



**BAULKHAM HILLS
HIGH
SCHOOL**

2023

**YEAR 11
YEARLY
EXAMINATIONS**

Mathematics Extension

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided at the back of this paper
- In Questions in Section II, show relevant mathematical reasoning and/or calculations
- Marks may be deducted for careless or badly arranged work

**Total
marks:
70**

Section I – 10 marks (pages 2 – 5)

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

Section II – 60 marks (pages 6 – 9)

- Attempt Questions 11 – 14
- Allow about 1 hour and 45 minutes for this section

Section I

10 marks

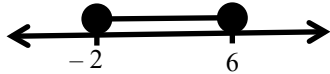
Attempt Questions 1 – 10

Allow about 15 minutes for this section

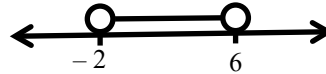
Use the multiple-choice answer sheet for Questions 1 – 10

1 Which of the following graphs represents the solution to $|x - 2| \leq 4$?

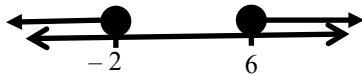
(A)



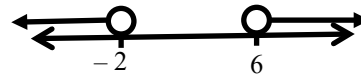
(B)



(C)



(D)



2 Which of the following is the natural domain of $f(x) = \cos^{-1}\left(\frac{x-a}{b}\right)$, where $b > 0$?

(A) $[-1, 1]$

(B) $[a - b, a + b]$

(C) $[a - 1, a + 1]$

(D) $[-b, x + b]$

3 The population N of a town, after t years, is given by the formula, $N = N_0 e^{0.04t}$ where N_0 is the initial population.

Which expression represents the number of years it takes until the town has doubled its initial population?

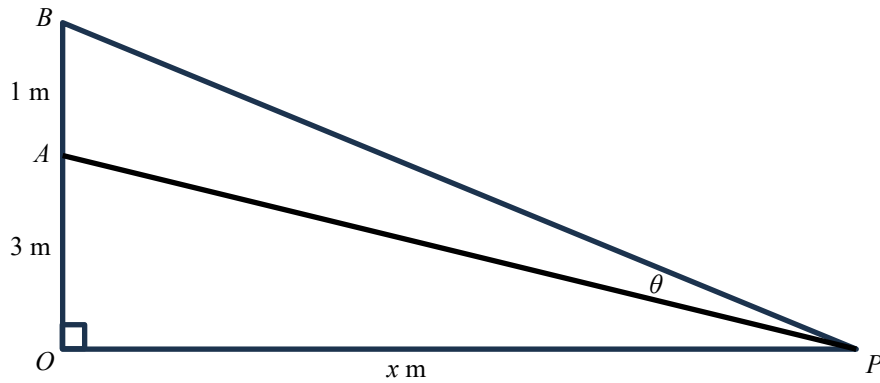
(A) $\frac{2\ln 100}{5}$

(B) $4\ln 2$

(C) $2\ln 25$

(D) $25\ln 2$

- 4 In the diagram below, $OA = 3$ metres, $AB = 1$ metre, $OP = x$ metres and $\angle APB = \theta$.



Which of the following equations is correct?

- (A) $\theta = \tan^{-1}\left(\frac{1}{x}\right) - \tan^{-1}\left(\frac{3}{x}\right)$
- (B) $\theta = \tan^{-1}\left(\frac{4}{x}\right) - \tan^{-1}\left(\frac{3}{x}\right)$
- (C) $\theta = \tan^{-1}\left(\frac{1}{\sqrt{9-x^2}}\right)$
- (D) $\theta = \tan^{-1}(3-x)$
- 5 The polynomial $ax^8 + bx^7 + 2$ is divisible by $(x+1)^2$.
What are the values of a and b ?
- (A) $a = -14$ and $b = -16$
- (B) $a = 14$ and $b = -16$
- (C) $a = -14$ and $b = 16$
- (D) $a = 14$ and $b = 16$

