Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	6	6	4	/	0	1	Signature	

Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Advanced Subsidiary

Monday 11 January 2010 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

Materials required for examination	**Items included with question papers**
Mathematical Formulae (Pink or Green)	Nil

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer to each question in the space following the question.
When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 9 questions in this question paper. The total mark for this paper is 75.
There are 24 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. Find the first 3 terms, in ascending powers of x, of the binomial expansion of

$$(3 - x)^6$$

and simplify each term.

(4)

Q1

(Total 4 marks)

edexcel

January 2010
Core Mathematics C2 6664
Mark Scheme

Question Number	Scheme	Marks
Q1	$\left[(3-x)^6=\right]3^6+3^5\times 6\times(-x)+3^4\times\binom{6}{2}\times(-x)^2$ $=729,\quad -1458x,\quad +1215x^2$	M1 B1,A1, A1 **[4]**
Notes	**M1** for <u>either</u> the x term <u>or</u> the x^2 term. Requires <u>correct</u> binomial coefficient in any form with the correct power of x – condone lack of negative sign and wrong power of 3. This mark may be given if no working is shown, but one of the terms including x is correct. Allow $\frac{6}{1}$, or $\frac{6}{2}$ (must have a power of 3, even if only power 1) First term must be 729 for **B1**, (writing just 3^6 is **B0)** can isw if numbers added to this constant later. Can allow 729(1… Term must be simplified to –1458x for **A1cao.** The x is required for this mark. **Final A1**is c.a.o and needs to be $+1215x^2$ (can follow omission of negative sign in working) Descending powers of x would be $x^6+3\times 6\times(-x)^5+3^2\times\binom{6}{4}\times(-x)^4+..$ i.e. $x^6-18x^5+135x^4+..$ This is M1B1A0A0 if completely "correct" or M1 B0A0A0 for <u>correct</u> binomial coefficient in any form with the correct power of x as before	
Alternative	**NB Alternative method:** $(3-x)^6=3^6(1+6\times(-\frac{x}{3})+\binom{6}{2}\times(-\frac{x}{3})^2+..)$ is **M1B0A0A0** – answers must be simplified to 729, $-1458x$, $+1215x^2$ for full marks (awarded as before) The mistake $(3-x)^6=3(1-\frac{x}{3})^6=3(1+6\times(-\frac{x}{3})+\times\binom{6}{2}\times(-\frac{x}{3})^2+..)$ may also be awarded **M1B0A0A0** Another mistake $3^6(1-6x+15x^2...)=729...$ would be M1B1A0A0	

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2. (a) Show that the equation

$$5\sin x = 1 + 2\cos^2 x$$

can be written in the form

$$2\sin^2 x + 5\sin x - 3 = 0$$

(2)

(b) Solve, for $0 \leqslant x < 360°$,

$$2\sin^2 x + 5\sin x - 3 = 0$$

(4)

Q2

(Total 6 marks)

Question Number	Scheme	Marks
Q2 (a)	$5\sin x = 1 + 2\left(1 - \sin^2 x\right)$	M1
	$2\sin^2 x + 5\sin x - 3 = 0$ **(*)**	A1cso (2)
(b)	$(2s-1)(s+3) = 0$ **giving** s =	M1
	$[\sin x = -3$ has no solution$]$ **so** $\sin x = \frac{1}{2}$	A1
	$\therefore \quad x = 30,\ 150$	B1, B1ft (4) **[6]**
(a)	M1 for a correct method to change $\cos^2 x$ into $\sin^2 x$ (must use $\cos^2 x = 1 - \sin^2 x$) A1 need 3 term quadratic printed in any order with =0 included	
(b)	M1 for attempt to solve given quadratic (usual rules for solving quadratics) (can use any variable here, *s*, *y*, *x*, or sin*x*) A1 requires no incorrect work seen and is for $\sin x = \frac{1}{2}$ **or** $x = \sin^{-1}\frac{1}{2}$ $y = \frac{1}{2}$ is A0 (unless followed by *x* = 30) B1 for 30 (α) not dependent on method 2nd B1 for 180 - α provided in required range (otherwise 540 - α) Extra solutions outside required range: Ignore Extra solutions inside required range: Lose final B1 Answers in radians: Lose final B1 S.C. Merely writes down two correct answers is M0A0B1B1 Or $\sin x = \frac{1}{2}$ $\therefore$ $x = 30,\ 150$ **is M1A1B1B1** Just gives one answer : 30 only is M0A0B1B0 or 150 only is M0A0B0B1 **NB** Common error is to factorise wrongly giving $(2\sin x + 1)(\sin x - 3) = 0$ $[\sin x = 3$ gives no solution$]$ $\sin x = -\frac{1}{2}$ $\Rightarrow$ $x = 210,\ 330$ This earns M1 A0 B0 B1ft Another common error is to factorise correctly $(2\sin x - 1)(\sin x + 3) = 0$ and follow this with $\sin x = \frac{1}{2}$, $\sin x = 3$ then $x = 30^\circ, 150^\circ$ This would be M1 A0 B1 B1	

