

1. Marks must be assigned in accordance with these marking instructions. In principle, marks are awarded for what is correct, rather than marks deducted for what is wrong.
2. Award one mark for each 'bullet' point. Each error should be underlined in RED at the point in the working where it first occurs, and not at any subsequent stage of the working.
3. The working subsequent to an error must be followed through by the marker with possible full marks for the subsequent working, provided that the difficulty involved is approximately similar. Where, subsequent to an error, the working is eased, a deduction(s) of mark(s) should be made.
This may happen where a question is divided into parts. In fact, failure to even answer an earlier section does not preclude a candidate from assuming the result of that section and obtaining full marks for a later section.
4. Correct working should be ticked (✓). This is essential for later stages of the SQA procedures. Where working subsequent to an error(s) is correct and scores marks, it should be marked with a crossed tick (✗). In appropriate cases attention may be directed to work which is not quite correct (e.g. bad form) but which has not been penalised, by underlining with a dotted or wavy line.
Work which is correct but inadequate to score any marks should be corrected with a double cross tick (✘).
5.
 - The total mark for each section of a question should be entered in red in the **outer** right hand margin, opposite the end of the working concerned.
 - Only the mark should be written, **not** a fraction of the possible marks.
 - These marks should correspond to those on the question paper and these instructions.
6. It is of great importance that the utmost care should be exercised in adding up the marks. Where appropriate, all summations for totals and grand totals must be carefully checked.
Where a candidate has scored zero marks for any question attempted, "0" should be shown against the answer.
7. As indicated on the front of the question paper, full credit should only be given where the solution contains appropriate working. Accept answers arrived at by inspection or mentally where it is possible for the answer so to have been obtained. Situations where you may accept such working will be indicated in the marking instructions.

cont/

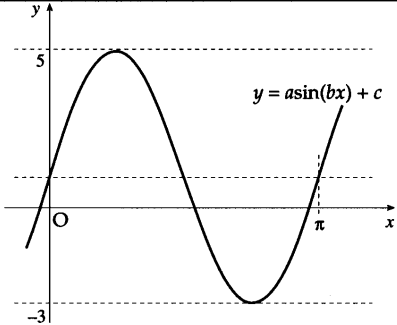
8. Do not penalise:
 - working subsequent to a correct answer
 - omission of units
 - bad form
 - legitimate variations in numerical answers
 - correct working in the “wrong” part of a question
9. No piece of work should be scored through - even where a fundamental misunderstanding is apparent early in the answer. Reference should always be made to the marking scheme - answers which are widely off-beam are unlikely to include anything of relevance but in the vast majority of cases candidates still have the opportunity of gaining the odd mark or two provided it satisfies the criteria for the mark(s).
10. If in doubt between two marks, give an intermediate mark, but without fractions. When in doubt between consecutive numbers, give the higher mark.
11. In cases of difficulty covered neither in detail nor in principle in the Instructions, attention may be directed to the assessment of particular answers by making a referral to the P.A. Please see the general instructions for P.A. referrals.
12. No marks should be deducted at this stage for careless or badly arranged work. In cases where the writing or arrangement is very bad, a note may be made on the upper left-hand corner of the front cover of the script.
- 13 **Do not write any comments on the scripts.** A summary of acceptable notation is given on page 4.

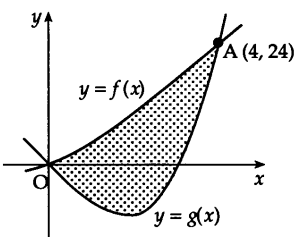
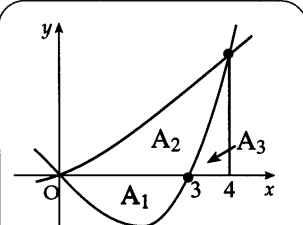
Summary

Throughout the examination procedures many scripts are remarked. It is essential that markers follow common procedures:

- 1 **Tick** correct working.
- 2 Put a mark in the **right-hand margin to match the marks allocations on the question paper.**
- 3 Do **not** write marks as fractions.
- 4 Put each mark **at the end** of the candidate’s response to the question.
- 5 **Follow through** errors to see if candidates can score marks subsequent to the error.
- 6 Do **not** write any comments on the scripts.

	Give 1 mark for each •	Illustrations for awarding each •
1	<p>$f(x) = 6x^3 - 5x^2 - 17x + 6$.</p> <p>(a) Show that $(x - 2)$ is a factor of $f(x)$.</p> <p>(b) Express $f(x)$ in its fully factorised form.</p>	4
1	<p>2.1.1, 2.1.3 CN C 03/101</p> <p>ans: proof and $(x-2)(2x+3)(3x-1)$ 4 marks</p> <p>•¹ ss : synthetic division, long division or evaluation •² ic : complete proof •³ ic : state quadratic factor •⁴ pd : factorise fully</p>	<p>•¹ $\begin{array}{r} 6 \quad -5 \quad -17 \quad 6 \\ 12 \\ \hline 6 \end{array}$</p> <p>•² $\begin{array}{r} 6 \quad -5 \quad -17 \quad 6 \\ 12 \quad 14 \quad -6 \\ \hline 6 \quad 7 \quad -3 \quad 0 \end{array}$</p> <p>•³ $6x^2 + 7x - 3$</p> <p>•⁴ $(x-2)(2x+3)(3x-1)$ stated explicitly</p>
	<p>Alternative 1</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>•¹ $f(2) = 6 \times 2^3 \dots\dots$ •² $f(2) = 48 - 20 - 34 + 6 = 0$ •³ $6x^2 + 7x - 3$ •⁴ $(x-2)(2x+3)(3x-1)$</p> </div> <p>Alternative 2</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>•¹</p> $\begin{array}{r} 6x^2 \\ x-2 \overline{) 6x^3 - 5x^2 - 17x + 6} \\ \underline{6x^3 - 12x^2} \\ 7x^2 - 17x \\ \underline{7x^2 - 14x} \\ -3x + 6 \\ \underline{-3x + 6} \\ 0 \end{array}$ <p>•²</p> $\begin{array}{r} 6x^2 + 7x - 3 \\ x-2 \overline{) 6x^3 - 5x^2 - 17x + 6} \\ \underline{6x^3 - 12x^2} \\ 7x^2 - 17x \\ \underline{7x^2 - 14x} \\ -3x + 6 \\ \underline{-3x + 6} \\ 0 \end{array}$ </div>	<p>Notes</p> <p>1 See page 16 for advice on solutions obtained via a graphics calculator</p>

