

ADVANCED SUBSIDIARY GCE MATHEMATICS

Core Mathematics 2

WEDNESDAY 9 JANUARY 2008

Afternoon Time: 1 hour 30 minutes

4722/01

Additional materials: Answer Booklet (8 pages) List of Formulae (MF1)

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Answer all the questions.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.
- You are permitted to use a graphical calculator in this paper.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is 72.
- You are reminded of the need for clear presentation in your answers.

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The diagram shows a sector AOB of a circle with centre O and radius 11 cm. The angle AOB is 0.7 radians. Find the area of the segment shaded in the diagram. [4]

2 Use the trapezium rule, with 3 strips each of width 2, to estimate the value of

$$\int_{1}^{7} \sqrt{x^2 + 3} \, \mathrm{d}x.$$
 [4]

- 3 Express each of the following as a single logarithm:
 - (i) $\log_a 2 + \log_a 3$, [1]

(ii)
$$2\log_{10} x - 3\log_{10} y$$
. [3]



1



In the diagram, angle $BDC = 50^{\circ}$ and angle $BCD = 62^{\circ}$. It is given that AB = 10 cm, AD = 20 cm and BC = 16 cm.

- (i) Find the length of *BD*. [2]
- (ii) Find angle *BAD*. [3]
- 5 The gradient of a curve is given by $\frac{dy}{dx} = 12\sqrt{x}$. The curve passes through the point (4, 50). Find the equation of the curve. [6]

6 A sequence of terms u_1, u_2, u_3, \ldots is defined by

$$u_n = 2n + 5$$
, for $n \ge 1$.

- (i) Write down the values of u_1 , u_2 and u_3 . [2]
- (ii) State what type of sequence it is. [1]

(iii) Given that
$$\sum_{n=1}^{N} u_n = 2200$$
, find the value of N. [5]





The diagram shows part of the curve $y = x^2 - 3x$ and the line x = 5.

- (i) Explain why $\int_0^5 (x^2 3x) dx$ does not give the total area of the regions shaded in the diagram. [1]
- (ii) Use integration to find the exact total area of the shaded regions. [7]
- 8 The first term of a geometric progression is 10 and the common ratio is 0.8.
 - (i) Find the fourth term.

[2]

- (ii) Find the sum of the first 20 terms, giving your answer correct to 3 significant figures. [2]
- (iii) The sum of the first N terms is denoted by S_N , and the sum to infinity is denoted by S_{∞} . Show that the inequality $S_{\infty} - S_N < 0.01$ can be written as

$$0.8^N < 0.0002$$
,

and use logarithms to find the smallest possible value of N. [7]

9 (i)



Fig. 1 shows the curve $y = 2 \sin x$ for values of x such that $-180^\circ \le x \le 180^\circ$. State the coordinates of the maximum and minimum points on this part of the curve. [2]

(ii)



Fig. 2 shows the curve $y = 2 \sin x$ and the line y = k. The smallest positive solution of the equation $2 \sin x = k$ is denoted by α . State, in terms of α , and in the range $-180^\circ \le x \le 180^\circ$,

- (a) another solution of the equation $2\sin x = k$, [1]
- (b) one solution of the equation $2 \sin x = -k$.
- (iii) Find the x-coordinates of the points where the curve $y = 2 \sin x$ intersects the curve $y = 2 3 \cos^2 x$, for values of x such that $-180^\circ \le x \le 180^\circ$. [6]

10 (i) Find the binomial expansion of $(2x + 5)^4$, simplifying the terms. [4]

(ii) Hence show that $(2x + 5)^4 - (2x - 5)^4$ can be written as

$$320x^3 + kx$$
,

where the value of the constant k is to be stated.

(iii) Verify that x = 2 is a root of the equation

$$(2x+5)^4 - (2x-5)^4 = 3680x - 800,$$

and find the other possible values of *x*.

