HURLSTONE AGRICULTURAL HIGH SCHOOL

MATHEMATICS
EXTENSION 1

2012

YEAR 11

YEARLY EXAMINATION

(TASK 3 – FINAL PRELIMINARY EXAMINATION)

EXAMINERS ~ S. FAULDS, P. BICZO, S. CUPAC, J. DILLON, B. MORRISON, G. HUXLEY

GENERAL INSTRUCTIONS

- Reading Time – 5 minutes.
- Working Time – 2 hours.
- Attempt **all** questions.
- Board approved calculators and mathematical templates may be used.
- This examination must **NOT** be removed from the examination room.
- Show all necessary working in Questions 11 – 14.
- **Start each question in a separate answer booklet.**
- Put your student number on each booklet.

Total marks – 70

Section I

10 marks

- Attempt Questions 1 – 10.
- Allow about 15 minutes for this section.
- Fill in your answers on the multiple choice answer sheet provided.

Section II

60 marks

- **Attempt Questions 11 – 14.** Each of these four (4) questions worth 15 marks. Allow about 1 hour 45 minutes for this section. **Each question is to be started in a new answer booklet.** Additional booklets are available if required.

STUDENT NAME: ______________________

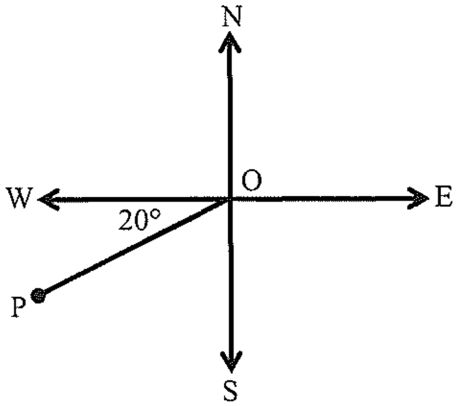
CLASS TEACHER: ______________________

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

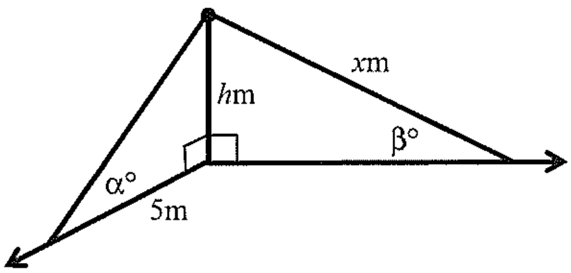
1.



In the above diagram, the true bearing of point O from point P is:

A: 020° **B:** 070° **C:** 110° **D:** 250°

2.



The diagram above shows a vertical mast of height h metres with wire stays attached to the top of the mast. The first stay has its other end attached to the ground 5 metres from the base of the mast, making an angle of α° with the ground. The second stay, of length x metres makes an angle of β° with the ground at its point of attachment.

The value of x is:

A: $5\tan\alpha \operatorname{cosec}\beta$ **B:** $5\tan\alpha\sin\beta$

C: $5\cot\alpha\sec\beta$ **D:** $5\cot\alpha\cos\beta$

3. Which of the following straight lines is perpendicular to the line $3x + 9y - 5 = 0$?

A: $3x - 9y = 0$ **B:** $15x + 5y + 7 = 0$

C: $4x + 12y + 11 = 0$ **D:** $18x - 6y - 1 = 0$

4. The quadratic equation $ax^2 + bx + c = 0$ has roots α and β. The sum of the roots, $\alpha + \beta = 8$ and the product of the roots, $\alpha\beta = -3$. What is the value of $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$?

A: $\frac{1}{64}$ **B:** $\frac{70}{9}$ **C:** 70 **D:** $\frac{64}{9}$

5. The points A(–1, 3), B(3, 4), C(2, –1) and D form the parallelogram ABCD. The co-ordinates of the point D must be:

A: (6, 0) **B:** (4, 9) **C:** (0, 8) **D:** (–2, –2)

6. Which value of k will give the quadratic equation $7x^2 + 5x + k = 0$ rational roots?

A: 35 **B:** 9 **C:** –2 **D:** –16

7. To make the function $f(x) = \frac{x^2 - 3x - 28}{x + 4}$ a continuous function, which one of the following points would need to be added to the function definition:

A: (4, –24) **B:** (– 4, –11) **C:** (4, –3) **D:** (– 4, 0)