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3. $$f(x) = 2x^3 + ax^2 + bx - 6$$

where a and b are constants.

When f(x) is divided by ($2x - 1$) the remainder is –5.

When f(x) is divided by ($x + 2$) there is no remainder.

(a) Find the value of a and the value of b.

(6)

(b) Factorise f(x) completely.

(3)

Question Number	Scheme	Marks
Q3 (a)	$f\left(\frac{1}{2}\right) = 2\times\frac{1}{8} + a\times\frac{1}{4} + b\times\frac{1}{2} - 6$	M1
	$f\left(\frac{1}{2}\right) = -5 \Rightarrow \frac{1}{4}a + \frac{1}{2}b = \frac{3}{4}$ or $a + 2b = 3$	A1
	$f(-2) = -16 + 4a - 2b - 6$	M1
	$f(-2) = 0 \Rightarrow 4a - 2b = 22$	A1
	Eliminating one variable from 2 linear simultaneous equations in *a* and *b*	M1
	$a = 5$ and $b = -1$	A1 (6)
(b)	$2x^3 + 5x^2 - x - 6 = (x+2)(2x^2 + x - 3)$	M1
	$= (x+2)(2x+3)(x-1)$	M1A1 (3)
	NB $(x+2)\left(x+\frac{3}{2}\right)(2x-2)$ is A0 But $2(x+2)\left(x+\frac{3}{2}\right)(x-1)$ is A1	**[9]**
(a)	1st M1 for attempting $f(\pm\frac{1}{2})$ Treat the omission of the –5 here as a slip and allow the M mark. 1st A1 for first correct equation in *a* and *b* simplified to three non zero terms (needs –5 used) s.c. If it is not simplified to three terms but is correct and is then used correctly with second equation to give correct answers- this mark can be awarded later. 2nd M1 for attempting $f(\mp 2)$ 2nd A1 for the second correct equation in *a* and *b*. simplified to three terms (needs 0 used) s.c. If it is not simplified to three terms but is correct and is then used correctly with first equation to give correct answers - this mark can be awarded later. 3rd M1 for an attempt to eliminate one variable from 2 linear simultaneous equations in *a* and *b* 3rd A1 for both $a = 5$ and $b = -1$ (Correct answers here imply previous two A marks)	
(b)	1st M1 for attempt to divide by (x+2) leading to a 3TQ beginning with correct term usually $2x^2$ 2nd M1 for attempt to factorize their quadratic provided no remainder A1 is cao and needs all three factors Ignore following work (such as a solution to a quadratic equation).	
(a)	<u>Alternative</u>; M1 for dividing by $(2x-1)$, to get $x^2 + (\frac{a+1}{2})x + \text{constant}$ **with remainder as a function of *a* and *b***, and A1 as before for equations stated in scheme . M1 for dividing by $(x+2)$, to get $2x^2 + (a-4)x...$ (No need to see remainder as it is zero and comparison of coefficients may be used) with A1 as before	
(b)	<u>Alternative</u>; M1 for finding second factor correctly by factor theorem, usually $(x - 1)$ M1 for using two known factors to find third factor , usually $(2x \pm 3)$ Then A1 for correct factorisation written as product $(x+2)(2x+3)(x-1)$	

