Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Advanced Subsidiary

Friday 13 January 2012 – Morning

Time: 1 hour 30 minutes

Materials required for examination	Items included with question papers
Mathematical Formulae (Pink)	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 or integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

Write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Core Mathematics C2), the paper reference (6664), your surname, initials and signature.

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 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.

Advice to Candidates

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

P40083A

1. A geometric series has first term $a = 360$ and common ratio $r = \frac{7}{8}$.

Giving your answers to 3 significant figures where appropriate, find

(*a*) the 20th term of the series,

(2)

(*b*) the sum of the first 20 terms of the series,

(2)

(*c*) the sum to infinity of the series.

(2)

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2. A circle C has centre $(-1, 7)$ and passes through the point $(0, 0)$. Find an equation for C.

(4)

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3. (*a*) Find the first 4 terms of the binomial expansion, in ascending powers of x, of

$$\left(1+\frac{x}{4}\right)^8,$$

giving each term in its simplest form.

(4)

(*b*) Use your expansion to estimate the value of $(1.025)^8$, giving your answer to 4 decimal places.

(3)

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4. Given that $y = 3x^2$,

(*a*) show that $\log_3 y = 1 + 2\log_3 x$.

(3)

(*b*) Hence, or otherwise, solve the equation

$$1 + 2\log_3 x = \log_3 (28x - 9).$$

(3)

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5. $$f(x) = x^3 + ax^2 + bx + 3, \text{ where } a \text{ and } b \text{ are constants.}$$

Given that when f (x) is divided by (x + 2) the remainder is 7,

(a) show that $2a - b = 6$.

(2)

Given also that when f(x) is divided by (x −1) the remainder is 4,

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

(4)

6.

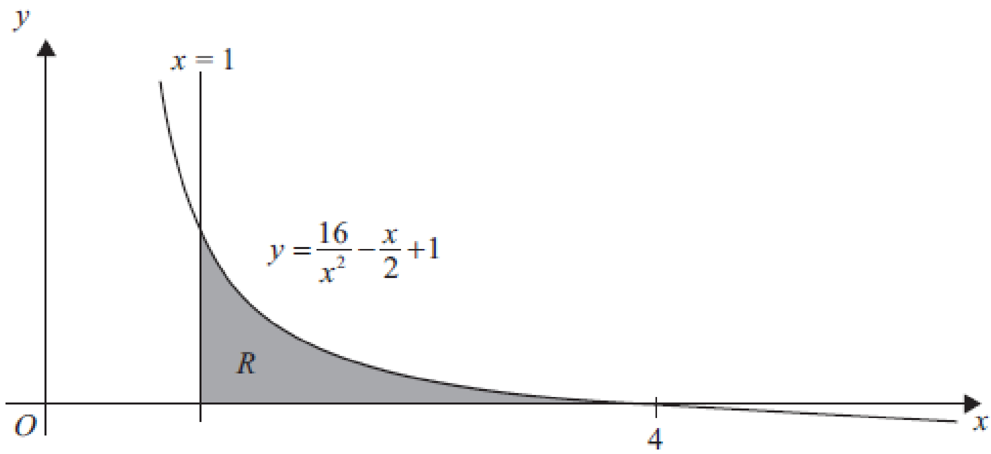

Figure 1

Figure 1 shows the graph of the curve with equation

$$y = \frac{16}{x^2} - \frac{x}{2} + 1, \qquad x > 0.$$

The finite region R, bounded by the lines $x = 1$, the x-axis and the curve, is shown shaded in Figure 1. The curve crosses the x-axis at the point (4, 0).

(a) Complete the table with the values of y corresponding to x = 2 and 2.5.

x	1	1.5	2	2.5	3	3.5	4
y	16.5	7.361			1.278	0.556	0

(2)

(b) Use the trapezium rule with all the values in the completed table to find an approximate value for the area of R, giving your answer to 2 decimal places.

(4)

(c) Use integration to find the exact value for the area of R.

(5)

7.

