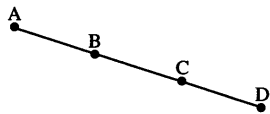


Give 1 mark for each •	Illustrations for awarding each •
<p>1 Find the equation of the line which passes through the point $(-1, 3)$ and is perpendicular to the line with equation $4x + y - 1 = 0$.</p>	3
<p>1 1.1.9, 1.1.7 CN C 03/1 ans: $x - 4y + 13 = 0$ 3 marks</p> <p>•¹ ic: interpret gradient from linear equ. •² ic: find perp. gradient •³ ic: state equation of line</p>	<p>•¹ $m = -4$ stated or implied by •² •² $m_{\text{perp}} = \frac{1}{4}$ •³ $y - 3 = \frac{1}{4}(x - (-1))$</p>
<p>Notes</p> <p>1 •³ is only available following an attempt to find the perpendicular gradient. 2 Wrong answer with no working gains no marks.</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>Example 1</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $m = 4$ •¹ ✗ $m_{\text{perp}} = -\frac{1}{4}$ •² ✗ f.t. $y - 3 = -\frac{1}{4}(x - -1)$ •³ ✗ f.t. 2 marks given </div> <p>Example 2</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $m = -4$ •¹ ✓ $y - 3 = -4(x - -1)$ •³ ✗ no perp. grad. 1 mark given </div> <p>Example 3</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $y = -4x - 1$ ignore the error (of -1) $m = -4$ •¹ ✓ <i>etc</i> </div> <p>Example 4</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $y = -4x + 1$ •¹ ✗ $m = 4$ •² ✗ $y - 3 = 4(x - -1)$ •³ ✗ f.t. BOD 1 mark awarded </div> <p>Example 5</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $m = 4$ $y - 3 = 4(x - -1)$ 0 marks given </div> </div> <div style="width: 48%;"> <p>Example 6</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $y = -4x + 1$ $\frac{dy}{dx} = -4$ is acceptable for •¹ $m = -4$ </div> <p>Example 7</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $y - 3 = \frac{1}{4}(x - -1)$ may be awarded 2 marks, <i>or</i> 1 mark being lost through $x - 4y = -13$ lack of communication </div> <p>Example 8</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $m = -4$ •¹ ✓ $m = \frac{1}{4}$ •² ✓ $y = \frac{1}{4}x + c$ $3 = \frac{1}{4} \times (-1) + c$ $c = 3 + \frac{1}{4}$ •³ ✓ 3 marks given </div> <p>Example 9</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $m = \frac{1}{4}$ and nothing else 0 marks given </div> <p>Example 10</p> <div style="border: 1px solid black; border-radius: 15px; padding: 5px;"> $m = -\frac{1}{4}$ •¹ ✗ $y - 3 = -\frac{1}{4}(x - -1)$ •² ✗ •³ ✗ b.o.d for perp gr. 1 mark awarded </div> </div> </div>	

	Give 1 mark for each • Illustrations for awarding each •
<p>3 Vectors u and v are defined by $u = 3i + 2j$ and $v = 2i - 3j + 4k$. Determine whether or not u and v are perpendicular to each other.</p>	2
<p>3 3.1.1/ .9/ .10 CN C 03/53 ans : vectors are perpendicular 2 marks •¹ ss : use scalar product and get zero •² pd : process</p>	<p>•¹ for perpendicularity $u \cdot v = 0$ •² $\begin{pmatrix} 3 \\ 2 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 2 \\ -3 \\ 4 \end{pmatrix} = 6 - 6 + 0 = 0$</p>
<p>Example 1</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>•¹ $\begin{pmatrix} 3 \\ 2 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 2 \\ 3 \\ 4 \end{pmatrix}$ •1 ✗ •² $6 + 6 + 0 = 12$ so u and v not perp. •2 ✗ f.t. 1 mark given</p> </div> <p>Example 2</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>$\cos(\theta) = a_1b_1 + a_2b_2 + a_3b_3$ •1 ✗ $= 6 - 6 + 0$ $= 0$ •2 ✗ f.t. $\theta = 90$ 1 mark given</p> </div> <p>Example 3</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>$\cos(\theta) = \frac{6 - 6 + 0}{ u v }$ •2 ✓ $= 0$ $\theta = 90$ •1 ✓ 2 marks given</p> </div> <p>Example 4</p> <div style="border: 1px solid black; padding: 5px;"> <p>$(3i + 2j)(2i - 3j + 4k)$ $= 6ii - 9i \cdot j + 12i \cdot k + 4ji - 6j \cdot j + 8jk$ •2 ✓ $= 6 - 6$ $= 0$ so u, v perpendicular •1 ✓ 2 marks given</p> </div>	<p>Notes 1 Accept correct use of the cosine rule 2 Treat $\begin{pmatrix} 3i \\ 2j \\ 0k \end{pmatrix}$ as bad form.</p> <p>Cosine rule</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>•¹ $\cos(A) = \frac{b^2 + c^2 - a^2}{2bc}$, and $a = \begin{pmatrix} 1 \\ 5 \\ -4 \end{pmatrix}$ or $\begin{pmatrix} -1 \\ -5 \\ 4 \end{pmatrix}$ •² 13, 29 and 42 and complete</p> </div> <p>Converse of Pythagoras</p> <div style="border: 1px solid black; padding: 5px;"> <p>•¹ length of third side $= \sqrt{42}$ •² $(\sqrt{13})^2 + (\sqrt{29})^2 = 13 + 29$ $= 42$ $= (\sqrt{42})^2$</p> </div>

	Give 1 mark for each •	Illustrations for awarding each •
6	<p>A and B are the points $(-1, -3, 2)$ and $(2, -1, 1)$ respectively. B and C are the points of trisection of AD, that is $AB = BC = CD$. Find the coordinates of D.</p>	 <p style="text-align: right;">3</p>