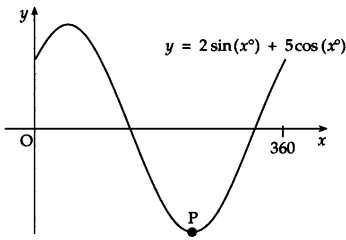
	Give 1 mark for each •	Illustrations for awarding each •
<p>2 The diagram shows a sketch of part of the graph of a trigonometric function whose equation is of the form $y = a \sin(bx) + c$. Determine the values of a, b and c.</p>		 <p style="text-align: right;">3</p>
<p>2 1.2.3, 2.3.3 CN C 03/new ans: $a = 4$, $b = 2$, $c = 1$ 3 marks</p> <ul style="list-style-type: none"> •¹ ic: interpret amplitude •² ic: interpret period •³ ic: interpret vertical displacement 		<ul style="list-style-type: none"> •¹ $a = 4$ •² $b = 2$ •³ $c = 1$
<p style="text-align: center;">Notes 1 Accept $4\sin(2x) + 1$ for 3 marks.</p>		

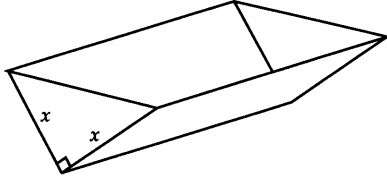
Give 1 mark for each •	Illustrations for awarding each •
<p>3 The incomplete graphs of $f(x) = x^2 + 2x$ and $g(x) = x^3 - x^2 - 6x$ are shown in the diagram. The graphs intersect at A (4, 24) and the origin.</p> <p>Find the shaded area enclosed between the curves.</p>	 <p style="text-align: right;">5</p>
<p>3 2.1.2, 2.2.7 CN CB 03/109 ans: $42\frac{2}{3}$ 5 marks</p> <p>•¹ ss : area = \int upper function – lower function •² ic : interpret limits •³ pd : simplify prior to integration •⁴ pd : integrate •⁵ pd : evaluate using limits</p>	<p>•¹ $\int_0^4 ((x^2 + 2x) - (x^3 - x^2 - 6x)) dx$ stated, or implied by •³ •² $\int_0^4 \dots$ •³ $\int (8x + 2x^2 - x^3) dx$ •⁴ $\left[4x^2 + \frac{2}{3}x^3 - \frac{1}{4}x^4 \right]_0^4$ •⁵ $42\frac{2}{3}$</p>
<p>Alternative 1</p> <p>•¹ $\int (x^2 + 2x) - (x^3 - x^2 - 6x) dx$ •² $\int_0^4 \dots$ •³ $\left[\frac{1}{3}x^3 + x^2 \right]_0^4$ •⁴ $\left[\frac{1}{4}x^4 - \frac{1}{3}x^3 - 3x^2 \right]_0^4$ •⁵ $42\frac{2}{3}$</p> <p>Alternative 2</p>  <p>•¹ $\int_0^3 (x^3 - x^2 - 6x) dx$ •² $A_2 + A_3 = \int_0^4 (x^2 + 2x) dx$ •³ $A_3 = \int_3^4 (x^3 - x^2 - 6x) dx$ •⁴ $15\frac{3}{4}$ or $37\frac{1}{3}$ or $10\frac{5}{12}$ •⁵ $15\frac{3}{4} + 37\frac{1}{3} - 10\frac{5}{12} = 42\frac{2}{3}$</p>	<p>Notes</p> <p>1 •¹ is lost for subtracting the wrong way round. •⁵ will also be lost for statements such as $-42\frac{2}{3} = 42\frac{2}{3}$, $-42\frac{2}{3}$ so ignore the -ve, $-42\frac{2}{3} = 42\frac{2}{3}$ sq units</p> <p>•⁵ may still be gained for statements such as $\dots -42\frac{2}{3}$ and so the area = $42\frac{2}{3}$.</p> <p>2 For candidates who split up the area into three integrals, see model in Alternative 2 3 Do not penalise decimal approximations 4 Differentiation loses •⁴ and •⁵ 5 $\int_4^0 (f(x) - g(x)) dx$ loses •² and possibly •⁵ 6 $\int_4^0 (g(x) - f(x)) dx$ is technically correct and hence all 5 marks are available 7 Accept at •³, $8x + 2x^2 - x^3$ appearing from solving "upper" = "lower" 8 using $f(x) + g(x)$ leading to 32 gains •², •⁴ and •⁵</p> <p>Example 1</p> <p>$\int (x^2 + 2x - x^3 - x^2 - 6x) dx$ •¹ ✓ bad form $\left[-\frac{1}{4}x^4 - 2x^2 \right]_0^4$ •² ✓ -96 •³ ✗ $\therefore \text{area} = 96$ •⁴ ✗ Eased •⁵ ✗</p> <p style="text-align: right;">3 marks given</p>

