# CURRICULUM, PEDAGOGY AND BEYOND









### Toolkit for teachers new to Mathematical Methods Units 1-4

### **Acknowledgement of country**

• I acknowledge the Traditional Owners of the unceded land on which I work, learn and live: the Wurundjeri Woi-wurrung people, and pay my respects to Elders past and present.

### A bit about myself...

- Vincent Lam
- <u>lamv@loyola.vic.edu.au</u>
- 2010-12: St Kevin's College
- 2013-21: Catholic Ladies' College, Eltham
- → Mathematics KLA Leader: 2016-21
- 2022-present: Loyola College, Watsonia



- Started teaching Maths Methods in 2013 (Year 11) and 2016 (Year 12)
- Background in Psychology/Behavioural Neuroscience

### Aim of today's session

- I aim to share with you a few tips, tricks and strategies that I have used ones which I have (and still find) useful.
- You may like them. You may hate them.
- May or may not work for you.

### Disclaimer

- Some analogies I will use may not be good mathematics...
- Mathematician hat off
- Maths educator hat on



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### Part 1: Mnemonics

### **Mnemonics**

- Tools used to organise concepts in memory
- We will look at some low-order mnemonics
- → Not necessarily conducive to understanding the concepts, but can help them calculate
- The merits of this can be debated, but not now.

### **Sketching quadratic graphs**

- Turning point form
- $y = 2(x-1)^2 3$
- Turning point
- Y-intercept
- Shape
- OXY
- Name graph

- Intercept form
- $y = x^2 + 3x + 2$
- Shape
- Intercepts
- Turning point
- Sketch
- Can skip steps if need be

### More quadratics...

• Trinomials (mainly monic, but can adapt for nonmonic)

• 
$$y = x^2 + 3x + 2$$

Factor	Factor	Sum
+2	+1	+3
-2	-1	-3

Completing the square

• 
$$y = x^2 + 3x + 2$$
  
(Don't know why this one sticks...)

- Halve
- Square
- Add
- Subtract
- The middle number!!!

### **Coordinates of a linear and quadratic**

• Find the intersection of y = -x - 1 and  $y = x^2 - 4x + 1$ 

- Equate
- Arrange
- Solve
- Y-value

### Sketching a(n) exponential/logarithm/hyperbola/truncus

- Shape
- Intercept (y-intercept for exponentials, x-intercept for logs)
- Point can be an endpoint
- Asymptote(s)
- Domain
- $f:(-\infty,0] \rightarrow R, f(x) = 3 \times 2^{x-1} 4$

### **Inverse functions**

- Swap x and y
- Y becomes the subject
- Domain
- $g: [1, \infty) \to R, g(x) = 2x^2 4x + 2$

### **Differentiation of power functions**

• 
$$y = x^2 - 4x + 1$$

- Front
- Multiply
- Lower

### **Cubics and emojis**

- $a^3 + b^3 = (a + b)(a^2 ab + b^2)$ • T +\_+
- $a^3 b^3 = (a b)(a^2 + ab + b^2)$
- No emoji, but sequence of - + +

### **Transformations**

- Transformation functions
- Co-ordinates
- Image
- New subject
- Sub in
- Y subject

- Stating transformations
- Basic form
- Apostrophes
- Equate
- Subject
- Fractions split
- Brackets expanded
- Then DRT order
- Will have a wide range of answers???

### **Remembering the discriminant**

- To the tune of *This Old Man*
- B times b, 4ac
- B square minus 4ac
- If you get a negative can't do anymore
- Otherwise keep going on...

### **Remembering the quadratic formula**

- To the tune of Santa Claus is Coming To Town
- Negative b
- Plus or minus
- Square root of the
- Discriminant
- Then divide all that by 2a

### **Exact trig. values**

- Table method
- Finger method







### Part 2: Analogies

### **Another disclaimer**

• With these analogies, they may initially seem to be poor maths

### Limits

- "Hypothetical y-values"
- But then, always get students to explain the WHY.
- Along the lines of "convergence".

### Domain, codomain, range



### **Open and closed domains**



### **Unit circle**

- Alphabetical
- (x = cos, y = sin)
- km vs. miles
- What does  $sin\left(\frac{\pi}{3}\right)$  mean?



### **Continuous probability distribution**

Liken it to a histogram first.

In fact, our Year 10 Enhanced class does an investigation task on histograms and relative area.





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# Part 3: Tips for students that I use

### A third disclaimer

- Not here to promote good maths.
- More to help students gain marks. This is a discussion for another time.

### **Division of polynomials**

- Monic divisor use synthetic division
- Non-monic divisor use long division
- Synthetic division is usually not in textbooks.

