Name:________________________

Teacher's Name:______________

Student Number

Knox Grammar School

2014
Preliminary
Yearly Examination

Mathematics Extension 1

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using blue or black pen only
- Board approved calculators may be used
- All necessary working should be shown in every question

Subject Teachers

Mr. M. Vuletich
Mr. I. Bradford
Ms. L. Dempsey
Ms. S. Yun
Examiner: Mr. D. Sedgman

Total Marks – 70

Section I Pages 4-7

- Attempt Questions 1 – 10.
- Use answer sheet attached.
- Allow 15 minutes for this section.

Section II Pages 8-12

- Answer each question in a separate writing booklet.
- Attempt questions 11- 14.
- All questions are of equal value.
- Allow 1 hour and 45 minutes for this section.

This paper MUST NOT be removed from the examination room

Number of Students in Course: 85

Section I

10 marks

Attempt Questions 1-10

Allow about 15 minutes for this section

Use this multiple choice answer sheet for questions 1 – 10.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample

2 + 4 = ? (A) 2 (B) 6 (C) 8 (D)

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ~~●~~ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

correct

A ● B ~~●~~ C ○ D ○

Name ____________________________

Knox Grammar School

Preliminary Examination

Extension 1 Mathematics 2014

Multiple Choice Answer Sheet

Teacher's Name ________________________________

Completely fill the response oval representing the most correct answer.

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 ○

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. The value of $\sum_{r=1}^{50}(2r-1)$ is:

(A) 5050

(B) 5000

(C) 2500

(D) 99

2. The point $P(x_3, y_3)$ divides the interval AB **externally** in the ratio 3 : 2.

If A is the point $(4, 3)$ and B is the point $(9, -2)$, which of these gives an expression to find the value of x_3 and y_3 respectively?

(A) $\dfrac{3\times(9)-2\times(4)}{3-2}, \dfrac{3\times(-2)-2\times(3)}{3-2}$

(B) $\dfrac{3\times(4)-2\times(9)}{3-2}, \dfrac{3\times(3)-2\times(-2)}{3-2}$

(C) $\dfrac{3\times(9)+2\times(4)}{3+2}, \dfrac{3\times(-2)+2\times(3)}{3+2}$

(D) $\dfrac{3\times(4)+2\times(9)}{3+2}, \dfrac{3\times(3)+2\times(-2)}{3+2}$

3. Which of these expressions will give the superannuation payout when \$1000 per **quarter** is invested at the beginning of each quarter for 20 years at the rate of 8% per **annum**. Interest is calculated **quarterly**.

(A) $\dfrac{1000(1.02)(1.02^{80}-1)}{0.02}$

(B) $\dfrac{1000(1.08^{30}-1)}{0.08}$

(C) $\dfrac{1000(1.02)(1.02^{20}-1)}{0.02}$

(D) $\dfrac{1000(1.08^{80}-1)}{0.08}$

4. The limit $\lim\limits_{x\to 4}\dfrac{\sqrt{x}-2}{x-4}$, evaluated using the difference of two squares, is given by:

(A) $\dfrac{1}{6}$

(B) undefined

(C) 0

(D) $\dfrac{1}{4}$

5. The solution set for the inequation $\dfrac{2x}{x+1}\leq 3$ is :

(A) $x>-1, \quad x\leq -3$

(B) $x\leq -3, \quad x\geq -1$

(C) $x\geq -3$

(D) $-3\leq x\leq -1$

6. The largest domain for $f(x)=\sqrt{x+3}-\dfrac{1}{\sqrt{3-x}}$ is:

(A) $x \ge -3, \quad x < 3$

(B) $x > -3, \quad x \le 3$

(C) $-3 \le x \le 3$

(D) $-3 \le x < 3$

7. The value of k for which the line $y = x+3$ is a tangent to the circle $(x-1)^2+(y+2)^2=k^2$ is:

(A) 1

(B) 3

(C) 18

(D) $3\sqrt{2}$

8. The expression for the first derivative given by the function rule, in surd form, of $\dfrac{1}{\sqrt{x^2-1}}$ is:

(A) $\dfrac{x}{\left(x^2-1\right)\sqrt{\left(x^2-1\right)}}$

(B) $\dfrac{-x}{\left(x^2-1\right)\sqrt{\left(x^2-1\right)}}$

(C) $\dfrac{-1}{\left(x^2-1\right)\sqrt{\left(x^2-1\right)}}$

(D) $\dfrac{1}{2\left(x^2-1\right)\sqrt{\left(x^2-1\right)}}$

9. Given the following geometric series for $0^\circ < x < 90^\circ$:

$1+\cos^2 x+\cos^4 x+\cos^6 x+.....$,

the expression for its limiting sum is given by:

