YEARLY PAST PAPERS
WITH TOPICAL QUESTIONS TRACKER

Cambridge IGCSE

Additional Mathematics (0606) Paper 2

SAMPLE EDITION
2018 QUESTION PAPERS & MARK SCHEMES

Note:

Introduction

Topical Questions Tracker: An Efficient Study Tool

A Topical Questions Tracker is a powerful tool, integrated as an appendix to Yearly Past Papers, enhancing the functionality of utilising Past Papers. This tool allows you to locate specific questions by topic, providing a much more efficient way to study for exams.

How the Topical Questions Tracker Works

The Topical Questions Tracker is organized according to the latest syllabus of the subject. Each topic includes a comprehensive list of all relevant questions from the yearly past papers. For each question, the tracker provides:

- The paper's code
- The question number
- The sub-question number (if applicable)
- The page number where the question is located, which is hyperlinked for easy navigation

By clicking on the linked page number, you can jump directly to the corresponding page in the document, making it quick and simple to find the exact question you're looking for.

Advantages of Topical Questions Trackers Over Traditional Past Papers

While traditional Topical Past Papers classify entire questions under a single topic, many questions contain sub-questions that may cover different topics. This can make it difficult to find specific practice material for a particular area of study.

The Topical Questions Tracker overcomes this limitation by categorizing each sub-question individually. This precise classification ensures that each part of the question is assigned to the appropriate topic, providing a more targeted and effective revision tool.

Efficient Navigation Tips

While the Topical Questions Tracker allows you to jump directly to specific questions by clicking on the linked page numbers, navigating back to the previous page to find the next question can be time-consuming and somewhat frustrating. To streamline this process, you can utilize the 'Previous View' and 'Next View' commands in Adobe Reader.

To access these commands, navigate to the menu and select View » Go to » Previous View or Next View. Alternatively, you can use the shortcut keys for quicker navigation:

- Previous View: ALT + Left Arrow
- Next View: ALT + Right Arrow

These commands enable you to seamlessly move back and forth between the last two pages visited, enhancing your study efficiency by minimizing unnecessary navigation steps.

Contents

1 2018 | Feb/Mar | Variant 2 | 0606_m18_qp_22 **3**
1.1 2018 | Feb/Mar | Variant 2 | 0606_m18_ms_22 . . . 20

2 2018 | May/Jun | Variant 2 | 0606_s18_qp_22 **30**
2.1 2018 | May/Jun | Variant 2 | 0606_s18_ms_22 . . . 47

3 2018 | May/Jun | Variant 3 | 0606_s18_qp_23 **58**
3.1 2018 | May/Jun | Variant 3 | 0606_s18_ms_23 . . . 75

4 2018 | Oct/Nov | Variant 1 | 0606_w18_qp_21 **85**
4.1 2018 | Oct/Nov | Variant 1 | 0606_w18_ms_21 . . . 102

5 2018 | Oct/Nov | Variant 2 | 0606_w18_qp_22 **111**
5.1 2018 | Oct/Nov | Variant 2 | 0606_w18_ms_22 . . . 128

6 2018 | Oct/Nov | Variant 3 | 0606_w18_qp_23 **139**
6.1 2018 | Oct/Nov | Variant 3 | 0606_w18_ms_23 . . . 156

A Topical Questions Tracker **165**
A.1 Functions . . . 165
A.2 Quadratic functions . . . 165
A.3 Equations, inequalities and graphs . . . 165
A.4 Indices and surds . . . 165
A.5 Factors of polynomials . . . 165
A.6 Simultaneous equations . . . 165
A.7 Logarithmic and exponential functions . . . 165
A.8 Straight line graphs . . . 165
A.9 Circular measure . . . 166
A.10 Trigonometry . . . 166
A.11 Permutations and combinations . . . 166
A.12 Series . . . 166
A.13 Vectors in two dimensions . . . 166
A.14 Differentiation and integration . . . 166

1 2018 | Feb/Mar | Variant 2 | 0606_m18_qp_22

Topic & Sub-topic Index of Questions

No.	Sub Q.	Topic	QP Page	MS Page
2		Quadratic functions	7	24
3		Permutations and combinations	7	24
4		Trigonometry	8	24
5		Vectors in two dimensions	9	25
6		Differentiation and integration	9	25
7		Circular measure	10	25
8		Logarithmic and exponential functions	11	25
9		Straight line graphs	12	26
10		Logarithmic and exponential functions	13	27
11		Trigonometry	15	28
12		Differentiation and integration	17	28

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4569060243

ADDITIONAL MATHEMATICS **0606/22**

Paper 2 **February/March 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **14** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

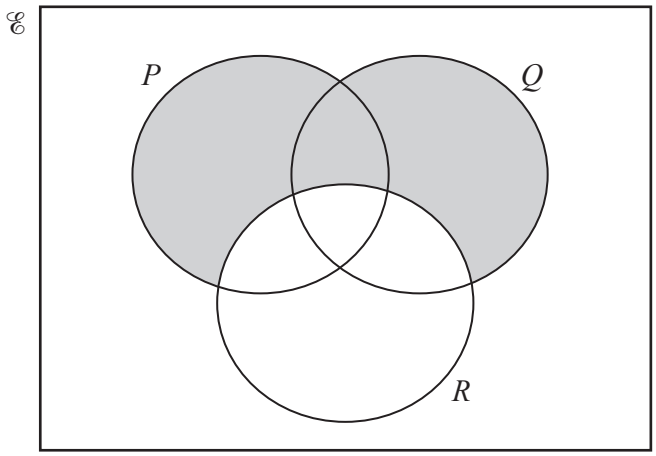
Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\Delta = \frac{1}{2} bc \sin A$$

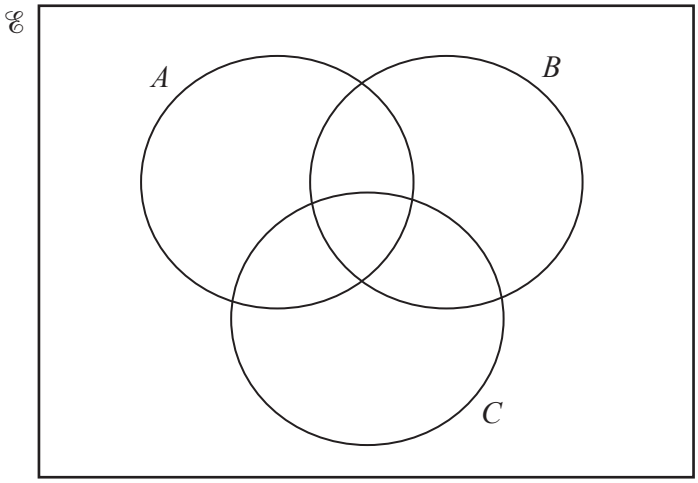
1 (a)



Using set notation, write down the set represented by the shaded region. [1]

(b) $\mathscr{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
$A = \{x: x \text{ is a prime number}\}$
$B = \{x: x \text{ is an even number}\}$
$C = \{1, 2, 3, 4, 8\}$

(i) Complete the Venn diagram to show the elements of each set. [3]



(ii) Write down the value of $\mathrm{n}((A \cup B \cup C)')$. [1]

2 Determine the set of values of k for which the equation $(3-2k)x^2+(2k-3)x+1=0$ has no real roots. [5]

3 A group of five people consists of two women, Alice and Betty, and three men, Carl, David and Ed.

(i) Three of these five people are chosen at random to be a chairperson, a treasurer and a secretary. Find the number of ways in which this can be done if the chairperson and treasurer are both men. [2]

These five people sit in a row of five chairs. Find the number of different possible seating arrangements if

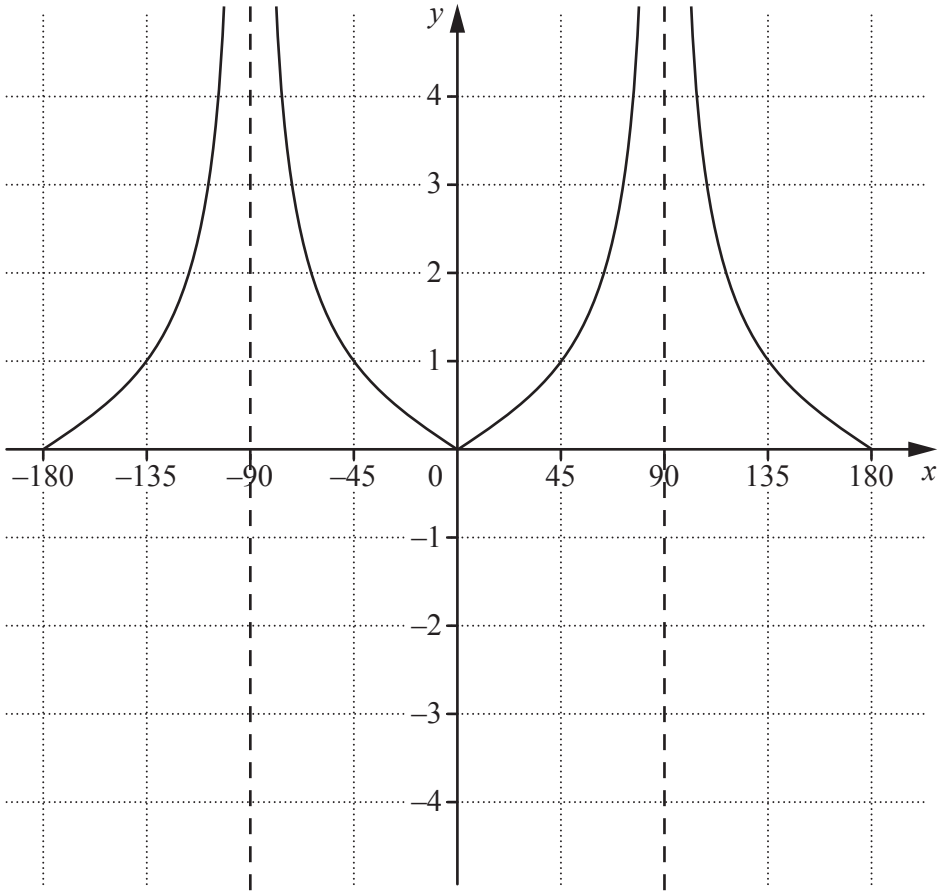
(ii) David must sit in the middle, [1]

(iii) Alice and Carl must sit together. [2]

4 **(a)** **(i)** State the amplitude of $15\sin 2x - 5$. [1]

(ii) State the period of $15\sin 2x - 5$. [1]

(b)

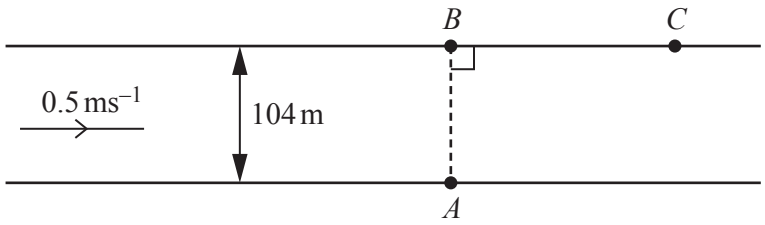


The diagram shows the graph of $y = |\mathrm{f}(x)|$ for $-180^\circ \leqslant x^\circ \leqslant 180^\circ$, where $\mathrm{f}(x)$ is a trigonometric function.

(i) Write down two possible expressions for the trigonometric function $\mathrm{f}(x)$. [2]

(ii) State the number of solutions of the equation $|\mathrm{f}(x)| = 1$ for $-180^\circ \leqslant x^\circ \leqslant 180^\circ$. [1]

5

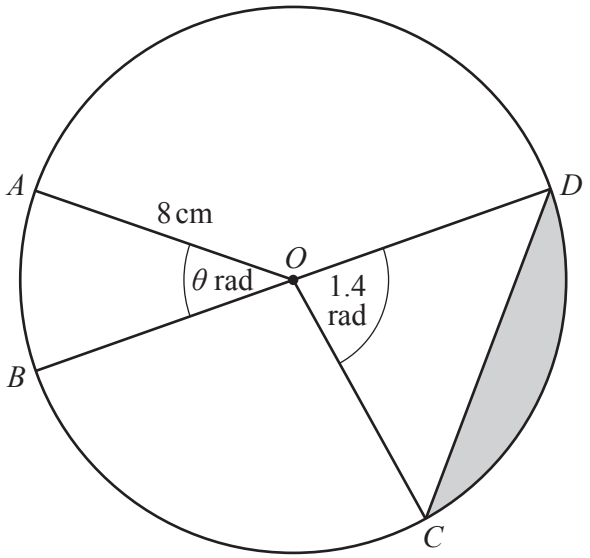


A river is 104 metres wide and the current flows at $0.5\,\text{ms}^{-1}$ parallel to its banks. A woman can swim at $1.6\,\text{ms}^{-1}$ in still water. She swims from point A and aims for point B which is directly opposite, but she is carried downstream to point C. Calculate the time it takes the woman to swim across the river and the distance downstream, BC, that she travels. [4]

6 **(i)** Differentiate $1 + \tan\left(\frac{x}{3}\right)$ with respect to x. [2]

(ii) Hence find $\int \sec^2\left(\frac{x}{3}\right)\mathrm{d}x$. [2]

7



The diagram shows a circle with centre O and radius 8 cm. The points A, B, C and D lie on the circumference of the circle. Angle $AOB = \theta$ radians and angle $COD = 1.4$ radians. The area of sector AOB is $20\,\text{cm}^2$.

(i) Find angle θ. [2]

(ii) Find the length of the arc AB. [2]

(iii) Find the area of the shaded segment. [3]

8 **(a)** Solve the following equations.

(i) $5e^{3x+4} = 14$ [2]

(ii) $\lg(2y - 7) + \lg y = 2\lg 3$ [4]

(b) Write $\dfrac{\log_2 p - \log_2 q}{(\log_2 r)(\log_r 2)}$ as a single logarithm to base 2. [2]

9 Solutions to this question by accurate drawing will not be accepted.

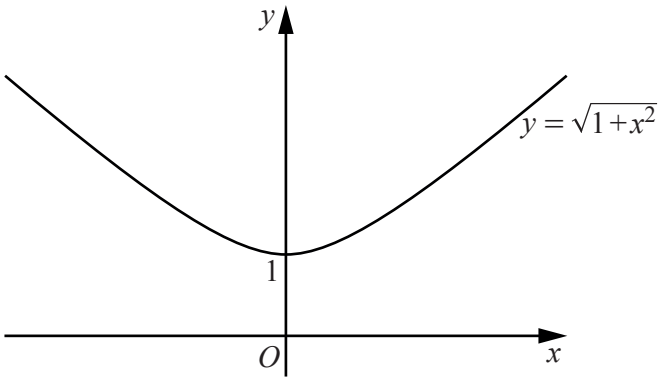
P is the point (8, 2) and Q is the point (11, 6).

(i) Find the equation of the line L which passes through P and is perpendicular to the line PQ. [3]

The point R lies on L such that the area of triangle PQR is 12.5 units^2.

(ii) Showing all your working, find the coordinates of each of the two possible positions of point R. [6]

10 **(a)** The function f is defined by $f(x) = \sqrt{1+x^2}$, for all real values of x. The graph of $y = f(x)$ is given below.