### **Chain rule**

- I often avoid giving them the formula.
- Instead, I use different colours.

- If  $y = 3x^2$
- What is  $\frac{dy}{dx}$ ?
- If  $y = 3()^2$
- Then  $\frac{dy}{dx} = 6(\ )^{2-1}$
- So if  $y = 3(5x^3)^2$
- $\cdot \frac{dy}{dx} = 6(5x^3) \times 15x^2$

### **Inverse functions: by inspection**

- Parallel to what?
- Where does it level off?



### **Product rule**

- I tend not to use "u" notation
- Nor the formula.
- $f(x) = \sin(3x)e^{4x-1}$

### Integration by recognition

• Write down the "contrapositive" statement first

WE4 If  $y = (3x^2 + 2x - 4)^3$ , find  $\frac{dy}{dx}$ . Hence, find an antiderivative of  $(3x + 1)(3x^2 + 2x - 4)^2$ .  $\frac{dy}{dx} = 6(3x + 1)(3x^2 + 2x - 4)^2$  $\therefore \int 6(3x + 1)(3x^2 + 2x - 4)^2 dx = (3x^2 + 2x - 4)^3$ 

• Then divide both sides by 6, etc...

### **Functions and relations**

- Lots of things are in alphabetical order!!!
- Domain-Range (*x*-*y*)
- (only a physical test not strictly on the course): Horizontal (x) and Vertical (y) line tests

### **Functions and relations**

- Listing transformations by inspection:
- $y = \pm Af(\pm b(x-h) + k$
- From *x*-axis first, then *y*-axis.



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### Part 4: Practical tips

### **Practical tips**

- Exam: "if-then" statements with trigger words.
- E.g. If it's asking for the maximum/minimum value, it is probably hinting at the derivative and equalling that to zero
- Dealing with parents: parents can often not realise the stepup is massive
- "Story behind the numbers"



### Phases of exam preparation

	Phase 1	Phase 2	Phase 3
Time	From the end of SAC 2	From the start of the	From the first day of swot
	content till the end of	spring break till the last	vac till the end of the
	Founder's term	day of school	exams
	(around 5 weeks)	(around 4 weeks)	(around 2 weeks)
Objectives	Know your theory.	Tie up any loose ends.	Tie up any loose ends on each
J			paper.
	Know how to perform the	Knowing the style of	
	basic calculation.	questions – what particular wording means	Continue to fill in knowledge
	Find out what knowledge gaps	the stating interaction	Sape you sum have.
	vou still have.	Continue to fill in	Memorise all the tricks that
		knowledge gaps you still	you have stumbled across.
	Note down all the tricks you	have.	
	have stumbled upon.		Answer questions within time
		Note down all the tricks you	limit.
	No need to do each question	have stumbled upon.	
	under exam conditions.		Do each full paper under
		Answer questions within	exam conditions:
		time limit.	• Exam 1 = 15 mins
			reading + 1 hour
		Do each question under	writing
		exam conditions (e.g. 2	• Exam $2 = 15$ mins
		marks – no more than 5	reading + 2 hours
	H (20 - 2016 (10.2))		writing
Exams	• Heffernan 2016 (1&2)	• <u>VCAA 2016 (1&amp;2) –</u>	• <u>NEAP 2021 (1&amp;2)</u>
	• Heffernan $2017(1\&2)$	printed for you	• <u>NEAP 2022 (1&amp;2)</u>
	• Heffernan 2018 $(1\&2)$	• <u>VCAA 201 / NH1</u> (18-2)	• <u>NEAP 2023 (1&amp;2)</u> 0.4T = 2022 (1.0.2)
	• Heffernan $2019(1\&2)$	$\frac{(1 \& 2)}{V (1 \& 2)}$	• $QATs 2023 (1\&2)$
	• Heffernan 2020 (1&2)	• VCAA 2017 (1&2)	<ul> <li>Insight 2023 (1&amp;2)</li> </ul>

### **Exam conditioning**

- Term breaks/after school exam conditioning
- Breaking down reading time
- Strategically answer questions in writing time

- Dealing with exam conditions is another skill.
- Students/parents have generally accepted that they need help with exam conditions.

### **Extra sessions**

- Showing commitment high challenge, high support
- Lunchtime, after school
- Avoid the words "help", "club"

### **Internet resources**

- Heaps of great resources
- Youtube: LMK Maths
- Facebook: Victorian Secondary Mathematics Teachers

## **Any questions?**

• Before you go...







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Step 2: Enter Event Code: may

Step 3: Enter the email you registered with

•

Step 4: Enter the Passcode you receive via email and click 'Verify'. Please be sure to check your Junk Mail for the email, or see the Registration Desk if you require further assistance.

**Event App** 



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