KAMBALA

Student Number: ________________

Trial HSC - Task 3
August 2013

Mathematics Extension 2

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
  Black pen is preferred
- Board-approved calculators may be used
- Answer questions 1 – 10 on the multiple choice answer sheet provided.
- Answer questions 11 – 16 in the booklets provided.
  Start each question in a new booklet.
- A table of standard integrals is provided at the back of this paper
- In Questions 11 – 16, show relevant mathematical reasoning and/or calculations

Total marks – 100

Section I – Pages 3 – 6
10 marks

- Attempt Questions 1 - 10
- Allow about 15 minutes for this section

Section II – Pages 7 – 14
90 marks

- Attempt Questions 11 - 16
- Allow about 2 hours 45 minutes for this section

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Section I

10 Marks
Attempt Questions 1 – 10
Allow about 15 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 10.

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1 Let $z = 3 + 2i$ and $w = 2 - i$.
What is the value of $\overline{z} + 3w$?

A. $9 + i$ B. $9 - i$ C. $9 - 3i$ D. $9 - 5i$

2 The equation $x^3 + 2xy - y^3 - 2 = 0$ defines y implicitly as a function of x.
What is the value of $\dfrac{dy}{dx}$ at the point $(1, 1)$?

A. 5 B. 1 C. $\dfrac{1}{5}$ D. -1

3 The equation $3x^3 + 2x^2 - 4x + 1 = 0$ has roots α, β and γ.
What is the value of $\dfrac{1}{\alpha^3\beta^3\gamma^3}$?

A. 27 B. -27 C. $\dfrac{1}{27}$ D. $-\dfrac{1}{27}$

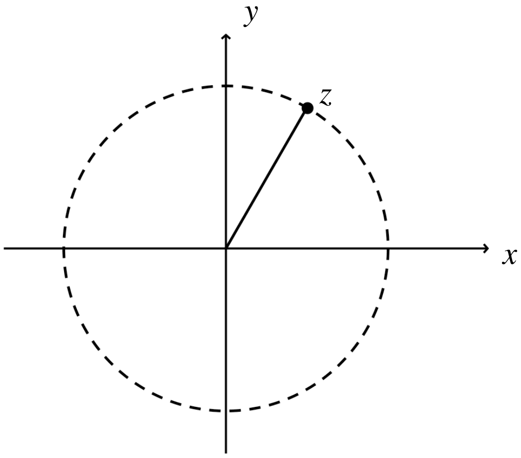
4 What is the eccentricity of the hyperbola $\dfrac{x^2}{6} - \dfrac{y^2}{10} = 1$?

A. $\dfrac{2\sqrt{10}}{5}$ B. $\dfrac{2\sqrt{6}}{3}$ C. $\dfrac{2\sqrt{3}}{3}$ D. $\dfrac{\sqrt{6}}{3}$

5 The polynomial $P(x) = 0$ has real coefficients. Three of the roots of $P(x)$ are $x = 4$, $x = 2 - i$ and $x = 1 + i$. What is the minimum degree of $P(x)$?

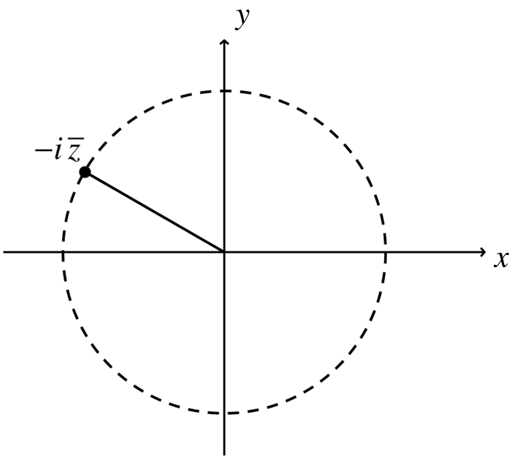
A. 3 B. 4 C. 5 D. 6

6 The complex number z is shown in the Argand diagram below.

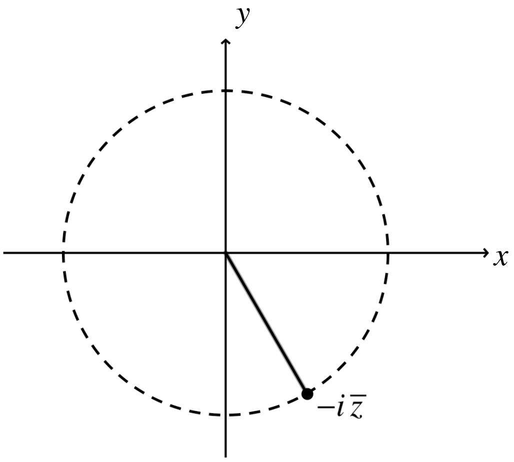


Which of the following best represents $-i\bar{z}$?

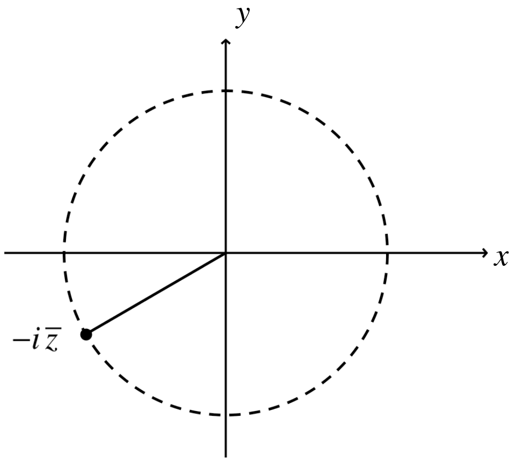
A.



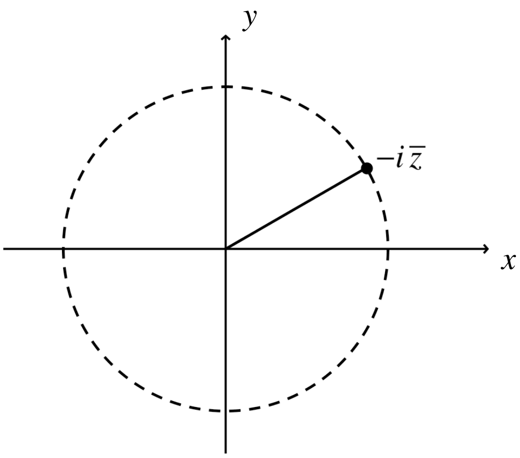
B.



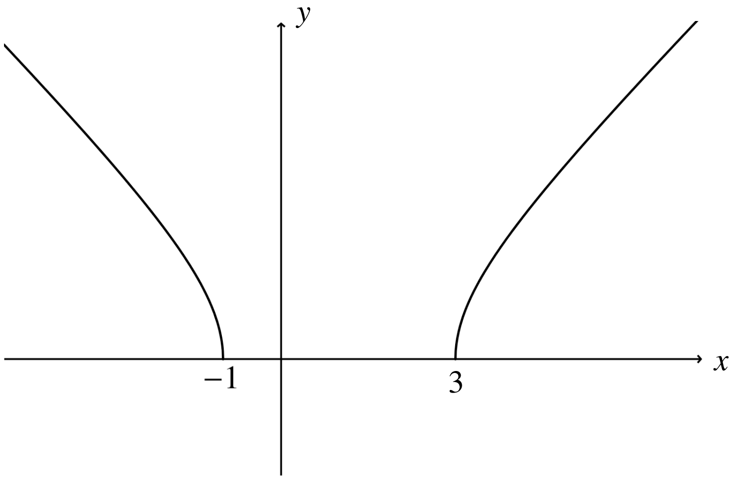
C.



D.

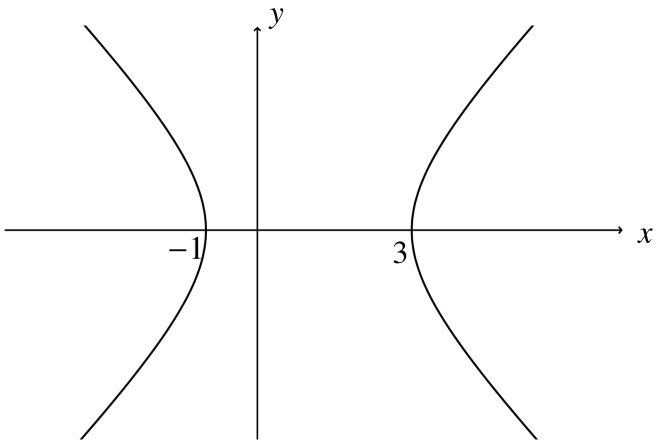


7 The graph of $y=\sqrt{f(x)}$ is shown below.

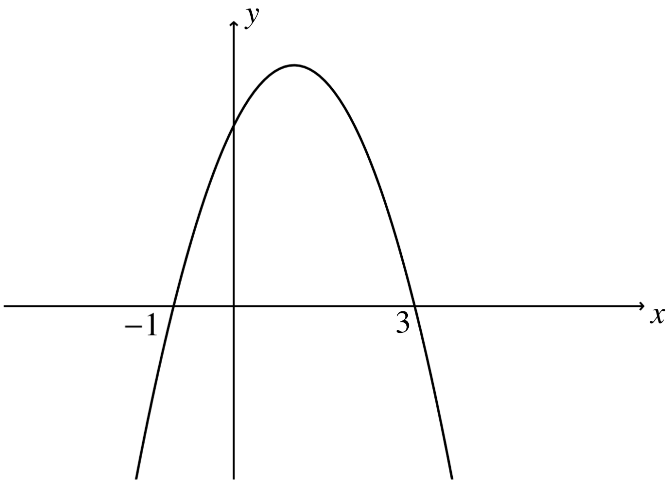


A possible graph of the function $y=f(x)$ is:

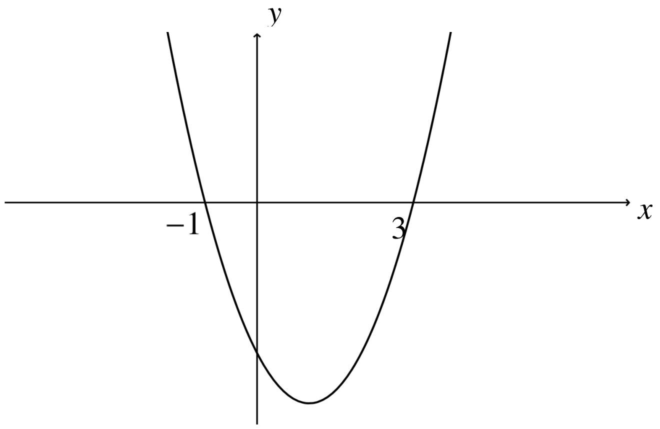
A.



