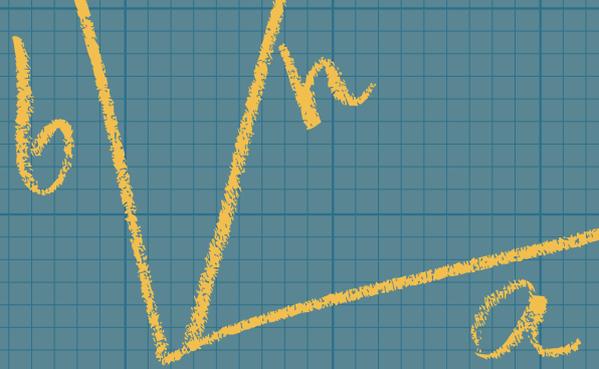




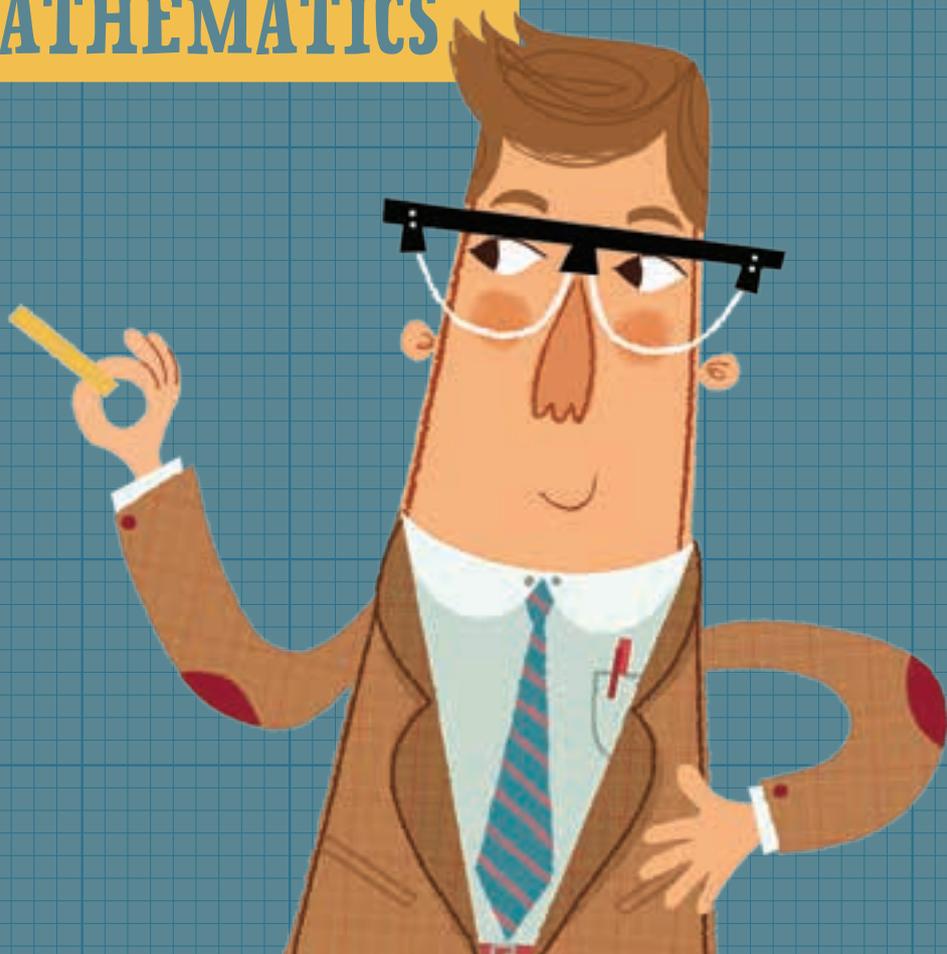
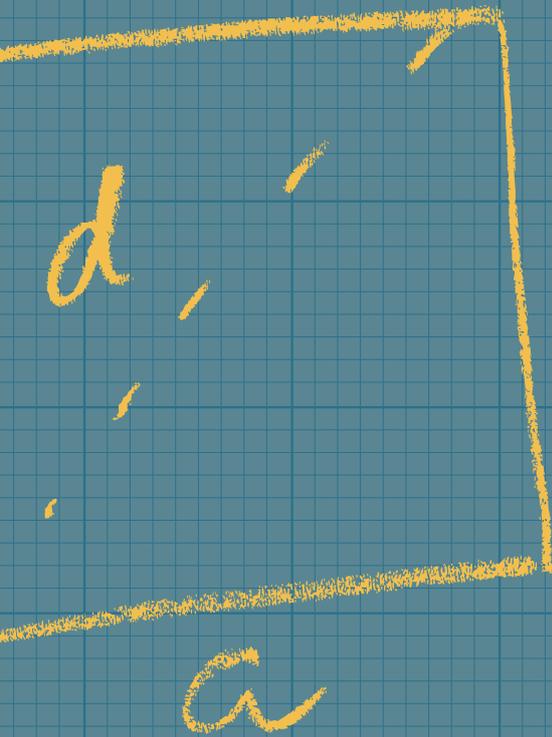
Personal Finance
Education Group

part of  YOUNG
enterprise



MATHS MATTERS

USING FINANCIAL CONTEXTS IN
SECONDARY MATHEMATICS



Department
for Education

SUPPORTED BY
MAYOR OF LONDON

INTRODUCTION

This resource is the result of a project conducted by **pfeg** (Personal Finance Education Group) funded through the London Schools Excellence Fund, exploring the link between delivering mathematics in a financial context and improving the engagement and attainment of young people. This project involved working directly with the maths departments from 25 secondary schools throughout London to trial and assess the impact on students of delivering the mathematics they would normally deliver but with a greater financial context.

To find out more about this please do feel free to explore the project area on our website:

www.pfeg.org/LondonLeadTeachers

Over the duration of the project it was observed that the vast majority of students significantly improved their attainment when mathematics was delivered using a financial context. This was in direct contrast to randomised control trial in which the students were delivered the same mathematics but without a financial context; in this case there was little or no improvement in attainment.

The reason for such an increase in attainment appears to be mainly related to the accessibility of certain questions. GCSE mathematics papers often contain up to 35% of questions which use finance as a context and, in some cases, it is this *context* which renders the question inaccessible to students, rather than the mathematical content. The provision of greater knowledge and understanding of these financial contexts enables students to better access such questions, and the mathematics therein.



HOW TO USE THE RESOURCE

The resource has been divided into five areas, in line with those within the mathematics programme of study:

1. Geometry and measure
2. Algebra
3. Number
4. Ratio, proportion and rates of change
5. Statistics and probability (these have been combined for the purpose of this resource).

For each of these areas, this resource provides:

- Examples of how a financial context could be applied to the subject content
- A case study detailing how one of the schools involved in the London Lead Teachers in Financial Mathematics project has developed financial context within the area
- Activity ideas that could be used in the classroom to deliver the subject content in a financial context

- Exam style questions which cover the subject content whilst also using a financial context that can be used to assess learning.

There is no set structure to working through or applying the content from this resource. It is intended to provide a useful starting point to begin developing financial context mathematics, or to provide further ideas and opportunities for those who have already begun integrating this contextualised model of delivery.

You may find when delivering these questions that students are unfamiliar with some of the financial terms e.g. VAT, investment or compound interest, and that briefly explaining these would be beneficial.