(i) Explain, with reference to the graph, why f does not have an inverse. [1]

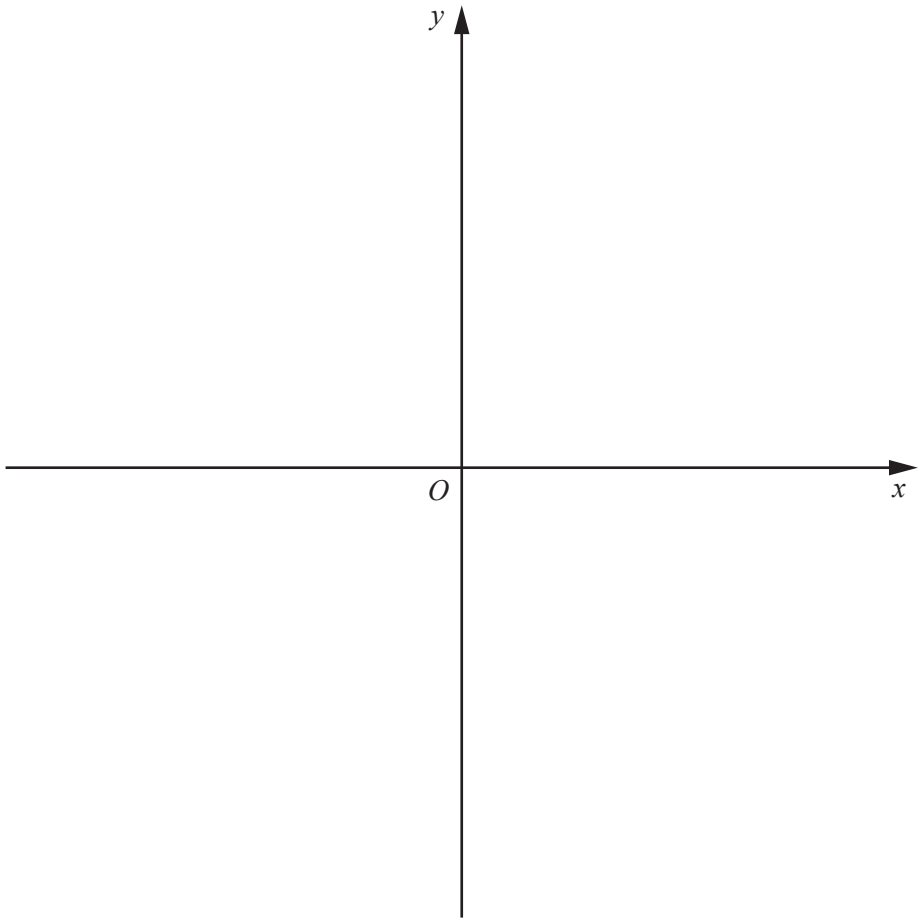
(ii) Find $f^2(x)$. [2]

(b) The function g is defined, for $x > k$, by $g(x) = \sqrt{1+x^2}$ and g has an inverse.

(i) Write down a possible value for k. [1]

(ii) Find $g^{-1}(x)$. [2]

(c) The function h is defined, for all real values of x, by $\mathrm{h}(x) = 4\mathrm{e}^x + 2$. Sketch the graph of $y = \mathrm{h}(x)$. Hence, on the same axes, sketch the graph of $y = \mathrm{h}^{-1}(x)$. Give the coordinates of any points where your graphs meet the coordinate axes. [4]



11 **(a)** **(i)** Show that $\dfrac{(1-\sin A)(1+\sin A)}{\sin A\cos A} = \cot A$. [2]

(ii) Hence solve $\dfrac{(1-\sin 3x)(1+\sin 3x)}{\sin 3x\cos 3x} = \dfrac{1}{2}$ for $0° \leqslant x \leqslant 180°$. [4]

(b) Solve $10\tan^2 y - \sec y - 1 = 0$ for $0 \leqslant y \leqslant 2\pi$ radians. [5]

12 The volume, V, and surface area, S, of a sphere of radius r are given by $V = \frac{4}{3}\pi r^3$ and $S = 4\pi r^2$ respectively.

The volume of a sphere increases at a rate of $200\,\text{cm}^3$ per second. At the instant when the radius of the sphere is 10 cm, find

(i) the rate of increase of the radius of the sphere, [4]

(ii) the rate of increase of the surface area of the sphere. [3]

BLANK PAGE

BLANK PAGE

1.1 2018 | Feb/Mar | Variant 2 | 0606_m18_ms_22

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/22**

Paper 22 **March 2018**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the March 2018 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method marks, awarded for a valid method applied to the problem.

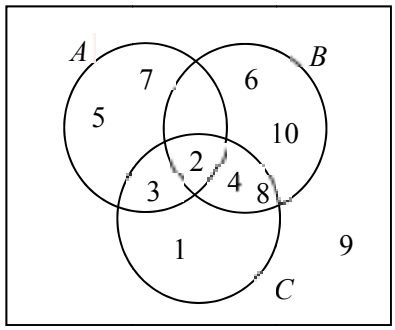
A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

B Mark for a correct result or statement independent of Method marks.

When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

Abbreviations

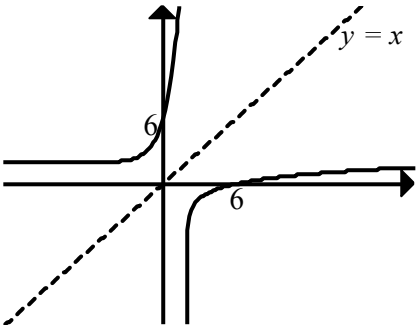
awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)	$(P \cup Q) \cap R'$ oe	**B1**	
1(b)(i)		**B3**	**B3, 2, 1, 0:** key statements: 2 correctly placed 3, 4, 8 correctly placed 1, 5, 7, 6, 10 correctly placed 9 correctly placed
1(b)(ii)	1	**B1**	**FT** *their* (b)(i); do not allow (1) or {1} etc.
2	$(2k-3)^2 - 4(3-2k)(1)$	**M1**	
	$4k^2 - 4k - 3$	**A1**	
	$(2k-3)(2k+1)$	**M1**	
	critical values are –0.5 and 1.5	**A1**	
	$(their(-0.5) < k < their1.5$	**A1**	**FT** *their* distinct critical values provided both M marks awarded; mark final answer; allow a pair of correctly connected inequalities e.g. $k > -0.5$ and $k < 1.5$
3(i)	${}^3P_2 \times {}^3P_1$ or $3 \times 2 \times 3$ oe soi	**M1**	
	18	**A1**	If **M0** then **SC1** for ${}^3P_2 \times {}^2P_1 = 12$ or $3 \times 2 \times 2 = 12$
3(ii)	24	**B1**	
3(iii)	$2 \times 4!$ oe soi	**M1**	
	48	**A1**	If **M0** then **SC1** for an answer following one omitted or incorrect factor/factorial e.g. 4! = 24 or ${}^4P_4 = 24$ or ${}^3P_3 \times 4 = 24$ or $2! \times 3! = 12$ or $2! \times 4 = 8$ or $(2! \times 3!) \times 3 = 36$
4(a)(i)	15	**B1**	
4(a)(ii)	180° or π (radians)	**B1**	
4(b)(i)	tan*x*, –tan*x*	**B2**	**B1** for each
4(b)(ii)	4	**B1**	

Question	Answer	Marks	Partial Marks
5	$\frac{104}{1.6}$ oe	**M1**	or e.g. $\frac{104}{\cos 17.354...} \div \sqrt{1.6^2 + 0.5^2}$
	65 or 64.9 to 65.1 (seconds)	**A1**	
	0.5 × *their* 65 oe	**M1**	or $\sqrt{\left(\frac{104}{\cos 17.354...}\right)^2 - 104^2}$ or finds a correct angle using trigonometry and then uses trigonometry again to find *BC* e.g. 104 × tan 17.354...
	32.5 or 32.49 to 32.6(metres)	**A1**	
6(i)	$\frac{d}{dx}\left(\tan\left(\frac{x}{3}\right)\right) = k\sec^2\left(\frac{x}{3}\right)$	**M1**	
	$\frac{1}{3}\sec^2\left(\frac{x}{3}\right)$ cao	**A1**	
6(ii)	$3\tan\left(\frac{x}{3}\right) + c$ oe	**B2**	**B1** for $3\tan\left(\frac{x}{3}\right) + 3$ or **M1** for $\int their \frac{dy}{dx} dx = \tan\left(\frac{x}{3}\right) +$ a constant
7(i)	$\frac{1}{2} \times 8^2 \times \theta = 20$ or $\pi \times 8^2 \times \frac{\theta}{360} = 20$	**M1**	
	$[\theta =] \frac{5}{8}$ or 0.625 rads oe	**A1**	
7(ii)	8 × *their* θ oe	**M1**	
	5 (cm) cao	**A1**	
7(iii)	$\frac{1}{2} \times 8^2 \times 1.4$ and $\frac{1}{2} \times 8^2 \times \sin 1.4$ soi	**M2**	**M1** for either area seen
	13.3 or 13.26 to 13.27 [cm^2]	**A1**	
8(a)(i)	$3x + 4 = \ln\left(\frac{14}{5}\right)$ oe OR $3x + 4 = \ln 14 - \ln 5$ oe	**M1**	
	$x = -0.99(012\ldots)$ isw or exact equivalent	**A1**	

Question	Answer	Marks	Partial Marks
8(a)(ii)	$\lg(2y^2 - 7y) = \lg 3^2$ soi	**B2**	**B1** for each of 2 correct moves
	$2y^2 - 7y - 9 = 0$ and attempt to solve	**M1**	
	$y = 4.5$ oe only	**A1**	
8(b)	$\log_2\left(\frac{p}{q}\right)$ as final answer www	**B2**	**B1** for numerator correctly simplified to $\log_2 p - \log_2 q = \log_2\left(\frac{p}{q}\right)$ or change of base $\log_r 2 = \frac{1}{\log_2 r}$ oe soi
9(i)	$m_{PQ} = \frac{6-2}{11-8}$ or better	**M1**	
	$m_L = \frac{-1}{their\ \frac{4}{3}}$ oe	**M1**	
	$y - 2 = -\frac{3}{4}(x - 8)$ isw or $y = -\frac{3}{4}x + c \quad c = 8$ isw	**A1**	

Question	Answer	Marks	Partial Marks
9(ii)	$PQ^2 = (11-8)^2 + (6-2)^2$	**M1**	or attempts to solve $\frac{1}{2}\begin{vmatrix} 8 & 11 & x & 8 \\ 2 & 6 & -\frac{3}{4}x+8 & 2 \end{vmatrix} = [\pm]12.5$ oe or $\frac{1}{2}\begin{vmatrix} 8 & 11 & x & 8 \\ 2 & 6 & y & 2 \end{vmatrix} = [\pm]12.5$
	$PQ = 5$ soi	**A1**	or expands correctly $\frac{1}{2}\left(8(6)+11\left(-\frac{3}{4}x+8\right)+2x\right.$ $\left.-2(11)-6x-8\left(-\frac{3}{4}x+8\right)\right) = [\pm]12.5$ oe or $\frac{1}{2}(8(6)+11y+2x$ $-2(11)-6x-8y) = [\pm]12.5$ oe
	$PR = 5$ soi	**A1**	or simplifies to $\frac{1}{2}\left(-\frac{25}{4}x+50\right) = [\pm]12.5$ oe or $4x-3y=51$ or $3y-4x=-1$ oe
	Valid method of solution e.g. $R(8 \pm 4, 2 \mp 3)$ or attempts to solve *their* $y = -\frac{3}{4}x+8$ and $25 = (x-8)^2+(y-2)^2$ oe or attempts to solve e.g. $4x-3y=51 \quad 3x+4y=32$ oe	**M1**	
	(4, 5) (12, –1)	**A2**	**A1** for each or for $x = 4$, $x = 12$ or $y = 5$, $y = -1$
10(a)(i)	Valid comment referencing the graph e.g. the function f is not one to one, as shown by the fact that the graph has a turning point	**B1**	or equivalent statement or arrows marked on a diagram; must validly reference the graph in some way.
10(a)(ii)	$\sqrt{1+\left(\sqrt{1+x^2}\right)^2}$	**M1**	
	$\sqrt{2+x^2}$	**A1**	mark final answer; must be simplified as far as possible
10(b)(i)	Any value greater than or equal to 0	**B1**	
10(b)(ii)	Correct method for finding inverse	**M1**	
	$g^{-1}(x) = \sqrt{x^2-1}$	**A1**	mark final answer

Question	Answer	Marks	Partial Marks
10(c)	fully correct pair of graphs  	**B4**	**B1** for exponential shape of h; must cross y-axis **B1** for an attempt at the graph of h and (0, 6) soi **B1** for correct reflection of *their* h in the line $y = x$ or logarithmic shape of inverse **B1** for an attempt at the graph of h^{-1} and (6, 0) soi **Max 3 marks if not fully correct**
11(a)(i)	$(1-\sin A)(1+\sin A)$ $=1-\sin^2 A$ $=\cos^2 A$	**M1**	
	$\frac{\cos^2 A}{\sin A \cos A} = \frac{\cos A}{\sin A} (= \cot A)$	**A1**	
11(a)(ii)	$\frac{1}{\tan 3x} = \frac{1}{2}$ or better	**M1**	
	Any triple angle correct from 63.4(349…) 243.4(349…) 423.4(349…)	**M1**	
	21.1(4…) 81.1(4...) 141.1(4...)	**A2**	**A1** for 21.1(4...) and 81.1(4...) or for 141.1(4...)
11(b)	$10(\sec^2 y - 1) - \sec y - 1 \ (= 0)$ soi	**M1**	
	$(10\sec y - 11)(\sec y + 1)$ oe	**M1**	
	$\cos y = \frac{10}{11}$ $\cos y = -1$ nfww	**A1**	
	π, 0.43[0], 5.85	**A2**	**A1** for any one correct
12(i)	$\frac{dV}{dr} = 4\pi r^2$ soi	**B1**	
	$\frac{dr}{dt} = \frac{dr}{dV} \times \frac{dV}{dt}$ oe attempted	**M1**	
	$\frac{dr}{dt} = \frac{1}{their\, 4\pi(10)^2} \times 200$ soi	**M1**	
	0.159 isw or 0.1591(54…) rot to 4 or more figs	**A1**	

Question	Answer	Marks	Partial Marks
12(ii)	$\frac{dS}{dr} = 8\pi r$ soi	**B1**	
	$\frac{dS}{dt} = 8\pi(10) \times their 0.159$	**M1**	
	awrt 40	**A1**	following correct solution

2 2018 | May/Jun | Variant 2 | 0606_s18_qp_22

Topic & Sub-topic Index of Questions

No.	Sub Q.	Topic	QP Page	MS Page
1		Trigonometry	33	51
3		Factors of polynomials	35	52
4		Quadratic functions	36	52
5		Permutations and combinations	37	52
6		Circular measure	38	53
7		Vectors in two dimensions	39	53
9		Differentiation and integration	41	55
10		Functions	42	55
11		Differentiation and integration	43	56
12		Differentiation and integration	44	57

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4401850851

ADDITIONAL MATHEMATICS **0606/22**

Paper 2 **May/June 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **15** printed pages and **1** blank page.

CAMBRIDGE International Examinations

[Turn over

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

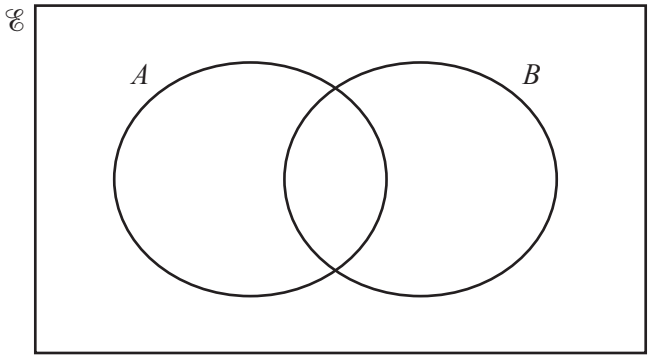
$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} bc \sin A$$

1 **(i)** Show that $\cos\theta\cot\theta + \sin\theta = \operatorname{cosec}\theta$. [3]

(ii) Hence solve $\cos\theta\cot\theta + \sin\theta = 4$ for $0° \leqslant \theta \leqslant 90°$. [2]

2 **(a)** On the Venn diagram below, shade the region that represents $A \cap B'$.



