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OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

MATHEMATICS

J560
For first teaching in 2015

J560/04 Summer 2018 series

Version 1

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. 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 can be downloaded from OCR.

Paper J560/04 series overview

Paper 4 is the first of three papers in the higher tier of the GCSE (9-1) Mathematics specification. There will be multi-stage and problem solving questions to answer.

Use of calculators
In this paper it is expected that calculators will be used. It is important that accuracy is maintained in calculations and also with values which are transferred between processes.

The candidates' responses to the problem solving questions showed improvement since last year. They will do even better if they set out their work logically and continue with their 'first thought' approach which is usually always correct.

Most successful questions	***Least successful questions***
• Ratio 5.01a, 5.01b (Q1) • Laws of indices 3.01c (Q2) • Bivariate data 12.03c (Q4) • Decay problem 5.03a (Q12) • Enumeration 11.02b (Q13)	• Conditional probability 11.02f (Q10) • Direct proportionality, Percentage change 2.03c & 5.02a (Q11) • Completing the square and graphs 7.01c (Q15) • Cosine rule and area of triangle 10.03a & 10.05e (Q18) • Solving quadratic equations 6.03b (Q20)

Candidates need to be more confident using a multiplier to work out percentages, in their knowledge of the different techniques that can be used to solve quadratic equations and with general algebraic manipulation.

Question 1(a)

1 **(a)** The ratio 2 centimetres to 5 metres can be written in the form 1 : *n*.

Find the value of *n*.

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

This question requires the candidates to use the fact that there are 100 centimetres in one metre and then to simplify the ratio by dividing by 2. Some candidates did not use the units, giving an answer of 2.5 whilst others thought that there were 1000 centimetres in one metre.

Question 1(b)

(b) Jay, Sheila and Harry share £7200 in the ratio 1 : 2 : 5.

How much does Harry receive?

(b) £ ..... **[2]**

This question requires the total of 7200 divided by the sum of the ratios (8) and then multiplied by 5 which most candidates did attempt. A few left their response as 900.

Question 2

2 Given that $y^{18} \div y^{6} = y^{k}$, find the value of k.

$k =$ ..... **[1]**

Most candidates correctly subtracted the indices to give an answer of 12. A few divided the indices to give an answer of 3.

Question 3(a)(i)

3 **(a)** **(i)** Write 120 as a product of its prime factors.

(a)(i) ..... **[3]**

The most successful method, by far, was to use a factor tree and all those who used one usually gave the correct answer.

Question 3(a)(ii)

(ii) The lowest common multiple (LCM) of x and 120 is 360.

Find the smallest possible value of x.

(ii) ..... **[2]**

This is an example of a short problem solving question. Candidates were expected to work out that x cannot be a factor of 120 but must be a factor of 360. This would have ruled out the common incorrect answer of 3. Therefore a list of factors of 360 starting with the lowest giving 2, 3, 4, 5, 6, 9……. would give the answer of 9 as the other five are factors of 120.

Question 3(b)

(b) Two numbers, A and B, are written as a product of prime factors.

$A = 2^4 \times 3^2 \times 7^2$ $B = 2^3 \times 3 \times 5 \times 7$

Find the highest common factor (HCF) of A and B.

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

This question required candidates to select the common prime factors in both numbers which are 2^3, 3 and 7 and then the HCF is the product of these factors. Some candidates did identify these factors without multiplying them to get the required answer. Those who worked out the actual values of the two numbers did not find that to be a helpful approach.

Question 4(a)

4 Lee wishes to find out if there is a relationship between a person's age and the time it takes them to complete a puzzle.

Lee decides to conduct an experiment.
She asks 12 people to complete the puzzle.
She records each person's age and the time taken to complete the puzzle.

(a) Make one criticism of Lee's method.

