

MATHEMATICS, ALGEBRA AND THE CONTEXT OF MONEY

Very few students are able to consider algebraic letters as generalised numbers or variables, most students will read the letters as specific unknowns. That is, most students can solve simple equations where you solve for x , however struggle with identifying the larger of $3n$ or $n + 3$. However if in our teaching we refer to some of the functions of a technological tool that students are familiar with, such as spreadsheets, they may develop a better understanding of the concept of variables.

Helping students see algebra in everyday life is one way to aid the learning of abstract algebra concepts.

Students have an awareness of how often they use their mobile phones to text or make phone calls and how that compares to others. We could use this to ask them to explore the relationship initially by arithmetic reasoning before forming an equation, which would help them see the algebra in everyday life!



DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: ALGEBRA

CASE STUDY - POSTAGE

The situation: the lead teacher at Sandringham School in St Albans gave her year 8 middle set students information about eight interesting items that had recently been sold online and asked them to find out about the cost of postage. The items varied in size, mass and value, and delivery destinations ranged from local to international.

The task: to calculate the maximum profit the seller made on each item after postage had been paid.

The process: the teacher encouraged her students to research Royal Mail prices and services to find the cheapest price they could pay to have the items sent to the various destinations.

Real life? An average child makes their first online purchase at the age of 10, so students are likely to buy online frequently but may not be considering the cost of postage. This task not only increases students' awareness of postage options and costs but by using real world prices and services students may feel encouraged to research postage costs to reduce the cost of their own purchases in future.

The situation: in the following lesson students considered the wedding photography business. The teacher gave her students information about four products and the price the photographer charged for each, for example individual photographs for 80p and a large photo album for £324.49.

The task: to find the total profit the wedding photographer would make on each of the four products.

The process: students first calculated the gross profit made on each product, before generalising to formulae. The teacher gradually introduced more complex conditions, for example, 'what if 40% of the selling price was profit?', each of which meant students needed to amend previous formulae. Finally, students calculated the postage costs, and were able to generate formulae for the total profit the photographer made on her products.

Real life? This activity combines a business context with financial mathematics. In the future, students are likely to use products or services offered by specialist businesses, so to be able to calculate value for money will be useful. Some may even be involved in running a small business. This also introduces concepts such as profit and product pricing.

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ACTIVITY IDEAS



Renting a car

Ask students to research the cost of renting a car for a week in the UK.


Introduce the following fictitious online companies and their pricing:

Company	Pricing
AAA	£350 per week for unlimited mileage
Beat us	£17 per day plus 15p per mile
Cars R us	£90 per week with the first 300 miles free and then 30p per mile

Ask students to investigate the cheapest option.

Encourage students to populate a table to results using spreadsheet formulas and show their results graphically.

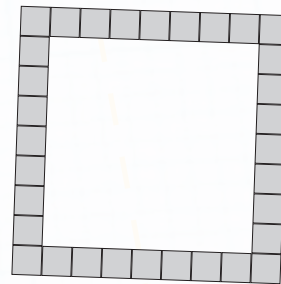
Students must present their recommendations with mathematical justifications.

Possible extension for students to recalculate costs: 

- the prices shown exclude VAT
- online booking discount of 15%.

Paving a garden border

You are designing your garden and you want to make a border for your grassed area using paving slabs. The paving slabs are of length 0.5 by 0.5m and cost £4.75 each.

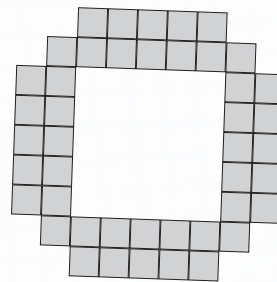


Ask students to calculate the number of paving slabs required and the cost for the following grassed areas:

- 3m by 3m lawn
- 5m by 5m lawn
- nm by nm lawn

Ask students to calculate the number of paving slabs required and the cost for various rectangular grassed areas. Ask them to generalise.

Extend the investigation to the cost of other shaped borders such as the one below, making clear the rules and methods they use.



Chocolate bar offers

The company Chocolate Bliss are launching a new chocolate bar. As part of the promotion they are offering a deal, 'buy two and get one free'.