[1]

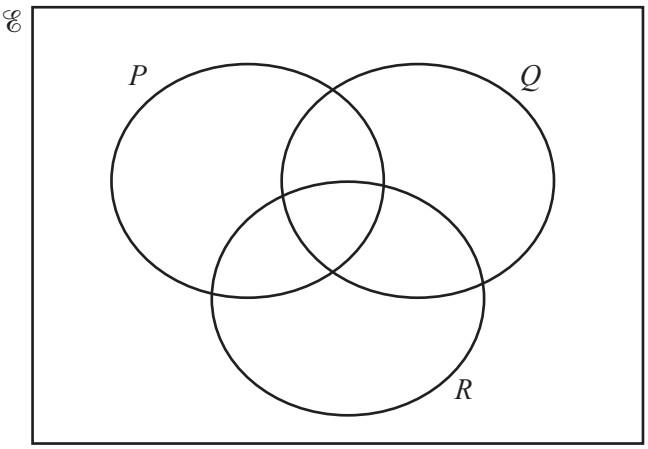
(b) The universal set $\mathscr{E}$ and sets P, Q and R are such that

$(P \cup Q \cup R)' = \varnothing$, $P' \cap (Q \cap R) = \varnothing$,

$\mathrm{n}(Q \cap R) = 8$, $\mathrm{n}(P \cap R) = 8$, $\mathrm{n}(P \cap Q) = 10$,

$\mathrm{n}(P) = 21$, $\mathrm{n}(Q) = 15$, $\mathrm{n}(\mathscr{E}) = 30$.

Complete the Venn diagram to show this information and state the value of $\mathrm{n}(R)$.



$\mathrm{n}(R) =$ ..... [4]

3 It is given that $x + 3$ is a factor of the polynomial $\mathrm{p}(x) = 2x^3 + ax^2 - 24x + b$. The remainder when $\mathrm{p}(x)$ is divided by $x - 2$ is -15. Find the remainder when $\mathrm{p}(x)$ is divided by $x + 1$. [6]

4 Find the coordinates of the points where the line $2y - 3x = 6$ intersects the curve $\frac{x^2}{4} + \frac{y^2}{9} = 5$. [5]

5 **(a)** Four parts in a play are to be given to four of the girls chosen from the seven girls in a drama class. Find the number of different ways in which this can be done. [2]

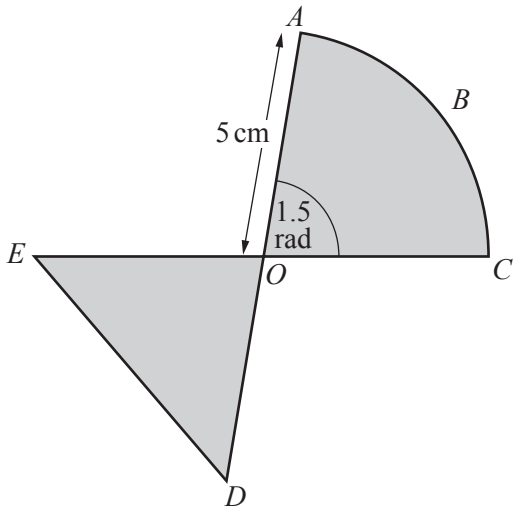
(b) Three singers are chosen at random from a group of 5 Chinese, 4 Indian and 2 British singers. Find the number of different ways in which this can be done if

(i) no Chinese singer is chosen, [1]

(ii) one singer of each nationality is chosen, [2]

(iii) the three singers chosen are all of the same nationality. [2]

6



In the diagram, ABC is an arc of the circle centre O, radius 5 cm, and angle AOC is 1.5 radians. AD and CE are diameters of the circle and DE is a straight line.

(i) Find the total perimeter of the shaded regions. [3]

(ii) Find the total area of the shaded regions. [3]

7 Vectors **i** and **j** are vectors parallel to the x-axis and y-axis respectively.

Given that $\mathbf{a} = 2\mathbf{i} + 3\mathbf{j}$, $\mathbf{b} = \mathbf{i} - 5\mathbf{j}$ and $\mathbf{c} = 3\mathbf{i} + 11\mathbf{j}$, find

(i) the exact value of $|\mathbf{a} + \mathbf{c}|$, [2]

(ii) the value of the constant m such that $\mathbf{a} + m\mathbf{b}$ is parallel to **j**, [2]

(iii) the value of the constant n such that $n\mathbf{a} - \mathbf{b} = \mathbf{c}$. [2]

8 **(a)** $\mathbf{A} = \begin{pmatrix} 2 & -1 \\ 1 & -3 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 0 & -2 \\ 3 & -5 \end{pmatrix}$. Find $(\mathbf{BA})^{-1}$. [4]

(b) The matrix $\mathbf{X}$ is such that $\mathbf{XC} = \mathbf{D}$, where $\mathbf{C} = \begin{pmatrix} -2 & 5 & 3 \\ 0 & 10 & 4 \end{pmatrix}$ and $\mathbf{D} = (-4 \quad 5 \quad 4)$.

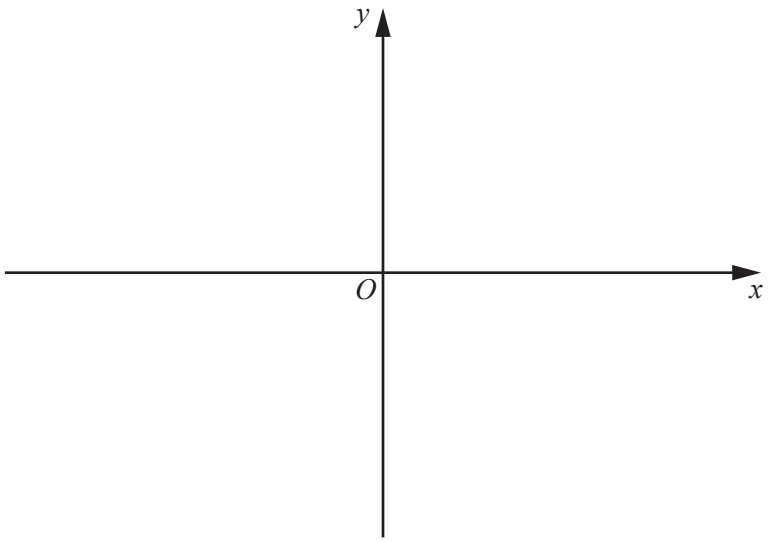
(i) State the order of the matrix $\mathbf{C}$. [1]

(ii) Find the matrix $\mathbf{X}$. [2]

9 **(i)** Differentiate $x^4(\sqrt{\sin x})$ with respect to x. [4]

(ii) Hence find $\int\left(x+\frac{x^4\cos x}{\sqrt{\sin x}}+8x^3(\sqrt{\sin x})\right)\mathrm{d}x$. [3]

10 **(a)** **(i)** On the axes below, sketch the graph of $y = |(x + 3)(x - 5)|$ showing the coordinates of the points where the curve meets the x-axis. [2]



(ii) Write down a suitable domain for the function $f(x) = |(x + 3)(x - 5)|$ such that f has an inverse. [1]

(b) The functions g and h are defined by

$$g(x) = 3x - 1 \qquad \text{for } x > 1,$$
$$h(x) = \frac{4}{x} \qquad \text{for } x \neq 0.$$

(i) Find $hg(x)$. [1]

(ii) Find $(hg)^{-1}(x)$. [2]

(c) Given that $p(a) = b$ and that the function p has an inverse, write down $p^{-1}(b)$. [1]

11 **(a)** Find $\int \sqrt[3]{2x-1}\,\mathrm{d}x$. [2]

(b) **(i)** Find $\int \sin 4x\,\mathrm{d}x$. [2]

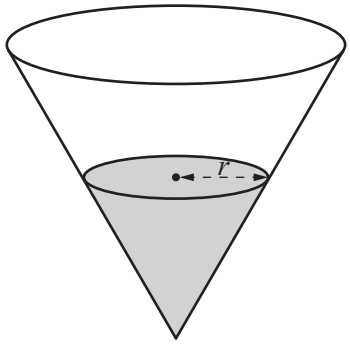
(ii) Hence evaluate $\int_{\frac{\pi}{8}}^{\frac{\pi}{4}} \sin 4x\,\mathrm{d}x$. [2]

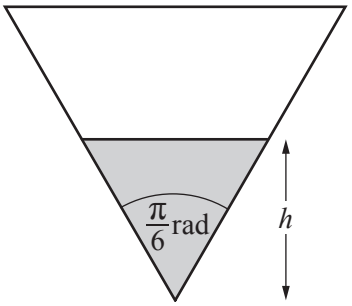
(c) Show that $\int_0^{\ln 8} \mathrm{e}^{\frac{x}{3}}\mathrm{d}x = 3$. [5]

12 In this question all lengths are in centimetres.

The volume of a cone of height h and base radius r is given by $V = \frac{1}{3}\pi r^2 h$.

It is known that $\sin\frac{\pi}{12} = \frac{\sqrt{6}-\sqrt{2}}{4}$, $\cos\frac{\pi}{12} = \frac{\sqrt{6}+\sqrt{2}}{4}$, $\tan\frac{\pi}{12} = 2-\sqrt{3}$.





A water cup is in the shape of a cone with its axis vertical. The diagrams show the cup and its cross-section. The vertical angle of the cone is $\frac{\pi}{6}$ radians. The depth of water in the cup is h. The surface of the water is a circle of radius r.

(i) Find an expression for r in terms of h and show that the volume of water in the cup is given by $V = \frac{\pi(7-4\sqrt{3})h^3}{3}$. [4]

(ii) Water is poured into the cup at a rate of $30\,cm^3\,s^{-1}$. Find, correct to 2 decimal places, the rate at which the depth of water is increasing when $h = 5$. [4]

BLANK PAGE

2.1 2018 | May/Jun | Variant 2 | 0606_s18_ms_22

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/22**

Paper 1 **May/June 2018**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method marks, awarded for a valid method applied to the problem.

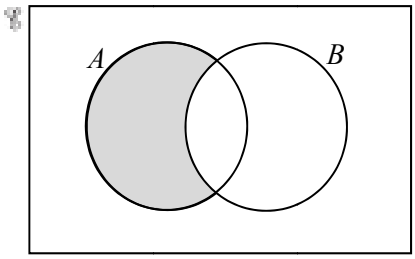
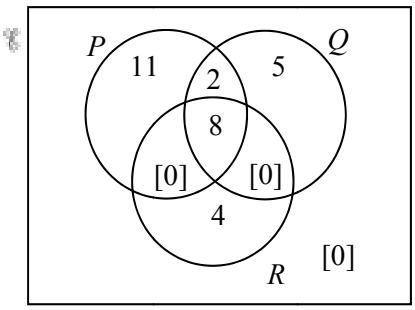
A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

B Mark for a correct result or statement independent of Method marks.

When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

Abbreviations

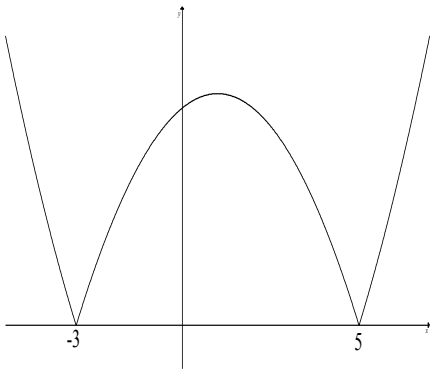
awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(i)	Uses $\cot\theta = \frac{\cos\theta}{\sin\theta}$ $\frac{\cos^2\theta + \sin^2\theta}{\sin\theta}$ Uses $\cos^2\theta + \sin^2\theta = 1$ Completes to $\frac{1}{\sin\theta} = \text{cosec}\,\theta$	**B3**	**B1** for using $\cot\theta = \frac{\cos\theta}{\sin\theta}$ oe or $\tan\theta = \frac{\sin\theta}{\cos\theta}$ oe at some stage **B1** for use of $\cos^2\theta + \sin^2\theta = 1$ oe **B1** for common denominator of $\sin\theta$ oe either in a compound fraction or in two partial fractions or for writing $\frac{1-\sin^2\theta}{\sin\theta}$ as $\frac{1}{\sin\theta} - \frac{\sin^2\theta}{\sin\theta}$ oe **Maximum of 2 marks if not fully correct or does not complete to cosecθ**
1(ii)	$\sin\theta = \frac{1}{4}$	**M1**	
	14.5° or 14.47[751…] rot to 4 or more figures isw	**A1**	Not from wrong working
2(a)		**B1**	
2(b)		**B3**	**B1** for 8 correctly placed and all the empty regions correct **B1** for 11, 2, 5 correctly placed **B1** for 4 correctly placed **maximum of 2 marks if fully correct but other values such as 30, 21 and/or 15 present within the diagram**
	their 12	**B1**	**STRICT FT** *their* Venn diagram

Question	Answer	Marks	Partial Marks
3	p(–3) = 0 or p(2) = –15 stated or implied	**M1**	
	$-54 + 9a + 72 + b = 0$ or better	**A1**	finds one correct equation; implies **M1**
	$16 + 4a - 48 + b = -15$ or better	**A1**	finds another correct equation; implies **M1**
	Solves a pair of simultaneous equations in a and b	**M1**	**dep** on first **M1** condone one sign or arithmetic error in *their* solution; as far as finding one unknown
	$a = -7$, $b = 45$	**A1**	
	60 cao	**A1**	
4	Eliminates one of the unknowns	**M1**	
	Simplifies to a correct 3-term quadratic: $2x^2 + 4x - 16$ [= 0] oe or $2y^2 - 6y - 36$ [= 0] oe	**A1**	
	Factorises or solves $(x+4)(x-2) = 0$ oe or $(y+3)(y-6) = 0$ oe	**M1**	**FT** *their* 3-term quadratic in x or y;
	(2, 6) and (–4, –3) oe	**A2**	Not from wrong working **A1** for either (2, 6) or (–4, –3) or **A1** for $x = 2$ and $x = -4$ or $y = 6$ and $y = -3$
5(a)	${}^7P_4$ or $7 \times 6 \times 5 \times 4$ oe	**M1**	
	840	**A1**	
5(b)(i)	20	**B1**	
5(b)(ii)	${}^5C_1 \times {}^4C_1 \times {}^2C_1$ or $5 \times 4 \times 2$ oe	**M1**	
	40	**A1**	
5(b)(iii)	${}^5C_3 + {}^4C_3$ oe	**M1**	
	14	**A1**	

Question	Answer	Marks	Partial Marks
6(i)	(Arc length =) 1.5 × 5 oe soi	**M1**	implied by 7.5
	(*DE* =) 10sin(0.75) oe soi	**M1**	implied by awrt 6.82
	34.3 or answer in range 34.31 to 34.32	**A1**	
6(ii)	(Area sector =) $\frac{1}{2} \times 5^2 \times 1.5$ oe	**M1**	implied by 18.75
	(Area triangle =) $\frac{1}{2} \times 5^2 \times \sin(1.5)$ oe	**M1**	implied by awrt 12.47
	31.2 or answer in range 31.21 to 31.22	**A1**	
7(i)	$\lvert their(\mathbf{a} + \mathbf{c})\rvert = \sqrt{their(5^2 + 14^2)}$	**M1**	
	$\sqrt{221}$	**A1**	mark final answer
7(ii)	[(2 + *m*)**i** + (3 – 5*m*)**j** therefore] *their* (2 + *m*) = 0	**M1**	for attempting to form **a** + *m***b** and equate the scalar of the **i** component to 0
	m = –2 only	**A1**	implies **M1**
7(iii)	[(2*n* – 1)**i** + (3*n* + 5)**j** = 3**i** + 11**j** or *n*(2**i** + 3**j**) = (3**i** + 11**j**) + (**i** – 5**j**) oe leading to] 2*n* – 1 = 3 or 3*n* + 5 = 11 oe, soi	**M1**	
	n = 2 only	**A1**	implies **M1**