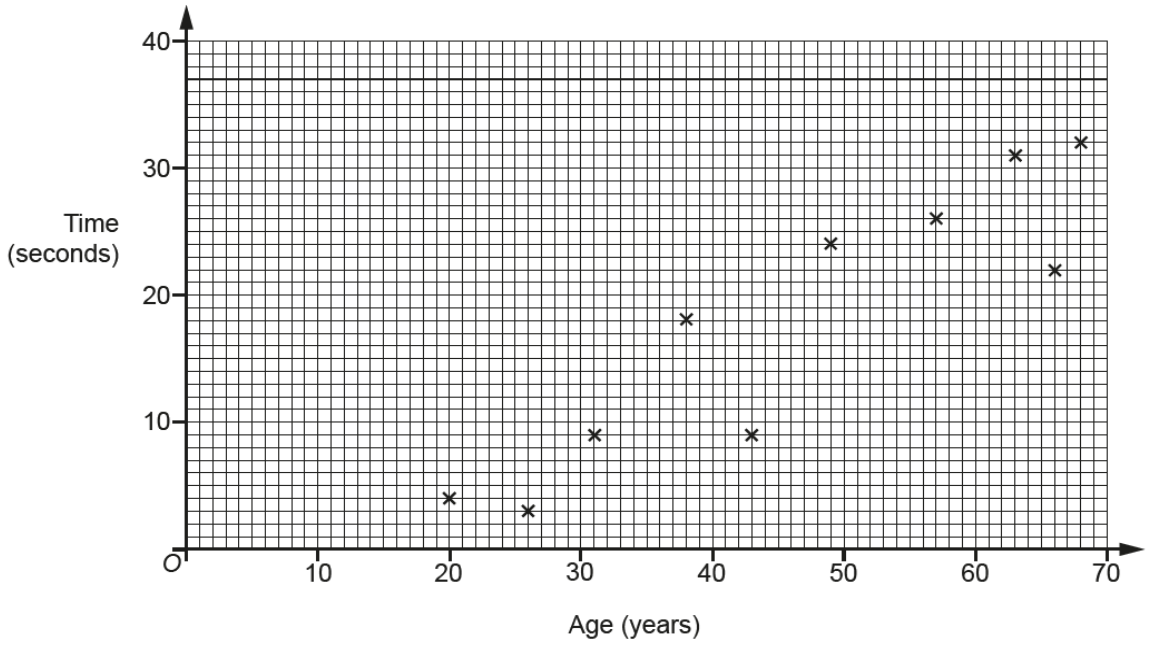
.....

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

It was expected that most would criticise the size of the sample. Some candidates demonstrated an excellent knowledge of selecting a representative sample and a variety of answers were allowed.

Question 4(b)

(b) This scatter diagram shows the results for ten of the people in Lee's experiment.



Here are the other two results.

Age (years)	47	60
Time (seconds)	21	34

Plot these results on the scatter diagram. **[2]**

The plotting was excellent. Few candidates did not attempt this part.

Question 4(c)

(c) What type of correlation is shown in the scatter diagram?

(c) ..... **[1]**

Almost all candidates gave the correct response of 'positive'. Those who did not usually gave 'strong'.

Question 4(d)

(d) Estimate the time it would take a person aged 35 to complete the puzzle.

Show your working to justify your answer.

(d) ..... **[2]**

Most responses fell within the tolerance interval. It was expected, but not required, that they would draw a line of best fit to enable an estimation to be made and most obliged by doing so.

Question 4(e)

(e) Lee says that at least 80% of the 12 people completed the puzzle in under 30 seconds.