8. Which of the following **is not** a property of a rhombus?

A: diagonals are equal

B: adjacent sides are equal

C: diagonals bisect angles through which they pass

D: diagonals are perpendicular bisectors of each other

9. The function $y = f(x)$ is drawn on a number plane.
The derivative of the function is given by $\frac{dy}{dx} = \frac{x+3}{x-1}$.
The tangent to the curve will be parallel to the x-axis when:

A: $x = 1$ **B:** $x = -3$ **C:** $x = -4$ **D:** $x = 0$

10. A line passing through the point of intersection of $3x - 2y + 7 = 0$ and $4x + 3y - 5 = 0$ also passes through the point (1, 1). Before simplifying, the equation of the line is:

A: $8 - 2k = 0$

B: $3x - 2y + 7 - 4(4x + 3y - 5) = 0$

C: $3x - 2y + 7 + 4(4x + 3y - 5) = 0$

D: $8 + 2k = 0$

Section II

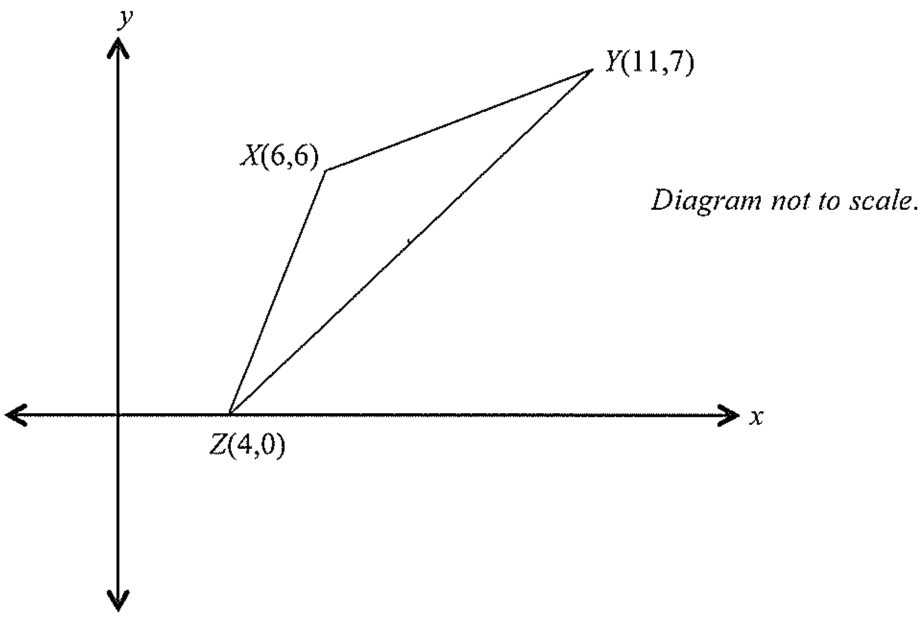
60 marks
Attempt Questions 11 – 14
Allow about 1 hour 45 minutes for this section

Answer each question in a new answer booklet.

All necessary working should be shown in every question.

Question 11 (15 marks) **Start a new answer booklet.** **Marks**

(a) The points X, Y and Z form a triangle as shown in the diagram below.



(i) Find the gradient of ZY. **1**

(ii) Show that the altitude from X to the side ZY has equation $x + y = 12$. **2**

(iii) Find the coordinates of P, the intersection of the altitude $x + y = 12$ and the side ZY. **2**

(iv) Show the distance XP is $2\sqrt{2}$ units. **1**

(v) Find the area of triangle XYZ. **2**

Question 11 continues on the next page...

Question 11 (continued) **Marks**

(b) In which ratio does the point $P(1, 6)$ divide the interval with endpoints $A(-3,4)$ and $B(3,7)$? **2**

(c) Explain why the line $3x+4y-45=0$ is a tangent to the circle $(x-4)^2+(y-2)^2=25$. **2**

(d) The angle between the lines $y=\frac{x}{4}+2$ and $y=mx+1$ is $45°$. Give the possible value(s) of m. **3**

Question 12 (15 marks) **Start a new answer booklet.** **Marks**

(a) Using differentiation from first principles, show that if $g(x)=3x^2-4x$, then $g'(x)=6x-4$. **2**

(b) Use the product rule to differentiate $f(x)=(x^3-2x+1)(x^2+x+1)$. **2**

(c) Find the derivative with respect to x of the following:

(i) $\dfrac{x^2-x}{5x^3}$ **2**

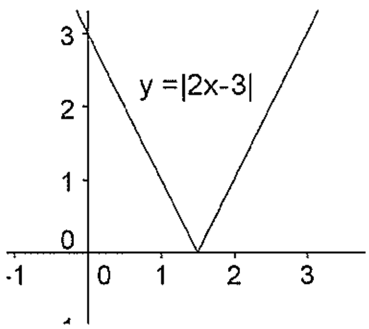
(ii) $(x^3-1)^5$ **2**

(d) The graph of the function $f(x)=x^3-x^2-x+1$ has a tangent at $x=0$ that has a y-intercept of 1. Determine the equation of the normal to the curve at $x=0$. **3**

(e) Determine $\lim\limits_{x\to\infty}\dfrac{3x}{x+5}$. **1**

(f) Prove that $f(x)=\dfrac{1}{x}$ is continuous at $x=3$. **2**

(g) The graph of $y=|2x-3|$ is shown below. **1**



The function is continuous at all points. Why is the function $y=|2x-3|$ not differentiable at the point $x=\dfrac{3}{2}$.

Question 13 (15 marks) **Start a new answer booklet.** **Marks**

(a) Sketch the curve $y = 2(x + 1)(x - 3)$. **2**
On your diagram, show the coordinates of the vertex, and any intercepts with the axes.

(b) Given $2x^2 - 7x \equiv ax^2 + 2ax + bx$, find b. **1**

(c) The quadratic equation $2x^2 - x + m = 0$ has one of it's roots equal to twice the other root.

(i) Show that one of the roots of the equation is $\frac{1}{6}$. **2**

(ii) Hence, find the value of m. **1**

(d) Solve for x, giving exact answers: **2**

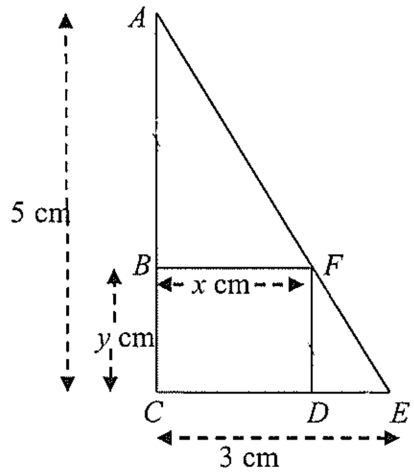
$$25^x - 13(5)^x + 12 = 0$$

(e) (i) Show that the discriminant of $px^2 + (3+p)x + (3+p)$ where p is a constant, is given by $-3p^2 - 6p + 9$. **1**

(ii) Hence, or otherwise, find the values of p for which $px^2 + (3+p)x + (3+p)$ is positive for all values of x. **2**

Question 13 continues on the next page...

(f)



In the diagram shown, $BCDF$ is a rectangle. CB and CD are produced to A and E, so that A, F and E are collinear. $AC = 5$ cm, $CE = 3$ cm, $CD = x$ cm and $BC = y$ cm.

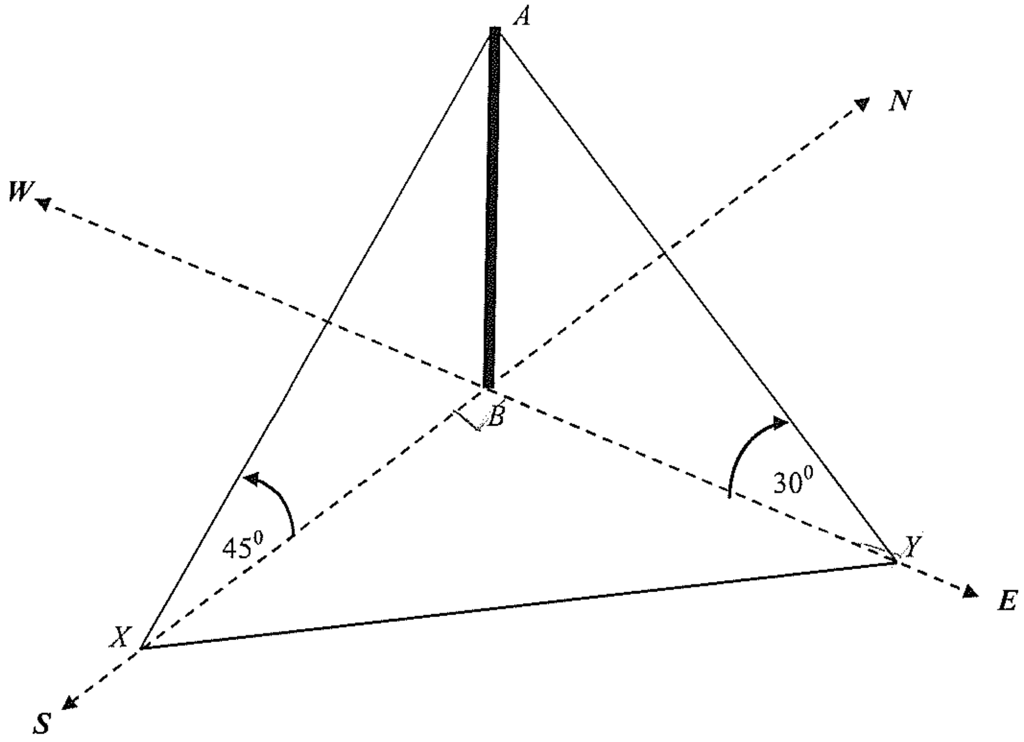
(i) You are given that triangles ABF and FDE are similar. **2**