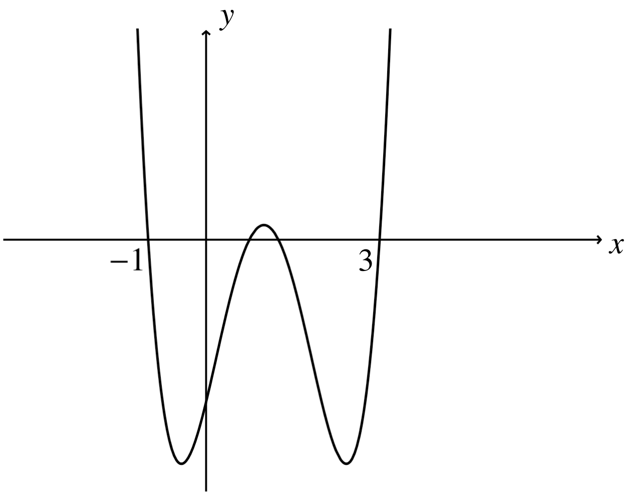
B.



C.



D.



8 If ω is an imaginary cube root of unity, then $\left(1+\omega-\omega^2\right)^7$ is equal to:

A. $-128\omega^2$	B. $128\omega^2$	C. -128ω	D. 128ω

9 Let $y=\cos^{-1} e^x$. An expression for $\frac{dy}{dx}$ is given by:

A. $-\tan y$	B. $-\cot y$	C. $-\operatorname{cosec} y$	D. $-\sec y$

10 What are all the values of *k* for which the graph of $y=2x^3-6x^2+k$ will have three distinct *x*-intercepts?

A. $k>0$	B. $k<8$	C. $k=0, 8$	D. $0<k<8$

End of Section I

Section II

60 Marks
Attempt Questions 11 – 16
Allow about 2 hours 45 minutes for this section

Answer each question in the booklets provided. Start each question in a new booklet.
In Questions 11 – 16, your responses should include relevant mathematical reasoning and/or calculations.

Question 11 (15 marks) Use a SEPARATE writing booklet.

(a) Express $\dfrac{2\sqrt{3}+i}{\sqrt{3}-i}$ in the form $x + iy$, where x and y are real. **2**

(b) Shade the region on the Argand diagram where the two inequalities **2**

$$|z+1| \le 1 \text{ and } |z-2i| \ge 2$$

both hold.

(c) Given $z_1 = i\sqrt{2}$ and $z_2 = \dfrac{2}{1-i}$

(i) Express z_1 and z_2 in modulus-argument form. **2**

(ii) If $z_1 = wz_2$, find w in modulus-argument form. **1**

(iii) On an Argand diagram, plot the points P, Q and R, where P represents z_1, Q represents z_2 and R represents $(z_1 + z_2)$. **2**

(iv) Show that $\operatorname{Arg}(z_1 + z_2) = \dfrac{3\pi}{8}$ and hence find the exact value of $\tan\dfrac{3\pi}{8}$. **2**

(d) Given that $2^{n+4} > (n+4)^2$ for all integral $n \ge 1$, show that $2^{3(a+2)} > 9(a+2)^2$. **2**

(e) Solve the equation $x^3 - 8x^2 - 5x + 84 = 0$, given that one of the roots is equal to the sum of the other two roots. **2**

Question 12 (15 marks) Use a SEPARATE writing booklet.

(a) Find $\displaystyle\int \frac{dx}{x^2 - 2x + 5}$. **2**

(b) Find $\displaystyle\int \ln x \, dx$. **2**

(c) Using the substitution $u = e^x$ and partial fractions, find $\displaystyle\int \frac{1}{e^x + 1} \, dx$. **3**

(d) Prove by the process of Mathematical Induction that $(1+x)^n - nx - 1$ is divisible by x^2 for all integral $n \geq 2$. **3**

(e) Given that $f(x) = |x-2| - 2$, sketch the graphs of the following showing the *x*- and *y*-intercepts. Use separate axes for each graph.

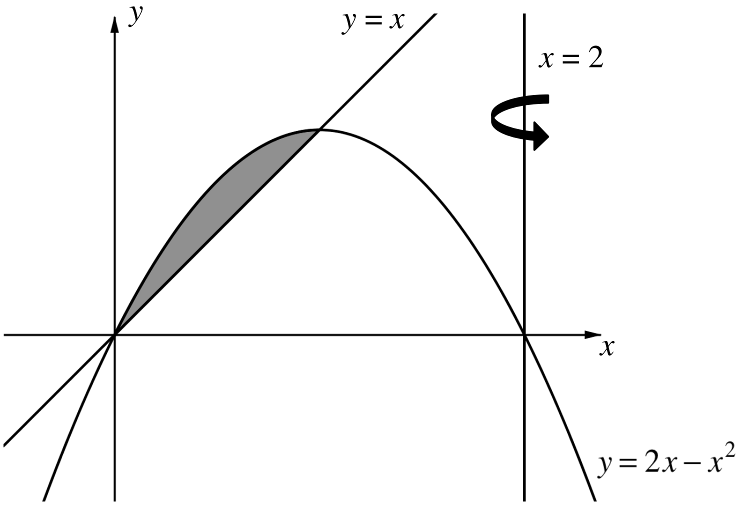
(i) $y = f(x)$ **1**

(ii) $y = [f(x)]^2$ **2**

(iii) $y = \ln[f(x)]$ **2**

Question 13 (15 marks) Use a SEPARATE writing booklet.

(a) The area between the two curves $y = 2x - x^2$ and $y = x$ is rotated about the line $x = 2$.



Using the method of cylindrical shells, calculate the exact volume of the solid of revolution formed. **3**

(b) (i) Find the centre and radius of the circle $x^2 + y^2 + 4x = 0$. **1**

(ii) Show that the line $y = mx + b$ will be a tangent to the circle if **2**

$$4(mb+1) = b^2$$

(iii) P is a point whose coordinates are $(k, 0)$. **2**
If P lies on the line $y = mx + b$ and is exterior to the circle, find possible values for k if the two tangents from P to the circle are perpendicular.

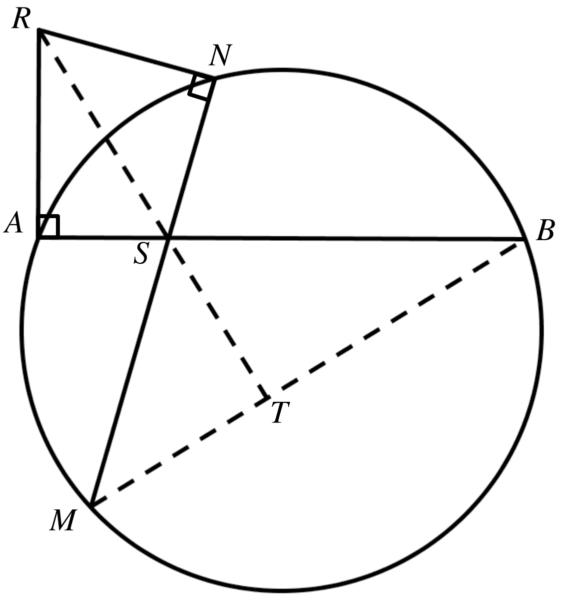
(c) (i) Show that $\int_0^a f(x)\,dx = \int_0^a f(a-x)\,dx$. **1**

(ii) Hence evaluate $\int_0^1 x^2\sqrt{1-x}\,dx$. **3**

Question 13 continues on page 10

Question 13 (continued)

(d) *AB* and *MN* are chords of a circle that intersect at *S*. *R* is a point external to the circle such that *RA* is perpendicular to the chord *AB* and *RN* is perpendicular to the chord *MN*. The line *RS* is produced to *T*, a point lying on *MB*.



Copy or trace this diagram into your answer booklet.

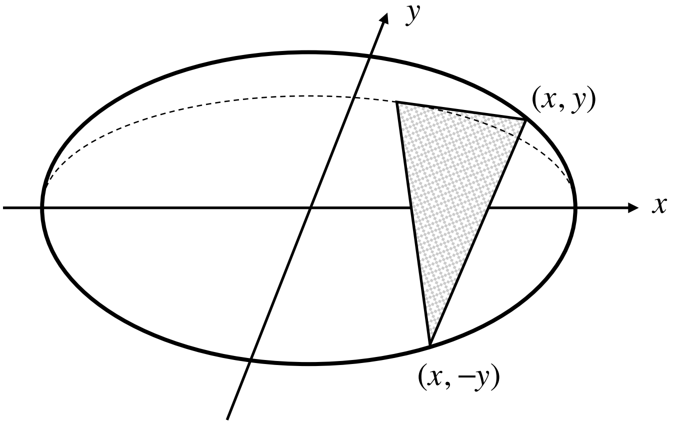
Prove that *RT* is perpendicular to *MB*. **3**

End of Question 13

Question 14 (15 marks) Use a SEPARATE writing booklet.