Ask students to consider:

- If each chocolate bar costs forty pence, how much would eight chocolate bars cost?
- How much would eight chocolate bars cost?
- How much would seventeen chocolate bars cost?
- How much would n chocolate bars cost?

Ask students to investigate the costs and generalise.

Extension



What if the deal offered was, 'buy three and get one free' or 'buy five and get one free' or 'buy n and get one free'? Ask students to investigate the costs and generalise.

Fencing a vegetable patch

Give students the scenario that they are landscape gardeners and they are designing a garden for a couple who have just bought a house with plenty of land.

As part of the garden they want an enclosed vegetable patch in any shape. They already have a few rolls of wired fencing, with a total length of 250 metres.

They want the largest vegetable patch they can with the given fencing.

Once the fencing is up fertiliser needs to be spread in the enclosed area.

The fertiliser come in sacks, each covering 50m^2 and costs £12.99.

Ask students to investigate:

- Starting with a rectangle, what is the maximum area that can be enclosed by the fence? and the cost of the fertiliser?
- Using other shapes what would be the maximum enclosed area? And the cost of the fertiliser?

Ask students to produce a spreadsheet to help with the calculations.



DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: ALGEBRA ASSESSING LEARNING USING EXAM STYLE QUESTIONS

Higher Tier Questions

Q1.

Sophie is researching the cost of booking a train ticket using two websites.

Each of the websites adds a credit card charge and a booking fee to the ticket price as shown in the table.

Websites	A	B
Credit card charge	2.25% of the ticket price	1.5% of the ticket price
Booking fee	90p	£1.80

Sophie will buy the ticket online using her credit card.

- a. The price of the ticket is the same on both websites and the total charges (credit card charge plus booking fee) works out to be the same using both websites.

Work out the cost of the ticket and the total charges.

Ticket cost _____

Total charges _____

- b. If the price of the ticket had been less than your answer in part (a) which website would be cheaper? Justify your answer.

Website _____



Q2.

Ronnie wants to save some money in a savings account. He is unsure how much to invest. So he tries to write a formula. If he invests $£x$ for 5 years and it earns compound interest at a rate of 2% per annum:

Interest for year 1	$£x \times 0.02$
Interest for year 5	$£x \times 0.02 \times 5$
	$£0.1x$

State what is wrong with Ronnie's method.

If after the 5 years the value of the investment was $£9,936.73$

How much would Ronnie need to invest originally? Show your working out.

£ _____

Q3.

Sonal has more money than Jay.

If Sonal gave Jay $£20$, they would have the same amount.

While if Jay gave Sonal $£22$, Sonal would then have twice as much as Jay.

How much do they each have?

Sonal _____

Jay _____



Higher and Foundation Tier Questions

Q4.

Mr and Mrs Jones and their 2 children are going to London by train.

The cost of an adult ticket is double the cost of a child ticket.

Mr Jones has a Family discount train card which gives them:

¼ off adult tickets	40% off child tickets
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Write an equation for the total cost (T) of the tickets when Mr Jones uses his Family discount train card in terms of x . Write in its simplest form.

$$T = \underline{\hspace{2cm}}$$

Q5.

Mia invests £6,200 in a savings account for 8 years.

The account pays compound interest at an annual rate of 2.05%

Using the compound interest formula work out the total amount of money in Mia's account at the end of 8 years.

$$£ \underline{\hspace{2cm}}$$



Foundation Tier Questions

Q6.

Fatima and Ali work at the same coffee shop.

They get paid £6.60 per hour plus any tips given to them.

Write a formula to work out the total amount of money they get paid each day.

Total pay = _____

The table shows the number of hours Fatima and Ali worked yesterday and the tips they each got.

	Number of hours worked	Tips
Fatima	7	£13.50
Ali	8	£10.20

How much did they each earn yesterday? Clearly show your working out.

Fatima _____

Ali _____

Q7.

Fred needs to hire a concrete mixer. The formula below shows how much he will have to pay.

Total charge = £35.50 plus £9 each day

Fred hired a concrete mixer for 5 days.

a. Work out the total charge.

Tony also hired a concrete mixer from the same company. He paid £134.50 in total.

b. Work out how many days Tony hired the concrete mixer for.

_____ days