2010
Preliminary Course
FINAL EXAMINATION
Tuesday 14th September

Mathematics

General Instructions

- Reading Time - 5 minutes.
- Working Time – 3 hours.
- Write using a black or blue pen.
- Approved calculators may be used.
- All necessary working should be shown for every question.
- Begin each question in a new booklet.

Total marks (**120**)

- Attempt Questions 1- 10.
- All questions are of equal value.

Outcomes to be Assessed:

A student:

P2 provides reasoning to support conclusions which are appropriate to the context.

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.

P5 understands the concept of a function and the relationship between a function and its graph.

Question 1 (12 Marks) Use a Separate Booklet **Marks**

a) Expand and simplify: $(x-3)(2x+1)$ **2**

b) Simplify $\sqrt{27}+\sqrt{12}$ **2**

c) Express the decimal $0.\dot{2}\dot{1}$ as a fraction in simplest form. **2**

d) Factorise the following expression fully: **2**

$4x^2 - 16$

e) Rationalise the denominator of: **2**

$$\frac{\sqrt{3}}{3-\sqrt{2}}$$

f) Solve for x : **2**

$$\frac{2x-1}{5} = \frac{3x+2}{4}$$

End of Question 1

Question 2 (12 Marks) Use a Separate Booklet **Marks**

a) Is the function $f(x) = 8x^3 - 7x$ even, odd or neither? (Show working). **2**

b) For the function $y = 2^x + 1$:

i) Sketch, showing all the essential features. **2**

ii) State the domain and range. **2**

c) Sketch the graph of $f(x) = x^2 + 5x + 6$, showing all essential features **3**

d) Show the region of the number plane where the following hold simultaneously (do **not** find points of intersection): **3**

$$x^2 + y^2 \leq 9$$

$$y < x$$

End of Question 2

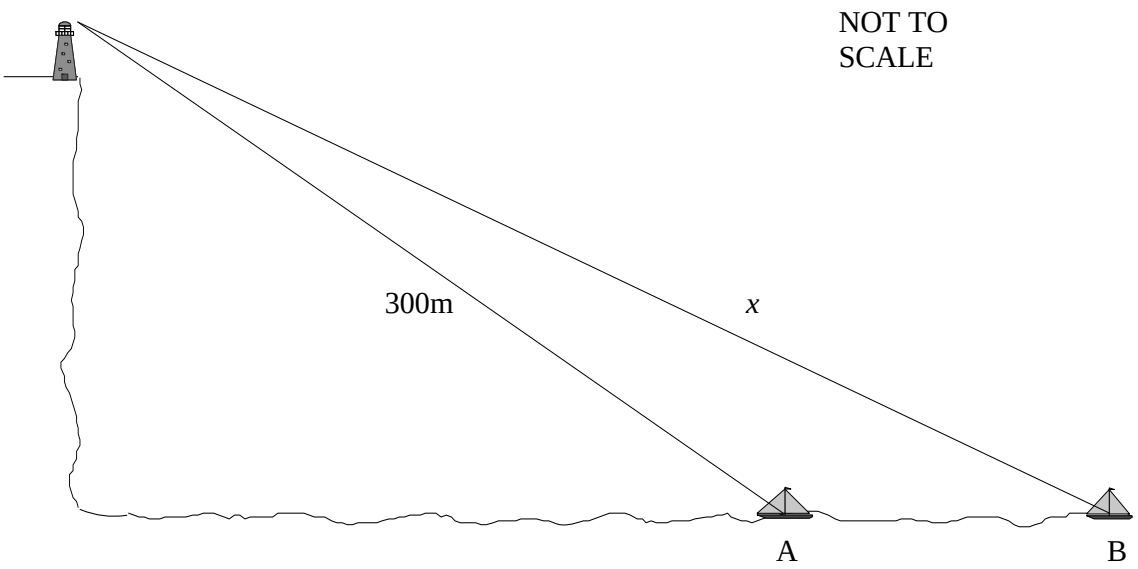
Question 3 (12 Marks) Use a Separate Booklet **Marks**

a) A rock climber is standing on the top of a vertical cliff which is 80 metres above sea level. The angle of depression of a tanker out to sea is 32^0.

i) Draw a diagram to show this information **1**

ii) Calculate the distance (to the nearest metre) from the base of the cliff to the tanker. **2**

b) Two yachts, 250 m apart, are both due east of a lighthouse, which is on top of a cliff. The angle of elevation of the lighthouse from Yacht A is 37^0 . It is known that Yacht A is exactly 300 m from the lighthouse.