6 Which of the following is equal to $\sin x \cos^3 x - \sin^3 x \cos x$?

(A) $\frac{1}{6} \sin 4x$

(B) $\frac{1}{4} \sin 4x$

(C) $\frac{1}{3} \sin 4x$

(D) $\frac{1}{2} \sin 4x$

7 Which of the following is the coefficient of x^n in the expansion of $(1+x)^n + (1-x)^n$?

(A) 0

(B) $\frac{1+(-1)^n}{2}$

(C) $1+(-1)^n$

(D) 2

8 Let α , β and γ be the roots of $2x^3 - 5x^2 + 2x - 1 = 0$.

Which equation has the roots $\frac{1}{\alpha}$, $\frac{1}{\beta}$ and $\frac{1}{\gamma}$?

(A) $x^3 - 2x^2 + 5x - 2 = 0$

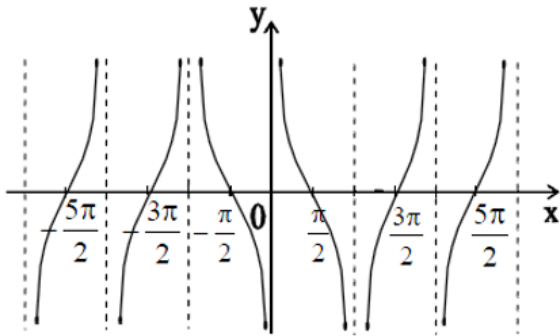
(B) $x^3 + 2x^2 + 25x - 2 = 0$

(C) $x^3 - 2x^2 + 25x - 8 = 0$

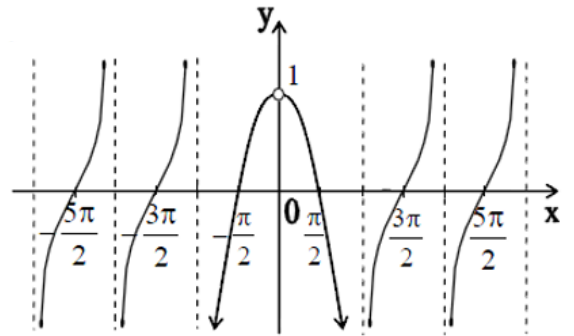
(D) $-2x^3 + 5x^2 - 2x + 1 = 0$

9 Which of the following is the graph of $y = x \cot x$?

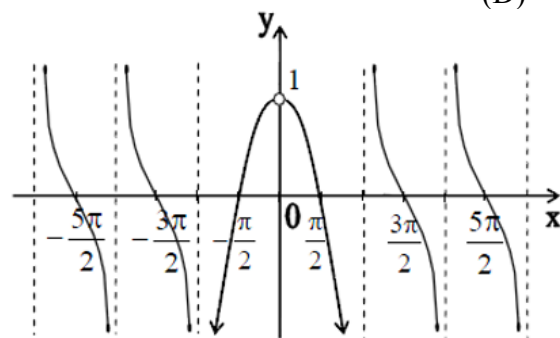
(A)



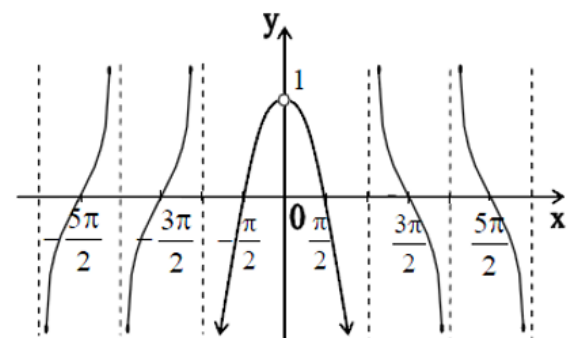
(B)



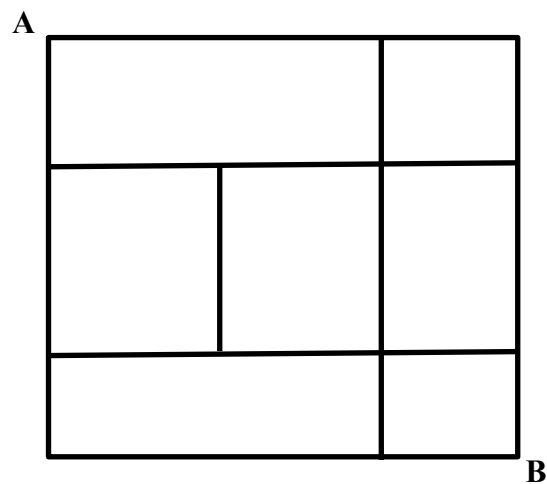
(C)



