C2

1.

1	0·5		
1·25	0·53935989		
1·5	0·603022689		
1·75	0·718421208	(5 values correct)	B2
2	1	(3 or 4 values correct)	B1

Correct formula with $h = 0{\cdot}25$ M1

$I \approx \frac{0{\cdot}25}{2} \times \{0{\cdot}5 + 1 + 2(0{\cdot}53935989 + 0{\cdot}603022689 + 0{\cdot}718421208)\}$

$I \approx 5{\cdot}221607574 \div 8$

$I \approx 0{\cdot}652700946$

$I \approx 0{\cdot}6527$ (f.t. one slip) A1

Special case for candidates who put $h = 0{\cdot}2$

1	0·5		
1·2	0·52999894		
1·4	0·573539334		
1·6	0·640184399		
1·8	0·753778361		
2	1	(all values correct)	B1

Correct formula with $h = 0{\cdot}2$ M1

$I \approx \frac{0{\cdot}2}{2} \times \{0{\cdot}5 + 1 + 2(0{\cdot}52999894 + 0{\cdot}573539334 + 0{\cdot}640184399 + 0{\cdot}753778361)\}$

$I \approx 6{\cdot}495002069 \div 10$

$I \approx 0{\cdot}6495002069$

$I \approx 0{\cdot}6495$ (f.t. one slip) A1

Note: Answer only with no working earns 0 marks

2. (*a*) $10\cos^2\theta + 3\cos\theta = 4(1 - \cos^2\theta) - 2$

(correct use of $\sin^2\theta = 1 - \cos^2\theta$) M1

An attempt to collect terms, form and solve quadratic equation in $\cos\theta$, either by using the quadratic formula or by getting the expression into the form $(a\cos\theta + b)(c\cos\theta + d)$, with $a \times c$ = candidate's coefficient of $\cos^2\theta$ and $b \times d$ = candidate's constant m1

$14\cos^2\theta + 3\cos\theta - 2 = 0 \Rightarrow (2\cos\theta + 1)(7\cos\theta - 2) = 0$

$\Rightarrow \cos\theta = \frac{2}{7}$, $\cos\theta = -\frac{1}{2}$ (c.a.o.) A1

$\theta = 73{\cdot}40°, 286{\cdot}60°$ B1

$\theta = 120°, 240°$ B1 B1

Note: Subtract 1 mark for each additional root in range for each branch, ignore roots outside range.
$\cos\theta$ = +, –, f.t. for 3 marks, $\cos\theta$ = –, –, f.t. for 2 marks
$\cos\theta$ = +, +, f.t. for 1 mark

(*b*) $3x - 21° = -54°, 234°, 306°, 594$ (one value) B1

$x = 85°, 109°$ B1 B1

Note: Subtract (from final two marks) 1 mark for each additional root in range, ignore roots outside range.

(*c*) Use of $\frac{\sin\phi}{\cos\phi} = \tan\phi$ M1

$\tan\phi = 0{\cdot}2$ A1

$\phi = 11{\cdot}31°, 191{\cdot}31°$ (f.t $\tan\phi = a$) B1

3. (*a*) $11^2 = 5^2 + x^2 - 2 \times 5 \times x \times {}^2/_5$ (correct use of cos rule) M1

An attempt to collect terms, form and solve quadratic equation in x, either by using the quadratic formula or by getting the expression into the form $(x + b)(x + d)$, with $b \times d$ = candidate's constant m1

$x^2 - 4x - 96 = 0 \Rightarrow x = 12$ (c.a.o.) A1

(*b*) $\frac{\sin XZY}{32} = \frac{\sin 19°}{15}$

(substituting the correct values in the correct places in the sin rule) M1

$XZY = 44°, 136°$ (at least one value) A1

Use of angle sum of a triangle = 180° M1

$YXZ = 117°, 25°$ (both values)

(f.t. candidate's values for XZY provided both M's awarded) A1

4. (*a*) $S_n = a + [a + d] + . . . + [a + (n - 1)d]$

(at least 3 terms, one at each end) B1

$S_n = [a + (n - 1)d] + [a + (n - 2)d] + . . . + a$

Either:

$2S_n = [a + a + (n - 1)d] + [a + a + (n - 1)d] + . . . + [a + a + (n - 1)d]$

Or:

$2S_n = [a + a + (n - 1)d]$ n times M1

$2S_n = n[2a + (n - 1)d]$

$S_n = \frac{n}{2}[2a + (n - 1)d]$ (convincing) A1

(*b*) $a + 2d + a + 3d + a + 9d = 79$ B1

$a + 5d + a + 6d = 61$ B1

An attempt to solve the candidate's linear equations simultaneously by eliminating one unknown M1

$a = 3$, $d = 5$ (both values) (c.a.o.) A1

(*c*) $a = 15$, $d = -2$ B1

$S_n = \frac{n}{2}[2 \times 15 + (n - 1)(-2)]$ (f.t. candidate's d) M1

$S_n = n(16 - n)$ (c.a.o.) A1

5. (*a*) $a + ar = 72$ B1

$a + ar^2 = 120$ B1

An attempt to solve candidate's equations simultaneously by correctly eliminating a M1