(Assume the cliff meets the water at right angles)

i) Using the cosine rule, show that x is 522 m (to the nearest metre). **2**

ii) Using the sine rule find the angle of elevation (to the nearest minute) of the lighthouse from Yacht B. **2**

Question 3 (continued) **Marks**

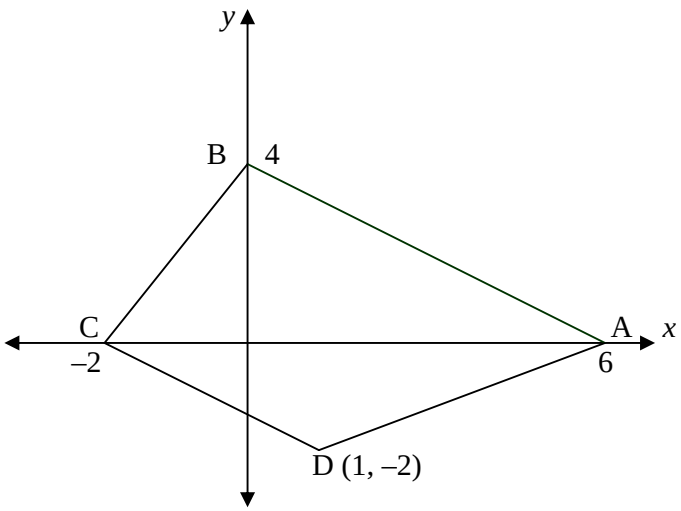
c) Solve $2\cos^2\theta = 1$ for $0^\circ \leq \theta \leq 360^\circ$ **3**

d) Solve for x: $4^{2x-1} = 8$ **2**

End of Question 3

Question 4 (12 Marks) Use a Separate Booklet **Marks**

a)



ABCD is a Trapezium as shown in the diagram above.
The coordinates of the point D are (1, –2).

(i) What acute angle does the line BC make with the positive x-axis? Give your answer to the nearest degree. **2**

(ii) Find the midpoint (M) of the interval AB. **1**

(iii) Show that the equation of the line CD is given by $2x + 3y + 4 = 0$. **2**

(iv) Show the distance from the point M to the line CD is equal to $\frac{16\sqrt{13}}{13}$ units. **2**

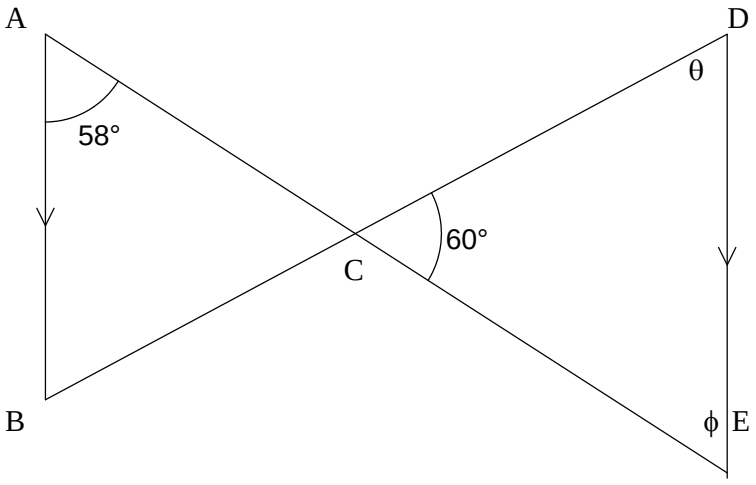
(v) Given that CD is $\sqrt{13}$ units, calculate the distance AB and hence find the area of the trapezium ABCD. **3**

b) Sketch $y = \sin x$ for $0^0 \le x \le 360^0$ **2**

End of Question 4

Question 5 (12 Marks) Use a Separate Booklet **Marks**

a) Find ϕ and θ, giving reasons. **2**



b) If $f(x) = \begin{cases} -3, & x \geq 0 \\ 2x-3, & x < 0 \end{cases}$

Evaluate $f(-1) + f(1)$. **2**

c) Factorise $a^3 + 8$ **2**

Question 5 continues

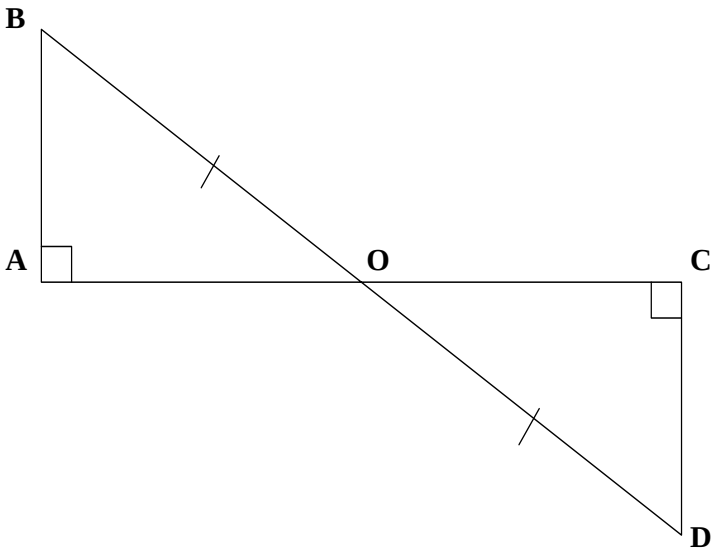
Question 5 (continued) **Marks**

d) The sum of the interior angles of a regular polygon is 3960°.

i) Show that the number of sides of the polygon is 24. **1**

ii) Find the size of each interior angle. **1**

e)



