Cambridge Assessment International Education

Specimen Paper Answers

Paper 1

Cambridge IGCSE®

Additional Mathematics 0606

Cambridge O Level

Additional Mathematics 4037

For examination from 2020

Version 1

Cambridge Pathway

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE Additional Mathematics 0606 and to show examples of very good answers.

This booklet contains answers to Specimen Paper 1 (2020), which has been marked by a Cambridge examiner. Each answer is accompanied by a brief commentary explaining its strengths and weaknesses. These examiner comments indicate where and why marks were awarded and how answers could be improved

The Specimen Papers and mark schemes are available to download from the School Support Hub www.cambridgeinternational.org/support.

2020 Specimen Paper 1
2020 Specimen Paper 1 Mark Scheme

Past exam resources and other teacher support materials are also available on the School Support Hub.

The mark scheme should be read alongside the examiner comments.

Types of mark

M	Method marks, awarded for a valid method applied to the problem.
A	Accuracy mark, given for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.
B	Mark for a correct result or statement independent of Method marks.

Assessment overview

All candidates take **two** papers.

All candidates take:	and:
Paper 1 2 hours, 50%	**Paper 2** 2 hours, 50%
80 marks	80 marks
Candidates answer all questions	Candidates answer all questions
Scientific calculators are required	Scientific calculators are required
Assessing grades A* – E	Assessing grades A* – E
Externally assessed	Externally assessed

Assessment objectives

The assessment objectives (AOs) are:

AO1 Demonstrate knowledge and understanding of mathematical techniques

Candidates should be able to:

- recall and use mathematical manipulative techniques
- interpret and use mathematical data, symbols and terminology
- comprehend numerical, algebraic and spatial concepts and relationships.

AO2 Apply mathematical techniques

Candidates should be able to:

- recognise the appropriate mathematical procedure for a given situation
- formulate problems into mathematical terms and select and apply appropriate techniques.

Weighting for assessment objectives

The approximate weightings allocated to each of the assessment objectives (AOs) are summarised below.

Assessment objectives as a percentage of the qualification

Assessment objective	Weighting in IGCSE %
AO1 Demonstrate knowledge and understanding of mathematical techniques	50
AO2 Apply mathematical techniques	50

Assessment objectives as a percentage of each component

Assessment objective	Weighting in components %	
	Paper 1	**Paper 2**
AO1 Demonstrate knowledge and understanding of mathematical techniques	50	50
AO2 Apply mathematical techniques	50	50

Question 1

Specimen answers

1 DO NOT USE A CALCULATOR IN THIS QUESTION.

The polynomial $p(x) = 2x^3 - 3x^2 + qx + 56$ has a factor $x - 2$.

(a) Show that $q = -30$. [1]

$$p(2) = 2(2)^3 - 3(2)^2 + q(2) + 56$$
$$p(2) = 0$$
$$\text{so } 16 - 12 + 2q + 56 = 0$$
$$2q = -60$$
$$q = -30$$

(b) Factorise $p(x)$ completely and hence state all the solutions of $p(x) = 0$. [4]

$$p(x) = 2x^3 - 3x^2 - 30x + 56$$
$$p(x) = (x-2)(2x^2 + x - 28)$$
$$p(x) = (x-2)(2x-7)(x+4)$$
$$x = 2,\ \frac{7}{2},\ -4$$

Examiner comment

Question 1(a)

As this is a 'Show that' question, it is essential that candidates show all their working. In this question, candidates preferably make use of the factor theorem. In this question, the candidate did exactly that, showing the substitution of $x = 2$ into each of the terms of the function. Each term was then simplified and hence the given result was obtained. One mark is available for this process. Although the other methods are acceptable, they are time consuming for just one mark.

Mark awarded = 1 out of 1

Question 1(b)

It must be noted that candidates are required to factorise first, and the use of the word 'hence' means that these results must be used to obtain the solutions. It is not expected that the candidate make use of their calculator in this question. As candidates were instructed not to use a calculator in this question, no marks would be awarded for this part if the candidate just gave the solutions with no working.

For this question, the candidate chose to factorise by observation, obtaining a linear factor and a quadratic factor initially. This is the method expected from a candidate who would gain high marks in this paper. A correct quadratic factor gained the candidate two B marks and subsequent factorisation of this correct quadratic factor earned the candidate a method mark. Three correct linear factors were obtained leading to the awarding of the final accuracy mark.