6	<p>3.1.6, 3.1.2 CN C 03/48 ans : (8, 3, -1) 3 marks</p> <p>•¹ ss : e.g. use a vector approach •² ic : interpret trisection •³ pd : process coordinates</p>	<p>•¹ $\vec{AB} = \begin{pmatrix} 3 \\ 2 \\ -1 \end{pmatrix}$ may be stated or implied by •2</p> <p>•² $\vec{AD} = 3\vec{AB} = \begin{pmatrix} 9 \\ 6 \\ -3 \end{pmatrix}$ may be stated or implied by •3 but not as well as the above!</p> <p>•³ $D = (8, 3, -1)$</p>
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Alternative 1

- ¹ $\vec{AB} = \begin{pmatrix} 3 \\ 2 \\ -1 \end{pmatrix}$
- ² $C = (5, 1, 0)$
- ³ $D = (8, 3, -1)$

Alternative 2

- ¹ $\vec{AB} = \begin{pmatrix} 3 \\ 2 \\ -1 \end{pmatrix}$
- ² $\vec{BD} = 2\vec{AB} = \begin{pmatrix} 6 \\ 4 \\ -2 \end{pmatrix}$
- ³ $D = (8, 3, -1)$

Alternative 3
one of many forms of the section formula

- ¹ $b = \frac{2}{3}a + \frac{1}{3}d$
- ² substitution
- ³ $d = \begin{pmatrix} 8 \\ 3 \\ -1 \end{pmatrix}$

Notes

- 1 Treat as bad form expressions such as $D = \begin{pmatrix} 8 \\ 3 \\ -1 \end{pmatrix}$ or $\vec{BD} = (6, 4, -2)$
- 2 $D = (8, 3, -1)$ with no working may be awarded 2 marks, 1 mark being lost for poor communication
- 3 A wrong answer with no working earns no marks
- 4 If A is taken as $(2, -1, 1)$ and B as $(-1, -3, 2)$ then work leading to $D(-7, -7, 4)$ may be awarded 2 marks.

Example 1

$C = (5, 1, 0)$	•1 ✓	•2 ✓
$D = (8, 3, -1)$	•3 ✓	
3 marks given		

	Give 1 mark for each •	Illustrations for awarding each •
7	Show that the line with equation $y = 2x + 1$ does not intersect the parabola with equation $y = x^2 + 3x + 4$.	5
7	<p>2.1.8, 2.1.6 CN B 03/27 ans : proof 5 marks</p> <p>•¹ ss : substitute linear into quadratic •² pd : express in standard form •³ ss : e.g. use discriminant •⁴ pd : evaluate discriminant •⁵ ic : complete proof</p>	<p>•¹ $x^2 + 3x + 4 = 2x + 1$ •² $x^2 + x + 3 = 0$ the zero explicitly stated •³ $b^2 - 4ac = 1^2 \dots\dots$ •⁴ $b^2 - 4ac = -11$ •⁵ $b^2 - 4ac < 0 \therefore$ no intersection</p>
	<p>Alternatives for marks •3 and •4</p> <p>•³ $a = 1, b = 1, c = 3$ •⁴ $b^2 - 4ac = 1 - 4 \times 1 \times 3 < 0$</p> <p>•³ roots = $\frac{-1 \pm \sqrt{1^2 - 4 \times 1 \times 3}}{2}$ •⁴ $\frac{-1 \pm \sqrt{-11}}{2}$</p> <p>Example 1</p> <p>$x^2 + 3x + 4 = 0$ $b^2 - 4ac = 9 - 16$ no marks awarded etc</p> <p>Example 2</p> <p>$x^2 + 3x + 4 \neq 2x + 1$ lose •2 for using the "not equals" sign. etc Treat the rest as bad form</p> <p>Example 3</p> <p>$y = (2x + 1)^2 + 3(2x + 1) + 4 = 0$ •1 ✗ $4x^2 + 10x + 8 = 0$ •2 ✗ $b^2 - 4ac = 100 - 128 = -28$ •3 ✗ so no intersection •4 ✗ •5 ✗ 3 marks given</p>	<p>Notes</p> <p>1 Use of the "alternative" discriminant $b^2 + 4ac$: lose •3 and follow through. All other versions lose •3, •4 and •5.</p> <p>•³ $(x + \frac{1}{2})^2 + \frac{11}{4}$ •⁴ so $x^2 + x + 3$ is U, min at $(-\frac{1}{2}, \frac{11}{4})$</p> <p>•³ $\frac{dy}{dx} = 2x + 1 = 0 \Rightarrow x = -\frac{1}{2}, y = \frac{11}{4}$ •⁴ so $x^2 + x + 3$ is U, min at $(-\frac{1}{2}, \frac{11}{4})$</p> <p>•³ $(x + \frac{1}{2})^2 + \frac{11}{4}$ •⁴ which is $\geq \frac{11}{4}$</p> <p>Example 4</p> <p>$x^2 + 3x + 4 = 2x + 1$ •1 ✓ $x^2 + x + 3 = 0$ •2 ✓ $b^2 - 4ac < 0$ •3 ✗ so no intersection •4 ✗ •5 ✓ 3 marks given</p> <p>Example 5</p> <p>$x^2 + 3x + 4 = 2x + 1$ •1 ✓ $x^2 + x + 3 = 0$ •2 ✓ $b^2 - 4ac < 0$ •3 ✗ so no real roots •4 ✗ •5 ✗ 2 marks given</p>

Give 1 mark for each •	Illustrations for awarding each •
8 Find $\int_0^1 \frac{dx}{(3x+1)^{\frac{3}{2}}}$.	4

8	<p>3.2.3 CN CA 03/55</p> <p>ans : $\frac{2}{3}$ 4 marks</p> <ul style="list-style-type: none"> •1 pd : express in standard form •2 pd : integrate •3 pd : integrate •4 pd : evaluate using limits 	<ul style="list-style-type: none"> •1 $(3x+1)^{-\frac{1}{2}}$ •2 $\frac{1}{\frac{1}{2}}(3x+1)^{\frac{1}{2}}$ •3 $\dots \times \frac{1}{3}$ •4 $\frac{2}{3}$
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Notes

- 1 Treat $\frac{2}{3} + c$ as bad form
- 2 $\frac{1}{1.5}$ does not gain •4
- 3 •4 is only available after an attempt has been made to integrate
- 4 •4 is only available if the evaluation involves a fractional power.

