Paper collated from year	2008
Content	Pure Chapters 1-13
Marks	100
Time	2 hours

1. Find the equation of the line passing through A(−1, 1) and B (3, 9). [3]

MEI C1 June 2008 Q-12(i)

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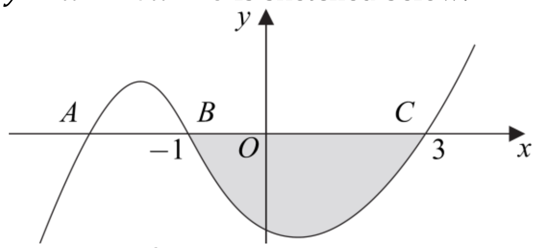
2. The curve with equation $y = x^3 - 7x - 6$ is sketched below. [3]



Find the gradient of the curve $y = x^3 - 7x - 6$ at the point B(-1, 0).

AQA C1 January 2008 Q-6 (iv)

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3. The polynomial $p(x)$ is given by $p(x) = x^3 + x^2 - 8x - 12$.

(a) Use the Factor Theorem to show that $x + 2$ is a factor of $p(x)$. [2]

(b) Express $p(x)$ as the product of linear factors. [2]

(c) Sketch the graph of $y = x^3 + x^2 - 8x - 12$, indicating the values of x where the curve touches or crosses the x-axis. [3]

AQA C1 June 2008 Q-6

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4. (a) Find the first 4 terms of the expansion of $\left(1+\frac{x}{2}\right)^{10}$ in ascending powers of x, giving each term in its simplest form. [4]

(b) Use your expansion to estimate the value of $(1.005)^{10}$, giving your answer to 5 decimal places. [3]

Edexcel C2 January 2008 Q-3

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5. Given that point A has the position vector 4**i** + 7**j** and point B has the position vector 10**i** + q**j**, where q is a constant, given that $|\overline{AB}| = 2\sqrt{13}$, find the two possible values of q showing detailed reasoning in your working. [5]

Unit Test 5: Vectors Q-5

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6. The quadratic equation $(k+1)x^2 + 4kx + 9 = 0$ has real roots.

(a) Show that $4k^2 - 9k - 9 \geq 0$. [3]

(b) Hence find the possible values of k. Write your answer using set notation. [4]

AQA C1 June 2008 Q-8

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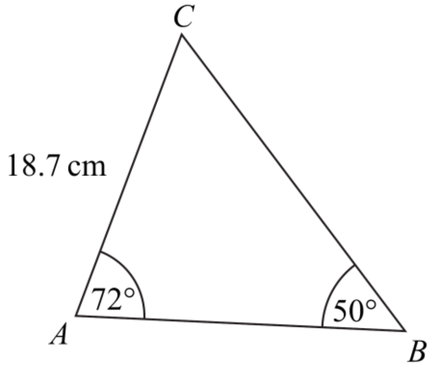
7. Differentiate $6x^2 + 1$ from first principles with respect to x. [4]

crashMATHS practice paper1 SetB Q-5

8. The diagram shows a triangle ABC. The length of AC is 18.7 cm, and the sizes of angles BAC and ABC are 72° and 50° respectively.



(a) Show that the length of BC = 23.2 cm, correct to the nearest 0.1 cm. [3]

(b) Calculate the area of triangle ABC, giving your answer to the nearest cm^2. [3]

AQA C2 January 2008 Q-3

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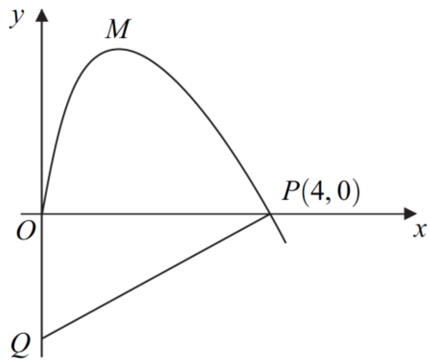
9. A curve, drawn from the origin O, crosses the x-axis at the point P(4, 0) .
The normal to the curve at P meets the y-axis at the point Q, as shown in the diagram.