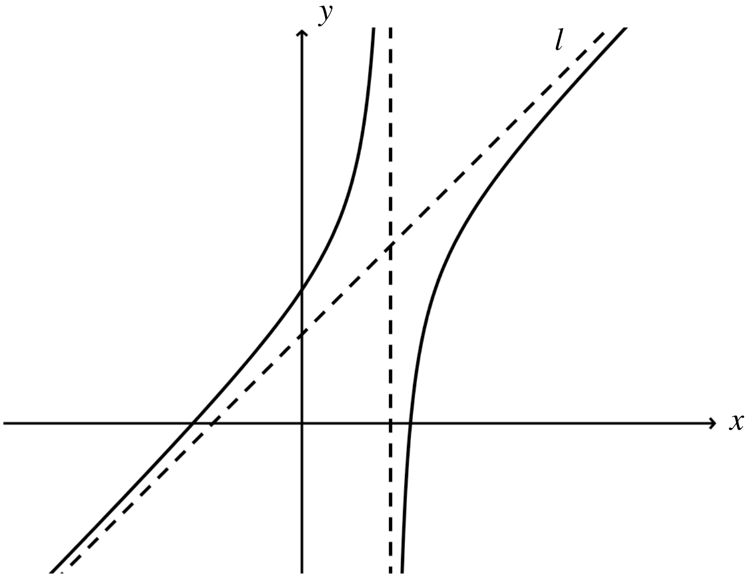
(a) The base of a certain solid is in the shape of an ellipse with equation $\frac{x^2}{16}+\frac{y^2}{9}=1$.

Sections parallel to the y-axis are equilateral triangles, with one side sitting in the base of the solid, as shown in the diagram below.



Find the exact volume of the shape. **4**

(b) The diagram shows the graph of $y=\frac{x^2-6}{x-2}$. The line l is an asymptote.



(i) Use the above graph to draw a one-third page sketch of the graph $y=\frac{x-2}{x^2-6}$. **2**

(ii) By writing $\frac{x^2-6}{x-2}$ in the form $mx+b+\frac{a}{x-2}$, find the equation of the line l. **2**

Question 14 continues on page 12

Question 14 (continued)

(c) (i) By considering the expansion of $\left(\cos\theta + i\sin\theta\right)^3$ and de Moivre's theorem, show that $\cos 3\theta = 4\cos^3\theta - 3\cos\theta$. **1**

(ii) Deduce that $8x^3 - 6x - 1 = 0$ has solutions $x = \cos\theta$, where $\cos 3\theta = \frac{1}{2}$. **2**

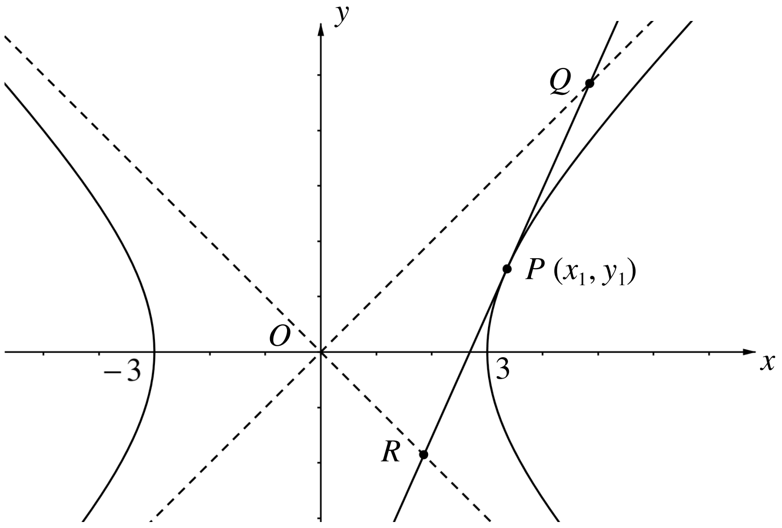
(iii) Find the roots of $8x^3 - 6x - 1 = 0$ in the form $\cos\theta$. **2**

(iv) Hence evaluate $\cos\left(\frac{\pi}{9}\right)\cos\left(\frac{2\pi}{9}\right)\cos\left(\frac{4\pi}{9}\right)$. **2**

End of Question 14

Question 15 (15 marks) Use a SEPARATE writing booklet.

(a) The hyperbola with equation $x^2 - y^2 = 9$ is shown in the diagram below. The point $P(x_1, y_1)$ lies on the hyperbola. The tangent to the hyperbola at *P* intersects the asymptotes of the hyperbola at points *Q* and *R*.



(i) Show that *e*, the eccentricity of the hyperbola, is equal to $\sqrt{2}$. **1**

(ii) Determine the coordinates of the foci, equations of the directrices and the equations of the asymptotes. **3**

(iii) Show that the equation of the tangent at *P* is **2**

$$yy_1 = xx_1 - 9$$

(iv) Prove that the area of triangle *QOR* is constant, where *O* is the origin. **3**

(b) The cubic function $y = x^3 - px + q$ has two turning points.

(i) Show that $p > 0$. **1**

(ii) The line $y = k$ intersects this cubic in three distinct points. **3**

Show that $q - \frac{2p}{3}\sqrt{\frac{p}{3}} < k < q + \frac{2p}{3}\sqrt{\frac{p}{3}}$.

(c) The equation $x^3 - x^2 - 3x + 5 = 0$ has roots α, β and γ . Find the equation whose roots are $(2\alpha + \beta + \gamma), (\alpha + 2\beta + \gamma)$ and $(\alpha + \beta + 2\gamma)$. **2**

Question 16 (15 marks) Use a SEPARATE writing booklet.

(a) $T_1, T_2, T_3, \ldots$ are terms of an arithmetic sequence with common difference d. All terms in the sequence are positive.

(i) Show that $\dfrac{1}{\sqrt{T_{n-1}}+\sqrt{T_n}} = \dfrac{\sqrt{T_n}-\sqrt{T_{n-1}}}{d}$ for $n = 2, 3, 4, \ldots$ **2**

(ii) Hence or otherwise, show that **2**

$$\frac{1}{\sqrt{T_1}+\sqrt{T_2}}+\frac{1}{\sqrt{T_2}+\sqrt{T_3}}+\ldots+\frac{1}{\sqrt{T_{n-1}}+\sqrt{T_n}}=\frac{n-1}{\sqrt{T_1}+\sqrt{T_n}}$$

for $n = 2, 3, 4, \ldots$

(b) The equations of two conics are $3x^2+4y^2=48$ and $3x^2-y^2=3$.

(i) Show that these two conics have the same pair of foci. **1**

(ii) The point $\left(4\cos\theta, 2\sqrt{3}\sin\theta\right)$ lies on the ellipse for **all** values of θ. **2**
Find the four values of θ for which this point also lies on the other conic.

(iii) Show that the two conics intersect at right angles. **3**

(c) (i) Show that $\left(1-x^2\right)^{\frac{n-3}{2}} - \left(1-x^2\right)^{\frac{n-1}{2}} = x^2\left(1-x^2\right)^{\frac{n-3}{2}}$ **1**

(ii) Let $I_n = \displaystyle\int_0^1 \left(1-x^2\right)^{\frac{n-1}{2}}\,dx$ where $n = 1, 2, 3, \ldots$ **3**

Show that $nI_n = (n-1)I_{n-2}$ for $n = 2, 3, 4, \ldots$

(iii) Evaluate I_5. **1**

End of Paper

STANDARD INTEGRALS

$$\int x^n \, dx = \frac{1}{n+1} x^{n+1}, \quad n \neq -1; \quad x \neq 0, \quad \text{if } n < 0$$

$$\int \frac{1}{x} \, dx = \ln x, \quad x > 0$$

$$\int e^{ax} \, dx = \frac{1}{a} e^{ax}, \quad a \neq 0$$

$$\int \cos ax \, dx = \frac{1}{a} \sin ax, \quad a \neq 0$$

$$\int \sin ax \, dx = -\frac{1}{a} \cos ax, \quad a \neq 0$$

$$\int \sec^2 ax \, dx = \frac{1}{a} \tan ax, \quad a \neq 0$$

$$\int \sec ax \tan ax \, dx = \frac{1}{a} \sec ax, \quad a \neq 0$$

$$\int \frac{1}{a^2 + x^2} \, dx = \frac{1}{a} \tan^{-1} \frac{x}{a}, \quad a \neq 0$$

$$\int \frac{1}{\sqrt{a^2 - x^2}} \, dx = \sin^{-1} \frac{x}{a}, \quad a > 0, \quad -a < x < a$$

$$\int \frac{1}{\sqrt{x^2 - a^2}} \, dx = \ln\left(x + \sqrt{x^2 - a^2} \right), \quad x > a > 0$$

$$\int \frac{1}{\sqrt{x^2 + a^2}} \, dx = \ln\left(x + \sqrt{x^2 + a^2} \right)$$

NOTE: $\ln x = \log_e x, \quad x > 0$

Student Number: ________________

Mathematics Extension 2

Trial HSC Task 3 August 2013

Section I

Multiple-Choice Answer Sheet

Circle the correct response

1. A B C D

2. A B C D

3. A B C D

4. A B C D

5. A B C D

6. A B C D

7. A B C D

8. A B C D

9. A B C D

10. A B C D

Kambala – 2013 – Year 12 – Ext 2 Trial HSC Examination **SOLUTIONS**

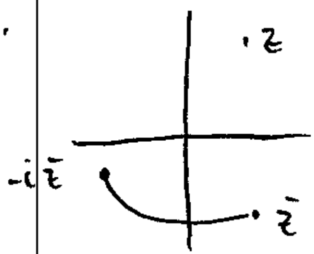
Qn	Solutions	Marks	Comments & Criteria
1	$z = 3+2i \quad w = 2-i$ $\bar{z} = 3-2i \quad 3w = 6-3i$ $\therefore \bar{z}+3w = 3-2i+6-3i$ $= 9-5i$	$\underline{\underline{D}}$	
2.	$x^3+2xy-y^3-2=0$ $3x^2+2y+2x\frac{dy}{dx}-3y^2\frac{dy}{dx}=0$ $(2x-3y^2)\frac{dy}{dx} = -3x^2-2y$ $\frac{dy}{dx} = \frac{-3x^2-2y}{(2x-3y^2)}$ At $(1,1)$ $\frac{dy}{dx} = \frac{-3-2}{2-3}$ $= \frac{-5}{-1}$ $= 5$	$\underline{\underline{A}}$	
3.	$3x^3+2x^2-4x+1=0$ $\alpha\beta\gamma = \frac{-1}{3}$ $(\alpha\beta\gamma)^3 = \frac{-1}{27}$ $\therefore \frac{1}{\alpha^3\beta^3\gamma^3} = -27$	$\underline{\underline{B}}$	
4.	$\frac{x^2}{6}-\frac{y^2}{10}=1 \quad a^2=6$ $b^2=10$ $b^2=a^2(e^2-1)$ $10=6(e^2-1)$		