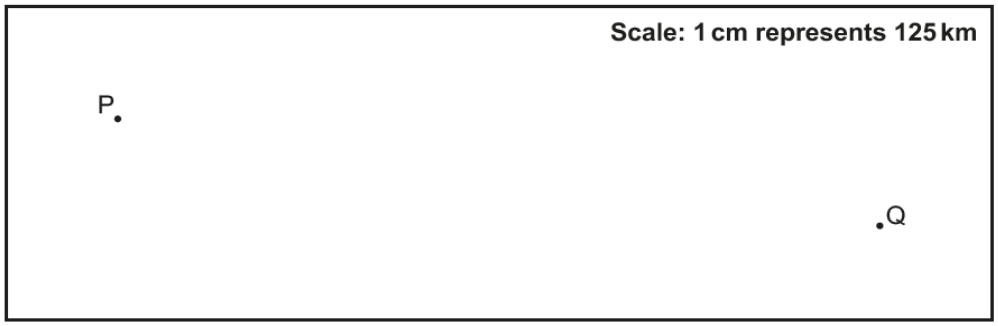
Is Lee correct?
Show working to support your answer.

..... **[3]**

Most candidates did count the number who completed it in under 30 seconds correctly and they then changed 9 out of 12 into a percentage which most knew was 75%. They then made the comparison with 80%. An alternative method, which many followed very successfully, was to calculate 80% of 12, which was 9.6, and then make the comparison with the counted 9.

Question 5(a)

5 The scale diagram below shows two cities, P and Q.



A plane departs from P at 09 47 and arrives at Q at 12 07.

(a) Work out the average speed, in kilometres per hour, of the plane.

(a) ..... km/h **[5]**

This is an example of a multi-stage question. Almost every candidate found the distance within tolerance and most worked out the time as 2 hours 20 minutes. The most successful method to work out the average speed was to divide by 140 minutes and then multiply by 60. Those who truncated the decimal introduced a small numerical error into their calculations.

Question 5(b)

(b) Give one reason why your answer may be inaccurate.

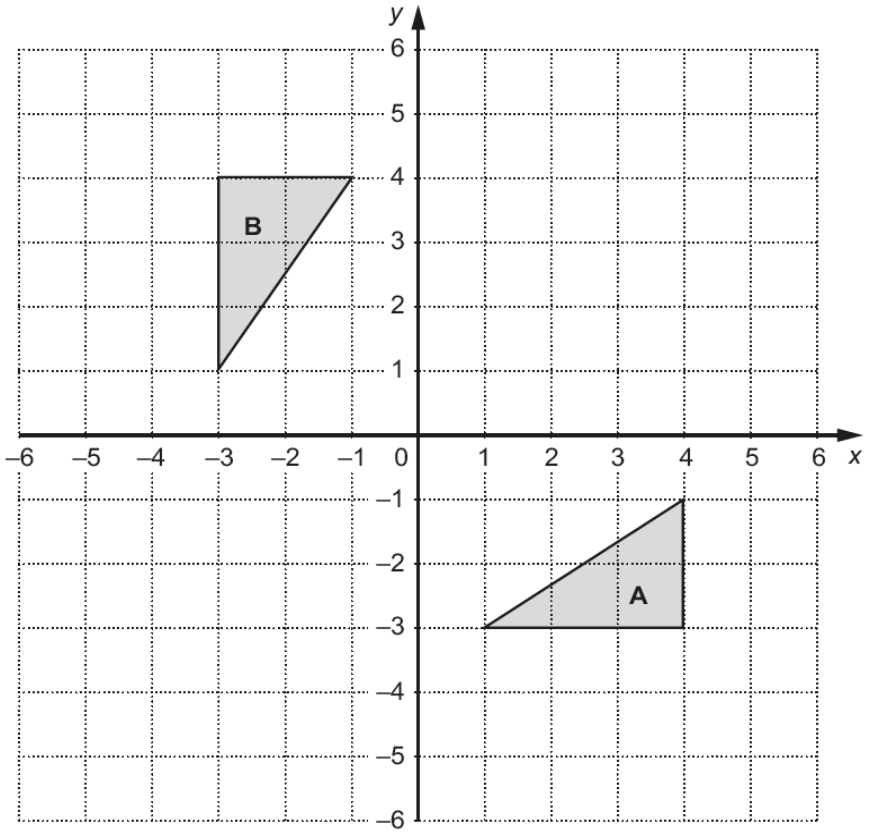
.....

