

Name:

Class:

Order	Unit	Links	Pre-requisite skills
1	Integers, powers & roots		
2	Lines, angles & shape		
3	Simplifying & substituting	Unit 1	Using powers, listing factors, understanding product / sum.
4	Area and perimeter	Unit 2	Forming expressions for area/perimeter algebraically through use of brackets, correct notation and simplifying expressions.
5	Calculations & Accuracy	Unit 1	Understanding numbers.
6	Construction and LOCI	Unit 2	Measuring angles for bearings, parallel line angle facts.
7	FDP	Unit 1	Using powers, understanding lowest common multiples.
8	Sequences, functions and graphs	Unit 3/5	Substituting into a function applying BIDMAS to calculate coordinates, factorising for roots of quadratics, understanding powers and all 4 operations with negatives.
9	Ratio & Proportion	Unit 1/7	Decimals/powers as multipliers, calculating/understanding fractions as parts.
10	Transformations	Unit 2/8	Identifying 90/180/270 degrees, plotting mirror lines of basic functions.
11	Pythagoras and Trigonometry	Unit 1/2/3/4/5	Powers/surds, types of triangles, use in area/perimeter problems to find required lengths, rounding answers.
12	Forming and solving	Unit 3/4	Properties of 2d shapes, angle facts including polygons & parallel lines, algebraic notation and simplifying, forming expressions.
13	Measures	Unit 1/7	Calculating, multiplying decimals and powers of 10 for metric conversions.
14	Volume and Surface area	Unit 4/5/13	Area of 2d shapes, rounding/calculating with bounds, conversion of units (length/area/volume), calculating missing sides using pythagoras/ trigonometry.
15	Probability	Unit 1/7	Types of numbers, calculating with fractions & decimals.
16	Inequalities	Unit 12/8/5/7	Solving equations, rounding, plotting graphs for regions, calculating with fractions.
17	Statistics	Unit 1/6/9/16	Using a protractor for pie charts, proportion to calculate angles for a pie chart, use of inequality symbols for recording data.

Homework 1 Due

Homework 2 Due

Homework 3 Due



Overview	Learning Objective		
<p>Topic: Integers, Powers and Roots</p> <p>Big Questions</p> <p>Convince me that $\sqrt{72} = 6\sqrt{2}$</p> <p>- What do I need to multiply $(4 + \sqrt{1})$ by to give $11 + 6\sqrt{3}$ as a simplified answer?</p>	<ul style="list-style-type: none"> - Calculate with standard index form. Multiplication. - calculate with standard form. Division. - Calculate with standard form. Addition. - Calculate in standard form. Subtraction. - Use index notation for negative integer indices - Know that $n^{1/2} = \sqrt{n}$ and $n^{1/3} = \sqrt[3]{n}$ for any positive number n. - Use index notation and index laws for simple fractional powers such as $16^{3/4}$ 	<ul style="list-style-type: none"> - Use index notation involving fractional negative powers. - Know that $n^{1/2} = \sqrt{n}$ and $n^{1/3} = \sqrt[3]{n}$ for any positive number n. - Use index notation and index laws for simple fractional powers such as $16^{3/4}$. - Simplify surds to the form $a\sqrt{b}$ - multiplying surds 	<ul style="list-style-type: none"> - Use index notation involving fractional negative powers. - Rationalise a denominator in the form $a\sqrt{b}$, $a + \sqrt{b}$ and $a + b\sqrt{c}$. - Construct an algebraic proof of number properties. Simplify surds, such as $4(3 + \sqrt{3})$ and $(2 - \sqrt{3})(4 + \sqrt{3})$ in the form $a + b\sqrt{3}$ - Rationalise the denominator of a surd such as $2/\sqrt{5}$.
<p>Topic: Lines, angles and shapes</p> <p>Big Questions</p> <p>- Show me a problem with a right-angle in a semi-circle.</p> <p>- Show me a problem where two angles are subtended by the same arc.</p> <p>- Show me a problem involving a cyclic quadrilateral.</p>	<ul style="list-style-type: none"> - Use the tangent/radius properties of a circle. - Apply circle theorems. - Prove circle theorems. 		
<p>Topic: Simplifying and substituting</p> <p>Big Questions</p> <p>- Can you have a negative square root?</p> <p>- Expand $(a + b)^3$</p>	<ul style="list-style-type: none"> - Expand products of more than two binomials. - Recognise and factorise the difference of two squares. 	<ul style="list-style-type: none"> - Factorise quadratics in the form $ax^2 + bx + c = 0$ where $a = 1$. - Factorise quadratics in the form $ax^2 + bx + c = 0$ where $a > 1$. 	<ul style="list-style-type: none"> - Simplify algebraic fractions that involve factorising. - Interpret the succession of two functions as a 'composite function'. - Interpret the reverse process as the 'inverse function'.