$10 = 6e^2-6$

$e^2 = 16/6 \longrightarrow$ or $e^2 = 8/3$

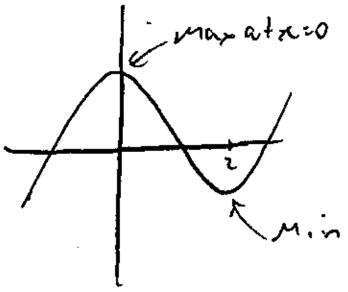
$e = 2\sqrt{2}/3 = \frac{2\sqrt{6}}{3}$

$e = \frac{4}{\sqrt{6}} = \frac{4\sqrt{6}}{6} = 2\sqrt{6}$ $\quad \underline{B}$

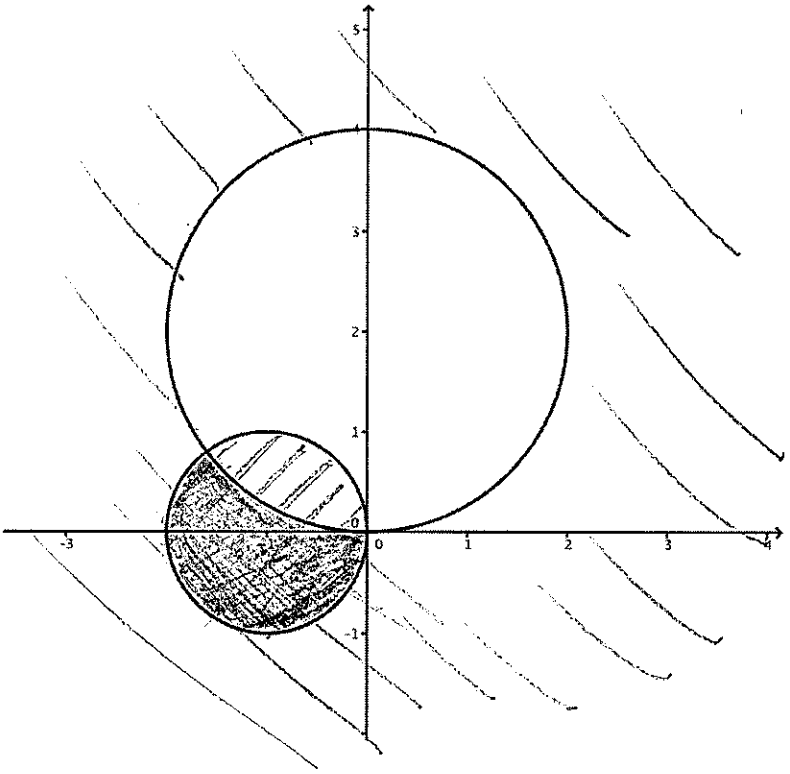
Qn	Solutions	Marks	Comments & Criteria
5.	Roots $x=4$, $x=2-i$, $x=1+i$ As $P(x)$ has real coefficients, Complex roots occur in conjugate pairs $\therefore$ Other roots are $x=2+i$, $x=1-i$ $\therefore$ min degree of $P(x)$ is 5.		$\underline{\underline{C}}$
6.	 $-i\bar{z}$ is a rotation through $\frac{\pi}{2}$ in a clockwise direction $\therefore$ $\underline{\underline{C}}$		
7.	Both A and C are possible, but A is not a function (fails vertical line test) $\therefore$ $f(x)$ must be C	$\underline{\underline{C}}$	
8	ω is a cube root of unity so a soln to $z^3=1$ i.e. $z^3-1=0$ Other roots are 1 and ω^2 $1+\omega+\omega^2=0$ (sum of roots) $\therefore 1+\omega=-\omega^2$ $(1+\omega-\omega^2)^7=(-2\omega^2)^7$ $=-128\omega^{14}$		

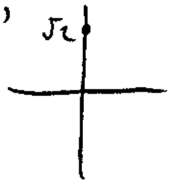
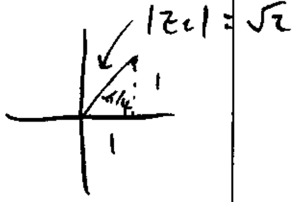
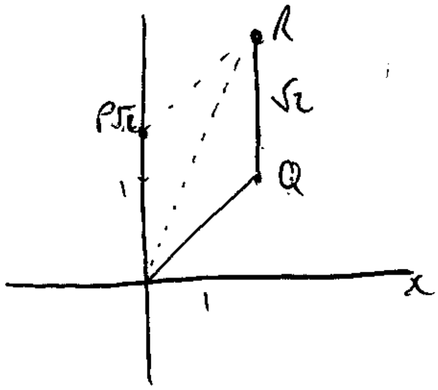
$= -128\,\omega^3.\omega^3.\omega^3.\omega^3.\omega^2$

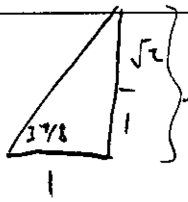
$= -128\,\omega^2$ as $\omega^3=1$ $\underline{\underline{A}}$

Qn	Solutions	Marks	Comments & Criteria
9.	$y = \cos^{-1} e^{x}$ $\therefore e^{x} = \cos y$ $\frac{dy}{dx}(-\sin y) = e^{x}$ $= \cos y$ $\therefore \frac{dy}{dx} = \frac{\cos y}{-\sin y}$ $= -\cot y$	$\underline{\underline{B}}$	
10.	$y = 2x^3 - 6x^2 + k$ $y' = 6x^2 - 12x$ $= 6x(x-2)$ $\therefore x = 0, 2$ are stat pts $\therefore$ Graph  At $x = 0$ $0 = 0 - 0 + k$ $k = 0$ At $x = 2$ $0 = 16 - 24 + k$ $k = 8$ $\therefore$ If k lies between 0 and 8 there are 3 roots $0 < k < 8$	$\underline{\underline{D}}$	

Qn	Solutions	Marks	Comments & Criteria
11	(a) $\frac{2\sqrt{3}+i}{\sqrt{3}-i}\times\frac{\sqrt{3}+i}{\sqrt{3}+i}$ $=\frac{(2\sqrt{3}+i)(\sqrt{3}+i)}{3+1}$ $=\frac{6+2\sqrt{3}i+\sqrt{3}i-1}{4}$ $=\frac{5+3\sqrt{3}i}{4}$ $=\frac{5}{4}+\frac{3\sqrt{3}}{4}i$		1 correct conjugate 1 simplified answer
	(b) $\lvert z+1\rvert\le1$ $\lvert z-(-1+0i)\rvert\le1$ Circle ctr (-1,0), radius 1 unit $\lvert z-2i\rvert\ge2$ $\lvert z-(0+2i)\rvert\ge2$ Circle Ctr (0,2) Radius 2 units		1 diagrams 1 regions correct



Qn	**Solutions**	**Marks**	**Comments & Criteria**
11	(c) $z_1 = i\sqrt{2}$ $z_2 = \frac{2}{1-i} \times \frac{1+i}{1+i}$ $= \frac{2+2i}{2}$ $= 1+i$ (i)   $z_1 = \sqrt{2}\,\text{cis}\,\frac{\pi}{2}$ $z_2 = \sqrt{2}\,\text{cis}\,\frac{\pi}{4}$		1 for z_1 1 for z_2
	(ii) $z_1 = w z_2$ i.e. $w = \frac{z_1}{z_2}$ $= \frac{\sqrt{2}}{\sqrt{2}}\,\text{cis}\left(\frac{\pi}{2} - \frac{\pi}{4}\right)$ $= \text{cis}\,\frac{\pi}{4}$		1 answer
	(iii) 		1 for P and Q 1 for R based on P and Q
	(iv) $\angle POQ = \frac{\pi}{2} - \frac{\pi}{4}$ $= \pi/4$ $\angle QOR$ bisects $\angle POQ = \frac{\pi}{8}$ as OPRQ is a rhombus $\therefore \angle ROx = \frac{\pi}{4} + \frac{\pi}{8} = \frac{3\pi}{8}$		1 for showing



$1+\sqrt{2}$

$$\tan\frac{3\pi}{8} = \frac{1+\sqrt{2}}{1} = 1+\sqrt{2}$$

1 for correct value based on diagram

Qn	Solutions	Marks	Comments & Criteria
11	(d) $2^{n+4} > (n+4)^2 \quad n \geq 1$ To show $2^{3(a+2)} > 9(a+2)^2$ i.e. $2^{3a+6} > 3^2(a+2)^2$ $2^{3a+6} > (3a+2)^2$ Using result given $n+4 = 3a+6$ $n = 3a+2$ $\therefore$ If you let $n = 3a+2$ then $2^{3(a+2)} > 9(a+2)^2$	$9(a+2)^2$ $= 3^4(a+2)^2$ $= (3a+6)^2$ as req'd.	1 for progress 1 for substitution
	(e) $x^3-8x^2-5x+84=0$ Let roots be $\alpha, \beta, (\alpha+\beta)$ Sum of roots: $\alpha+\beta+(\alpha+\beta) =$ $2\alpha+2\beta=8$ $\alpha+\beta=4$ Product $\alpha\beta(\alpha+\beta) = \frac{-84}{1}$ $(4-\beta)\beta(4-\cancel{\beta}+\cancel{\beta}) = -84$ $(4\beta-\beta^2)\cancel{4} = -\cancel{84}\ 21$ $\beta^2-4\beta=21$ $\beta^2-4\beta-21=0$ $(\beta-7)(\beta+3)=0$ $\therefore \beta = 7$ or -3	$\frac{-(-8)}{1}$ $\Rightarrow \alpha=(4-\beta)$	1 for sum/produ or progress