ACKNOWLEDGMENTS

London Lead Teachers

We would like to express our thanks to all of the 25 schools involved in the London Lead Teachers in Financial Mathematics project for their contribution to this resource.

London Schools Excellence Fund

The London Schools Excellence Fund sits within the Mayor's Education Programme, which follows on from the 2011-2012 Mayor's Education Inquiry into London Education. Together, the Department Of Education and the GLA have invested £24 million in over 100 projects across 800 schools, to build on London's existing achievements and to further develop teaching and learning across London schools.



SUPPORTED BY
MAYOR OF LONDON

MATHEMATICS, GEOMETRY AND MEASURES AND THE CONTEXT OF MONEY

Geometry is mainly used as a practical guide for measuring lengths, areas and volumes. Developing students' knowledge of shapes leads to an increased ability to reason spatially, to visualise objects and, eventually, use geometry to solve problems. Learning how to measure and compare lengths, weights and capacity is an important life skill, therefore geometry and measures have many real life concrete uses that are easily related to money.

For example, the concepts of perimeter, area and volume are really important when planning a project in a home, such as:

- the area or volume of a bed or desk when designing a bedroom
- the area of a wall that requires painting
- the perimeter of a garden that requires fencing
- the volume of a driveway that needs gravelling.

And of course all of these projects require materials that cost money.

Before starting any of these projects we have to use mathematics to estimate the amount of the materials that will be needed, such as paint which can be purchased in a range of tin sizes. Accuracy in estimation will lead to savvy purchases, whereas errors in estimation could have costly consequences!





DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: GEOMETRY AND MEASURE

CASE STUDY - ICE CREAM CONES

The situation: the lead teacher at Highgate Wood School, Haringey gave her year 8 middle set a range of problems to solve using just a litre of ice cream and a sheet of wafer.

The task: to find out how many ice cream cones students could make from one litre of ice cream and the sheet of wafer, and then to consider how to make the maximum profit.

The process: students started by looking at how many cuboid ice creams they could make from one litre of ice cream, and what this would cost. The teacher then increased level of complexity, posing challenges such as:

- if the ice cream was covered with a 0.1cm layer of chocolate, what would the increased volume of the choc ice be? How much would this cost?
- what percentage of the covered ice cream is chocolate? How is this calculated?
- What is the optimum angle to produce a wafer ice cream cone for maximum profit? Why is this?

Finally, students produced an ice cream business report and presented this to their peers.

Real life? This activity deals with fun and familiar objects, rather than simply mathematical concepts. Adding the enterprise element added interest for students, again grounding the activity in reality. As one student said in their feedback, 'I learned to think for myself'. An ice cream reward at the end ensured this activity's popularity!

DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: GEOMETRY AND MEASURE

ACTIVITY IDEAS

Tiling a bathroom

The task is for students to estimate the cost of tiling a bathroom.

Using the dimensions of a room ask students to draw an accurate plan of each wall, highlighting the window, door, bath and the area to be tiled.

Give students the choice of three tiles varying in size and price such as:

	A	B	C
Size	40x15 cm	60x30 cm	15x7.5 cm
Price	£2.30 per tile plus VAT	£4.39 per tile plus VAT	£0.69 per tile plus VAT

For each tile, ask students to calculate how many tiles they would need, and the cost to tile the bathroom.

Extension ideas could include: 

- Estimating the cost of tiling the floor
- Students could measure the size of their own bathrooms, and calculate the cost of tiling an area.

Designing a drinks can

Give students the scenario that they have just got a job as a designer for a drinks company and have been given the task of designing the shape of a can for a new drink. The boss wants an original, eye catching design that will stand out in the market, however must be cost efficient and have a capacity of 330 ml.

Students will need to consider:

- the capacity and the optimum shape of the can
- how many cans be made from a sheet of metal measuring 50cm by 1m
- the cost of each can give the sheet of metal costs £5.

Students will need to explain and justify their answers.

Designing a garden

Ask students to design the layout of a garden on a budget.

The garden could be rectangular shaped with a rectangular patio, semi-circular lawn, a circular pond and a trapezium shaped vegetable patch etc. Materials could include grass turf, paving slabs, gravel, fences etc.

Students could be asked to research and calculate the cost of:

- laying the grass turf
- paving slabs for the patio
- fencing for the vegetable patch etc.

Painting a room

Task students to estimate the cost of painting a bedroom.

Using the dimensions of a room ask students to draw an accurate plan of each wall, highlighting windows, doors, and the area to be painted.

Ask students to research:

- the cost of different types of wall paint such as matt, satin, silk emulsion
- deals such as 3 for 2, buy one get one free, 10% off
- capacity of paint tins
- value for money.

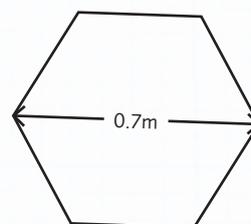
Given 1 litre of paint will cover approximately 12 square metres per coat, ask students to estimate the cost of painting the bedroom.

Extension ideas could include: 

- estimating the costs of painting the ceiling
- students measuring the size of their own bedrooms or the classroom
- extending the task to different rooms such as the bathroom, so students can consider the type and cost of the paint required.

Designing a mirror

Ask students to design mirrors of various shapes and sizes, such as a circular mirror with a diameter of 50 cm or isosceles triangle with a base and a perpendicular height of 0.6 m or a regular hexagonal mirror with a length of 0.7 m etc.



The mirrors are surrounded with an edging made of metal strips. The metal strips are sold in metre lengths for £5.65 plus VAT at 20%. Ask students to work out the cost of the edging for each of their mirrors.

As an extension ask students to design three different shaped mirrors with an area of 1m^2 and then to work out the cost of the edging. Ask students to explain their findings. 



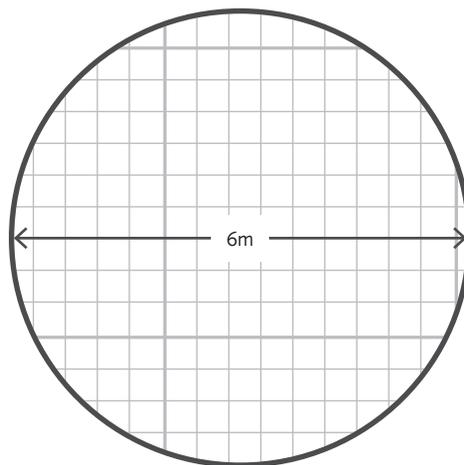
DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: GEOMETRY AND MEASURE

ASSESSING LEARNING USING EXAM STYLE QUESTIONS

Higher Tier Questions

Q1.

Jenny has a vegetable garden in the shape of a circle.



The garden has a diameter of 6 metres.

Jenny wants to put fencing around the edge of the garden.

The fencing costs £4.99 per metre plus VAT at 20%.

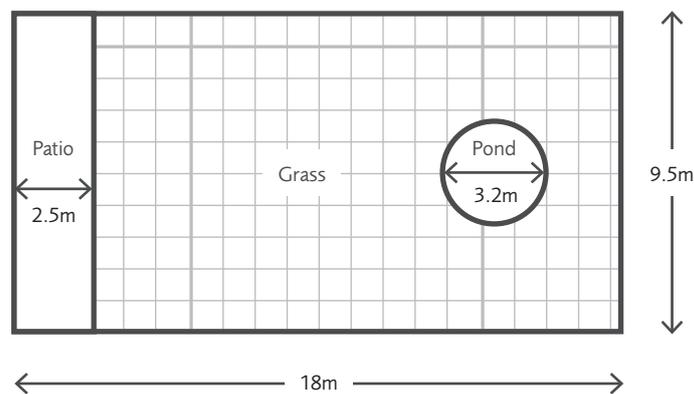
Work out the total cost of the fencing.