Prime Number	A positive integer greater than 1 that can only be divided by itself and 1 without leaving a remainder.
Base	The big number on the <u>left</u> ; the number that will be multiplied by itself.
Index	The small number on the <u>top-right</u> ; the number of times a value is multiplied by itself. Another word for index.
Power of exponent	Plural of index
Indices	The reciprocal of a number is one divided by that number

Steps to estimate a square root	<ol style="list-style-type: none"> 1: Identify the square on either side. 2: Place the squares and their roots at end of a blank line. 3: Identify the halfway point. 4: Place your number on the line. 5: Estimate its position. 6: Square your answer to check.
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Prime Factor Tree



Rule	Example
1 $x^1 = x$	$5^1 = 5$
2 $x^0 = 1$	$5^0 = 1$
3 $x^n \times x^m = x^{n+m}$	$x^2 \times x^3 = x^{2+3} = x^5$
4 $x^n \div x^m = x^{n-m}$	$x^5 \div x^2 = x^{5-2} = x^3$
5 $(x^m)^n = x^{m \times n}$	$(x^3)^2 = x^{3 \times 2} = x^6$
6 $(x \times y)^n = x^n \times y^n$	$(x \times y)^3 = x^3 \times y^3$
7 $(x \div y)^n = x^n / y^n$	$(x \div y)^3 = x^3 / y^3$
8 $x^{-n} = 1/x^n$	$x^{-2} = 1/x^2$
9 $x^{-1/n} = \sqrt[n]{x}$	$x^{-1/2} = \sqrt{2/x}$
10 $x^{m/n} = \sqrt[n]{x^m}$	$x^{2/3} = (\sqrt[3]{x})^2$

Remember

$$a^2 + a^2 = 2a^2 \quad \text{BUT} \quad a^2 \times a^2 = a^4$$

Integers

"Integer" is just a posh word for whole number.

7, 23, and 67 are examples. 1 is not a prime number.

So: 1, 7, 298, -3, 0 and -49 are all integers, but 2.5 is not and neither is $3\frac{5}{8}$!

Multiples

The Multiples of a number are all the numbers in your number's times table.

Don't forget: you must count the number itself!

e.g. Some multiples of 7 are: 7, 14, 21, 28... but there are loads more, like 700 and 4445

Factors

The Factors of a number are all integers that divide into your number exactly (there must not be a remainder!)

Don't forget: 1 is a factor of all numbers, and so is the number itself!

e.g. The factors of 12 are: 1, 2, 3, 4, 6 and 12

In index form	Written using powers	In index form, $4 \times 4 \times 4$ is 4^3
Expand	Write in a longer form, without indices	7^3 expands to give $7 \times 7 \times 7$
Evaluate	Find the value; work out	I would 2^3 to get 32
Simplify	Write in the simplest, neatest form	$2^3 \times 2^2$ simplifies to 2^5

Standard Form

A number between 1 and 10 \times A power of 10

A number in standard form must be written in this way.

