
'Who put the maths in chemistry?'

Raising student awareness & self-efficacy in mathematical process skills in first-year chemistry.

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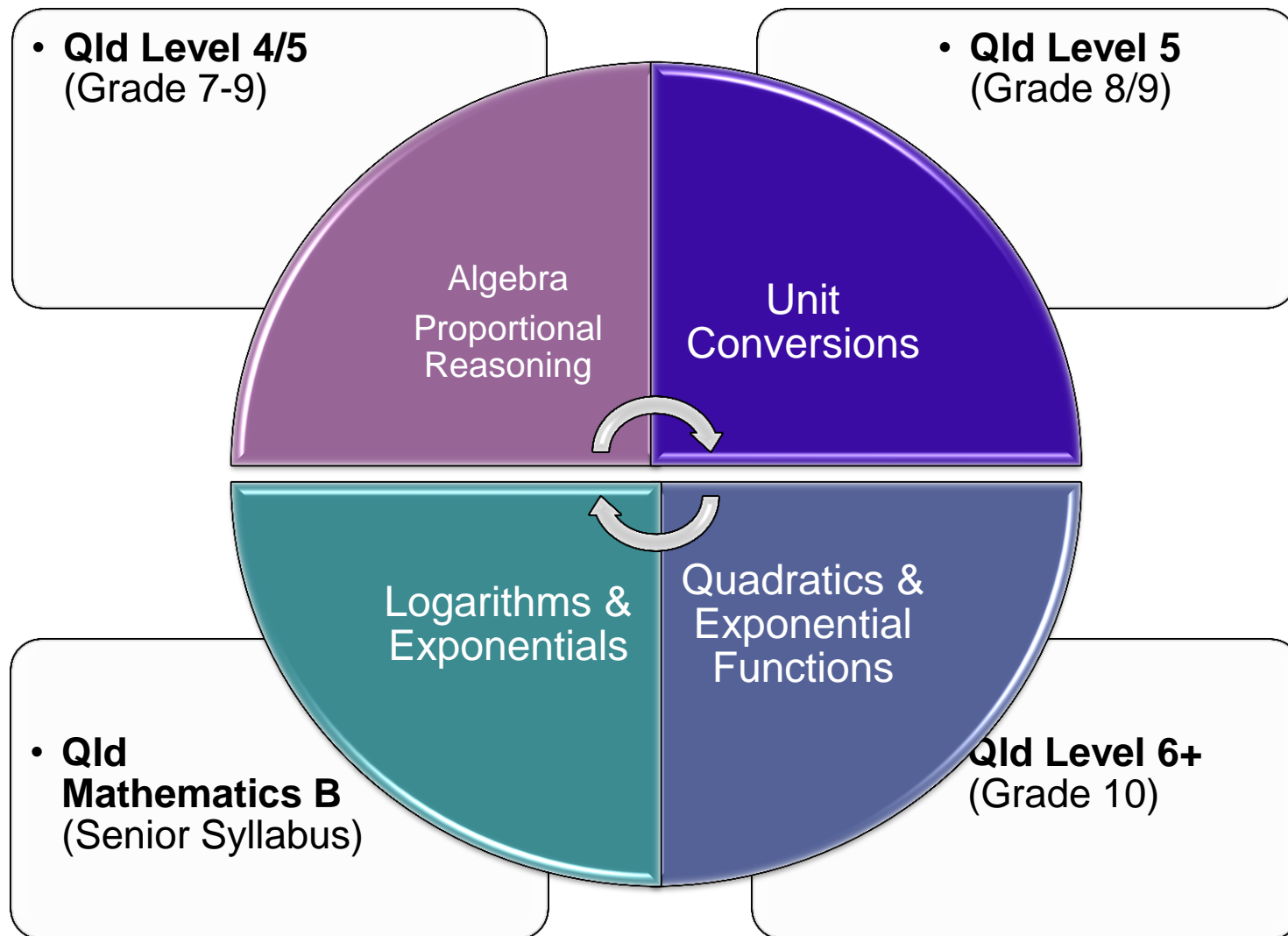
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1st Year Chemistry: Assumed Maths Process Skills



Are we testing maths skills or chemistry skills?