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

This is an example of a simple mathematical modelling situation. As they were given the time of flight, the only inaccuracy could be in the distance flown so we accepted comments about distance.

Question 6(a)

6 Triangles **A** and **B** are drawn on a coordinate grid.



(a) Describe fully the **single** transformation that maps triangle **A** onto triangle **B**.

.....

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

Most gave the correct single transformation. A few gave a double transformation and some candidates could not give the correct equation of the mirror line.

Question 6(b)

(b) Triangle **A** can also be mapped onto triangle **B** using a combination of two transformations:

- a transformation T, followed by
- a reflection in the line $x = 0$.

Describe fully transformation T.

.....

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

This question was answered better than in previous years. Most candidates realised that it was a rotation although some did not give the correct direction of rotation. A few candidates did show their working clearly on the diagram and, as in previous years, there was credit given for correct working on the diagram if no marks were scored from the answer.

Question 7(a)

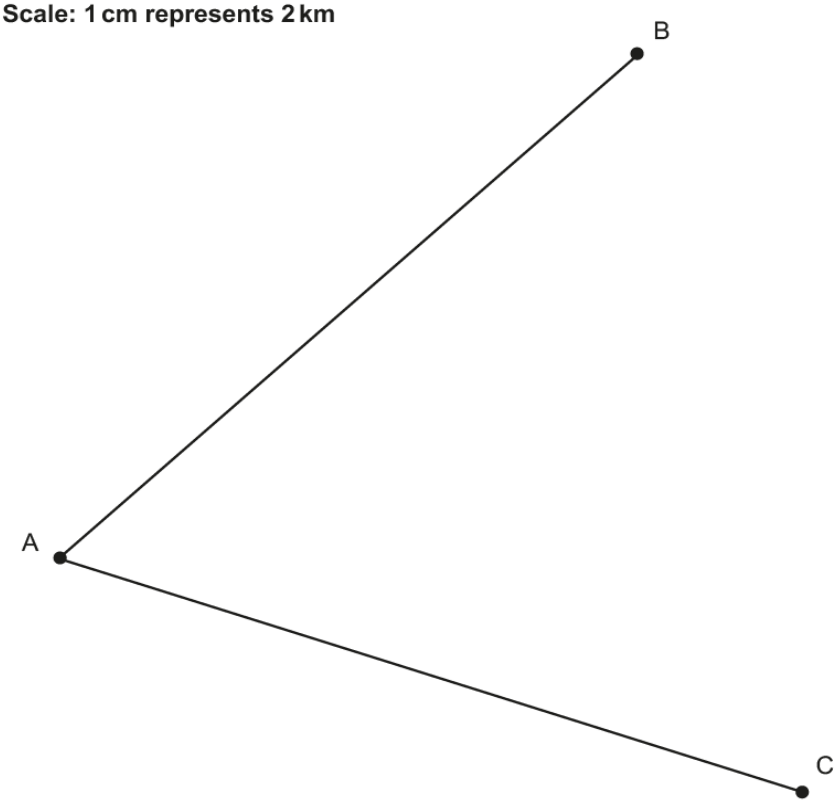
7 The scale diagram below shows towns, A, B and C.
Line AB represents the road from A to B and line AC represents the road from A to C.

A shopping centre is to be built so that it is

- nearer to the road from A to B than the road from A to C,
- less than 14 km from town C.

(a) Using construction, shade the region where the shopping centre could be built.
Show all your construction lines.

Scale: 1 cm represents 2 km



[5]

The constructions were usually performed accurately and clearly. Some candidates drew an accurate bisector of angle BAC without showing any construction arcs. The arcs centred on C were generally drawn very accurately; some were a little short in length and therefore the candidates could not appreciate that there were two points of intersection. A few of them drew the arc centred on point A instead of point C.