Prove that $\Delta AOB \equiv \Delta COD$. **2**

f) Solve $|3x-5| \leq 2$ **2**

End of Question 5

Question 6 (12 Marks) Use a Separate Booklet **Marks**

a) Solve the following, leaving answers in exact simplified form: **3**

$x^2 - 6x + 7 = 0$

b) Solve $(5^x)^2 - 26(5^x) + 25 = 0$ for x. **3**

c) Show that $-3x^2 + x - 1 < 0$ for all x. **2**

d) For the equation $2x^2 + 5x - 3 = 0$ with roots α and β, find the value of:

i) $\alpha + \beta$ **1**

ii) $\alpha\beta$ **1**

iii) $\frac{1}{\alpha} + \frac{1}{\beta}$ **2**

End of Question 6

Question 7 (12 Marks) Use a Separate Booklet **Marks**

a) By completing the square, find values of a and b such that:

i) $x^2 + 2x + 5 = (x + a)^2 + b$ **2**

ii) Hence sketch $y = x^2 + 2x + 5$ **2**

b) Consider the equation $x^2 + (k+3)x + 9 = 0$.

For what values of k does the equation have:

i) equal roots? **2**

ii) distinct real roots? **1**

c) Find the value of a if $\sin 35^0 = \cos(a + 30)^0$ **1**

d) Find the exact value of $\sin 120^0 \cos 45^0$ **2**

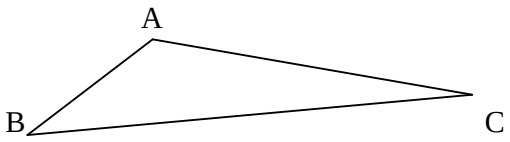
e) Given that $\cos\theta = -\frac{4}{5}$ and $\sin\theta > 0$, find the exact value of $\tan\theta$ **2**

End of Question 7

Question 8 (12 Marks) Use a Separate Booklet **Marks**

a) Solve $|2x-3|=5x$ **3**

b)



In the diagram, AB = 12 cm, AC = 16 cm and BC = 21 cm.

i) Find, correct to the nearest minute, $\angle$BAC. **3**

ii) Hence, find the area of ΔABC. **2**

c) For the function $f(x)=\sqrt{4-x^2}$, write down the natural domain and range. **2**

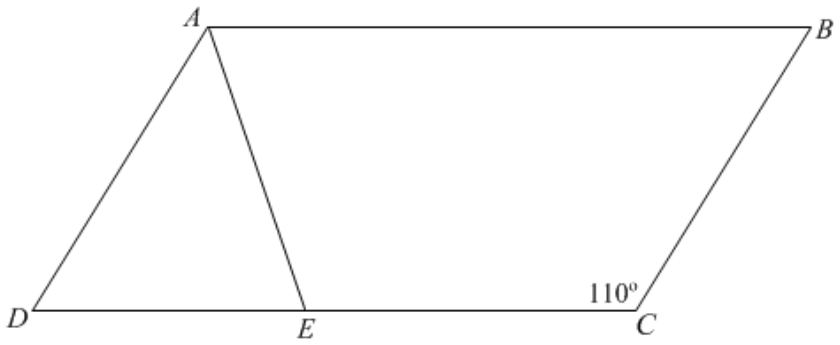
d) Find the value of m in $x^2+2mx-6=0$ if one of the roots is 2. **2**

End of question 8

Question 9 (12 Marks) Use a Separate Booklet **Marks**

a) Find values of A, B and C if $x^2 + x - 2 \equiv A(x-2)^2 + Bx + C$ **3**

b) $ABCD$ is a parallelogram and $AD = AE$. **3**



Find $\angle DAE$, giving reasons.

c) A golf ball is projected upwards so that its height (h) in metres, above the ground, is given by the formula $h = 90t - 15t^2$, where t is the time in seconds.

i) When was the ball 75 metres above the ground? **2**

ii) How long before the ball falls to the ground? **2**

iii) What was the highest point reached by the ball? **2**

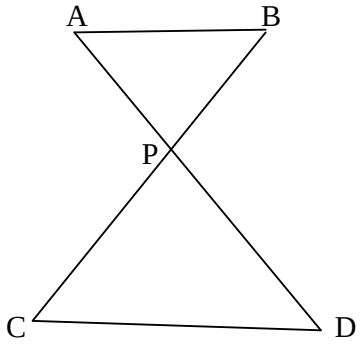
End of Question 9

Question 10 (12 Marks) Use a Separate Booklet **Marks**

a) Prove that $\tan\theta + \cot\theta = \sec\theta\,\text{cosec}\,\theta$ **3**

b) By completing the squares determine the centre and radius of the following circle: $x^2 - 2x + y^2 - 4y - 4 = 0$ **3**

c)



In the diagram, AB || CD, and AD and BC intersect at P.
Copy or trace the diagram onto your own paper.