The challenges:

- **Maths process skills impact on solving problems**
(of course ... we formulate MCQ distractors based on this!)
- **Units**
(chemistry is a minefield!)
- **Critical reasoning does the answer make sense?**
(anything goes!)

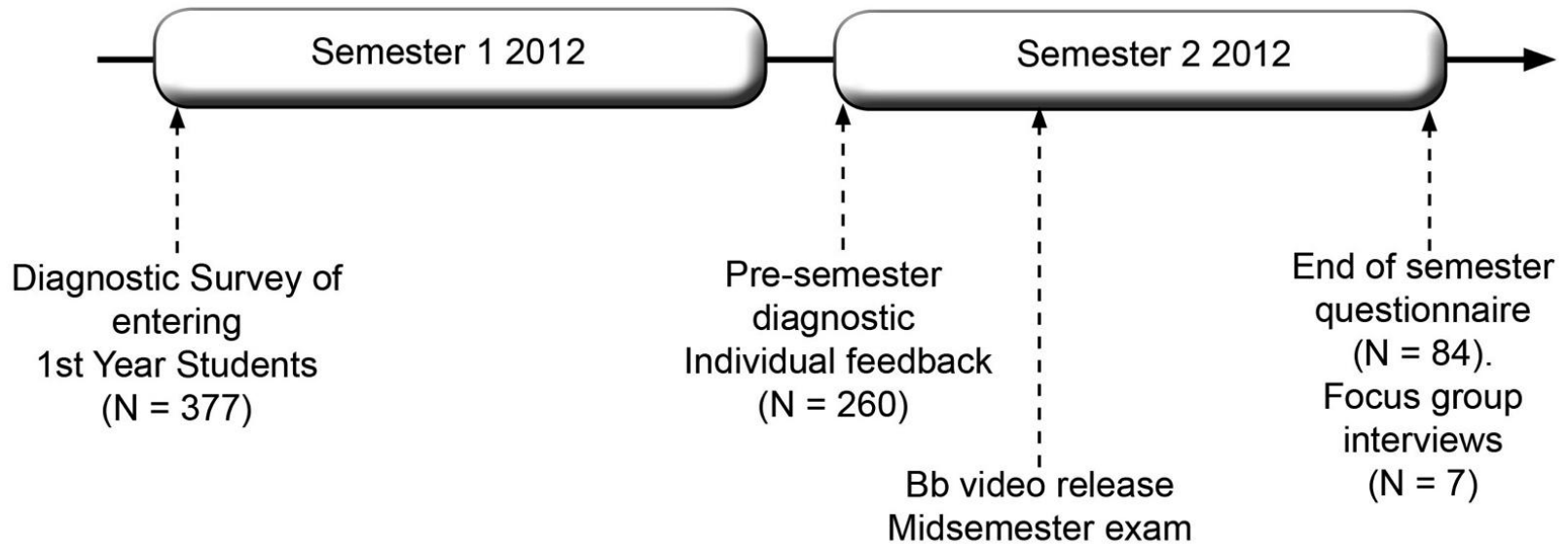
- Calculate the mass percentage in 5 g of the cereal

1363.5%w/w

The goals:

- **Raise student awareness and confidence in their quantitative skills**
- **Provide resources which students can access in self-regulated study**

Project timeline & evaluation (2012)



Additional data:

- Logs of completion of online activities and resource access via Bb
- UQ ethical clearance gained

Are we testing maths skills or chemistry skills?

Item	Stem	Category	% Both Correct & 'Certain'
1	Evaluate $2^3 + 3^2$	Exponents	83
2	Solve for x: $9/3 = 12/x$	Algebra	76
3	Solve for x: $(x-7)/0.3 = 20.2$	Algebra	88
4	Solve for x: $\log_{10}(x-1) = 2$	Logarithm	41
5	Solve for x: $2^x = 32$	Exponent	59
6	What number is $(0.01)^{-1/2}$ equal to?	Exponent	53
7	Solve for n: $1.5 \times 2 = n \times 8 \times 2$	Algebra	62
8	Solve for T_1 : $500 - T_1 = 202$	Algebra	54
9	Solve for P_2 : $\ln(100/P_2) = 0.4$	Logarithm	21
10	Solve for s: $s^2 - 2s - 8 = 0$	Quadratic	45
11	What number is $-\log_{10}[0.01]$ equal to?	Logarithm	46
12	Solve for t: $0.6 = e^{-0.00003t}$	Exponent	25