$\therefore$ Roots $x = -3, 7, -3+7$

i.e. $x = -3, 4, 7$ 1 correct soln

Qn	Solutions	Marks	Comments & Criteria
12	(a) $\int \frac{dx}{x^2-2x+5}$		
	$= \int \frac{dx}{x^2-2x+1+4}$		
	$= \int \frac{dx}{(x-1)^2+2^2}$		1 completing square
	$= \int \frac{dx}{2^2+(x-1)^2}$		
	$= \frac{1}{2}\tan^{-1}\left(\frac{x-1}{2}\right) + c$		1 correct integral
	(b) $\int \ln x \, dx$ $\quad u=\ln x \quad v=x$		
	$= \int 1.\ln x \, dx$ $\quad u'=\frac{1}{x} \quad v'=1$		1 for parts set-up
	$= x\ln x - \int \frac{1}{x}.x \, dx$		
	$= x\ln x - \int 1.dx$		
	$= x\ln x - x + c$		1 for correct answer
	(c) $\int \frac{1}{e^x+1} dx$ $\quad$ Let $u=e^x$		
	$\frac{du}{dx}=e^x$		
	$= \int \frac{1}{u+1}\cdot\frac{du}{u}$ $\quad du=e^x dx$		
	$dx = \frac{du}{e^x}$		1 correct substitution set up
	$= \int \frac{1}{u(u+1)} du$		
	Now $\frac{1}{u(u+1)} = \frac{A}{u} + \frac{B}{u+1}$		
	$1 = A(u+1) + Bu$		
	Let $u=0 \Rightarrow A=1$		

$u=-1 \Rightarrow 1=-B$

$B=-1$ $\qquad$ 1 for partial fractions

Qn	Solutions	Marks	Comments & Criteria

$\therefore \int \frac{1}{u(u+1)}\,du$

$= \int \frac{1}{u}\,du - \int \frac{1}{u+1}\,du$

$= \ln(u) - \ln(u+1) + c$

But $u = e^x$

$\therefore I = \ln e^x - \ln(e^x+1) + c$

$= x - \ln(e^x + 1) + c$ — 1 for answer

(d) To prove $(1+x)^n - nx - 1$ is div for x^2 for $n \geq 2$

Show true for $n = 2$

$(1+x)^2 - 2x - 1$

$= 1 + 2x + x^2 - 2x - 1$

$= x^2$

$= 1.x^2$ $\therefore$ Div by x^2

True for $n=2$. — 1 for $n=2$

Assume true for $n=k$

i.e. $(1+x)^k - kx - 1 = P(x).x^2$ for some polynomial $P(x)$

i.e. $(1+x)^k = P(x).x^2 + kx + 1$ ✱

Prove true for $n = k+1$

i.e. Show $(1+x)^{k+1} - (k+1)x - 1$ is div by x^2

$(1+x)^{k+1} - (k+1)x - 1$

$= (1+x)(1+x)^k - kx - x - 1$

$= (1+x)\left[P(x).x^2 + kx + 1\right] - kx - x - 1$ from ✱ — 1 for substn

$= P(x).x^2 + \cancel{kx} + \cancel{1} + P(x).x^3 + kx^2 \cancel{+x} \cancel{-kx} \cancel{-x} \cancel{-1}$

$= P(x)x^2 + P(x).x^3 + kx^2$

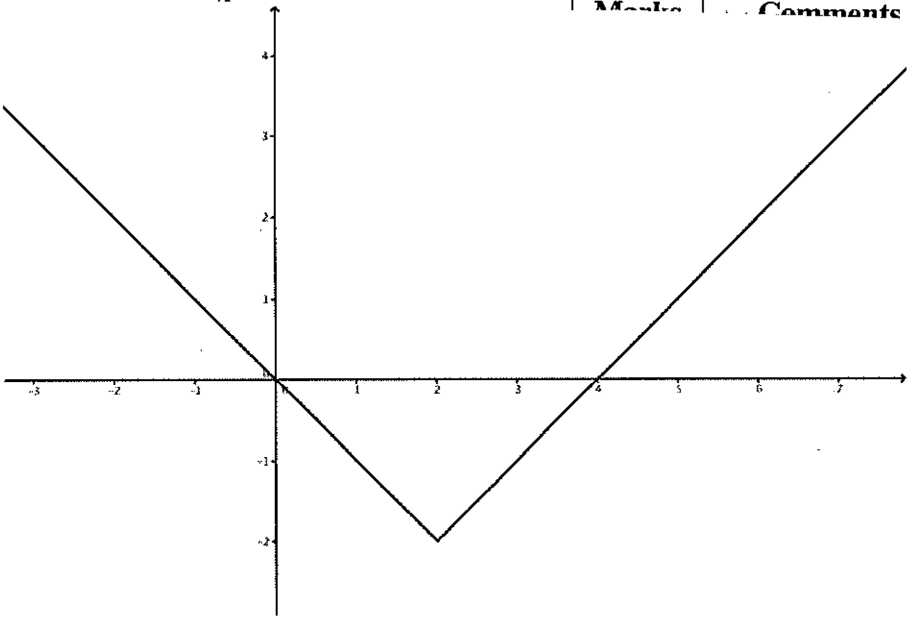
$= x^2\left[P(x) + P(x)x + k\right]$ which is div by x^2.

1 final proof

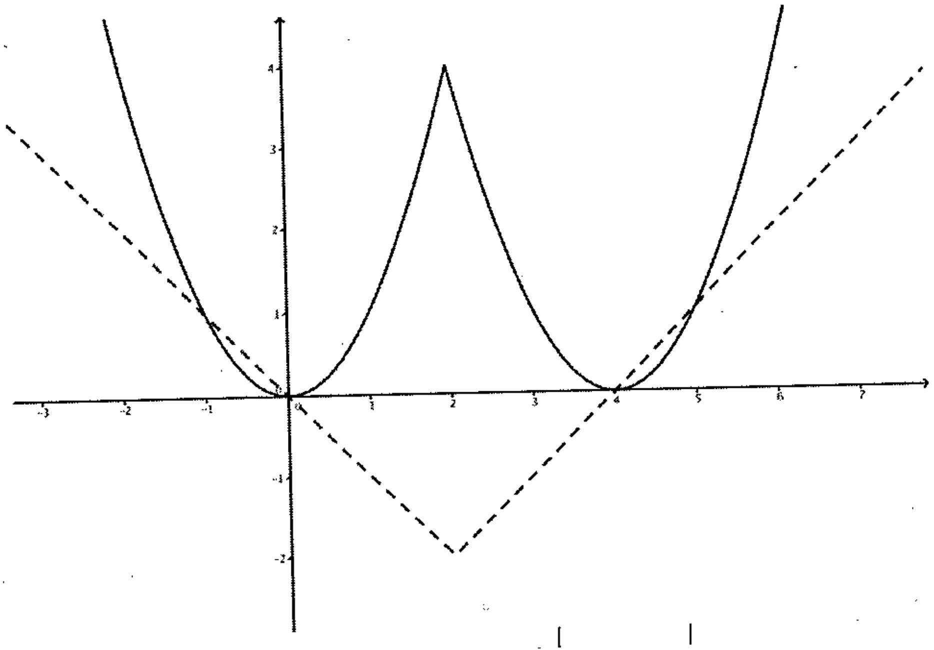
∴ By the process of
Math Induction,
this is proven for
all integral $n \geq 2$.

⑨

Qn **Marks** **Comments & Criteria**

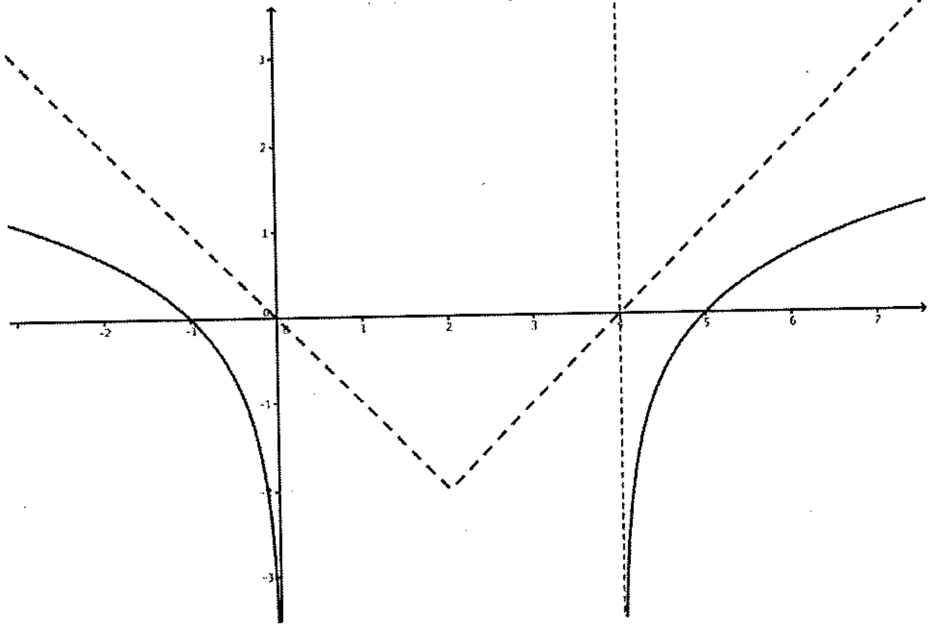


1



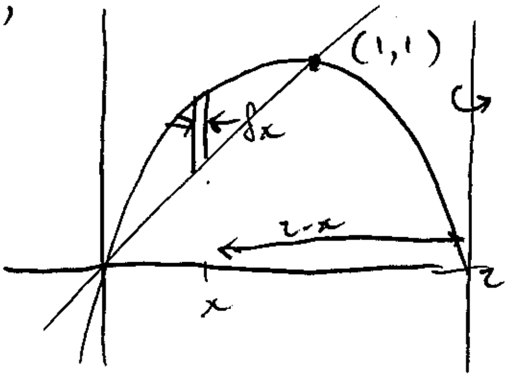
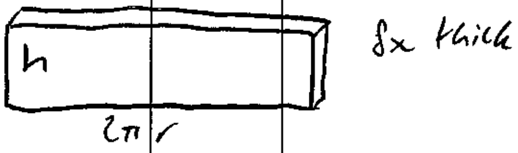
1 for shape