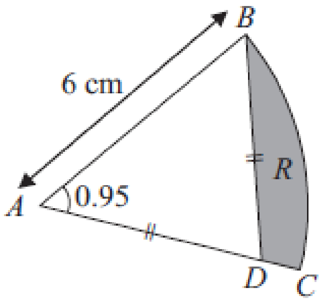

Figure 2

Figure 2 shows *ABC*, a sector of a circle of radius 6 cm with centre *A*. Given that the size of angle *BAC* is 0.95 radians, find

(*a*) the length of the arc *BC*,

(2)

(*b*) the area of the sector *ABC*.

(2)

The point *D* lies on the line *AC* and is such that *AD* = *BD*. The region *R*, shown shaded in Figure 2, is bounded by the lines *CD*, *DB* and the arc *BC*.

(*c*) Show that the length of *AD* is 5.16 cm to 3 significant figures.

(2)

Find

(*d*) the perimeter of *R*,

(2)

(*e*) the area of *R*, giving your answer to 2 significant figures.

(4)

8.

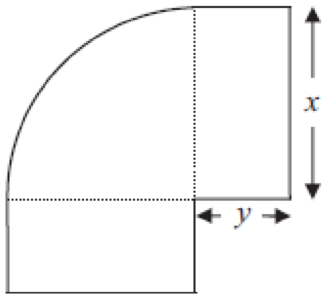

Figure 3

Figure 3 shows a flowerbed. Its shape is a quarter of a circle of radius x metres with two equal rectangles attached to it along its radii. Each rectangle has length equal to x metres and width equal to y metres.

Given that the area of the flowerbed is 4m^2,

(a) show that

$$y = \frac{16 - \pi x^2}{8x}.$$

(3)

(b) Hence show that the perimeter P metres of the flowerbed is given by the equation

$$P = \frac{8}{x} + 2x.$$

(3)

(c) Use calculus to find the minimum value of P.

(5)

(d) Find the width of each rectangle when the perimeter is a minimum.
Give your answer to the nearest centimetre.

(2)

9. (i) Find the solutions of the equation $\sin(3x - 15°) = \frac{1}{2}$, for which $0 \leq x \leq 180°$.

(6)

(ii)

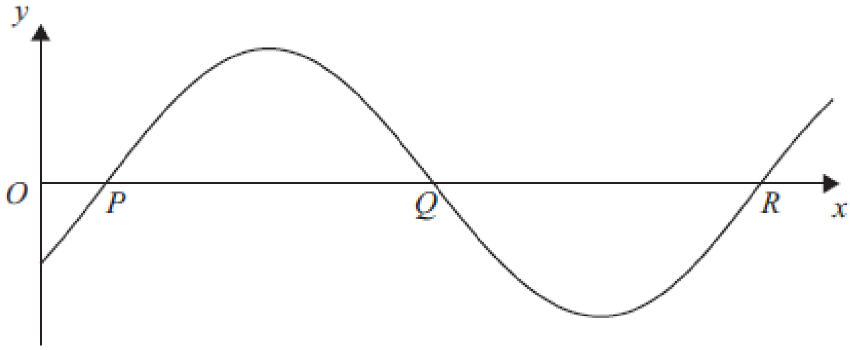

Figure 4

Figure 4 shows part of the curve with equation

$$y = \sin(ax - b), \text{ where } a > 0, \quad 0 < b < \pi.$$

The curve cuts the x-axis at the points P, Q and R as shown.

Given that the coordinates of P, Q and R are $\left(\frac{\pi}{10}, 0\right)$, $\left(\frac{3\pi}{5}, 0\right)$ and $\left(\frac{11\pi}{10}, 0\right)$ respectively, find the values of a and b.