Midsemester exam question

$$T = 27 + 273 = 300 \text{ K}$$

$$P = 2 \text{ bar} = 2 \times 10^5 \text{ Pa}$$

At a temperature of 27.0 °C, a compressed gas cylinder contains 15.0 L of nitrogen gas and the pressure gauge reads 2.00 bar. How many moles of gas does the cylinder contain?

(A) 1.20×10^{-5} moles	3%
(B) 8.32×10^{-4} moles	2%
(C) 1.20 moles	65%
(D) 0.83 moles	4%
(E) 1.20×10^3 moles	26%

$$V = 15.0 \text{ L} = 15 \times 10^{-3} \text{ m}^3$$

$$PV = nRT$$

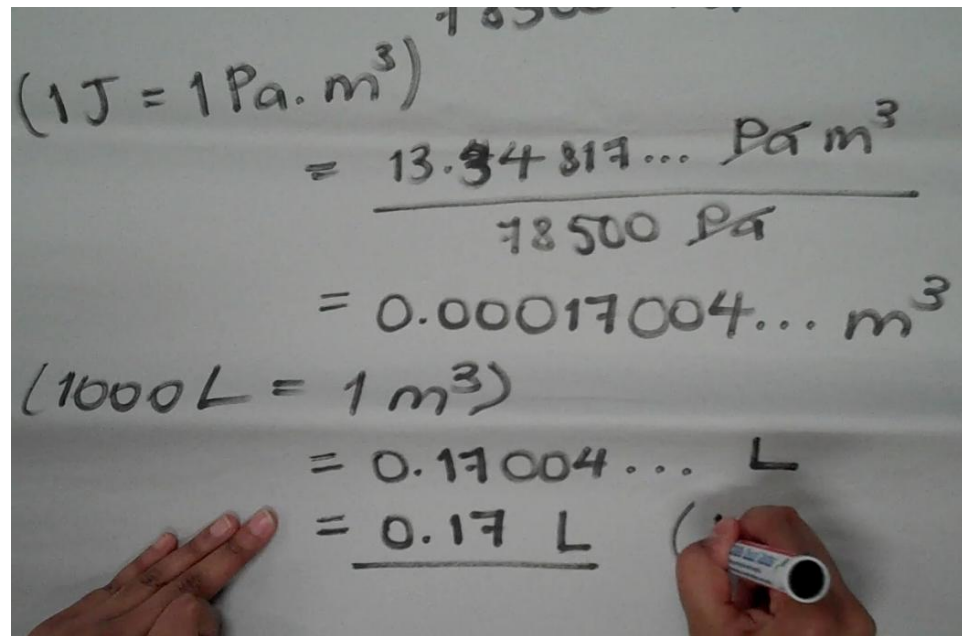
$$n = \frac{pV}{RT}$$

$$n = \frac{(2 \times 10^5)(15 \times 10^{-3})}{8.314 \times 300} = 1.2 \text{ moles}$$

Bb video focusing on QS

Web resources: abstract to course.

UQ chemistry tutor: connected to UQ community & context.



Handwritten calculations on a whiteboard:

$$(1 \text{ J} = 1 \text{ Pa} \cdot \text{m}^3)$$
$$= \frac{13.34817 \dots \text{ Pa} \cdot \text{m}^3}{18500 \text{ Pa}}$$
$$= 0.00017004 \dots \text{ m}^3$$

(1000 L = 1 m³)

$$= 0.17004 \dots \text{ L}$$
$$= \underline{0.17 \text{ L}}$$

Bb analytics indicated that this video was viewed > 1200 times.

Student self-awareness

‘Thinking across the chemistry problem-solving exercises you have completed in this course, which mathematical process has troubled you the most?’