Example 1

$\left[\frac{1}{(3x+1)^{\frac{3}{2}}} \right]_0^1$ $= \frac{2}{\frac{3}{2} \times 3} \left(\frac{1}{8} - 1 \right)$ $= -\frac{63}{16}$	<ul style="list-style-type: none"> •1 ✗ •2 ✗ •3 ✓ f.t. •4 ✓ f.t. <p style="text-align: center;">2 marks given</p>
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Example 2

$\left[\frac{1}{\frac{3}{2}(3x+1)^{-\frac{1}{2}}} \right]_0^1$ $= \dots$ $= \frac{2}{3}$	<ul style="list-style-type: none"> •1 ✗ •2 ✗ •3 ✗ •4 ✓ f.t. <p style="text-align: center;">1 mark given</p>
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Example 4

$\left[2(3x+1)^{\frac{1}{2}} \right]_0^1$ $= 2 \times 4^{\frac{1}{2}} - 2 \times 1^{\frac{1}{2}}$ $= 2$	<ul style="list-style-type: none"> •1 ✓ •2 ✓ •3 ✗ •4 ✓ f.t. <p style="text-align: center;">3 marks given</p>
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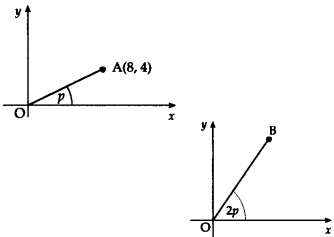
Example 3

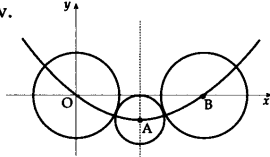
$\left[-\frac{3}{2}(3x+1)^{\frac{3}{2}} \right]_0^1$ $= \dots$ $= \frac{21}{16}$	<ul style="list-style-type: none"> •1 ✗ •2 ✗ •3 ✗ •4 ✓ f.t. <p style="text-align: center;">1 mark given</p>
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Example 5

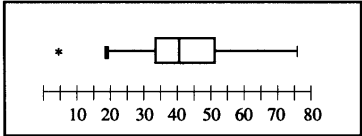
$\left[2(3x+1)^{\frac{1}{2}} \right]_0^1$ $= \left[(6x+2)^{\frac{1}{2}} \right]_0^1$ $= \dots$ $= \sqrt{2}$	<ul style="list-style-type: none"> •1 ✓ •2 ✓ •3 ✗ •4 ✗ <p style="text-align: center;">2 marks given</p>
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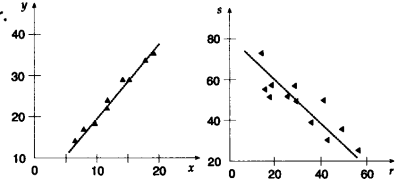
	Give 1 mark for each •	Illustrations for awarding each •
9	<p>Functions $f(x) = \frac{1}{x-4}$ and $g(x) = 2x+3$ are defined on suitable domains.</p> <p>(a) Find an expression for $h(x)$ where $h(x) = f(g(x))$.</p> <p>(b) Write down any restriction on the domain of h.</p>	<p>2</p> <p>1</p>
9	<p>1.2.1, 1.2.6 CN CA 03/5</p> <p>(a) ans : $\frac{1}{2x-1}$ 2 marks</p> <p>(b) ans : $x \neq \frac{1}{2}$ 1 mark</p> <p>•¹ ic : start composite function</p> <p>•² ic : complete composite function</p> <p>•³ ic : interpret denominator</p>	<p>•¹ $f(2x+3)$ stated or implied by •²</p> <p>•² $\frac{1}{2x+3-4}$</p> <p>•³ $x \neq \frac{1}{2}$</p>
	<p>Example 1</p> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; width: fit-content;"> <p>... $\left(\frac{1}{x-4}\right)$ •1 ✗</p> <p>$\frac{2}{x-4} + 3$ •2 ✗ f.t.</p> <p>$x \neq 4$ •3 ✗ f.t.</p> <p>2 marks given</p> </div>	<p>Notes</p> <p>1 Use example 1 if candidate finds $g(f(x))$ [which they may call $f(g(x))$]!</p> <p>2 •3 is only available for working containing an algebraic fraction e.g. $\frac{a}{x+c}$ or harder.</p> <p>3 for •3 accept any statement involving a $\frac{1}{2}$ e.g.</p> <p>a $x \neq \frac{1}{2}$ (the actual restriction)</p> <p>b $x = \frac{1}{2}$ (the value to be restricted from the domain)</p> <p>c $x > \frac{1}{2}$ (part of the restricted domain)</p> <p>d $x < \frac{1}{2}$ (also part of the restricted domain)</p> <p>In each case the candidate has identified the value of x which makes the denominator zero (which was the point of (b)).</p> <p>4 for (b) do not accept unsimplified forms such as $2x-1=0$.</p> <p>4 for •3, treat $h \neq \frac{1}{2}$ as bad form.</p>