[6]

[2]

[1]

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4722 Core Mathematics 2

| 1area of sector = $\sqrt{x} \times 11^2 \times 0.7$ = 42.35 area of triangle = $\sqrt{x} \times 11^2 \times 0.7$ = 42.35 = 33.7MI All A | | | Mark To | otal |
|--|---|---|------------------------|---|
| Image: Constraint of the system of the sy | 1 | area of sector = $\frac{1}{2} \times 11^2 \times 0.7$ = 42.35 area of triangle = $\frac{1}{2} \times 11^2 \times \sin 0.7 = 38.98$ hence area of segment = 42.35 - 38.98 = 3.37 | M1 A1 M1 A1 4 | Attempt sector area using $(\frac{1}{2})r^2\theta$ Obtain 42.35, or unsimplified equiv, soiAttempt triangle area using $\frac{1}{2}absinC$ or equiv, andsubtract from attempt at sectorObtain 3.37, or better |
| 2area $\approx \frac{1}{2} \times 2 \times \left[2 + 2\left(\sqrt{12} + \sqrt{28}\right) + \sqrt{52}\right]$ M1Attempt y-values at $x = 1, 3, 5, 7$ only Correct trapezium rule, any h , for their y values to find area between $x = 1$ and $x = 7$ Correct h (so if or their y values) Obtain 26.7 or better (correct working only)3(i) $\log_{\pi} 6$ B11State $\log_{\pi} 6$ cwo(ii) $2\log_{0} x - 3\log_{0} y = \log_{0} x^{2} - \log_{0} y^{3}$ $= \log_{10} \frac{x^{2}}{y^{3}}$ M1 M1*Use $b \log a = \log a^{a}$ at least once4(i) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$ $BD = 18.4 \text{ cm}$ M1 Attempt to use correct sine rule in ΔBCD , or equiv.4(ii) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$ $BD = 18.4 \text{ cm}$ M1 A1Attempt to use correct cosine rule in ΔBCD , or equiv.5 $\int 12x^{\frac{1}{2}} dx = 8x^{\frac{3}{2}}$ M1 A1Attempt to integrate5 $\int 12x^{\frac{1}{4}} dx = 8x^{\frac{3}{4}} + c$ $y = 8x^{\frac{3}{4}} - 14$ M1 Attempt to integrateAttempt following $kx^{\frac{1}{2}}$ only5 $\int 12x^{\frac{1}{4}} dx = 8x^{\frac{3}{4}} + c$ $y = 8x^{\frac{3}{4}} - 14$ M1 Attempt to integrateAttempt following $kx^{\frac{1}{2}}$ only6M1 Attempt on integrateAttempt following $kx^{\frac{1}{2}}$ onlyState $y = 8x^{\frac{3}{4}} - 14$ Attempt on $x = 0$ At a f, as long as single power of x | | | 4 |] |
| ≈ 26.7 $MI = 1 \text{ and } x = 7$ $MI = 1 \text{ and } x = 7$ $Correct trapezium rule, any h, for their y values to find area between x = 1 and x = 7$ $Correct h (soi) for their y values Obtain 26.7 or better (correct working only)$ $\boxed{4}$ $\boxed{4}$ $(i) \log_{x} 6$ $(ii) 2\log_{0} x - 3\log_{0} y = \log_{0} x^{2} - \log_{0} y^{3}$ $= \log_{10} \frac{x^{2}}{y^{3}}$ $MI = 1 \text{ State } \log_{a} e \log a^{b} a \text{ least once}$ $\boxed{4}$ $WI = b \log a - \log b = \log^{7/b}$ $MI = 0 \text{ Use } \log a - \log b = \log^{7/b}$ $MI = 0 \text{ Use } \log a - \log b = \log^{7/b}$ $MI = 0 \text{ Obtain } \log_{10} \frac{x^{2}}{y^{3}} \text{ evo}$ $\boxed{4}$ $\boxed{4}$ $(i) \frac{BD}{\sin 62} = \frac{16}{\sin 50}$ $BD = 18.4 \text{ cm}$ $A1 = 3$ $Obtain 18.4 \text{ cm}$ $A1 = 2$ $Obtain 18.4 \text{ cm}$ $A1 = 3$ $Obtain 6.4^{0}$ $\boxed{5}$ $y - 8x^{\frac{1}{2}} + c \Rightarrow 50 - 8 \times 4^{\frac{1}{2}} + c$ $\Rightarrow c = -14$ $Hence \ y = 8x^{\frac{1}{2}} - 14$ MI $A1 = 4$ MI $A1 = 4$ MI MI $A1 = 7$ $A1 $ | 2 | area $\approx \frac{1}{2} \times 2 \times \left\{2 + 2\left(\sqrt{12} + \sqrt{28}\right) + \sqrt{52}\right\}$ | M1 | Attempt <i>y</i> -values at $x = 1, 3, 5, 7$ only |
| ≈ 26.7 $MI = A + A + A + A + A + A + A + A + A + A$ | | | M1 | Correct trapezium rule, any <i>h</i> , for their <i>y</i> values to find area between $x = 1$ and $x = 7$ |
| Image: State log_a 6Image: State log_a 6 cwo3 (i) $\log_a 6$ B1 1State log_a 6 cwo(ii) $2\log_0 x - 3\log_0 y = \log_0 x^2 - \log_0 y^3$ M1*Use $\log a - \log b = \log a^b$ at least once $= \log_{10} \frac{x^2}{y^2}$ M1*Use $\log a - \log b = \log^{a/b}$ A1 3Obtain $\log_{10} \frac{x^2}{y^2}$ cwoImage: State log a - log b = log a^b at least once4(i) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$ M1 $BD = 18.4 \text{ cm}$ A1 2(ii) $18.4^2 = 10^2 + 20^2 - 2 \times 10 \times 20 \times \cos \theta$ M1 $\cos \theta = 0.3998$ Attempt to use correct cosine rule in ΔBD , or equiv. $\theta = 66.4^0$ M1Attempt to rearrange equation to find cos BAD (from $a^2 = b^2 + c^2 \pm (2)bc \cos A$) $\theta = 66.4^0$ M1 $y = 8x^{\frac{1}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{1}{2}} + c$ $y = 8x^{\frac{1}{2}} - 14$ M1Hence $y = 8x^{\frac{1}{2}} - 14$ $d = 0$ At a g as single power of x $d = 0$ | | ≈ 26.7 | M1 A1 4 | Correct <i>h</i> (soi) for their <i>y</i> values Obtain 26.7 or better (correct working only) |
| 3(i) $\log_a 6$ B11State $\log_a 6 \operatorname{cwo}$ (ii) $2\log_0 x - 3\log_0 y = \log_0 x^2 - \log_0 y^3$ $= \log_{10} \frac{x^2}{y^3}$ M1*Use $b\log a = \log a^b$ at least once $a = \log_{10} \frac{x^2}{y^3}$ M1*Use $\log a - \log b = \log^{a/b}$ A13Obtain $\log_{10} \frac{x^2}{y^3}$ cwo4(i) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$ $BD = 18.4 \operatorname{cm}$ M1Attempt to use correct sine rule in ΔBCD , or equiv.A12(ii) $18.4^2 = 10^2 + 20^2 - 2 x 10 x 20 x \cos \theta$ $\cos \theta = 0.3998$ M1 $\theta = 66.4^0$ A15 $\int 12x^{\frac{1}{2}} dx = 8x^{\frac{1}{2}}$ 5 $\int 12x^{\frac{1}{2}} dx = 8x^{\frac{1}{2}}$ M1Attempt to integrate $A1$ $y = 8x^{\frac{1}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{1}{2}} + c$ $y = 8x^{\frac{1}{2}} - 14$ Hence $y = 8x^{\frac{1}{2}} - 14$ G | | | 4 | |