Show that $y = \dfrac{15-5x}{3}$.

(ii) **Without the use of calculus**, show that the maximum area of rectangle $BCDF$ is $3 \cdot 75 \text{ cm}^2$. **2**

Question 14 (15 marks) **Start a new answer booklet.** **Marks**

(a) A pole, AB is 4 metres high and on level ground.
Point X is due south of the pole and the angle of elevation from X to the top of the pole is 45°.
Another point Y is due east of the pole and the angle of elevation from Y to the top of the pole is 30°



(i) Show that $BX = 4$ metres and $BY = 4\sqrt{3}$ metres. **2**

(ii) What is the bearing of X from Y? **2**

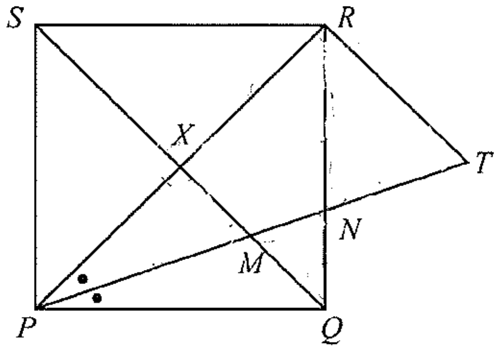
(b) Solve the equation $\sin 2\theta = \cos\theta$ for $0 \le \theta \le 2\pi$. **2**

(c) Solve the inequality $\dfrac{3-2x}{x-3} \le 4$. **2**

Question 14 continues on the next page…

Question 14 (continued) **Marks**

(d) *PQRS* is a square. The diagonals intersect at *X*.
PM, where *M* lies on *QS*, bisects $\angle QPX$.
$PM = MT$.
PT cuts *RQ* at *N*.



(i) What is the size of $\angle PXM$? Give a reason for your answer. **1**

(ii) Prove that $\angle NRT = 45°$. **2**

(iii) Prove that $\Delta NRT \parallel\!| \Delta NQM$. **2**

(iv) Prove that $\dfrac{RN}{QN} = \dfrac{2XM}{QM}$. **2**

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Question No. 1-10 Multiple Choice Solutions

Solutions

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

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Question No. 11 | Solutions and Marking Guidelines

Outcomes Addressed in this Question

P4 - chooses and applies appropriate arithmetic, algebraic, graphical, trigonometric and geometric techniques

Outcome	Solutions	Marking Guidelines

a) (i)

$Z(4,0)\ \ Y(11,7)$

$m=\dfrac{y_2-y_1}{x_2-x_1}$

$=\dfrac{7-0}{11-4}$

$=1$

(1 mark) correct gradient

(ii)

$X(6,6)$, altitude perpendicular to ZY, $m=-1$

$y-y_1=m(x-x_1)$

$y-6=-1(x-6)$

$y-6=-x+6$

$\therefore x+y=12$

(2 marks) correct solution
(1 mark) substantial progress towards correct solution

(iii)

Equation of ZY is $y=x-4$

$x+y=12...(1)$

$y=x-4...(2)$

Solve simultaneously to find intersection:

$x+(x-4)=12$

$2x-4=12$

$x=8$

when $x=8$:

$y=4$

$\therefore P(8,4)$

(2 marks) correct solution
(1 mark) substantial progress towards correct solution

(iv)

$P(8,4)\ \ X(6,6)$

$d=\sqrt{(6-8)^2+(6-4)^2}$

$=\sqrt{(-2)^2+(2)^2}$

$=\sqrt{8}$

$=2\sqrt{2}$

(1 mark) correct solution with working.