(D)



10 Moving only to the right or down, how many different routes are there from A to B ?



(A) 10

(B) 12

(C) 14

(D) 18

END OF SECTION I

Section II

60 marks

Attempt Questions 11 – 14

Allow about 1 hour and 45 minutes for this section

Answer each question on the appropriate answer sheet. Extra paper is available.

For questions in Section II, your responses should include relevant mathematical reasoning and/or calculations.

Question 11 (15 marks) Use the pages labelled Question 11 in the answer booklet

- (a) Sketch $y = 2\tan^{-1}(2x - 1)$. 2
- (b) Consider the function $f(x) = \frac{2}{x+1}$
- (i) Find the inverse function of $f(x)$. 1
- (ii) State the range of the inverse function. 1
- (c) A team of 4 players consists of 2 men and 2 women.
If a total of 7 players are available, of which 3 are men and 4 are women;
- (i) How many different teams can be selected? 1
- (ii) If 2 of the players are husband and wife, and wish to play on the same team, how many different teams can be selected if both are chosen? 1
- (d) Determine the term independent of x in the binomial expansion $\left(x^2 - \frac{1}{x}\right)^9$. 2
- (e) Show that $\frac{1 + \cos x}{\sin x} = \frac{1}{t}$ where $t = \tan \frac{x}{2}$. 2
- (f) Solve $\frac{x^2 + 5}{x} > 6$ 3
- (g) Evaluate $\sin\left[\tan^{-1}\left(\frac{2}{3}\right) - \cos^{-1}\left(\frac{12}{13}\right)\right]$. 2

Question 12 (15 marks) Use the pages labelled Question 12 in the answer booklet

- (a) A curve is defined by the parametric equations $x = 1 + 2t$ and $y = 1 - 4t^2$. 2
Find the cartesian equation of the curve.

- (b) In how many ways can the letters of the word

PAHVANITHAS

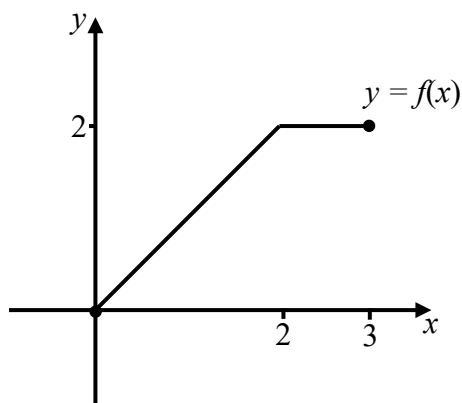
be arranged if;

- (i) all of the letters are used. 2
(ii) all of the A's are together and the arrangement must start and finish with a vowel. 2

- (c) Show that $\frac{\cos 2\theta + \sin 2\theta - 1}{\cos 2\theta - \sin 2\theta + 1} = \tan \theta$. 2

- (d) Solve in simplest exact form, the inequality $e^{2x} - 4e^x + 3 < 0$. 2

- (e) The graph of $y = f(x)$ is shown below.



Sketch graphs of;

- (i) $y = f(|x|)$. 1
(ii) $y = \frac{1}{f(x)}$. 2
(iii) $y^2 = f(x)$. 2

Question 13 (15 marks) Use the pages labelled Question 13 in the answer booklet

(a) Show that $\tan\left(\frac{x+y}{2}\right)\cot\left(\frac{x-y}{2}\right) = \frac{\sin x + \sin y}{\sin x - \sin y}$. 2

(b) Without expanding, find 2

$$1 + 5(x-1) + 10(x-1)^2 + 10(x-1)^3 + 5(x-1)^4 + (x-1)^5.$$

(c) Prove $2\tan^{-1}\left(\frac{1}{3}\right) = \tan^{-1}\left(\frac{3}{4}\right)$. 2

(d) Two of the roots of the equation $4x^3 + px^2 - 20x + 12 = 0$ are reciprocals. 3
Find the value of p .