Q2.

Ajay has a garden in the shape of a rectangle.

The garden has a rectangular patio, a circular pond and the rest is laid with grass.



Ajay is going to spread fertiliser over all the grass.

One box of fertiliser will cover 40 m^2 of grass and it costs £0.06 per m^2 .

How many boxes of fertiliser does Ajay need and what is the cost?

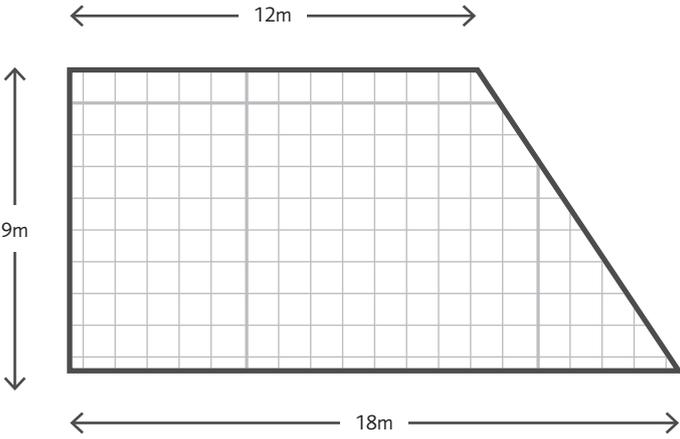
You must show your working.



Higher and Foundation Tier Questions

Q3.

Here is a diagram of Dev's driveway.



Dev wants to cover his driveway with tarmac.

It costs £2.56 to cover each square metre of tarmac.

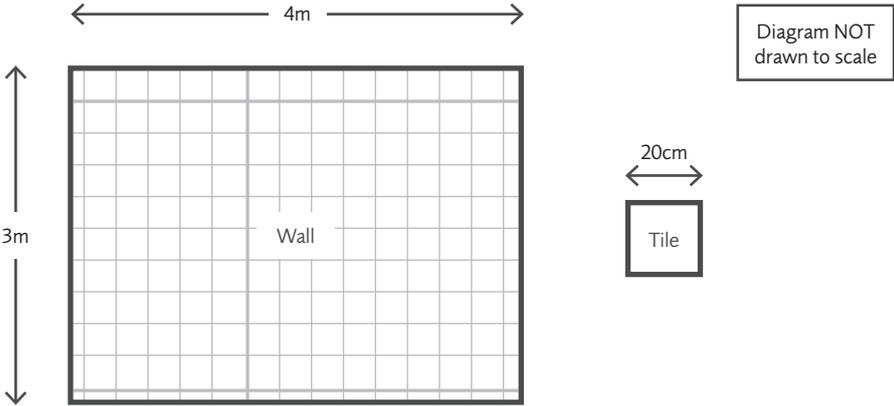
Work out the total cost of the tarmac Dev needs.



Foundation Tier Questions

Q4.

Henry wants to cover his bathroom wall with tiles.



The tiles are squares with sides of length 20 cm.

The tiles are sold in packs of 10 tiles.

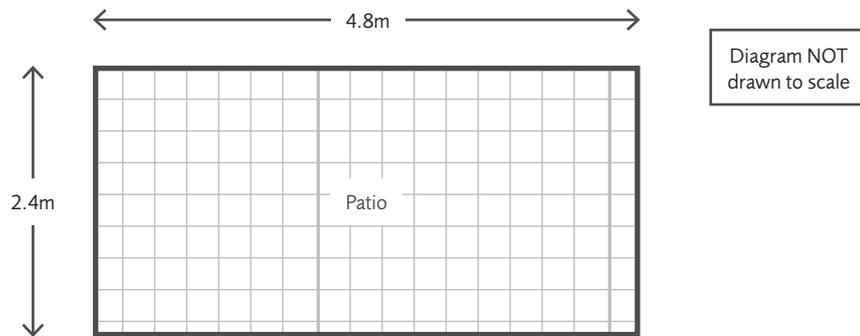
Each pack costs £25 plus VAT. The rate of VAT is 20%.

Henry has £1,000. How much change will he have?



Q5.

The diagram shows a Lena's rectangular patio which is 4.2 m long and 2.4 m wide.



Lena wants to cover the patio with paving slabs.

Each paving slab is a square of side 60 cm.

a. Lena buys 32 of the paving slabs. Has she bought enough to cover the patio?

You must show all your working.

The paving slabs cost £6.45 each.

b. Work out the total cost of the 32 paving slabs. Show your working.

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.

DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: ALGEBRA

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.

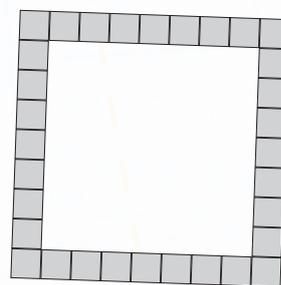
Students must present their recommendations with mathematical justifications.

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.

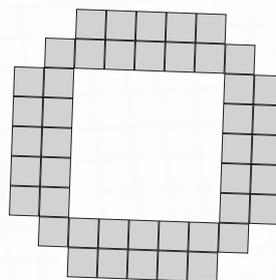


Ask students to calculate the number of paving slabs required and the cost for the following grassed areas:

- 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 $\pounds x$ for 5 years and it earns compound interest at a rate of 2% per annum:

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

State what is wrong with Ronnie's method.

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

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

\pounds _____

Q3.

Sonal has more money than Jay.

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

While if Jay gave Sonal $\pounds 22$, 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:

$\frac{1}{4}$ off adult tickets	40% off child tickets
---------------------------------	-----------------------

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

MATHEMATICS, NUMBER AND THE CONTEXT OF MONEY

In the mathematics national curriculum, financial mathematics is now emphasised for the first time in the form of problem solving.

Showing a problem and evolving the skills needed to solve that problem is more engaging for students than teaching the skills without a context. The context allows students to see a purpose for the learning; therefore they become more involved in the learning which enhances their understanding.

There seems to be a natural easy link to the real life context of money through the teaching of number. Many teachers use the context of money to help students understand decimals, four rules of number, ratio and percentages.

The curriculum highlights the requirement for students to interpret and solve problems in financial mathematics; to facilitate this we could ask them to research economical forms of travel, compare deals on phones tariffs etc.