It is important that the questions are read carefully as sometimes a candidate will obtain the factors and then forget to obtain the solutions.

Mark awarded = 4 out of 4

Total mark awarded = 5 out of 5

Question 2

Specimen answers

2 Variables x and y are related by the equation $y = x\sqrt{x}$.

(a) Find $\dfrac{dy}{dx}$. [2]

$$y = x^{\frac{3}{2}}\text{ , so } \frac{dy}{dx} = \frac{3}{2}x^{\frac{1}{2}}$$

(b) Hence find the approximate change in x when y increases from 8 by the small amount 0.015. [3]

When $y = 8,\ x = 4$ and $\dfrac{dy}{dx} = 3$

Using $\delta y \approx \dfrac{dy}{dx} \times \delta x$ where $\delta y = 0.015$

$$0.015 \approx 3 \times \delta x$$

$$\delta x \approx 0.005$$

Examiner comment

Question 2(a)

This question requires straightforward differentiation. The candidate starts by simplifying the equation $y = x\sqrt{x}$ to $y = x^{\frac{3}{2}}$ which is awarded one B mark. Correct differentiation of this simplified equation gains the candidate the second B mark. It is expected that a high scoring candidate would use this method of simplification rather than attempt differentiation of a product.

Mark awarded = 2 out of 2

Question 2(b)

The word 'hence' means that the candidate is expected to make use of their result from part (a). The use of the rule involving small changes is expected. This must not be confused with rates of change, which is a common error.

The candidate calculated the value of x together with the value of $\dfrac{dy}{dx}$ when $y = 8$ in order to use the rule of small changes. A correct equation was then formed by the substitution of these values resulting in a correct solution. Full marks were gained by the candidate.

Mark awarded = 3 out of 3

Total mark awarded = 5 out of 5

Question 3

Specimen answers

3 **(a)** Express $12x^2 - 6x + 5$ in the form $p(x - q)^2 + r$, where p, q and r are constants to be found. [3]

$$\begin{aligned}12x^2 - 6x + 5 &= 12\left(x^2 - \frac{1}{2}x\right) + 5\\ &= 12\left(\left(x - \frac{1}{4}\right)^2 + \frac{1}{16}\right) + 5\\ &= 12\left(x - \frac{1}{4}\right)^2 + \frac{3}{4} + 5\\ &= 12\left(x - \frac{1}{4}\right)^2 + \frac{23}{4}\end{aligned}$$

(b) Hence find the greatest value of $(12x^2 - 6x + 5)^{-1}$ and state the value of x at which this occurs. [2]

$$\left(12x^2 - 6x + 5\right)^{-1} = \frac{1}{12\left(x - \frac{1}{4}\right)^2 + \frac{23}{4}}$$

Greatest value occurs when $x = \frac{1}{4}$

Greatest value is $\frac{4}{23}$

Examiner comment

Question 3(a)

Because it is often difficult to determine if a candidate has applied a correct method throughout the question, each of the values is worth one B mark. In this case, the candidate makes a slip in the completion of the square, by having $+\frac{1}{16}$ rather than $-\frac{1}{16}$. This means that the candidate obtained two marks even though their constant term was incorrect.

Mark awarded = 2 out of 3

Question 3(b)

The use of the word ‘hence’ means that the candidate is expected to make use of their result from part (a). Candidates may be tempted to use a method making use of calculus, but in this case, as the phrase ‘or otherwise’ has not been included in the wording of the question, such an approach would not be awarded any marks.

The candidate has realised that the greatest value occurs when the denominator of the fraction has a least value and has made use of the completed square form obtained in part (a).

The candidate is not penalised twice for the same error, using their incorrect $\frac{23}{4}$ correctly, and so gains full marks for this part of the question.

Answers given in terms of coordinates are allowed, but it is recommended that candidates give their answer in the form specified in the question.