(v)

$d_{ZY}=\sqrt{(11-4)^2+(7-0)^2}$

$=\sqrt{98}$

$A=\dfrac{1}{2}\times b\times h$

$=\dfrac{1}{2}\times\sqrt{98}\times 2\sqrt{2}$

$=14\text{u}^2$

(2 marks) correct solution
(1 mark) substantial progress towards correct solution

(b)

$P(1,6)\ A(-3,4)\ B(3,7)$

Let ratio be $k:1$ $(AP:AB)$

$x=\dfrac{mx_2+nx_1}{m+n}$

$1=\dfrac{k(3)+1(-3)}{k+1}$

$k+1=3k-3$

$k=2$

$\therefore$ Ratio is 2:1

(2 marks) correct solution
(1 mark) substantial progress towards correct solution

(c)

$3x+4y-45=0$ Circle with centre $(4,2)$ radius 5

The line is a tangent if the perpendicular distance from the centre of circle to the line is the same length as the radius of the circle.

$d=\dfrac{|ax_1+by_1+c|}{\sqrt{a^2+b^2}}$

$=\dfrac{|3(4)+4(2)-45|}{\sqrt{9+16}}$

$=\dfrac{|-25|}{5}$

$=5$

$\therefore$ The line is a tangent since the perpendicular distance from the centre of the circle to the line is the same length as the radius of the circle.

(2 marks) correct solution with explanation.
(1 mark) substantial progress towards correct solution

(d)

$y=\dfrac{1}{4}x+2,\ m_1=\dfrac{1}{4}$

Let $m_2=m$

$\tan\theta=\left|\dfrac{m_1-m_2}{1+m_1m_2}\right|$

$\tan 45^\circ=\left|\dfrac{\frac{1}{4}-m}{1+\frac{1}{4}m}\right|$

$1=\left|\dfrac{\frac{1-4m}{4}}{\frac{4+m}{4}}\right|$

$1=\left|\dfrac{1-4m}{4+m}\right|$

$\dfrac{1-4m}{4+m}=1$ *or* $\dfrac{1-4m}{4+m}=-1$

$1-4m=4+m$ $1-4m=-4-m$

$\therefore m=\dfrac{5}{3}$ $m=\dfrac{-3}{5}$

(3 marks) two values for m.
(2 marks) one value for m.
(1 mark) some progress towards correct solution.

Year 11	Mathematics Extension 1	Yearly Exam 2012
Question No. 12	Solutions and Marking Guidelines	

Outcomes Addressed in this Question

P4 Chooses and applies appropriate arithmetic, algebraic, graphical, trigonometric and geometric techniques.
P6 Relates the derivative of a function to the slope of its graph.
P7 Determines the derivative of a function through routine application of the rules of differentiation.
P8 Understands and uses the language and notation of calculus.

Outcome	Solutions	Marking Guidelines
P4 P6 P7 P8	**Question 12:** (a) If $g(x)=3x^2-4x$ show that $g'(x)=6x-4$ $g'(x)=\text{Limit}_{h\to 0}\dfrac{\{3(x+h)^2-4(x+h)\}-\{3x^2-4x\}}{h}$ $=\text{Limit}_{h\to 0}\dfrac{\{3x^2+6xh+3h^2-4x-4x\}-\{3x^2-4x\}}{h}$ $=\text{Limit}_{h\to 0}\dfrac{3x^2+6xh+3h^2-4x-4h-3x^2+4x}{h}$ $=\text{Limit}_{h\to 0}\dfrac{6xh+3h^2-4h}{h}$ $=\text{Limit}_{h\to 0}\dfrac{h(6x+3h-4)}{h}$ $=\text{Limit}_{h\to 0}6x+3h-4$ $=6x-4$	(1 mark deducted for each minor error) 1 mark 1 mark
	(b) $f(x)=(x^3-2x+1)(x^2+x+1)$ {If $f(x)=uv$, then $f'(x)=u'v+uv'$ or similar) $f'(x)=(3x^2-2)(x^2+x+1)+(x^3-2x+1)(2x+1)$ $=3x^4+3x^3+3x^2-2x^2-2x-2+2x^4+x^3-4x^2-2x+2x+1$ $=5x^4+4x^3-3x^2-2x-1$	(1 mark deducted for each minor error) 1 mark 1 mark
	(c) $h(x)=\dfrac{x^2-x}{5x^3}$ $\{h(x)=\dfrac{u}{v}$ $h'(x)=\dfrac{u'v-uv'}{v^2}\}$ $h'(x)=\dfrac{(2x-1)(5x^3)-(x^2-x)15x^2}{25x^6}$ $=\dfrac{10x^4-5x^3-15x^4+15x^3}{25x^6}$ $=\dfrac{-5x^4+10x^3}{25x^6}$ $=\dfrac{5x^3(2-x)}{25x^6}$ $=\dfrac{2-x}{5x^3}$	(1 mark deducted for each minor error) 1 mark 1 mark