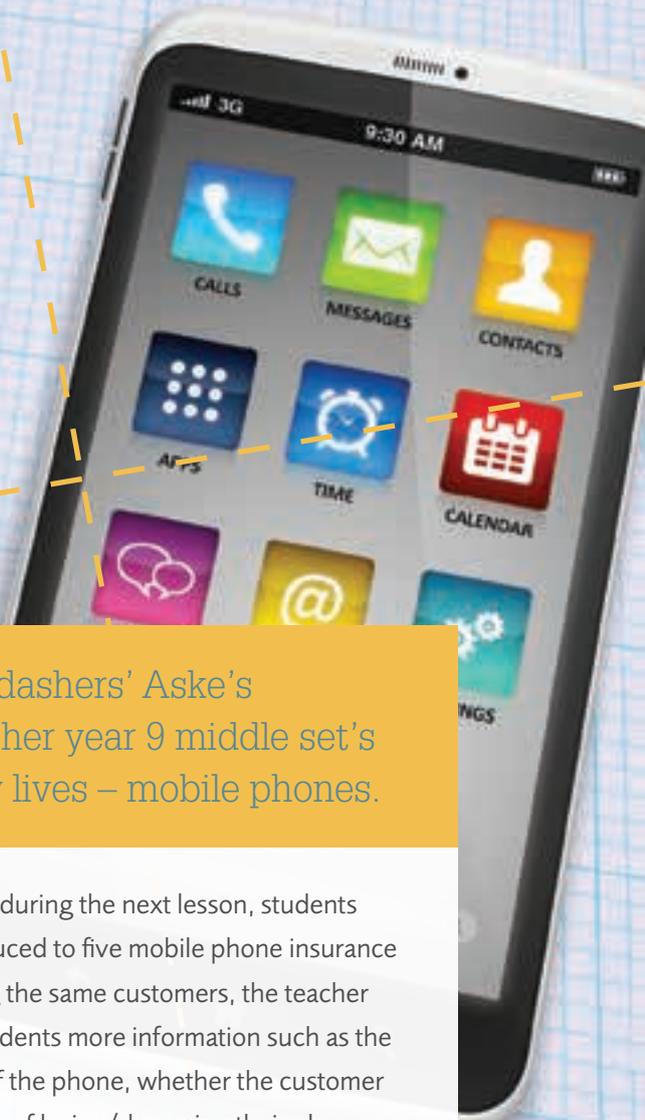
We could use manipulatives such as household bills, pay slips, invoices, bank statements etc., all of which are essential in preparing students for their future lives.

$$a = \sqrt{a \times c}$$



DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: NUMBER

CASE STUDY - MOBILE PHONES



The situation: the lead teacher at Haberdashers' Aske's Hatcham College in Lewisham structured her year 9 middle set's lesson around something key to their daily lives – mobile phones.

The task: to find the most suitable tariff plan for a range of fictional customers.

How to: students initially grounded the lesson with an example from their own lives, asking questions such as:

- Who pays for your phone? Is it pay as you go or fixed term contract?
- What most influenced your choice of phone?
- Before buying your phone how much comparison of mobile phone tariffs did you make?

This provoked plenty of discussion which helped clarify key words and terms used in the lesson, such as 'pay as you go', 'network' and 'insurance'.

Students imagined they worked in a phone shop. They were introduced to different tariff plans and customers who used their phones in a variety of ways. Students then advised customers as to which was the most suitable tariff plan for them, based on the customer's average monthly use, justifying their recommendation clearly to the customer.

Extension: during the next lesson, students were introduced to five mobile phone insurance plans. Using the same customers, the teacher gave her students more information such as the age/value of the phone, whether the customer had a history of losing/damaging their phone, and so on. The students then advised the customers about the plan that was most suitable for them.

Real life? The tasks required the students to communicate mathematically to justify their choices for the customers.

DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: NUMBER

ACTIVITY IDEAS

Energy bills

Using a variety of electricity and gas household bills (blanking out personal information), ask students to answer key questions such as:

- How many units have been used? Is this per month, per quarter or per year?
- What is the cost per unit? Is the bill correct?
- How can the bill be paid? Is there a discount for paying monthly using direct debit? Can I pay by cash and is there a discount?
- In one year how much would you save by paying monthly using direct debit than cash?
- Is VAT charged? If so at what percentage rate?
- Is there a standing charge? If so what is this for? etc.

Using one of the household bills ask students to use the internet to research the cost per unit with other providers. Ask students to consider:

- Does it make a difference if I live in the Midlands or London?
- What is the maximum / minimum I could pay for a certain number of units?
- How else could I save money on my bill?

Ask students to read their own household gas and electricity meters at various intervals and work out the costs using the above research.

Taste testing

Using three different brands of (for example) milk chocolate digestive biscuits that vary in price; ask students to taste test them and rank as to which they think is the most expensive to the least expensive. You will need to break up the biscuits as they will vary in size. Ask students to guess the cost of the biscuits, and then reveal the actual costs.

Ask questions such as:

- Is it worth paying for the most expensive packet?
- Do all the packets have the same number of biscuits inside?
- What is the volume of each biscuit?
- What is the cost per biscuit for each packet?
- Which packet is the best value for money considering the capacity?
- How much would it cost if I bought the most expensive packet weekly for a month?
- How much would I save if I bought the least expensive packet weekly for a month?

Extension



Ask students to consider if each packet of biscuit had a deal such as 3 for 2, 10% off, buy one get one half price etc. For each deal what percentage is each packet reduced by? Which packet is now value for money?

Mobile phone tariffs

Ask students to research the cost of using their mobile phones, either online or at a phone shop. They are to identify four different tariffs that could be used on their phones such as Pay as you Go, Fixed term contracts, and those with varying free minutes and texts etc.

Using their four different tariffs ask students to investigate which is the best deal for them. Encourage students to use a spreadsheet and draw graphs of the costs against usage of the phone. Students will need to justify their answer of the best value!

Saving

Ask students to consider if they saved £1 each day, starting from the age of 18 years old to the age of 65 years old

- How much would they have with no interest?
- How much would they have with 2% interest paid annually?
- How much would they have with 5% interest paid annually?

Encourage students to use a spreadsheet and draw graphs.

Finally get them to consider what rate of interest they would need to have one million pounds.

Extension



Ask students to research interest rates on three different savings accounts and then recalculate.

Healthy meals

Ask students to plan a healthy meal for a family of four on a budget of ten pounds.

It is recommended that everybody should eat five portions of fruit or vegetables per day; ask students to identify some healthy recipes that they could use for their evening meal for the family.

The students will need to find the cheapest ingredients from the main supermarkets online. Using this information they will need to work out the cost of the amount of ingredients used on the recipe and hence the cost of the meal.

Justifying their choices students will identify a healthy and economical meal for the family of four.

Extension



Ask students to plan healthy meals for a week on a budget.

Paying for a holiday

Suggest to the students that a group of friends wants to go on holiday abroad. They all need to borrow money to pay for the holiday that is costing £600 per person.

Ask students to research some ways to lend money and their interest rates such as a bank loan, credit card, pay day loans or other advertised companies.

Using the varying providers and interest rates ask students to calculate the real cost of the holiday, given that each person will pay back £30 per month.



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

Higher Tier Questions

Q1.

Sophie is setting up a business and needs to buy some plants.

The plants are sold in bulk bundles at £106.46 plus 20% VAT.

Sophie orders 3 bundles and will get a discount on the total order.

The table shows the discount she will get.

Total Order	Discount
£100 - £300	3%
£301 - £400	7%
£401 and above	10%

Work out the total cost of the order. You must show your working.



Q2.

Ash and Priya and their two boys are travelling to France for a holiday.

They will be travelling by ferry using one of the following companies:

C&O Ferries or United Ferries.

The tables give information about the costs for each adult and each child to travel with the ferry companies.

C & O Ferries	July		
Week	2	3	4
Adult	£30	£33.50	£37.25
Child	£16	£19.50	£23.25

United Ferries	July		
Week	2	3	4
Adult	£31	£34.75	£38.25
Child	£15.50	£18.50	£21.75

The family want to travel in either the second or third week of July.