(A) $\text{cosec}^2 x$

(B) $\sin^2 x$

(C) $\text{cosec}\, x$

(D) $\cos^2 x$

10. The solution of $\log_{10}(x-3)(x-1)=0$ is:

(A) $x=1, \quad x=3$

(B) $x=2+\sqrt{2}$

(C) $x=2\pm\sqrt{2}$

(D) No solution.

Section II 60 marks

Attempt Questions 11-14.
Allow about 1 hour 45 minutes for this section
Answer each question in the appropriate writing booklet. Extra writing booklets are available.
All necessary working should be shown in every question.

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

(a) Find the acute angle between the lines $2x - 3y = 0$ and $x + 3y = 0$, giving your answer correct to the nearest degree. **2**

(b) Sketch the region defined by $y \le |2x-1|$. **2**

(c) Solve $2\sin 2\theta - \sqrt{3} = 0$ for $0° \le \theta \le 360°$. **3**

(d) Find the gradient of the tangent to the curve, whose parametric equations are **2**

$x = 5t^2$ and $y = 10t$, at the point where $t = 3$.

(e) Given $w(x) = \dfrac{f(x)}{g(x)}$ with $f(x)$ being an even function and $g(x)$ an odd function, **2**
prove that $w(x)$ is an odd function.

(f) Prove $\dfrac{1 - \sin^2\theta\cos^2\theta}{\cos^2\theta} = \tan^2\theta + \cos^2\theta$. **2**

(g) If the points $P\,(2p, p^2)$, $F(0,1)$ and $Q(-\dfrac{2}{p}, k)$ are **collinear**, show that the value **2**

of k in terms of p is given by $k = \dfrac{1}{p^2}$.

Question 12 is on the next page.

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

(a) By drawing appropriate straight lines on the same axes as the graph of $y = 2^x$, **2**

determine the number of solutions for each of the following equations:

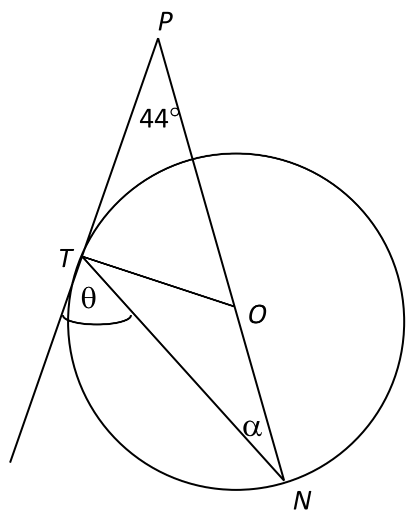
(i) $2^x = x + 2$

(ii) $2^x = 2 - x$

(b) Solve for $0^o \leq \theta \leq 360^o$, to the nearest degree: $4\sec^2\theta - \tan\theta = 7$. **4**

(c) Using the fact that $(\sqrt{x} + \sqrt{y})^2 = x + y + 2\sqrt{xy}$, express $11 + 4\sqrt{6}$ in the form $(\sqrt{x} + \sqrt{y})^2$. **3**

(d) In the diagram below, O is the centre of the circle and PT is a tangent. **3**



Find the value of the pronumerals θ and α, giving reasons.

(e) Given $f(x) = x^2 + 3x - 2$, simplify $\dfrac{f(h) - f(-h)}{2h}$. **3**

Question 13 is on the next page.