The curve, defined for $x \geq 0$, has equation

$$y = 4x^{\frac{1}{2}} - x^{\frac{3}{2}}$$

(a) (i) Find $\frac{dy}{dx}$. [3]

(ii) Find an equation of the normal to the curve at P (4, 0) [3]

(b) (i) Find $\int 4x^{\frac{1}{2}} - x^{\frac{3}{2}}\, dx$ [3]

(ii) Find the total area of the region bounded by the curve and the lines PQ and QO. [3]

AQA C2 January 2008 Q-5

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10. (a) Sketch the graph of $y = 3^x$, stating the coordinates of the point where the graph crosses the y-axis [2]

(b) Describe a single geometrical transformation that maps the graph of $y = 3^x$: onto the graph of $y = 3^{x+1}$ [2]

(c) (i) Using the substitution $Y = 3^x$, show that the equation [2]

$$9^x - 3^{x+1} + 2 = 0$$

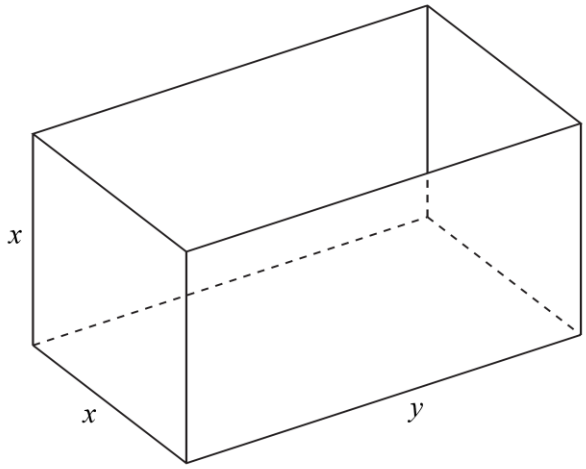
can be written as

$$(Y - 1)(Y - 2) = 0$$

(ii) Hence show that the equation $9^x - 3^{x+1} + 2 = 0$ has a solution $x = 0$ and, by using logarithms, find the other solution, giving your answer to four decimal places. [2]

AQA C2 January 2008 Q-8

11. Figure shows an open-topped water tank, in the shape of a cuboid, which is made of sheet metal. The base of the tank is a rectangle x metres by y metres. The height of the tank is x metres.



The capacity of the tank is 100 m^3.

(a) Show that the area A m^2 of the sheet metal used to make the tank is given by [4]

$$A = \frac{300}{x} + 2x^2.$$

(b) Use calculus to find the value of x for which A is stationary. [4]

(c) Prove that this value of x gives a minimum value of A. [2]

Edexcel C2 January 2008 Q-9

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12. (a) Show that the equation [2]

$$3\sin^2\theta - 2\cos^2\theta = 1$$

can be written as

$$5\sin^2\theta = 3.$$

(b) Hence solve, for $0° \leqslant \theta < 360°$, the equation [3]

$$3\sin^2\theta - 2\cos^2\theta = 1,$$

giving your answers to 1 decimal place.

Edexcel C2 January 2008 Q-4

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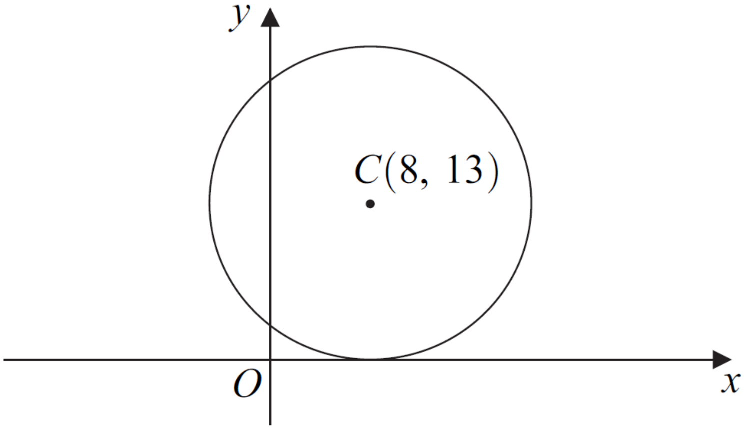
13. Use a counterexample to show that if n is an integer, $n^2 + 1$ is not necessarily prime. [2]