Ash wants to travel with the cheapest ferry company.

Each of the ferry companies offer a discount for booking early. The table show the discounts:

Early booking discount	
C & O Ferries	1/5 off
United Ferries	25% off

Ash will book early. If the family travel in week 3, which ferry company is cheaper to travel with and how much will it cost? You must show all your working.

How much will the family save by traveling on week 2 rather than week 3 of July using your chosen company above?



Higher and Foundation Tier Questions

Q3.

Sami buys 90 bags of potatoes from a farm at £4 each.

He sells $\frac{1}{3}$ of the bags for £5.75 each.

Of the remaining he sells 65% of the bags for £5 each.

How many bags does Sami have left?

How much profit has Sami made so far?

If Sami wants to make a total profit of at least £100, how much should he sell each of the remaining bags for, to the nearest pound?



Foundation Tier Questions

Q4.

Tom needs to buy some tins of paint. He researches the cost of the paint in two shops.

For the same size tin of Matt Emulsion Paint:

Shop	Normal price	Special offer
Shop A	£8.99	Buy 2 tins and get 1 free
Shop B	£7.50	15% off the normal price

Tom needs to buy 3 tins of paint. He wants to get all the tins of paint from the same shop.

Which of the two shops offer the cheapest price for 3 tins of paint?

How much will this cost? Show your working out.



Foundation Tier Questions

Q5.

Mr Ameen is taking his form group on a school trip to the museum.

The cost of entry to the museum is shown in the table.

Ticket	Prices
Adult	£12
Child	£7
Senior	£8
Family ticket (2 adult and 2 child tickets)	£30

Mr Ameen buys 23 child tickets and 3 adult tickets.

Mr Ameen pays with four £50 notes. How much change should he get?

Q6.

A school is raising money for a charity. The charity has advertised '£3 will buy 5 meals'.

Work out the cost of one of the meals. Give your answer in pence.

_____ p

How much money will the school need to raise to buy 200 children lunches for 5 days?

MATHEMATICS, RATIO, PROPORTION AND RATES OF CHANGE AND THE CONTEXT OF MONEY

The maths curriculum calls for a greater coverage of ratio, proportion and rates of change. Ratio and proportional thinking is complex and hence a difficult skill for many students to grasp. The skill emerges slowly and there is evidence that many students don't actually acquire it; they often learn how to solve problems by remembering routine steps, rather than building a deep understanding.

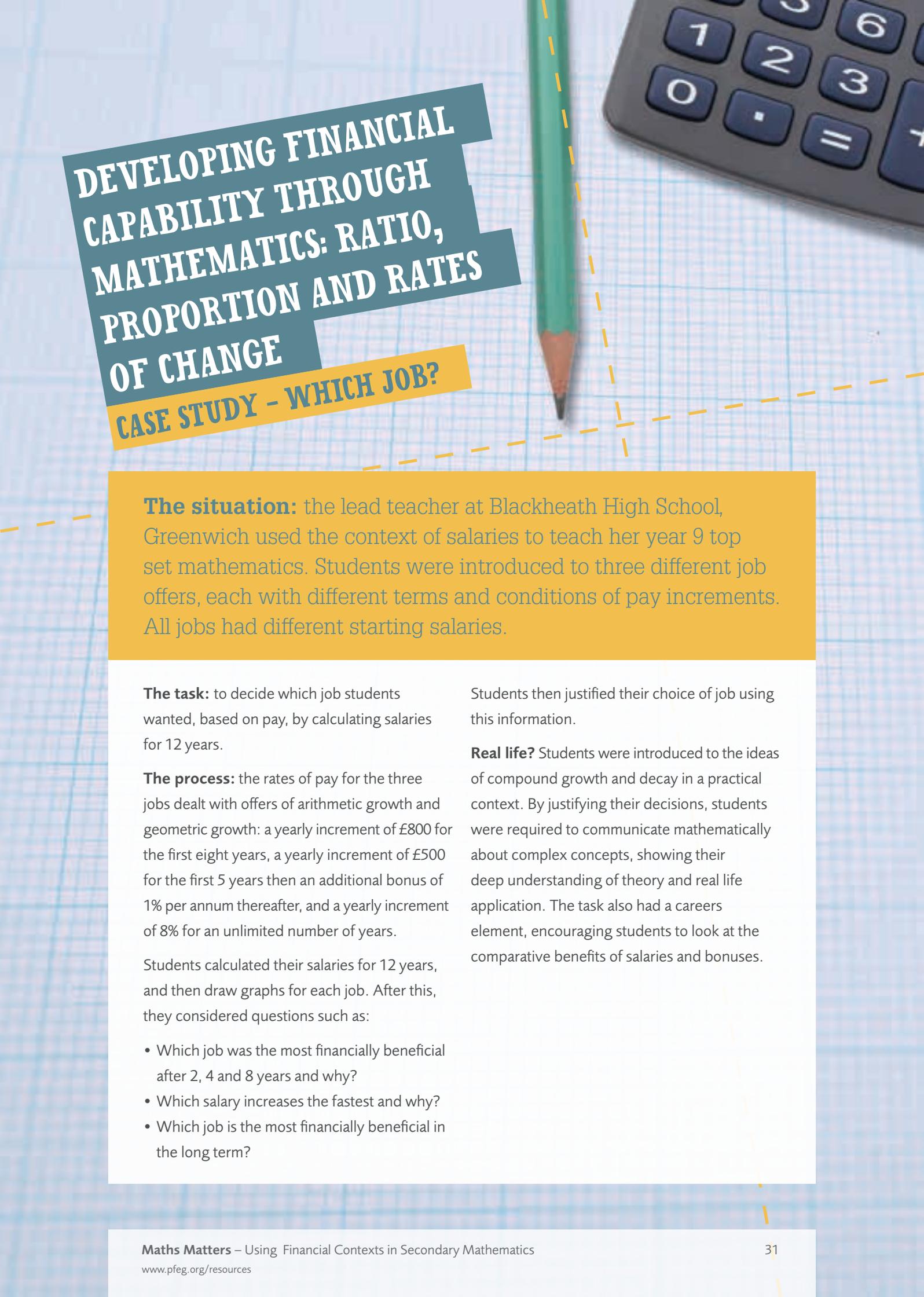
Ratio and proportional reasoning involves the ability to solve a variety of problems such as missing values, numerical comparisons and qualitative situations. Therefore a variety of strategies need to be taught, such as populating tables to see number patterns, drawing graphs, unit-rate, change of factor, and a fraction approach.

In order for students to develop a deep understanding, they require hands on experiences with ratio and proportion and rates of change situations, such as:

- unit pricing at a supermarket
- conversion rates at a post office
- sale prices in a store
- interest rates on bank accounts.

These examples allow for real life problems to be modelled which will help students save money in the future!





DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: RATIO, PROPORTION AND RATES OF CHANGE

CASE STUDY - WHICH JOB?

The situation: the lead teacher at Blackheath High School, Greenwich used the context of salaries to teach her year 9 top set mathematics. Students were introduced to three different job offers, each with different terms and conditions of pay increments. All jobs had different starting salaries.

The task: to decide which job students wanted, based on pay, by calculating salaries for 12 years.

The process: the rates of pay for the three jobs dealt with offers of arithmetic growth and geometric growth: a yearly increment of £800 for the first eight years, a yearly increment of £500 for the first 5 years then an additional bonus of 1% per annum thereafter, and a yearly increment of 8% for an unlimited number of years.