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

(a) Using a graphical method or otherwise, write down the set of solutions to the inequality $|2x-1| \le x+1$. **3**

(b) Find the value of m if the quadratic equation $x^2 + mx + (m+2) = 0$ has its roots that are the reciprocals of one another. **2**

(c) Prove that $x^2 + (k-3)x - k = 0$ has real roots for all real values of k. **2**

(d) (i) Find the equation of the tangent to the curve $y = x^2$ at the point (a, a^2) on the curve. **2**

(ii) Find the values of a if this tangent passes through the point $(2, -5)$. **1**

(iii) Hence find the equations of the two tangents to the curve $y = x^2$ that pass through the point $(2, -5)$. **2**

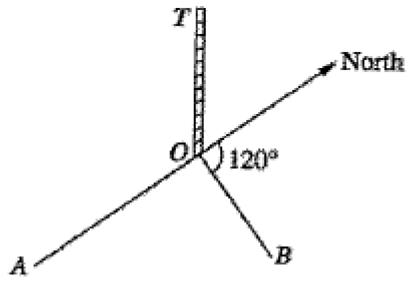
(e) Let α, β be the roots of $4x^2 - 6x + 1 = 0$. Given that $\alpha - \beta = \frac{\sqrt{5}}{2}$, find the values of x and y if $\alpha^4 - \beta^4 = \frac{x\sqrt{5}}{y}$. **3**

Question 14 is on the next page.

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

(a) From a point A due south of a tower, the angle of elevation of the top of the tower T, is $23°$. From another point B, on a bearing of $120°$ from the tower, the angle of elevation of T is $32°$.

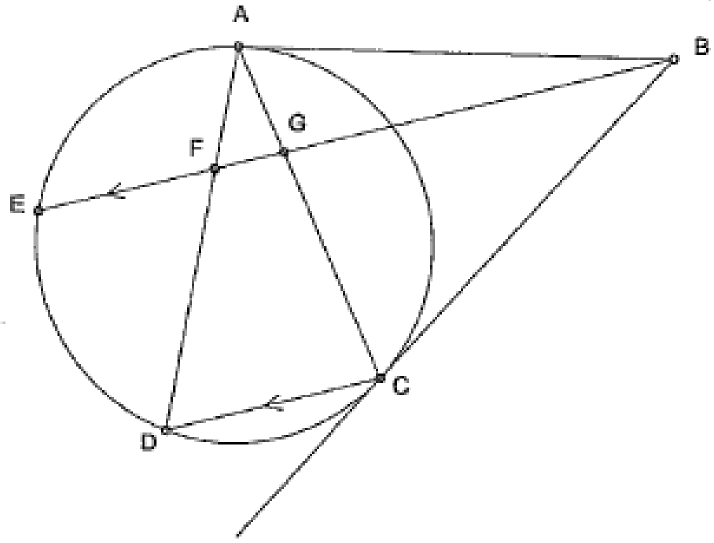
The distance AB is 200 metres.



(i) Copy the diagram into your writing booklet, adding the given information to your diagram. **1**

(ii) Hence find the height of the tower. **3**

(b) In the diagram EB is parallel to DC. Tangents from B meet the circle at A and C.



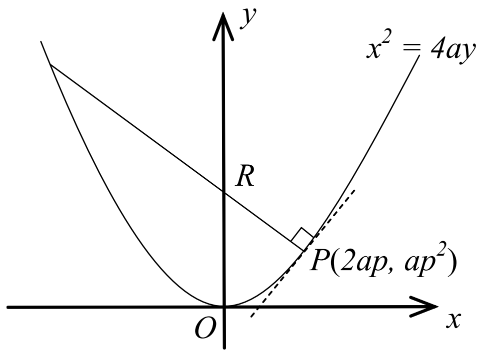
Copy or trace the diagram into your writing booklet.

(i) Explain why ΔABC is isosceles. **1**

(ii) Hence or totherwise, prove that $\angle BCA = \angle BFA$. **2**

Question 14 continues on the next page.

(d) $P\ (2ap,\ ap^2)$ is a point on the parabola $x^2 = 4ay$. The normal at P meets the y-axis at R.



(i) Show that the equation of the **normal** at P is $x + py = 2ap + ap^3$. **2**

(ii) Given the normal cuts the y-axis at R, state the coordinates of R. **1**

(iii) From P a line PT is drawn perpendicular to the directrix meeting it in T. State the coordinates of T. **1**

(iv) If M is the midpoint of RT, find the coordinates of M. **1**

(v) The locus of M is a parabola. Find the equation of this parabola stating the coordinates of its vertex and focus. **3**

End of Assessment

2014 Year 11 Mathematics Extension 1 Yearly Examination SOLUTIONS

Suggested Solution (s)	Comments	Suggested Solution (s)	Comments

Multiple Choice

1. $S_{50} = 1+3+\cdots+99$

$= \frac{50}{2}(1+99) = 2500$ (C)