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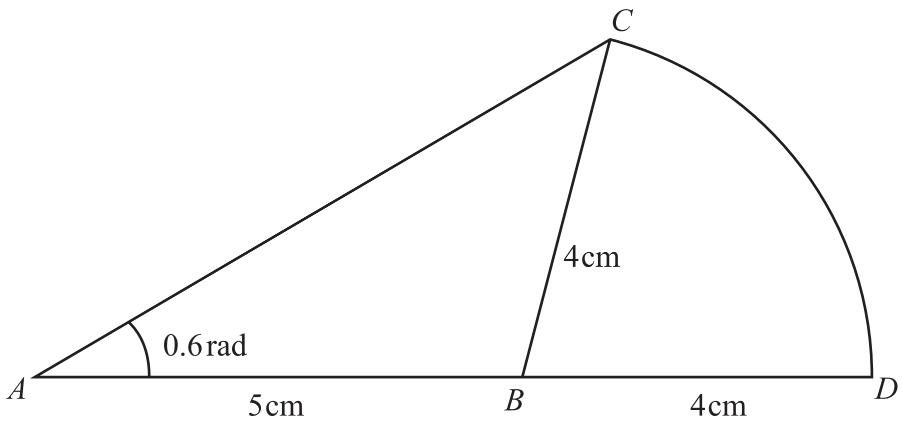

Figure 1

An emblem, as shown in Figure 1, consists of a triangle *ABC* joined to a sector *CBD* of a circle with radius 4 cm and centre *B*. The points *A*, *B* and *D* lie on a straight line with *AB* = 5 cm and *BD* = 4 cm. Angle *BAC* = 0.6 radians and *AC* is the longest side of the triangle *ABC*.

(a) Show that angle *ABC* = 1.76 radians, correct to 3 significant figures.
(4)

(b) Find the area of the emblem.
(3)

Question Number	Scheme	Marks
Q4 (a)	**Either** $\frac{\sin(A\hat{C}B)}{5} = \frac{\sin 0.6}{4}$ $\therefore\ A\hat{C}B = \arcsin(0.7058...)$ $= [0.7835..\ \text{ or }\ 2.358]$ Use angles of triangle $A\hat{B}C = \pi - 0.6 - A\hat{C}B$ (But as AC is the longest side so) $A\hat{B}C = 1.76$ **(*)**(3sf) [Allow $100.7^\circ \to 1.76$] In degrees $0.6 = 34.377^\circ$, $A\hat{C}B = 44.9^\circ$ **or** $4^2 = b^2 + 5^2 - 2 \times b \times 5\cos 0.6$ $\therefore b = \frac{10\cos 0.6 \pm \sqrt{(100\cos^2 0.6 - 36)}}{2}$ $= [6.96\ \text{ or }\ 1.29]$ Use sine / cosine rule with value for b $\sin B = \frac{\sin 0.6}{4} \times b$ or $\cos B = \frac{25 + 16 - b^2}{40}$ (But as AC is the longest side so) $A\hat{B}C = 1.76$ **(*)**(3sf)	M1 M1 M1, A1 (4)
(b)	$\left\lvert C\hat{B}D = \pi - 1.76 = 1.38 \right\rvert$ Sector area = $\frac{1}{2} \times 4^2 \times (\pi - 1.76) = [11.0 \sim 11.1]$ $\frac{1}{2} \times 4^2 \times 79.3$ is M0 Area of $\Delta ABC = \frac{1}{2} \times 5 \times 4 \times \sin(1.76) = [9.8]$ or $\frac{1}{2} \times 5 \times 4 \times \sin 101$ Required area = awrt 20.8 or 20.9 or 21.0 or gives 21 (2sf) after correct work.	M1 M1 A1 (3) **[7]**
(a) (b)	1st M1 for correct use of sine rule to find *ACB* or cosine rule to find *b* (M0 for ABC here or for use of sin x where *x* could be *ABC*) 2nd M1 for a correct expression for angle *ACB* (This mark may be implied by .7835 or by arcsin (.7058)) and needs accuracy. In second method this M1 is for correct expression for *b* – may be implied by 6.96. [Note $10\cos 0.6 \approx 8.3$] (do not need two answers) 3rd M1 for a correct method to get angle *ABC* in method (i) or sin*ABC* or cos*ABC* , in method (ii) (If sin *B* >1, can have M1A0) A1cso for correct work leading to 1.76 3sf . Do not need to see angle 0.1835 considered and rejected. 1st M1 for a correct expression for sector area or a value in the range 11.0 – 11.1 2nd M1 for a correct expression for the area of the triangle or a value of 9.8 Ignore 0.31 (working in degrees) as subsequent work. A1 for answers which round to 20.8 or 20.9 or 21.0. No need to see units.	
(a)	<u>Special case</u> If answer 1.76 is assumed then usual mark is M0 M0 M0 A0. A Fully checked method may be worth M1 M1 M0 A0. A maximum of 2 marks. The mark is either 2 or 0. <u>Either</u> **M1** for $A\hat{C}B$ is found to be 0,7816 (angles of triangle) then **M1** for checking $\frac{\sin(A\hat{C}B)}{5} = \frac{\sin 0.6}{4}$ with conclusion giving numerical answers **This gives a maximum mark of 2/4** <u>OR</u> **M1** for *b* is found to be 6.97 (cosine rule) **M1** for checking $\frac{\sin(ABC)}{b} = \frac{\sin 0.6}{4}$ with conclusion giving numerical answers **This gives a maximum mark of 2/4** Candidates making this assumption need a complete method. They cannot earn M1M0. So the score will be 0 or 2 for part (a). Circular arguments earn 0/4.	