Students calculated their salaries for 12 years, and then draw graphs for each job. After this, they considered questions such as:

- Which job was the most financially beneficial after 2, 4 and 8 years and why?
- Which salary increases the fastest and why?
- Which job is the most financially beneficial in the long term?

Students then justified their choice of job using this information.

Real life? Students were introduced to the ideas of compound growth and decay in a practical context. By justifying their decisions, students were required to communicate mathematically about complex concepts, showing their deep understanding of theory and real life application. The task also had a careers element, encouraging students to look at the comparative benefits of salaries and bonuses.

DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: RATIO, PROPORTION AND RATES OF CHANGE

ACTIVITY IDEAS

A pound a day

Ask students to calculate how much they would have saved if they saved £1 each day, starting from the age of 18 years old to the age of 65 years old.

Ask them to consider the following questions:

- How much would you have with no interest?
- How much would you have with 5% paid annually?
- How much would you have with 10% paid annually?

Finally ask them to consider what rate of interest they would need to have a million pounds at the age of 65.

Encourage students to set up a spreadsheet with formulas for the calculations.

Extension



Students research current interest rates on savings accounts and then recalculate.

Traveling abroad

Give students the scenario that they are travelling abroad for their summer holidays with their families. They need to convert £1000 spending money into their destination's local currency. Ask students where this can be done. Do the rates vary?

Background story:

Last summer I went to Spain. I exchanged some of my money before leaving England, but then needed to convert some more when I arrived. I found an exchange rate at the Spanish airport offering $1 \text{ GBP} = 1.25 \text{ EUR}$. They also listed $1 \text{ EUR} = 0.87 \text{ GBP}$.

There were two rates of exchange, the first rate was for those travelling into the country that needed to buy Euros and the other rate was for those traveling out of the country that needed to sell their Euros.

Ask students to consider the following questions:

- Calculate the rates of currency exchange from the data given. Why is there a difference in the conversion rates? Is that fair?
- If you bought £1000 worth of Euros at $1 \text{ GBP} = 1.25 \text{ EUR}$ and then sold them back at $1 \text{ EUR} = 1.15 \text{ GBP}$, how much money would you get back?

Ask students to research the best current conversion rate for their chosen holiday destination using, for example:

<http://travelmoney.moneysavingexpert.com/holiday-money/>

Ask them to produce a conversion chart and graph for their conversion rate.



Recipe for success

Give the students a recipe for a cake that serves, for example, 8 people. Ask students to rewrite the recipe for various numbers of people, for example 6 or 12 people.

Using online shopping websites ask students to research the cost of the ingredients considering unit pricing and hence value for money.

Then ask students to consider the following questions:

- What is the cost of each ingredient for the whole cake?
- What is the cost of each ingredient for each serving of cake?

Give students the scenario that they make 5 cakes for a charity coffee morning. They sell each slice for 50p more than the cost of making it. How much profit is made?

Chocolate selection

Give students the scenario that they are the package designer for a chocolate company. They have been tasked with designing three sample selection boxes, each with the same capacity.

Using their three designs, students need to work out which design would be the most cost effective, that is, which would use the least amount of packaging.

Students will need to calculate the surface area of each design and then the unit cost of the packaging, given the cost of the material is 1 penny per square cm.

Extension



The company now wants to design three sizes of selection boxes: mini, regular and mega. The boxes need to be mathematically similar.

Given the regular is the students' chosen cost effective design from above, ask students to calculate for the mini and mega selection boxes the

- dimensions
- capacity
- scale factor
- cost per unit

Students need to identify which scale factor designs they would use and why.



DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: RATIO, PROPORTION AND RATES OF CHANGE ASSESSING LEARNING USING EXAM STYLE QUESTIONS

Higher Tier Questions

Q1.

Caleb, Sara and Alicia share some money. Sara gets $\frac{1}{5}$ of the money.

Alicia and Caleb share the rest of the money in the ratio 2 : 3

What is Caleb's share of the money?

Q2.

Jon buys a house for £250,000 and sells it for £299,500

a. Calculate Jon's percentage profit.

Jon decides to invests £250,000 for 2 years at compound interest of 3.05% per year.

b. Calculate the value of the investment at the end of 2 years.



Q3.

The table shows the average cost of petrol in the UK and the USA.

	UK	USA
petrol cost	£1.10 per litre	\$2.07 per US gallon

The table below show the conversion rates of litres to gallons and pounds to dollars.

UK	USA
3.785 litres	1 gallon
£1	\$1.48

Is petrol cheaper in the UK or USA? Justify your answer.

Higher and Foundation Tier Questions

Q4.

The price of a laptop is reduced by 25% in a sale.

The sale price of the laptop is now £299.25.

Calculate the original price of the laptop.



Q5.

At the local supermarket milk is sold in various sizes of bottle.

The table shows the size of the bottles in pints and the cost.

Pints	1	2	3	4
Cost	49p	89p	£1	£1.48

Which size of milk bottle is the best value for money? Justify your answer.

Q6.

Sam is offered two jobs which both have the same salary of £800 per month.

However after an initial probationary period of a month with job A he is offered a 10% increase, whereas in job B he is offered an extra £25 a week.

Which job offer should Sam accept? You must show your working.



Q7.

Shelina and her family are going to Spain for a holiday.

Shelina wants to produce a conversion chart to help change between pounds (£) and euros (€).

Given that £1 is equivalent to €1.32, complete the table.

Pounds (£)	Euros (€)
1	1.3
2	
5	
10	
20	
50	
100	

- a. Shelina changes £650 into euros (€). How many euros should she get?

At the end of the holiday week Shelina has €200 and £400 left. Their hotel bill comes to €500

Shelina pays the bill with the €200 and some of the pounds.

- b. Use the conversion table to work out how many pounds she has left.

MATHEMATICS, STATISTICS AND PROBABILITY AND THE CONTEXT OF MONEY

Students encounter information daily in a number of different ways and in different forms. How did they get to school? How far did they travel? What did they have for breakfast? How many people live in their homes? We can help them to develop a better understanding of statistics by processing some of this daily information.

Students would understand inferential statistics as the way we are able to conclude something about a large group based upon the study of a relatively small portion of that group. Stating a hypothesis, gathering data from a random sample and then using statistical tools to determine the chances that we need to accept the hypothesis or not. Therefore for this resource we have combined the two national curriculum areas, as statistics is built up from probability.

Statistics and probability have many real life concrete uses that are easily related to money using some of the data that students encounter. For example,

- How much pocket money do students get each week?
- What did students have for lunch and how much did it cost?
- How did students travel to school and much did it cost?

Helping students to learning how to collect, organise, analyse, and interpret this numerical information called data is an important life skill.





DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: STATISTICS AND PROBABILITY

CASE STUDY - INSURANCE

The situation: City of London Academy's lead teacher gave his students a range of tasks that encouraged them to explore the world of insurance. The project for his year 9 top set involved statistics based on choosing a holiday destination for a family of four, in which students were given details such as budget, timing and the family's ideal holiday climate.

The task: as a travel advisor, make and justify a recommendation about the best destination for this family and the most cost-effective hire car.

The process: after choosing their destination based on budget, activities and climate, and using their set budget, students then examined the expenses associated with different rental cars. They looked at the factors influencing the cost of insurance such as a person's age, experience and the type of car.