Going from standard form to ordinary numbers

$$5 \times 10^{10} = \boxed{50\,000\,000\,000} \quad 0.00006 = \boxed{6 \times 10^{-4}}$$

$$7.1 \times 10^6 = \boxed{7\,100\,000} \quad 0.00000072 = \boxed{7.2 \times 10^{-7}}$$

Look at the power: positive the number will get bigger, if negative the number will be smaller.

Multiplying Standard Form

$$(a \times 10^n)(b \times 10^m) = (a \times b)(10^n \times 10^m)$$

$$(2 \times 10^6) \times (4 \times 10^4) = 2 \times 4 \times 10^6 \times 10^4$$

$$= 8 \times 10^{6+4} \quad (8 \times 10^{10}) \div (2 \times 10^7) = (8 \div 2) \times (10^{10} \div 10^7)$$

$$= 4 \times 10^{10-7}$$

Adding and Subtracting Standard Form

Step 1: Take the numbers in Standard Form back to an ordinary number.

Step 2: Add or subtract the numbers

Step 3: Put the answer back into Standard Form

Simplify $\sqrt{72} = \sqrt{36 \times 2}$

$$= 6 \times \sqrt{2}$$

$$= 6\sqrt{2}$$

What is the largest square number that is a factor of 72?

Rationalise the denominator

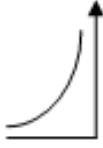


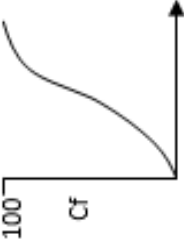
Example: This is the same as multiplying by 1

$$\frac{1}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{1 \times \sqrt{5}}{\sqrt{5} \times \sqrt{5}}$$

$$= \frac{\sqrt{5}}{\sqrt{5 \times 5}} = \frac{\sqrt{5}}{\sqrt{25}} = \frac{\sqrt{5}}{5}$$

Date Due:

Score to beat:

Section A: Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
1. Write $\frac{3}{11}$ as a recurring decimal		11. Factorise: $x^2 + 5x + 4$		21. Linear-Quadratic-Cubic-Reciprocal Which function is represented by this graph? 	
2. Write 0.29 as a fraction		12. Factorise: $x^2 - 9$		22. What inequality is represented here? 	
3. Work out the balance for £4500 invested for 2 years at 4% per annum		13. Multiply & simplify: $(2a + 1)(a + 3)$		23. On a spinner: P(3) = $\frac{1}{4}$ and the p(4) = $\frac{1}{4}$ What is the probability of getting 3 or 4 	
4. The value of a car depreciates by 35% per year. Work out the current value of a car bought 2 years ago for £20000.		14. Multiply & simplify: $(3x - 2)^2$		24. A courgette seed and a pumpkin seed are planted. P(courgette seed germinates) = $\frac{1}{2}$ P(pumpkin seed germinates) = $\frac{1}{2}$ What is the probability that BOTH seeds germinate?	
5. In a '20% off' sale, a coat was £220. Work out the original price.		15. Make r the subject of the formula: $A = \pi r^2$		25. Show on the cumulative frequency graph how to take the median reading 	
6. The cost of a scooter has increased by 20% to £72. Work out the original price.		16. Make t the subject of the formula: $S = at + bt$			
7. Write 84000 in standard form:		17. $S = \frac{u^2 + v^2}{2a}$ Find S when, $u = -1$ $v = -2$ $a = 2$			
8. Write 2.4×10^{-2} as an ordinary number		18. $D = ut + kt^2$ Find D when $u = 20$ $t = 1.2$ $k = -5$			
9. Work out $(4 \times 10^4) \times (2 \times 10^3)$ Give your answer in standard form		19. If $\tan x = \frac{3}{8}$, find x (3sf)			
10. Work out $(6.3 \times 10^7) \div (4.2 \times 10^{-2})$ Give your answer in standard form		20. Each of these measures is rounded to nearest whole: $a = 5\text{cm}$ and $b = 3\text{cm}$ Calculate the upper bound of $a + b$			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	

Circumference	The distance around the edge of the circle
Radius	The distance from the centre of the circle to the edge of the circle
Diameter	The distance across the circle from edge to edge, going through the centre
Tangent	A straight line that touches the circle
Chord	A line that touches each edge of the circle but does not go through the centre
Segment	The area created between the circumference and a chord
Arc	Part of the circumference
Sector	A slice of the circle - looks like pizza!