(4)

TOTAL FOR PAPER: 75 MARKS

END

January 2012
C2 6664
Mark Scheme

Question number	Scheme	Marks
1 (a)	Uses $360\times\left(\frac{7}{8}\right)^{19}$, to obtain 28.5	M1, A1 (2)
(b)	Uses $S=\frac{360(1-(\frac{7}{8})^{20})}{1-\frac{7}{8}}$, or $S=\frac{360((\frac{7}{8})^{20}-1)}{\frac{7}{8}-1}$ to obtain 2680	M1, A1 (2)
(c)	Uses $S=\frac{360}{1-\frac{7}{8}}$, to obtain 2880	M1, A1cao (2) **6**
Notes	**(a)** **M1:** Correct use of formula with power = 19 **A1:** Accept 28.47, or 28.474 or indeed 28.47446075 **(b)** **M1:** Correct use of formula with n = 20 **A1:** Accept 2681, 2680.7, 2680.68 or 2680.679 or indeed 2680.678775 (N.B. 2680.67 or 2680.0 is **A0**) **(c)** **M1:** Correct use of formula **A1:** Accept 2880 only	
Alternative method	**Alternative to (a)** Gives **all 20 terms** 315, 275.6(25), 241.17(1875), … (1st 3 accurate)	M1
	All correct and last term as above **A1:** Accept 28.5, 28.47, or 28.474 or indeed 28.47446075	A1
	Alternative to (b) Gives **all 20 terms** 315, 275.6(25), 241.17(1875), … (1st 3 accurate) and adds	M1
	Sum correct **A1:** Accept 2680, 2681, 2680.7, 2680.68 or 2680.679 or indeed 2680.678775	A1

Question number	Scheme	Marks
2	The equation of the circle is $(x+1)^2+(y-7)^2=(r^2)$ The radius of the circle is $\sqrt{(-1)^2+7^2}=\sqrt{50}$ or $5\sqrt{2}$ or $r^2=50$ So $(x+1)^2+(y-7)^2=50$ or equivalent	M1 A1 M1 A1 (4) **4**
Notes	**M1** is for this expression on left hand side– allow *errors in sign* of 1 and 7. **A1** correct signs (just LHS) **M1** is for Pythagoras or substitution into equation of circle to give *r* or r^2 Giving this value as diameter is **M0** **A1**, cao for cartesian equation with numerical values but allow $(\sqrt{50})^2$ or $(5\sqrt{2})^2$ or any exact equivalent A correct answer implies a correct method – so answer given with no working earns all four marks for this question.	
Alternative method	Equation of circle is $x^2+y^2\pm 2x\pm 14y+c=0$ Equation of circle is $x^2+y^2+2x-14y+c=0$ Uses (0,0) to give $c=0$, **or** finds $r=\sqrt{(-1)^2+7^2}=\sqrt{50}$ or $5\sqrt{2}$ or $r^2=50$ So $x^2+y^2+2x-14y=0$ or equivalent	M1 A1 M1 A1

Question number	Scheme	Marks
3 (a).	$(1+\frac{x}{4})^8 = 1+2x+..,\quad \ldots\ldots$	B1
	$+\frac{8\times7}{2}(\frac{x}{4})^2+\frac{8\times7\times6}{2\times3}(\frac{x}{4})^3,$	M1 A1
	$= \quad +\frac{7}{4}x^2+\frac{7}{8}x^3$ or $= \quad +1.75x^2+0.875x^3$	A1 (4)
(b)	States or implies that x = 0.1	B1
	Substitutes their value of x (provided it is <1) into series obtained in (a)	M1
	i.e. 1 + 0.2 + 0.0175 + 0.000875, = 1.2184	A1 cao (3) **7**
Alternative for (b) **Special case**	Starts again and expands $(1+0.025)^8$ to 1+ 8×0.025 $+\frac{8\times7}{2}(0.025)^2+\frac{8\times7\times6}{2\times3}(0.025)^3,$ = 1.2184 (Or 1 + 1/5 + 7/400 + 7/8000 = 1.2184)	B1,M1,A1
Notes	**(a) B1** must be simplified The **method** mark **(M1)** is awarded for an attempt at Binomial to get the third and/or fourth term – need correct binomial coefficient combined with correct power of x. Ignore bracket errors or errors in powers of 4. Accept any notation for ${}^8C_2$ and ${}^8C_3$, e.g. $\binom{8}{2}$ and $\binom{8}{3}$ (unsimplified) or 28 and 56 from Pascal's triangle. (The terms may be listed without + signs) First **A1** is for two completely correct unsimplified terms **A1** needs the fully simplified $\frac{7}{4}x^2$ *and* $\frac{7}{8}x^3$. **(b) B1 –** states or uses x =0.1 or $\frac{x}{4}=\frac{1}{40}$ **M1** for substituting their value of x (0 < x <1) into expansion (e.g. 0.1 (correct) or 0.01, 0.00625 or even 0.025 but **not** 1 nor 1.025 which would earn **M0**) **A1** Should be answer printed cao (not answers which round to) and should follow correct work. **Answer with no working at all** is B0, M0, A0 States 0.1 then just writes down answer is B1 M0A0	