Question	Answer	Marks	Partial Marks
8(a)	$\begin{pmatrix} -2 & 6 \\ 1 & 12 \end{pmatrix}$	**B2**	**B1** for a 2 by 2 matrix with 2 or 3 correct elements
	$their\left[\frac{1}{-30}\begin{pmatrix} 12 & -6 \\ -1 & -2 \end{pmatrix}\right]$ oe isw	**B2**	**FT** *their* non-singular **BA** **B1 FT** for either $\frac{1}{their(-30)}\begin{pmatrix} & \\ & \end{pmatrix}$ or $...\times their\begin{pmatrix} 12 & -6 \\ -1 & -2 \end{pmatrix}$ If *their* **BA** is singular, **B0** then **SC1** for $...\times their\begin{pmatrix} 12 & -6 \\ -1 & -2 \end{pmatrix}$ OR **Alternative method $\mathbf{A^{-1}B^{-1}}$:** **B2** for $\mathbf{A^{-1}} = \frac{1}{-5}\begin{pmatrix} -3 & 1 \\ -1 & 2 \end{pmatrix}$ isw or $\mathbf{B^{-1}} = \frac{1}{6}\begin{pmatrix} -5 & 2 \\ -3 & 0 \end{pmatrix}$ isw or **B1** for a multiplier of $\frac{1}{-5}$ or for $\begin{pmatrix} -3 & 1 \\ -1 & 2 \end{pmatrix}$ or for a multipler of $\frac{1}{6}$ or for $\begin{pmatrix} -5 & 2 \\ -3 & 0 \end{pmatrix}$ **B2 FT** for $\mathbf{A^{-1}}\ \mathbf{B^{-1}} = their\frac{1}{-30}\times their\begin{pmatrix} 12 & -6 \\ -1 & -2 \end{pmatrix}$ or **B1 FT** for a 2 by 2 matrix with 2 or 3 correct elements **Maximum of 3 marks if not fully correct**
8(b)(i)	2×3	**B1**	
8(b)(ii)	$\begin{pmatrix} 2 & -\frac{1}{2} \end{pmatrix}$ oe isw	**B2**	**B1** for each correct element; must be in a 1 by 2 matrix or **M1** for a full method as far as finding values for the two elements

Question	Answer	Marks	Partial Marks
9(i)	$\frac{\mathrm{d}}{\mathrm{d}x}\left(\sqrt{\sin x}\right)=\frac{1}{2}(\sin x)^{-\frac{1}{2}}(\cos x)$ oe	**B2**	**B1** for $\frac{1}{2}(\sin x)^{-\frac{1}{2}}\times...$ or for $\frac{1}{2}(\sin x)^{-\frac{1}{2}}$ or for $\frac{1}{2}(...)^{-\frac{1}{2}}\times\cos x$ or for $their\,\frac{1}{2}(\sin x)^{\left(their\frac{1}{2}\right)-1}\times\cos x$
	$their\left(4x^3\right)\sqrt{\sin x}$ $+x^4\left(their\,\frac{1}{2}(\sin x)^{-\frac{1}{2}}(\cos x)\right)$ oe	**M1**	Applies correct form of product rule
	$4x^3\sqrt{\sin x}+x^4\left(\frac{1}{2}(\sin x)^{-\frac{1}{2}}(\cos x)\right)$ oe isw	**A1**	Not from wrong working
9(ii)	$\int\left(4x^3\sqrt{\sin x}\right)\mathrm{d}x$ $+\int\left(x^4\times\frac{1}{2}(\sin x)^{-\frac{1}{2}}(\cos x)\right)\mathrm{d}x$ $=x^4\sqrt{\sin x}$ oe	**M1**	or $\int x\,\mathrm{d}x+2\int\left(\frac{x^4\cos x}{2\sqrt{\sin x}}+4x^3\sqrt{\sin x}\right)\mathrm{d}x$ oe **FT** *their* **(i)**
	$\frac{x^2}{2}+2x^4\sqrt{\sin x}\ [+c]$	**A2**	**A1** for $\int x\,\mathrm{d}x+2x^4\sqrt{\sin x}$
10(a)(i)		**B2**	**B1** for correct shape **B1** for roots marked on the graph or seen nearby provided graph drawn and one root is negative and one is positive
10(a)(ii)	Any correct domain	**B1**	
10(b)(i)	$\frac{4}{3x-1}$	**B1**	mark final answer

Question	Answer	Marks	Partial Marks
10(b)(ii)	Correct method for finding inverse function e.g. swopping variables **and** changing subject or vice versa; or indicates $(\text{hg})^{-1}(x) = \text{g}^{-1}\text{h}^{-1}(x)$ and finds $\text{g}^{-1}(x) = \frac{x+1}{3}$ and $\text{h}^{-1}(x) = \frac{4}{x}$	**M1**	**FT** only if *their*hg(x) of the form $\frac{a}{bx+c}$ where a, b and c are integers
	$\left[(\text{hg})^{-1}(x) =\right] \frac{1}{3}\left(\frac{4}{x}+1\right)$ oe isw or $\left[(\text{hg})^{-1}(x) =\right] \frac{4+x}{3x}$ oe isw	**A1**	**FT** *their* $(\text{hg})^{-1}(x) = \frac{a-cx}{bx}$ oe If **M0** then **SC1** for *their* hg(x) of the form $y = \frac{a}{x} + b$ oe leading to *their* $(\text{hg})^{-1}(x)$ of the form $y = \frac{a}{x-b}$ isw
10(c)	a cao	**B1**	
11(a)	$\frac{(2x-1)^{\frac{4}{3}}}{\frac{4}{3}\times 2}$ $[+c]$ oe isw	**B2**	**B1** for $k \times \frac{(2x-1)^{\left(\frac{1}{3}+1\right)}}{\left(\frac{1}{3}+1\right)}$ where $k \neq 0$
11(b)(i)	$k\cos 4x\,[+c]$ where $k < 0$ or $k = \frac{1}{4}$	**M1**	
	$-\frac{1}{4}\cos 4x\,[+c]$	**A1**	
11(b)(ii)	Sight of correct substitution of limits: $-\frac{1}{4}\cos\frac{4\pi}{4} - \left(-\frac{1}{4}\cos\frac{4\pi}{8}\right)$ oe	**M1**	**FT** *their* $k\cos 4x$ from **(b)(i)** **dep** on **M1** awarded in **(b)(i)**
	$\frac{1}{4}$	**A1**	does **not** imply **M1**

Question	Answer	Marks	Partial Marks
11(c)	$\int e^{\frac{x}{3}}\,dx = ke^{\frac{x}{3}}\ [+c]$	**M1**	k any non-zero constant
	$k = 3$	**A1**	
	Sight of correct substitution of limits: $their\ ke^{\frac{\ln 8}{3}} - their\ ke^{0}$ oe	**M1**	**dep** on first **M1**
	Shows how to deal with the power of the first term e.g. $\frac{\ln 8}{3} = \ln 8^{\frac{1}{3}}$ or $\frac{\ln 8}{3} = \ln 2$ or $3\left(\sqrt[3]{8}\right)$ seen	**B1**	
	$6 - 3 = 3$	**A1**	Not from wrong working
12(i)	$\tan\frac{\pi}{12} = \frac{r}{h}$ oe	**M1**	
	$r = h(2-\sqrt{3})$ or $r = h\tan\frac{\pi}{12}$ oe	**A1**	
	$[V =]\frac{1}{3}\pi\left(2-\sqrt{3}\right)^2 h^2 \times h$ oe	**M1**	Correctly uses *their* expression for r in terms of h in formula for volume of a cone dependent on finding an expression connecting r and h
	$[V =]\frac{\pi\left(4-4\sqrt{3}+3\right)h^3}{3}$ oe correctly leading to $[V =]\frac{\pi\left(7-4\sqrt{3}\right)h^3}{3}$ **AG**	**A1**	
12(ii)	Correct derivative of V e.g. $\frac{3\pi\left(7-4\sqrt{3}\right)h^2}{3}$ oe isw	**B1**	
	$\frac{dh}{dt} = \frac{dh}{dV} \times \frac{dV}{dt}$ soi	**B1**	
	$\frac{1}{their\left(\frac{dV}{dh}\right)\Big\vert_{h=5}} \times 30$	**M1**	if correct implies **B1 B1;** if incorrect, a correct **FT** statement implies the second **B1**
	5.32	**A1**	

3 2018 | May/Jun | Variant 3 | 0606_s18_qp_23

Topic & Sub-topic Index of Questions

No.	Sub Q.	Topic	QP Page	MS Page
2		Differentiation and integration	62	79
3		Permutations and combinations	63	79
4		Factors of polynomials	64	80
5		Functions	65	80
6		Circular measure	66	81
7		Differentiation and integration	67	81
8		Straight line graphs	68	81
9		Quadratic functions	69	82
10		Differentiation and integration	70	82
11		Trigonometry	71	83
12		Differentiation and integration	72	83

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

5291701669

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **May/June 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **15** printed pages and **1** blank page.

CAMBRIDGE International Examinations

[Turn over

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1}\, b + \binom{n}{2} a^{n-2}\, b^2 + \ldots + \binom{n}{r} a^{n-r}\, b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\Delta = \frac{1}{2} bc \sin A$$

1 A, B and C are subsets of the same universal set.

(i) Write each of the following statements in words.

(a) $A \not\subset B$ [1]

(b) $A \cap C = \varnothing$ [1]

(ii) Write each of the following statements in set notation.

(a) There are 3 elements in set A or B or both. [1]

(b) x is an element of A but it is not an element of C. [1]

2 The variables x and y are such that $y = \ln(3x - 1)$ for $x > \frac{1}{3}$.

(i) Find $\frac{dy}{dx}$. [2]

(ii) Hence find the approximate change in x when y increases from $\ln(1.2)$ to $\ln(1.2) + 0.125$. [3]

3 A 7-character password is to be selected from the 12 characters shown in the table. Each character may be used only once.

	Characters			
Upper-case letters	A	B	C	D
Lower-case letters	e	f	g	h
Digits	1	2	3	4

Find the number of different passwords

(i) if there are no restrictions, [1]

(ii) that start with a digit, [1]

(iii) that contain 4 upper-case letters and 3 lower-case letters such that all the upper-case letters are together and all the lower-case letters are together. [3]

[Turn over

4 Do not use a calculator in this question.

It is given that $x+4$ is a factor of $\mathrm{p}(x) = 2x^3 + 3x^2 + ax - 12$. When $\mathrm{p}(x)$ is divided by $x-1$ the remainder is b.

(i) Show that $a = -23$ and find the value of the constant b. [2]

(ii) Factorise $\mathrm{p}(x)$ completely and hence state all the solutions of $\mathrm{p}(x) = 0$. [4]

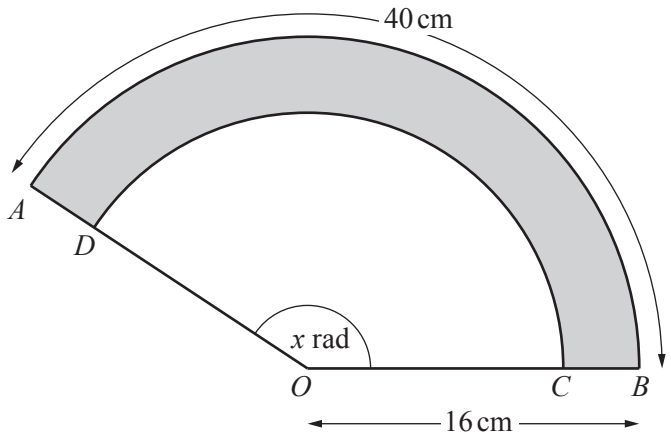
5 The function f is defined by $\mathrm{f}(x) = \dfrac{1}{2x-5}$ for $x > 2.5$.

(i) Find an expression for $\mathrm{f}^{-1}(x)$. [2]

(ii) State the domain of $\mathrm{f}^{-1}(x)$. [1]

(iii) Find an expression for $\mathrm{f}^{2}(x)$, giving your answer in the form $\dfrac{ax+b}{cx+d}$, where a, b, c and d are integers to be found. [3]

6



In the diagram AOB and DOC are sectors of a circle centre O. The angle AOB is x radians. The length of the arc AB is 40 cm and the radius OB is 16 cm.

(i) Find the value of x. [2]

(ii) Find the area of sector AOB. [2]

(iii) Given that the area of the shaded region $ABCD$ is 140 cm^2, find the length of OC. [3]

7 Differentiate with respect to x

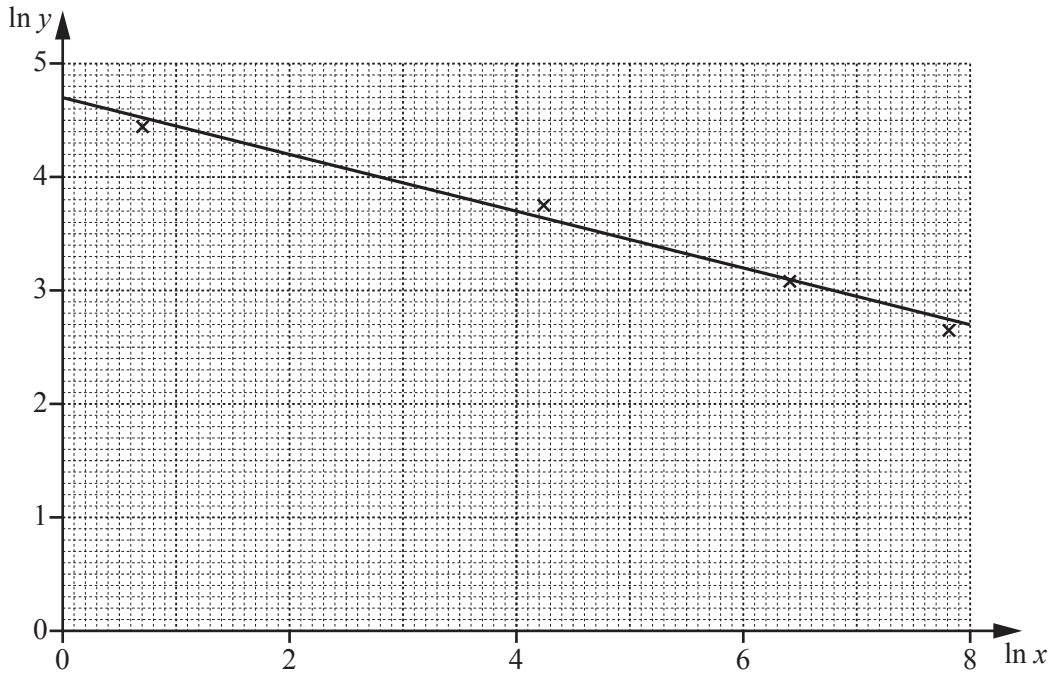
(i) $4x\tan x$, [2]

(ii) $\dfrac{e^{3x+1}}{x^2-1}$. [3]

8 An experiment was carried out recording values of y for certain values of x. The variables x and y are thought to be connected by the relationship $y = ax^n$, where a and n are constants.

(i) Transform the relationship $y = ax^n$ into straight line form. [2]

The values of $\ln y$ and $\ln x$ were plotted and a line of best fit drawn. This is shown in the diagram below.