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5. (a) Find the positive value of x such that

$$\log_x 64 = 2$$

(2)

(b) Solve for x

$$\log_2(11 - 6x) = 2\log_2(x - 1) + 3$$

(6)

Question Number	Scheme	Marks
Q5 (a)	$\log_x 64 = 2 \quad \Rightarrow \quad 64 = x^2$	M1
	So $x = 8$	A1 (2)
(b)	$\log_2(11-6x) = \log_2(x-1)^2 + 3$	M1
	$\log_2\left[\dfrac{11-6x}{(x-1)^2}\right] = 3$	M1
	$\dfrac{11-6x}{(x-1)^2} = 2^3$	M1
	$\{11-6x = 8(x^2-2x+1)\}$ and so $0 = 8x^2 - 10x - 3$	A1
	$0 = (4x+1)(2x-3) \quad \Rightarrow x = \ldots$	dM1
	$x = \dfrac{3}{2}, \left[-\dfrac{1}{4}\right]$	A1 (6)
		[8]
(a)	M1 for getting out of logs A1 Do not need to see x = -8 appear and get rejected. Ignore x = -8 as extra solution. x= 8 with no working is M1 A1	
(b)	1st M1 for using the $n\log x$ rule 2nd M1 for using the log$x$ - log$y$ rule or the log$x$ + log$y$ rule as appropriate 3rd M1 for using 2 to the power– need to see 2^3 or 8 (May see $3 = \log_2 8$ used) **If all three M marks have been earned and logs are still present** in equation **do not give** final M1. So solution stopping at $\log_2\left[\dfrac{11-6x}{(x-1)^2}\right] = \log_2 8$ would earn M1M1M0 1st A1 for a correct 3TQ 4th dependent M1 for attempt to solve or factorize their 3TQ to obtain x =… (mark depends on three previous M marks) 2nd A1 for 1.5 (ignore -0.25) s.c 1.5 only – no working – is 0 marks	
(a)	<u>Alternatives</u> Change base : (i) $\dfrac{\log_2 64}{\log_2 x} = 2$, so $\log_2 x = 3$ and $x = 2^3$, is M1 or (ii) $\dfrac{\log_{10} 64}{\log_{10} x} = 2$, $\log x = \frac{1}{2}\log 64$ so $x = 64^{\frac{1}{2}}$ is M1 then x = 8 is A1 **BUT** $\log x = 0.903$ so x = 8 is M1A0 (loses accuracy mark) (iii) $\log_{64} x = \frac{1}{2}$ so $x = 64^{\frac{1}{2}}$ is M1 then x = 8 is A1	

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6. A car was purchased for £18 000 on 1st January.
On 1st January each following year, the value of the car is 80% of its value on 1st January in the previous year.