1 for [illegible] point



1 asympt

1 correct curve

Qn	Solutions	Marks	Comments & Criteria
13	(a)   $h = (2x - x^2) - x$ $= x - x^2$ $r = 2 - x$		1 for correct h, r
	$\delta V = 2\pi r h\, \delta x$ $= 2\pi(2-x)(x-x^2)\delta x$ $= 2\pi(2x - 2x^2 - x^2 + x^3)\delta x$ $= 2\pi(2x - 3x^2 + x^3)\delta x$ $V = \sum_{x=0}^{1} 2\pi(2x - 3x^2 + x^3)\delta x$ $= \lim_{\delta x \to 0} \sum_{x=0}^{1} 2\pi(2x - 3x^2 + x^3)\delta x$ $V = 2\pi\int_0^1 (x^3 - 3x^2 + 2x)\,dx$		1 for integral
	$= 2\pi\left[\frac{x^4}{4} - x^3 + x^2\right]_0^1$ $= 2\pi\left[\left(\frac{1}{4} - 1 + 1\right) - (0 - 0 + 0)\right]$ $= 2\pi \times \frac{1}{4}$ $= \frac{\pi}{2}\ u^2$		1 correct answer
	(b) (i) $x^2 + y^2 + 4x = 0$ $x^2 + 4x + 4 + y^2 = 4$ $(x+2)^2 + y^2 = 4$ $\therefore$ Ctr $(-2, 0)$		1

Radius 2 units

Qn	Solutions	Marks	Comments & Criteria
	(b)(ii) $y = mx + b$ $\quad (x+2)^2 + y^2 = 4$		
	i.e. $(x+2)^2 + (mx+b)^2 = 4$		
	$x^2 + 4x + \cancel{4} + m^2x^2 + 2mbx + b^2 - \cancel{4} = 0$		
	$(m^2+1)x^2 + (2mb+4)x + b^2 = 0$		1 for quadratic
	Tangent if $\Delta = 0$		
	i.e. $b^2 - 4ac = 0$		
	$(2mb+4)^2 - 4(m^2+1)(b^2) = 0$		
	$\cancel{4m^2b^2} + 16mb + 16 - \cancel{4m^2b^2} - 4b^2 = 0$		
	$16mb + 16 = 4b^2$		
	$4mb + 4 = b^2$		
	$4(mb+1) = b^2$	as req'd	1 for discriminant work. or similar
	(iii) $P(k, 0)$		
	$y = mx + b$		
	At P $\quad 0 = mk + b$		
	$b = -mk$		
	Sub into result from (ii)		
	$4[m(-mk) + 1] = (-mk)^2$		
	$-4m^2k + 4 = m^2k^2$		
	$m^2k^2 + 4m^2k - 4 = 0$		
	$(k^2+4k)m^2 - 4 = 0$		1 for progress
	Two possible values of m if tangents are perpendicular		
	i.e. $m_1 m_2 = -1 \implies$ product of roots $= -1$		
	$\therefore \dfrac{-4}{k^2+4k} = -1$		
	$k^2 + 4k = 4$		

$k^2 + 4k + 4 = 4 + 4$

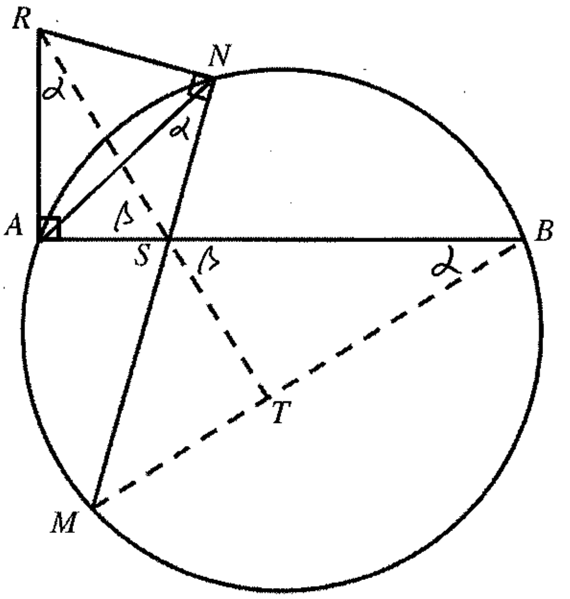
$(k+2)^2 = 8$

$k + 2 = \pm 2\sqrt{2}$

$\therefore k = 2 + 2\sqrt{2} \quad 2 - 2\sqrt{2}$ $\qquad$ 1 for k values

Qn	Solutions	Marks	Comments & Criteria
13	(c) (i) $\int_0^a f(x)\,dx$ Let $u =$	$a-x$	$\frac{du}{dx} = -1 \Rightarrow \frac{du}{\cancel{dx}} = -dx$
	$x =$	$a-u$	
	when x	$= a$,	$u = 0$
	x	$= 0$	$u = a$
	$= \int_a^0 f(a-u)\,(-du)$		
	$= \int_0^a f(a-u)\,du$		1 for showing
	$= \int_0^a f(a-x)\,dx$ as integral is independent of variable		
	(ii) $\int_0^1 x^2\sqrt{1-x}\,dx$		
	$= \int_0^1 (1-x)^2\sqrt{1-(1-x)}\,dx$		1
	$= \int_0^1 (1-x)^2\sqrt{x}\,dx$		
	$= \int_0^1 (1-2x+x^2)\cdot x^{1/2}\,dx$		
	$= \int_0^1 (x^{1/2} - 2x^{3/2} + x^{5/2})\,dx$		1 for rearranging integral
	$= \left[\frac{x^{3/2}}{3/2} - \frac{2x^{5/2}}{5/2} + \frac{x^{7/2}}{7/2}\right]_0^1$		
	$= \left[\frac{2}{3} - \frac{4}{5} + \frac{2}{7}\right] - \left[0 - 0 + 0\right]$		
	$= 16/105$		1 for answer

Qn	Solutions	Marks	Comments & Criteria
13	(d)		



To Prove $RT \perp MB$

RANS is a cyclic quadrilateral as opposite ∠'s supplementary 1

$\angle RAS + \angle RNS = \cancel{8}90^\circ + 90^\circ = 180^\circ$

(α) $\angle ARS = \angle ANS$ (angles at circumference on same segment equal)

(α) $\angle ANS = \angle ABM$ (angles at circumference standing on same arc are equal) 1

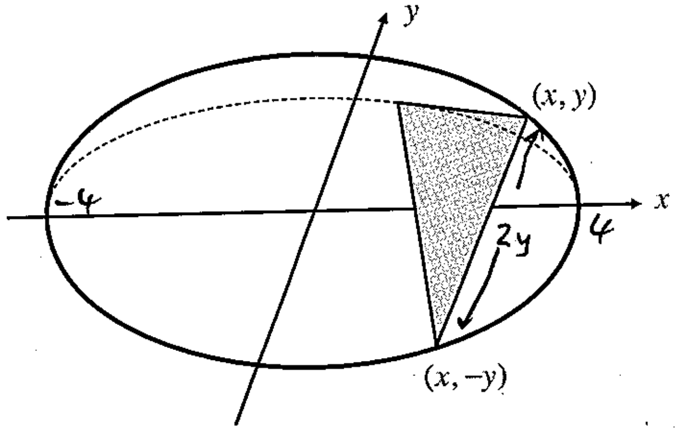
(β) $\angle RSA = \angle TSB$ (vertically opposite angles equal)

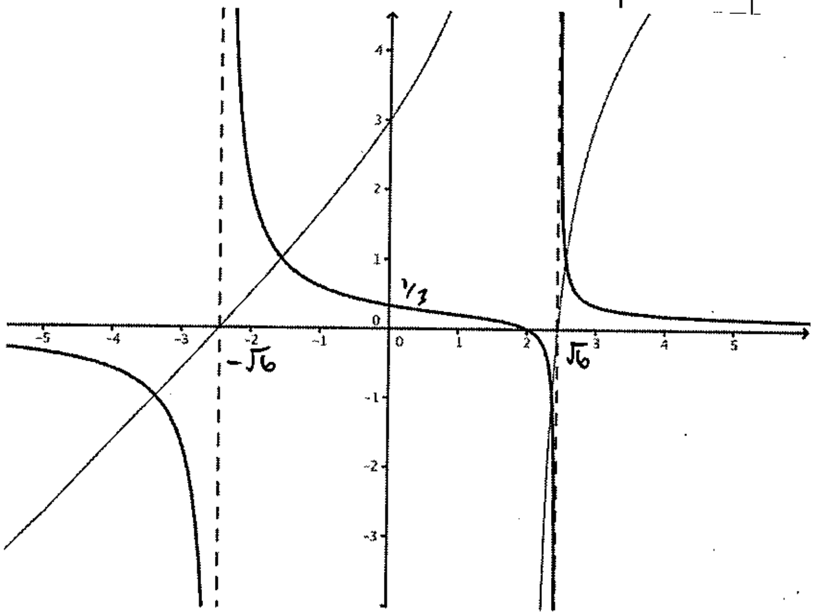
$\therefore \triangle RAS ||| \triangle STB$ (Equiangular)

$\therefore \angle STB = \angle RAS = 90^\circ$ (Corresponding angles in similar triangles are equal)

$\therefore RT$ is perpendicular to MB. 1

$\therefore$ Proven

Qn	Solutions	Marks	Comments & Criteria
14	(a) 		
	Triangle is equilateral with side length 2y		
	Area of $\Delta = \frac{1}{2}ab\sin C$		
	$= \frac{1}{2} \times 2y \times 2y \times \sin 60$		
	$= 2y^2 \times \frac{\sqrt{3}}{2}$		
	$= \sqrt{3}\,y^2$	1	Area Δ
	$V = \int_{-4}^{4} \sqrt{3}\,y^2\,dx$ $\quad \frac{x^2}{16} + \frac{y^2}{9} = 1$		
	$= 2\sqrt{3}\int_0^4 9\left(1 - \frac{x^2}{16}\right)dx$ $\quad y^2 = 9\left(1 - \frac{x^2}{16}\right)$	1	rearranging integral
	$= 18\sqrt{3}\int_0^4 \left(1 - \frac{x^2}{16}\right)dx$		
	$= 18\sqrt{3}\left[x - \frac{x^3}{48}\right]_0^4$	1	
	$= 18\sqrt{3}\left[\left(4 - \frac{64}{48}\right) - (0 - 0)\right]$		
	$= \overset{6}{\cancel{18}}\sqrt{3} \times \frac{8}{\cancel{3}}$		
	$= 48\sqrt{3}\ u^3$	1	Answer