| (ii) $2\log_{0}x - 3\log_{0}y = \log_{0}x^{2} - \log_{0}y^{3}$ $= \log_{10}\frac{x^{2}}{y^{2}}$ M1* Use $b\log a = \log a^{b}$ at least once Use $\log a - \log b = \log^{a}/b$ A1 Obtain $\log_{10}\frac{x^{2}}{y^{2}}$ evo 4 (i) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$ BD = 18.4 cm A1 2 Obtain 18.4 cm A1 2 Obtain 18.4 cm (ii) $18.4^{2} = 10^{2} + 20^{2} - 2 \times 10 \times 20 \times \cos \theta$ Cf d M1 Attempt to use correct sine rule in ΔBCD , or equiv. A1 2 Obtain 18.4 cm (ii) $18.4^{2} = 10^{2} + 20^{2} - 2 \times 10 \times 20 \times \cos \theta$ Cf d A1 3 Obtain $\log_{10}\frac{x^{2}}{y^{2}}$ evo 5 $\int 12x^{\frac{1}{2}}dx = 8x^{\frac{1}{2}}$ M1 Attempt to integrate A1 $$ Obtain 66.4^{0} Cf d M1 Attempt to integrate A1 $$ Obtain $8x^{\frac{2}{2}}$, with or without $+ c$ M1 Use (4, 50) to find c $x^{\frac{1}{2}}$ only A1 6 Contain $e^{x^{\frac{1}{2}}}$ only State $y = 8x^{\frac{1}{2}} - 14$ Contain $e^{x^{\frac{1}{2}}}$ only State $y = 8x^{\frac{1}{2}} - 14$ Contain $e^{x^{\frac{1}{2}}}$ only Contain $e^{x^{\frac{1}{2}}}$ Contain $e^{x^{\frac{1}{2}}}$ only Contain $e^{x^{\frac{1}{2}}}$ only Contain $e^{x^{\frac{1}{2}}}$ only Contain $e^{x^{\frac{1}{2}}}$ only Contain $e^{x^{\frac{1}{2}}} - 14$ Contain e^{x^{\frac | 3 | (i) $\log_a 6$ | B1 1 | State $\log_a 6$ cwo |
| $= \log_{10} \frac{x^2}{y^3}$ M1dep* Use log $a - \log b = \log^{a}/b$ A1 3 Obtain $\log_{10} \frac{x^2}{y^3}$ evo 4 4 (i) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$ BD = 18.4 cm (ii) $18.4^2 = 10^2 + 20^2 - 2 \times 10 \times 20 \times \cos \theta$ Cos $\theta = 0.3998$ M1 Attempt to use correct cosine rule in ΔBD Attempt to rearrange equation to find cos BAD (from $a^2 = b^2 + c^2 \pm (2)bc \cos A$) $\theta = 66.4^{\theta}$ A1 3 Obtain 6.4^{θ} S $\frac{5}{5} \int 12x^{\frac{1}{2}}dx = 8x^{\frac{3}{2}}$ M1 Attempt to integrate A1 $\frac{1}{\sqrt{2}} Obtain 18x^{\frac{1}{2}}$ M1 Attempt to integrate A1 $\frac{1}{\sqrt{2}} Obtain correct, unsimplified, integral following their f(x) A1 Obtain 8x^{\frac{1}{2}}, with or without +c y = 8x^{\frac{1}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{1}{2}} + c \frac{1}{\sqrt{2}} C = -14 Hence y = 8x^{\frac{1}{2}} - 14 M2 \frac{1}{\sqrt{2}} C = -14 \frac{1}{$ | | (ii) $2\log_0 x - 3\log_0 y = \log_0 x^2 - \log_0 y^3$ | M1* | Use $b \log a = \log a^b$ at least once |
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| Image: A constraint of the system of the | | | A1 3 | Obtain $\log_{10} \frac{x^2}{y^3}$ cwo |
| 4 (i) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$ $BD = 18.4 \text{ cm}$ (i) $18.4^2 = 10^2 + 20^2 - 2 \times 10 \times 20 \times \cos \theta$ $\cos \theta = 0.3998$ $\theta = 66.4^0$ A1 3 Attempt to use correct sine rule in ΔBD , or equiv. A1 2 Obtain 18.4 cm Attempt to use correct cosine rule in ΔABD Attempt to rearrange equation to find cos BAD (from $a^2 = b^2 + c^2 \pm (2)bc \cos A$) $\theta = 66.4^0$ A1 3 Obtain 66.4^0 S 5 $\int 12x^{\frac{1}{2}}dx = 8x^{\frac{3}{2}}$ M1 Attempt to integrate A1 $$ Obtain correct, unsimplified, integral following their f(x) obtain $8x^{\frac{1}{2}}$, with or without $+ c$ $y = 8x^{\frac{3}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{3}{2}} + c$ $\Rightarrow c = -14$ Hence $y = 8x^{\frac{3}{2}} - 14$ Attempt to $x^{\frac{3}{2}} - 14$ Attempt to find c A1 6 A1 6 A1 7 A1 7 | | | 4 |] |