(e) The population of birds on an island changes according to the differential equation

$$\frac{dP}{dt} = k(P - 3500)$$

where P is the population of birds, t is the time in years and k is the constant of proportionality.

Initially there were 40 birds, and after 5 years the population has increased to 125 birds.

- (i) Verify that $P = 3500 - Ae^{kt}$, where A is a constant, satisfies the differential equation. 1
- (ii) Find the value of A . 1
- (iii) Find the value of k correct to 3 significant figures. 2
- (iv) Sketch the function $P = 3500 - Ae^{kt}$ for $t \geq 0$, showing any intercepts and asymptotes. 2

Question 14 (15 marks) Use the pages labelled Question 14 in the answer booklet

(a) A polynomial $P(x)$ is defined by $P(x) = x^3 - b^3$, where b is a constant.

(i) Express $P(x)$ as the product of a linear and a quadratic factor 1

(ii) Simplify $\frac{(\tan^2\theta - 1)(\sin\theta \cos\theta + 1)}{\cos^2\theta(\tan^3\theta - 1)}$ 2

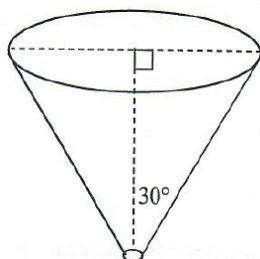
(b) Find the multiplicity of the root $x = 1$ of the equation $P(x) = 0$, where 2

$$P(x) = nx^{n+1} - (n+1)x^n + 1, \quad n \neq 0.$$

(c) Solve the equation $\sin^{-1}(2x^2 - 4x) + \cos^{-1}(2 - x) = \frac{\pi}{2}$ 3

(d) A large container in the shape of an inverted cone with semi-vertical angle 30° is full of water.

A hole is made at the vertex of the cone that allows the container to empty at a constant rate of 12 kL/min.



(i) Show that when the water has a depth of h metres, its volume is given 1
by $V = \frac{1}{9}\pi h^3$.

(You may assume that the volume cut from the cone when creating the hole, is negligible).

(ii) Hence find, in simplest exact form, the rate at which the depth of the water 3
is changing when its volume is 24π kL. (Note: $1 \text{ kL} = 1 \text{ m}^3$)

(e) Let $P(x) = x^2 - 2ax + a^4$ where a is a non-zero real number. 3

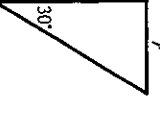
When $P(x)$ is divided by $x + b$, the remainder is 1.

The polynomial $Q(x) = bx^2 + x + 1$ has a factor of $(ax - 1)$.

Determine the value(s) of b .

