June 2005
6664 Core Mathematics C2
Mark Scheme

Question number	Scheme	Marks
1.	$\frac{dy}{dx} = 4x - 12$ $4x - 12 = 0 \quad x = 3$ $y = -18$	B1 M1 A1ft A1 (4) **4**
	M1: Equate $\frac{dy}{dx}$ (not just y) to zero and proceed to $x = \ldots$ A1ft: Follow through only from a linear equation in x. <u>Alternative:</u> $y = 2x(x-6) \Rightarrow$ Curve crosses x-axis at 0 and 6 — B1 (By symmetry) $x = 3$ — M1 A1ft $y = -18$ — A1 <u>Alternative:</u> $(x-3)^2$ — B1 for $(x-3)^2$ seen somewhere $y = 2(x^2 - 6x) = 2\{(x-3)^2 - 9\}$ — $x = 3$ M1 for attempt to complete square and deduce $x = \ldots$ A1ft [$(x-a)^2 \Rightarrow x = a$] $y = -18$ — A1	

Question number	Scheme	Marks
2.	(a) $x\log 5 = \log 8$, $x = \frac{\log 8}{\log 5}$, $= 1.29$	M1, A1, A1 (3)
	(b) $\log_2 \frac{x+1}{x}$ (or $\log_2 7x$)	B1
	$\frac{x+1}{x} = 7$ $x = \ldots$, $\frac{1}{6}$ (Allow 0.167 or better)	M1, A1 (3)
		6
	(a) Answer only 1.29 : Full marks. Answer only, which rounds to 1.29 (e.g. 1.292): M1 A1 A0 Answer only, which rounds to 1.3 : M1 A0 A0 Trial and improvement: Award marks as for "answer only". (b) M1: Form (by legitimate log work) and solve an equation in *x*. Answer only: No marks unless verified (then full marks are available).	

Question number	Scheme	Marks
3.	(a) Attempt to evaluate f(–4) or f(4)	M1
	$f(-4) = 2(-4)^3 + (-4)^2 - 25(-4) + 12 \quad (= 128 + 16 + 100 + 12) \; = 0$, so ….. is a factor.	A1 (2)
	(b) $(x+4)(2x^2 - 7x + 3)$	M1 A1
	……...$(2x-1)(x-3)$	M1 A1 (4)
		6
	(b) First M requires $(2x^2 + ax + b),\; a \neq 0, b \neq 0$. Second M for the attempt to factorise the quadratic. <u>Alternative:</u> $(x+4)(2x^2 + ax + b) = 2x^3 + (8+a)x^2 + (4a+b)x + 4b = 0$, then compare coefficients to find <u>values</u> of a and b. [M1] $a = -7,\; b = 3$ [A1] <u>Alternative:</u> Factor theorem: Finding that $f\left(\frac{1}{2}\right) = 0, \therefore (2x-1)$ is a factor [M1, A1] n.b. Finding that $f\left(\frac{1}{2}\right) = 0, \therefore (x - \frac{1}{2})$ is a factor scores M1, A0 ,unless the factor 2 subsequently appears. Finding that $f(3) = 0, \therefore (x-3)$ is a factor [M1, A1]	

Question number	Scheme	Marks
4.	(a) $1+12px, \; +\frac{12\times 11}{2}(px)^2$	B1, B1 (2)
	(b) $12p(x) = -q(x)$ $\quad 66p^2(x^2) = 11q(x^2)$ (Equate terms, or coefficients)	M1
	$\Rightarrow \quad 66p^2 = -132p$ (Eqn. in p or q only)	M1
	$p = -2, \quad q = 24$	A1, A1 (4)
		6
	(a) Terms can be listed rather than added. First B1: Simplified form must be seen, but may be in (b). (b) First M: May still have $\binom{12}{2}$ or ${}^{12}C_2$ Second M: <u>Not</u> with $\binom{12}{2}$ or ${}^{12}C_2$. Dependent upon having p's in each term. Zero solutions must be rejected for the final A mark.	