2. (A)

3. $A_1 =$ first quarterly pmt $= 1000(1.02)^{80}$

$A_2 = 1000(1.02)^{79}$

$A_{80} = 1000(1.02)^1$

$S_{80} = 1000(1.02)^1[1+1.02+1.02^2+\cdots 1.02^{79}]$

$= \dfrac{1000(1.02)[1(1.02)^{80}-1]}{1.02-1}$

$= \dfrac{1000(1.02)[1.02^{80}-1]}{0.02}$ (A)

4. $\lim\limits_{x\to 4} \dfrac{\sqrt{x}-2}{(\sqrt{x}-2)(\sqrt{x}+2)} = \dfrac{1}{4}$ (D)

5. $2x(x+1) \le 3(x+1)^2$

$3(x+1)^2 - 2x(x+1) \ge 0$

$(x+1)[3(x+1)-2x] \ge 0$

$(x+1)(x+3) \ge 0$

$x > -1,\ x \le -3$ (A) $\quad x \ne -1$

6. Largest domain

$x+3 \ge 0 \cap 3-x > 0$

$x \ge -3,\ x < 3$ (D)

Hence $-3 \le x < 3$

7. Use p. distance formula $x-y+3=0$ from centre $(1,-2)$

$k = \dfrac{|1(1)-1(-2)+3|}{\sqrt{1^2+(-1)^2}} = \dfrac{6}{\sqrt{2}}$

$k = \dfrac{6\sqrt{2}}{2} = 3\sqrt{2}$ (D)

Comments: $k > 0$ = radius

8. $y = \dfrac{1}{\sqrt{x^2-1}} = (x^2-1)^{-\frac{1}{2}}$

$\dfrac{dy}{dx} = -\dfrac{1}{2}(x^2-1)^{-3/2}, 2x$

$= \dfrac{-x}{(x^2-1)\sqrt{x^2-1}}$ (B)

9. $S_\infty = \dfrac{1}{1-\cos^2 x} = \dfrac{1}{\sin^2 x} = \operatorname{cosec}^2 x$ (A)

10. $(x-3)(x-1) = 10^0 = 1$

$\Rightarrow x^2-4x+2=0$

$x = 2 \pm \sqrt{2}$ ———— *

on substitution into $\log_{10}(x-3)(x-1)$

both $x = 2 \mp \sqrt{2}$ work & $\ne 0$

N.B. Solutions exist on: (C)

$(x-3)(x-1) > 0 \Rightarrow x < 1$ or $x > 3$

with $x = 2+\sqrt{2}$ & $x = 2-\sqrt{2}$

$\simeq 3.4 \qquad \simeq 0.6$

1/

2014 Year 11 Mathematics Extension 1 Yearly Examination SOLUTIONS

Suggested Solution (s)	Comments

Question 11

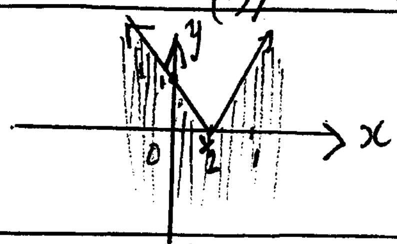
(a) $\tan\theta = \left|\dfrac{m_1 - m_2}{1 + m_1 m_2}\right|$

$= \dfrac{2/3 - \left(\frac{-1}{3}\right)}{1 + \frac{2}{3}\left(\frac{-1}{3}\right)} = \dfrac{1}{\frac{7}{9}} = \dfrac{9}{7}$

Hence $\theta = \tan^{-1}\left(\frac{9}{7}\right) = 52^0$ (n deg)

Comments: 1 expression, 1 angle.

(b)



Comments: 1 graph, 1 region

(c) $\sin 2\theta = \dfrac{\sqrt{3}}{2} \quad 0^0 \le \theta \le 360^0$

$2\theta = 60^0, 120^0, 420, 480^0$ ①

$\theta = 30^0, 60^0, 210^0, 240^0$ ①

(d) $\dfrac{dy}{dx} = \dfrac{dy}{dt} \Big/ \dfrac{dx}{dt} = 10 \times \dfrac{1}{10t} = \dfrac{1}{t}$ ①

$\therefore m_T = \dfrac{dy}{dx} = \dfrac{1}{3}$ ①

(e) $w(x) = \dfrac{f(x)}{g(x)} \quad f(x) = f(-x)$ even, $g(-x) = -g(x)$ odd. ①

$w(-x) = \dfrac{f(-x)}{g(-x)} = \dfrac{f(x)}{-g(x)} = \dfrac{-f(x)}{g(x)} = -w(x)$ ①

Hence $w(x)$ is an odd fn.