Question 7(b)

(b) Explain why the region found in part **(a)** may not be an appropriate site for the shopping centre.

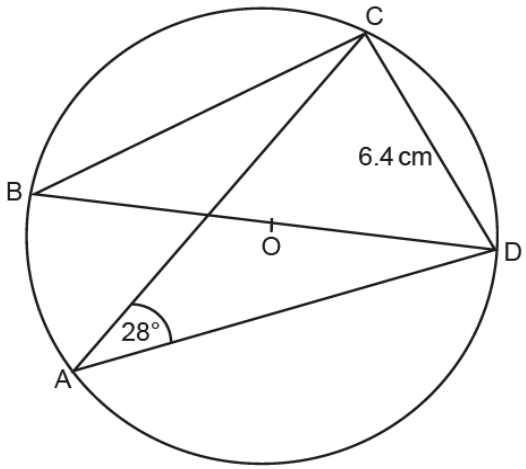
.....

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

This part tested whether they appreciated that there are constraints to consider other than mathematical ones, so we saw and accepted a wide variety of reasonable responses.

Question 8

8 A, B, C and D are points on the circumference of a circle, centre O.



Not to scale

Angle CAD = 28° and CD = 6.4 cm.
BD is a diameter of the circle.

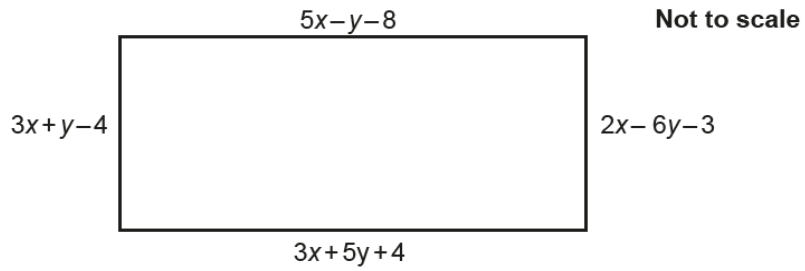
Calculate the area of the circle.

..... cm^2 **[5]**

This is an example of a problem solving question which tests whether they can select the appropriate triangle to use and populate it with the correct angles and lengths. Many candidates thought that triangle ACD had a right angle at D even though they had correctly marked the angle DBC as 28°. Those who selected the correct triangle to work with, usually gave an acceptable response. In this question we did see examples of truncated numbers in the working which led to inaccurate final figures.

Question 9

9 The dimensions, in centimetres, of this rectangle are shown as algebraic expressions.



Work out the length and width of the rectangle.

length = ... cm

width = ... cm

[6]

This question is another problem solving question with a multi-stage aspect. They are expected to generate two linear simultaneous equations, by equating the lengths and the widths separately, and then solve them, putting their answers back into the expressions to get the length and width. This question needed the work to be organised. Many candidates made the correct start but algebraic errors made their task more difficult. Some produced one equation from equating the lengths but did not find the second one.

Exemplar 1

$5x-y-8 = 3x+5y+4$

$3x+y-4 = 2x-6y-3$

$2x-6y=12$

$x+7y=1$

$2x-6y=12$

$2x+14y=2$

$-20y=10$

$y=-0.5$

$x+7(-0.5)=1$

$x+3.5=1$

$x=-2.5$

$x=4.5$

4.5

$3(4.5)+5(-0.5)+4$

$3(4.5)+-0.5-4=9$

length = 15 cm

width = 9 cm

[6]

This exemplar shows how this question can be solved with the minimum amount of working.