If ΔABP is similar to ΔDCP and AB = 5 cm, CD = 7 cm and BC = 12 cm, find the length of BP. **2**

d) Sketch $y = \dfrac{-1}{x+2} + 2$ **2**

e) Show that $2(2^k - 1) + 2^{k+1} = 2(2^{k+1} - 1)$ **2**

End of Exam

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Preliminary Final
EXAMINATION 2010

Mathematics

SOLUTIONS

Question 1	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(a)	$(x-3)(2x+1)$ $=2x^2+x-6x-3$ $=2x^2-5x-3$	2	
(b)	$\sqrt{27}+\sqrt{12}$ $=3\sqrt{3}+2\sqrt{3}$ $=5\sqrt{3}$ $=\sqrt{75}$ $\therefore A=75$	2	1 for simplifying 1 for solution
(c)	$x=0.212121.....$ $100x=21.21212121....$ $99x=21$ $x=\frac{21}{99}$ $0.\dot{2}\dot{1}=\frac{7}{33}$	2	
(d)	$4x^2-16$ $=4(x^2-4)$ $=4(x+2)(x-2)$	2	
(e)	$\frac{\sqrt{3}}{3-\sqrt{2}}\times\frac{3+\sqrt{2}}{3+\sqrt{2}}$ $=\frac{3\sqrt{3}+\sqrt{6}}{9-2}$ $=\frac{3\sqrt{3}+\sqrt{6}}{7}$	2	
(f)	$\frac{2x-1}{5}=\frac{3x+2}{4}$ $4(2x-1)=5(3x+2)$ $8x-4=15x+10$ $7x=-14$ $x=-2$	2	

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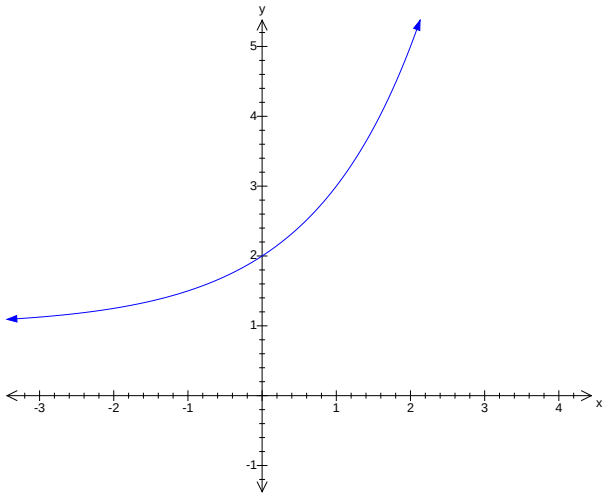
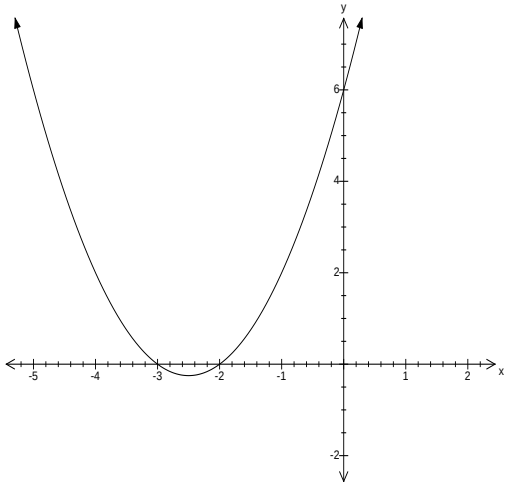
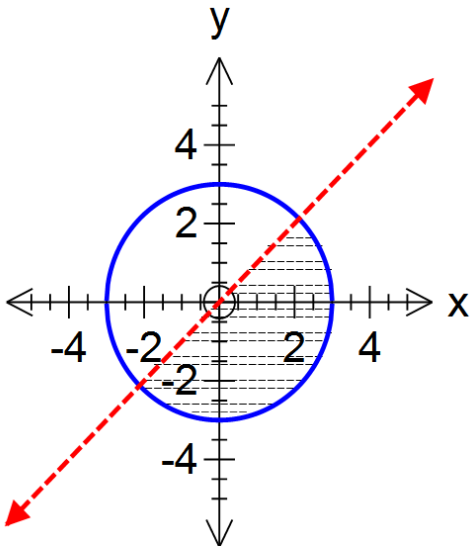
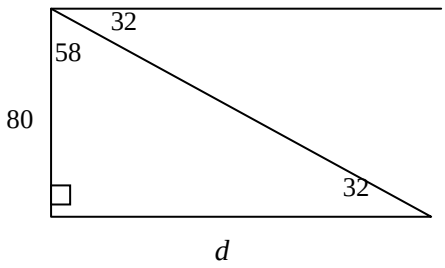
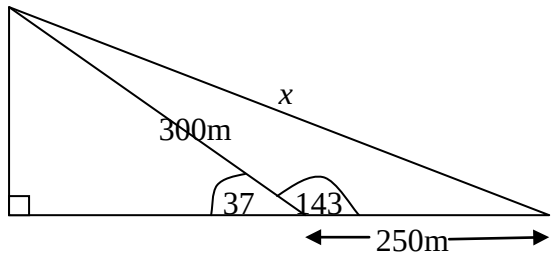
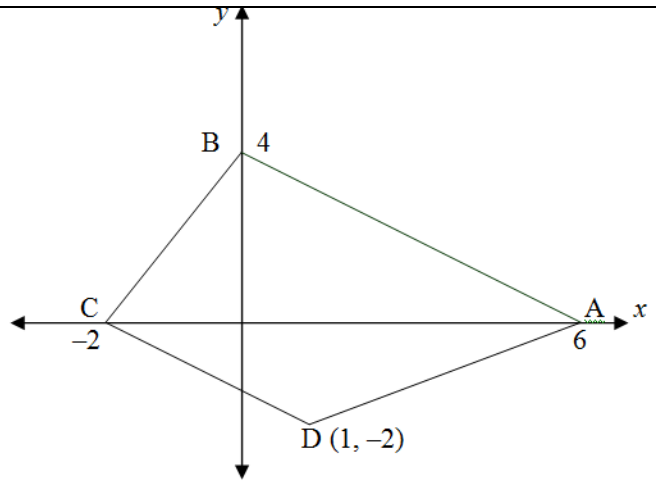
Question 2	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(a)	$f(x) = 8x^3 - 7x$ $f(-x) = 8(-x)^3 - 7(-x)$ $= -8x^3 + 7x$ $= -(8x^3 - 7x)$ $= -f(x)$ As $f(-x) = -f(x)$, the function is odd.	2	2 for showing substitution for $-x$ and correct result of odd 1 for correct sub of $-x$
(b) i)	 	2	2 correct shape, y intercept, another point (eg (1, 3) and asymptote $y = 1$ 1 correct asymptote $y = 1$ and general shape
(ii)	Domain: all real x Range: $y > 1$	2	1 mark for each
(c)	 	3 2 1	Intercepts, vertex and scale correct Incorrect scale for the 6 and $-\frac{1}{4}$ Intercepts and shape