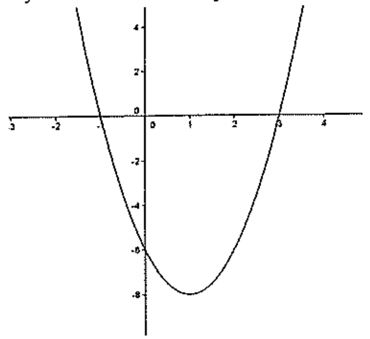
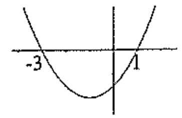
(d) (i)	$\angle PXM=90^0$ (diagonals of a square are perpendicular)	Award 1 for correct solution
(ii)	In ΔPXM and ΔPRT $\dfrac{PX}{PR}=\dfrac{1}{2}$ (X is the midpoint of PR) $\dfrac{PM}{PT}=\dfrac{1}{2}$ (M is the midpoint of PT) $\angle PXM=\angle RPT$ (same angle) $\therefore \Delta PXM \parallel\!\mid \Delta PRT$ (sides about equal angles are in the same ratio) $\therefore \angle PXM=\angle PRT$ (matching angles in similar triangles are equal) $\therefore \angle PRT=90^0$ But $\angle PRQ=45^0$ (diagonals of a square bisect the vertex angles ~ which are 90^0) $\angle NRT+45^0=90^0$ (angle sum of right angle PRT is 90^0) $\therefore \angle NRT=45^0$. or Diagonals of the square bisect each other at X $PX=XR$ ($\therefore$ X is the midpoint of PR) $PM=MT$ (given)($\therefore$ M is the midpoint of PT) $\therefore XM \parallel RT$ (an interval joining the midpoints of two sides of ΔPRT is parallel to the third side) $\therefore \angle PXM=\angle PRT$ ($=90^0$, corresponding angles are equal, $XM \parallel RT$) $\therefore \angle PRQ=45^0$ (diagonals of a square bisect the vertex angles ~ which are 90^0) But $\angle NRT+45^0=90^0$ (angle sum of right angle PRT is 90^0) $\therefore \angle NRT=45^0$.	Award 2 Correct solution (with full justification) Award 1 Correct solution (with insufficient justification)
(iii)	In ΔNRT and ΔNQM $\angle NQM=45^0$ (diagonals of a square bisect the vertex angles ~ which are 90^0) But $\angle NRT=45^0$ (from (ii)) $\therefore \angle NQM=\angle NRT$ $\angle TNR=\angle MNQ$ (vertically opposite angles are equal) $\therefore \Delta NRT \parallel\!\mid \Delta NQM$ (equiangular)	Award 2 Correct solution (with full justification) Award 1 Correct solution (with insufficient justification)
(iv)	In ΔNRT and ΔNQM $\dfrac{NR}{NQ}=\dfrac{NT}{NM}=\dfrac{RT}{QM}$ (matching sides in similar triangles are in the same ratio) $XM=\dfrac{RT}{2}$ (interval joining the midpoints of two sides of ΔPRT is half the length of the third side *or* $\dfrac{XM}{RT}=\dfrac{1}{2}$ (matching sides in similar triangles are in the same ratio)) $\therefore RT=2XM$ $\therefore \dfrac{NR}{NQ}=\dfrac{2XM}{QM}$.	Award 2 Correct solution (with full justification) Award 1 Correct solution (with insufficient justification)