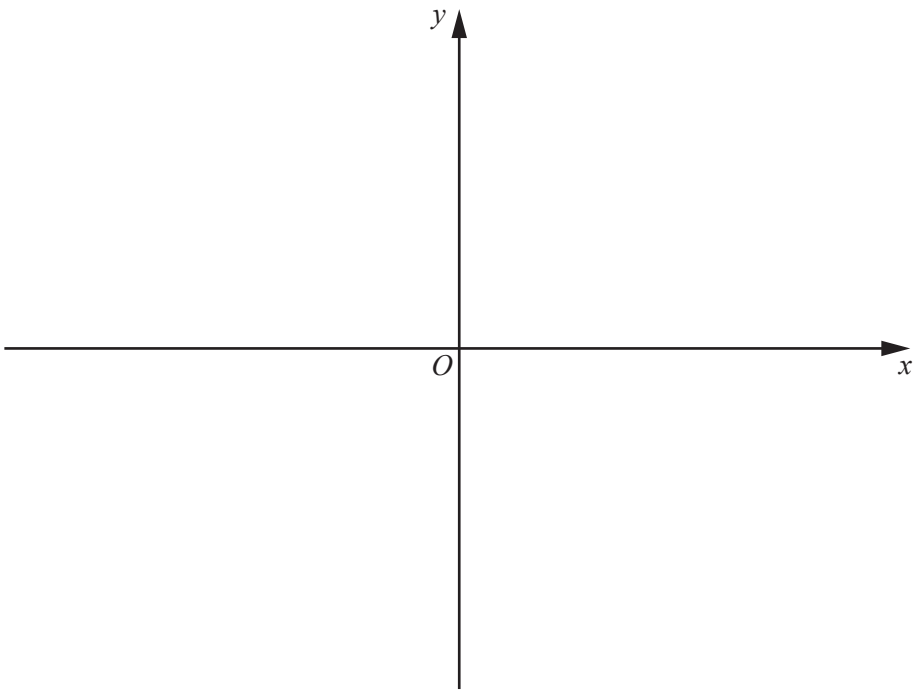


(ii) Use the graph to find the value of a and of n, stating the coordinates of the points that you use. [3]

(iii) Find the value of x when $y = 50$. [2]

9 **(i)** Express $5x^2 - 14x - 3$ in the form $p(x + q)^2 + r$, where p, q and r are constants. [3]

(ii) Sketch the graph of $y = |5x^2 - 14x - 3|$ on the axes below. Show clearly any points where your graph meets the coordinate axes. [4]



(iii) State the set of values of k for which $|5x^2 - 14x - 3| = k$ has exactly four solutions. [2]

10 A particle moves in a straight line such that its displacement, s metres, from a fixed point O at time t seconds, is given by $s = 4 + \cos 3t$, where $t \geqslant 0$. The particle is initially at rest.

(i) Find the exact value of t when the particle is next at rest. [2]

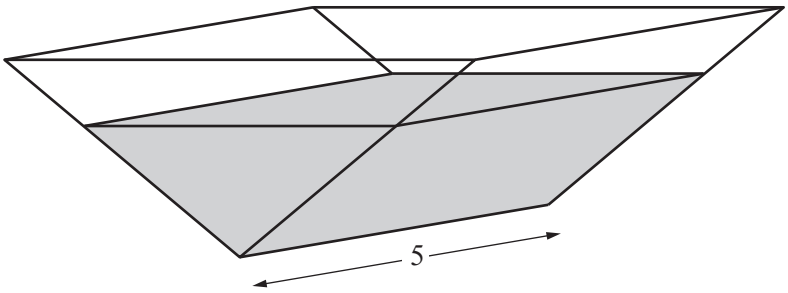
(ii) Find the distance travelled by the particle between $t = \frac{\pi}{4}$ and $t = \frac{\pi}{2}$ seconds. [3]

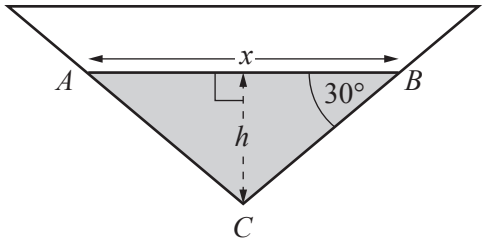
(iii) Find the greatest acceleration of the particle. [2]

11 **(a)** Solve $10\cos^2 x + 3\sin x = 9$ for $0° < x < 360°$. [5]

(b) Solve $3\tan 2y = 4\sin 2y$ for $0 < y < \pi$ radians. [5]

12 In this question all lengths are in metres.





A water container is in the shape of a triangular prism. The diagrams show the container and its cross-section. The cross-section of the water in the container is an isosceles triangle ABC, with angle ABC = angle BAC = 30°. The length of AB is x and the depth of water is h. The length of the container is 5.

(i) Show that $x = 2\sqrt{3}h$ and hence find the volume of water in the container in terms of h. [3]

(ii) The container is filled at a rate of $0.5\,m^3$ per minute. At the instant when h is 0.25 m, find

(a) the rate at which h is increasing, [4]

(b) the rate at which x is increasing. [2]

BLANK PAGE

3.1 2018 | May/Jun | Variant 3 | 0606_s18_ms_23

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **May/June 2018**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method marks, awarded for a valid method applied to the problem.

A Accuracy mark, awarded 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.

When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

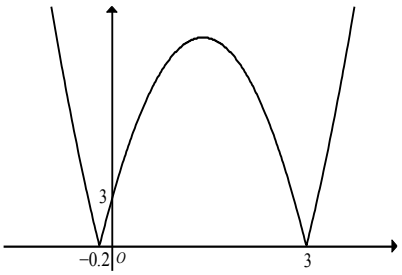
Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(i)(a)	A is not a [proper] subset of B oe	**B1**	
1(i)(b)	A and C are mutually exclusive oe or A intersection C is the empty set oe	**B1**	
1(ii)(a)	$\mathrm{n}(A \cup B) = 3$	**B1**	
1(ii)(b)	$x \in (A \cap C')$ oe	**B1**	
2(i)	$k \times \frac{1}{3x-1}$	**M1**	
	$3 \times \frac{1}{3x-1}$	**A1**	
2(ii)	$x = \frac{11}{15}$ soi	**B1**	
	$0.125 \approx \textit{their} \left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\|_{x=\textit{their}\frac{11}{15}} \times \delta x$ oe	**M1**	
	0.05 nfww	**A1**	
3(i)	$\left({}^{12}P_7 =\right) 3\,991\,680$	**B1**	
3(ii)	$(4 \times {}^{11}P_6 =) \; 1\,330\,560$	**B1**	
3(iii)	$4! \times 4! \times 2$ oe	**M2**	**M1** for $4! \times 4!$ oe only or ${}^4P_4 \times {}^4P_3$ oe only
	1152	**A1**	

Question	Answer	Marks	Partial Marks
4(i)	$2(-4)^3+3(-4)^2-4a-12=0$ with one correct interim step leading to $a=-23$	**B1**	Note: = 0 must be seen or may be implied by e.g. $-92 = 4a$ or $92 = -4a$ or convincingly showing that $2(-4)^3+3(-4)^2-4(-23)-12=0$ or correct synthetic division at least as far as $\begin{array}{c\|cccc} -4 & 2 & 3 & a & -12 \\ & & -8 & 20 & -4a-80 \\ \hline & 2 & -5 & a+20 & 0 \end{array}$ then $a = -23$ or correct long division to, e.g. verify –23, at least as far as $\begin{array}{r} 2x^2-5x-3 \\ x+4\overline{)2x^3+3x^2-23x-12} \\ \underline{2x^3+8x^2} \\ -5x^2-23x \\ \underline{-5x^2-20x} \\ -3x-12 \\ \underline{-3x-12} \\ 0 \end{array}$
	$p(1)=2+3-23-12$ $b=-30$	**B1**	
4(ii)	finds a correct quadratic factor e.g. $(2x^2-5x-3)$	**B2**	**B1** for quadratic factor with 2 correct terms OR **B1** for finding $(x-3)$ using factor theorem **B1** for convincingly finding $(2x+1)$ as third factor
	Product of three linear factors $(2x+1)(x-3)(x+4)$	**M1**	
	$x=-\frac{1}{2}$, $x=3$, $x=-4$ nfww	**A1**	If **M0** then **SC1** if quadratic factorised correctly but does not show full factorisation but does give all 3 solutions correctly
5(i)	Putting $y = f(x)$, changing subject to x and swopping x and y or vice versa	**M1**	
	$f^{-1}(x)=\frac{1}{2}\left(\frac{1}{x}+5\right)$ or $\frac{5x+1}{2x}$ oe isw	**A1**	
5(ii)	$x > 0$ oe	**B1**	

Question	Answer	Marks	Partial Marks
5(iii)	$\dfrac{1}{2\left(\dfrac{1}{2x-5}\right)-5}$	**B1**	
	$\dfrac{1}{\dfrac{2-5(2x-5)}{2x-5}}$ oe	**M1**	**FT** if expression of equivalent difficulty e.g. $\dfrac{1}{\left(\dfrac{1}{2x-5}\right)-5}$
	Completes to $\dfrac{2x-5}{-10x+27}$ oe final answer	**A1**	
6(i)	$16x = 40$ oe	**M1**	
	$x = 2.5$ oe (radians)	**A1**	
6(ii)	$\frac{1}{2}(16)^2(2.5)$ oe	**M1**	
	320	**A1**	
6(iii)	$\frac{1}{2}r^2(their 2.5) = (their 320) - 140$ oe	**M1**	**FT** provided *their* 320 > 140
	correct simplification to $r^2 = \ldots$	**M1**	**dep** on first **M1**
	12	**A1**	
7(i)	$4\tan x + 4x\sec^2 x$ isw	**B2**	Fully correct **B1** for one correct term as part of e.g. a sum of 2 terms
7(ii)	$\dfrac{\mathrm{d}}{\mathrm{d}x}(\mathrm{e}^{3x+1}) = 3\mathrm{e}^{3x+1}$	**B1**	
	$\dfrac{(x^2-1)(their 3\mathrm{e}^{3x+1}) - their(2x)\mathrm{e}^{3x+1}}{(x^2-1)^2}$	**M1**	
	$\dfrac{(x^2-1)(3\mathrm{e}^{3x+1}) - 2x\mathrm{e}^{3x+1}}{(x^2-1)^2}$ oe isw	**A1**	
8(i)	Takes logs of both sides	**M1**	
	$\ln y = \ln a + n\ln x$ or $\lg y = \lg a + n\lg x$	**A1**	

Question	Answer	Marks	Partial Marks
8(ii)	$n =$ –0.2 to –0.3 nfww	**B1**	
	attempts to equate y-intercept to ln a or forms *their* ln equation with *their* gradient and a point on the line or uses two points on the line to form a pair of simultaneous equations	**M1**	
	$a = e^{4.7}$ isw or 110 or 109.9[47…]	**A1**	maximum of 2 marks if no coordinates stated
8(iii)	use of ln(50) and ln$x$ = 3 to 3.2	**M1**	or for $\frac{50}{theira} = x^{their\ n}$ or better or for $\ln 50 = \ln(theira) + (their\ n)\ln x$ oe
	awrt 22 or 23 to 2 significant figures	**A1**	implies **M1**
9(i)	$5\left(x-\frac{7}{5}\right)^2 - \frac{64}{5}$	**B3**	**B1** for each of p, q, r correct in correct format; allow correct equivalent values. If **B0**, then **SC2** for $5\left(x-\frac{7}{5}\right) - \frac{64}{5}$ or **SC1** for correct values but incorrect format
9(ii)		**B4**	**B2** for fully correct shape in correct position or **B1** for fully correct shape translated parallel to the x-axis **B1** for y-intercept at (0, 3) marked on graph **B1** for roots marked on graph at –0.2 and 3
9(iii)	$0 < k < \left\lvert their\left(-\frac{64}{5}\right)\right\rvert$	**B2**	**FT** *their* **(i)** **B1** for any inequality using *their* $\frac{64}{5}$ or max y value is *their* 12.8soi
10(i)	$v = \frac{ds}{dt} = -3\sin 3t$	**B1**	
	When $v = 0$, $t = \frac{\pi}{3}$	**B1**	

Question	Answer	Marks	Partial Marks
10(ii)	Finding s when $t = \frac{\pi}{4}$ and $t = \frac{\pi}{2}$	**M1**	
	Finding s when $t = their\frac{\pi}{3}$ and correct plan	**M1**	Using *their* **(i)** correctly
	1.29 nfww	**A1**	
10(iii)	$a = \frac{\mathrm{d}v}{\mathrm{d}t} = -9\cos 3t$	**B1**	
	9	**B1**	**FT** *their* $k\cos 3t$
11(a)	$10(1-\sin^2 x)+3\sin x = 9$	**M1**	
	Solves $10\sin^2 x - 3\sin x - 1 = 0$ oe	**M1**	**dep** on first **M1** Solves *their* three term quadratic in $\sin x$
	$\sin x = \frac{1}{2}$, $\sin x = -\frac{1}{5}$	**A1**	
	30º, 150º and 191.5º, 348.5º awrt	**A2**	**A1** for any two correct solutions
11(b)	$3\frac{\sin 2y}{\cos 2y} = 4\sin 2y$ oe	**M1**	
	Solves $3\sin 2y - 4\sin 2y\cos 2y\ [=0]$	**M1**	**dep** on first **M1**
	$\sin 2y = 0$ $\cos 2y = \frac{3}{4}$	**A1**	
	Any two of π, 0.72273…, 5.56045… nfww	**A1**	
	$\frac{\pi}{2}$, 0.361, 2.78 awrt nfww	**A1**	**SC**: cancels out sin2y after **M1M0** allow **SC1** for 0.72273… and 5.56045... and **SC1**for 0.361 and 2.78
12(i)	$\tan 30 = \frac{h}{x/2}$ oe	**M1**	
	Correct completion to given answer	**A1**	
	$V = 5\sqrt{3}h^2$ isw	**B1**	

Question	Answer	Marks	Partial Marks
12(ii)(a)	$\frac{\mathrm{d}V}{\mathrm{d}h} = their 10\sqrt{3}\,h$ or $\frac{5\sqrt{3}}{2}$	**B1**	**FT** $their\,V = k\,h^2$
	$\frac{\mathrm{d}h}{\mathrm{d}t} = \frac{\mathrm{d}h}{\mathrm{d}V} \times \frac{\mathrm{d}V}{\mathrm{d}t}$ soi	**M1**	
	$\frac{\mathrm{d}h}{\mathrm{d}t} = \frac{1}{their\left(\frac{\mathrm{d}V}{\mathrm{d}h}\right)} \times 0.5$	**M1**	
	0.115 or 0.11547 to 0.1155 oe	**A1**	
12(ii)(b)	$\left(\frac{\mathrm{d}x}{\mathrm{d}t} = \frac{\mathrm{d}x}{\mathrm{d}h} \times \frac{\mathrm{d}h}{\mathrm{d}t} =\right) 2\sqrt{3} \times their \frac{1}{5\sqrt{3}}$	**M1**	
	$\frac{2}{5}$	**A1**	

4 2018 | Oct/Nov | Variant 1 | 0606_w18_qp_21

Topic & Sub-topic Index of Questions

No.	Sub Q.	Topic	QP Page	MS Page
1		Equations, inequalities and graphs	88	106
2		Logarithmic and exponential functions	88	106
3		Indices and surds	89	106
4		Trigonometry	90	107
6		Permutations and combinations	92	107
7		Trigonometry	93	107
8		Differentiation and integration	94	108
9		Differentiation and integration	95	108
10		Straight line graphs	97	109

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

120780581 3

ADDITIONAL MATHEMATICS **0606/21**

Paper 2 **October/November 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **14** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$.

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\Delta = \frac{1}{2} bc \sin A$$

1 Solve the inequality $(2-x)(x+9) < 10$. [4]

2 **(a)** Solve $3^{\left(\frac{x}{2}-1\right)} = 10$. [3]

(b) Solve $2e^{1-2y} = 3e^{3y+2}$. [4]

3 Do not use a calculator in this question.

(a) Simplify $(\sqrt{2}+2\sqrt{5})(4\sqrt{2}-3\sqrt{5})$, giving your answer in the form $a+b\sqrt{c}$, where a, b and c are integers. [3]

(b) Simplify $\dfrac{4-3\sqrt{6}}{\sqrt{3}+\sqrt{2}}$, giving your answer in the form $p\sqrt{3}+q\sqrt{2}$, where p and q are integers. [4]

4 Solve $\sec x = \cot x - 5\tan x$ for $0° < x < 360°$. [6]

5 $\mathbf{A} = \begin{pmatrix} 3 & 2 \\ -1 & 1 \end{pmatrix}$.