4	Quadrilateral	90°	360°	2
5	Pentagon	108°	540°	3
6	Hexagon	120°	720°	4
7	Heptagon	128.6°	900°	5

Co-interior/Supplementary Angles
Make an F shape. Angles are equal.

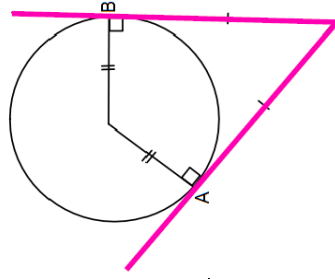
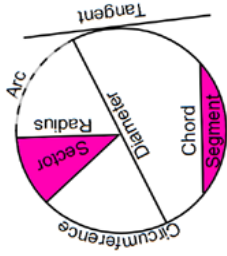
Corresponding angles
Make an X shape. Angles are equal.

Alternate Angles
Make a C-shape. Angles add up to 180°

Vertically Opposite angles
Make a Z shape. Angles are equal.

6. Tangents to a Circle

- ✓ A tangent to a circle is always perpendicular to the radius.
- ✓ Two tangents from the same points are equal in length



Exterior Angles

The sum of exterior angles in any shape (or polygon) equal 360°

Interior Angles

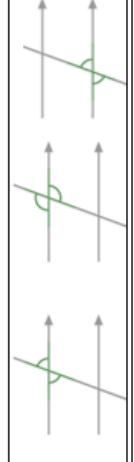
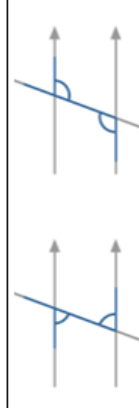
For n sides

Sum of interior angles

$$= (n - 2) \times 180$$

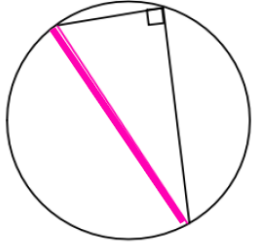
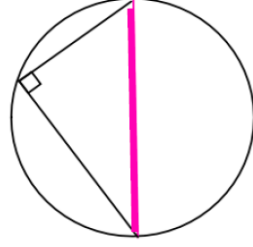
Each interior angle

$$= \frac{(n - 2) \times 180}{N}$$



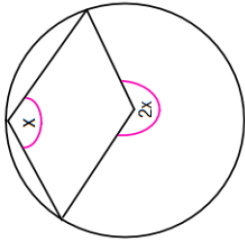
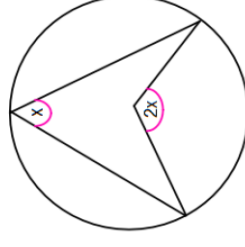
1. Angle in a Semi Circle

- ✓ The angles at the circumference standing on a diameter are equal to 90°



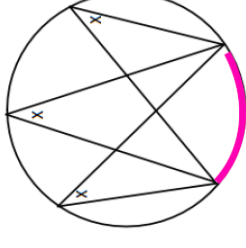
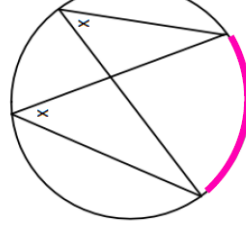
2. Angle at the Centre

- ✓ The angle at the centre is twice the angle on the circumference



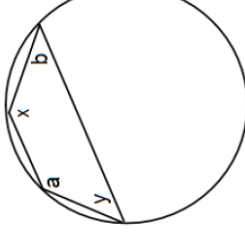
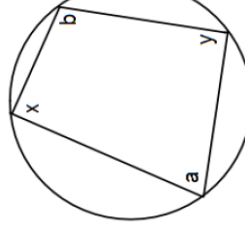
3. Angles on the Same Arc