Year 11 Yearly	Mathematics Extension 1	Examination 2012
Question No.13	Solutions and Marking Guidelines	

Outcomes Addressed in this Question

P4 chooses and applies appropriate arithmetic, algebraic, graphical, trigonometric and geometric techniques

P5 Understands the concept of a function and the relationship between a function and its graph

Outcome	Solutions	Marking Guidelines
P5	a) $y=2(x+1)(x-3)$ cuts the x axis at $x=-1, 3$ Axis of symmetry, halfway between at $x=1$ When $x=1$, $y=2\times2\times-2=-8$. $\therefore$ vertex $(1,-8)$ Cuts y axis when $x=0$ at $y=2\times1\times-3=-6$. 	2 marks: correct graph 1 mark : significant progress towards correct graph
P4	b) $2x^2-7x\equiv ax^2+2ax+bx$ $\equiv ax^2+(2a+b)x$ Equating like coefficients, $a=2$, $2a+b=-7$ $4+b=-7$ $b=-11$ $\therefore a=2$, $b=-11$.	1 mark : correct answer
P4	c) (i) Let the roots be α, 2α Given $2x^2-x+m=0$, sum of roots $=\frac{-b}{a}=\frac{1}{2}$ product of roots $=\frac{c}{a}=\frac{m}{2}$ Sum of roots $3\alpha=\frac{1}{2}$ $\therefore \alpha=\frac{1}{6}$	2 marks: correct solution 1 mark : significant progress towards correct solution
P4	(ii) Product of roots $2\alpha^2=\frac{m}{2}$ $2\left(\frac{1}{6}\right)^2=\frac{m}{2}$ $m=\frac{1}{9}$	1 mark: correct solution
P4	d) $25^x-13(5)^x+12=0$ $(5^2)^x-13(5^x)+12=0$ $(5^x)^2-13(5^x)+12=0$ Let $u=5^x$. $\therefore u^2-13u+12=0$ $(u-12)(u-1)=0$ $u=12$ and $u=1$. $\therefore 5^x=12$ and $5^x=1$. $x=\log_5 12$ or $x=0$.	2 marks: correct answers 1 mark: significant progress towards correct answer
P4	e) (i) For $px^2+(3+p)x+(3+p)$ $\Delta=b^2-4ac$ $=(3+p)^2-4p(3+p)$ $=9+6p+p^2-12p-4p^2$ $=-3p^2-6p+9$	1 mark: correct solution
P4,5	(ii) For the quadratic to be positive, $\Delta<0$ and the co-efficient of x^2 must be positive $\therefore -3p^2-6p+9<0$ $p^2+2p-3>0$ $(p-1)(p+3)>0$ $\therefore p<-3$ and $p>1$  But the co-efficient of x^2 must be positive. $\therefore p>1$ only.	2 marks: correct solution 1 mark: significant progress towards correct answer
P4	f) (i) As triangles ABF and FDE are similar, their sides are in the same ratio. $\therefore \frac{x}{3-x}=\frac{5-y}{y}$ $\therefore xy=(3-x)(5-y)$ $xy=15-3y-5x+xy$ $0=15-3y-5x$ $\therefore y=\frac{15-5x}{3}$	2 marks: correct solution 1 mark: significant progress towards correct answer
P4,5	(ii) Area of the rectangle, $A=xy$ $\therefore A=x\left(\frac{15-5x}{3}\right)$ which is a concave down parabola and hence has a maximum value on the axis of symmetry. $A=\frac{-5x^2}{3}+5x$ has axis of symmetry at $A=\frac{-5}{2\times-5/3}$ ie. $x=\frac{3}{2}$. When $x=\frac{3}{2}$, $\therefore A=\frac{3}{2}\left(\frac{15-5\times 3/2}{3}\right)=3.75$ $\therefore$ maximum area of the rectangle is $3\cdot75$ cm^2.	2 marks: correct solution 1 mark: significant progress towards correct answer

Year 11 Question 14	Mathematics Extension 1 Solutions and Marking Guidelines	Yearly Examination 2012

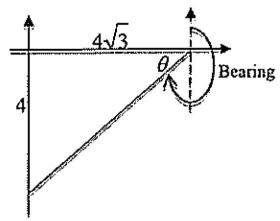
Outcomes Addressed in this Question

P3 **performs routine arithmetic and algebraic manipulation involving** surds, simple rational expressions and **trigonometric identities**