(i) Find $\mathbf{A}^2$. [2]

(ii) Find constants p and q such that $p\mathbf{A}^2 + q\mathbf{A} = \mathbf{I}$. [4]

6 A 5-digit code is to be formed from the digits 1, 2, 3, 4, 5, 6, 7, 8, 9. Each digit can be used once only in any code. Find how many codes can be formed if

(i) the first digit of the code is 6 and the other four digits are odd, [2]

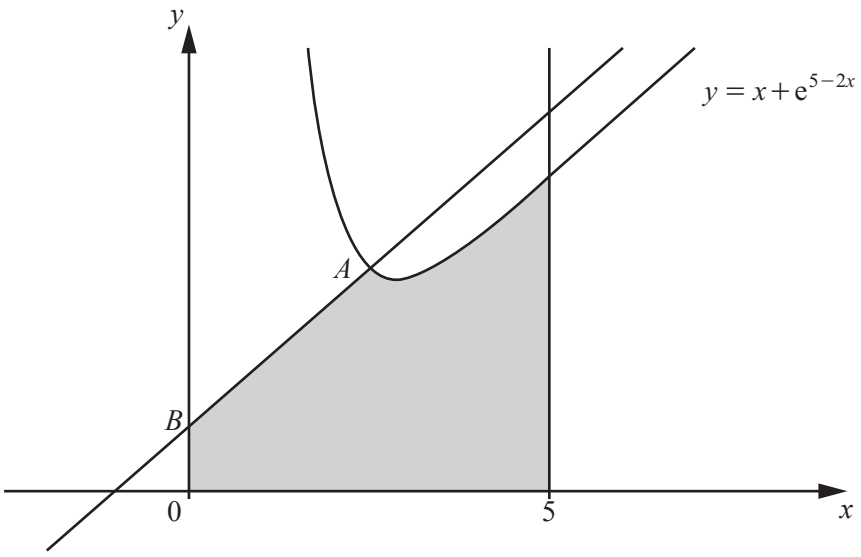
(ii) each of the first three digits is even, [2]

(iii) the first and last digits are prime. [2]

7 **(i)** Show that $\frac{1}{1-\cos x} - \frac{1}{1+\cos x} = 2\operatorname{cosec} x \cot x$. [4]

(ii) Hence solve the equation $\frac{1}{1-\cos x} - \frac{1}{1+\cos x} = \sec x$ for $0 \leqslant x \leqslant 2\pi$ radians. [4]

8

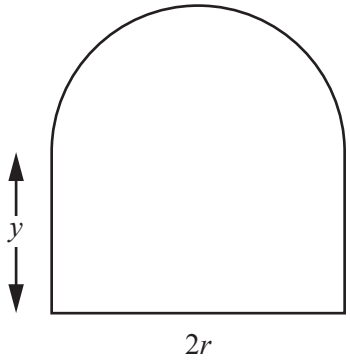


The diagram shows part of the curve $y = x + e^{5-2x}$, the normal to the curve at the point A and the line $x = 5$. The normal to the curve at A meets the y-axis at the point B. The x-coordinate of A is 2.5.

(i) Find the equation of the normal AB. [4]

(ii) Showing all your working, find the area of the shaded region. [6]

9 In this question, all lengths are in metres.



The diagram shows a window formed by a semi-circle of radius r on top of a rectangle with dimensions $2r$ by y. The total perimeter of the window is 5.

(i) Find y in terms of r. [2]

(ii) Show that the total area of the window is $A = 5r - \frac{\pi r^2}{2} - 2r^2$. [2]

(iii) Given that r can vary, find the value of r which gives a maximum area of the window and find this area. (You are not required to show that this area is a maximum.) [5]

10 The line $y = 12 - 2x$ is a tangent to two curves. Each curve has an equation of the form $y = k + 6 + kx - x^2$, where k is a constant.

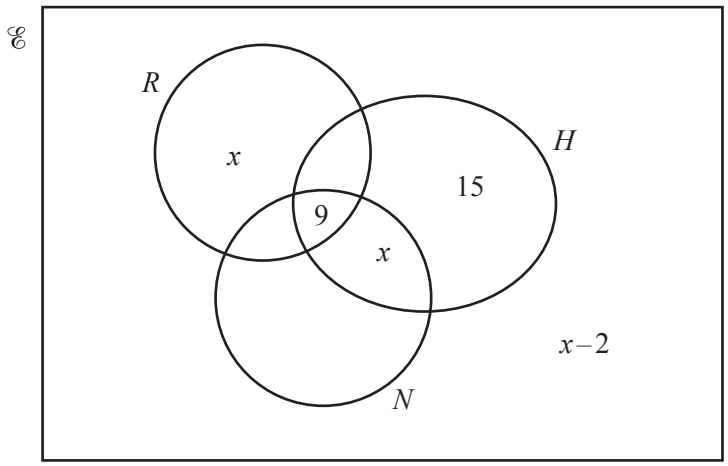
(i) Find the two values of k. [5]

The line $y = 12 - 2x$ is a tangent to one curve at the point A and the other curve at the point B.

(ii) Find the coordinates of A and of B. [3]

(iii) Find the equation of the perpendicular bisector of AB. [3]

11



There are 70 girls in a year group at a school. The Venn diagram gives **some** information about the numbers of these girls who play rounders (R), hockey (H) and netball (N).

$\text{n}(R) = 28$ $\text{n}(H) = 38$ $\text{n}(N) = 35$.

Find the value of x and hence the number of girls who play netball only. [6]

BLANK PAGE

BLANK PAGE

4.1 2018 | Oct/Nov | Variant 1 | 0606_w18_ms_21

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/21**

Paper 2 **October/November 2018**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method marks, awarded for a valid method applied to the problem.

A Accuracy mark, awarded 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.

When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Partial Marks
1	$x^2 + 7x - 8\ (> 0)$	**2**	**M1** for expanding and collecting terms
	$x < -8$ or $x > 1$	**2**	**M1** for factorising $(x+8)(x-1) > 0$
2(a)	Take logs: $\left(\frac{x}{2} - 1\right)\log 3 = \log 10$	**M1**	
	Make x the subject: $x = 2\left(\frac{\log 10}{\log 3} + 1\right)$	**M1**	
	6.19	**A1**	
2(b)	$e^{5y+1} = \frac{2}{3}$	**2**	**M1** for attempt to combine exponential terms
	–0.281	**2**	**M1** for taking natural logs: $5y + 1 = \ln\left(\frac{2}{3}\right)$
3(a)	Expand 4 terms: $8 + 8\sqrt{10} - 3\sqrt{10} - 30$	**M1**	
	–22	**A1**	
	$5\sqrt{10}$	**A1**	
3(b)	$\frac{\left(4 - 3\sqrt{6}\right)}{\left(\sqrt{3} + \sqrt{2}\right)} \times \frac{\left(\sqrt{3} - \sqrt{2}\right)}{\left(\sqrt{3} - \sqrt{2}\right)}$	**M1**	Multiply numerator and denominator by $\left(\sqrt{3} - \sqrt{2}\right)$
	$\frac{4\sqrt{3} - 3\sqrt{18} - 4\sqrt{2} + 3\sqrt{12}}{3 - 2}$	**M1**	Expand
	$10\sqrt{3} - 13\sqrt{2}$	**A2**	**A1** for each term

Question	Answer	Marks	Partial Marks
4	$\frac{1}{\cos x} = \frac{\cos x}{\sin x} - 5\frac{\sin x}{\cos x}$	**B1**	Correctly converts 3 terms into $\sin x$ and $\cos x$
		M1	Uses $\cos^2 x = 1 - \sin^2 x$
	$6\sin^2 x + \sin x - 1 = 0$	**A1**	
	$(3\sin x - 1)(2\sin x + 1) = 0$	**M1**	
	19.5°, 160.5°, 210°, 330°	**A2**	**A1** for 2 correct **A1** for further 2 correct
5(i)	$A^2 = \begin{pmatrix} 7 & 8 \\ -4 & -1 \end{pmatrix}$	**2**	Minus 1 each error.
5(ii)	$7p + 3q = 1$ $8p + 2q = 0$ $-4p - q = 0$, $-p + q = 1$	**2**	**M1** forms two equations in p and q **A1** Both correct
	$p = -\frac{1}{5}, q = \frac{4}{5}$	**2**	**M1** solves equations to find p and q
6(i)	120	**2**	**B2** $5\times4\times3\times2$ or **B1** for pattern $n(n-1)(n-2)(n-3)$
6(ii)	720	**2**	**B1** $4\times3\times2$ **B1 dep** $\times6\times5 = 720$
6(iii)	2520	**2**	**B1** $4\times\ldots\times\ldots\times\ldots\times3$ **B1 Dep** $\times7\times6\times5 = 2520$
7(i)	$\frac{(1+\cos x)-(1-\cos x)}{(1-\cos x)(1+\cos x)}$	**M1**	Taking common denominator
	$= \frac{2\cos x}{1-\cos^2 x}$	**A1**	
	$= \frac{2\cos x}{\sin^2 x}$	**M1**	Using $1-\cos^2 x = \sin^2 x$
	$= \frac{2\cos x}{\sin x} \times \frac{1}{\sin x}$ $= 2\operatorname{cosec} x \cot x$	**A1**	Fully correct completion AG

Question	Answer	Marks	Partial Marks
7(ii)	$2\text{cosec}x\cot x = \sec x$	**M1**	
	$\cot^2 x = \frac{1}{2}$	**A1**	
	$0.955,\ 2.19,\ 4.10,\ 5.33$	**A2**	**A1** for 2 correct values **A1** for further 2 correct values
8(i)	$\frac{dy}{dx} = 1 - 2e^{2-5x}$	**B1**	
	$x = 2.5 \rightarrow \frac{dy}{dx} = -1$ and $y = 3.5$	**B1**	
	Grad of normal = $\frac{-1}{\frac{dy}{dx}}$	**M1**	
	$y = x + 1$	**A1**	Equation of normal
8(ii)	Area of trapezium $= \frac{1}{2} \times 2.5 \times 4.5$	**M1**	
	5.625 sq units	**A1**	
	$\int_{2.5}^{5} x + e^{(5-2x)} dx$	**M1**	Area under curve
	$= \left[\frac{x^2}{2} - \frac{1}{2} e^{(5-2x)} \right]_{2.5}^{5}$	**A1**	
		M1	insert limits and subtract (= 9.87)
	Shaded area $= 15.5$	**A1**	5.625 + 9.87
9(i)	$2y + 2r + \pi r = 5$	**B1**	
	$y = \frac{5 - 2r - \pi r}{2}$	**B1**	**Dep**

Question	Answer	Marks	Partial Marks
9(ii)	$A = 2yr + \frac{\pi r^2}{2}$	**M1**	
	$= r(5 - 2r - \pi r) + \frac{\pi r^2}{2}$ $= 5r - 2r^2 - \frac{\pi r^2}{2}$	**A1**	
9(iii)		**M1**	differentiate
	$\frac{dA}{dr} = 5 - \pi r - 4r$	**A1**	
	$\frac{dA}{dr} = 0$	**M1**	set to zero and attempt to solve
	$r = \frac{5}{\pi + 4} = 0.7$	**A1**	
	$A = 1.75$	**A1**	
10(i)	$12 - 2x = k + 6 + kx - x^2$ $\rightarrow x^2 - (2 + k)x + 6 - k = 0$	**M1**	* Equate and collect terms
	$b^2 - 4ac = 0$ $\rightarrow (2 + k)^2 = 4(6 - k)$	**M1**	**Dep***
	$k^2 + 8k - 20 = 0$	**A1**	
	$(k + 10)(k - 2) = 0$	**M1**	
	$k = -10$ or 2	**A1**	
10(ii)	$(-4, 20)$ and $(2, 8)$	**3**	**M1** Insert values of k in equations and solve for x **A1** $x^2 + 8x + 16 = 0 \rightarrow x = -4$ $\rightarrow y = 20$ **A1** $x^2 - 4x + 4 = 0$ $\rightarrow x = 2 \rightarrow y = 8$

Question	Answer	Marks	Partial Marks
10(iii)	Grad of perpendicular $=\frac{1}{2}$	**B1**	
	Midpoint $(-1\ ,14)$	**B1**	**FT**
	Eqn $\frac{y-14}{x+1}=\frac{1}{2}\rightarrow y=\frac{1}{2}x+14.5$	**B1**	**FT**
11	$\mathrm{n}\left(\left(R\cap H\right)\cap N'\right)=14-x$	**B1**	
	$\mathrm{n}\left(\left(R\cap N\right)\cap H'\right)=5$	**B1**	
	$\mathrm{n}(N\cap(\mathrm{R}\cup H)')=21-x$	**B1**	
	$x+9+x+15+14-x+5+21-x+x-2$ = 70	**M1**	correctly form equation in x and attempt to solve
	$x=8$	**A1**	
	$\mathrm{n}(N\cap(\mathrm{R}\cup H)')=13$	**A1**	

5 2018 | Oct/Nov | Variant 2 | 0606_w18_qp_22

Topic & Sub-topic Index of Questions

No.	Sub Q.	Topic	QP Page	MS Page
1		Equations, inequalities and graphs	114	132
3		Differentiation and integration	115	132
4		Logarithmic and exponential functions	116	132
5		Simultaneous equations	117	133
6		Series	118	133
7		Indices and surds	119	134
8		Trigonometry	120	134
9		Differentiation and integration	121	134
10		Quadratic functions	123	136
11		Functions	125	136
12		Vectors in two dimensions	126	138

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

4422989634 8

ADDITIONAL MATHEMATICS **0606/22**

Paper 2 **October/November 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **15** printed pages and **1** blank page.

CAMBRIDGE International Examinations

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1}\, b + \binom{n}{2} a^{n-2}\, b^2 + \ldots + \binom{n}{r} a^{n-r}\, b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

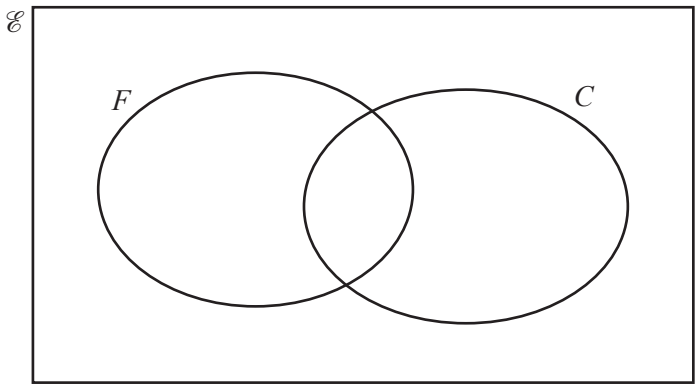
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\Delta = \frac{1}{2} bc \sin A$$

1 Solve the inequality $(x-3)(x+4) > x+13$. [3]

2



There are 105 boys in a year group at a school. Some boys play football (F) and some play cricket (C).

- x boys play both football and cricket.
- The number of boys that play neither game is the same as the number of boys that play both.
- 40 boys play cricket.
- The number of boys that only play football is twice the number of boys that only play cricket.

Complete the Venn diagram and find the value of x. [5]

3 A curve has equation $y = \frac{x^3}{\sin 2x}$. Find

(i) $\frac{\mathrm{d}y}{\mathrm{d}x}$, [3]

(ii) the equation of the tangent to the curve at the point where $x = \frac{\pi}{4}$. [3]

4 Solve

(i) $2^{3x-1} = 6$, [3]

(ii) $\log_3(y+14) = 1 + \frac{2}{\log_y 3}$. [5]

5 Solve the simultaneous equations

$$\frac{8^{p+1}}{4^{q}} = 2^{11},$$

$$\frac{3^{2p+5}}{27^{\frac{1}{3}}} = 9^{3q}.$$ [5]

6 **(a)** A 5-character code is to be formed from the 13 characters shown below. Each character may be used once only in any code.