	Give 1 mark for each •	Illustrations for awarding each •
10	<p>A is the point (8, 4). The line OA is inclined at an angle p radians to the x-axis.</p> <p>(a) Find the exact values of</p> <p>(i) $\sin(2p)$</p> <p>(ii) $\cos(2p)$.</p> <p>The line OB is inclined at an angle $2p$ radians to the x-axis.</p> <p>(b) Write down the exact value of the gradient of OB.</p>	 <p style="text-align: right;">5</p> <p style="text-align: right;">1</p>
10	<p>2.3.3, 1.1.6 NC CB 03/34</p> <p>(a) ans : $\frac{4}{5}, \frac{3}{5}$ 5 marks</p> <p>(b) ans : $\frac{4}{3}$ 1 mark</p> <p>•1 pd : calculate hypotenuse</p> <p>•2 pd : calculate sinp and cosp</p> <p>•3 ss : use double angle formula</p> <p>•4 pd : process sin2p</p> <p>•5 pd : process cos2p</p> <p>•6 pd: relate gradient and tan</p>	<p>•1 hypot = $\sqrt{80}$</p> <p>•2 $\sin(p) = \frac{4}{\sqrt{80}}$ and $\cos(p) = \frac{8}{\sqrt{80}}$</p> <p>•3 $\sin(2p) = 2 \sin(p) \cos(p)$</p> <p>•4 $\sin(2p) = \frac{4}{5}$</p> <p>•5 $\cos(2p) = \frac{3}{5}$</p> <p>•6 $\frac{4}{3}$</p>
	<p>Example 1</p> <div style="border: 1px solid black; padding: 5px;"> <p>$\tan(p) = \frac{1}{2}$ •1 ✗</p> <p>$p = 30^\circ$ •2 ✗</p> <p>$\sin(p) = \frac{1}{2}, \cos(p) = \frac{\sqrt{3}}{2}$ •3 ✗ f.t.</p> <p>$\sin(2p) = 2 \sin(p) \cos(p)$</p> <p>$= 2 \times \frac{1}{2} \times \frac{\sqrt{3}}{2}$ •4 ✗ f.t.</p> <p>$= \frac{\sqrt{3}}{2}$</p> <p>$\cos(2p) = 2 \cos^2(p) - 1$</p> <p>$= 2 \left(\frac{\sqrt{3}}{2}\right)^2 - 1$ •5 ✗ f.t.</p> <p>$= \frac{1}{2}$</p> <p>$\tan(2p) = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3}$ •6 ✗ f.t.</p> <p style="text-align: right;">3,1 marks given</p> </div> <p>Example 2</p> <div style="border: 1px solid black; padding: 5px;"> <p>$\tan(p) = \frac{1}{2}$ •1 ✗</p> <p>$p = 30^\circ$ •2 ✗</p> <p>$\sin(2p) = \sin 60$ •3 ✗</p> <p>$= \frac{\sqrt{3}}{2}$ •4 ✗</p> <p>$\cos(2p) = \cos 60$ •5 ✗</p> <p>$= \frac{1}{2}$ •6 ✗</p> <p>$\tan(2p) = \tan 60 = \sqrt{3}$ 0 marks given</p> </div>	<p>Notes</p> <p>1 accept uncancelled fractions for •4, •5 and •6.</p> <p>e.g. $\frac{64}{80}, \frac{48}{80}$ and $\frac{64}{48}$ are common</p> <p>2 marks 4-6 are not available to candidates who base their answers on the assumption that $p = 30^\circ, 45^\circ$ etc so that $\sin(2p) = \sin(60)$ etc. See examples 1 & 2.</p> <p>Example 3</p> <div style="border: 1px solid black; padding: 5px;"> <p>a wrong hypotenuse leading to</p> <p>hyp = $\sqrt{32}$ •1 ✗</p> <p>$\sin(p) = \frac{4}{\sqrt{32}}, \cos(p) = \frac{8}{\sqrt{32}}$ •2 ✗</p> <p>$\sin(2p) = 2 \sin(p) \cos(p)$ •3 ✗</p> <p>$= 2 \times \frac{4}{\sqrt{32}} \times \frac{8}{\sqrt{32}}$ •4 ✗</p> <p>$= 2$</p> <p>$\cos(2p) = 2 \cos^2(p) - 1$</p> <p>$= 2 \left(\frac{8}{\sqrt{32}}\right)^2 - 1$ •5 ✗</p> <p>$= \frac{3}{2}$</p> <p>$\tan(2p) = \frac{2}{\frac{3}{2}} = \frac{4}{3}$ •6 ✗</p> <p style="text-align: right;">3,1 marks given</p> </div>

	Give 1 mark for each •	Illustrations for awarding each •
11	<p>• O, A and B are the centres of the three circles shown in the diagram below.</p> <p>• The two outer circles are congruent and each touches the smallest circle.</p> <p>• Circle centre A has equation $(x-12)^2 + (y+5)^2 = 25$.</p> <p>• The three centres lie on a parabola whose axis of symmetry is shown by the broken line through A.</p> <p>(a) (i) State the coordinates of A and find the length of the line OA. 2</p> <p>(ii) Hence find the equation of the circle with centre B. 3</p> <p>(b) The equation of the parabola can be written in the form $y = px(x+q)$. Find the values of p and q. 2</p>	
11	<p>2.4.1, 2.1.10 CN CBA 03/40</p> <p>(a) ans : A(12, -5), OA = 13 $(x-24)^2 + y^2 = 64$ 5 marks</p> <p>(b) ans : $p = \frac{5}{144}$, $q = -24$ 2 marks</p> <p>•¹ ic : interpret centre •² pd : use Pythagoras •³ ic : interpret radius •⁴ ic : interpret centre •⁵ ic : state equ of circle •⁶ pd : process •⁷ pd : process</p>	<p>•¹ $A = (12, -5)$ •² $OA = 13$ accept $\sqrt{169}$ •³ $r_B = 8$ stated or implied by •⁵ •⁴ $B = (24, 0)$ stated or implied by •⁵ •⁵ $(x-24)^2 + y^2 = 64$ •⁶ $p = \frac{5}{144}$ •⁷ $q = -24$</p>
		<p>Notes</p> <p>1 Take care with the implications at •3 and •4. Only the correct values for r and B can be implied by •5. Incorrect values of r and/or B must be stated before the equation of the circle is given in order that •5 can be awarded as a follow-through mark.</p>

