terms. Many candidates found it difficult to show that the final expression was an odd number; the most successful attempts usually divided this expression by 2 and then they would be left with a decimal or they factorised their expression with 2 or 4 as a common factor and they would usually be left with + 1 or + 3 on the end.

Question 16 (a)

16 Li bought a house at the start of 2016.
Li assumes the value of the house, £V, can be predicted using the formula

$V = 185000 \times 1.035^n$

where n is the number of years after the start of 2016.

(a) Explain how you know that the value of the house is predicted to increase each year.

.....

..... **[1]**

A precise and correct answer was needed for this question so to say that the multiplier was 1.035 or that we are multiplying or that it was a positive number was not enough. An explanation was needed to show why multiplying by 1.035 always increased the other number.

Question 16 (b)

(b) Write down the percentage increase per year that is used in the formula.

(b) ..... % **[1]**

This was well answered. The two most common errors were either 1.035% or 35%.

Question 16 (c)

(c) Write down the value of the house at the start of 2016.

(c) £ ..... **[1]**

This was answered well, though some candidates found it necessary to multiply 185 000 by 1.035 to give an answer of 191 475.

Question 16 (d)

(d) Calculate the predicted value of the house at the start of 2020, giving your answer correct to **4** significant figures.

(d) £ ..... **[2]**

Most candidates used the correct method with 4 as the power. The biggest issue appeared to be the rounding, some did not round at all so gave an answer of 212 291 while others rounded down to 212 000.

Question 16 (e) (i)

(e) **(i)** Compared with its value at the start of 2016, show that the formula predicts the house will have doubled in value at some point during 2036. **[3]**

Candidates needed to show the predicted value at the start of 2036 and then the predicted value at the start of 2037. Many candidates showed just one of these values and then tried to make an argument from that point.

Question 16 (e) (ii)

(ii) Give **one** reason why this may not happen.

.....

..... **[1]**

This proved to have many possible answers and it was well answered. The answer needed to show that the increase of 3.5% each year may not happen for 20 years.

Question 17

17 There are 15 sweets in a bag.
10 of the sweets are toffee and 5 are mint.
Reece takes two of the sweets at random.

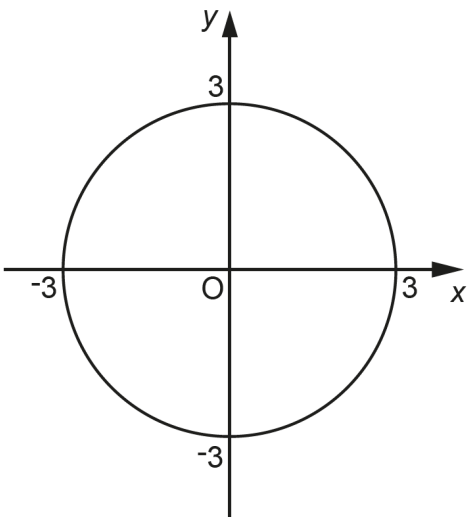
Work out the probability that Reece takes one of each type of sweet.

..... **[4]**

The most successful candidates usually drew a tree diagram and realised that in the second draw there were just 14 sweets available. Candidates need to read the question carefully because some candidates calculated the probability of taking two of the same type of sweets. Most candidates usually multiplied two probabilities on two branches and then they added their two results together. However, many of these had 13 as a denominator, on the basis that two sweets were taken simultaneously and then another was taken. Candidates cannot always assume a tree diagram will be provided so they need to be able to work out the possibilities on the branches themselves.

Question 18

18 The diagram shows a circle, centre the origin.



Write down the equation of the circle.

..... **[2]**

Many candidates knew that the equation was $x^2 + y^2 = r^2$ but they did not know what r represented. Some tried to write down a linear equation.

Question 19 (a)

19 **(a)** Write as a single fraction in its simplest form.

$$\frac{4}{2n+3} - \frac{2n}{n^2+1}$$

(a) ..... **[4]**

Generally, when a question demands a fraction is written 'in its simplest form' it should be written as a product of brackets rather than as a polynomial expression in n. In the numerator some candidates did multiply the brackets out, $4(n^2 + 1) – 2n(2n + 3)$, but then would write the final term of this as $+ 6n$ and not $– 6n$; they had forgotten that they were multiplying $– 2n$ by $+ 3$. Many candidates would have all three parts correct but algebraic slips would mean they did not score full marks.

Question 19 (b)

(b) Simplify.

$$\frac{x^2 - x - 12}{2x^2 - 3x - 20}$$

(b) ..... **[5]**

Many candidates were able to factorise the numerator, a few though wrote $(x - 3)(x + 4)$ while others gave $(x - 6)(x + 6)$ or $(x + 1)(x - 12)$. However, they found the denominator much harder to factorise and there were many alternatives to the correct pair such as $(x + 4)(x - 5)$ or $(2x + 2)(x - 2.5)$.

Question 20

20 Solve this inequality.

$x^2 + 4x - 12 \leqslant 0$

Give your answer using set notation.
You must show your working.

..... **[5]**

Candidates were expected to factorise the quadratic expression, or to use the quadratic formula, to find the two roots of the companion equation. Many candidates, however, tried to add 12 to both sides and then tried to solve their equation by factorising the expression $x^2 + 4x$. They often reached a solution such as $x = \sqrt{3}$. Those who did find -6 and 2 were usually unable to express the solution using set notation. Some put the inequality symbols the wrong way round.

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