crashMATHS practice paper1 SetB Q-10

14. The circle S has centre C(8, 13), and touches the x-axis, as shown in the diagram.



(a) Write down an equation for S, giving your answer in the form [2]

$$(x-a)^2 + (y-b)^2 = r^2$$

(b) The point P with coordinates (3, 1) lies on the circle.

(i) Find the gradient of the straight line passing through P and C. [1]

(ii) Hence find an equation of the tangent to the circle S at the point P, giving your answer in the form $ax + by = c$, where a, b and c are integers. [4]

(iii) The point Q also lies on the circle S, and the length of PQ is 10. Calculate the shortest distance from C to the chord PQ. [3]

AQA C1 June 2008 Q-7

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15. The percentage of the adult population visiting the cinema in Great Britain has tended to increase since the 1980s. The table shows the results of surveys in various years.

Year	1986/87	1991/92	1996/97	1999/00	2000/01	2001/02
Percentage of the adult population visiting the cinema	31	44	54	56	55	57

Source: Department of National Statistics, www.statistics.gov.uk

This growth may be modelled by an equation of the form

$$P = at^b,$$

where P is the percentage of the adult population visiting the cinema, t is the number of years after the year 1985/86 and a and b are constants to be determined.

(i) Show that, according to this model, the graph of $\log_{10} P$ against $\log_{10} t$ should be a straight line of gradient b. State, in terms of a, the intercept on the vertical axis. [3]

Answer part (ii) of this question on the insert provided.

(ii) Complete the table of values on the insert, and plot $\log_{10} P$ against $\log_{10} t$. Draw by eye a line of best fit for the data. [4]

(iii) Use your graph to find the equation for P in terms of t. [4]