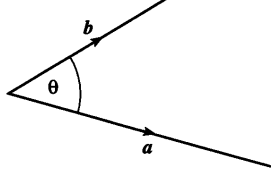
	Give 1 mark for each •	Illustrations for awarding each •
4	<p>(a) Find the equation of the tangent to the curve with equation $y = x^3 + 2x^2 - 3x + 2$ at the point where $x = 1$.</p> <p>(b) Show that this line is also a tangent to the circle with equation $x^2 + y^2 - 12x - 10y + 44 = 0$ and state the coordinates of the point of contact.</p>	<p>5</p> <p>6</p>
4	<p>1.3.9, 2.4.4 CN CB 03/104</p> <p>(a) ans: $y = 4x - 2$ 5 marks</p> <p>(b) proof & (2, 6) 6 marks</p> <p>•¹ ss : know to differentiate and start</p> <p>•² pd : differentiate</p> <p>•³ pd : evaluate gradient</p> <p>•⁴ pd : evaluate y-coordinate</p> <p>•⁵ ic : state equation of line</p> <p>•⁶ ss : prepare for substitution</p> <p>•⁷ ss : substitute</p> <p>•⁸ pd : express in standard form</p> <p>•⁹ ss : know how to solve</p> <p>•¹⁰ ic : complete proof</p> <p>•¹¹ pd : determine coordinates</p>	<p>•¹ $\frac{dy}{dx} = 3x^2 \dots$</p> <p>•² $\frac{dy}{dx} = 3x^2 + 4x - 3$</p> <p>•³ $m = \frac{dy}{dx}_{x=1} = 4$ gradient stated or implied by •⁵</p> <p>•⁴ $y_{x=1} = 2$</p> <p>•⁵ $y - 2 = 4(x - 1)$</p> <p>•⁶ $y = 4x - 2$</p> <p>•⁷ $x^2 + (4x - 2)^2 - 12x - 10(4x - 2) + 44 = 0$</p> <p>•⁸ $17x^2 - 68x + 68 = 0$</p> <p>•⁹ $17(x - 2)(x - 2) = 0$</p> <p>•¹⁰ equal roots \Rightarrow tangent</p> <p>•¹¹ pt of contact = (2, 6)</p>
	<p>Alternative 1</p> <p>•⁶ $y = 4x - 2$</p> <p>•⁷ $C = (6, 5)$ and $m_{radius} = -\frac{1}{4}$</p> <p>•⁸ $y - 5 = -\frac{1}{4}(x - 6)$</p> <p>•⁹ start to solve sim. equations</p> <p>•¹⁰ $x = 2, y = 6$</p> <p>•¹¹ check that (2, 6) lies on the circle</p>	<p>Notes</p> <p>1 •⁵ is only available after an attempt has been made to find the gradient from differentiation</p> <p>2 alternatives for •⁹</p> <p>•⁹ $(x - 2)(17x - 34) = 0$</p> <p>3 alternatives for •¹⁰</p> <p>•¹⁰ $x = 2, 2 \Rightarrow$ tangent</p> <p>or •¹⁰ $x = 2$ only \Rightarrow tangent</p> <p>4 alternative for •⁹ and •¹⁰</p> <p>•⁹ $b^2 - 4ac = 68^2 - 4 \times 17 \times 68$</p> <p>•¹⁰ $= 68^2 - 68^2 = 0 \Rightarrow$ tangent</p> <p>5 alternative for •¹⁰ and •¹¹</p> <p>•¹⁰ $x = 2, y = 6$ and $m_{radius} = -\frac{1}{4}$</p> <p>•¹¹ $m_1 m_2 = 4 \times -\frac{1}{4} = -1 \Rightarrow$ line is tangent</p> <p>6 For notes 2, 3 and 4 it is acceptable to deal with the reduced quadratic $x^2 - 4x + 4 = 0$.</p> <p>7 an “= 0” must occur somewhere between •⁷ and •⁹</p>
	<p>Example 1</p> <p>$3x^2 + 4x - 3$ •1 ✓</p> <p>$3 \times 1^2 + 4 \times 1 - 3 = 4$ •2 ✓</p> <p>$1^3 + 2 - 3 + 2 = 2$ •3 ✗</p> <p>$y - 4 = 2(x - 1)$ •4 ✗</p> <p>•5 ✗</p> <p>3 marks given</p>	
	<p>Cave</p> <p>Look out for candidates who use $y = -\frac{1}{4}x + \frac{9}{4}$ instead of $y = 4x - 2$ leading to point of contact of (5, 1). This is worth 5 marks.</p>	

Give 1 mark for each •		Illustrations for awarding each •
<p>5 The diagram shows part of the sketch of a function f.</p> <p>f has a minimum turning point at $(0, -3)$ and a point of inflexion at $(-4, 2)$.</p> <p>(a) Sketch the graph of $y = f(-x)$.</p> <p>(b) On the same diagram sketch the graph of $y = 2f(-x)$.</p>		<p>2</p> <p>2</p>
<p>5 1.2.4 CN CA 03/84r</p> <p>(a) ans: sketch 2 marks</p> <p>(b) ans: sketch 2 marks</p> <p>•¹ ic : interpret $f(-x)$</p> <p>•² ic : communication</p> <p>•³ ic : interpret $2f$</p> <p>•⁴ ic : communication</p>	<p>•¹ refl. in y-axis & $(0, -3)$</p> <p>•² annotate $(4, 2), (3, 0), (-1, 0)$</p> <p>•³ a scaling & $(3, 0), (-1, 0)$</p> <p>•⁴ annotate $(0, -6), (4, 4)$</p>	<p>Alternative 1</p> <ul style="list-style-type: none"> •¹ $(-1, 0)$ and $(3, 0)$ •² minimum at $(0, -3)$ and p/i at $(4, 2)$ •³ $(-1, 0)$ and $(3, 0)$ •⁴ minimum at $(0, -6)$ and p/i at $(4, 4)$ <p>Notes</p> <p>1 Ignore poor drawing skills no labels on graphs using separate diagrams</p> <p>2 For (a) reflection in x-axis scores 1 out of 2 reflection in $x = -3$ scores 1 out of 2 reflection in $(0, 0)$ scores 1 out of 2</p> <p>3 For (b) sketching $2f(2x)$ etc scores no marks sketching $f(\frac{1}{2}x)$ etc scores no marks</p> <p>4 for •³, any scaling parallel to the y-axis is acceptable.</p>