	Give 1 mark for each •	Illustrations for awarding each •
12	Simplify $3 \log_e(2e) - 2 \log_e(3e)$, expressing your answer in the form $A + \log_e(B) - \log_e(C)$ where A, B and C are whole numbers.	4
12	<p>3.3.6, 3.3.2 CN BA 03/43</p> <p>ans : $1 + \ln(8) - \ln(9)$ 4 marks</p> <p>•¹ pd : use log laws •² pd : use log laws •³ pd : process •⁴ pd : use log laws</p>	<p>•¹ $\ln(2e)^3 - \ln(3e)^2$ •² $\ln\left(\frac{(2e)^3}{(3e)^2}\right)$ •³ $\ln\left(\frac{8e}{9}\right)$ •⁴ $1 + \ln(8) - \ln(9)$</p>
	<p>Alternative 1</p> <p>•¹ $3[\ln(2) + \ln(e)]$ •² $-2[\ln(3) + \ln(e)]$ •³ $3 \ln(2) + 3 - 2 \ln(3) - 2$ •⁴ $1 + \ln(8) - \ln(9)$</p> <p>Example 1</p> <p>$\ln(2e)^3 - \ln(3e)^2$ •1 ✓ $\ln\left(\frac{2e^3}{3e^2}\right)$ •2 ✗ $\ln\left(\frac{8e}{9}\right)$ •3 ✗ $1 + \ln(2) - \ln(3)$ •4 ✓ 3 marks given</p> <p>Example 2</p> <p>$\ln(2e)^3 - \ln(3e)^2$ •1 ✓ $\ln(8e) - \ln(9e)$ •3 ✗ $\ln\left(\frac{8e}{9e}\right)$ •2 ✓ $\ln(8) - \ln(9)$ •4 ✗ Eased 2 marks given</p> <p>Example 3</p> <p>$\ln(2e)^3 - \ln(3e)^2$ •1 ✓ $\ln\left(\frac{2e^3}{3e^2}\right)$ •2 ✓ ev. line 3 $\ln\left(\frac{8}{9}\right)$ •3 ✗ $\ln(8) - \ln(9)$ •4 ✗ Eased 2 marks given</p>	<p>Notes</p> <p>1 $\ln 2e^3 - \ln 3e^2$ will not gain •1 unless you see an '8' and a '9' appearing in subsequent work, in which case you can treat it as bad form.</p> <p>Example 4</p> <p>$\ln 2e^3 - \ln 3e^2$ •1 ✓ see line 2 $\ln\left(\frac{8e^3}{9e^2}\right)$ •2 ✓ $\ln(8) - \ln(9) + \ln(e)$ •3 ✓ ev in line 4 •4 ✗ 3 marks given</p> <p>Example 5</p> <p>$\ln(8e) - \ln(9e)$ •1 ✗ $\ln\left(\frac{8e}{9}\right)$ •2 ✗ $1 + \ln(8) - \ln(9)$ •3 ✗ •4 ✗ 1 mark given</p> <p>Example 6</p> <p>$\ln(8e) - \ln(9e)$ •1 ✗ $\ln\left(\frac{8e}{9e}\right)$ •2 ✗ $\ln(8) - \ln(9)$ •3 ✗ Eased •4 ✗ Eased 1 mark given</p> <p>Example 7</p> <p>$3 \ln(2) + \ln(e) - 2 \ln(3) + \ln(e)$ •1 ✗ $\ln(8) + 1 - \ln(9) + 1$ •2 ✗ $2 + \ln(8) - \ln(9)$ •3 ✓ •4 ✓ 2 marks given</p>

	Give 1 mark for each •	Illustrations for awarding each •
1	<p>The times taken by a group of students to complete a statistical project are given in the stem-and-leaf diagram.</p> <p>Identify any outliers and illustrate the data with a box-plot.</p>	<p>Time taken to the nearest minute</p> <pre> 0 5 1 9 2 7 7 8 3 0 2 4 5 5 6 8 9 4 0 0 1 2 2 3 6 8 8 9 5 1 3 3 4 8 8 6 0 7 6 n = 31 5 3 represents 53 minutes </pre> <p style="text-align: right;">5</p>
S1	<p>4.1.2, 4.1.4 CN C 03/64</p> <p>ans : 5 is outlier, boxplot 5 marks</p> <ul style="list-style-type: none"> •¹ pd : calculate quartiles •² ss : know how to caculate fence •³ ic : determine upper fence/outliers •⁴ ic : determine lower fence/outliers •⁵ ic : determine mean/draw box-plot 	<ul style="list-style-type: none"> •¹ 34 & 51 •² $LF = Q_1 - \frac{3}{2}(Q_3 - Q_1)$ •³ 76.5 & no outliers •⁴ 8.5 & 5 min. is outlier •⁵ 41 & box - plot
		

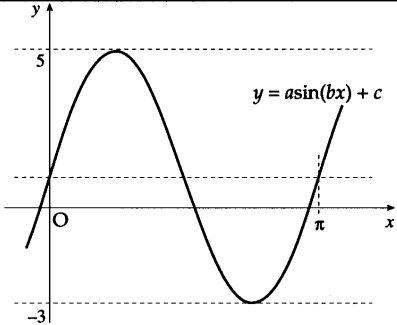
	Give 1 mark for each •	Illustrations for awarding each •
	<p>2 The diagrams below show the scattergraphs of y on x and s on r.</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>The equation of the least squares regression line of y on x is $y = 1.7x + 2$.</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>The equation of the least squares regression line of s on r is $s = 81 - 1.05r$.</p> </div> <p>(a) Predict the expected value of (i) y when $x = 10$ (ii) s when $r = 20$.</p> <p>(b) Which prediction is more reliable? Give a reason for your answer.</p>	 <p style="text-align: right;">2 1</p>
<p>S2</p>	<p>4.4.3 NC C 03/59 (a) ans : 19, 60 2 marks (b) ans : y on x more reliable</p> <ul style="list-style-type: none"> •¹ pd : use regression equation •² pd : use regression equation •³ ic : interpret scatter diagram 	<ul style="list-style-type: none"> •¹ 19 •² 60 •³ y on x more reliable as diagram shows stronger relationship