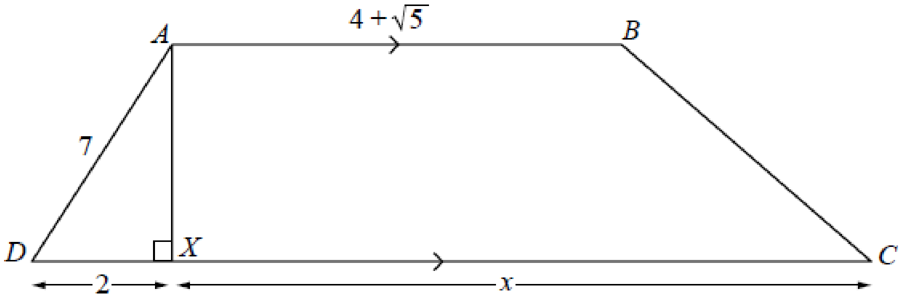
Mark awarded = 2 out of 2

Total mark awarded = 4 out of 5

Question 4

Specimen answer

4 DO NOT USE A CALCULATOR IN THIS QUESTION.



The diagram shows a trapezium *ABCD* in which *AD* = 7 cm and *AB* = $(4+\sqrt{5})$ cm. *AX* is perpendicular to *DC* with *DX* = 2 cm and *XC* = *x* cm.

Given that the area of trapezium *ABCD* is $15(\sqrt{5}+2)$ cm^2, obtain an expression for *x* in the form $a+b\sqrt{5}$, where *a* and *b* are integers. [6]

$$\text{Area of trapezium} = \frac{1}{2}\ (\text{ sum of the parallel sides}) \times (\text{the distance between them})$$

$$15\left(\sqrt{5}+2\right)=\frac{1}{2}\left(2+x+4+\sqrt{5}\right)\left(\sqrt{7^2-2^2}\right)$$

$$30\left(\sqrt{5}+2\right)=\left(6+\sqrt{5}+x\right)\left(\sqrt{45}\right)$$

$$30\left(\sqrt{5}+2\right)=\left(6+\sqrt{5}+x\right)\left(3\sqrt{5}\right)$$

$$10\left(\sqrt{5}+2\right)=\left(6+\sqrt{5}+x\right)\left(\sqrt{5}\right)$$

$$10\sqrt{5}+20=\left(6+\sqrt{5}+x\right)\left(\sqrt{5}\right)$$

$$10+\frac{20}{\sqrt{5}}=\left(6+\sqrt{5}+x\right)$$

$$10+4\sqrt{5}=\left(6+\sqrt{5}+x\right)$$

$$x=4+3\sqrt{5}$$

Examiner comment

Question 4

It is essential that candidates do not use a calculator in this question. It is also essential that each step of working is shown in order to convince an examiner that a calculator has not been used. In this question the candidate has done exactly that. A candidate expected to gain a high grade on this paper should be able to produce a solution of this type without the use of a calculator.

The candidate recognised that the shape in question is a trapezium and found the length of AX making use of Pythagoras' theorem expressing this length in its simplest surd form.

The formula for the area of the trapezium was used, with the candidate substituting in all the given information correctly together with the length of AX.

Each step of the simplification process was shown and so obtained all the available marks. There are different approaches to this simplification, but expansion and rationalisation need to be seen somewhere in this process.