(a) Show that the value of the car exactly 3 years after it was purchased is £9216.
(1)

The value of the car falls below £1000 for the first time n years after it was purchased.

(b) Find the value of n.
(3)

An insurance company has a scheme to cover the maintenance of the car.
The cost is £200 for the first year, and for every following year the cost increases by 12% so that for the 3rd year the cost of the scheme is £250.88

(c) Find the cost of the scheme for the 5th year, giving your answer to the nearest penny.
(2)

(d) Find the total cost of the insurance scheme for the first 15 years.
(3)

Question Number	Scheme	Marks
Q6 (a)	$18000\times(0.8)^3 \quad = £9216$ * [may see $\frac{4}{5}$ or 80% or equivalent].	B1cso (1)
(b)	$18000\times(0.8)^n < 1000$	M1
	$n\log(0.8) < \log\left(\frac{1}{18}\right)$	M1
	$n > \dfrac{\log\left(\frac{1}{18}\right)}{\log(0.8)} = 12.952....$ so n = 13.	A1 cso (3)
(c)	$u_5 = 200\times(1.12)^4,$ = £314.70 or £314.71	M1, A1 (2)
(d)	$S_{15} = \dfrac{200(1.12^{15}-1)}{1.12-1}$ or $\dfrac{200(1-1.12^{15})}{1-1.12}$, = 7455.94….. awrt £7460	M1A1, A1 (3) **[9]**
(a)	B1 NB Answer is printed **so need working**. May see as above or $\times 0.8$ in three steps giving 14400, 11520, 9216. Do not need to see £ sign but should see 9216 .	
(b)	1st M1 for an attempt to use nth term and 1000. Allow n or n – 1 and allow > or = 2nd M1 for use of logs to find n Allow n or n – 1 and allow > or = A1 Need n = 13 This is an accuracy mark and must follow award of both M marks but should not follow incorrect work using n – 1 for example. Condone slips in inequality signs here.	
(c)	M1 for use of their a and r in formula for 5th term of GP A1 cao need one of these answers – answer can imply method here NB 314.7 – A0	
(d)	M1 for use of sum to 15 terms of GP using their a and their r (allow if formula stated correctly and one error in substitution, but must use n not n - 1) 1st A1 for a fully correct expression (not evaluated)	
(b)	Alternative Methods Trial and Improvement See 989.56 (or 989 or 990) identified with 12, 13 or 14 years for **first M1** See 1236.95 (or 1236 or 1237) identified with 11, 12 or 13 years for second **M1** Then n = 13 is **A1 (needs both Ms)** **Special case** $18000\times(0.8)^n < 1000$ so n = 13 as 989.56<1000 is M1M0A0 (not discounted n = 12)	
(c)	May see the terms 224, 250.88, 280.99, 314.71 with a small slip for M1 A0, or done accurately for M1A1	
(d)	Adds 15 terms 200 + 224 + 250.88+… + (977.42) **M1** Seeing 977… is **A1** Obtains answer 7455.94 **A1** or awrt £7460 NOT 7450	

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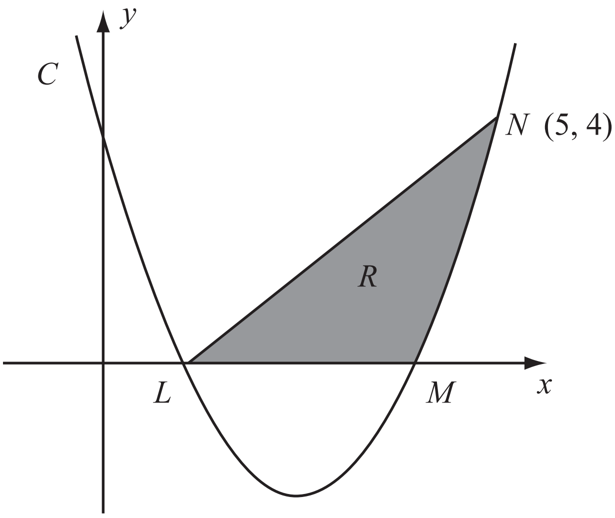

Figure 2

The curve C has equation $y = x^2 - 5x + 4$. It cuts the x-axis at the points L and M as shown in Figure 2.