Give 1 mark for each •		Illustrations for awarding each •
6	If $f(x) = \cos(2x) - 3\sin(4x)$, find the exact value of $f'(\frac{\pi}{6})$.	4
6	<p>3.2.2, 3.2.1, 1.2.11 NC BA 03/42</p> <p>ans : $6 - \sqrt{3}$ 4 marks</p> <p>•¹ pd : differentiate compound trig •² pd : differentiate compound trig •³ ic : interpret •⁴ pd : evaluate derivative</p>	<p>•¹ $f'(x) = -2\sin(2x) + \dots$ •² $\dots - 12\cos(4x)$ •³ $f'(\frac{\pi}{6}) = -2\sin(\frac{2\pi}{6}) - 12\cos(\frac{4\pi}{6})$ •⁴ $6 - \sqrt{3}$</p>
<p>Alternative 1</p> <div style="border: 1px solid black; border-radius: 10px; padding: 10px; width: fit-content;"> <p>•¹ $f'(x) = -2\sin(2x) + \dots$ •² $\dots - 12\cos(4x)$ •³ $-2\sin(\frac{2\pi}{6}) = -\sqrt{3}$ •⁴ $-12\cos(\frac{4\pi}{6})$</p> </div> <p>Example 1</p> <div style="border: 1px solid black; border-radius: 10px; padding: 10px; width: fit-content;"> <p>$f'(x) = -\sin(2x) - 3\cos(4x)$ •¹ ✗ $-\sin(\frac{2\pi}{6}) = -\frac{\sqrt{3}}{2}$ •² ✗ $-3\cos(\frac{4\pi}{6}) = +\frac{3}{2}$ •³ ✗ •⁴ ✗</p> <p>3 marks given</p> </div> <p>Example 2</p> <div style="border: 1px solid black; border-radius: 10px; padding: 10px; width: fit-content;"> <p>$f'(x) = -\frac{1}{2}\sin(2x) - \frac{3}{4}\cos(4x)$ •¹ ✗ $-\frac{1}{2}\sin(\frac{2\pi}{6}) = -\frac{\sqrt{3}}{4}$ •² ✗ $-\frac{3}{4}\cos(\frac{4\pi}{6}) = +\frac{3}{8}$ •³ ✗ •⁴ ✗</p> <p>3 marks given</p> </div>		<p>Notes</p> <p>1 Evidence for •³:</p> <p>$-2\sin 2(\frac{\pi}{6}) - 12\cos 4(\frac{\pi}{6})$ $-2\sin(\frac{\pi}{3}) - 12\cos(\frac{2\pi}{3})$ •³ ✓ or $-2\sin(\frac{2\pi}{6}) - 12\cos(\frac{4\pi}{6})$ •³ ✓ or $-2 \times \frac{\sqrt{3}}{2} - 12 \times (-\frac{1}{2})$ •³ ✓ or $-1.732 + 6$ •³ ✓ but $-2 \times 2 \times \frac{1}{2} - 12 \times 4 \times \frac{\sqrt{3}}{2}$ •³ ✗</p> <p>2 Do not penalise the use of 30° at •³</p> <p>3 Do not penalise $\frac{-4\sqrt{3}}{4}$ instead of $-\sqrt{3}$</p>

Give 1 mark for each •	Illustrations for awarding each •
<p>7 Part of the graph of $y = 2 \sin(x^\circ) + 5 \cos(x^\circ)$ is shown in the diagram.</p> <p>(a) Express $y = 2 \sin(x^\circ) + 5 \cos(x^\circ)$ in the form $k \sin(x^\circ + a^\circ)$ where $k > 0$ and $0 \leq a < 360$.</p> <p>(b) Find the coordinates of the minimum turning point P.</p>	 <p style="text-align: right;">4 3</p>
<p>7 3.4.1, 3.4.3 Ca BA 03/118</p> <p>(a) ans : $\sqrt{29} \sin(x + 68.2)^\circ$ 4 marks</p> <p>(b) ans : $(201.8^\circ, -\sqrt{29})$ 3 marks</p> <ul style="list-style-type: none"> •¹ ic : expand •² ic : compare coefficients •³ pd : process k •⁴ pd : process angle •⁵ ic : interpret minimum •⁶ pd : process •⁷ ic : interpret y-coordinate 	<ul style="list-style-type: none"> •¹ $k \sin(x^\circ) \cos(a^\circ) + k \cos(x^\circ) \sin(a^\circ)$ stated explicitly •² $k \cos(a^\circ) = 2, k \sin(a^\circ) = 5$ stated explicitly •³ $k = \sqrt{29}$ (5.4...) •⁴ $a = 68.2^\circ$ •⁵ $\sqrt{29} \sin(x + 68.2)^\circ = -\sqrt{29}$ •⁶ $x_p = 201.8^\circ$ •⁷ $y_p = -\sqrt{29}$
<p>Example 1</p> <p>(b)</p> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;"> $\sqrt{29} \sin(x + 68.2)^\circ = -1$ $x = 123, 281 \quad \text{award 1 mark}$ $(281, -1) \text{ or } (281, -\sqrt{29})$ </div> <p>Example 2</p> <p>(b)</p> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;"> <p>at P, $m = 0$</p> $2 \cos(x) + 5(-\sin(x)) = 0 \quad \bullet 5 \times \text{note 6}$ $\tan(x) = \frac{2}{5}$ $x = 21.8, 201.8 \quad \bullet 6 \checkmark$ $x = 201.8 \text{ at minimum} \quad \bullet 7 \checkmark$ $(201.8, -\sqrt{29})$ <p style="text-align: right;">2 marks given</p> </div> <p>Notes cont</p> <p>10 If the •4 answer is in radians, the mark is lost If the •6 answer is in radians, the mark is lost If both answers at •4 and •6 are in radians, only penalise once.</p>	<p>Notes</p> <ol style="list-style-type: none"> 1 Candidates may use any form eg $k \sin(x - a)$ as long as the final answer is in the form $k \sin(x + a)$. If not they lose •4 2 For •1 treat $k \sin x \cos a + \cos x \sin a$ as bad form provided you see $k \cos(a^\circ)$ and $k \sin(a^\circ)$ appearing for •2. 3 For •1 accept $k(\sin x \cos a + \cos x \sin a)$. 4 For •4 accept any answer which rounds to 68 5 The following are acceptable for •5 <ul style="list-style-type: none"> •⁵ $\sin(x + 68.2)^\circ = -1$ or •⁵ $x + 68.2 = 270$ 6 candidates who use differentiation for (b) will most likely lose 1 mark for omitting the factor $\frac{\pi}{180}$ 7 $(201.8^\circ, -\sqrt{29})$ with no working at all may earn marks •6 and •7. 8 $(-\sqrt{29}, 201.8^\circ)$ with no working at all may earn mark •7. 9 See page 16 for advice on solutions obtained via a graphics calculator