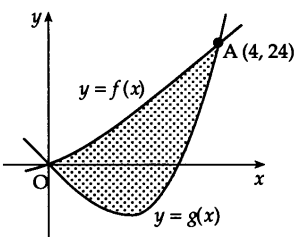
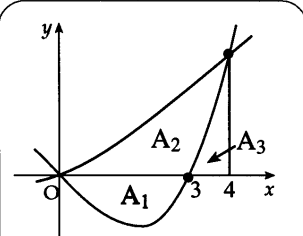
	Give 1 mark for each •	Illustrations for awarding each •																																				
3	<p>A farmer sells eggs in boxes of 6. The discrete random variable X represents the number of brown eggs in a box.</p> <p>X has the following probability distribution:</p> $P(X = x) = \begin{cases} \frac{1}{3}k(7-x) & \text{for } x = 0, 1, 2, 3, 4, 5 \text{ and } 6 \\ 0 & \text{otherwise} \end{cases}$ <p>where k is a constant.</p> <p>(a) Find the value of k.</p> <p>(b) Find the expected value and variance of X, the number of brown eggs in a box.</p>	<p>2</p> <p>3</p>																																				
S3	<p>4.2.11, 4.2.12 CN C 03/68</p> <p>(a) ans : $\frac{3}{28}$ 2 marks</p> <p>(b) ans : 2, 3 3 marks</p> <p>•¹ ss : use $\Sigma P(X) = 1$</p> <p>•² pd : evaluate k</p> <p>•³ pd : calculate expected value</p> <p>•⁴ pd : calculate $E(X^2)$</p> <p>•⁵ pd : calculate variance</p>	<p>•¹ $P(X) \frac{7k}{3}, \frac{6k}{3}, \frac{5k}{3}, \frac{4k}{3}, \frac{3k}{3}, \frac{2k}{3}, \frac{k}{3}$</p> <p>•² $\Sigma P(X) = 1 \Rightarrow k = \frac{3}{28}$</p> <p>•³ $E(X) = 2$</p> <p>•⁴ $E(X^2) = 7$</p> <p>•⁵ $V(X) = 3$</p>																																				
<table border="1" style="margin: auto; border-collapse: collapse;"> <thead> <tr> <th style="padding: 5px;">x</th> <th style="padding: 5px;">0</th> <th style="padding: 5px;">1</th> <th style="padding: 5px;">2</th> <th style="padding: 5px;">3</th> <th style="padding: 5px;">4</th> <th style="padding: 5px;">5</th> <th style="padding: 5px;">6</th> <th style="padding: 5px;"></th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">$P(x)$</td> <td style="padding: 5px;">$\frac{7k}{3}$</td> <td style="padding: 5px;">$\frac{6k}{3}$</td> <td style="padding: 5px;">$\frac{5k}{3}$</td> <td style="padding: 5px;">$\frac{4k}{3}$</td> <td style="padding: 5px;">$\frac{3k}{3}$</td> <td style="padding: 5px;">$\frac{2k}{3}$</td> <td style="padding: 5px;">$\frac{k}{3}$</td> <td style="padding: 5px;">$\Sigma = \frac{28k}{3} = 1 \quad k = \frac{3}{28}$</td> </tr> <tr> <td style="padding: 5px;">$xP(x)$</td> <td style="padding: 5px;">0</td> <td style="padding: 5px;">6</td> <td style="padding: 5px;">10</td> <td style="padding: 5px;">12</td> <td style="padding: 5px;">12</td> <td style="padding: 5px;">10</td> <td style="padding: 5px;">$6 \times \frac{1}{28}$</td> <td style="padding: 5px;">$\Sigma = \frac{56}{28} = 2$</td> </tr> <tr> <td style="padding: 5px;">$x^2P(x)$</td> <td style="padding: 5px;">0</td> <td style="padding: 5px;">6</td> <td style="padding: 5px;">20</td> <td style="padding: 5px;">36</td> <td style="padding: 5px;">48</td> <td style="padding: 5px;">50</td> <td style="padding: 5px;">$36 \times \frac{1}{28}$</td> <td style="padding: 5px;">$\Sigma = \frac{196}{28} = 7$ $\text{var} = 7 - 2^2 = 3$</td> </tr> </tbody> </table>			x	0	1	2	3	4	5	6		$P(x)$	$\frac{7k}{3}$	$\frac{6k}{3}$	$\frac{5k}{3}$	$\frac{4k}{3}$	$\frac{3k}{3}$	$\frac{2k}{3}$	$\frac{k}{3}$	$\Sigma = \frac{28k}{3} = 1 \quad k = \frac{3}{28}$	$xP(x)$	0	6	10	12	12	10	$6 \times \frac{1}{28}$	$\Sigma = \frac{56}{28} = 2$	$x^2P(x)$	0	6	20	36	48	50	$36 \times \frac{1}{28}$	$\Sigma = \frac{196}{28} = 7$ $\text{var} = 7 - 2^2 = 3$
x	0	1	2	3	4	5	6																															
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Give 1 mark for each •	Illustrations for awarding each •
Additional marks in Paper 1	
Question 1 +1	
<ul style="list-style-type: none"> •¹ ic : rearrange in standard form •² ic : interpret gradient from linear equ. •³ ic : find perp. gradient •⁴ ic : state equation of line 	<ul style="list-style-type: none"> •¹ $y = -4x + 1$ •² $m = -4$ •³ $m_{\text{perp}} = \frac{1}{4}$ •⁴ $y - 3 = \frac{1}{4}(x - (-1))$
Question 2 +1	
<ul style="list-style-type: none"> •¹ ic : start to complete square •² pd : finish completing the square •³ ic : sketch •⁴ ic : sketch •⁵ ic : sketch 	<ul style="list-style-type: none"> •¹ $(x + 3)^2$ •² +2 •³ <i>U-shaped parabola</i> •⁴ <i>minimum at (-3, 2)</i> •⁵ <i>intercept on y-axis at (0, 11)</i>
Question 3 +1	
<ul style="list-style-type: none"> •¹ ic : interpret unit vectors •² ss : know to use scalar product and get zero •³ pd : process 	<ul style="list-style-type: none"> •¹ $\begin{pmatrix} 3 \\ 2 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ -3 \\ 4 \end{pmatrix}$ •² for perpendicularity "$u \cdot v = 0$" •³ $\begin{pmatrix} 3 \\ 2 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 2 \\ -3 \\ 4 \end{pmatrix} = 6 - 6 + 0 = 0$
Question 4 +1	
<ul style="list-style-type: none"> •¹ ss : e.g. form two equations in p and q •² pd : process •³ ic : state the condition for limit to exist •⁴ ss : algebraic strategy for limit •⁵ pd : process limit 	<ul style="list-style-type: none"> •¹ $15 = 12p + q, 16 = 15p + q$ •² $p = \frac{1}{3}, q = 11$ •³ since $-1 < \frac{1}{3} < 1$, limit exists •⁴ e.g. $L = \frac{1}{3}L + 11$ •⁵ $L = 16\frac{1}{2}$
Question 5 +1	
<ul style="list-style-type: none"> •¹ pd : express in standard form •² pd : express in standard form •³ pd : differentiate fractional index •⁴ pd : differentiate negative index •⁵ pd : evaluation •⁶ pd : evaluation 	<ul style="list-style-type: none"> •¹ $x^{\frac{1}{2}}$ •² $2x^{-2}$ •³ $\frac{1}{2}x^{-\frac{1}{2}}$ •⁴ $-4x^{-3}$ •⁵ $\frac{1}{2} \times 4^{-\frac{1}{2}} = \frac{1}{4}$ or $-4 \times 4^{-3} = -\frac{1}{16}$ •⁶ $\frac{3}{16}$