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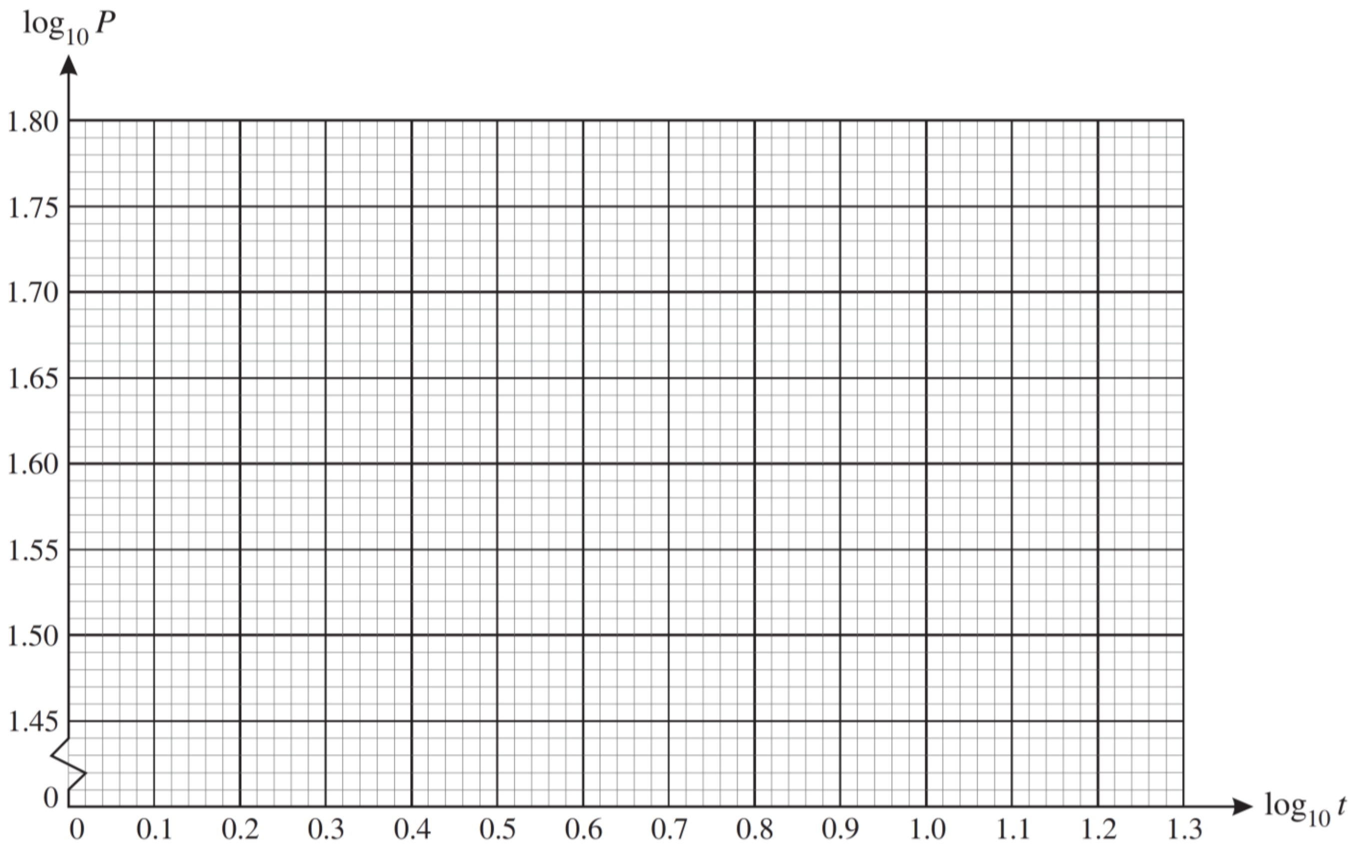
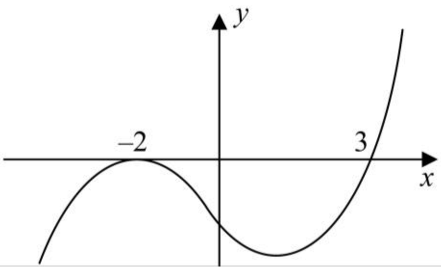
Insert for Q-15

Year	1986/87	1991/92	1996/97	1999/00	2000/01	2001/02
t	1	6	11	14	15	16
P	31	44	54	56	55	57
$\log_{10} t$			1.04			
$\log_{10} P$			1.73			



Mark scheme

1.	grad AB = $\dfrac{9-1}{3--1}$ or 2	M1		
	$y - 9 = 2(x - 3)$ or $y - 1 = 2(x + 1)$	M1		ft their m, or subst coords of A or B in y = their $m\,x + c$
	$y = 2x + 3$ o.e.	A1		or B3
2.	$\dfrac{dy}{dx} = 3x^2 - 7$	M1		One term correct
		A1		All correct (no + c etc)
	When $x = -1$, gradient = – 4	A1	3	CSO
3.	$p(-2) = -8 + 4 + 16 - 12$	M1		NOT long division
	$= 0 \Rightarrow (x+2)$ is factor	A1	2	$p(-2)$ shown $= 0$ **and** statement
	$p(x) = (x+2)(x^2 - x - 6)$	A1		Correct quadratic factor or $(x-3)$ shown to be factor by Factor Theorem
	$p(x) = (x+2)^2(x-3)$ or $(x+2)(x+2)(x-3)$	A1	3	CSO; SC: B1 for $(x+2)(x***)(x-3)$ by inspection or without working
		M1		Cubic shape (one max and one min)
		A1		Maximum at (–2,0) and through (3, 0) – at least one of these values marked
		A1	3	"correct" graph as shown (touching smoothly at –2, 3 marked and minimum to right of y-axis)