| $BD = 18.4 \text{ cm}$ (ii) $18.4^2 = 10^2 + 20^2 - 2 \times 10 \times 20 \times \cos \theta$ $\cos \theta = 0.3998$ $\theta = 66.4^0$ A1 A $M1$ Attempt to use correct cosine rule in ΔABD Attempt to rearrange equation to find cos BAD (from $a^2 = b^2 + c^2 \pm (2)bc \cos A$) $\theta = 66.4^0$ A1 B $M1$ Attempt to integrate $S = \frac{12}{5}$ A1 Attempt to integrate $A1 \sqrt{2}$ Obtain 66.4^0 B $M1$ Attempt to integrate $A1 \sqrt{2}$ Attempt to integrat | 4 | (i) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$ | M1 | Attempt to use correct sine rule in $\triangle BCD$, or equiv. |
| (ii) $18.4^2 = 10^2 + 20^2 - 2 \times 10 \times 20 \times \cos \theta$ $\cos \theta = 0.3998$ $\theta = 66.4^{0}$ M1 Attempt to use correct cosine rule in ΔABD Attempt to rearrange equation to find $\cos BAD$ (from $a^2 = b^2 + c^2 \pm (2)bc \cos A$) $\theta = 66.4^{0}$ S 5 $\int 12x^{\frac{1}{2}}dx = 8x^{\frac{3}{2}}$ M1 Attempt to integrate A1 $$ Obtain correct, unsimplified, integral following their f(x) A1 Obtain $8x^{\frac{1}{2}}$, with or without $+ c$ $y = 8x^{\frac{3}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{3}{2}} + c$ $\Rightarrow c = -14$ Hence $y = 8x^{\frac{3}{2}} - 14$ A1 A1 Attempt to integrate A1 $$ Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only A1 A1 Attempt expression of x A1 Attempt to integrate | | BD = 18.4 cm | A1 2 | 2 Obtain 18.4 cm |
| $\theta = 66.4^{0}$ Attempt to rearange equation to find cos <i>BAD</i> (from $a^{2} = b^{2} + c^{2} \pm (2)bc \cos A$) $\theta = 66.4^{0}$ A1 3 Obtain 66.4^{0} S $\int 12x^{\frac{1}{2}}dx = 8x^{\frac{3}{2}}$ M1 Attempt to integrate A1 $$ Obtain correct, unsimplified, integral following their f(x A1 Obtain $8x^{\frac{3}{2}}$, with or without $+ c$ Use (4, 50) to find c A1 $$ Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only Hence $y = 8x^{\frac{3}{2}} - 14$ A1 $$ Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only A1 $$ Obtain $c = -14$, as long as single power of x | | (ii) $18.4^2 = 10^2 + 20^2 - 2 \times 10 \times 20 \times \cos \theta$ | M1 | Attempt to use correct cosine rule in $\triangle ABD$ |
| $\theta = 66.4^{0}$ A1 3 Obtain 66.4 ⁰ 5 $\int 12x^{\frac{1}{2}}dx = 8x^{\frac{3}{2}}$ M1 Attempt to integrate A1 Obtain correct, unsimplified, integral following their f(x A1 Obtain $8x^{\frac{3}{2}}$, with or without + c $y = 8x^{\frac{3}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{3}{2}} + c$ $\Rightarrow c = -14$ Hence $y = 8x^{\frac{3}{2}} - 14$ M1 Use (4, 50) to find c A1 Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only A1 6 State $y = 8x^{\frac{3}{2}} - 14$ aef, as long as single power of x I | | $\cos\theta = 0.3998$ | INI I | (from $a^2 = b^2 + c^2 \pm (2)bc \cos A$) |