Question number	Scheme	Marks
5.	(a) $(x+10=)$ 60 α	B1
	120 (M: $180-\alpha$ or $\pi-\alpha$)	M1
	$x = 50$ $x = 110$ (or 50.0 and 110.0) (M: Subtract 10)	M1 A1 (4)
	(b) $(2x=)$ 154.2 β Allow a.w.r.t. 154 or a.w.r.t. 2.69 (radians)	B1
	205.8 (M: $360-\beta$ or $2\pi-\beta$)	M1
	$x = 77.1$ $x = 102.9$ (M: Divide by 2)	M1 A1 (4)
		8

(a) First M: Must be subtracting from 180 <u>before</u> subtracting 10.

(b) First M: Must be subtracting from 360 <u>before</u> dividing by 2,
<u>or</u> dividing by 2 then subtracting from 180.

In each part:
Extra solutions outside 0 to 180 : Ignore.
Extra solutions between 0 and 180 : A0.

<u>Alternative for (b): (double angle formula)</u>

$1-2\sin^2 x = -0.9$	$2\sin^2 x = 1.9$	B1
	$\sin x = \sqrt{0.95}$	M1
	$x = 77.1$	
	$x = 180-77.1 = 102.9$	M1 A1

Question number	Scheme	Marks
6.	(a) Missing y values: 1.6(00) 3.394 3.2(00)	B1 B1 (2)
	(b) $(A=)\ \frac{1}{2}\times 4,\ \{(0+0)+2(1.6+2.771+3.394+3.2)\}$	B1, M1 A1ft
	= 43.86 (or a more accurate value) (or 43.9, or 44)	A1 (4)
	(c) Volume = $A \times 2 \times 60$	M1
	= 5260 (m^3) (or 5270, or 5280)	A1 (2)
		8
	(b) Answer only: No marks. (c) Answer only: Allow. (The M mark in this part can be "implied").	

Question number	Scheme	Marks
7.	(a) $\frac{\sin x}{8} = \frac{\sin 0.5}{7}$ or $\frac{8}{\sin x} = \frac{7}{\sin 0.5}$, $\sin x = \frac{8 \sin 0.5}{7}$	M1 A1ft
	$\sin x = 0.548$	A1 (3)
	(b) $x = 0.58$ (α) (This mark may be earned in (a)).	B1
	$\pi - \alpha = 2.56$	M1 A1ft (3)
		6
	(a) M: Sine rule attempt (sides/angles possibly the "wrong way round"). A1ft: follow through from sides/angles are the "wrong way round". <u>Too many d.p. given:</u> Maximum 1 mark penalty in the complete question. (Deduct on first occurrence).	

Question number	Scheme	Marks	
8.	(a) Centre (5, 0) (or $x = 5$, $y = 0$)	B1 B1	(2)
	(b) $(x \pm a)^2 \pm b \pm 9 + (y \pm c)^2 = 0 \Rightarrow r^2 = \ldots$ or $r = \ldots$, Radius = 4	M1, A1	(2)
	(c) (1, 0), (9, 0) Allow just $x = 1$, $x = 9$	B1ft, B1ft	(2)
	(d) Gradient of $AT = -\frac{2}{7}$	B1	
	$y = -\frac{2}{7}(x - 5)$	M1 A1ft	(3)
			9
	(a) (0, 5) scores B1 B0. (d) M1: Equation of straight line through centre, <u>any</u> gradient (except 0 or ∞) (The equation can be in any form). A1ft: Follow through from centre, but gradient must be $-\frac{2}{7}$.		