Question 10

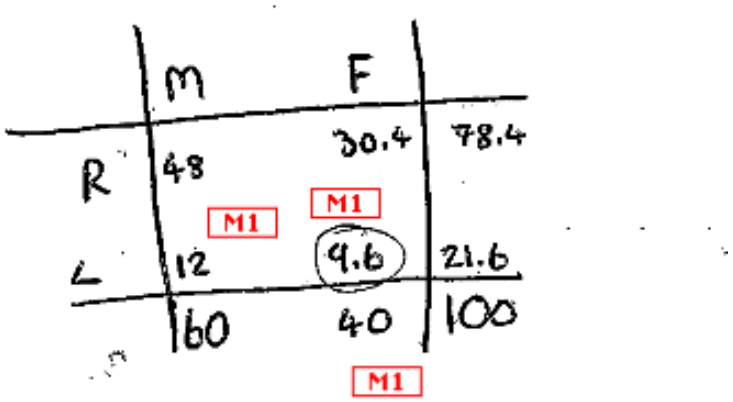
10 60% of the people in a town are males.
20% of the males are left-handed.
21.6% of all the people are left-handed.

Work out the percentage of the people who are not male who are left-handed.

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

This question involves conditional probability but with the correct organisation of the information, it could be solved using a two-way table. The best solutions either used a tree diagram or they started with a population of 100 and produced a two-way table. Many candidates did reach 9.6% but they did not realise that this is the probability of a subject being a 'left-handed not male' and they often gave this as their final response. The key was to link 9.6% with the 40%. The lower scoring responses would get 1 mark for 40% of 'not males'.

Exemplar 2



9.6%

In this exemplar the candidate has drawn a two-way table, and all of the information is present to get this question fully correct. However, they reached an answer of 9.6% and stopped at that point without linking it to the 40%.

Question 11

11 *y* is directly proportional to the square of *x*.

Find the percentage increase in *y* when *x* is increased by 15%.

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

This question required the percentage increase to be written as a scalar multiplier, 1.15, and then to square it, which can lead neatly to the answer. Many candidates did in fact get this far but they could not reach the correct answer from the figure 1.3225.

Question 12(a)

12 The value of a car, £V, is given by

$$V = 16\,500 \times 0.82^n$$

where n is the number of years after it is bought from new.

(a) Write down the value of the car when new.

(a) £ ..... **[1]**

Most candidates gave the correct answer of 16 500 and a few gave the value after one year of 13 530.

Question 12(b)

(b) Write down the annual percentage decrease in the value of the car.

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

The two common responses were 18 (the correct answer) and 82.

Question 12(c)

(c) Show that the value of the car after 4 years is less than half its value when new. **[2]**

Most candidates correctly worked out the value of the car after 4 years from the expression $16\,500 \times 0.82^4$ and then compared it to one half of their answer to part (a).

Question 13(a)

13 A menu has

- 6 starters
- 10 main dishes
- 7 desserts.

(a) A three-course meal consists of a starter, a main dish and a dessert.

How many different three-course meals are possible?

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

Most candidates correctly worked out 6 × 10 × 7 = 420.

Question 13(b)

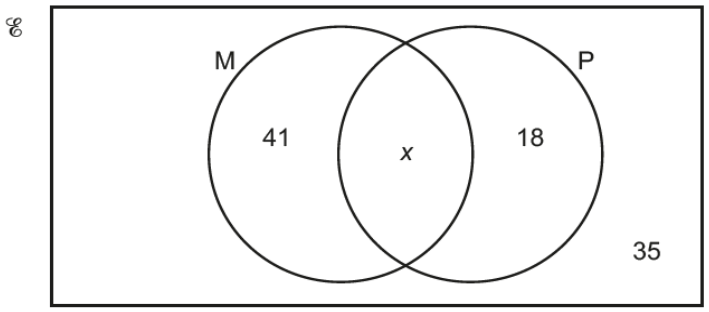
(b) A two-course meal consists either of a starter with a main dish, a starter with a dessert or a main dish with a dessert.

Show that there are 172 possible different two-course meals. **[3]**

Most candidates correctly worked out 6 × 10 + 6 × 7 + 10 × 7 and they showed this equals 172. This is important because this part is a 'Show that' question and it requires the candidates to show that the figure given is the correct one.