Letters : A, B, C, D, E, F

Numbers: 1, 2, 3, 4, 5, 6, 7

Find the number of different codes in which no two letters follow each other and no two numbers follow each other. [3]

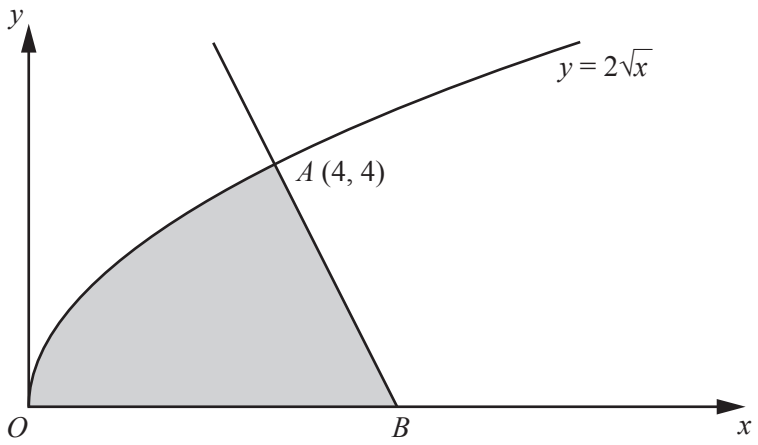
(b) A netball team of 7 players is to be chosen from 10 girls. 3 of these 10 girls are sisters. Find the number of different ways the team can be chosen if the team does not contain all 3 sisters. [3]

7 Solve the quadratic equation $\left(1-\sqrt{3}\right)x^2+x+\left(1+\sqrt{3}\right)=0$, giving your answer in the form $a+b\sqrt{3}$, where a and b are constants. [6]

8 **(i)** Show that $\frac{1}{1-\sin x} - \frac{1}{1+\sin x} = 2\tan x \sec x$. [4]

(ii) Hence solve the equation $\frac{1}{1-\sin x} - \frac{1}{1+\sin x} = \operatorname{cosec} x$ for $0° \leqslant x \leqslant 360°$. [4]

9



The diagram shows part of the curve $y = 2\sqrt{x}$. The normal to the curve at the point A (4, 4) meets the x-axis at the point B.

(i) Find the equation of the line AB. [4]

(ii) Find the coordinates of B. [1]

(iii) Showing all your working, find the area of the shaded region. [4]

10 Two lines are tangents to the curve $y = 12 - 4x - x^2$. The equation of each tangent is of the form $y = 2k + 1 - kx$, where k is a constant.

(i) Find the two possible values of k. [5]

(ii) Find the coordinates of the point of intersection of the two tangents. [4]

[Turn over

11 The functions f and g are defined for real values of $x \geqslant 1$ by

$$\mathrm{f}(x) = 4x - 3,$$

$$\mathrm{g}(x) = \frac{2x+1}{3x-1}.$$

(i) Find $\mathrm{gf}(x)$. [2]

(ii) Find $\mathrm{g}^{-1}(x)$. [3]

(iii) Solve $\mathrm{fg}(x) = x - 1$. [4]

12 A plane that can travel at 260 km/h in still air heads due North. A wind with speed 40 km/h from a bearing of 310° blows the plane off course. Find the resultant speed of the plane and its direction as a bearing correct to 1 decimal place. [6]

BLANK PAGE

5.1 2018 | Oct/Nov | Variant 2 | 0606_w18_ms_22

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/22**

Paper 2 **October/November 2018**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method marks, awarded for a valid method applied to the problem.

A Accuracy mark, awarded 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.

When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Partial Marks
1	$x^2+x-12>x+13$	**M1**	expand and simplify
	$\rightarrow x^2\ldots 25$	**A1**	
	$x>5$ or $x<-5$ or $x>5$, $x<-5$ or $x>5$ and $x<-5$	**A1**	
2	$\mathrm{n}(F\cap C)=\mathrm{n}(F\cup C)'=x$	**B1**	
	$\mathrm{n}(C\cap F')=40-x$	**B1**	
	$\mathrm{n}(F\cap C')=80-2x$ or $2(40-x)$	**B1**	
	$x+x+40-x+80-2x=105$	**M1**	
	$x=15$	**A1**	cao
3(i)	$\dfrac{3x^2\sin 2x-x^3\times 2\cos 2x}{(\sin 2x)^2}$	**3**	**M1** Quotient rule **A2/1/0** minus one each error isw
3(ii)	$y=\dfrac{\pi^3}{64}$ $[=0.48\ldots]$	**B1**	
	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{3\pi^2}{16}$ [=1.85] oe	**B1**	
	$y=\dfrac{3\pi^2}{16}x-\dfrac{\pi^3}{32}$ $[y=1.85x-0.97]$	**B1**	cao
4(i)	Take logs : $(3x-1)\log 2=\log 6$	**M1**	
	Make x the subject : $x=\dfrac{\frac{\log 6}{\log 2}+1}{3}$ oe	**A1**	
	awrt 1.19 or awrt 1.195	**A1**	

Question	Answer	Marks	Partial Marks
4(ii)	$1 = \log_3 3$	**B1**	
	$\frac{2}{\log_y 3} = 2\log_3 y$	**B1**	
	$3y^2 - y - 14 = 0$	**B1**	
	$(3y-7)(y+2)=0$	**M1**	Solve a three term quadratic
	$y = \frac{7}{3}$ only	**A1**	
5	$\frac{2^{3(p+1)}}{2^{2q}} = 2^{11}$ or $\frac{3^{2p+5}}{3^{3\left(\frac{1}{3}\right)}} = 3^{2(3q)}$	**M1**	
	Use $\frac{x^a}{x^b} = x^{a-b}$ or $x^a \times x^b = x^{a+b}$	**M1**	
	$3p + 3 - 2q = 11$ and $2p + 5 - 1 = 6q$	**A1**	Allow unsimplified
		M1	solve
	$p = 4$ and $q = 2$	**A1**	
6(a)	Number first $= 7\times6\times5\times6\times5$ or ${}^7P_3 \times {}^6P_2$ or 6300	**B1**	
	Letter first $= 6\times5\times4\times7\times6$ or ${}^6P_3 \times {}^7P_2$ or 5040	**B1**	
	6300 + 5040 = 11 340	**B1**	
6(b)	With 2 sisters = ${}^7C_5 \times {}^3C_2 = 63$ With 1 sister = ${}^7C_6 \times {}^3C_1 = 21$ With no sister = ${}^7C_7 = 1$ and Total 85	**3**	**B1** One combination evaluated **B1**Another combination evaluated **B1** Third combination and 85
	OR		
	Total no of ways = ${}^{10}C_7 = 120$	**B1**	
	With 3 sisters = ${}^7C_4 = 35$	**B1**	
	Without 3 sisters = $120 - 35 = 85$	**B1**	

Question	Answer	Marks	Partial Marks
7	$\left(1-\sqrt{3}\right)\left(1+\sqrt{3}\right)=-2$	**B1**	
		M1	* uses quadratic formula
	$x=\dfrac{-1\pm\sqrt{1-4\left(1-\sqrt{3}\right)\left(1+\sqrt{3}\right)}}{2\left(1-\sqrt{3}\right)}$	**A1**	
		M1	**Dep*** × numerator and denominator by *their* $\left(1+\sqrt{3}\right)$
	$x=1+\sqrt{3}$ or $x=-\dfrac{1}{2}-\dfrac{\sqrt{3}}{2}$	**A2**	**A1** for each
8(i)	$\dfrac{\left(1+\sin x\right)-\left(1-\sin x\right)}{\left(1-\sin x\right)\left(1+\sin x\right)}$	**M1**	
	$\dfrac{2\sin x}{1-\sin^2 x}$	**A1**	
	$\dfrac{2\sin x}{\cos^2 x}$	**M1**	
	$\dfrac{2\sin x}{\cos x}\times\dfrac{1}{\cos x}=2\tan x\sec x$	**A1**	**AG**
8(ii)		**M1**	equate $2\sec x\tan x=\operatorname{cosec} x$
	$\tan^2 x=\dfrac{1}{2}$	**A1**	
	$35.3°, 144.7°, 215.3°, 324.7°$	**2**	**A1** two correct
9(i)	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=x^{-\frac{1}{2}}$	**B1**	
	$x=4\rightarrow\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{1}{2}$	**B1**	
	grad of normal $=-2$	**M1**	
	$\dfrac{y-4}{x-4}=-2\rightarrow\left[y=-2x+12\right]$	**A1**	

Question	Answer	Marks	Partial Marks
9(ii)	(6, 0)	**B1**	**FT**
9(iii)	Area of triangle $= \frac{1}{2} \times 2 \times 4 = 4$	**B1**	**FT**
	Area under curve $= \int 2x^{\frac{1}{2}} \, dx$	**M1**	
	$= \frac{4}{3} x^{\frac{3}{2}}$	**A1**	
	Total area $= 14\frac{2}{3}$ $[14.7]$	**A1**	**FT**
	OR		
	Area of trapezium $OBAP$ $= \frac{1}{2}(6+4) \times 4 = 20$	**B1**	**FT**
	Area between curve and y- axis $= \int \frac{y^2}{4} dy$	**M1**	
	$= \frac{y^3}{12}$	**A1**	
	Total area $= 14\frac{2}{3}$ $[14.7]$	**A1**	**FT**

Question	Answer	Marks	Partial Marks
10(i)	$2k+1-kx=12-4x-x^2$ $x^2+4x-kx+2k-12+1$	**M1**	*
	b^2-4ac $\rightarrow (4-k)^2-4(2k-11)$	**M1**	**Dep***
	$k^2-16k+60$	**A1**	
	$(k-6)(k-10)$	**M1**	
	$k=6$ or 10	**A1**	
	OR		
	$k=4+2x$	**M1**	*
	$-4x-2x^2+8+4x+1=12-4x-x^2$ or $2k+1-k\left(\frac{k-4}{2}\right)=12-2(k-4)-\left(\frac{k-4}{2}\right)^2$	**M1**	**Dep***
	x^2-4x+3 or $k^2-16k+60$	**A1**	
	$(x-1)(x-3)$ or $(k-6)(k-10)$	**M1**	
	$x=1$ or $x=3\rightarrow k=$ 6 or 10	**A1**	
10(ii)	$k=6\rightarrow[y]=13-6x$	**B1**	**FT**
	$k=10\rightarrow[y]=21-10x$	**B1**	**FT**
		M1	solve
	$x=2$, $y=1$.	**2**	cao
11(i)	$\text{gf}(x)=\frac{2(4x-3)+1}{3(4x-3)-1}$	**M1**	
	$=\frac{8x-5}{12x-10}$	**A1**	

Question	Answer	Marks	Partial Marks
11(ii)	$y(3x-1)=2x+1$ or $x(3y-1)=2y+1$	**B1**	
	$(3y-2)x=y+1$ or $(3x-2)y=x+1$	**M1**	
	$g^{-1}(x)=\frac{x+1}{3x-2}$	**A1**	
11(iii)	$4\left(\frac{2x+1}{3x-1}\right)-3[=x-1]$	**B1**	
	$3x^2-3x-6$ oe	**B1**	
	$3(x+1)(x-2)$	**M1**	
	$x=2$ only	**A1**	

Question	Answer	Marks	Partial Marks
12	Identifying angle with downward vertical of wind as $50°$	**B1**	
	Triangle drawn with sides $260, 40$ and included angle of $50°$.	**B1**	
	Cosine rule : $(v_r)^2 = 260^2 + 40^2 - 2 \times 260 \times 40\cos 50°$	**M1**	*
	$v_r = 236$	**A1**	
	Sine rule : $\frac{\sin\alpha}{40} = \frac{\sin 50°}{v_r}$ or Cosine rule : $40^2 = 260^2 + 236^2 - 2 \times 260 \times 236\cos\alpha$	**M1**	**dep***
	$\alpha = 7.5°$	**A1**	
	OR Using components		
	Identifying angle with downward vertical of wind as $50°$	**B1**	
	$v_w = \begin{pmatrix} 40\cos 40° \\ -40\cos 50° \end{pmatrix}$	**B1**	
	$\boldsymbol{v_r} = \sqrt{(40\cos 40°)^2 + (260 - 40\cos 50)^2}$	**M1**	
	$\boldsymbol{v_r} = 236$	**A1**	
	$\tan\alpha = \frac{40\cos 40°}{260 - 40\cos 50°}$	**M1**	
	$\alpha = 7.5°$	**A1**	

6 2018 | Oct/Nov | Variant 3 | 0606_w18_qp_23

Topic & Sub-topic Index of Questions

No.	Sub Q.	Topic	QP Page	MS Page
1		Equations, inequalities and graphs	142	160
3		Quadratic functions	143	160
4		Differentiation and integration	144	161
6		Logarithmic and exponential functions	146	162
7		Permutations and combinations	147	162
8		Straight line graphs	148	162
9		Trigonometry	149	163
10		Differentiation and integration	151	163
11		Straight line graphs	153	164

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **October/November 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$.

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

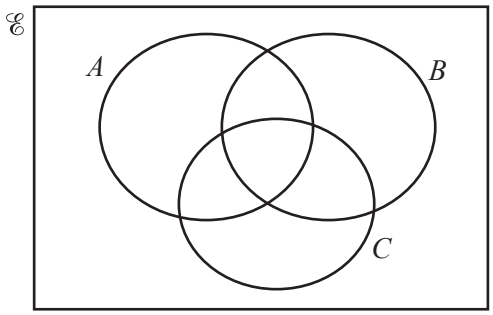
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

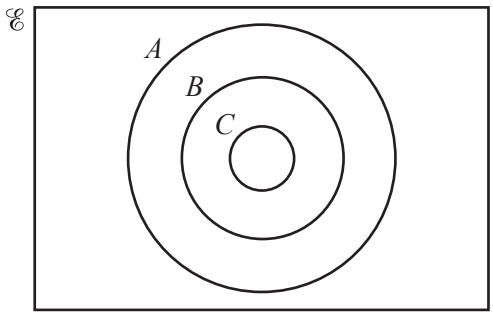
$$\Delta = \frac{1}{2} bc \sin A$$

1 Solve the equation $|5x-3|=-3x+13$. [3]

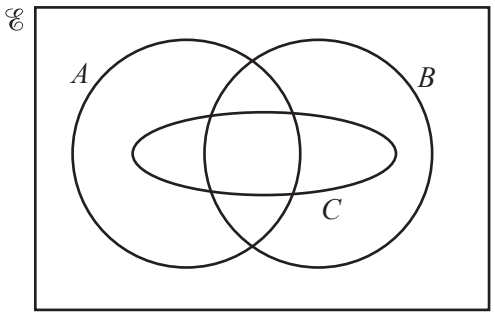
2 On each of the Venn diagrams below, shade the region indicated.



$(A \cup B \cup C)'$



$A \cap B \cap C'$



$(A \cap B) \cup C'$

[3]

3 **(i)** Write $8+7x-x^2$ in the form $a-(x-b)^2$, where a and b are constants. [3]

(ii) Hence state the maximum value of $8+7x-x^2$ and the value of x at which it occurs. [2]

(iii) Using your answer to **part (i)**, or otherwise, solve the equation $8+7z^2-z^4=0$. [3]

4 $\dfrac{d^2y}{dx^2} = 2x + \dfrac{3}{(x+1)^4}$

(i) Find $\dfrac{dy}{dx}$, given that $\dfrac{dy}{dx} = 1$ when $x = 1$. [3]

(ii) Find y in terms of x, given that $y = 3$ when $x = 1$. [3]

5 Given that $\mathbf{A} = \begin{pmatrix} 2 & 3 \\ 1 & 4 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 1 & 4 \\ -2 & 5 \end{pmatrix}$, find

(i) $\mathbf{A}^{-1}$, [2]

(ii) the matrix $\mathbf{C}$ such that $\mathbf{CA} = \mathbf{B}$, [2]

(iii) the matrix $\mathbf{D}$ such that $\mathbf{A}^{-1}\mathbf{D} + \mathbf{B} = \mathbf{I}$. [3]

6 Solve the simultaneous equations

$$\log_2(x+2y) = 3,$$

$$\log_2 3x - \log_2 y = 1.$$

[5]

7 A squad of 20 boys, which includes 2 sets of twins, is available for selection for a cricket team of 11 players. Calculate the number of different teams that can be selected if

(i) there are no restrictions, [1]

(ii) both sets of twins are selected, [2]

(iii) one set of twins is selected but neither twin from the other set is selected, [2]

(iv) exactly one twin from each set of twins is selected. [2]

8 Variables x and y are such that when y^2 is plotted against e^{2x} a straight line is obtained which passes through the points (1.5, 5.5) and (3.7, 12.1). Find

(i) y in terms of e^{2x}, [3]

(ii) the value of y when $x = 3$, [1]

(iii) the value of x when $y = 50$. [3]

9 **(a)** Solve $2\sin\left(x+\frac{\pi}{4}\right)=\sqrt{3}$ for $0<x<\pi$ radians. [3]

(b) Solve $3\sec y=4\operatorname{cosec} y$ for $0°<y<360°$. [3]

(c) Solve $7\cot z - \tan z = 2\operatorname{cosec} z$ for $0° < z < 360°$. [6]

10 The equation of a curve is $y = x^2\sqrt{3+x}$ for $x \geqslant -3$.

(i) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$. [3]

(ii) Find the equation of the tangent to the curve $y = x^2\sqrt{3+x}$ at the point where $x = 1$. [3]

(iii) Find the coordinates of the turning points of the curve $y = x^2\sqrt{3+x}$. [4]

11 A line with equation $y = -5x + k + 5$ is a tangent to a curve with equation $y = 7 - kx - x^2$.

(i) Find the two possible values of k. [5]

(ii) Find, for **each** of your values of k,

- the equation of the tangent
- the equation of the curve
- the coordinates of the point of contact of the tangent and the curve. [5]

(iii) Find the distance between the two points of contact. [2]

BLANK PAGE

6.1 2018 | Oct/Nov | Variant 3 | 0606_w18_ms_23

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **October/November 2018**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method marks, awarded for a valid method applied to the problem.