| 5 $\int 12x^{\frac{1}{2}} dx = 8x^{\frac{3}{2}}$ M1Attempt to integrate $5 \int 12x^{\frac{1}{2}} dx = 8x^{\frac{3}{2}}$ M1Attempt to integrate $A1$ Obtain correct, unsimplified, integral following their f(x $y = 8x^{\frac{3}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{3}{2}} + c$ M1Use (4, 50) to find c $\Rightarrow c = -14$ M1Use (4, 50) to find cHence $y = 8x^{\frac{3}{2}} - 14$ A16State $y = 8x^{\frac{3}{2}} - 14$ State $y = 8x^{\frac{3}{2}} - 14$ aef, as long as single power of x | | $\theta = 66.4^{\circ}$ | A1 3 | $\mathbf{B} \text{Obtain 66.4}^{0}$ |
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| $y = 8x^{\frac{3}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{3}{2}} + c$ $\Rightarrow c = -14$ Hence $y = 8x^{\frac{3}{2}} - 14$ $A1\sqrt{$ A1 $A1\sqrt{$ A1 $A1\sqrt{$ A1 $A1\sqrt{$ A1 $A1\sqrt{$ A1} | 5 | $\int 12x^{\frac{1}{2}} dx = 8x^{\frac{3}{2}}$ | M1 | Attempt to integrate |
| $y = 8x^{\frac{3}{2}} + c \Rightarrow 50 = 8 \times 4^{\frac{3}{2}} + c$ $\Rightarrow c = -14$ Hence $y = 8x^{\frac{3}{2}} - 14$ A1 Obtain $8x^{\frac{2}{2}}$, with or without $+ c$ Use (4, 50) to find c Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only A1 Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only A1 Obtain $c = 8x^{\frac{3}{2}} - 14$ A1 Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only A1 Obtain $c = 8x^{\frac{3}{2}} - 14$ Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only A1 Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only Obtain $c = -14$, following | | | A1√ | Obtain correct, unsimplified, integral following their $f(x)$ |
| $y = 8x^{\frac{1}{2}} + c \Longrightarrow 50 = 8 \times 4^{\frac{1}{2}} + c$ $\Rightarrow c = -14$ Hence $y = 8x^{\frac{3}{2}} - 14$ M1 Use (4, 50) to find c Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only State $y = 8x^{\frac{3}{2}} - 14$ are single power of x | | 3 3 | A1 | Obtain $8x^{\frac{1}{2}}$, with or without + c |
| $\Rightarrow c = -14$ Hence $y = 8x^{\frac{3}{2}} - 14$ A1 $$ A1 6 Bar of the formula of the | | $y = 8x^{\overline{2}} + c \Longrightarrow 50 = 8 \times 4^{\overline{2}} + c$ | M1 | Use (4, 50) to find <i>c</i> |
| Hence $y = 8x^2 - 14$ A1 6 State $y = 8x^2 - 14$ aef, as long as single power of x 6 | | $\Rightarrow c = -14$ | A1√ | Obtain $c = -14$, following $kx^{\frac{3}{2}}$ only |
| 6 | | Hence $y = 8x^2 - 14$ | A1 6 | State $y = 8x^{\frac{1}{2}} - 14$ aef, as long as single power of x |
| | | | 6 | |
| | | | | |