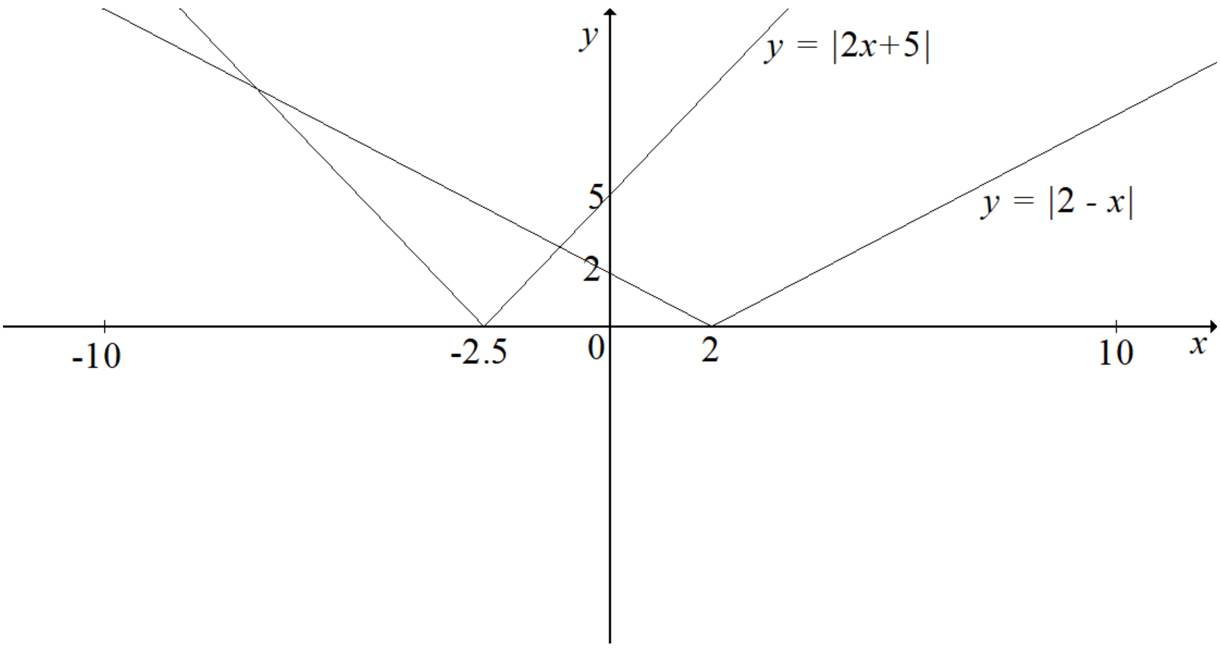
It is also acceptable to treat the shape as a rectangle and two triangles, but this method will involve more simplification.

Mark awarded = 6 out of 6

Question 5

Specimen answers

5 **(a)** On the axes below, sketch the graph of $y = |2x + 5|$ and the graph of $y = |2 - x|$, stating the coordinates of the points where each graph meets the coordinate axes. [4]



(b) Solve $|2x + 5| \leqslant |2 - x|$. [3]

Critical values:

$2x+5=2-x$ so $x=-1$

$2x+5=-2+x$ so $x=-7$

Using graph in part (a) $-7 < x < -1$

Examiner comment

Question 5(a)

The candidate drew a straight line graph for $y = 2x + 5$ and for $y = 2 - x$ reflecting the part of the line below the x-axis in the x-axis in order to obtain the correct graphs of the given functions.

Both 'arms' of each of the graphs are symmetrical about a vertical line through the vertex of the graph. It is essential that the intercepts of the graphs with the axes are labelled on the graph.

B2 was awarded as both graphs are the correct shape and both have their vertices in the correct quadrant. B1 was given for each correct pair of intercepts.

Mark awarded = 4 out of 4

Question 5(b)

The candidate recognised that, although the word 'hence' had not been used, parts (a) and (b) are connected, as the same equations are being used. It was not expected that candidate should read off the values of x from the points of intersection of the two graphs as part (a) is only a sketch and, therefore, not of the required accuracy.

Candidates can square both sides of the equation and obtain the critical values from the solution of the resulting quadratic equation.

The candidate chose to form two linear equations from the original equation. Care was taken with the signs of these equations and the resulting simplification in order to obtain the two correct critical values.

The candidate made reference to the sketch graph in part (a) in an attempt to write down the correct inequality using the critical values. However, incorrect signs have been used in the final answer, i.e. $<$ rather than $\leqslant$. This meant that the final accuracy mark was not awarded.

Mark awarded = 2 out of 3

Total mark awarded = 6 out of 7

Question 6

Specimen answer

6 Find the equation of the normal to the curve $y = \frac{2x-1}{\sqrt{x^2+5}}$ at the point where $x = 2$.

Give your answer in the form $ax + by = c$, where a, b and c are integers. [8]

$$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{2\left(x^2+5\right)^{\frac{1}{2}} - (2x-1)\frac{1}{2}\left(x^2+5\right)^{-\frac{1}{2}}}{x^2+5}$$

When $x = 2$, $y = 1$ and $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{6-\frac{1}{2}}{9}$

The gradient of the tangent is $\frac{11}{18}$

The gradient of the normal is $-\frac{18}{11}$

Equation of the normal $\quad y-1 = -\frac{18}{11}(x-2)$

$$11y - 11 = -18x + 36$$

$$18x + 11y = 47$$

Examiner comment

Question 6

This question tests the use of the quotient rule in differentiation. It is acceptable to write the function as a product and use the product rule although it is more likely that sign errors will occur using this approach. It is recommended that if the function is given as a quotient, it should be differentiated as a quotient. The question also tests the use of the chain rule.