Qn	Solutions	Marks	Comments & Criteria
14 (b)	(i) 		1 Asymptotes 1 shape
	(ii) $\frac{x^2-6}{x-2} = mx+b+\frac{a}{x-2}$ $x+2$ $x-2\ )\ x^2-0x-6$ x^2-2x $2x-6$ $2x-4$ -2 $\therefore \frac{x^2-6}{x-2} = x+2-\frac{2}{x-2}$ ∴ Eqn of l : $y = x+2$		1 progress 1 correct soln.
(c)	(i) $(\cos\theta+i\sin\theta)^3$ $=\cos^3\theta+3\cos^2\theta.i\sin\theta+3\cos\theta.i^2\sin^2\theta+i^3\sin^3\theta$ $=\cos^3\theta-3\cos\theta\sin^2\theta+i(3\cos^2\theta\sin\theta-\sin^3\theta)$ $=\cos^3\theta-3\cos\theta(1-\cos^2\theta)+i(3\cos^2\theta\sin\theta-\sin^3\theta)$		

$=\cos^3\theta-3\cos\theta+3\cos^3\theta+i(3\cos^2\theta\sin\theta-\sin^3\theta)$

$=4\cos^3\theta-3\cos\theta+i(3\cos^2\theta\sin\theta-\sin^3\theta)$

Qn	Solutions	Marks	Comments & Criteria
	$z = \text{cis}\,\theta$		
	$z^3 = (\text{cis}\,\theta)^3$		
	$= 1^3 \text{cis}\,3\theta$		
	$z^3 = \cos 3\theta + i\sin 3\theta$		
	Equating Re parts		
	$\cos 3\theta = 4\cos^3\theta - 3\cos\theta$		1 for showing
	(ii) $8x^3 - 6x - 1 = 0$		
	Let $x = \cos\theta$		
	i.e. $8\cos^3\theta - 6\cos\theta - 1 = 0$		
	$2(4\cos^3\theta - 3\cos\theta) - 1 = 0$		1
	$2\cos 3\theta - 1 = 0$		
	$2 \times \frac{1}{2} - 1 = 0$ where $\cos 3\theta = \frac{1}{2}$		1
	$\therefore \cos\theta = x$ is a soln.		
	(iii) $\cos 3\theta = \frac{1}{2}$		
	$3\theta = \cos^{-1}\left(\frac{1}{2}\right)$		
	$3\theta = \frac{\pi}{3} + 2n\pi$ for $n = 0, \pm 1, \pm 2$ etc		
	$= \frac{\pi + 6n\pi}{3}$		
	$3\theta = \frac{\pi(6n+1)}{3}$		1
	$\theta = \frac{\pi(6n+1)}{9}$		
	$\theta = \frac{\pi}{9}, \frac{5\pi}{9}, \frac{7\pi}{9}$		1
	$\therefore$ Solns are $\cos\frac{\pi}{9}, \cos\left(\frac{5\pi}{9}\right), \cos\left(\frac{7\pi}{9}\right)$		

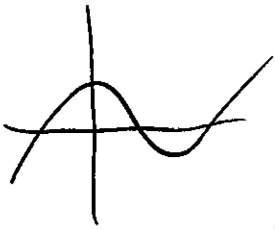
Qn	Solutions	Marks	Comments & Criteria
	(iv) $\cos\frac{5\pi}{9} = -\cos\frac{4\pi}{9}$		
	$\cos\frac{7\pi}{9} = -\cos\frac{2\pi}{9}$		
	$\therefore \cos\frac{\pi}{9}.\cos\frac{5\pi}{9}.\cos\frac{7\pi}{9}$		
	$= \cos\frac{\pi}{9}\left(-\cos\frac{4\pi}{9}\right)\left(-\cos\frac{2\pi}{9}\right)$	1	for equating
	$= \cos\frac{\pi}{9}\cos\frac{2\pi}{9}\cos\frac{4\pi}{9}$		
	= product of roots.		
	$\alpha\beta\gamma = -\frac{(-1)}{8}$		
	$= \frac{1}{8}$		1 value
	$\therefore \cos\frac{\pi}{9}\cos\frac{2\pi}{9}\cos\frac{4\pi}{9} = \frac{1}{8}$		
15	(a)(i) $x^2 - y^2 = 9$		
	$\frac{x^2}{9} - \frac{y^2}{9} = 1$ or		As $a^2 = b^2$ i.e $a = b$ $\therefore$ A rectangular hyperbola $\therefore e = \sqrt{2}$
	$b^2 = a^2(e^2 - 1)$		
	$9 = 9(e^2 - 1)$		
	$1 = e^2 - 1$		
	$e^2 = 2$		
	$e = \sqrt{2}$ $\therefore$ A rectangular hyperbola		1
	(ii) $a = 3,\ b = 3$		
	Foci : $(\pm ae, 0)$		1
	$= (\pm 3\sqrt{2}, 0)$		
	Directrices : $x = \pm a/e$ $= \pm 3/\sqrt{2} = \pm\frac{3\sqrt{2}}{2}$		1
	Asymptotes $y = \pm x$ (as $e = \sqrt{2}$)		

or $y = \pm\frac{bx}{a}$

$= \pm\frac{3x}{3}$ 1

$y = \pm x$

Qn	Solutions	Marks	Comments & Criteria
15	(iii) $x^2 - y^2 = 9$ $2x - 2y\frac{dy}{dx} = 0$ $\frac{dy}{dx} = \frac{2x}{2y}$ $= x/y$		1
	At P, $m_T = \frac{x_1}{y_1}$ Eqn $y - y_1 = m(x - x_1)$ $y - y_1 = \frac{x_1}{y_1}(x - x_1)$ $y_1 y - y_1^2 = x_1 x - x_1^2$ $yy_1 = xx_1 - x_1^2 + y_1^2$ $= xx_1 - (x_1^2 - y_1^2)$ $yy_1 = xx_1 - 9$	as $x^2 - y^2 = 9$ i.e. $x_1^2 - y_1^2 = 9$	1
	(iv) At Q $y = x$ $\therefore xy_1 = xx_1 - 9$ $x = \frac{9}{x_1 - y_1}$ $\therefore y = \frac{9}{x_1 - y_1}$ At R $y = -x$ $-xy_1 = xx_1 - 9$ $x = \frac{9}{x_1 + y_1}$ $\therefore y = \frac{-9}{x_1 + y_1}$		1
	Area $\triangle QOR = \frac{1}{2}bh = \frac{1}{2}\cdot OQ \cdot OR$ $OQ^2 = \left(\frac{9}{x_1 - y_1}\right)^2 + \left(\frac{9}{(x_1 - y_1)}\right)^2$ $= \frac{162}{(x_1 - y_1)^2}$ $OQ = \frac{9\sqrt{2}}{x_1 - y_1}$ $OR^2 = \left(\frac{9}{(x_1 + y_1)}\right)^2 + \left(\frac{-9}{(x_1 + y_1)}\right)^2$ $= \frac{162}{(x_1 + y_1)^2}$ $OR = \frac{9\sqrt{2}}{(x_1 + y_1)}$		1

Qn	Solutions	Marks	Comments & Criteria
	$\therefore$ Area $\triangle QOR$ $=\frac{1}{\cancel{2}}\times\frac{9\sqrt{\cancel{2}}}{x_1-y_1}\times\frac{9\sqrt{\cancel{2}}}{x_1+y_1}$ $=\frac{81}{x_1^2-y_1^2}$ $=\frac{81}{9}$ $=9u^2$ $\therefore$ a constant value.		1
	(b) $y=x^3-px+q$ (i) $y'=3x^2-p$ $=0$ when $3x^2=p$ $x=\pm\sqrt{\frac{p}{3}}$ $\therefore$ 2 turning pts when $p>0$		1
	(ii) At $x=\sqrt{\frac{p}{3}}$ $y=\left(\frac{\sqrt{p}}{\sqrt{3}}\right)^3-p\sqrt{\frac{p}{3}}+q$ $=\frac{p}{3}\sqrt{\frac{p}{3}}-p\sqrt{\frac{p}{3}}+q$ $=-\frac{2p}{3}\sqrt{\frac{p}{3}}+q$ $=q-\frac{2p}{3}\sqrt{\frac{p}{3}}$	1	
	At $x=-\sqrt{\frac{p}{3}}$ $y=\left(-\sqrt{\frac{p}{3}}\right)^3+p\sqrt{\frac{p}{3}}+q$ $=-\frac{p}{3}\sqrt{\frac{p}{3}}+p\sqrt{\frac{p}{3}}+q$ $=\frac{2p}{3}\sqrt{\frac{p}{3}}+q$ $=q+\frac{2p}{3}\sqrt{\frac{p}{3}}$		1
	 $\therefore$ Min at $\left(\sqrt{\frac{p}{3}},q-\frac{2p}{3}\sqrt{\frac{p}{3}}\right)$ Max at $\left(-\sqrt{\frac{p}{3}},q+\frac{2p}{3}\sqrt{\frac{p}{3}}\right)$ For 3 intercepts, k lies between max and min $\therefore q-\frac{2p}{3}\sqrt{\frac{p}{3}}<k<q+\frac{2p}{3}\sqrt{\frac{p}{3}}$ as req'd		1