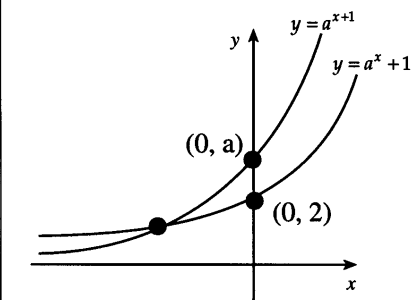
	Give 1 mark for each •	Illustrations for awarding each •																
8	<p>An open water tank, in the shape of a triangular prism, has a capacity of 108 litres. The tank is to be lined on the inside in order to make it watertight.</p> <p>The triangular cross-section of the tank is right-angled and isosceles, with equal sides of length x cm.</p> <p>The tank has a length of l cm.</p> <p>(a) Show that the surface area to be lined, A cm², is given by $A(x) = x^2 + \frac{432000}{x}$.</p> <p>(b) Find the value of x which minimises this surface area.</p>																	
8	<p>1.3.15 CN CBA 03/97</p> <p>(a) ans : proof 3 marks</p> <p>(b) ans : 60 5 marks</p> <p>•¹ ss : identify crucial aspect</p> <p>•² ic : start proof</p> <p>•³ ic : complete proof</p> <p>•⁴ ss : know to set derivative to zero</p> <p>•⁵ pd : express in standard form</p> <p>•⁶ pd : differentiate</p> <p>•⁷ pd : solve</p> <p>•⁸ ic : justify minimum</p>	<p>•¹ $length = \frac{108000}{\frac{1}{2}x^2}$</p> <p>•² $SA = 2 \times \frac{1}{2}x^2 + 2x \times length$</p> <p>•³ $\dots SA = x^2 + \frac{432000}{x}$</p> <p>•⁴ $\frac{dA}{dx} = \dots = 0$</p> <p>•⁵ $432000x^{-1}$</p> <p>•⁶ $2x - 432000x^{-2}$</p> <p>•⁷ $x = 60$</p> <p>•⁸ e.g. nature table</p>																
	<p>Notes cont</p> <p>6 For •8, a sketch of the graph would an acceptable alternative. At least 3 point should be shown (eg at $x = 59, x=60$ and $x=61$).</p>	<p>Notes</p> <p>1 Evidence of the nature table should take the form</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="padding: 2px 10px;">x</td> <td style="padding: 2px 10px;">60^-</td> <td style="padding: 2px 10px;">60</td> <td style="padding: 2px 10px;">60^+</td> </tr> <tr> <td style="padding: 2px 10px;">$\frac{dA}{dx}$</td> <td style="padding: 2px 10px;">$-ve$</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">$+ve$</td> </tr> <tr> <td></td> <td style="padding: 2px 10px;">\backslash</td> <td style="padding: 2px 10px;">$-$</td> <td style="padding: 2px 10px;">$/$</td> </tr> <tr> <td></td> <td colspan="3" style="text-align: center; padding: 2px 10px;">minimum</td> </tr> </table> <p>2 For •8, the second derivative is acceptable</p> <p>$\frac{d^2A}{dx^2} = 2 + 864000x^{-3}$</p> <p>$\frac{d^2A}{dx^2} \Big _{x=60} = 2 + 4 > 0$</p> <p>so minimum at $x = 60$</p> <p>3 A trial and error approach earns no marks</p> <p>4 The “ = 0 ” shown at •4 must appear somewhere for •4 to be awarded (but not necessarily at •4 stage)</p> <p>5 in (b) if a candidate uses an incorrect formula then only •4, •5 and •6 are available i.e. maximum score would be 3 marks. To score 3 marks, working has to be of a similar difficulty.</p>	x	60^-	60	60^+	$\frac{dA}{dx}$	$-ve$	0	$+ve$		\backslash	$-$	$/$		minimum		
x	60^-	60	60^+															
$\frac{dA}{dx}$	$-ve$	0	$+ve$															
	\backslash	$-$	$/$															
	minimum																	

	Give 1 mark for each •	Illustrations for awarding each •
9	<p>The diagram shows vectors a and b.</p> <p>If $a = 5$, $b = 4$ and $a \cdot (a + b) = 36$, find the size of the acute angle θ between a and b.</p>	 <p style="text-align: right;">4</p>
9	<p>3.1.9 Ca BA 03/115</p> <p>ans: 56.6° 4 marks</p> <p>•¹ ss : use distributive law •² pd : expand scalar product •³ pd : expand scalar product •⁴ pd ; complete calculations</p>	<p>•¹ $a \cdot (a + b) = a \cdot a + a \cdot b$ •² $a \cdot b = 5 \times 4 \cos(\theta)$ •³ $a \cdot a = 5^2$ •⁴ $[\cos(\theta) = 0.55] \Rightarrow \theta = 56.6^\circ \text{ 0.99 radians}$</p>
	<p>Example 1</p> <div style="border: 1px solid black; border-radius: 10px; padding: 10px; margin: 10px 0;"> <p>$a \cdot (a + b) = a^2 + ab$ •1 ✓ bad form $ab = 5 \times 4 \cos(\theta)$ •2 ✓ bad form $a^2 = 5^2$ •3 ✓ bad form $\theta = 56.6^\circ$ •4 ✓</p> <p style="text-align: right;">4 marks given</p> </div> <p>Example 2</p> <div style="border: 1px solid black; border-radius: 10px; padding: 10px; margin: 10px 0;"> <p>$a \cdot a + a \cdot b = 36$ •1 ✓ $25 \cos(\theta) + 20 \cos(\theta) = 36$ •2 ✓ $\cos(\theta) = \frac{36}{45}$ •3 ✗ $\theta = 36.9$ •4 ✗</p> <p style="text-align: right;">2 marks given</p> </div> <p>Example 3 CAVE</p> <div style="border: 1px solid black; border-radius: 10px; padding: 10px; margin: 10px 0;"> <p>$\cos(\theta) = \frac{ a b }{a \cdot b}$ $= \frac{20}{36}$ 0 marks given $\theta = 56.3$</p> </div>	<p>Notes</p> <p>1 Using "$a \cdot b = a b \sin(\theta)$" loses 1 mark</p>