Question 14(a)

14 The Venn diagram shows the number of students studying Mathematics (M) and the number of students studying Physics (P) in a college.
35 students do not study either subject.



(a) The total number of students is 121.

Find the value of x.

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

Most candidates attempted 121 – 41 – 18 – 35 or equivalent and gave the answer as 27.

Question 14(b)

(b) One of the 121 students is selected at random.

Find the probability that this student studies Mathematics, given that they study Physics.

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

Most candidates gave the answer $\frac{27}{121}$ which earned some credit. Those who calculated that there were 18 + 27 = 45 students who studied Physics and gave the final response as $\frac{27}{45}$ earned full marks.

Question 15(a)

15 **(a)** Write $x^2 - 8x + 25$ in the form $(x - a)^2 + b$.

(a) ..... **[3]**

It was very encouraging to see this question on topic 6.01f answered so well. Most candidates who started with the square term $(x - 4)^2$ usually gave the correct expression. The other common response was $(x - 8)^2 + 25$.

Question 15(b)

(b) Write down the coordinates of the turning point of the graph of $y = x^2 - 8x + 25$.

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

This follows from their answer to part (a) so the correct expression in (a) will lead to (4, 9) whereas the expression in (a) of $(x - 8)^2 + 25$ should lead to a point here of (8, 25). We do allow them to start again and use a different method. It was quite common to see the correct expression in (a) and (8, 25) in (b) as many candidates did not see the connection between part (a) and the other two parts.

Question 15(c)

(c) Hence describe the single transformation which maps the graph of $y = x^2$ onto the graph of $y = x^2 - 8x + 25$.

.....

.....

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

This is testing Section 7.03a in the specification. There were a few candidates who recognised the transformation as a translation but most of them did not see the connection with the other two parts.

Question 16

16 Solve by factorisation.

$3x^2 + 11x - 20 = 0$

$x =$ ..... or $x =$ ..... **[3]**

The key to this question is to use the method that is requested in the demand. Some candidates obtained full credit by correctly factorising the quadratic expression and then writing down the two correct solutions to the equation. Many used the quadratic formula and they were given some credit if they found the correct solutions from that.

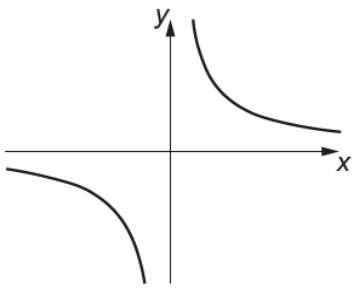
Question 17(a) (b) (c)

17 For each graph below, select its possible equation from this list.

$y = \frac{1}{x}$ $y = \cos x$ $y = x^2$ $y = \left(\frac{1}{2}\right)^x$ $y = 2^x$

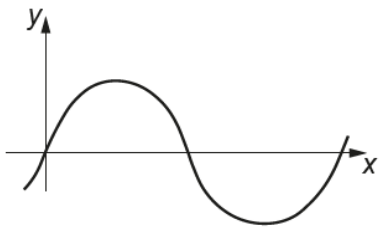
$y = \sin x$ $y = 2^{-x}$ $y = \tan x$ $y = x^3$ $y = \frac{1}{x^2}$

(a)



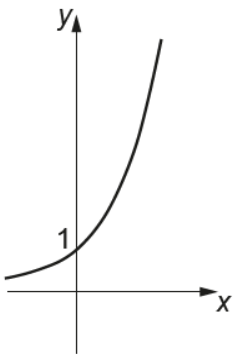
(a) $y =$ .....

(b)



(b) $y =$ .....

(c)



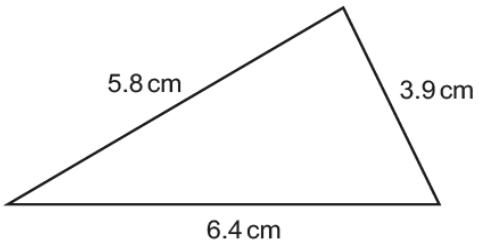
(c) $y =$ .....