Mark Scheme

| | | | Mark | Total | |
|---|-------|--|------|-------|--|
| 6 | (i) | $u_1 = 7$ | B1 | | Correct u_1 |
| | () | $u_2 = 9, u_3 = 11$ | B1 | 2 | Correct u_2 and u_3 |
| | | | | | |
| | (ii) | Arithmetic Progression | B1 | 1 | Any mention of arithmetic |
| | (iii) | $\frac{1}{2}N(14 + (N-1) \times 2) = 2200$ | B1 | | Correct interpretation of sigma notation |
| | | | M1 | | Attempt sum of AP, and equate to 2200 |
| | | $N^2 + 6N - 2200 = 0$ | A1 | | Correct (unsimplified) equation |
| | | (N - 44)(N + 50) = 0 | M1 | | Attempt to solve 3 term quadratic in N |
| | | hence $N = 44$ | A1 | 5 | Obtain $N = 44$ only $(N = 44$ www is full marks) |
| | | | | | |
| | | | | 8 | |
| 7 | (i) | Some of the area is below the <i>x</i> -axis | B1 | 1 | Refer to area / curve below <i>x</i> -axis or 'negative |
| | (ii) | | M1 | | Attempt integration with any one term correct |
| | (11) | | A1 | | Obtain $\frac{1}{3}x^3 - \frac{3}{2}x^2$ |
| | | $\left[\frac{1}{3}x^3 - \frac{3}{2}x^2\right]_0^3 = \left(9 - \frac{27}{2}\right) - \left(0 - 0\right)$ | M1 | | Use limits 3 (and 0) – correct order / subtraction |
| | | $= -4\frac{1}{2}$ | A1 | | Obtain (-)4 ¹ / ₂ |
| | | $\left[\frac{1}{3}x^3 - \frac{3}{2}x^2\right]_3^5 = \left(\frac{125}{3} - \frac{75}{2}\right) - \left(9 - \frac{27}{2}\right)$ | M1 | | Use limits 5 and 3 – correct order / subtraction |
| | | $=8\frac{2}{3}$ | A1 | | Obtain $8^2/_3$ (allow 8.7 or better) |
| | | Hence total area is $13^{1}/_{6}$ | A1 | 7 | Obtain total area as $13^{1}/_{6}$, or exact equiv |
| | | | | | SD: if no longer [f(u) du then D1 for using |
| | | | | | [0, 3] and [3, 5] |
| | | | | | |
| | | | | 8 | |
| 8 | (i) | $u = 10 \times 0.8^3$ | M1 | | Attempt using ar^{n-1} |
| 0 | (1) | $u_4 = 1000.8$ = 5.12 | | 2 | Obtain 5 12 aef |
| | | 5.12 | 111 | - | obtain 5.12 act |
| | (;;) | $10(1-0.8^{20})$ | M1 | | Attempt use of correct sum formula for a CP |
| | (11) | $S_{20} = \frac{1}{1 - 0.8}$ | IVII | | Attempt use of correct sum formula for a GP |
| | | = 49.4 | A1 | 2 | Obtain 49.4 |
| | | | | | |
| | (iii) | $10 - 10(1 - 0.8^{N}) < 0.01$ | M1 | | Attempt S_{α} using a |
| | () | $\frac{1}{1-0.8} - \frac{1}{(1-0.8)} < 0.01$ | | | $1 \omega 0 \frac{1-r}{1-r}$ |
| | | | A1 | | Obtain $S_{\infty} = 50$, or unsimplified equiv |
| | | $50 - 50(1 - 0.8^N) < 0.01$ | M1 | | Link $S_{\infty} - S_N$ to 0.01 and attempt to rearrange |
| | | $0.8^N < 0.0002$ A.G. | A1 | | Show given inequality convincingly |
| | | $\log 0.8^N < \log 0.0002$ | M1 | | Introduce logarithms on both sides |
| | | $N \log 0.8 < \log 0.0002$ | M1 | | Use $\log a^b = b \log a$, and attempt to find N |
| | N > | 38.169, hence $N = 39$ | A1 | 7 | Obtain $N = 39$ only |
| | | | | | |
| | | | I | 11 | |