4.

$$\left(1+\frac{1}{2}x\right)^{10} = 1 + \underline{\binom{10}{1}\left(\frac{1}{2}x\right) + \binom{10}{2}\left(\frac{1}{2}x\right)^2 + \binom{10}{3}\left(\frac{1}{2}x\right)^3}$$

= 1 + $5x$; + $\dfrac{45}{4}$ (or 11.25)x^2 + $15x^3$ (coeffs need to be these, i.e, simplified)

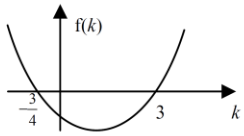
[Allow A1A0, if totally correct with unsimplified, single fraction coefficients)

$(1 + \tfrac{1}{2} \times 0.01)^{10} = 1 + 5(0.01) + (\dfrac{45}{4}$ or $11.25)(0.01)^2 + 15(0.01)^3$

= 1 + 0.05 + 0.001125 + 0.000015

= 1.05114 cao

5.		
	Correctly interprets the meaning of $\left|\overrightarrow{AB}\right| = 2\sqrt{13}$, by writing $(6)^2 + (q-7)^2 = \left(2\sqrt{13}\right)^2$ o.e.	**M1**
	Correct method to solve quadratic equation in q. For example, $(q-7)^2 = 16$ or $q^2 - 14q + 33 = 0$	**M1**
	$q - 7 = \pm 4$ or $(q-11)(q-3) = 0$ or $q = \dfrac{14 \pm \sqrt{14^2 - 4 \times 1 \times 33}}{2 \times 1}$	**M1**
	$q = 11$ or 3	**A2**

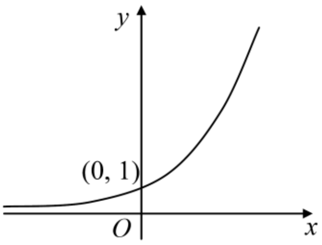
6.	**(a)**	$b^2-4ac=16k^2-36(k+1)$	M1		Condone one slip
		Real roots: discriminant $\geqslant 0$	B1		
		$\Rightarrow 16k^2-36k-36\geqslant 0$			
		$\Rightarrow 4k^2-9k-9\geqslant 0$	A1	3	AG (watch signs)
	(b)	$(4k+3)(k-3)$	M1		Or correct use of formula (unsimplified)
		critical points $(k=)\ -\frac{3}{4},\ 3$	A1		Not in a form involving surds Values may be seen in inequalities etc
		 sketch	M1		Or sign diagram
		$k\geqslant 3,\quad k\leqslant -\frac{3}{4}$	A1	4	NMS full marks

7.

$\lim\limits_{h\to 0}\left(\dfrac{6(x+h)^2+1-(6x^2+1)}{h}\right)=\lim\limits_{h\to 0}\left(\dfrac{12xh+h^2}{h}\right)$	Uses limit definition	M1
	Expands brackets	M1A1
$=\lim\limits_{h\to 0}(12x+h)$	Correct derivative	
$=12x$		A1
		(4)

8.	**(a)**	$\dfrac{BC}{\sin 72}=\dfrac{18.7}{\sin 50}$ [=24.4….]	M1		Use of the sine rule
		$BC=\dfrac{18.7\sin 72}{\sin 50}$	m1		Rearrangement
		(BC)=23.21(6..){= 23.2 to nearest 0.1cm}	A1	3	AG Need >1dp if using cm eg 23.21 or 23.22; at least 1dp if using mm.
	(b)	Angle C = 180° – (50°+72°) = 58°	M1		Valid method to find either angle C (PI eg by sin C =0.848(04..)) or side AB
		Area of triangle = 0.5×18.7×23.2..×sin C	M1		OE eg 0.5×18.7×AB×sin72°
		….. = 184 cm^2	A1	3	Accept 183.8 to 184.2 Condone missing/wrong units