Give 1 mark for each •	Illustrations for awarding each •
<p>Question 8 +1</p> <ul style="list-style-type: none"> •¹ pd : express in standard form •² pd : integrate •³ pd : integrate •⁴ ic : substitute the limits •⁵ pd : evaluate 	<ul style="list-style-type: none"> •¹ $(3x+1)^{\frac{1}{2}}$ •² $\frac{1}{\frac{1}{2}}(3x+1)^{\frac{1}{2}}$ •³ $\dots \times \frac{1}{3}$ •⁴ $\left[\frac{2}{3}(3 \times 1 + 1)^{\frac{1}{2}} \right] - \left[\frac{2}{3}(3 \times 0 + 1)^{\frac{1}{2}} \right]$ •⁵ $\frac{2}{3}$
<p>Question 10 +2</p> <ul style="list-style-type: none"> •¹ pd : calculate hypotenuse •² pd : calculate sinp and cosp •³ ss : use double angle formula •⁴ pd : process sin2p •⁵ ss : use double formula •⁶ pd : process cos2p •⁷ ic: relate gradient and tan •⁸ pd : process 	<ul style="list-style-type: none"> •¹ hypot = $\sqrt{80}$ •² $\sin(p) = \frac{4}{\sqrt{80}}$ and $\cos(p) = \frac{8}{\sqrt{80}}$ •³ $\sin(2p) = 2 \sin(p) \cos(p)$ •⁴ $\sin(2p) = \frac{4}{5}$ •⁵ $\cos(2p) = 2 \cos^2(p) - 1$ •⁶ $\cos(2p) = \frac{3}{5}$ •⁷ gradient = $\tan(2p)$ •⁸ $\frac{4}{3}$
<p>Question 11 +1</p> <ul style="list-style-type: none"> •¹ ic : interpret centre •² pd : use Pythagoras •³ ic : interpret radius •⁴ ic : interpret centre •⁵ ic : state equ of circle •⁶ ic : interpret B and q •⁷ ss : strategy for p •⁸ pd : process 	<ul style="list-style-type: none"> •¹ $A = (12, -5)$ •² $OA = 13$ •³ $r_B = 8$ •⁴ $B = (24, 0)$ •⁵ $(x-24)^2 + y^2 = 64$ •⁶ $q = -24$ •⁷ substitute $(12, -5)$ •⁸ $p = \frac{5}{144}$
<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:</p> <p>Paper 1 60 Paper 2 70 Total 130</p>	

Give 1 mark for each •		Illustrations for awarding each •
<p>1 $f(x) = 6x^3 - 5x^2 - 17x + 6$.</p> <p>(a) Show that $(x - 2)$ is a factor of $f(x)$.</p> <p>(b) Express $f(x)$ in its fully factorised form. 4</p>		
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> $\begin{array}{r} 6x^2 \\ x-2 \overline{) 6x^3 - 5x^2 - 17x + 6} \\ \underline{6x^3 - 12x^2} \\ 7x^2 - 17x \\ \underline{7x^2 - 14x} \\ -3x + 6 \\ \underline{-3x + 6} \\ 0 \\ 0 \end{array}$ <p>•²</p> $\begin{array}{r} 6x^2 + 7x - 3 \\ x-2 \overline{) 6x^3 - 5x^2 - 17x + 6} \\ \underline{6x^3 - 12x^2} \\ 7x^2 - 17x \\ \underline{7x^2 - 14x} \\ -3x + 6 \\ \underline{-3x + 6} \\ 0 \\ 0 \end{array}$ </div>		<p>Notes</p> <p>1 See page 16 for advice on solutions obtained via a graphics calculator</p>

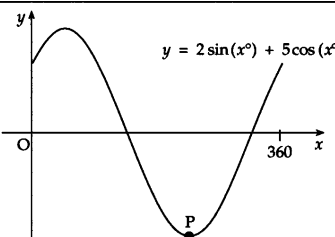
Give 1 mark for each •	Illustrations for awarding each •
<p>2 The diagram shows a sketch of part of the graph of a trigonometric function whose equation is of the form $y = a \sin(bx) + c$. Determine the values of a, b and c.</p>	 <p style="text-align: right;">3</p>
<p>2 1.2.3, 2.3.3 CN C 03/new ans: $a = 4$, $b = 2$, $c = 1$ 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>	

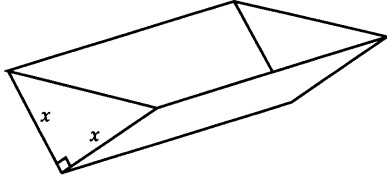
Give 1 mark for each •	Illustrations for awarding each •
<p>3 The incomplete graphs of $f(x) = x^2 + 2x$ and $g(x) = x^3 - x^2 - 6x$ are shown in the diagram. The graphs intersect at A (4, 24) and the origin.</p> <p>Find the shaded area enclosed between the curves.</p>	 <p style="text-align: right;">5</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 $\int ((x^2 + 2x) - (x^3 - x^2 - 6x)) dx$ 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 ... $-42\frac{2}{3}$ 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</p> <p>3 Do not penalise decimal approximations</p> <p>4 Differentiation loses •⁴ and •⁵</p> <p>5 $\int_4^0 (f(x) - g(x)) dx$ loses •² and possibly •⁵</p> <p>6 $\int_4^0 (g(x) - f(x)) dx$ is technically correct and hence all 5 marks are available</p> <p>7 Accept at •³, $8x + 2x^2 - x^3$ appearing from solving "upper" = "lower"</p> <p>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 •² ✓ $\left[-\frac{1}{4}x^4 - 2x^2 \right]_0^4$ •³ ✗ -96 •⁴ ✓ Eased ∴ area = 96 •⁵ ✓</p> <p style="text-align: right;">3 marks given</p>