End of paper

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Solution		QUESTION 14	Marks	Comments
14(a) (i)	$P(x) = x^3 - b^3$ $= (x-b)(x^2 + bx + b^2)$	1	1 mark • Correct answer	
14(a) (ii)	$(\tan^2 \theta - 1)(\sin \theta \cos \theta + 1) = (\tan \theta + 1)(\tan \theta - 1)(\sin \theta \cos \theta + 1)$ $\cos^2 \theta (\tan^3 \theta - 1) = \cos^2 \theta (\tan \theta - 1)(\tan^2 \theta + \tan \theta + 1)$ $= (\tan \theta + 1)(\sin \theta \cos \theta + 1)$ $\cos^2 \theta \left(\frac{\sec^2 \theta + \sin \theta}{\cos \theta} \right)$ $= (\tan \theta + 1)(\sin \theta \cos \theta + 1)$ $= (1 + \sin \theta \cos \theta)$	2	2 marks • Correct solution 1 mark • Substantial progress towards the simplification	
14(b)	$P(x) = nx^{n+1} - (n+1)x^n + 1$ $P'(x) = n(n+1)x^n - n(n+1)x^{n-1}$ $P'(1) = n(n+1) - n(n+1) = 0$ $P''(x) = n^2(n+1)x^{n-1} - n(n+1)(n-1)x^{n-2}$ $P''(1) = n^2(n+1) - n(n+1)(n-1)$ $= n^3 + n^2 - n^3 + n$ $= n^2 + n$ $\neq 0$ $\therefore x=1$ is a root of multiplicity 2	2	2 marks • Correct solution 1 mark • Uses the fact that multiple roots are roots of the derivative as well as the polynomial	
14(c)	$\sin^{-1}(2x^2 - 4x) + \cos^{-1}(2-x) = \frac{\pi}{2}$ $2x^2 - 4x = 2 - x \quad \left(\because \sin^{-1}x + \cos^{-1}x = \frac{\pi}{2} \right)$ $2x^2 - 3x - 2 = 0$ $(2x+1)(x-2) = 0$ $x = -\frac{1}{2}$ or $x = 2$	3	3 marks • Correct solution 2 marks • Finds two possibilities for solutions using a correct method 1 mark • Uses the inverse trig property in an attempt to find a solution • Finds a correct answer	
14(d) (i)	 $\frac{r}{h} = \tan 30^\circ$ $r = h \tan 30^\circ$ $r = \frac{h}{\sqrt{3}}$ $V = \frac{1}{3}\pi r^2 h$ $= \frac{1}{3}\pi \left(\frac{h}{\sqrt{3}}\right)^2 h$ $= \frac{1}{9}\pi h^3$	1	1 mark • Correct solution	

Solution		Marks	Comments
14(d) (ii)	$V = \frac{1}{9}\pi h^3$ $\frac{dV}{dh} = \frac{1}{3}\pi h^2$ $= -36$ $\frac{dh}{dt} = -\frac{36}{\pi(6)^2}$ $= -\frac{1}{\pi}$ when $V = 24\pi, \frac{1}{9}\pi h^3 = 24\pi$ $h^3 = 216$ $h = 6$ \therefore the depth is decreasing at a rate of $\frac{1}{\pi}$ m/min	3	3 marks • Correct solution 2 marks • Finds both the height of the water and an expression for $\frac{dV}{dh}$ 1 mark • Finds the height of the water • Finds an expression for $\frac{dV}{dh}$
14(e)	$P(-b) = 1$ $b^2 + 2ab + a^4 = 1$ $\frac{Q}{a} \left(\frac{1}{a} \right) = 0$ $\frac{b}{a^2} + 1 + 1 = 0$ $b + a + a^2 = 0$ $b = -a^2 - a$ $\therefore (-a^2 - a)^2 + 2a(-a^2 - a) + a^4 = 1$ $a^4 + 2a^3 + a^2 - 2a^3 - 2a^2 + a^4 = 1$ $2a^4 - a^2 - 1 = 0$ $(2a^2 + 1)(a^2 - 1) = 0$ $a^2 = -\frac{1}{2}$ or $a^2 = 1$ $a = \pm 1$ no solutions $\therefore b = -2$ or $b = 0$	3	3 marks • Correct solution 2 marks • Finds an equation in terms of a or b 1 mark • Use the factor or remainder theorem.