(a) Find the coordinates of the point L and the point M.
(2)

(b) Show that the point N (5, 4) lies on C.
(1)

(c) Find $\int (x^2 - 5x + 4)\, dx$.
(2)

The finite region R is bounded by LN, LM and the curve C as shown in Figure 2.

(d) Use your answer to part (c) to find the exact value of the area of R.
(5)

Question Number	Scheme	Marks
Q7 (a)	**Puts** $y = 0$ and attempts to solve quadratic e.g. $(x-4)(x-1)=0$ Points are (1,0) and (4, 0)	M1 A1 (2)
(b)	$x = 5$ gives $y = 25 - 25 + 4$ and so (5, 4) lies on the curve	B1cso (1)
(c)	$\int (x^2 - 5x + 4)\,dx = \frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x \quad (+c)$	M1A1 (2)
(d)	Area of triangle = $\frac{1}{2}\times 4\times 4 = 8$ or $\int (x-1)\,dx = \frac{1}{2}x^2 - x$ with limits 1 and 5 to give 8	B1
	Area under the curve = $\int_4^5 \quad \frac{1}{3}\times 5^3 - \frac{5}{2}\times 5^2 + 4\times 5 \quad \left[= -\frac{5}{6}\right]$	M1
	$\frac{1}{3}\times 4^3 - \frac{5}{2}\times 4^2 + 4\times 4 \quad \left[= -\frac{8}{3}\right]$	M1
	$\int_4^5 = -\frac{5}{6} - -\frac{8}{3} = \frac{11}{6}$ or equivalent (allow 1.83 or 1.8 here)	A1 cao
	Area of R = $8 - \frac{11}{6} = 6\frac{1}{6}$ or $\frac{37}{6}$ or $6.1\dot{6}$ (not 6.17)	A1 cao (5)
		[10]
(a)	M1 for attempt to find L and M A1 Accept $x = 1$ and $x = 4$, then isw or accept L =(1,0) , M = (4,0) Do not accept L = 1, M = 4 nor (0 , 1), (0 , 4) (unless subsequent work) Do not need to distinguish L and M. Answers imply M1A1.	
(b)	See substitution, working should be shown, need conclusion which could be just y = 4 or a tick. Allow y = 25 - 25 + 4 = 4 But not 25 - 25 + 4 = 4. ($y = 4$ may appear at start) Usually 0 = 0 or 4 = 4 is B0	
(c)	M1 for attempt to integrate $x^2 \to kx^3, x \to kx^2$ or $4 \to 4x$ A1 for correct integration of all three terms (do not need constant) isw. Mark correct work when seen. So e.g. $\frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x$ is A1 then $2x^3 - 15x^2 + 24x$ would be ignored as subsequent work.	
(d)	B1 for this triangle only (not triangle LMN) 1st M1 for substituting 5 into their changed function 2nd M1 for substituting 4 into their changed function	
(d)	Alternative method: $\int_1^5 (x-1) - (x^2 - 5x + 4)dx + \int_1^4 x^2 - 5x + 4dx$ can lead to correct answer Constructs $\int_1^5 (x-1) - (x^2 - 5x + 4)dx$ is B1 M1 for substituting 5 and 1 and subtracting in first integral M1 for substituting 4 and 1 and subtracting in second integral A1 for answer to first integral i.e. $\frac{32}{3}$ (allow 10.7) and A1 for final answer as before..	

(d)	Another alternative $\int_4^5 (x-1)-(x^2-5x+4)\mathrm{d}x + \textit{area of triangle LMP}$ Constructs $\int_4^5 (x-1)-(x^2-5x+4)\mathrm{d}x$ is B1 M1 for substituting 5 and 4 and subtracting in first integral M1 for complete method to find area of triangle (4.5) A1 for answer to first integral i.e. $\frac{5}{3}$ and A1 for final answer as before.
(d)	Could also use $\int_4^5 (4x-16)-(x^2-5x+4)\mathrm{d}x + \textit{area of triangle LMN}$ Similar scheme to previous one. Triangle has area 6 A1 for finding Integral has value $\frac{1}{6}$ and A1 for final answer as before.