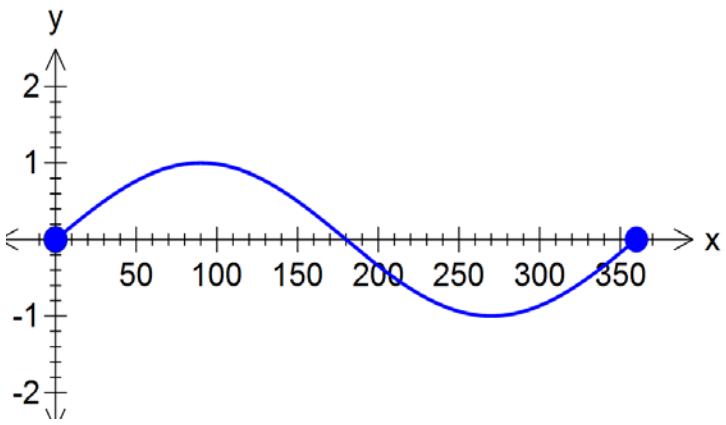
Question 2	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(d)		3 2 1	for correct graphs incl dotted line for $y = x$ and correct region shaded incorrect region or $y = x$ not dotted correct circle

Question 3	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(a)	i) 	1	1 for correct diagram clearly showing angle of depression
	ii) $\tan 58 = \frac{d}{80}$ $80 \tan 58 = d$ $d = 128.026...$ $= 128 \text{ m}$ (nearest m)	2	2 correct calculator answer 1 correct initial trig statement

Question 3	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(b)	i)  $x^2 = 300^2 + 250^2 - 2(300)(250)\cos(143)$ $x^2 = 272295.326...$ $x = 521.8192...$ $= 522\,(\text{nearest m})$ ii) $\frac{\sin B}{300} = \frac{\sin 143}{522}$ $\sin B = 0.34587...$ $B = 20.23...$ $= 20^o 14'$	2 2	2 for substituting correct data into the correct cosine rule and correct calculator answer 1 for substituting correct data into the correct cosine rule 2 for substituting correct data into the correct sine rule and correct calculator answer. Must use 522m as stated in the previous part (i) 1 for substituting correct data into the correct sine rule
(c)	$2\cos^2\theta = 1$ $\cos^2\theta = \frac{1}{2}$ $\cos\theta = \pm\frac{1}{\sqrt{2}}$ $\therefore \quad \theta = 45^\circ, 135^\circ, 225^\circ, 315^\circ$	3	3 for all four correct angles 2 for correctly answering 45^o and 315^o 1 for getting $\cos\theta = \frac{1}{\sqrt{2}}$
(d)	$4^{2x-1} = 8$ $(2^2)^{2x-1} = 2^3$ $2^{4x-2} = 2^3$ $\therefore 4x - 2 = 3$ $x = \frac{5}{4}$	2	2 correct answer and setting out 1 for writing $2^{4x-2} = 2^3$