Give 1 mark for each •		Illustrations for awarding each •
10 Solve the equation $3 \cos(2x) + 10 \cos(x) - 1 = 0$ for $0 \leq x \leq \pi$, correct to 2 decimal places.		5
10	<p>2.3.1 Ca BA 03/106 ans: 1.23 radians 5 marks</p> <p>•¹ ss : know to use double angle formula •² pd : arrange in standard form •³ ss : know how to solve •⁴ pd : solve •⁵ pd : solve</p>	<p>•¹ $3(2 \cos^2(x) - 1) \dots$ •² $6 \cos^2(x) + 10 \cos(x) - 4 = 0$ •³ $2(3 \cos(x) - 1)(\cos(x) + 2)$ •⁴ $\cos(x) = \frac{1}{3}$ <i>and</i> $\cos(x) = -2$ •⁵ $x = 1.23$ <i>and</i> no solution</p>
<p>Example 1</p> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p>$6 \cos^2(x) + 10 \cos(x) - 2 = 0$ •¹ ✗ <i>leading to</i> •² ✗ $\cos(x) = 0.180$ <i>or</i> $\cos(x) = -1.84$ •³ ✗ $x = 1.39$ <i>radians no solution</i> •⁴ ✗ •⁵ ✗</p> <p style="text-align: right;">4 marks given</p> </div>		<p>Notes</p> <p>1 alternative for •³</p> <p>•³ $\cos(x) = \frac{-10 \pm \sqrt{10^2 - 4 \times 6 \times (-4)}}{2 \times 6}$</p> <p>2 •⁵ must include some indication that $\cos(x) = -2$ has no solutions.</p> <p>3 in the event of other substitutions being used for $\cos(2x)$, no credit can be given until the equation reduces to a quadratic in $\cos(x)$.</p> <p>4 •⁴ and •⁵ are only available as a consequence of solving a quadratic equation.</p> <p>5 •⁴ and •⁵ may also be marked as follows</p> <p style="padding-left: 20px;">•⁴ $\cos(x) = \frac{1}{3}$ <i>and</i> $x = 1.23$ •⁵ $\cos(x) = -2$ <i>and</i> no solution</p> <p>6 For •⁵, accept $\frac{70.5\pi}{180}$ in lieu of 1.23</p> <p>7 If an answer starts</p> <p style="padding-left: 20px;">$3 \times 2 \cos^2(x) - 1 + 10 \cos(x) - 1 = 0$ $6 \cos^2(x) + 10 \cos(x) - 4 = 0$ then treat the first line as bad form.</p> <p>If an answer starts</p> <p style="padding-left: 20px;">$3 \times 2 \cos^2(x) - 1 + 10 \cos(x) - 1 = 0$ $6 \cos^2(x) + 10 \cos(x) - 2 = 0$ then use Example 1.</p>

	Give 1 mark for each •	Illustrations for awarding each •
11	(a) (i) Sketch the graph of $y = a^x + 1, a > 2$. (ii) On the same diagram sketch the graph of $y = a^{x+1}, a > 2$.	2
	(b) Prove that the graphs intersect at a point where the x -coordinate is $\log_a\left(\frac{1}{a-1}\right)$.	3

11	3.3.7, 3.3.4 CN A 03/120 (a) ans: sketch 2 marks (b) ans : proof 3 marks	<ul style="list-style-type: none"> •¹ expo sketch thr (0,2) •² expo sketch thr (0,a) •³ $a^{x+1} = a^x + 1$ •⁴ $a \times a^x - a^x = 1$ •⁵ $(a-1) \times a^x = 1$...& complete
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Notes

- 1 For •2, the second graph must cut the y -axis above $(0, 2)$ and must finish up between the first graph and the x -axis as x tends to minus infinity. '2' and 'a' must be marked on the y -axis.
- 2 Both graphs correct but with no annotation may be awarded 1 mark.

Alternative 1

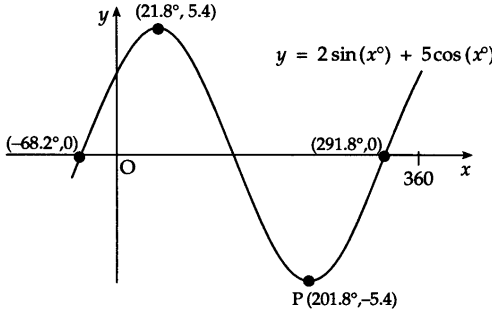
$$\begin{aligned} \text{Let } x &= \log_a\left(\frac{1}{a-1}\right) \\ \text{Then } \frac{1}{a-1} &= a^x && \bullet 1 \checkmark \\ y = a^x + 1 & && \bullet 2 \checkmark \\ &= \frac{1}{a-1} + 1 && \\ &= \frac{a}{a-1} && \\ y = a^{x+1} & && \\ &= a^x \times a && \\ &= \frac{1}{a-1} \times a && \\ &= \frac{a}{a-1} && \\ \therefore \text{curves intersect at } & \left(\log_a\left(\frac{1}{a-1}\right), \frac{a}{a-1}\right) && \bullet 3 \checkmark \end{aligned}$$

3 marks given

Alternative 1

$$\begin{aligned} \text{Let } x &= \log_a\left(\frac{1}{a-1}\right) \\ \text{Then } \frac{1}{a-1} &= a^x && \bullet 1 \checkmark \\ 1 &= a^x(a-1) && \bullet 2 \checkmark \\ 1 &= a^{x+1} - a^x && \\ a^x + 1 &= a^{x+1} && \\ \text{Hence the graphs intersect} & && \bullet 3 \checkmark \end{aligned}$$

3 marks given

	Give 1 mark for each •	Illustrations for awarding each •
1	<p>Solutions obtained by employing the facilities on a graphics calculator</p> <p>(a) •¹ $f(2) = 6 \times 2^3 \dots\dots$ •² $f(2) = 48 - 20 - 34 + 6 = 0$</p> <p>(b) •³ for a sketch of the cubic with the zeroes indicated at $2, \frac{1}{3}$ and $-\frac{2}{3}$ and the statement : the roots are $2, \frac{1}{3}$ and $-\frac{2}{3}$.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>•⁴ so $f(x) = k(x-2)(x+\frac{2}{3})(x-\frac{1}{3})$ by comparing the leading terms, for example, of $f(x) = k(x-2)(x+\frac{2}{3})(x-\frac{1}{3})$ and $f(x) = 6x^3 - 5x^2 - 17x + 6$ we have $k = 6$ and so $f(x) = (x-2)(2x+3)(3x-1)$ explicitly stated</p> </div>	
7	<p>The graphics calculator plot shows the following</p> 	<p>(a) •¹ <i>annotated on diagram</i> max at $(21.8, 5.4)$ and min at $(201.8, -5.4)$ •² <i>annotated on diagram</i> $(-68.2, 0)$ or $(291.8, 0)$ •³ "from the amplitude $k = 5.4$" •⁴ "from the left shift $a = 68.2$"</p> <p>(b) •⁵, •⁶ $P = (201.8, -5.4)$ •⁷ The last mark has to be awarded for some communication about the minimum e.g. the minimum should occur at 270 shifted left by 68.2</p>