Question number	Scheme	Marks
4. (a)	$\log_3 3x^2 = \log_3 3 + \log_3 x^2$ or $\log y - \log x^2 = \log 3$ or $\log y - \log 3 = \log x^2$	B1
	$\log_3 x^2 = 2\log_3 x$	B1
	Using $\log_3 3 = 1$	B1 (3)
(b)	$3x^2 = 28x - 9$	M1
	Solves $3x^2 - 28x + 9 = 0$ to give $x = \frac{1}{3}$ or $x = 9$	M1 A1 (3) **6**
Notes (a)	**B1** for correct use of addition rule (or correct use of subtraction rule) **B1:** replacing $\log x^2$ by $2\log x$ – **not** $\log 3x^2$ by $2\log 3x$ this is **B0** **B1**. for replacing $\log 3$ by 1 (or use of $3^1 = 3$) If candidate has been awarded 3 marks and their proof includes an error or omission of reference to log*y* withhold the last mark. So just B1 B1 B0 These marks must be awarded for **work in part (a)** only	
(b)	**M1** for removing logs to get an equation in *x*– statement in scheme is sufficient. This needs to be accurate without any errors seen in part (b). **M1** for attempting to solve three term quadratic to give *x* = (see notes on marking quadratics) **A1** for the two correct answers – this depends on second M mark only. Candidates often begin again in part (b) and do not use part (a). If such candidates make errors in log work in part (b) they score first **M0**. The second **M** and the **A** are earned as before. It is possible to get M0M1A1 or M0M1A0.	
Alternative to (b) using *y*	Eliminates *x* to give $3y^2 - 730y + 243 = 0$ with no errors is M1 Solves quadratic to find *y*, then uses values to find *x* M1 A1 as before	

<table>
<tr><th>Question number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>5 (a)

(b)</td><td>$\mathrm{f}(-2) = -8 + 4a - 2b + 3 = 7$

so $2a - b = 6$ *

$\mathrm{f}(1) = 1 + a + b + 3 = 4$

Solve two linear equations to give a = 2 and b = -2</td><td>M1
A1
(2)

M1 A1

M1 A1
(4)

6</td></tr>
<tr><td>Notes</td><td>(a) M1 : Attempts f(± 2) = 7 or attempts long division as far as putting remainder equal to 7 (There may be sign slips)
A1 is for correct equation with remainder = 7 and for the printed answer with no errors and no wrong working between the two
(b) M1 : Attempts f(± 1) = 4 or attempts long division as far as putting remainder equal to 4
A1 is for correct equation with remainder = 4 and powers calculated correctly
M1 : Solving simultaneous equations (may be implied by correct answers). This mark may be awarded for attempts at elimination or substitution leading to values for both a and b. Errors are penalised in the accuracy mark.
A1 is cao for values of a and b and explicit values are needed.
Special case: Misreads and puts remainder as 7 again in (b). This may earn M1A0M1A0 in part (b) and will result in a maximum mark of 4/6</td><td></td></tr>
<tr><td>Long Divisions</td><td>$$\begin{array}{r|l} & x^2 + (a-2)x + (b-2a+4) \\ (x+2) & x^3 + ax^2 + bx + 3 \\ & x^3 + 2x^2 \\ & \ldots\ldots\ldots\ldots\ldots\ldots \end{array}$$ and reach their “3 - 2b + 4a - 8” = 7 M1
$$\begin{array}{r|l} & x^2 + (a+1)x + (b+a+1) \\ (x-1) & x^3 + ax^2 + bx + 3 \\ & x^3 - x^2 \\ & \ldots\ldots\ldots\ldots \end{array}$$ and reach their “3 + b + a + 1” = 4 M1
A marks as before</td><td></td></tr>
</table>