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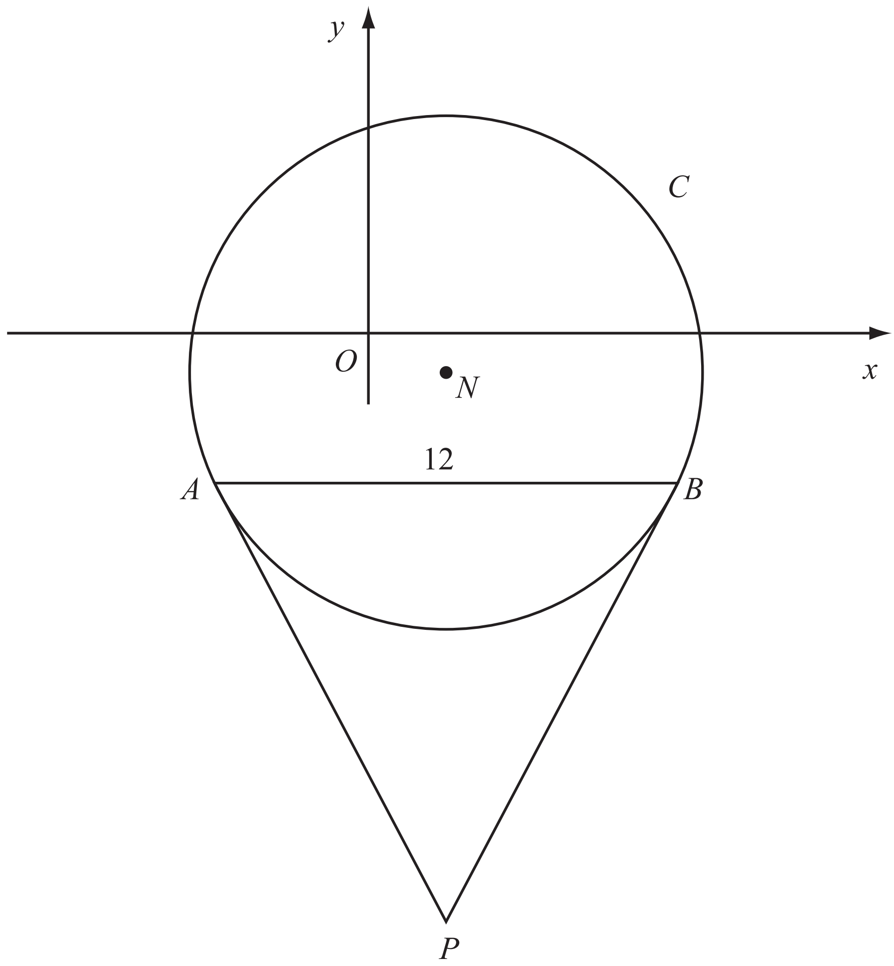

Figure 3

Figure 3 shows a sketch of the circle *C* with centre *N* and equation

$$(x-2)^2 + (y+1)^2 = \frac{169}{4}$$

(a) Write down the coordinates of *N*.

(2)

(b) Find the radius of *C*.

(1)

The chord *AB* of *C* is parallel to the *x*-axis, lies below the *x*-axis and is of length 12 units as shown in Figure 3.

(c) Find the coordinates of *A* and the coordinates of *B*.

(5)

(d) Show that angle *ANB* = 134.8°, to the nearest 0.1 of a degree.

(2)

The tangents to *C* at the points *A* and *B* meet at the point *P*.

(e) Find the length *AP*, giving your answer to 3 significant figures.