	Give 1 mark for each •	Illustrations for awarding each •									
1	<p>After a leaflet drop advertising a new garden centre, a random sample of households were surveyed. The results are summarised in the following table.</p> <table border="1" style="margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 30%; text-align: center;">Read the leaflet</th> <th style="width: 30%; text-align: center;">Did not read the leaflet</th> </tr> </thead> <tbody> <tr> <td>Visited the centre</td> <td style="text-align: center;">80</td> <td style="text-align: center;">20</td> </tr> <tr> <td>Did not visit the centre</td> <td style="text-align: center;">60</td> <td style="text-align: center;">40</td> </tr> </tbody> </table> <p>(a) Find (i) $P(\text{leaflet read})$ 2 (ii) $P(\text{leaflet read and garden centre visited})$. (b) Comment on whether the proportion who had visited the garden centre was the same whether or not they had read the leaflet. 3</p>		Read the leaflet	Did not read the leaflet	Visited the centre	80	20	Did not visit the centre	60	40	
	Read the leaflet	Did not read the leaflet									
Visited the centre	80	20									
Did not visit the centre	60	40									
S1	<p>4.1.1, 4.1.3 CN CA 03/new</p> <p>(a) ans: $\frac{140}{200}, \frac{80}{200}$ 2 marks</p> <p>(b) ans : comment 3 marks</p> <p>•¹ ic : interpret table •² ic : interpret table •³ ic : interpret sample •⁴ ic : interpret sample •⁵ ic : comment</p>	<p>•¹ $\frac{140}{200}$ •² $\frac{80}{200}$ •³ $\frac{80}{140} = 0.57$ •⁴ $\frac{20}{60} = 0.33$ & not the same •⁵ seems that the leaflet had some effect</p>									

	Give 1 mark for each •	Illustrations for awarding each •
2	<p>The scatter diagrams A and B show the scores of ten players in an open golf championship.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>A</p> </div> <div style="text-align: center;"> <p>B</p> </div> </div> <p>(a) In diagram A, $\Sigma x = 716$, $\Sigma x^2 = 51338$, $\Sigma y = 689$, $\Sigma y^2 = 47521$, $\Sigma xy = 49351$. Calculate the correlation coefficient. 3</p> <p>(b) In diagram B, the correlation coefficient is 0.694. Comment on the relationship between</p> <p>(i) the scores on days 1 and 2</p> <p>(ii) the scores on days 3 and 4. 2</p>	
S2	<p>4.4.4 Ca C 03/130</p> <p>(a) ans: $r = 0.3126$ 3 marks</p> <p>(b) ans : comment 2 marks</p> <ul style="list-style-type: none"> •¹ pd : process one S •² pd : process other two Ss •³ pd : process correlation coefficient •⁴ ic : interpret results •⁵ ic : interpret results 	<ul style="list-style-type: none"> •¹ determine any one from $S_{xx} = 72.4$, $S_{yy} = 48.9$, $S_{xy} = 18.6$ •² determine remaining two •³ $r = 0.3126$ •⁴ no linear relationship •⁵ moderate linear relationship

	Give 1 mark for each •	Illustrations for awarding each •
3	<p>The regulations for a charity state that the Board of Trustees must consist of 6 people.</p> <p>(a) How many ways are there of choosing 6 members from 10 nominations?</p> <p>Ideally the Board should consist of four employees of the charity and two persons not employed by the charity (i.e. volunteers).</p> <p>Ten people have been nominated for the Board. Six are employees and four are volunteers.</p> <p>(b) If each nominee has an equally likely chance of being selected, what is the probability that the six members elected will form the ideal choice, that is four employees and two volunteers?</p>	<p>1</p> <p>3</p>
S3	<p>4.2.5, 4.2.10 CN B 03/128</p> <p>(a) ans: 210 1 mark</p> <p>(b) ans : $\frac{3}{7}$ 3 marks</p> <p>•¹ ss : know to use nCr</p> <p>•² pd : process</p> <p>•³ pd : process</p> <p>•⁴ ss : know how to determine probability</p>	<p>•¹ ${}^{10}C_6 = 210$</p> <p>•² 4 workers: ${}^6C_4 = 15$</p> <p>•³ 2 co - opts: ${}^4C_2 = 6$</p> <p>•⁴ $P(\text{ideal}) = \frac{15 \times 6}{210} = \frac{3}{7}$</p>

	Give 1 mark for each •	Illustrations for awarding each •
4	<p>The cumulative distribution function for a continuous random variable X is given by</p> $F(x) = \begin{cases} 0 & x < 0 \\ \frac{1}{4}x^2 & 0 \leq x \leq 2 \\ 1 & x > 2 \end{cases}$ <p>(a) Calculate the exact value of the median. 2</p> <p>(b) Determine the probability density function $f(x)$. 2</p> <p>(c) Calculate the mean of X. 2</p>	
S4	<p>4.3.1 CN CA 03/new</p> <p>(a) ans : $+\sqrt{2}$ 2 marks</p> <p>(b) ans : $f(x) = \frac{1}{2}x$ for $0 \leq x \leq 2$ $f(x) = 0$ otherwise 2 marks</p> <p>(c) ans : $\frac{4}{3}$ 2 marks</p> <p>•¹ ic : interpret cdf and median •² pd : process •³ ss : know $pdf = \frac{d}{dx} cdf$ •⁴ pd : process •⁵ ss : know $mean = \int xf(x) dx$ •⁶ pd : process</p>	<p>•¹ $F(m) = \frac{1}{2}$ •² $m = +\sqrt{2}$ •³ $f(x) = \frac{d}{dx} F(x)$ •⁴ $f(x) = \frac{1}{2}x$ for $0 \leq x \leq 2$ $f(x) = 0$ otherwise •⁵ $\mu = \int_0^2 \frac{1}{2}x^2 dx$ •⁶ $\mu = \frac{4}{3}$</p>