Question number	Scheme	Marks
6: (a)		

x	1	1.5	2	2.5	3	3.5	4
y	16.5	7.361	**4**	**2.31**	1.278	0.556	0

B1, B1 (2)

(b) $\frac{1}{2}\times 0.5, \quad \{(16.5+0)+2(7.361+4+2.31+1.278+0.556)\}$ — B1, M1A1ft

= 11.88 (or answers listed below in note) — A1 (4)

(c) $\int_1^4 \frac{16}{x^2}-\frac{x}{2}+1\,\mathrm{d}x = \left[-\frac{16}{x}-\frac{x^2}{4}+x\right]_1^4$ — M1 A1 A1

$=[-4-4+4]-[-16-\tfrac{1}{4}+1]$ — dM1

$= 11\tfrac{1}{4}$ or equivalent — A1 (5)

11

Notes

(a) **B1** for 4 or any correct equivalent e.g. 4.000 **B1** for 2.31 or 2.310

(b) **B1:** Need 0.25 or ½ of 0.5

M1: requires first bracket to contain first y value plus last y value (0 may be omitted or be at end) **and** second bracket to include no additional y values from those in the scheme. They may however omit one value as a slip.

N.B. Special Case - Bracketing mistake

$\frac{1}{2}\times 0.5(16.5+0)+2(7.361+4+2.31+1.278+0.556)$ scores **B1 M1 A0 A0** unless the final answer implies that the calculation has been done correctly (then full marks)

A1ft: This should be correct but ft their 4 and 2.31

A1: Accept 11.8775 or 11.878 or 11.88 only

(c) **M1** Attempt to integrate ie power increased by 1 or 1 becomes x ,

A1 two correct terms, next **A1** all three correct unsimplified (ignore +c)

(Allow $-16x^{-1}-0.25x^2+1x$ or equivalent)

d**M1** **(This cannot be earned if previous M mark has not been awarded)** Uses limits 4 and 1 in their integrated expression and subtracts (either way round)

A1 11.25 or 11 ¼ or 45/4 or equivalent (penalise negative final answer here)

Alternative Method for (b)

Separate trapezia may be used : B1 for 0.25, M1 for $\frac{1}{2}h(a+b)$ used 5 or 6 times (and A1ft all correct for their “4” and “2.31”) final A1 for 11.88 etc. as before

In part (b) Need to use trapezium rule – answer only (with no working) is 0/4 -any doubts send to review In part (c) need to see integration