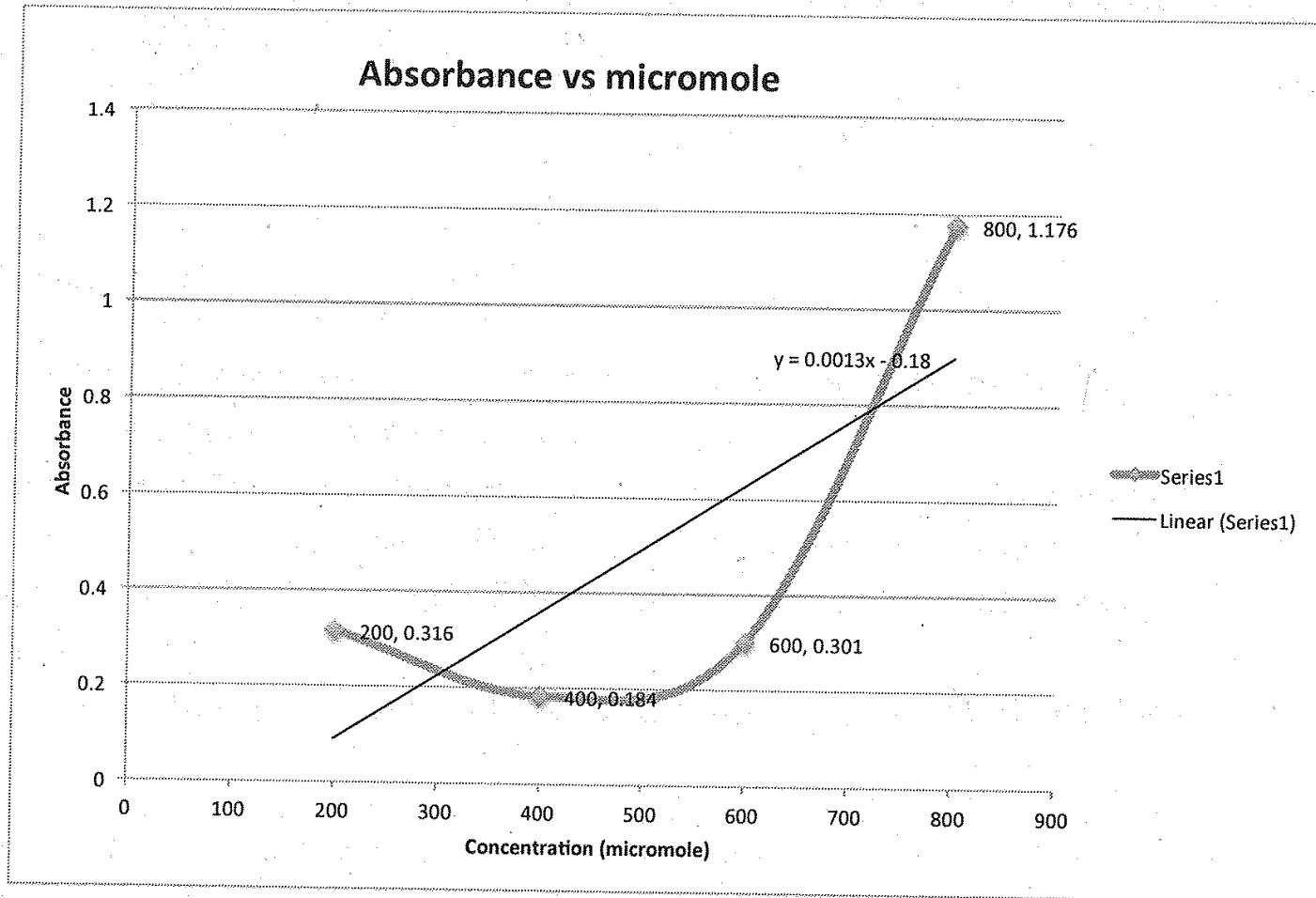
- Integration/differentiation (19%)
- Logarithms (17%)
- Quadratic equations (15%)
- Unit conversion (10%)

Example Comments:

“Understanding what the question is asking, knowing what to put into the formula and how to rearrange equations.”

“The diagnostic test helped me to identify a problem area ... I required extra resources (a Maths in Chemistry textbook) to gain proficiency in algebra..”

The tip of the iceberg?



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