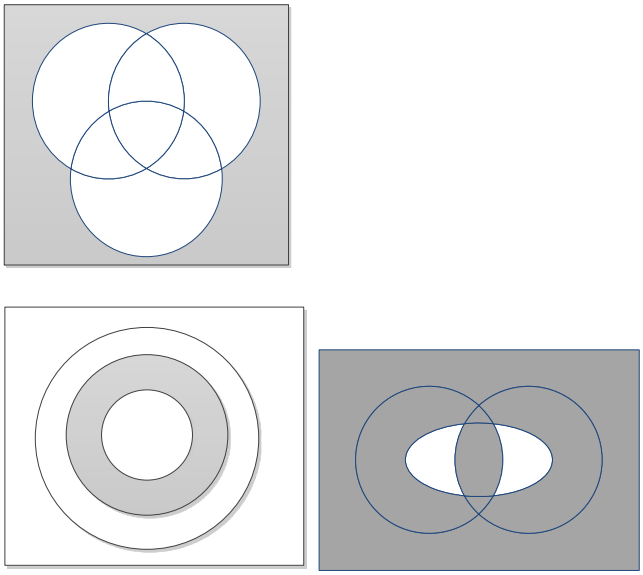
A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

B Mark for a correct result or statement independent of Method marks.

When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Partial Marks
1	$x = 2$	**B1**	
	$3 - 5x = -3x + 13$ oe	**M1**	
	$x = -5$	**A1**	
2		**3**	**B1** for each correct diagram
3(i)	$\frac{81}{4} - \left(x - \frac{7}{2}\right)^2$	**3**	**B1** $b = \frac{7}{2}$ **M1** $\pm 8 \pm \left(\frac{7}{2}\right)^2$ seen or expand given form and equate for 8 or 7 **A1** fully correct
3(ii)	maximum *their* $\frac{81}{4}$ when $x =$ *their* $\frac{7}{2}$ from *their* correct form	**2**	**B1** **B1**
3(iii)	$\left(z^2 - \frac{7}{2}\right)^2 = \frac{81}{4}$ oe	**M1**	replace x by z^2 in *their* **(i)** and equate to zero.
	$z^2 = \frac{7}{2} \pm \frac{9}{2}$	**M1**	
	$z = \pm\sqrt{8}$	**A1**	

Question	Answer	Marks	Partial Marks
4(i)	integrate: increase in powers of at least one term	**M1**	*
	$\frac{\mathrm{d}y}{\mathrm{d}x} = x^2 - \frac{1}{(x+1)^3} + (C)$	**A1**	
	$C = \frac{1}{8}$	**A1**	
4(ii)	integrate *their* **(i)**: increase in powers of at least one term	**M1**	**Dep***
	$y = \frac{1}{3}x^3 + \frac{1}{2(x+1)^2} + \frac{1}{8}x + (D)$	**A1**	two correct terms in x
	$D = \frac{29}{12}$	**A1**	
5(i)	$\frac{1}{5}\begin{pmatrix} 4 & -3 \\ -1 & 2 \end{pmatrix}$	**2**	**B1** $\begin{pmatrix} 4 & -3 \\ -1 & 2 \end{pmatrix}$ **B1** $\frac{1}{5}$
5(ii)	post multiply by $\mathbf{A}^{-1}$ $\mathbf{C} = \mathbf{B}\mathbf{A}^{-1}$	**M1**	
	$\frac{1}{5}\begin{pmatrix} 0 & 5 \\ -13 & 16 \end{pmatrix}$	**A1**	
5(iii)	$\mathbf{I} - \mathbf{B} = \begin{pmatrix} 0 & -4 \\ 2 & -4 \end{pmatrix}$ or $\mathbf{AB} = \begin{pmatrix} -4 & 23 \\ -7 & 24 \end{pmatrix}$	**B1**	
	$\mathbf{D} = \mathbf{A}(\mathbf{I} - \mathbf{B})$ or $\mathbf{D} = \mathbf{A} - \mathbf{AB}$	**M1**	
	$\mathbf{D} = \begin{pmatrix} 6 & -20 \\ 8 & -20 \end{pmatrix}$	**A1**	

Question	Answer	Marks	Partial Marks
6	$\log_2 8 = 3$ or $\log 3x - \log y = \log \frac{3x}{y}$ (any base) or $\log_2 2 = 1$ soi	**B1**	implied by one correct equation
	$x + 2y = 8$	**B1**	
	$\frac{3x}{y} = 2$	**B1**	
	solve correct equations for x or y	**M1**	
	$x = 2$ and $y = 3$	**A1**	
7(i)	167 960	**1**	
7(ii)	evidence of selecting from 16	**M1**	
	$[{}^{16}C_7 =]$ 11 440	**A1**	
7(iii)	$2 \times {}^{n}C_r$ with $n = 16$ or $r = 9$	**M1**	
	$\left[2 \times {}^{16}C_9 =\right]$ 22880	**A1**	
7(iv)	$4 \times {}^{n}C_r$ with $n = 16$ or $r = 9$	**M1**	
	$\left[4 \times {}^{16}C_9 =\right]$ 45760	**A1**	
8(i)	$\frac{12.1 - 5.5}{3.7 - 1.5}$ [= 3]	**B1**	correct expression for gradient
	$\frac{y^2 - 5.5}{e^{2x} - 1.5}$ = *their* grad or correctly use $y^2 =$ (*their m*) $e^{2x} + c$ with one point to find c	**M1**	
	$y = [\pm]\sqrt{3e^{2x} + 1}$	**A1**	
8(ii)	[±]34.8	**1**	

Question	Answer	Marks	Partial Marks
8(iii)	$50 = \sqrt{(their3)e^{2x} + their1}$ or $2500 = (their3)e^{2x} + their1$	**B1**	*
	$2x = \ln\left(\frac{2499}{3}\right)$	**M1**	**Dep*** obtain $2x$ explicitly
	3.36 cao	**A1**	
9(a)	$x + \frac{\pi}{4} = \frac{\pi}{3}$	**M1**	
	$\frac{\pi}{12}$ and $\frac{5\pi}{12}$ (0.262 and 1.31)	**A2**	**A1** for one correct
9(b)	correctly use $\sec y = \frac{1}{\cos y}$ and $\text{cosec}\, y = \frac{1}{\sin y}$	**M1**	
	$\tan y = \frac{4}{3}$	**A1**	obtain expression for tan$y$ or y explicitly
	53.1° and 233.1°	**A1**	
9(c)	correctly rewrite equation in terms of sin$z$ and cos$z$	**M1**	
	use $\sin^2 z = 1 - \cos^2 z$	**M1**	appropriate use of pythagorean identity for forming an equation in one trig ratio
	$8\cos^2 z - 2\cos z - 1 = 0$ oe	**A1**	
	$(4\cos z + 1)(2\cos z - 1) = 0$	**M1**	solve 3 term quadratic in cos$z$
	60° and 300° and 104.5° and 255.5°	**A2**	**A1** for any two correct
10(i)	$\frac{d}{dx}\sqrt{3+x} = \frac{1}{2}(3+x)^{-\frac{1}{2}}$	**B1**	
	correctly substitute *their* $\frac{1}{2}(3+x)^{-\frac{1}{2}}$ and *their* $2x$ into product rule	**M1**	
	$\frac{dy}{dx} = x^2 \times \frac{1}{2}(3+x)^{-\frac{1}{2}} + 2x(3+x)^{\frac{1}{2}}$	**A1**	

Question	Answer	Marks	Partial Marks
10(ii)	$y = 2$	**B1**	
	$\frac{dy}{dx} = \frac{17}{4}$	**B1**	
	$\frac{y-2}{x-1} = \frac{17}{4}$ $\left(y = \frac{17}{4}x - \frac{9}{4}\right)$ oe or use $y = mx + c$ and find c	**B1**	**FT** on *their* 2 and *their* $\frac{17}{4}$ from *their* $\frac{dy}{dx}$
10(iii)	set *their* $\frac{dy}{dx} = 0$	**M1**	
	obtain correct quadratic equation $5x^2 + 12x$ [= 0] soi	**A1**	
	(0, 0) and (–2.4, 4.46)	**A2**	**A1** for one point or two correct values of x
11(i)	$-5x + k + 5 = 7 - kx - x^2$	**M1**	*
	$b^2 - 4ac\ (=0) \rightarrow (k-5)^2 - 4(k-2)\ (=0)$	**M1**	**Dep***
	$k^2 - 14k + 33\ \ (=0)$	**A1**	
	$(k-11)(k-3)\ \ (=0)$	**M1**	**Dep dep** * solve quadratic in k
	$k = 11$ and $k = 3$	**A1**	
11(ii)	$y = -5x + 16$ and $y = 7 - 11x - x^2$ $y = -5x + 8$ and $y = 7 - 3x - x^2$	**B2**	**FT** *their k* **B1** for any two correct
	solve one tangent/curve pair for one variable from quadratic equation with repeated root	**M1**	
	(–3, 31) and (1, 3)	**A2**	**A1** for one correct point or two correct x values
11(iii)	find distance between any two points found in **(ii)**	**M1**	
	$\sqrt{800}$ oe	**A1**	

A Topical Questions Tracker

A.1 Functions

0606_s18_QP_22 Question: 10 QP Page: 42 MS Page: 55
0606_s18_QP_23 Question: 5 QP Page: 65 MS Page: 80
0606_w18_QP_22 Question: 11 QP Page: 125 MS Page: 136

A.2 Quadratic functions

0606_m18_QP_22 Question: 2 QP Page: 7 MS Page: 24
0606_s18_QP_22 Question: 4 QP Page: 36 MS Page: 52
0606_s18_QP_23 Question: 9 QP Page: 69 MS Page: 82
0606_w18_QP_22 Question: 10 QP Page: 123 MS Page: 136
0606_w18_QP_23 Question: 3 QP Page: 143 MS Page: 160

A.3 Equations, inequalities and graphs

0606_w18_QP_21 Question: 1 QP Page: 88 MS Page: 106
0606_w18_QP_22 Question: 1 QP Page: 114 MS Page: 132
0606_w18_QP_23 Question: 1 QP Page: 142 MS Page: 160

A.4 Indices and surds

0606_w18_QP_21 Question: 3 QP Page: 89 MS Page: 106
0606_w18_QP_22 Question: 7 QP Page: 119 MS Page: 134

A.5 Factors of polynomials

0606_s18_QP_22 Question: 3 QP Page: 35 MS Page: 52
0606_s18_QP_23 Question: 4 QP Page: 64 MS Page: 80

A.6 Simultaneous equations

0606_w18_QP_22 Question: 5 QP Page: 117 MS Page: 133

A.7 Logarithmic and exponential functions

0606_m18_QP_22 Question: 8 QP Page: 11 MS Page: 25
0606_m18_QP_22 Question: 10 QP Page: 13 MS Page: 27
0606_w18_QP_21 Question: 2 QP Page: 88 MS Page: 106
0606_w18_QP_22 Question: 4 QP Page: 116 MS Page: 132
0606_w18_QP_23 Question: 6 QP Page: 146 MS Page: 162

A.8 Straight line graphs

0606_m18_QP_22 Question: 9 QP Page: 12 MS Page: 26
0606_s18_QP_23 Question: 8 QP Page: 68 MS Page: 81
0606_w18_QP_21 Question: 10 QP Page: 97 MS Page: 109
0606_w18_QP_23 Question: 8 QP Page: 148 MS Page: 162

0606_w18_QP_23 Question: 11 QP Page: 153 MS Page: 164

A.9 Circular measure

0606_m18_QP_22 Question: 7 QP Page: 10 MS Page: 25
0606_s18_QP_22 Question: 6 QP Page: 38 MS Page: 53
0606_s18_QP_23 Question: 6 QP Page: 66 MS Page: 81

A.10 Trigonometry

0606_m18_QP_22 Question: 4 QP Page: 8 MS Page: 24
0606_m18_QP_22 Question: 11 QP Page: 15 MS Page: 28
0606_s18_QP_22 Question: 1 QP Page: 33 MS Page: 51
0606_s18_QP_23 Question: 11 QP Page: 71 MS Page: 83
0606_w18_QP_21 Question: 4 QP Page: 90 MS Page: 107
0606_w18_QP_21 Question: 7 QP Page: 93 MS Page: 107
0606_w18_QP_22 Question: 8 QP Page: 120 MS Page: 134
0606_w18_QP_23 Question: 9 QP Page: 149 MS Page: 163

A.11 Permutations and combinations

0606_m18_QP_22 Question: 3 QP Page: 7 MS Page: 24
0606_s18_QP_22 Question: 5 QP Page: 37 MS Page: 52
0606_s18_QP_23 Question: 3 QP Page: 63 MS Page: 79
0606_w18_QP_21 Question: 6 QP Page: 92 MS Page: 107
0606_w18_QP_23 Question: 7 QP Page: 147 MS Page: 162

A.12 Series

0606_w18_QP_22 Question: 6 QP Page: 118 MS Page: 133

A.13 Vectors in two dimensions

0606_m18_QP_22 Question: 5 QP Page: 9 MS Page: 25
0606_s18_QP_22 Question: 7 QP Page: 39 MS Page: 53
0606_w18_QP_22 Question: 12 QP Page: 126 MS Page: 138

A.14 Differentiation and integration

0606_m18_QP_22 Question: 6 QP Page: 9 MS Page: 25
0606_m18_QP_22 Question: 12 QP Page: 17 MS Page: 28
0606_s18_QP_22 Question: 9 QP Page: 41 MS Page: 55
0606_s18_QP_22 Question: 11 QP Page: 43 MS Page: 56
0606_s18_QP_22 Question: 12 QP Page: 44 MS Page: 57
0606_s18_QP_23 Question: 2 QP Page: 62 MS Page: 79
0606_s18_QP_23 Question: 7 QP Page: 67 MS Page: 81
0606_s18_QP_23 Question: 10 QP Page: 70 MS Page: 82
0606_s18_QP_23 Question: 12 QP Page: 72 MS Page: 83
0606_w18_QP_21 Question: 8 QP Page: 94 MS Page: 108
0606_w18_QP_21 Question: 9 QP Page: 95 MS Page: 108
0606_w18_QP_22 Question: 3 QP Page: 115 MS Page: 132

0606_w18_QP_22 Question: 9 QP Page: 121 MS Page: 134
0606_w18_QP_23 Question: 4 QP Page: 144 MS Page: 161
0606_w18_QP_23 Question: 10 QP Page: 151 MS Page: 163