(2)

Question Number	Scheme	Marks
Q8 (a)	$N\,(2, -1)$	B1, B1 (2)
(b)	$r = \sqrt{\frac{169}{4}} = \frac{13}{2} = 6.5$	B1 (1)
(c)	Complete Method to find x coordinates, $x_2 - x_1 = 12$ and $\frac{x_1 + x_2}{2} = 2$ then solve	M1
	To obtain $x_1 = -4$, $x_2 = 8$	A1ft A1ft
	Complete Method to find y coordinates, using equation of circle or Pythagoras i.e. let d be the distance below N of A *then* $d^2 = 6.5^2 - 6^2 \Rightarrow d = 2.5 \Rightarrow y = ..$	M1
	So $y_2 = y_1 = -3.5$	A1 (5)
(d)	Let $A\hat{N}B = 2\theta \Rightarrow \sin\theta = \frac{6}{"6.5"} \Rightarrow \theta = (67.38)...$	M1
	So angle ANB is 134.8 *	A1 (2)
(e)	AP is perpendicular to AN so using triangle ANP $\tan\theta = \frac{AP}{"6.5"}$	M1
	Therefore $AP = 15.6$	A1cao (2)
		[12]
(a) (b)	B1 for 2 (α) , B1 for –1 B1 for 6.5 o.e.	
(c)	1st M1 for finding x coordinates – may be awarded if either x co-ord is correct A1ft,A1ft are for $\alpha - 6$ and $\alpha + 6$ if x coordinate of N is α 2nd M1 for a method to find y coordinates – may be given if y co-ordinate is correct A marks is for –3.5 only.	
(d)	M1 for a full method to find θ or angle ANB (eg sine rule or cosine rule directly or finding another angle and using angles of triangle.) **ft their 6.5 from radius or wrong *y*.** (cos ANB = $\frac{"6.5"^2 + "6.5"^2 - 12^2}{2 \times "6.5" \times "6.5"}$ =-0.704) A1 is a printed answer and must be 134.8 – do not accept 134.76.	
(e)	M1 for a full method to find AP Alternative Methods N.B. May use triangle AXP where X is the mid point of AB. Or may use triangle ABP. From circle theorems may use angle BAP = 67.38 or some variation. Eg $\frac{AP}{\sin 67.4} = \frac{12}{\sin 45.2}$, $AP = \frac{6}{\sin 22.6}$ or $AP = \frac{6}{\cos 67.4}$ are each worth M1	

Leave blank

9. The curve C has equation $y = 12\sqrt{(x)} - x^{\frac{3}{2}} - 10, \quad x > 0$

(a) Use calculus to find the coordinates of the turning point on C.

(7)

(b) Find $\frac{d^2y}{dx^2}$.

(2)

(c) State the nature of the turning point.

(1)

Question Number	Scheme	Marks
Q9 (a)	$\left[y = 12x^{\frac{1}{2}} - x^{\frac{3}{2}} - 10\right]$	
	$[y' =]$ $6x^{-\frac{1}{2}} - \frac{3}{2}x^{\frac{1}{2}}$	M1 A1
	Puts their $\frac{6}{x^{\frac{1}{2}}} - \frac{3}{2}x^{\frac{1}{2}} = 0$	M1
	So $x =$ $, \frac{12}{3} = 4$ (If $x = 0$ appears also as solution then lose A1)	M1, A1
	$x = 4, \Rightarrow y = 12\times 2 - 4^{\frac{3}{2}} - 10$, so $y = 6$	dM1,A1 (7)
(b)	$y'' = -3x^{-\frac{3}{2}} - \frac{3}{4}x^{-\frac{1}{2}}$	M1A1 (2)
(c)	[Since x >0] It is a maximum	B1 (1) **[10]**
(a)	1st M1 for an attempt to differentiate a fractional power $x^n \to x^{n-1}$ A1 a.e.f – can be unsimplified 2nd M1 for forming a suitable equation using their y' =0 3rd M1 for correct processing of fractional powers leading to x = … (Can be implied by x = 4) A1 is for x = 4 only. If x = 0 also seen and not discarded they lose this mark only. 4th M1 for substituting their value of x back into y to find y value. Dependent on three previous M marks. Must see evidence of the substitution with attempt at fractional powers to give M1A0, but y = 6 can imply M1A1	
(b)	M1 for differentiating their y' again A1 should be simplified	
(c)	B1 . Clear conclusion needed and must follow correct y'' It is dependent on previous A mark (Do not need to have found x earlier). (Treat parts (a),(b) and (c) together for award of marks)	