Suggested Solution (s)	Comments

(f) LHS $= \dfrac{1 - (1 - \cos^2 x)\cos^2 x}{\cos^2 x}$

Comments: ALTERNATIVE SOLUTIONS AVAILABLE ①

$= \dfrac{1 - \cos^2 x + \cos^4 x}{\cos^2 x}$

$= \dfrac{\sin^2 x + \cos^4 x}{\cos^2 x}$

$= \dfrac{\sin^2 x}{\cos^2 x} + \cos^2 x$ ①

$= \tan^2 x + \cos^2 x = RHS$

(g) If PFQ are collinear points

then $m_{PF} = m_{QF}$

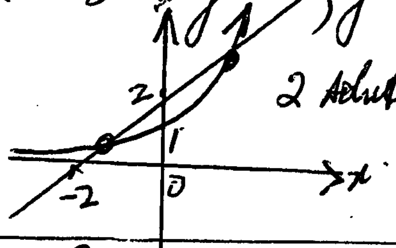
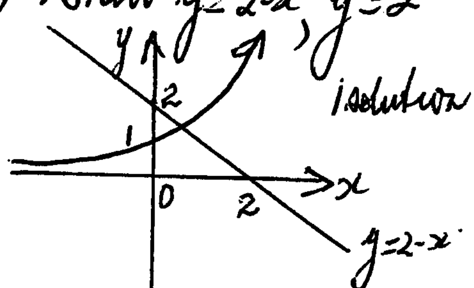
ie $\dfrac{1 - p^2}{0 - 2p} = \dfrac{k - 1}{\frac{-2}{p} - 0}$ ①

$\dfrac{-2}{p}(1 - p^2) = -2p(k - 1)$

$\dfrac{1}{p^2}(1 - p^2) = k - 1$

$\dfrac{1}{p^2} - 1 = k - 1$ ①

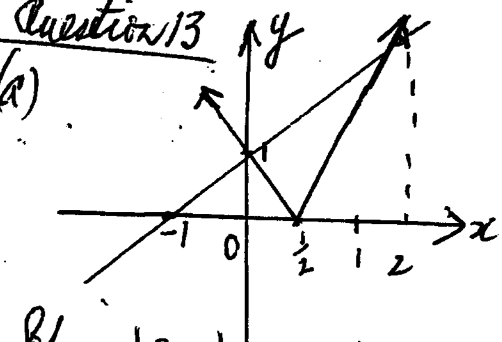
Hence $k = \dfrac{1}{p^2}$

Suggested Solution (s)	Comments
Question 12	
a(i) Draw $y=x+2$, $y=2^x$  2 solutions.	①
(ii) Draw $y=2-x$, $y=2^x$  1 solution	①
(b) $4(1+\tan^2\theta)-\tan\theta=7$	①
$4\tan^2\theta-\tan\theta-3=0$	
$(4\tan\theta+3)(\tan\theta-1)=0$	①
$\tan\theta=-\frac{3}{4}$, $\tan\theta=1$.	①
Angles $\theta=143^\circ$, $\theta=323^\circ$ (nearest degree); Angles $\theta=45$, $\theta=225^\circ$	①
(c) $(\sqrt{x}+\sqrt{y})^2=x+y+2\sqrt{xy}=x+y+\sqrt{4xy}$	
$11+4\sqrt{6}\Rightarrow x+y=11$, $4\sqrt{6}=\sqrt{4xy}$	①
Hence $xy=24$ ie $y=\frac{24}{x}$	
$x+y=11\Rightarrow x+\frac{24}{x}=11$	①