[3]

Part (b) attracted the most correct responses. The alternative responses selected included $y = \tan x$ and $y = \left(\frac{1}{2}\right)^x$ for part (a), $y = \cos x$ for part (b) and $y = 2^{-x}$ for part (c).

Question 18

18 Calculate the area of this triangle.

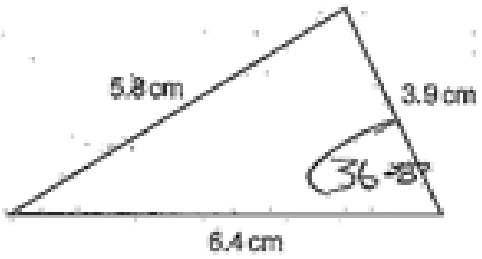


Not to scale

..... cm^2 **[6]**

This question required use of the cosine rule to find one of the angles and then use of the formula ½*ab*sin C to find the area of the triangle. It is considered to be a problem solving question because the candidates have to make a decision to find an angle and which angle to find. The success in using the cosine rule was varied and errors in using it were made. It was common to see the correct order of operations not followed. Some candidates successfully used the cosine rule and then they would attribute the answer to the wrong angle. The use of other methods, mainly with right-angled triangles, rarely led to a successful outcome.

Exemplar 3



Area = $\frac{1}{2}ab\sin C$

$a^2 = b^2 + c^2 - 2bc\cos A$

$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

$a = 3.9$
$b = 5.8$
$c = 6.4$

$\cos A = \frac{5.8^2 + 6.4^2 - 3.9^2}{2 \times 5.8 \times 6.4}$

$\cos A = \frac{59.39}{74.24}$

$\cos A = 0.79$

$\cos A^{-1} = 36.87$ M2 M1

Area $= \frac{1}{2}ab\sin C$

Area $= \frac{1}{2} 3.9 \times 6.4 \times \sin 36.87$ M1 ✗

~~Area = $0.5 \times 3.9 \times 5.8 \times \sin 36.87$~~

~~Area = $0.5 \times 3.9 \times 6.4 \times 36.87$~~

Area $= \frac{1}{2} \times 3.9 \times 6.4 \times 36.87$ 7.5 ..... cm^2 [6]

In this exemplar, the candidate has clearly found the angle which is opposite to side 3.9 cm but it has been marked as the one opposite to side 5.8 cm. The candidate knows to use the formula ½*ab*sin C to find the area of the triangle but uses a wrong value and gets an incorrect final answer. As the candidate has shown all of their working, method marks can be credited.

Question 19

19 Here are the first four terms of a quadratic sequence.

0 9 22 39

The nth term can be written as $an^2 + bn + c$.

Find the values of a, b and c.

a = ...

b = ...

c = ...

[4]

The most common correct method was to find the second difference of 4 and, using that, to write the value of a as 2. The difference between the sequence generated by $2n^2$ and the given sequence can be used to find the values of b and c. The alternative method of writing three linear simultaneous equations was rarely used and did not usually lead to the correct values.

Question 20

20 Solve this equation, giving your answers correct to 1 decimal place.

$$\frac{5}{x+2}+\frac{3}{x-3}=2$$

$x =$ ..... or $x =$ ..... **[6]**

This question is aimed at the higher scoring candidates and yet the success rate was high and many of the lower scoring candidates were able to get some credit for work attempted. This question needed the two fractions to be added with a common denominator of $(x + 2)(x – 3)$. The numerator should have been $5(x – 3) + 3(x + 2)$. Many candidates just used 5 + 3 for their numerator. There were many numerical errors in manipulating the equation, commonly −15 + 6 was written as −21. At this stage many attempts stopped and no further progress was usually made.

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