Solution	Marks	Comments
<p>12(e) (iii)</p>	2	<ul style="list-style-type: none"> 2 marks Correct graph 1 mark Sideways parabola drawn for $0 \leq x \leq 2$ Horizontal lines $y = \sqrt{2}$ and $y = -\sqrt{2}$ drawn for $2 \leq x \leq 3$ $y = \sqrt{x}$
QUESTION 13		
<p>13(a)</p> $\tan\left(\frac{x+y}{2}\right) \cot\left(\frac{x-y}{2}\right) = \frac{\sin\left(\frac{x+y}{2}\right) \cos\left(\frac{x-y}{2}\right)}{\cos\left(\frac{x+y}{2}\right) \sin\left(\frac{x-y}{2}\right)}$ $= \frac{\frac{1}{2} \left[\sin\left(\frac{x+y}{2} + \frac{x-y}{2}\right) + \sin\left(\frac{x+y}{2} - \frac{x-y}{2}\right) \right]}{\frac{1}{2} \left[\sin\left(\frac{x-y}{2} + \frac{x+y}{2}\right) + \sin\left(\frac{x-y}{2} - \frac{x+y}{2}\right) \right]}$ $= \frac{\sin x + \sin y}{\sin x + \sin(-y)}$ $= \frac{\sin x + \sin y}{\sin x - \sin y}$	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Correctly transforms a product of two trig functions into a simplified sum of two trig functions
<p>13(b)</p> $1 + 5x + 10x^2 + 10x^3 + 5x^4 + x^5 = (1+x)^5$ $\therefore 1 + 5(x-1) + 10(x-1)^2 + 10(x-1)^3 + 5(x-1)^4 + (x-1)^5 = (1+x-1)^5 = x^5$	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Recognises the pattern of a binomial expansion
<p>13(c)</p> $\text{Let } \theta = \tan^{-1}\left(\frac{1}{3}\right)$ $\tan 2\theta = \frac{2 \tan \theta}{1 - \tan^2 \theta}$ $= \frac{2 \times \frac{1}{3}}{1 - \frac{1}{9}}$ $= \frac{\frac{2}{3}}{\frac{8}{9}} = \frac{2}{4}$ $2\theta = \tan^{-1}\left(\frac{2}{4}\right)$ $\therefore 2 \tan^{-1}\left(\frac{1}{3}\right) = \tan^{-1}\left(\frac{2}{4}\right)$	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Correctly uses double angle result

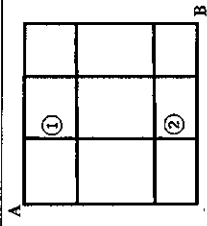
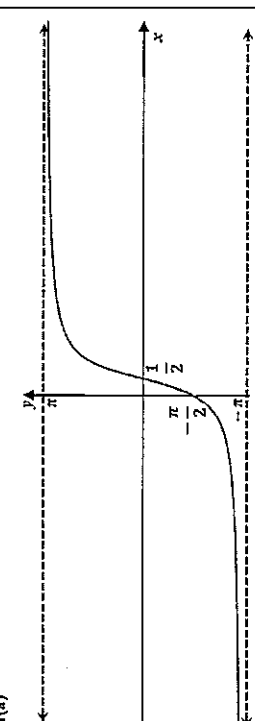
Solution	Marks	Comments
<p>13(d)</p> <p>Let the roots be $\alpha, \frac{1}{\alpha}$ and β</p> $\alpha + \frac{1}{\alpha} + \beta = -\frac{p}{a}$ $\beta = -3$ $\alpha + \frac{1}{\alpha} - 3 = -\frac{p}{a}$ $\alpha + \frac{1}{\alpha} = 3 - \frac{p}{a}$ $\left(\alpha + \frac{1}{\alpha}\right) + \alpha\beta + \frac{\alpha}{\beta} = -5$ $1 - 3\alpha - \frac{3}{\alpha} = -5$ $3\left(\alpha + \frac{1}{\alpha}\right) = 6$ $3 - \frac{p}{a} = 2$ $\frac{p}{a} = 1$ $p = 4$	3	<ul style="list-style-type: none"> 3 marks Correct solution 2 marks Finds an equation where p is the only unknown 1 mark Finds β
<p>13(e) (i)</p> $P = 3500 + Ae^{kt}$ $\frac{dP}{dt} = -kAe^{kt}$ $= -k(3500 - Ae^{kt} - 3500)$ $= -k(P - 3500)$ <p>13(e) (ii) when $t = 0, P = 40 \Rightarrow 40 = 3500 - A$ $A = 3460$</p> <p>13(e) (iii) when $t = 5, P = 125 \Rightarrow 125 = 3500 - 3460e^{5k}$ $3460e^{5k} = 3375$ $e^{5k} = \frac{3375}{3460}$ $5k = \ln\left(\frac{3375}{3460}\right)$ $k = \frac{1}{5} \ln\left(\frac{3375}{3460}\right)$ $= -0.00497$ (to 3 sig figs)</p>	1	<ul style="list-style-type: none"> 1 mark Correct solution
<p>13(e) (iv)</p>	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Correct shape Correct asymptote