The following lesson, this activity led students onto the cost of running different cars (that is, fixed cost = insurance, variable cost based on x thousands of miles). This activity required skills in creating, interpreting and using graphs in real-life contexts.

Extension: the teacher extended this activity to his year 11 higher ability class, asking

them to investigate the varying price of car insurance across England. Using a study pool of three cars and five cities, students looked at the connection between their selected city's distance from London and the cost of car insurance for each car. Some students progressed to researching the different factors that influence car insurance costs.

Real life? After completing this project with his class, the teacher found that both projects helped his students improve their understanding of mathematics by using a real life, financial education context. By allowing students to make decisions about holidays and cars, they engaged well with the project and improved their understanding of the value of insuring their important investments.

DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: STATISTICS AND PROBABILITY

ACTIVITY IDEAS

Cost of chocolate

Give students the scenario that they are working for a well known chocolate firm and they are about to launch a new chocolate bar. They need to decide on a competitive retail price, given the new chocolate bar weighs 44grams.

Ask students to investigate the cost and weight of at least ten different branded bars of chocolate.

Students will need to consider how they will:

- collect the data (considering deals such as 3 for 2)
- represent data to compare the price and weight of chocolate bars (encourage students to calculate averages and draw scatter graphs)
- interpret the data.

Justifying their choices, they need to set a price for the new chocolate bar!

Mobile phone survey

Ask students to do a survey on the use of their mobile phones.

Researching:

- how they are used such as phone calls, texts, internet, photos etc
- how often they are used
- how much it costs.

Ask students to determine whether the phone package deal they are using is value for money or have they found that there could a better one!

Buying a car

Ask students to research various cars in the price range of £6,000 to £15,000 that they would consider buying when they are older. They will need to research costs, engine size, economy rating and insurance group etc.

For each car they will need to consider:

- the weekly / yearly cost of making a 10 mile journey Monday to Friday
- an approximation on yearly running costs including servicing, tax and insurance
- the repayment costs of borrowing money to pay for the car from various establishments.

Justifying their choices using statistical tool, students select the car that they would purchase!

Planning a holiday

Ask students to plan a summer holiday for a family of four with two adults and two children, aged 11 and 15 years old. Identify the criteria such as 10 nights, budget of £3,500, twin rooms in a 3★ to 5★ hotel, hire of a car, warm climate.

Students will need to consider:

- the cost of travel to the location (flight and taxi) and the holiday time spent travelling
- the average temperature of the location including the probability of rain
- the cost of hiring a car and fuel costs per mile,
- the cost of a hotel, including the average price per person per day (considering food costs and possible activities)
- the additional cost for activities such as tours to places of interest
- spending money and currency conversion costs.

Using this information, identify a location that the family can afford to go within their budget!

House prices

Ask students to use www.rightmove.co.uk or www.zoopla.co.uk to explore the house prices in five different locations across England. For example they could explore the house prices in different cities or choose from a range of cities and rural locations.

Ask students to make some predictions, such as: the average price for a 3 bedroom semi-detached house in Manchester would be...

Each group will need to identify their criteria before they begin to research prices, such as a 2 bedroom flat within 2 miles from the city centre or a 3 bedroom semi-detached house within 1 mile from a main train line.

Extension



Britain's Office for National Statistics stated that UK house prices have risen by an average of 10.5% in the year to May 2014.

(<http://www.ons.gov.uk/ons/rel/hpi/house-price-index/may-2014/index.html>)

Ask students to explore the changes in house prices in various cities around UK over the last few years.



DEVELOPING FINANCIAL CAPABILITY THROUGH MATHEMATICS: STATISTICS AND PROBABILITY

ASSESSING LEARNING USING EXAM STYLE QUESTIONS

Higher Tier Questions

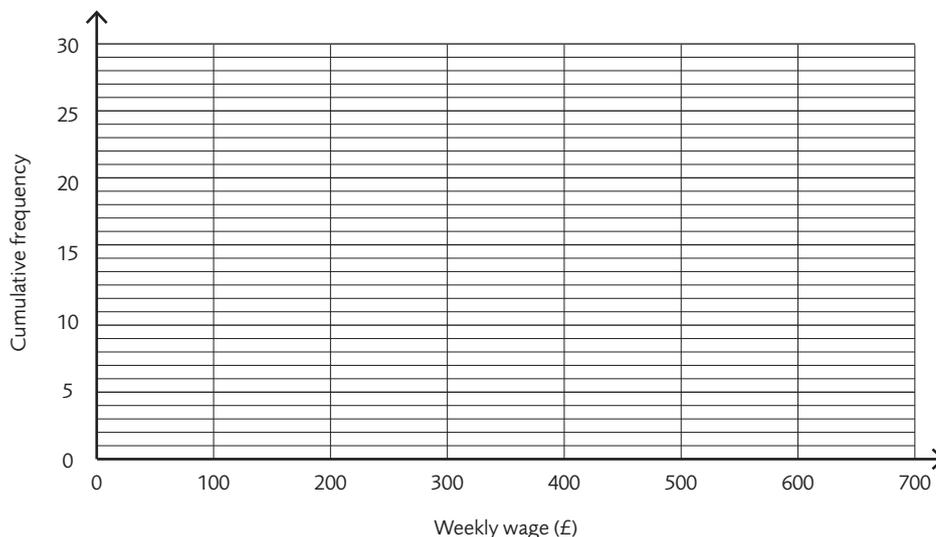
Q1.

The table shows information about the weekly wages of some office workers.

- a. Complete the cumulative frequency column.

Weekly wage (£x)	Frequency	Cumulative Frequency
$100 < x \leq 200$	8	
$200 < x \leq 300$	15	
$300 < x \leq 400$	30	
$400 < x \leq 500$	17	
$500 < x \leq 600$	7	
$600 < x \leq 700$	3	

- b. Draw a cumulative frequency graph on the grid for the weekly wages.





c. Use your graph to find an estimate for the interquartile range.

d. Using your graph estimate the number of workers with a weekly wage greater than £550.

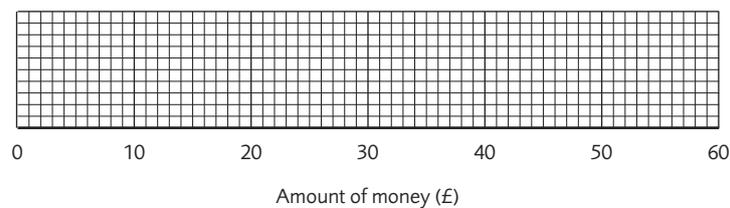


Q2.

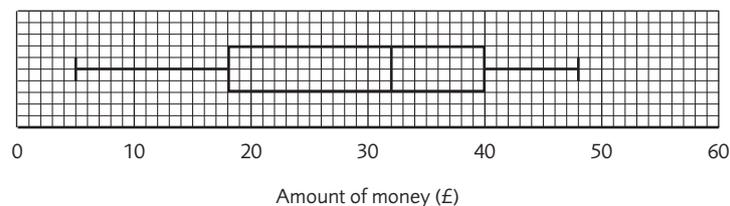
Some students have decided to participate in a sponsored race (girls vs boys) in order to raise money for charity. The table shows information about the amounts of money (£) the boys raised.

Least amount of money (£)	8
Lower quartile	17
Median	26
Upper quartile	38
Greatest amount of money (£)	45

- a. On the grid, draw a box plot for the information in the table.



The box plot shows information about the amounts of money (£) the girls raised.