Question number	Scheme	Marks
9.	(a) $(S =)\ a + ar + ... + ar^{n-1}$ "S =" not required. Addition required.	B1
	$(rS =)\ ar + ar^2 + ... + ar^n$ "rS =" not required (M: Multiply by r)	M1
	$S(1-r) = a(1-r^n)$ $S = \frac{a(1-r^n)}{1-r}$ (M: Subtract and factorise) (*)	M1 A1cso (4)
	(b) $ar^{n-1} = 35000 \times 1.04^3 = 39400$ (M: Correct a and r, with n = 3, 4 or 5).	M1 A1 (2)
	(c) $n = 20$ (Seen or implied)	B1
	$S_{20} = \frac{35000(1-1.04^{20})}{(1-1.04)}$	M1 A1ft
	(M1: Needs <u>any</u> r value, a = 35000, n =19, 20 or 21).	
	(A1ft: ft from n =19 or n =21, but r must be 1.04).	
	= 1 042 000	A1 (4)
		10
	(a) B1: At least the 3 terms shown above, and no extra terms. A1: Requires a completely correct solution. <u>Alternative for the 2 M marks</u>: M1: Multiply numerator and denominator by 1 – r. M1: Multiply out numerator convincingly, and factorise. (b) M1 can also be scored by a "year by year" method. <u>Answer only:</u> 39 400 scores full marks, 39 370 scores M1 A0. (c) M1 can also be scored by a "year by year" method, <u>with terms added</u>. In this case the B1 will be scored if the correct number of years is considered. <u>Answer only:</u> Special case: 1 042 000 scores 2 B marks, scored as 1, 0, 0, 1 (Other answers score no marks). <u>Failure to round correctly in (b) and (c):</u> Penalise once only (first occurrence).	

Question number	Scheme	Marks
10.	(a) $\int (2x + 8x^{-2} - 5)\,dx = x^2 + \frac{8x^{-1}}{-1} - 5x$	M1 A1 A1
	$\left[x^2 + \frac{8x^{-1}}{-1} - 5x\right]_1^4 = (16 - 2 - 20) - (1 - 8 - 5)$ (= 6)	M1
	$x = 1$: $y = 5$ and $x = 4$: $y = 3.5$	B1
	Area of trapezium = $\frac{1}{2}(5 + 3.5)(4 - 1)$ $(= 12.75)$	M1
	Shaded area = 12.75 – 6 = 6.75 (M: Subtract either way round)	M1 A1 (8)
	(b) $\frac{dy}{dx} = 2 - 16x^{-3}$	M1 A1
	(Increasing where) $\frac{dy}{dx} > 0$; For $x > 2$, $\frac{16}{x^3} < 2$, $\therefore \frac{dy}{dx} > 0$ (Allow ≥)	dM1; A1 (4)
		12
	(a) Integration: One term wrong M1 A1 A0; two terms wrong M1 A0 A0. Limits: M1 for substituting limits 4 and 1 into a changed function, and subtracting the right way round.	
	<u>Alternative:</u>	
	$x = 1$: $y = 5$ and $x = 4$: $y = 3.5$	B1
	Equation of line: $y - 5 = -\frac{1}{2}(x - 1)$ $y = \frac{11}{2} - \frac{1}{2}x$, subsequently used in integration with limits.	3rd M1
	$\left(\frac{11}{2} - \frac{1}{2}x\right) - \left(2x + \frac{8}{x^2} - 5\right)$ (M: Subtract either way round)	4th M1
	$\int \left(\frac{21}{2} - \frac{5x}{2} - 8x^{-2}\right) dx = \frac{21x}{2} - \frac{5x^2}{4} - \frac{8x^{-1}}{-1}$ (Penalise integration mistakes, not algebra for the ft marks)	1st M1 A1ft A1ft
	$\left[\frac{21x}{2} - \frac{5x^2}{4} - \frac{8x^{-1}}{-1}\right]_1^4 = (42 - 20 + 2) - \left(\frac{21}{2} - \frac{5}{4} + 8\right)$ (M: Right way round)	2nd M1
	Shaded area = 6.75	A1
	(The follow through marks are for the subtracted version, and again deduct an accuracy mark for a wrong term: One wrong M1 A1 A0; two wrong M1 A0 A0.)	
	<u>Alternative for the last 2 marks in (b):</u> M1: Show that $x = 2$ is a minimum, using, e.g., 2nd derivative. A1: Conclusion showing understanding of "increasing", with accurate working.	