The candidate made use of the quotient rule, as was expected, and attempted to use the chain rule in order to obtain the gradient of the curve at the given point. An error in the differentiation of $\left(x^2+5\right)^{\frac{1}{2}}$ meant that the candidate was unable to obtain the available B mark. However, an attempt to use the quotient rule with the correct order of terms and a difference in the numerator meant that the candidate was able to gain the method mark available. It is suggested that candidates substitute in the value of $x = 2$ into the unsimplified form of the derivative as it is less likely that an error from numerical simplification will occur than it is from algebraic simplification. The candidate did attempt this, although the value of the gradient obtained was incorrect. A correct value for y when $x = 2$ was obtained.

A knowledge of the property relating the gradients of perpendicular lines is needed, together with the formation of the equation of a straight line with a given gradient passing through a given point.

The candidate made use of the straight line form $y - y_1 = m\left(x - x_1\right)$ as only a simple substitution and simplification to the required form is needed. A valid attempt at the equation of the normal was made as the candidate had found the gradient of the normal using their incorrect gradient at the point $(2,\ 1)$. The final answer was given in the required form. The error in the application of the chain rule meant that the candidate was able to obtain all the method marks available and the B mark for $y = 1$. Setting the solution out clearly meant that the examiner was able to identify the correct methods where they were applied and award the marks appropriately.

Sometimes, when the form $y = mx + c$ is used, candidates will find c and then not give the equation. Provided the equation is given then this method is of course acceptable.

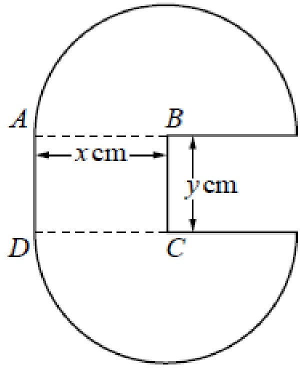
It should also be noted in this question that a specific form of the normal is required.

Mark awarded = 4 out of 8

Question 7

Specimen answers

7



The diagram shows a badge, made of thin sheet metal, consisting of two semi-circular pieces, centres *B* and *C*, each of radius *x* cm. They are attached to each other by a rectangular piece of thin sheet metal, *ABCD*, such that *AB* and *CD* are the radii of the semicircular pieces and *AD* = *BC* = *y* cm.

(a) Given that the area of the badge is 20 cm^2, show that the perimeter, *P* cm, of the badge is given by

$$P = 2x + \frac{40}{x}.$$ [4]

Area of the badge = area of a circle of radius *x* + area of a rectangle *x* by *y*

$$20 = \pi x^2 + xy$$

$$y = \frac{20}{x} - \pi x$$

Perimeter of the badge = circumference of a circle radius x + $2x + 2y$

$$P = 2\pi x + 2x + 2\left(\frac{20}{x} + \pi x\right)$$

$$P = 2x + \frac{40}{x}$$

(b) Given that x can vary, find the minimum value of P, justifying that this value is a minimum. [5]

$$P = 2x + \frac{40}{x}$$

$$\frac{dP}{dx} = 2 - \frac{40}{x^2}$$

When $\frac{dP}{dx} = 0,\ x = 2\sqrt{5}$

$\frac{d^2P}{dx^2} = \frac{80}{x^3}$ which is positive when $x = 2\sqrt{5}$ so P has a minimum value

Examiner comment

Question 7(a)

This question is structured so that if a candidate is unable to do the first part of the question, they have a given answer which they may use in part (b).

The candidate recognised that a relationship between x and y was needed to start with. The area of the shape in terms of x and y was found and then equated to 20, resulting in a correct equation giving y in terms of x. The perimeter of the shape was then calculated in terms of x and y and then, using the previous work, the perimeter of the shape was obtained in terms of x only, by eliminating y.

Each step of the process was carried out clearly so that the reasoning of the candidate could be checked and followed. Full marks were given for this clear and concise solution.