| | | | Mark | Fotal | |
|----|-------------|---|-----------------------------------|-------------|--|
| 9 | (i) (ii) | (90°, 2), (-90°, -2) (a) 180 - α (b) - α or α - 180 | B1 B1 B1 B1 | 2 1 1 | State at least 2 correct values State all 4 correct values (radians is B1 B0) State 180 - α State - α or α - 180 (radians or unsimplified is B1B0) |
| | (iii) | $2\sin x = 2 - 3\cos^{2} x$ $2\sin x = 2 - 3(1 - \sin^{2} x)$ $3\sin^{2} x - 2\sin x - 1 = 0$ $(3\sin x + 1)(\sin x - 1) = 0$ $\sin x = -\frac{1}{3}, \sin x = 1$ $x = -19.5^{\circ}, -161^{\circ}, 90^{\circ}$ | M1 A1 A1 A1√ A1 | 6 | Attempt use of $\cos^2 x = 1 - \sin^2 x$ Obtain $3\sin^2 x - 2\sin x - 1 = 0$ aef with no brackets Attempt to solve 3 term quadratic in sinx Obtain $x = -19.5^{\circ}$ Obtain second correct answer in range, following their x Obtain 90° (radians or extra answers is max 5 out of 6) SR: answer only (and no extras) is B1 B1 $\sqrt{B1}$ |
| | | | 1 | 10 | |
| 10 | (i) | $(2x+5)^4 = (2x)^4 + 4(2x)^3 5 + 6(2x)^2 5^2 + 4(2x) 5^3 + 5^4$ $= 16x^4 + 160x^3 + 600x^2 + 1000x + 625$ | M1* M1* A1dep A1 |)* 4 | Attempt expansion involving powers of $2x$ and 5 (at least 4 terms) Attempt coefficients of 1, 4, 6, 4, 1 Obtain two correct terms Obtain a fully correct expansion |
| | (ii) | $(2x+5)^4 - (2x-5)^4 = 320x^3 + 2000x$ | M1 A1 | 2 | Identify relevant terms (and no others) by sign change oe Obtain $320x^3 + 2000x$ cwo |
| | (iii) | $9^4 - (-1)^4 = 6560 \text{ and } 7360 - 800 = 6560 \text{ A.G.}$ $320x^3 - 1680x + 800 = 0$ $4x^3 - 21x + 10 = 0$ $(x - 2)(4x^2 + 8x - 5) = 0$ (x - 2)(2x - 1)(2x + 5) = 0 Hence $x = \frac{1}{2}, x = -\frac{21}{2}$ | B1 M1 A1√ A1 M1 A1 | 6 | Confirm root, at any point Attempt complete division by $(x - 2)$ or equiv Obtain quotient of $ax^2 + 2ax + k$, where <i>a</i> is their coeff of x^3 Obtain $(4x^2 + 8x - 5)$ (or multiple thereof) Attempt to solve quadratic Obtain $x = \frac{1}{2}$, $x = -\frac{2}{2}$ |
| | | | [1 | 12 | SR: answer only is B1 B1 |