Suggested Solution (s)	Comments
Question 12c (continued)	
$x^2-11x+24=0$. So $11+4\sqrt{6}=(\sqrt{3}+\sqrt{8})^2$	
$(x-3)(x-8)=0$	
So $x=3$ in which case $y=8$; $x=8$ in which case $y=3$.	①
(d) $\angle PTO=90^\circ$ (angle between tangent and radius $=90^\circ$)	
$\angle TOP=90-44=46^\circ$ (Angle sum of $\Delta=180^\circ$)	①
$\angle TNO=\alpha=\frac{46^\circ}{2}=23^\circ$.	①
Since ΔOTN is isosceles (Equal radii)	
$\angle\theta=180-23-90=67^\circ$ (Supplementary angles add to 180°)	
Hence $\alpha=23^\circ$, $\theta=67^\circ$	①
(e) $\frac{f(h)-f(-h)}{2h}=\frac{h^2+3h-2-[h^2-3h-2]}{2h}$	$f(x)=x^2+3x-2$. ②
$=\frac{6h}{2h}$	
$=3$	①

VALUES CAN BE FOUND BY INSPECTION

2014 Year 11 Mathematics Extension 1 Yearly Examination SOLUTIONS

Suggested Solution (s)	Comments	Suggested Solution (s)	Comments
Question 13 (a)  Solving $\|2x-1\| = x+1$ $2x-1 = x+1$ $-(2x-1)=x+1$ $x=2$ $-3x=0$ $x=0$ Hence $\|2x-1\| \le x+1$ for $0 \le x \le 2$	(2) Algebraic Methods available. (1)	(d)(i) $y=x^2$, $\frac{dy}{dx}=2x=2a$ when $x=a$ Eq^n of tangent $y-a^2=2a(x-a)$ ie $y=2ax-a^2$ — (1)	at (a,a^2) (1) (1)
		(ii) If $y=2ax-a^2$ passes through $(2,-5)$ $-5=2a(2)-a^2$ $a^2-4a-5=0$ $(a-5)(a+1)=0$ Hence $a=5$, $a=-1$. When $a=5$, $y=10x-25$ from (1) $a=-1$, $y=-2x-1$ from (1)	(1)
(b) Let roots be α, β $\therefore \beta=\frac{1}{\alpha}$ $\therefore \alpha\beta=1$ Product of roots for $x^2+mx+(m+2)=0$ ie $\frac{m+2}{1}=1$ Hence $m=-1$	(1) (1)	(e) $4x^2-6x+1=0$ $\alpha+\beta=\frac{3}{2}$, $\alpha\beta=\frac{1}{4}$ (1) $\alpha^4-\beta^4=(\alpha^2-\beta^2)(\alpha^2+\beta^2)$ $=(\alpha-\beta)(\alpha+\beta)(\alpha^2+\beta^2)$ $=(\alpha-\beta)(\alpha+\beta)\left[(\alpha+\beta)^2-2\alpha\beta\right]$ $=\frac{3\sqrt{5}}{4}\left[\left(\frac{3}{2}\right)^2-2\left(\frac{1}{4}\right)\right]$ $=\frac{3\sqrt{5}}{4}\left[\frac{9}{4}-\frac{1}{2}\right]=\frac{3\sqrt{5}}{4}\times\frac{7}{4}$ $=\frac{21\sqrt{5}}{16}$	$\alpha-\beta=\frac{\sqrt{5}}{2}$ (1) (1)
(c) for real roots for all real x $\Delta=b^2-4ac \geq 0$ for $x^2+(k-3)x-k=0$ RTP $(k-3)^2-4(1)(-k)\geq 0$ Now k^2-2k+9 which always ≥ 0 Hence Δ always ≥ 0	(1) (1)		

Hence roots are always real regardless of value of k.

Note: $k^2-2k+9=(k-1)^2+8 \geq 8$
≥ 0

$\therefore x=21$ & $y=16$.

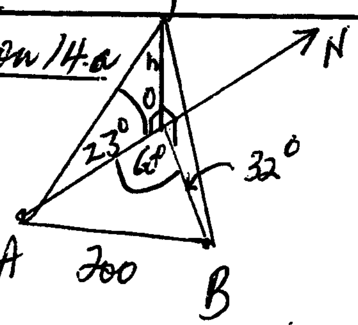
4.