	Solution	Marks	Comments
11(d)	$\left(x^2 - \frac{1}{x}\right)^9; T_{k+1} = \binom{9}{k} (x^2)^{9-k} \left(-\frac{1}{x}\right)^k$ $= \binom{9}{k} (-1)^k x^{18-3k}$ <p>independent term has $x^0 \Rightarrow 18 - 3k = 0$ $k = 6$ \therefore independent term is $T_7 = \binom{9}{6} (-1)^6 = 84$</p>	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Finds an expression for the general term Recognises that the constant term is when the power of x is zero
11(e)	$\frac{1 + \cos x}{\sin x} = \frac{1 + 1 - t^2}{2t}$ $= \frac{2}{1 + t^2}$ $= \frac{2}{2t}$ $= \frac{1}{t}$	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Correct substitution of t results for either $\sin x$ or $\cos x$
11(f)	$x^2 + 5 > 6$ $x^2 + 5 = 6x$ $x^2 - 6x + 5 = 0$ $(x-5)(x-1) = 0$ $x = 5 \text{ or } x = 1$	3	<ul style="list-style-type: none"> 3 marks Correct graphical solution on number line or algebraic solution, with correct working 2 marks Bald answer Identifies the correct critical points via a correct method Correct conclusion to their critical points obtained using a correct method 1 mark Uses a correct method Acknowledges a problem with the denominator.
11(g)	<p>Let $\alpha = \tan^{-1}\left(\frac{2}{3}\right)$ and $\beta = \cos^{-1}\left(\frac{12}{13}\right)$</p> $\sin \left[\tan^{-1}\left(\frac{2}{3}\right) - \cos^{-1}\left(\frac{12}{13}\right) \right] = \sin \alpha \cos \beta - \cos \alpha \sin \beta$ $= \left(\frac{2}{\sqrt{13}}\right)\left(\frac{12}{13}\right) - \left(\frac{3}{\sqrt{13}}\right)\left(\frac{5}{13}\right)$ $= \frac{9}{13\sqrt{13}} - \frac{15}{13\sqrt{13}}$ $= \frac{-6}{13\sqrt{13}}$	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Recognises that the inverse trig functions represent angles and finds other trig ratios to use in the substitution

	Solution	Marks	Comments
12(a)	$x = 1 + 2t$ $y = 1 - 4t^2$ $t = \frac{x-1}{2}$ $y = 1 - 4\left(\frac{x-1}{2}\right)^2$ $y = 1 - (x-1)^2$ $y = 1 - x^2 + 2x - 1$ $y = 2x - x^2$	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Makes t the subject of either x or y
12(b) (i)	<p># arrangements = $\frac{11!}{3!2!}$ $= 3\,326\,400$</p>	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Treats at least one of the repeated letters correctly
12(b) (ii)	<p># arrangements = $2 \times 1 \times \frac{7!}{2!}$ $= 5040$</p>	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Correctly arranges the consonants or the vowels
12(c)	<p>Let $t = \tan \theta$, $\cos 2\theta + \sin 2\theta = \frac{1 - t^2}{1 + t^2} + \frac{2t}{1 + t^2}$</p> $= \frac{2t - 2t^2}{2 - 2t^2}$ $= \frac{2t(1-t)}{2(1-t)}$ $= t$ $= \tan \theta$	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Rewrites the expression with θ as the angle in all trig expressions
12(d)	$e^{2x} - 4e^x + 3 < 0$ $(e^x - 1)(e^x - 3) < 0$ $1 < e^x < 3$ $\ln 1 < x < \ln 3$ $0 < x < \ln 3$	2	<ul style="list-style-type: none"> 2 marks Correct solution 1 mark Finds a solution in terms of e^x
12(e) (i)		1	<ul style="list-style-type: none"> 1 mark Correct graph
12(e) (ii)		2	<ul style="list-style-type: none"> 2 marks Correct graph 1 mark Hyperbola drawn for $0 < x \leq 2$ Horizontal line $y = \frac{1}{2}$ drawn for $2 \leq x \leq 3$

