**1.**

| | | | |
|---|---|---|---|
| 1 | 1·414213562 | | |
| 1·25 | 1·341640787 | | |
| 1·5 | 1·290994449 | | |
| 1·75 | 1·253566341 | (5 values correct) | B2 |
| 2 | 1·224744871 | (3 or 4 values correct) | B1 |

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

$I \approx \frac{0{\cdot}25}{2} \times \{1{\cdot}414213562 + 1{\cdot}224744871 + 2(1{\cdot}341640787 + 1{\cdot}290994449 + 1{\cdot}253566341)\}$

$I \approx 10{\cdot}41136159 \div 8$

$I \approx 1{\cdot}301420198$

$I \approx 1{\cdot}301$ (f.t. one slip) A1

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

| | | | |
|---|---|---|---|
| 1 | 1·414213562 | | |
| 1·2 | 1·354006401 | | |
| 1·4 | 1·309307341 | | |
| 1·6 | 1·274754878 | | |
| 1·8 | 1·247219129 | | |
| 2 | 1·224744871 | (all values correct) | B1 |

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

$I \approx \frac{0{\cdot}2}{2} \times \{1{\cdot}414213562 + 1{\cdot}224744871 + 2(1{\cdot}354006401 + 1{\cdot}309307341 + 1{\cdot}274754878 + 1{\cdot}247219129)\}$

$I \approx 13{\cdot}00953393 \div 10$

$I \approx 1{\cdot}300953393$

$I \approx 1{\cdot}301$ (f.t. one slip) A1

**Note: Answer only with no working earns 0 marks**

**2.** (*a*) $12(1 - \sin^2\theta) - 5\sin\theta = 10$ (correct use of $\cos^2\theta = 1 - \sin^2\theta$) M1

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

$12\sin^2\theta + 5\sin\theta - 2 = 0 \Rightarrow (4\sin\theta - 1)(3\sin\theta + 2) = 0$

$\Rightarrow \sin\theta = \frac{1}{4}, \sin\theta = -\frac{2}{3}$ (c.a.o.) A1

$\theta = 14{\cdot}48°, 165{\cdot}52°$ B1

$\theta = 221{\cdot}81°, 318{\cdot}19°$ B1 B1

Note: Subtract 1 mark for each additional root in range for each branch, ignore roots outside range.

$\sin\theta = +, -$, f.t. for 3 marks, $\sin\theta = -, -$, f.t. for 2 marks

$\sin\theta = +, +$, f.t. for 1 mark

(*b*) $2x = -58°, 122°, 302°$ (at least one value) B1

$x = 61°, 151°$, (both values) B1

Note: Subtract a maximum of 1 mark for additional roots in range, ignore roots outside range.

(*c*) $\sin\phi + 2\sin\phi\cos\phi = 0$ **or** $\tan\phi + 2\tan\phi\cos\phi = 0$

**or** $\sin\phi\left(\frac{1}{\cos\phi} + 2\right) = 0$ M1

$\sin\phi = 0$ (or $\tan\phi = 0$) , $\cos\phi = -\frac{1}{2}$ (both values) A1

$\phi = 0°, 180°$ (both values) A1

$\phi = 120°$ A1

Note: Subtract a maximum of 1 mark for each additional root in range for each branch, ignore roots outside range.

**Special Case:**

No factorisation but division throughout by $\sin\phi$ (or $\tan\phi$) to yield

$1 + 2\cos\phi = 0$ (or equivalent) M1

$\phi = 120°$ A1

**3.** (*a*) $\frac{1}{2} \times AC \times 11 \times \sin 110° = 31$

(substituting the correct values in the correct places in the area formula) M1

$AC = 5{\cdot}998$ ($AC = 6$) A1

$BC^2 = 6^2 + 11^2 - 2 \times 6 \times 11 \times \cos 110°$

(substituting the correct values in the correct places in the cos rule, (f.t. candidate's value for $AC$) M1

$BC = 14{\cdot}22$ (f.t. candidate's value for $AC$) A1

(*b*) $\frac{\sin XZY}{2} = \frac{\sin 60°}{2\sqrt{3} - 1}$ (substituting the correct values in the correct places in the sine formula) M1

$\sin XZY = \frac{2 \times \sin 60°}{2\sqrt{3} - 1}$ m1

$\sin XZY = \frac{6 + \sqrt{3}}{11}$ A1

**4.** $3 \times \frac{x^{3/2}}{3/2} - 6 \times \frac{x^{-3}}{-3} - x + c$ B1, B1, B1

(–1 if no constant term present)