2014 Year 11 Mathematics Extension 1 Yearly Examination SOLUTIONS

Suggested Solution (s)	Comments	Suggested Solution (s)	Comments

Question 14 a

(i)



In ΔTOA $AO = \frac{h}{\tan 23} = h\cot 23^\circ$

In ΔTOB $OB = \frac{h}{\tan 32} = h\cot 32^\circ$ — ①

In ΔAOB using Cosine Rule ①

$200^2 = h^2\cot^2 23 + h^2\cot^2 32 - 2h\cot 23\, h\cot 32 \cos 60^\circ$

$200^2 = h^2 [\cot^2 23 + \cot^2 32 - 2\cot 23\cot 32 \cdot \frac{1}{2}]$

$h^2 = \frac{200^2}{\cot^2 23 + \cot^2 32 - \cot 23\cot 32}$

$h^2 = 9214.5335$

$h \doteq 96$ metres nearest metre ①

(b) (i) ΔABC is isosceles since $AB = BC$ (Equal tangents) ①

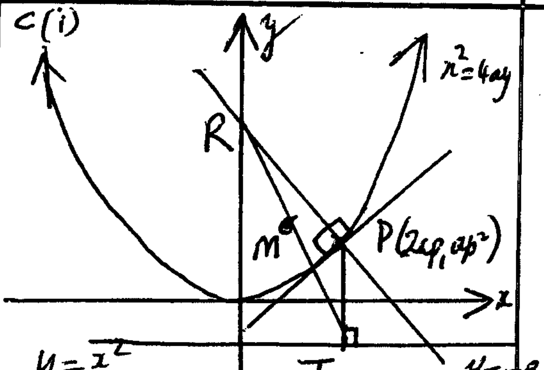
(ii) Let $\angle ACB = \angle BAC = \theta$ (from pt (i))

$\therefore \angle FDC = \theta$ (Angle between tangent and chord is equal to the angle in the alternate segment) ①

$\angle FDC = \angle AFG = \theta$ (Corresponding angles between $\parallel$ lines FG & CD) ①

Hence $\angle BGA = \angle BFA$

c (i)



$y = \frac{x^2}{4a}$

$\frac{dy}{dx} = \frac{x}{2a} = \frac{2ap}{2a} = p$. Hence $M_T = p$. Hence

Gradient of normal $= \frac{-1}{p}$ ①

Eq^n of normal $y - y_1 = m(x - x_1)$

$y - ap^2 = -\frac{1}{p}(x - 2ap)$. ①

$py - ap^3 = -x + 2ap$.

Hence $x + py = 2ap + ap^3$ — (A)

(ii) y intercept $(x=0)$

$\therefore$ Using (A) $y = \frac{2ap + ap^3}{p} = 2a + ap^2$

$\therefore R = (0, 2a + ap^2)$.

(iii) $T = (2ap, -a)$. ①

(iv) $M = \frac{2ap + 0}{2}, \frac{-a + 2a + ap^2}{2}$ ①

$= \left(ap, \frac{a + ap^2}{2}\right) = \left(ap, \frac{a(1+p^2)}{2}\right)$

(v) Let $X = ap$ $Y = \frac{a}{2}(1+p^2)$ at M

$\therefore Y = \frac{a}{2}\left(1 + \frac{X^2}{a^2}\right)$, $\frac{2Y}{a} = 1 + \frac{X^2}{a^2}$ — $y = \frac{x^2}{2a} + \frac{a}{2}$

$2aY = a^2 + X^2$

$x^2 = 2a(y - \frac{a}{2})$ which is a ①

parabola with vertex $(0, \frac{a}{2})$ ① Focal length $= \frac{a}{2}$

Hence focus $= (0, \frac{a}{2} + \frac{a}{2}) = (0, a)$. ①

5.

Yr 11 Mathematics Extension 1 Yearly Q11 Analysis (YUS)

(a) There were still a few students unaware of the correct formula.

(b) Generally done ok, but still room for improvement. Scale must be shown. There were still a few students mixing up x-and y- intercepts.

(c) Most students correctly calculated the size of angle between 0 and 360, but failed to get the last two parts of the answers. Most of them forgot to double the domain.

(d) Many students were unable to see the use of chain rule successfully, which would have lead to the answer quickly. A lot of them were changing to Cartesian form then differentiate it then substitute the values. Quite a few made mistakes with the derivative of the chain function in the process.

(e) Setting out was not done well, while most understood the concept of odd and even functions.

(f) Generally done well.

(g) Most students understood what needed to be done here.