Question number	Scheme	Marks
7 (a)	$r\theta = 6\times 0.95, = 5.7$ (cm)	M1, A1 (2)
(b)	$\frac{1}{2}r^2\theta = \frac{1}{2}\times 6^2\times 0.95, = 17.1\ \left(\text{cm}^2\right)$	M1, A1 (2)
(c)	Let *AD* = *x* then $\frac{x}{\sin 0.95} = \frac{6}{\sin 1.24}$ so *x* = 5.16 * OR *x* = 3 / cos 0.95 OR so *x* = 3/ sin 0.62 so *x* = 5.16 * OR $x^2 = 6^2 + x^2 - 12x\cos 0.95$ leading to *x* = , so *x* = 5.16 *	M1 A1 (2)
(d)	Perimeter = ‘5.7’+5.16 +6 – 5.16= “11.7” **or 6 + their 5.7**	M1A1 ft (2)
(e)	Area of triangle *ABD* = $\frac{1}{2}\times 6\times 5.16\times \sin 0.95$ = 12.6 or $\frac{1}{2}\times 6\times 3\times \tan 0.95$ = 12.6 (½ base x height) or $\frac{1}{2}\times 5.16\times 5.16\times \sin 1.24$ =12.6 So Area of *R* = ‘17.1’ – ‘12.6’ = 4.5	M1 A1 M1 A1 (4) **12**
Notes	(a) **M1:** Needs *θ* in radians for this formula. Could convert to degrees and use degrees formula. **A1:** Does not need units (b**) M1:** Needs *θ* in radians for this formula. Could convert to degrees and use degrees formula. **A1:** Does not need units (c) **M1:** Needs complete correct trig method to achieve *x* = May have worked in degrees, using 54.4 degrees and 71.1 degrees Using angles of triangle sum to 360degrees is not correct method so is M0 **A1:** accept answers which round to 5.16 (NB This is given answer) If the answer 5.16 is **assumed** and **verified** award M1A0 for correct work (d) **M1:** Accept answer only as implying method, or just 6 + 5.7 **A1 :** can be scored even following wrong answer to part (c) (e) **M1:** needs complete method for area of triangle *ABD* not *ABC* **A1:** Accept awrt 12.6 (If area of triangle is not evaluated or is given as 12.5 (truncated) this mark may be implied by 4.5 later) **M1:** Uses area of *R* = area of sector – area of triangle *ABD* (not *ABC*) **A1:** Answers wrt 4.5	
Alternative For part (e)	Finds area of segment **and** area of triangle *BDC* by correct methods **M1** Obtains 2.4585 **and** 2.0498 – accept answers wrt 2.5, 2.1 **A1** Uses area of segment + area of triangle *BDC* ,to obtain 4.5 (not 4.6) **M1, A1** **NB Just finding area of segment is M0**	

Question number	Scheme	Marks
8 (a)	$kr^2 + cxy = 4$ or $kr^2 + c[(x+y)^2 - x^2 - y^2] = 4$	M1
	$\frac{1}{4}\pi x^2 + 2xy = 4$	A1
	$y = \dfrac{4 - \frac{1}{4}\pi x^2}{2x} = \dfrac{16 - \pi x^2}{8x}$ *	B1 cso (3)
(b)	$P = 2x + cy + k\pi r$ where $c = 2$ or 4 and $k = ¼$ or $½$	M1
	$P = \dfrac{\pi x}{2} + 2x + 4\left(\dfrac{4 - \frac{1}{4}\pi x^2}{2x}\right)$ or $P = \dfrac{\pi x}{2} + 2x + 4\left(\dfrac{16 - \pi x^2}{8x}\right)$ o.e.	A1
	$P = \dfrac{\pi x}{2} + 2x + \dfrac{8}{x} - \dfrac{\pi x}{2}$ so $P = \dfrac{8}{x} + 2x$ *	A1 (3)
(c)	$\left(\dfrac{dP}{dx} =\right) -\dfrac{8}{x^2} + 2$	M1 A1
	$-\dfrac{8}{x^2} + 2 = 0 \Rightarrow x^2 = ..$	M1
	and so $x = 2$ o.e. (ignore extra answer x = -2)	A1
	$P = 4 + 4 = 8$ (m)	B1 (5)
(d)	$y = \dfrac{4 - \pi}{4}$, (and so width) = 21 (cm)	M1, A1 (2) **13**
Notes	(a) **M1**: Putting sum of one or two xy terms and one kr^2 term equal to 4 **(**k and c may be wrong) **A1:** For any correct form of this equation with x for radius (may be unsimplified) **B1 :** Making y the subject of their formula to give this printed answer with no errors (b) **M1** : Uses Perimeter formula of the form $2x + cy + k\pi r$ where $c = 2$ or 4 and $k = ¼$ or $½$ **A1:** Correct unsimplified formula with y substituted as shown, i.e. $c = 4$, $k = ½$, $r = x$ and $y = \dfrac{16 - \pi x^2}{8x}$ or $y = \left(\dfrac{4 - \frac{1}{4}\pi x^2}{2x}\right)$ **A1:** obtains printed answer with at least one line of correct simplification or expansion before giving printed answer or stating result has been shown or equivalent (c) **M1:** At least one power of x decreased by 1 (Allow $2x$ becomes 2) **A1:** accept any equivalent correct answer **M1:** Setting $\dfrac{dP}{dx}$ =0 and finding a value for correct power of x for candidate **A1 :** For x = 2. (This mark may be given for equivalent and may be implied by correct P) **B1:** 8 (cao) N.B. This may be awarded if seen in part (d) (d) **M1 :** Substitute x value found in (c) into equation for y from (a) (or substitute x and P into equation for P from (b)) and evaluate (may see 0.2146 and correct answer implies M1 or need to see substitution if x value was wrong.) **A1** is for 21 or 21cm or 0.21m as this is to nearest cm	