There is an alternate method which may be used, which involves obtaining the perimeter of the shape in terms of both x and y as well as the area of the shape in terms of both x and y, but the candidate made use of the more straightforward approach.

Mark awarded = 4 out of 4

Question 7(b)

Differentiation of the result from part (a) with respect to x is necessary. The candidate was aware that the letter P was being used and used the appropriate notation.

Equating this result to zero and solving the resulting equation was shown clearly and the resulting value of x was kept in an exact form, even though this was not specified in the question. It is worth mentioning that it is probably easier to keep the value of x obtained in exact form as it is a relatively simple surd and errors can occur when copying out numbers to several significant figures.

A substitution of the value for x was not made to find the corresponding value of P. This is often not done as the candidate may think that the value of x they have just found is the minimum value. An answer in surd form or to three significant figures would have been acceptable.

Justification that this is a minimum value was made using the second derivative.

A clearly well set out solution which loses the accuracy mark available for the value of P. This highlights the necessity of the candidate checking that they have actually fulfilled the requirements of the question.

Inspection of the gradient either side of the stationary value, together with the correct conclusion, would also have been acceptable. When using the second derivative, it is acceptable to make a statement to the effect that as x is positive, $\frac{80}{x^3}$ is always positive and therefore the stationary point is a minimum. It should be noted that if candidates substitute in the value for x, a correct value must be obtained, together with a conclusion, to obtain the mark available.

Mark awarded = 4 out of 5

Total mark awarded = 8 out of 9

Question 8

Specimen answers

8 **(a)** Giving your answer in its simplest form, find the exact value of

(i) $\int_{0.2}^{1} e^{5x-1}\, dx$, [4]

$$\left[\frac{1}{5}e^{5x-1}\right]_{0.2}^{1} = \frac{1}{5}\left(e^4 - 1\right)$$

(ii) $\int_{1}^{2} \left(x + \frac{1}{x^2}\right)^2 dx$. [5]

$$\int_1^2 x^2 + \frac{2}{x} + \frac{1}{x^4}\ dx = \left[\frac{x^3}{3} + 2\ln x - \frac{1}{3x^3}\right]_1^2$$

$$= \left(\frac{8}{3} + 2\ln 2 - \frac{1}{24}\right) - \left(\frac{1}{3} - \frac{1}{3}\right)$$

$$= 4.01$$

(b) Find $\int \sin\frac{x}{6}\, dx$. [2]

$$-6\cos\frac{x}{6} + c$$

Examiner comment

Question 8(a)

(i) This is a question designed to test integration involving an exponential function. The candidate recalled that the index of the exponential function remains unchanged when integrating and that all they had to consider was the coefficient of the exponential term. This was done correctly.

A correct application of the limits into the square bracket notation was made, with the candidate realising that when $x = 0$ was substituted, the exponential term had a non-zero value. It is worth writing the substitution of the limits out in full in order to demonstrate a correct method, as the candidate has done.

The exact form of the answer was also required and this was given by the candidate.

Mark awarded = 4 out of 4

(ii) This question is to test that the candidate knows that an expansion and simplification of the brackets is necessary before any integration is attempted. Integration involves the introduction of a logarithmic term as well as the standard result used for terms of the type $kx^n, n \neq -1$. The candidate was able to show all this clearly with work set out well. As in the previous part, substitution of the limits correctly into the square bracket notation was needed. Once again, it was essential that this was done clearly so that a correct method can be evidenced. Limits were substituted in the correct order and the difference of the two separate values found. An exact answer was again required, however, the candidate made use of their calculator and thus was unable to gain the last accuracy mark after obtaining all the other available marks. This highlights the need for candidates to check that the response they have given is in the required form.

It must also be noted that questions of this type can be done using the numerical integration function available on many calculators which are now available and which can be used in this examination. An answer-only in questions of this type will not obtain any marks as all workings must be shown.

Mark awarded = 4 out of 5

Question 8(b)

A very straightforward example of integration of a trigonometric function. The candidate realised that the answer contained $\cos\frac{x}{6}$ and calculated the appropriate coefficient. An arbitrary constant was included in the final answer, thus gaining full marks.