Give 1 mark for each •	Illustrations for awarding each •
Additional marks in Paper 2	
<p>Question 1 +1</p> <ul style="list-style-type: none"> •¹ ss : know to evaluate $f(2)$ •² pd : evaluate $f(2)$ and complete proof •³ ss : synthetic division or long division •⁴ ic : state quadratic factor •⁵ pd : factorise fully 	<ul style="list-style-type: none"> •¹ $f(2) = 6 \times 2^3 \dots\dots$ •² $f(2) = 48 - 20 - 34 + 6 = 0$ so $(x-2)$ is factor •³ $2 \begin{array}{r rrrr} 6 & -5 & -17 & 6 \\ & 12 & 14 & -6 \\ \hline & 6 & 7 & -3 & 0 \end{array}$ •⁴ $6x^2 + 7x - 3$ •⁵ $(x-2)(2x+3)(3x-1)$
<p>Question 2 +3</p> <ul style="list-style-type: none"> •¹ ic : interpret amplitude •² ic : explanation •⁵ ic : interpret period •⁴ ic : explanation •⁵ ic : interpret vertical displacement •⁶ ic : explanation 	<ul style="list-style-type: none"> •¹ $a = 4$ •² half the vertical distance between max and min •³ $b = 2$ •⁴ graph completes 2 cycles between 0 and 2π •⁵ $c = 1$ •⁶ half way between $y = 5$ and $y = -3$
<p>Question 3 +1</p> <ul style="list-style-type: none"> •¹ ss : area = \int upper function - lower function •² ic : interpret diagram for limits •³ pd : simplify prior to integration •⁴ pd : integrate •⁵ ic : interpret the limits •⁶ pd : evaluate using limits 	<ul style="list-style-type: none"> •¹ $\int ((x^2 + 2x) - (x^3 - x^2 - 6x)) dx$ stated, or implied by •³ •² $\int_0^4 \dots\dots$ •³ $\int (8x + 2x^2 - x^3) dx$ •⁴ $[4x^2 + \frac{2}{3}x^3 - \frac{1}{4}x^4]_0^4$ •⁵ $(4 \times 4^2 + \frac{2}{3} \times 4^3 - \frac{1}{4} \times 4^4) - 0$ •⁶ $42 \frac{2}{3}$
<p>Question 4 +1</p> <ul style="list-style-type: none"> •¹ ss : know to differentiate •² pd : differentiate •³ pd : differentiate •⁴ pd : evaluate gradient •⁵ pd : evaluate y-coordinate •⁶ ic : state equation of line 	<ul style="list-style-type: none"> •¹ $\frac{dy}{dx} =$ •² any 2 terms from $3x^2 + 4x - 3$ •³ $\frac{dy}{dx} = 3x^2 + 4x - 3$ •⁴ $m = \frac{dy}{dx}_{x=1} = 4$ gradient stated or implied by •⁶ •⁵ $y_{x=1} = 2$ •⁶ $y - 2 = 4(x - 1)$
<p>Question 5 +1</p> <ul style="list-style-type: none"> •¹ ic : interpret $f(-x)$ •² ic : communication •³ ic : communication •⁴ ic : interpret $2f$ •⁵ ic : communication 	<ul style="list-style-type: none"> •¹ refl. in y - axis •² annotate any two from $(0, -3), (4, 2), (3, 0), (-1, 0)$ •³ annotate remaining two •⁴ a scaling & $(3, 0), (-1, 0)$ •⁵ annotate $(0, -6), (4, 4)$

Give 1 mark for each •	Illustrations for awarding each •
<p>Question 6 +1</p> <ul style="list-style-type: none"> •¹ pd : differentiate compound trig •² pd : differentiate compound trig •³ ic : interpret •⁴ pd : evaluate derivative •⁵ pd : evaluate derivative 	<ul style="list-style-type: none"> •¹ $f'(x) = -2 \sin(2x) + \dots$ •² $\dots - 12 \cos(4x)$ •³ $f'(\frac{\pi}{6}) = -2 \sin(\frac{2\pi}{6}) - 12 \cos(\frac{4\pi}{6})$ •⁴ $-2 \sin(\frac{2\pi}{6}) = -\sqrt{3}$ •⁵ $-12 \cos(\frac{4\pi}{6}) = 6$
<p>Question 8 +2</p> <ul style="list-style-type: none"> •¹ ss : identify crucial aspect •² ic : start proof •³ ic : complete proof •⁴ ss : know to differentiate •⁵ ss : know to set derivative to zero •⁶ pd : express in standard form •⁷ pd : differentiate •⁸ pd : start to solve •⁹ pd : solve •¹⁰ ic : justify minimum 	<ul style="list-style-type: none"> •¹ $length = \frac{108000}{\frac{1}{2}x^2}$ •² $SA = 2 \times \frac{1}{2}x^2 + 2x \times length$ •³ $\dots SA = x^2 + \frac{432000}{x}$ •⁴ $\frac{dA}{dx} = \dots$ •⁵ $\frac{dA}{dx} = 0$ •⁶ $432000x^{-1}$ •⁷ $2x - 432000x^{-2}$ •⁸ $2x = \frac{432000}{x^2}$ •⁹ $x = 60$ •¹⁰ e.g. nature table
<p>Question 9 +1</p> <ul style="list-style-type: none"> •¹ ss : use distributive law •² pd : expand scalar product •³ pd : expand scalar product •⁴ ic : substitution •⁵ pd : complete calculations 	<ul style="list-style-type: none"> •¹ $a.(a + b) = a.a + a.b$ •² $a.b = 5 \times 4 \cos(\theta)$ •³ $a.a = 5^2$ •⁴ $20 \cos(\theta) = 11$ •⁵ $\theta = 56.6^\circ$
<p>Increase in marks for Paper 1 = 9 Increase in marks for Paper 2 = 11 Total increase in marks = 20.</p> <p>For 2004 the marks will allocated as follows: Paper 1 60 Paper 2 70 Total 130</p>	