**5.** (*a*) $S_n = a + [a + d] + \ldots + [a + (n-1)d]$

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

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

Either:

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

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*) $\frac{n}{2}[2 \times 4 + (n-1) \times 2] = 460$ M1

**Either:** Rewriting above equation in a form ready to be solved

$2n^2 + 6n - 920 = 0$ or $n^2 + 3n - 460 = 0$ or $n(n+3) = 460$

**or:** $n = 20, n = -23$ A1

$n = 20$ (c.a.o.) A1

(*c*) $a + 4d = 9$ B1

$(a + 5d) + (a + 9d) = 42$ B1

An attempt to solve the candidate's two linear equations

Simultaneously by eliminating one unknown M1

$d = 4$ (c.a.o.) A1

$a = -7$ (f.t. candidate's value for $d$) A1

**6.** (*a*) $r = -0{\cdot}6$ B1

$S_\infty = \frac{40}{1 - (-0{\cdot}6)}$ M1

$S_\infty = 25$ (c.a.o.) A1

(*b*) (i) $ar^3 = 8$ B1

$ar^2 + ar^3 + ar^4 = 28$ B1

An attempt to solve these equations simultaneously by eliminating $a$ M1

$\frac{r^3}{r^2 + r^3 + r^4} = \frac{8}{28} \Rightarrow 2r^2 - 5r + 2 = 0$ (convincing) A1

(ii) $r = 0{\cdot}5$ ($r = 2$ discarded, c.a.o.) B1

$a = 64$ (f.t. candidate's value for $r$, provided $|r| < 1$) B1

**7.**

Area $= \int^{3} \left(3x + \frac{x^3}{5}\right) dx$ (use of integration) M1

$\frac{3x^2}{2} + \frac{x^4}{4 \times 5}$ (correct integration) B1, B1

Area $= (27/2 + 81/20) - (3/2 + 1/20)$ (an attempt to substitute limits) m1

Area $= 16$ (c.a.o.) A1

**8.** (*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:**

$(2y - 1) \log_{10} 6 = \log_{10} 4$

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

$y = \dfrac{\log_{10} 4 + \log_{10} 6}{2 \log_{10} 6}$ A1

$y = 0{\cdot}887$ (f.t. one slip, see below) A1

**Or:**

$2y - 1 = \log_6 4$ (rewriting as a log equation) M1

$y = \dfrac{\log_6 4 + 1}{2}$ A1

$y = 0{\cdot}887$ (f.t. one slip, see below) A1

Note: an answer of $y = -\,0{\cdot}113$ from $y = \dfrac{\log_{10} 4 - \log_{10} 6}{2 \log_{10} 6}$

earns M1 A0 A1

an answer of $y = 1{\cdot}774$ from $y = \dfrac{\log_{10} 4 + \log_{10} 6}{\log_{10} 6}$

earns M1 A0 A1

(*c*) $\log_a 4 = \dfrac{1}{2} \Rightarrow 4 = a^{1/2}$ (rewriting log equation as power equation)

M1

$a = 16$ A1

**9.** (*a*) $A(4, -1)$ B1

A correct method for finding radius M1

Radius = $\sqrt{10}$ A1

(*b*) (i) **Either:**

An attempt to substitute the coordinates of $P$ in the equation of $C$ M1

Verification that $x = 7$, $y = -2$ satisfy equation of $C$ and hence $P$ lies on $C$ A1

**Or:**

An attempt to find $AP^2$ M1

$AP^2 = 10 \Rightarrow P$ lies on $C$ A1

(ii) A correct method for finding $Q$ M1

$Q(1, 0)$ (f.t. candidate's coordinates for $A$) A1

(*c*) An attempt to substitute $(2x - 4)$ for $y$ in the equation of the circle M1

$x^2 - 4x + 3 = 0$ (or $5x^2 - 20x + 15 = 0$) A1

$x = 1, x = 3$ (correctly solving candidate's quadratic, both values) A1

Points of intersection are $(1, -2), (3, 2)$ (c.a.o.) A1

**10.** (*a*) (i) $L = R\theta - r\theta$ B1

(ii) $K = \frac{1}{2}R^2\theta - \frac{1}{2}r^2\theta$ B1

(*b*) An attempt to eliminate $\theta$ M1

Use of $R^2 - r^2 = (R + r)(R - r)$ m1

$r = \frac{2K}{L} - R$ A1