It is very easy for candidates to mix up integration and differentiation when dealing with trigonometric functions such as this one, so care must be taken. It is expected that an arbitrary constant is included in the final answer as this is an indefinite integral.

Mark awarded = 2 out of 2

Total mark awarded = 10 out of 11

Question 9

Specimen answer

9 DO NOT USE A CALCULATOR IN THIS QUESTION.

In the expansion of $(1 + 2x)^n$, the coefficient of x^4 is ten times the coefficient of x^2.

Find the value of the positive integer n. [6]

$${}^nC_4(1)^{n-4}(2)^4 = 10\,{}^nC_2(1)^{n-2}(2)^2$$

$$\frac{n!}{(n-4)!4!}\times 16 = 10\times\frac{n!}{(n-2)!2!}\times 4$$

$$\frac{2}{3} = \frac{20}{(n-2)(n-3)}$$

$$(n-2)(n-3) = 30$$

$$n^2 - 5n - 24 = 0$$

$$(n-8)(n+3) = 0$$

n is a positive integer so $n = 8$

Examiner comment

Question 9

For this question, candidates need to be familiar with either the general term of the binomial expansion or the expansion of $(1 + 2x)^n$. Here, the candidate chose to use the general term of the binomial expansion and identified and used the correct terms. Knowledge of simplification of algebraic factorial terms was shown as the general term method is used, whereas if a straightforward use of the expansion of $(1 + 2x)^n$ is used, this simplification would not have been necessary. One of the most common errors when dealing with binomial expansions is not taking the correct powers of the coefficients of the terms in x. In this case, the candidate showed a full understanding of the problem and was able to simplify the correct equation obtained from the given information. The resulting quadratic equation and its factorisation was shown clearly and the correct solutions were obtained. The negative root was discarded and so the candidate was able to obtain full marks. Inclusion of the negative solution would have resulted in the loss of the final accuracy mark. This highlights the need for candidates to also check that the answer they have is appropriate. Inclusion of the negative solution will result in A0.

Mark awarded = 6 out of 6

Question 10

Specimen answers

10 **(a)** An arithmetic progression has a first term of 5 and a common difference of –3.

Find the number of terms such that the sum to n terms is first less than –200. [4]

$$a = 5,\ d = -3$$

$$S_n = \frac{n}{2}\left(10 + (n-1)(-3)\right)$$

$$\frac{n}{2}(10 - 3n + 3) < -200$$

$$13n - 3n^2 + 400 < 0$$

$$3n^2 - 13n - 400 > 0$$

Critical values: $n = \dfrac{13 \pm \sqrt{169 + 4800}}{6}$

$n = 13.9$ as n must be positive

n must be an integer that satisfies $3n^2 - 13n - 400 > 0$, so $n = 14$

(b) A geometric progression is such that its 3rd term is equal to $\frac{81}{64}$ and its 5th term is equal to $\frac{729}{1024}$.

(i) Find the first term of this progression and the positive common ratio of this progression. [5]

$$ar^2 = \frac{81}{64} \text{ and } ar^4 = \frac{729}{1024}$$

$$\frac{81}{64}r^2 = \frac{729}{1024}$$

$$r^2 = \frac{9}{16}$$

$$r = \pm\frac{3}{4}$$

$$a \times \frac{9}{16} = \frac{81}{64}$$

$$a = \frac{9}{4}$$

(ii) Hence find the sum to infinity of this progression. [1]

$$S_\infty = \frac{9/4}{1 - 3/4}$$

$$S_\infty = 9$$

Examiner comment

Question 10(a)

The candidate used the notation that is common to arithmetic progressions to write the information given in the question using this notation, i.e. $a = 5$, $d = -3$. This made it easier to substitute into the formula for the sum to n terms and simplify. The candidate chose to treat the question as an inequality until it came to finding the critical values for the resulting quadratic inequality. Use of the quadratic formula was made as factorisation was not possible. The candidate realised that the number of terms in an expansion has to be a positive integer, so only the positive root of the quadratic equation was considered and rounded up to give the correct integer value required. Full marks were given for this clear and concise solution.