$3r^2 - 5r - 2 = 0$ (convincing) A1

(*b*) An attempt to solve quadratic equation in r, either by using the quadratic formula or by getting the expression into the form $(ar + b)(cr + d)$, with $a \times c = 3$ and $b \times d = -2$ M1

$(3r + 1)(r - 2) = 0 \Rightarrow r = -{}^1/_3$ A1

$a \times (1 - {}^1/_3) = 72 \Rightarrow a = 108$ (f.t. candidate's derived value for r) B1

$S_\infty = \frac{108}{1 - (-{}^1/_3)}$ (correct use of formula for S_∞, f.t. candidate's derived values for r and a) M1

$S_\infty = 81$ (c.a.o.) A1

6. (*a*) $3 \times \frac{x^{3/2}}{3/2} - 2 \times \frac{x^{-2/3}}{-2/3} + c$ B1 B1

(–1 if no constant term present)

(*b*) (i) $36 - x^2 = 5x$ M1

An attempt to rewrite and solve quadratic equation in x, either by using the quadratic formula or by getting the expression into the form $(x + a)(x + b)$, with $a \times b = -36$ m1

$(x - 4)(x + 9) = 0 \Rightarrow A(4, 20)$ (c.a.o.) A1

$B(6, 0)$ B1

(ii) Area of triangle = 40 (f.t. candidate's coordinates for A) B1

Area under curve $= \int_4^6 (36 - x^2)\,dx$ (use of integration) M1

$\int 36\,dx = 36x$ **and** $\int x^2\,dx = \frac{x^3}{3}$ B1

Area under curve = [(216 – 216/3) – (144 – 64/3)]

(substitution of candidate's limits) m1

= 64/3

Use of candidate's, x_A, x_B as limits and trying to find total area by adding area of triangle and area under curve m1

Total area = 40 + 64/3 = 184/3 (c.a.o.) A1

7. (*a*) Let $p = \log_a x$

Then $x = a^p$ (relationship between log and power) B1

$x^n = a^{pn}$ (the laws of indices) B1

$\therefore \log_a x^n = pn$ (relationship between log and power)

$\therefore \log_a x^n = pn = n \log_a x$ (convincing) B1

(*b*) **Either:**

$(x/2 - 3) \log_{10} 9 = \log_{10} 6$

(taking logs on both sides and using the power law) M1

$x = \dfrac{2(\log_{10} 6 + 3 \log_{10} 9)}{\log_{10} 9}$ A1

$x = 7{\cdot}631$ (f.t. one slip, see below) A1

Or:

$x/2 - 3 = \log_9 6$ (rewriting as a log equation) M1

$x = 2(\log_9 6 + 3)$ A1

$x = 7{\cdot}631$ (f.t. one slip, see below) A1

Note: an answer of $x = -4{\cdot}369$ from $x = \dfrac{2(\log_{10} 6 - 3 \log_{10} 9)}{\log_{10} 9}$

earns M1 A0 A1

an answer of $x = 3{\cdot}815$ from $x = \dfrac{\log_{10} 6 + 3 \log_{10} 9}{\log_{10} 9}$

earns M1 A0 A1

an answer of $x = 1{\cdot}908$ from $x = \dfrac{(\log_{10} 6 + 3 \log_{10} 9)}{2\log_{10} 9}$

earns M1 A0 A1

an answer of $x = 4{\cdot}631$ from $x = \dfrac{2\log_{10} 6 + 3 \log_{10} 9}{\log_{10} 9}$

earns M1 A0 A1

Note: Answer only with no working earns 0 marks

(*c*) $\log_a (x - 2) + \log_a (4x + 1) = \log_a [(x - 2)(4x + 1)]$ (addition law) B1

$2 \log_a (2x - 3) = \log_a (2x - 3)^2$ (power law) B1

$(x - 2)(4x + 1) = (2x - 3)^2$ (removing logs) M1

$x = 2{\cdot}2$ (c.a.o.) A1

Note: Answer only with no working earns 0 marks

8. (*a*) $A(2, -3)$ B1

A correct method for finding the radius M1

Radius = $\sqrt{12}$ A1

(*b*) $AT^2 = 61$ (f.t. candidate's coordinates for A) B1

Use of $RT^2 = AT^2 - AR^2$ M1

$RT = 7$ (f.t. candidate's radius and coordinates for A) A1

9.	Area of sector $POQ = {}^1/_2 \times r^2 \times 1{\cdot}12$		B1
	Area of triangle $POQ = {}^1/_2 \times r^2 \times \sin(1{\cdot}12)$		B1
	$10{\cdot}35 = {}^1/_2 \times r^2 \times 1{\cdot}12 - {}^1/_2 \times r^2 \times \sin(1{\cdot}12)$		
	(f.t. candidate's expressions for area of sector and area of triangle)		M1
	$r^2 = \dfrac{2 \times 10{\cdot}35}{(1{\cdot}12 - 0{\cdot}9)}$ (o.e.)	(c.a.o.)	A1
	$r = 9{\cdot}7$	(f.t. one numerical slip)	A1