P4 **chooses and applies appropriate** arithmetic, algebraic, graphical, **trigonometric** and geometric **techniques**

PE2 **uses multi-step deductive reasoning in a variety of contexts**

PE3 **solves problems involving** permutations and combinations, **inequalities**, polynomials, circle geometry and parametric representations

Outcome	Solutions	Marking Guidelines
(a) (i)	$\frac{AB}{BX}=\tan 45^\circ$ $\quad \frac{AB}{BY}=\tan 30^\circ$ $\frac{4}{BX}=1$ $\quad \frac{4}{BY}=\frac{1}{\sqrt{3}}$ $\therefore BX=4$ $\quad \therefore BY=4\sqrt{3}$	**Award 2** Both *BX* and *BY* correct (with appropriate justification) **Award 1** Only one of *BX* or *BY* correct (with appropriate justification)
(ii)	 $\tan\theta=\frac{4}{4\sqrt{3}}=\frac{1}{\sqrt{3}}$ $\quad \therefore \text{Bearing}=240^\circ$ or $S60^\circ W$ $\theta=30^\circ$	**Award 2** Correct solution **Award 1** Substantial progress towards solution
(b)	$\sin 2\theta=\cos\theta$ $2\sin\theta\cos\theta=\cos\theta$ $2\sin\theta\cos\theta-\cos\theta=0$ $\cos\theta(2\sin\theta-1)=0$ $\therefore \cos\theta=0$ or $\sin\theta=\frac{1}{2}$ $\therefore \theta=\frac{\pi}{2},\frac{3\pi}{2}$ or $\theta=\frac{\pi}{6},\frac{5\pi}{6}$	**Award 2** Correct solution **Award 1** Substantial progress towards solution
(c)	$\frac{3-2x}{x-3}\le 4 \quad x\ne 3$ $(3-2x)(x-3)\le 4(x-3)^2$ $4(x-3)^2-(3-2x)(x-3)\ge 0$ $(x-3)(4(x-3)-(3-2x))\ge 0$ $(x-3)(6x-15)\ge 0$ $3(x-3)(2x-5)\ge 0$ Solution of the quadratic inequality is $x\le\frac{5}{2}$ or $x\ge 3$ But $x\ne 3$ $\therefore$ The solution of the original inequality is $x\le\frac{5}{2}$ or $x>3$	**Award 2** Correct solution **Award 1** Substantial progress towards solution
	(d) $q(x)=(x^3-1)^5$ $\{q(x)=q(u)$ where $u=u(x)$, $\frac{dq}{dx}=\frac{dq}{du}\frac{du}{dx}\}$ $q(u)=u^5$, where $u=x^3-1$ $\frac{dq}{dx}=5u^4\times 3x^2$ $=15x^2(x^3-1)^4$	(1 mark deducted for each minor error) 1 mark 1 mark
	(e) $\frac{df(x)}{dx}=3x^2-2x-1$ $\frac{df}{dx}/_{x=0}=-1$ i.e. the tangent has gradient -1 at (0,-1) The normal has gradient 1 at (0,1) The equation of the normal is $y=x+1$	(1 mark deducted for each minor error) 1 mark 1 mark 1 mark
	(f) $\text{Limit}_{x\to 5}\frac{3x}{x+5}=\text{Limit}_{x\to 5}\frac{\frac{3x}{x}}{\frac{x}{x}+\frac{5}{x}}$ $\text{Limit}_{x\to 5}\frac{3x}{x+5}=3$	1 mark
	(g) The function is continuous if: $\text{Lt}_{x\to 3^-}f(x)=\text{Lt}_{x\to 3^+}f(x)=f(3)$ $\text{Lt}_{x\to 3^-}f(x)=\frac{1}{3}$ $\quad \text{Lt}_{x\to 3^+}f(x)=\frac{1}{3}$ *and* $f(3)=\frac{1}{3}$ $\therefore$ *continuous*	(2 marks for full proof, 1 mark for 2 parts) 2 marks
	(h) $\text{Lt}_{x\to 1\frac{1}{2}^-}g'(x)\ne \text{Lt}_{x\to 1\frac{1}{2}^+}g'(x)$ *i.e.* $-2\ne 2$ OR Not smooth OR Riding a mini-train etc. story. OR Sharp point OR Spike	1 mark for any of these