Question 4	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment

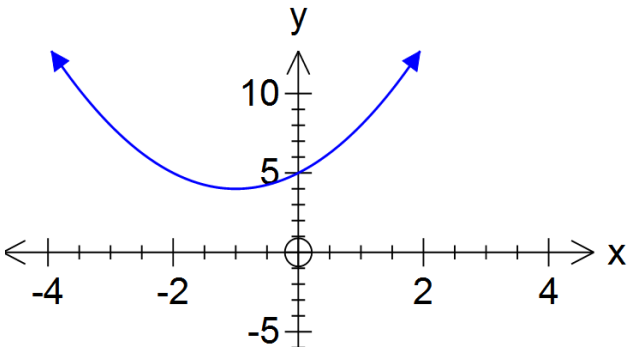
Question 4	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(a)			
	(i) $m_{AB} = \frac{4}{2}$ $= 2$ $m = \tan\theta$ $\tan\theta = 2$ $\theta = \tan^{-1} 2$ $= 63.4349.....^\circ$ $= 63^\circ \left(to\ nearest\ \deg ree\right)$	2	2 marks: correct solution 1 mark:: correct gradient, incorrect angle OR Incorrect gradient, Correct angle from mistake
	(ii) Midpoint of *AB*: $M\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$ $M\left(\frac{6+0}{2}, \frac{0+4}{2}\right)$ $M\left(3,2\right)$	1	1 mark: correct answer
	(iii) $m_{CD} = \frac{y_2-y_1}{x_2-x_1}$ $= \frac{-2-0}{1--2}$ $= \frac{-2}{3}$ Equation of line *CD* $y-y_1 = m\left(x-x_1\right)$ $y-0 = \frac{-2}{3}\left(x+2\right)$ $3y = -2x-4$ $\therefore\ 2x+3y+4=0$	2	2 marks: correct solution with correct working 1 mark: correct gradient, incorrect equation or not enough working.

Question 4	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
	(iv) $d = \dfrac{\lvert ax_1 + by_1 + c \rvert}{\sqrt{a^2 + b^2}}$ $= \dfrac{\lvert 2(3) + 3(2) + 4 \rvert}{\sqrt{2^2 + 3^2}}$ $= \dfrac{16}{\sqrt{13}} \times \dfrac{\sqrt{13}}{\sqrt{13}}$ $= \dfrac{16\sqrt{13}}{13} units$	2	2 marks: correct answer with correct working 1 mark: not rationalising denominator OR Not showing how final answer was found
	(v) $AB^2 = 4^2 + 6^2$ $= 16 + 36$ $AB = \sqrt{52}$ $= 2\sqrt{13}$ $Area = \dfrac{1}{2}(a+b)h$ $= \dfrac{1}{2}\left(\sqrt{13} + 2\sqrt{13}\right) \times \dfrac{16\sqrt{13}}{13}$ $= \dfrac{1}{2} \times 3\sqrt{13} \times \dfrac{16\sqrt{13}}{13}$ $= 24\ units^2$	3	3 marks: correct answer with correct working 2 marks: distance correct incorrect area formula correct area from mistake 1 mark: correct distance
(b)		2	

Question 5	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(a)	$\angle ACB = 60^\circ$ (vert.opp. $\angle DCE$) $\angle ABC = 62^\circ$ (angle sum of triangle = 180°) $\theta = 62^\circ$ (alternate angle to $\angle ABC$) $\phi = 58^\circ$ (alternate angle to $\angle BAC$)	2	
(b)	f(-1)= 2(-1)-3 = -2-3 = -5 f(1) = -3 f(-1)+f(1) = -5 +-3 =-8	2	
(c)	$a^3 + 8$ $= (a+2)(a^2 - 2a + 4)$	2	
(d)	i) $S = 180n - 360$ $3960 = 180n - 360$ $4320 = 180n$ $24 = n$ ii) $3960 \div 24 = 165^\circ$	1 1	
(e)	$\angle BAO = \angle OCD$ (= 90° *given*) $\angle BOA = \angle COD$ (vertically opposite $\angle$ =) BO = OD (*given*) $\therefore \Delta AOB \equiv \Delta COD$ (*AAS*)	2	
(f)	$\lvert 3x-5 \rvert \le 2$ $-2 \le 3x - 5 \le 2$ $3 \le 3x \le 7$ $1 \le x \le \frac{7}{3}$	2	

Question 6	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(a)	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{--6 \pm \sqrt{(-6)^2 - 4 \times 1 \times 7}}{2 \times 1}$ $= \frac{6 \pm \sqrt{36 - 28}}{2}$ $= \frac{6 \pm \sqrt{8}}{2}$ $= \frac{6 \pm 2\sqrt{2}}{2}$ $= 3 \pm \sqrt{2}$ $\approx 1.59 , 4.41$	3	
(b)	$(5^2)^x - 26(5^x) + 25 = 0$ Let $m=5^x$ $m^2 - 26m + 25 = 0$ $(m-25)(m-1) = 0$ $m = 25, m = 1$ $5^x = 25, 5^x = 1$ $\therefore x = 2, x = 0$	3	
(c)	Need to show that $\Delta < 0$ and $a < 0$ (negative definite) $b^2 - 4ac = 1^2 - (4 \times -3 \times -1)$ = 1- (12) = -11 a = -3 < 0 $\therefore$ Expression is negative definite and will always be less than zero for all x values.	2	