Qn	Solutions	Marks	Comments & Criteria
15	(c) $x^3 - x^2 - 3x + 5 = 0$		
	Roots α, β, γ		
	Sum of roots $\alpha + \beta + \gamma = \frac{-(-1)}{1}$ $= 1$		
	Roots of eqn $2\alpha + \beta + \gamma,\ \alpha + 2\beta + \gamma,\ \alpha + \beta + 2\gamma$		
	Now $2\alpha + \beta + \gamma = \alpha + \beta + \gamma + \alpha$ $= 1 + \alpha$		1
	∴ Roots of new eqn are $1+\alpha,\ 1+\beta,\ 1+\gamma$		
	$x = 1 + \alpha$ $\Rightarrow \alpha = x - 1$ etc		
	∴ Eqn $(x-1)^3 - (x-1)^2 - 3(x-1) + 5 = 0$		
	$x^3 - 3x^2 + 3x - 1 - x^2 + 2x - 1 - 3x + 3 + 5 = 0$ $\underline{x^3 - 4x^2 + 2x + 6 = 0}$		1
16	(a) $T_n = T_{n-1} + d$		
	(i) $\frac{1}{\sqrt{T_{n-1}} + \sqrt{T_n}} \times \frac{\sqrt{T_{n-1}} - \sqrt{T_n}}{\sqrt{T_{n-1}} - \sqrt{T_n}}$		Rationalising Denom. 1
	$= \frac{\sqrt{T_{n-1}} - \sqrt{T_n}}{T_{n-1} - T_n}$		
	$= \frac{\sqrt{T_{n-1}} - \sqrt{T_n}}{T_{n-1} - (T_{n-1} + d)}$		
	$= \frac{\sqrt{T_{n-1}} - \sqrt{T_n}}{-d}$		

$= \frac{\sqrt{T_n} - \sqrt{T_{n-1}}}{d}$ as req'd 1

Qn	Solutions	Marks	Comments & Criteria
16	(a)(ii) From (i) $\frac{1}{\sqrt{T_1}+\sqrt{T_2}} = \frac{\sqrt{T_2}-\sqrt{T_1}}{d}$ etc $\therefore \frac{1}{\sqrt{T_1}+\sqrt{T_2}} + \frac{1}{\sqrt{T_2}+\sqrt{T_3}} + \dots + \frac{1}{\sqrt{T_{n-1}}+\sqrt{T_n}}$ $= \frac{\sqrt{T_2}-\sqrt{T_1}}{d} + \frac{\sqrt{T_3}-\sqrt{T_2}}{d} + \dots + \frac{\sqrt{T_n}-\sqrt{T_{n-1}}}{d}$ $= \frac{1}{d}\left[\cancel{\sqrt{T_2}} - \sqrt{T_1} + \cancel{\sqrt{T_3}} - \cancel{\sqrt{T_2}} + \cancel{\dots} + \sqrt{T_n} - \sqrt{T_{n-1}}\right]$ etc $= \frac{\sqrt{T_n}-\sqrt{T_1}}{d} \times \frac{\sqrt{T_n}+\sqrt{T_1}}{\sqrt{T_n}+\sqrt{T_1}}$ $= \frac{T_n - T_1}{d(\sqrt{T_n}+\sqrt{T_1})}$ $= \frac{(n-1)\cancel{d}}{\cancel{d}(\sqrt{T_n}+\sqrt{T_1})}$ $= \frac{n-1}{\sqrt{T_n}+\sqrt{T_1}}$ $= \frac{n-1}{\sqrt{T_1}+\sqrt{T_n}}$ as req'd		Now $T_n = T_1 + (n-1)d$ i.e. $u_n = a + (n-1)d$ $\therefore T_n - T_1 = (n-1)d$

Qn	Solutions	Marks	Comments & Criteria
16	(b) $3x^2+4y^2=48$ $\quad 3x^2-y^2=3$ $\frac{x^2}{16}+\frac{y^2}{12}=1$ $\quad x^2-\frac{y^2}{3}=1$ (i) Foci: Ellipse $b^2=a^2(1-e^2)$ $12=16(1-e^2)$ $12=16-16e^2$ $-4=-16e^2$ $e^2=\frac{1}{4}$ $e=\frac{1}{2}$ $\therefore$ Foci $(\pm ae,0)$ i.e. $(\pm 2,0)$ * $\therefore$ Same foci Hyperbola $b^2=a^2(e^2-1)$ $3=1(e^2-1)$ $3=e^2-1$ $e^2=4$ $e=2$ $\therefore ae=2$ Foci : $(\pm ae,0)$ $=(\pm 2,0)$ * $ae=4\times\frac{1}{2}=2$ (ii) $(4\cos\theta,\ 2\sqrt{3}\sin\theta)$ satisfies $3x^2-y^2=3$ $3(16\cos^2\theta)-12\sin^2\theta=3$ $16\cos^2\theta-4\sin^2\theta=1$ $16\cos^2\theta-4(1-\cos^2\theta)=1$ $16\cos^2\theta-4+4\cos^2\theta=5$ $20\cos^2\theta=5$ $\cos^2\theta=\frac{1}{4}$ $\cos\theta=\pm\frac{1}{2}$ $\therefore\theta=\frac{\pi}{3},\frac{2\pi}{3},\frac{4\pi}{3},\frac{5\pi}{3}$		1 1 1

At $\theta=\frac{\pi}{3}$ $\left(4\times\frac{1}{2},\ 2\sqrt{3}\times\frac{\sqrt{3}}{2}\right)=(2,3)$

By symmetry : Pts of intersection $(2,3)$ $(2,-3)$ $(-2,3)$ $(-2,-3)$

Qn	Solutions	Marks	Comments & Criteria
Q16	(b)(iii) Show intersect at right angles i.e. show tangents intersect at right angles $m_1 m_2 = -1$		
	$3x^2 + 4y^2 = 48$ $6x + 8y\frac{dy}{dx} = 0$ $\frac{dy}{dx} = -\frac{6x}{8y}$ $= \frac{-3x}{4y}$ (m_1)		1
	$3x^2 - y^2 = 3$ $6x - 2y\frac{dy}{dx} = 0$ $\frac{dy}{dx} = \frac{6x}{2y}$ $= \frac{3x}{y}$		1
	At $(2,3)$ $\left.\begin{array}{l} m_1 = \frac{-6}{12} = -\frac{1}{2} \\ m_2 = \frac{6}{3} = 2 \end{array}\right\}$	$m_1 m_2 = -1$	
	At $(2,-3)$ $\left.\begin{array}{l} m_1 = \frac{-6}{-12} = \frac{1}{2} \\ m_2 = \frac{6}{-3} = -2 \end{array}\right\}$	$m_1 m_2 = -1$	
	At $(-2,3)$ $\left.\begin{array}{l} m_1 = \frac{6}{12} = \frac{1}{2} \\ m_2 = \frac{-6}{3} = -2 \end{array}\right\}$	$m_1 m_2 = -1$	1
	At $(-2,-3)$ $\begin{array}{l} m_1 = \frac{6}{-12} = -\frac{1}{2} \\ m_2 = \frac{-6}{-3} = 2 \end{array}$	$\Big\}$ $m_1 m_2 = -1$	

$\therefore$ Intersect at right angles

Qn	Solutions	Marks	Comments & Criteria
16	(c)(i) $(1-x^2)^{\frac{n-3}{2}} - (1-x^2)^{\frac{n-1}{2}} = x^2(1-x^2)^{\frac{n-3}{2}}$		
	LHS $= (1-x^2)^{\frac{n-3}{2}} - (1-x^2)^{\frac{n-1}{2}}$		
	$= (1-x^2)^{\frac{n-3}{2}}\left[1-(1-x^2)\right]$		
	$= (1-x^2)^{\frac{n-3}{2}}(1-1+x^2)$		
	$= x^2(1-x^2)^{\frac{n-3}{2}}$		
	= RHS		
	∴ Shown		
	(ii) $I_n = \int_0^1 (1-x^2)^{\frac{n-1}{2}}\,dx$		
	$= \int_0^1 1.(1-x^2)^{\frac{n-1}{2}}\,dx$		$u = (1-x^2)^{\frac{n-1}{2}}$
			$u' = \frac{n-1}{2}(1-x^2)^{\frac{n-3}{2}}.(-2x)$
	$\therefore I_n = \left[(1-x^2)^{\frac{n-1}{2}}.x\right]_0^1 - \int_0^1 -(n-1)x(1-x^2)^{\frac{n-3}{2}}.x\,dx$		$= -(n-1)x(1-x^2)^{\frac{n-3}{2}}$
	$= \left\{\underbrace{\left[(1-1)^{\frac{n-1}{2}}.1\right]}_{0} - \underbrace{\left[(1-0)^{\frac{n-1}{2}}.0\right]}_{0}\right\} + (n-1)\int_0^1 x^2(1-x^2)^{\frac{n-3}{2}}\,dx$		$v' = 1$ $v = x$
	$= (n-1)\int_0^1\left[(1-x^2)^{\frac{n-3}{2}} - (1-x^2)^{\frac{n-1}{2}}\right]dx$		from (i)
	$= (n-1)\int_0^1 (1-x^2)^{\frac{n-3}{2}} - (n-1)\underbrace{\int (1-x^2)^{\frac{n-1}{2}}\,dx}_{(I_n)}$		
	$\therefore I_n = (n-1)\underbrace{\int_0^1 (1-x^2)^{\frac{n-3}{2}}}_{(I_{n-2})} - (n-1)I_n$		
	$nI_n = (n-1)I_{n-2}$ as req'd		

Qn	Solutions	Marks	Comments & Criteria
16	(c) (iii) $n I_n = (n-1) I_{n-2}$ i.e. $I_n = \frac{(n-1)}{n} I_{n-2}$ $I_5 = \frac{4}{5} \times I_3$ $I_3 = \frac{2}{3} I_1$ $I_1 = \int_0^1 (1-x^2)^{\frac{1-1}{2}} dx$ $= \int_0^1 (1-x^2)^0 dx$ $= \int_0^1 1 . dx$ $= [x]_0^1$ $= 1$ $\therefore I_3 = \frac{2}{3}$ $I_5 = \frac{4}{5} \times \frac{2}{3}$ $= \frac{8}{15}$		1