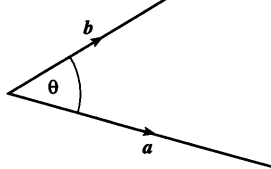
	Give 1 mark for each •	Illustrations for awarding each •
4	<p>(a) Find the equation of the tangent to the curve with equation $y = x^3 + 2x^2 - 3x + 2$ at the point where $x = 1$.</p> <p>(b) Show that this line is also a tangent to the circle with equation $x^2 + y^2 - 12x - 10y + 44 = 0$ and state the 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. 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 style="text-align: right;">2 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: 15px; 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: 15px; 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: 15px; 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> <p>•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</p>		<p>•¹ $k \sin(x^\circ) \cos(a^\circ) + k \cos(x^\circ) \sin(a^\circ)$ stated explicitly</p> <p>•² $k \cos(a^\circ) = 2, k \sin(a^\circ) = 5$ stated explicitly</p> <p>•³ $k = \sqrt{29}$ (5.4...)</p> <p>•⁴ $a = 68.2^\circ$</p> <p>•⁵ $\sqrt{29} \sin(x + 68.2)^\circ = -\sqrt{29}$</p> <p>•⁶ $x_p = 201.8^\circ$</p> <p>•⁷ $y_p = -\sqrt{29}$</p>
<p>Example 1</p> <p>(b)</p> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: fit-content; margin: 10px auto;"> $\sqrt{29} \sin(x + 68.2)^\circ = -1$ $x = 123, 281 \quad \text{award 1 mark}$ $(281, -1) \text{ or } (281, -\sqrt{29})$ </div> <p>Example 2</p> <p>(b)</p> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: fit-content; margin: 10px auto;"> <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> <p>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</p> <p>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.</p> <p>3 For •1 accept $k(\sin x \cos a + \cos x \sin a)$.</p> <p>4 For •4 accept any answer which rounds to 68</p> <p>5 The following are acceptable for •5</p> <p>•⁵ $\sin(x + 68.2)^\circ = -1$ or •⁵ $x + 68.2 = 270$</p> <p>6 candidates who use differentiation for (b) will most likely lose 1 mark for omitting the factor $\frac{\pi}{180}$</p> <p>7 $(201.8^\circ, -\sqrt{29})$ with no working at all may earn marks •6 and •7.</p> <p>8 $(-\sqrt{29}, 201.8^\circ)$ with no working at all may earn mark •7.</p> <p>9 See page 16 for advice on solutions obtained via a graphics calculator</p>

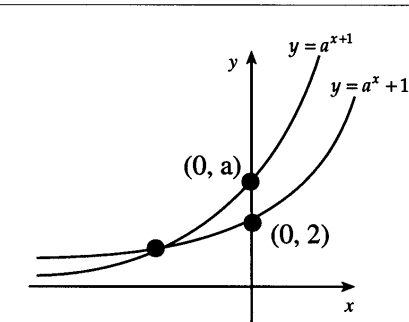
	Give 1 mark for each •	Illustrations for awarding each •																
8	<p>An open water tank, in the shape of a triangular prism, has a capacity of 108 litres. The tank is to be lined on the inside in order to make it watertight.</p> <p>The triangular cross-section of the tank is right-angled and 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. 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 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 $[\cos(\theta) = 0.55] \Rightarrow \theta = 56.6^\circ$ 0.99 radians</p>
	<p>Example 1</p> <div style="border: 1px solid black; border-radius: 10px; padding: 10px;"> <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;"> <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;"> <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 $\cos(x) = \frac{1}{3}$ and $\cos(x) = -2$ •⁵ $x = 1.23$ and 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 ✗ $\cos(x) = 0.180$ or $\cos(x) = -1.84$ •³ ✗ $x = 1.39$ radians no solution •⁴ ✗ •⁵ ✗ 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="margin-left: 20px;">•⁴ $\cos(x) = \frac{1}{3}$ and $x = 1.23$ •⁵ $\cos(x) = -2$ and 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="margin-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="margin-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

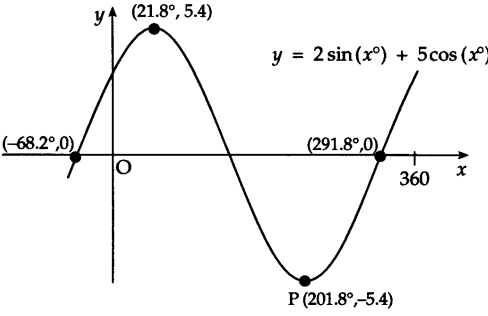
$$\begin{aligned} \text{Let } x &= \log_a\left(\frac{1}{a-1}\right) \\ \text{Then } \frac{1}{a-1} &= a^x && \bullet 1 \checkmark \\ y = a^x + 1 & && \bullet 2 \checkmark \\ &= \frac{1}{a-1} + 1 && \\ &= \frac{a}{a-1} && \\ y = a^{x+1} & && \\ &= a^x \times a && \\ &= \frac{1}{a-1} \times a && \\ &= \frac{a}{a-1}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

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 $-\frac{3}{2}$ and the statement : the roots are $2, \frac{1}{3}$ and $-\frac{3}{2}$.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>•⁴ so $f(x) = k(x-2)(x+\frac{3}{2})(x-\frac{1}{3})$ by comparing the leading terms, for example, of $f(x) = k(x-2)(x+\frac{3}{2})(x-\frac{1}{3})$ 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-left: auto; margin-right: 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; align-items: flex-start;"> <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:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 100px;">Paper 1</td> <td style="text-align: right;">60</td> </tr> <tr> <td>Paper 2</td> <td style="text-align: right;">70</td> </tr> <tr> <td>Total</td> <td style="text-align: right;">130</td> </tr> </table>		Paper 1	60	Paper 2	70	Total	130
Paper 1	60						
Paper 2	70						
Total	130						