Question 6	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(d)	i) $\alpha + \beta = -\frac{b}{a}$ $= -\frac{5}{2}$	1	
	ii) $\alpha\beta = \frac{c}{a}$ $= -\frac{3}{2}$	1	
	iii) $\frac{1}{a} + \frac{1}{\beta} = \frac{\alpha + \beta}{\alpha\beta}$ $= -\frac{5}{2} \div -\frac{3}{2}$ $= -\frac{5}{2} \times -\frac{2}{3}$ $= \frac{5}{3}$	2	

Question 7	Preliminary HSC Examination- Mathematics		2010	
Part	Solution		Marks	Comment
(a)	i) $x^2 + 2x + 5 = (x^2 + 2x + 1) + 5 - 1$ $= (x+1)^2 + 4$ $\therefore a = 1, b = 4$		2	
	ii) 		2	

Question 7	Preliminary HSC Examination- Mathematics		2010	
Part	Solution		Marks	Comment
(b	i) $x^2+(k+3)x+9=0$ $b^2-4ac=0$ $(k+3)^2-4\times1\times9=0$ $k=3,-9$ $k^2+6k+9-36=0$ $k^2+6k-27=0$ $(k+9)(k-3)=0$ $k=3,-9$	2		
	ii) $b^2-4ac>0$ $(k+9)(k-3)>0$ $k<-9, k>3$	1		
c)	$\cos(90-35)=\cos(a+30)$ $\therefore 90-35=a+30$ $a=25$	1		
d)	$\sin120°\cos45°$ $=\frac{\sqrt{3}}{2}\times\frac{1}{\sqrt{2}}$ $=\frac{\sqrt{3}}{2\sqrt{2}}$	2		
(e)	If cos is negative and sin is positive, angle is in second quadrant and tan is negative. $\tan\theta=-\frac{3}{4}$		2	

Question 8

a)	$\lvert 2x-3\rvert = 5x$ $2x-3=5x \quad or \quad -(2x-3)=5x$ $3x=-3 \quad or \quad -2x+3=5x$ $x=-1 \quad or \quad 7x=3$ $=\frac{3}{7}$ Testing x = -1 $LHS=\lvert 2x-3\rvert=\lvert 2(-1)-3\rvert$ $=\lvert -5\rvert$ $=5$ $RHS=5(-1)$ $=-5$ Testing $x=\frac{3}{7}$ $LHS=\lvert 2x-3\rvert=\left\lvert 2(\frac{3}{7})-3\right\rvert$ $=\left\lvert -2\frac{1}{7}\right\rvert$ $=2\frac{1}{7}$ $RHS=5\times(\frac{3}{7})$ $=2\frac{1}{7}$ $\therefore x=\frac{3}{7}$ is a solution	3	
b)	i) $CosA=\frac{12^2+16^2-21^2}{2\times 12\times 16}$ $=-0.10677....$ $A=96^0 8'$ ii) $Area=\frac{1}{2}\times 12\times 16\times \sin 96^0 8'$ $=95.451...$ $=95.5cm^2(1dp)$	3 2	

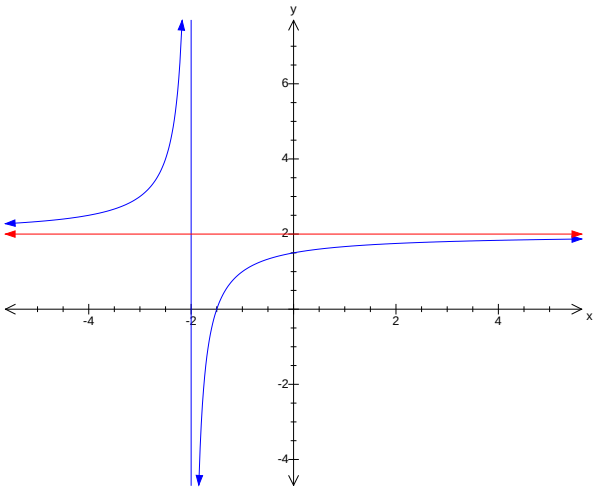
c)	Domain: $-2 \le x \le 2$ Range: $0 \le y \le 2$	2	
d)	If 2 is a root then it satisfies the equation: $2^2 + 2 \times m \times 2 - 6 = 0$ $4 + 4m - 6 = 0$ $4m - 2 = 0$ $m = \frac{2}{4}$ $= \frac{1}{2}$	2	