Mark awarded = 4 out of 4

Question 10(b)

(i) As with the previous part, the candidate chose to use the notation that is commonly used for geometric progressions, write down each of the two terms in terms of both a and r and equate them to the given two pieces of information. The resulting two equations were solved using a division method which resulted in an equation in r^2 only. The candidate did not discard the negative root for the common ratio even though they had been told that it was a positive common ratio. Again, this highlights the need to check that the answers given are appropriate. As a result, the candidate was unable to obtain the accuracy mark for the common ration. As the value of r^2 was positive whatever value of r was taken, the candidate was not penalised for the value of the first term found. It was essential that the candidate used the correct formula for the nth term as it is a given formula.

Mark awarded = 4 out of 5

(ii) This part of the question requires the use of the sum to infinity equation, which is a given formula, together with the values of a and r found in part (i). The candidate used their positive value of the common ratio correctly to gain full marks.

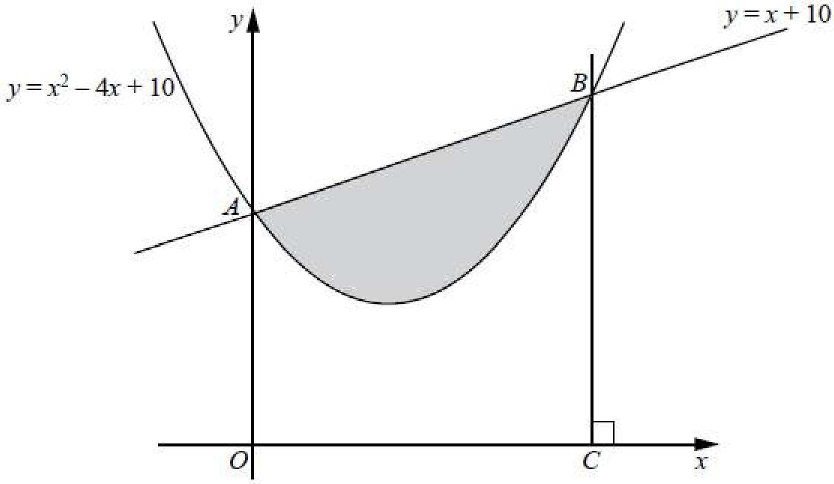
Mark awarded = 1 out of 1

Total mark awarded = 9 out of 10

Question 11

Specimen answer

11



The graph of $y = x^2 - 4x + 10$ cuts the y-axis at point A. The graphs of $y = x^2 - 4x + 10$ and $y = x + 10$ intersect one another at the points A and B. The line BC is perpendicular to the x-axis. Calculate the area of the shaded region enclosed by the curve and the line AB. [8]

Coordinates of A $(0,10)$

At B $\quad x^2 - 4x + 10 = x + 10$

$$x^2 - 5x = 0$$

$x(x-5) = 0$ so at B, $x = 5$ and $y = 15$

Shaded area = area of trapezium $ABCO$ − area under the curve

$$= \frac{1}{2}(15+10)(5) - \int_0^5 x^2 - 4x + 10 \, \mathrm{d}x$$

$$= \frac{125}{2} - \left[\frac{x^3}{3} - 2x^2 + 10x\right]_0^5$$

$$= \frac{125}{2} - \left(\left(\frac{125}{3} - 50 + 50\right) - 0\right)$$

$$= \frac{125}{6}$$

Examiner comment

Question 11

This unstructured question required the candidate to formulate a plan of action, which they correctly did, as evidenced by the well set-out solution.

The coordinates of both A and B needed to be found first and this was done by finding the intersection of the given curve and the given line using simultaneous equations. A simple quadratic equation gave the values of x at both A and B. The candidate chose to write down the coordinates of A straightaway which was perfectly acceptable and obtained the x-coordinate of B from the correct solution of the quadratic equation.

There were two possible ways forward and the candidate chose to make use of the following method:

Area of shaded region = area of trapezium – area under the curve enclosed by the x- and y-axes.

This was fairly straightforward as the candidate knew the formula for the area of a trapezium so this was calculated easily from the initial work done. A straightforward integration and application of the limits obtained in the initial work then followed. Each step of the problem solution was set out well and was easy for the examiner to follow. This resulted in full marks being awarded.

As an alternative, use of a subtraction method which leads to a straightforward integration and application of limits would also have been acceptable.

Mark awarded = 8 out of 8

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