9.	$\dfrac{dy}{dx}=4\times\dfrac{1}{2}x^{-\frac{1}{2}}-\dfrac{3}{2}x^{\frac{1}{2}}=2x^{-\frac{1}{2}}-\dfrac{3}{2}x^{\frac{1}{2}}$	M1 A1A1	3	A power decreased by 1 A1 for each correct term
	At $P(4,0)$, $\dfrac{dy}{dx}=\dfrac{2}{\sqrt{4}}-\dfrac{3}{2}\times 2$			Attempts $\dfrac{dy}{dx}$ when $x=4$
	$=1-3=-2$	A1		AG
	Gradient of normal = $\dfrac{1}{2}$	M1		Use of or stating $m\times m'=-1$
	Equation of normal is $y-0=m[x-4]$			m numerical; can be awarded even if $m=-2$
	$y-0=\dfrac{1}{2}(x-4)\Rightarrow\ 2y=x-4$	A1	3	ACF of the equation
	$\displaystyle\int\left(4x^{\frac{1}{2}}-x^{\frac{3}{2}}\right)dx=4\dfrac{x^{\frac{3}{2}}}{1.5}-\dfrac{x^{\frac{5}{2}}}{2.5}\ \{+c\}$	M1 A1,A1	3	One power correct Condone absence of "+c"
	$=\dfrac{8}{3}x^{\frac{3}{2}}-\dfrac{2}{5}x^{\frac{5}{2}}\{+c\}$			
	Area under curve = $4\dfrac{4^{\frac{3}{2}}}{1.5}-\dfrac{4^{\frac{5}{2}}}{2.5}-\{0\}$	M1		F(4) − {F(0)}
	Total area = F(4) + area triangle OPQ	m1		
	Total area = $\dfrac{128}{15}+4=\dfrac{188}{15}$ = 12.5 (3…)	A1	3	Accept 3 sf if clear

10.		B1		Shape (graph must clearly go below the intersection pt.). Condone if x-axis is a tangent
		B1	2	Only intersection with y-axis at (0, 1) stated/indicated … (accept 1 on y-axis as equivalent) 0
	Translation;	B1;		Must be 'Translation' or 'translate(d)' for 1st B mark
	$\begin{bmatrix} -1 \\ 0 \end{bmatrix}$	B1	2	Accept **full** equivalent to vector in words provided linked to 'translation'
	$9^x = (3^2)^x = 3^{2x} = (3^x)^2 = Y^2$; $3^{x+1} = 3^x \times 3^1 = 3Y$	M1		Justifying either $9^x = Y^2$ or $3^{x+1} = 3Y$
	$9^x - 3^{x+1} + 2 = 0 \Rightarrow Y^2 - 3Y + 2 = 0$ $\Rightarrow (Y-1)(Y-2) = 0$	A1	2	AG
	$Y = 1 \Rightarrow 3^x = 1 \Rightarrow x = 0$	B1		AG (Accept direct substitution if convinced)
	$Y = 2 \Rightarrow 3^x = 2$ $\log_{10} 3^x = \log_{10} 2$			Takes logs of both, PI by 'correct' value(s) later. or $x = \log_3 2$ seen
	$x \log_{10} 3 = \log_{10} 2$			Use of $\log 3^x = x \log 3$ or $\log_3 2 = \frac{\lg 2}{\lg 3}$ OE (PI by $\log_3 2 = 0.630$ or 0.631 or better)
	$x = \frac{\lg 2}{\lg 3} = 0.630929.... = 0.6309$ to 4dp	A1	2	Must show that logarithms have been used otherwise 0/3

11. (Total area) = $3xy + 2x^2$

(Vol:) $x^2 y = 100$ $\quad (y = \frac{100}{x^2}, xy = \frac{100}{x})$

Deriving expression for area in terms of x only

(Substitution, or clear use of, y or xy into expression for area)