Question 9	Preliminary HSC Examination- Mathematics		2010
Part	Solution	Marks	Comment
(a)	$LHS = x^2 + x - 2 \quad RHS = A(x-2)^2 + Bx + C$ $= Ax^2 - 4Ax + 4A + Bx + C$ $= Ax^2 - x(4A - B) + 4A + C$ Equating coefficients, $A = 1 \quad -(4A - b) = 1 \quad 4A + C = -2$ $-4 + B = 1 \quad 4 + C = -2$ $B = 5 \quad C = -6$	3	3 for correct solutions 2 for two correct solutions 1 for one correct solution
(b)	$\langle ADE + \langle BCD = 180^o$ (cointerior angles $AD \parallel AE$) $\langle ADE = 180^o - 170^o$ $= 70^o$ $\langle AED = \langle ADE$ (opposite equal sides of isosceles ΔAED) $\langle AED = 70^o$ $\therefore \langle DAE = 180^o - \langle ADE - \langle AED$ (angle sum of a triangle) $= 180^o - 70^o - 70^o$ $= 40^o$	3	3 for showing clear logical working with correct reasoning and correct answer 2 one incorrect step or reason 1 only one step correctly completed

Question 9	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(c)	i) let h = 75, $75 = 90t - 15t^2$ $15t^2 - 90t + 75 = 0$ $t^2 - 6t + 5 = 0$ $(t-5)(t-1) = 0$ $\therefore$ the ball is 75m at 1 second and 5 seconds	2	2 for correct answer with working 1 for creating the correct quadratic and putting it equal to zero ready to solve
	ii) let h = 0, $0 = 90t - 15t^2$ $0 = 15t(6-t)$ $t = 0,\ 6$ $\therefore$ the ball falls to the ground after 6 seconds	2	2 for correct answer with working 1 for creating the correct factorised quadratic and putting it equal to zero ready to solve
	(iii) let $t = 3$, $h = 90(3) - 15(3)^2$ $= 270 - 135$ $= 135$ $\therefore$ the highest point reached by the ball is 135m.		2 for correct answer with working 1 for knowing to substitute three seconds to find highest point

Question 9	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(a)	$LHS = x^2 + x - 2 \quad RHS = A(x-2)^2 + Bx + C$ $= Ax^2 - 4Ax + 4A + Bx + C$ $= Ax^2 - x(4A - B) + 4A + C$ Equating coefficients, $A = 1 \quad -(4A - b) = 1 \quad 4A + C = -2$ $-4 + B = 1 \quad 4 + C = -2$ $B = 5 \quad C = -6$	3	3 for correct solutions 2 for two correct solutions 1 for one correct solution

Question 9	Preliminary HSC Examination- Mathematics	2010	
Part	Solution	Marks	Comment
(b)	$\langle ADE + \langle BCD = 180^o$ (cointerior angles $AD \parallel AE$) $\langle ADE = 180^o - 170^o$ $= 70^o$ $\langle AED = \langle ADE$ (opposite equal sides of isosceles ΔAED) $\langle AED = 70^o$ $\therefore \langle DAE = 180^o - \langle ADE - \langle AED$ (angle sum of a triangle) $= 180^o - 70^o - 70^o$ $= 40^o$	3	3 for showing clear logical working with correct reasoning and correct answer 2 one incorrect step or reason 1 only one step correctly completed
(c)	i) let h = 75, $75 = 90t - 15t^2$ $15t^2 - 90t + 75 = 0$ $t^2 - 6t + 5 = 0$ $(t-5)(t-1) = 0$ $\therefore$ the ball is 75m at 1 second and 5 seconds	2	2 for correct answer with working 1 for creating the correct quadratic and putting it equal to zero ready to solve
	ii) let h = 0, $0 = 90t - 15t^2$ $0 = 15t(6-t)$ $t = 0,\ 6$ $\therefore$ the ball falls to the ground after 6 seconds	2	2 for correct answer with working 1 for creating the correct factorised quadratic and putting it equal to zero ready to solve
	(iii) let $t = 3$, $h = 90(3) - 15(3)^2$ $= 270 - 135$ $= 135$ $\therefore$ the highest point reached by the ball is 135m.		2 for correct answer with working 1 for knowing to substitute three seconds to find highest point

	Question 10 Solutions	Marks	Comment
a)	$LHS = \frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta}$ $= \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta}$ $= \frac{1}{\sin\theta\cos\theta}$ $= \sec\theta\,\mathrm{cosec}\,\theta$ $= RHS$	3 2 1	Correct solution first 2 steps first step only
b)	$x^2 - 2x + 1 + y^2 - 4y + 4 = 4 + 1 + 4$ $(x-1)^2 + (y-2)^2 = 9$ centre $(1, 2)$ radius 3	3 2 1	Correct working, radius and centre 1 error correct centre and radius from poor attempt correct completing square for one letter
c)	$\frac{x}{12-x} = \frac{5}{7}$ (corresponding sides in similar triangles are in the same ratio) $7x = 60 - 5x$ $12x = 60$ x or $BP = 5$	2 1	answer plus reason answer only
d)		2 1	both asymptotes, intercepts or point on arms and shape both asymptotes or 1 error
e)	$\text{LHS} = 2^{k+1} - 2 + 2^{k+1}$ $= 2(2^{k+1}) - 2$ $= 2(2^{k+1} - 1)$ $= \text{RHS}$	2 1	both of the first 2 lines of working first line of working only before giving result