BAULKHAM HILLS HIGH SCHOOL
YEAR 11 EXTENSION YEARLY 2023 SOLUTIONS

Solution		SECTION I	Marks	Comments
1. A -	$ x-2 \leq 4$ or $x-2 \leq 4$ $x \leq 6$ $-x+2 \leq 4$ $-x \leq 2$ $x \geq -2$ $-2 \leq x \leq 6$ 		1	
2. B -	$-1 \leq \frac{x-a}{b} \leq 1$ $-b \leq x-a \leq b$ $a-b \leq x \leq a+b$		1	
3. D -	when $N = 2N_0 \cdot 2N_0 = N_0 e^{0.04t}$ $e^{0.04t} = 2$ $0.04t = \ln 2$ $t = 25 \ln 2$		1	
4. B -	$\theta = \angle OPB = \angle OPA$ $= \tan^{-1} \left(\frac{4}{x} \right) - \tan^{-1} \left(\frac{3}{x} \right)$		1	
5. D -	$P(x) = ax^3 + bx^2 + 2$ $P'(x) = 3ax^2 + 2bx$ since -1 is a double root, then $P(-1) = P'(-1) = 0$ $a - b + 2 = 0 \Rightarrow 8a - 8b = -16$ (+) $-8a + 7b = 0$ $-b = -16$ $b = 16 \therefore a = 14$		1	
6. B -	$\sin^3 x - \sin^3 x \cos x = \sin x \cos x (\cos^2 x - \sin^2 x)$ $= \frac{1}{2} \sin 2x \cos 2x$ $= \frac{1}{4} \sin 4x$		1	
7. C -	$(1+x)^n + (1-x)^n$ $= 1 + \binom{n}{1}x + \binom{n}{2}x^2 + \binom{n}{3}x^3 + \dots + x^n + 1 - \binom{n}{1}x + \binom{n}{2}x^2 - \binom{n}{3}x^3 + \dots + (-1)^n x^n$ $= 1 + (-1)^n$		1	
8. A -	$a + \beta + \gamma = \frac{5}{2}$ $a\beta + a\gamma + \beta\gamma = 1$ $\frac{1}{a} + \frac{1}{\beta} + \frac{1}{\gamma} = \frac{\beta\gamma + a\gamma + a\beta}{a\beta\gamma}$ $= \frac{1}{\frac{5}{2}} = \frac{2}{5}$ \therefore it is either A or C However $\frac{1}{a\beta\gamma} = 2$, thus the answer must be A		1	

Solution		Marks	Comments
9. D -	$y = x$ is an odd function $y = \cot x$ is an odd function odd function \times odd function = even function so $y = x \cot x$ is an even function, thus D is the correct graph	1	
10. B -	 <p>The total number of routes would be the same as the total number of routes in the above diagram minus the routes using paths ① or ②</p> <p># routes = routes from A to B - routes using ① - routes using ② + routes using both ① and ②</p> $= {}^6C_3 - 1 \times 1 \times 1 \times {}^4C_2 - 3 \times {}^4C_1 \times 1 \times 1 \times 2C_2 + 1 \times 1 \times 1 \times 1 \times {}^3C_3$ $= 20 - 6 - 3 + 1$ $= 12$	1	
SECTION II			
QUESTION 11			
11(a)		2	2 marks • Correct solution 1 mark • Correct shape • Correct range
11(b) (i)	$x = \frac{2}{y+1}$ $x(y+1) = 2$ $y+1 = \frac{2}{x}$ $y = \frac{2}{x} - 1$ $y = \frac{2-x}{x}$	1	1 mark • Correct solution
11(b) (ii)	Domain of $f(x)$ is all real x except $x = -1$ \therefore range of $f'(x)$ is all real y except $y = -1$	1	1 mark • Correct answer
11(c) (i)	Teams = ${}^3C_2 \times {}^4C_2$ $= 18$	1	1 mark • Correct answer
11(c) (ii)	Teams = $1 \times {}^2C_1 \times 1 \times {}^3C_1$ $= 6$	1	1 mark • Correct answer