- b. Use the box plots to compare the amounts of money raised by the boys and the girls.

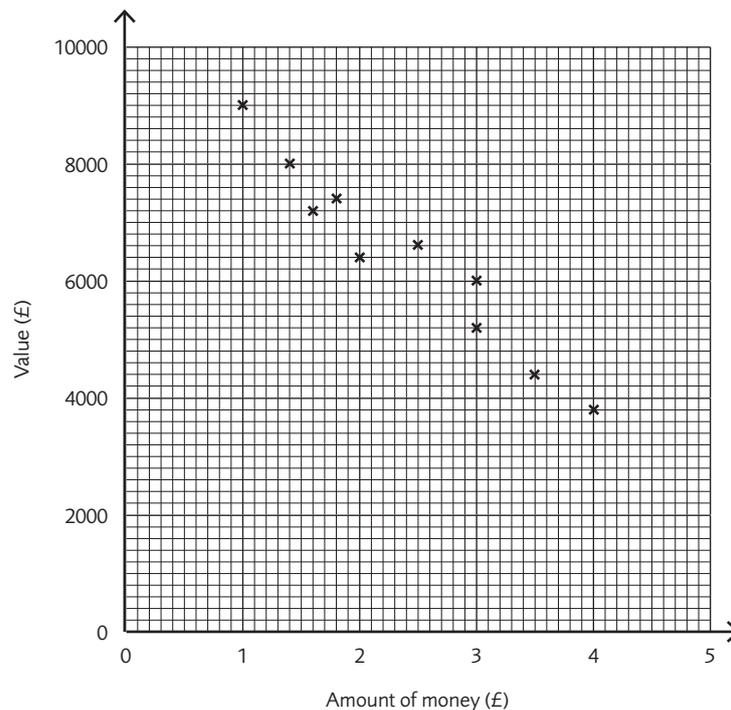


Higher and Foundation Tier Questions

Q3.

The scatter graph shows information on the age and the value of some motorbikes.

The bikes are all the same make and type.



a. Plot the information from the table on the scatter graph.

Age (years)	1.5	2.8	3.5
Value (£)	7800	5600	4800

b. Describe the correlation between the age and the value of the motorbikes.

c. Draw the line of best fit and use this to estimate the value of a motorbike that is 2.5 years old.

£ _____



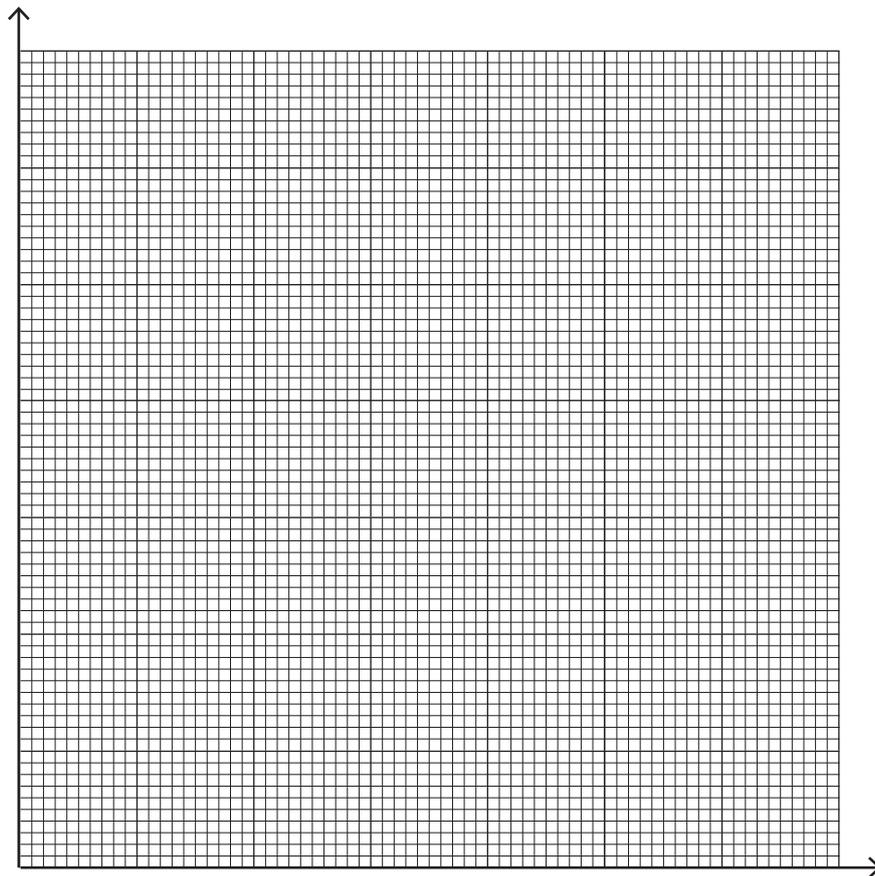
Q4.

Jai and An sell bikes.

The table shows their sales (£) to the nearest hundred in the last quarter of 2014.

	September	October	November	December
Jai	200	400	1000	1400
An	300	600	800	1000

Show this information in a suitable diagram.





Foundation Tier Questions

Q5.

The diagram shows some coins. There are three 1p coins, one 2p coin and two 5p coins.

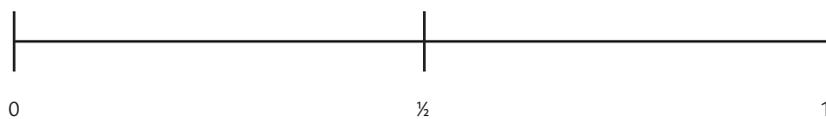


Rebecca takes one of these coins at random.

- a. Circle the word which best describes the probability that she will take a 20p coin

impossible unlikely evens likely certain

- b. On the probability scale, mark with a cross (x) the probability that she will take a 1p coin.



- c. Write down the probability that she will take a 5p coin.

ABOUT PFEG

pfeg is part of Young Enterprise and together we are the UK's leading enterprise and financial education charity.

pfeg is the most trusted, independent provider of knowledge, support and resources for anyone teaching children and young people about money. Its mission is to ensure that all young people leaving school are equipped with the confidence, skills and knowledge they need in financial matters to take part fully in society.

OTHER USEFUL RESOURCES

You may also find the *Introducing Financial Mathematics – A practical guide for key stages 3 and 4* resource useful. This resource provides guidance that puts personal finance into context for teachers and students, clarifies curriculum links and learning objectives and offers strategies and ideas for the successful delivery of personal finance education.

Also provided are a range of activities that explore many key issues, including savings and investments, currency exchange and income. You can order or download this resource from the **pfeg** website www.pfeg.org/MathsGuidance&Resource

FREE ADVICE AND GUIDANCE

pfeg offers a free service for anyone involved in teaching children and young people about money. Specialist education consultants use their experience to give practical advice and guidance about any aspect of financial education. This can range from identifying appropriate teaching resources to providing ideas on how to deliver engaging and relevant financial education to your learners.

So, why don't you ASK**pfeg** for help and advice? See www.pfeg.org/AdvisoryService, email support@pfeg.org or call 0300 6660 127.

pfeg (Part of Young Enterprise)

Head office: Yeoman House Sekforde Street London EC1R 0HF

Registered Charity No.313697

'**pfeg** is part of Young Enterprise and together we are the UK's leading enterprise and financial education charity'



Personal Finance
Education Group

part of