Question number	Scheme	Marks
9 (i)	$\sin(3x-15)=\frac{1}{2}$ so $3x-15=30$ (α) and x = 15 Need $3x-15=180-\alpha$ or $3x-15=540-\alpha$ Need $3x-15=180-\alpha$ and $3x-15=360+\alpha$ and $3x-15=540-\alpha$ x = 55 or 175 x = 55 , 135 , 175	M1 A1 M1 M1 A1 A1 (6)
Notes	**M1** Correct order of operation: inverse sine then linear algebra - not just 3*x*-15 = 30 (slips in linear algebra lose Accuracy mark) **A1** Obtains first solution 15 **M1** Uses either 180 – α or 540 – α, **M1** uses all three 180 – α and 360 + α and 540 – α **A1**, for one further correct solution 55 or 175, (depends only on second M1) **A1** – all 3 further correct solutions If more than 4 solutions in range, lose last **A1** Common slips: Just obtains 15 and 55, or 15 and 175 – usually M1A1M1M0A1A0 Just obtains 15 and 135 is usually M1A1M0M0A0A0 (It is easy to get this erroneously) Obtains 5, 45, 125 and 165 – usually M1A0M1M1A0A0 Obtains 25, 65, 145, (185) usually M1A0M1M1A0A0 Working in radians – lose last A1 earned for $\frac{\pi}{12}, \frac{11\pi}{36}, \frac{3\pi}{4}$ and $\frac{35\pi}{36}$ or numerical equivalents Mixed radians and degrees is usually Method marks only Methods involving no working should be sent to Review	
9 (ii)	At least one of $(\frac{a\pi}{10}-b)=\ 0$ (or $n\pi$) $(\frac{a3\pi}{5}-b)=\ \pi$ {or $(n+1)\pi$} or in degrees or $(\frac{a11\pi}{10}-b)=\ 2\pi$ {or $(n+2)\pi$} If two of **above equations** used eliminates *a* or *b* to find one or both of these or uses period property of curve to find *a* or uses other valid method to find either *a* or *b* (May see $\frac{5\pi}{10}a=\pi$ so *a* =) Obtains *a* = 2 Obtains $b=\frac{\pi}{5}$ (must be in radians)	M1 M1 A1 A1 (4)

Notes	M1: Award for $(\frac{a\pi}{10} - b) = 0$ or $\frac{a\pi}{10} = b$ BUT $\sin(\frac{a\pi}{10} - b) = 0$ is M0 M1: As described above but solving $(\frac{a\pi}{10} - b) = 0$ with $(\frac{a3\pi}{5} - b) = 0$ is M0 (It gives *a* = *b* = 0) Special cases: Can obtain full marks here for both correct answers with no working M1M1A1A1 For *a* = 2 only, with no working, award M0M1A1A0 For *b* = $\frac{\pi}{5}$ only with no working M1M0A0A1
Alternative	Some use translations and stretches to give answers. If they achieve *a=2* they earn second method and first accuracy. If they achieve correct value for *b* they earn first method and second accuracy. Common error is *a = 2* and *b* = $\frac{\pi}{10}$. This is usually M0M1A1A0 unless they have stated $(\frac{a\pi}{10} - b) = 0$ earlier in which case they earn first M1.