(Area =) $\frac{300}{x} + 2x^2$ **AG**

$$\frac{dA}{dx} = -\frac{300}{x^2} + 4x$$

Setting $\frac{dA}{dx} = 0$ and finding a value for correct power of x, for cand. M1

[$x^3 = 75$]

$x = 4.2172$ awrt 4.22 (allow exact $\sqrt[3]{75}$)

$$\frac{d^2A}{dx^2} = \frac{600}{x^3} + 4 = \text{positive}$$ therefore minimum

Substituting found value of x into (a)

(Or finding y for found x and substituting both in $3xy + 2x^2$)

[$y = \frac{100}{4.2172^2} = 5.6228$]

Area = 106.707 awrt 107

12. (a) $3\sin^2\theta - 2\cos^2\theta = 1$

$3\sin^2\theta - 2(1 - \sin^2\theta) = 1$ (M1: Use of $\sin^2\theta + \cos^2\theta = 1$)

$3\sin^2\theta - 2 + 2\sin^2\theta = 1$

$5\sin^2\theta = 3$ cso AG

(b) $\sin^2\theta = \frac{3}{5}$, so $\sin\theta = (\pm)\sqrt{0.6}$

Attempt to solve both $\sin\theta = +$.. and $\sin\theta = -$ (may be implied by later work) M1

$\theta = 50.7685^\circ$ awrt $\theta = 50.8^\circ$ (dependent on first M1 only)

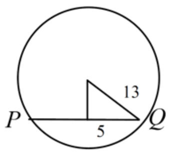
θ ($= 180^\circ - 50.7685_c{}^\circ$); $= 129.23\ldots^\circ$ awrt 129.2°

[f.t. dependent on first M and 3rd M]

$\sin\theta = -\sqrt{0.6}$

$\theta = 230.785^\circ$ and 309.23152° awrt 230.8°, 309.2° (both)

13.	Counter-example **and** shows it doesn't work	Counterexample	B1
	e.g. $n = 3$, then $n^2 + 1 = 10$ which is not prime	Shows it doesn't work	B1

14.	**(a)**	$(x-8)^2 + (y-13)^2$	B1		**Exactly this** with + and squares
		$= 13^2$	B1	2	Condone 169
	(b)(i)	grad $PC = \frac{12}{5}$	B1	1	Must simplify $\frac{-12}{-5}$
	(ii)	grad of tangent $= \frac{-1}{\text{grad } PC} = -\frac{5}{12}$	B1√		Condone $-\frac{1}{2.4}$ etc
		tangent has equation $y - 1 = -\frac{5}{12}(x-3)$	M1 A1		ft gradient but M0 if using grad *PC* Correct – but not in required final form
		$5x + 12y = 27$ OE	A1	4	MUST have integer coefficients
	(iii)	half chord $= 5$	B1		Seen or stated
		 $d^2 = (\text{their } r)^2 - 5^2$ (provided $r > 5$)	M1		Pythagoras used correctly $d^2 = 13^2 - 5^2$
		Distance = 12	A1	3	CSO

15.	i	$\log P = \log a + b \log t$ www	1		
		comparison with $y = mx + c$	1	must be with correct equation	
		intercept = $\log_{10} a$	1	condone omission of base	3
	ii	$\log t$ 0 0.78 1.15 1.18 1.20	1	accept to 2 or more dp	
		$\log P$ 1.49 1.64 1.75 1.74 1.76	1		
		plots f.t.	1		
		ruled line of best fit	1		4
	iii	gradient rounding to 0.22 or 0.23	2	M1 for y step / x-step	
		$a = 10^{1.49}$ s.o.i.	1	accept1.47 – 1.50 for intercept	
		$P = 31t^m$	1	accept answers that round to 30 – 32 , their positive m	4
		allow the form $P = 10^{0.22\log t + 1.49}$			