Yr 11 Mathematics Extension 1 Yearly Q12 Analysis (DEL)

(a) Most students were able to sketch the graphs (the majority placing all three on the one set of axes) then determine the number of solutions in each case. In the rare cases of graphs being drawn correctly without correctly determining the number of solutions, one mark was awarded.

(b) Successful students were able to make the first substitution of $1+\tan^2\theta$ for $\sec^2\theta$ and continue on to solve the resultant quadratic equation in $\tan\theta$, yielding four solutions. Marks were awarded according to the progress students made from thereon. Unfortunately, those who made the substitution $\sec^2\theta = \dfrac{1}{\cos^2\theta}$ could make no progress with the equation so no marks could be awarded.

(c) This was able to be solved by inspection quite quickly once they acknowledged that $x+y=11$ and $4\sqrt{6}=2\sqrt{24}\ \therefore\ xy=24$. Students were asked to express $11+4\sqrt{6}$ in the form $(x+y)^2$ so they needed to either begin with $11+4\sqrt{6}$ or finish with "$11+4\sqrt{6}=(\sqrt{8}+\sqrt{3})^2$".

(d) Although not penalized here, students should be aware of the need to draw the diagram. Discretions with reasoning were tolerated to a point though it was apparent that many students had not taken the time to learn appropriate wording. The most common error was to use the alternate angle theorem. Generally quite well done and well set out.

(e) Those who understood function notation fared well here. The most common error was to not properly square (–h). Students should be encouraged to use brackets around negative terms as a matter of course and they will avoid the associated errors.

Yr 11 Mathematics Extension 1 Yearly Q13 Analysis (BRA)

(a) A lot of students interpreted $|2x-1| \le x+1$ incorrectly as $2x-1 \le \pm(x+1)$, instead of $\pm(2x-1) \le x+1$.Reliance on recipes has its pitfalls as was evidenced here. On the analogy of $|x| \le a$ implies $-a \le x \le a$ students wrote $-(x+1) \le 2x-1 \le x+1$. In the main, such students were successful. Those who attempted a graphical solution and were careful about scales were so rewarded. Information extracted from poorly constructed graphs was invariably wrong.

(b) There was much confusion with the meaning of: *roots that are the reciprocals of one another*. Many thought this meant $\alpha = -\dfrac{1}{\beta}$. Many more students attempted to find the roots explicitly in terms of *m* by solving $\alpha + \dfrac{1}{\alpha} = -m.$ They were puzzled as to how the information could be used. A lot of effort was expended for little reward. More still thought *roots that are the reciprocals of one another* meant that $\Delta = 0.$

(c) Most recognised the condition for real roots as $\Delta \ge 0$. A significant number wrote $\Delta > 0$ only. Of those who computed the discriminant successfully as $k^2 - 2k + 9$ there remained the dilemma of how to interpret the result. Some appealed to the POSITIVE DEFINITENESS of the expression; others completed the square. Weaker arguments were presented and credit granted where there was merit.

(d) (i) Everyone computed the derivative correctly. Weaker students left the gradient as 2*x*, whereby the equation for the tangent ended up as a quadratic expression.

(ii) Well done.

(iii) This should been an easy two marks with students simply substituting there values for *a* found in (ii) into the tangent formula developed in (i). However, many decided to develop these tangent lines from scratch and consequently wasted valuable exam time.

(e) Some confusion over the handling of $\alpha^2 - \beta^2$. Knowing $\alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$, they believed $\alpha^2 - \beta^2 = (\alpha-\beta)^2 + 2\alpha\beta$. Apart from this, most errors were arithmetic in nature.

Yr 11 Mathematics Extension 1 Yearly Q14 Analysis (VUL)

(a) (i)Most students copied and added information to the diagram correctly.

(ii)Many students assumed values for angle QAB and angle QBA which oversimplified the question and marks could not be awarded.

(b) Many students ignored the instruction to copy the diagram

(i) Generally well done though some students had trouble expressing the theorem involved

(ii) Many students did not give coherent reasoning to the deductions they made.

(c) (i) Quite well done, though a number of students failed to show how the gradient of the tangent at the Point P was p

(ii)Quite well done.

(iii)A number of students did not know the equation of the directrix which made this part difficult.

(iv)Quite well done as most students knew the midpoint formula.

(v) Poorly done, many students either did not get to this part. Students were not aware they had to eliminate the parameter p.

FINIS