- ✓ Angles at the circumference standing on the same arc are equal



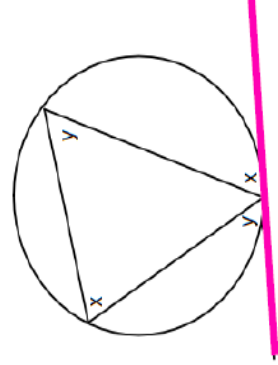
4. Cyclic Quadrilateral

- ✓ Opposite angles in a cyclic quad add up to 180°
- ✓ The vertices MUST be on the circumference



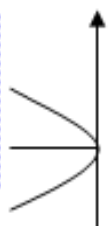


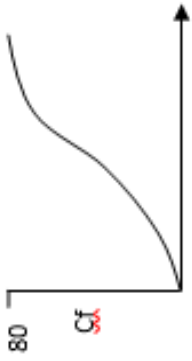
5. Alternate Segment

- ✓ The angle between a tangent and a chord is equal to any angle made by that chord in the alternate segment



Date Due:

Score to beat:

Section A: Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
1. Write $\frac{5}{11}$ as a recurring decimal		11. Factorise: $x^2 + 7x + 6$		21. <u>Linear-Quadratic-Cubic-Reciprocal</u> Which function is represented by this graph? 	
2. Write 0.27 as a fraction		12. Factorise: $x^2 - 36$		22. What inequality is represented here? 	
3. Work out the balance for £3000 invested for 3 years at 5% per annum		14. Multiply & simplify: $(3x + 4)(x + 1)$		23. On a spinner: $P(3) = \frac{1}{4}$ and the $p(4) = \frac{3}{4}$ What is the probability of getting 3 or 4 	
4. The value of a car depreciates by 24% per year. Work out the current value of a car bought 3 years ago for £20000.		14. Multiply & simplify: $(2x + 5)^2$		24. A courgette seed and a pumpkin seed is planted. $P(\text{courgette seed germinates}) = \frac{1}{4}$ $P(\text{pumpkin seed germinates}) = \frac{1}{4}$ What is the probability that BOTH seeds germinate?	
5. In a '20% off' sale, a coat was £68. Work out the original price.		15. Make r the subject of the formula: $V = \pi r^2 h$		25. Show on the cumulative frequency graph how to take the median reading 	
6. The cost of a scooter has increased by 20% to £144. Work out the original price.		16. Make b the subject of the formula: $S = ab - bc$			
7. Write 63000 in standard form:		17. $S = \frac{u^2 + v^2}{2a}$ Find S when, $u = -4$ $v = -2$ $a = 5$			
8. Write 1.6×10^{-2} as an ordinary number		18. $D = ut + kt^2$ Find D when $u = 10$ $t = 1.4$ $k = -3$			
9. Work out $(3 \times 10^5) \times (2 \times 10^4)$ Give your answer in standard form		19. If $\tan x = \frac{7}{12}$, find x (3sf)			
10. Work out $(6.67 \times 10^8) \div (4.6 \times 10^{-3})$ Give your answer in standard form		20. Each of these measures is rounded to nearest whole: $a = 5\text{cm}$ and $b = 3\text{cm}$ Calculate the lower bound of $a + b$			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	

Expression: A collection of terms. (Simplified)

Equation: Expressions that equal one another. (Solved) (An inequality is a special ≠ equation)

Identity: An equation that is true for all values of the variables. (Show)

Formula: An identity seen as a general rule. (Subject)

Function: (Substitute)

An expression for which inputs are used to generate outputs from inputs.

Constants are numbers that stand on their own. They will not have an "x", "y", "z", or any other variable attached to them. They can be small numbers, like "7", or big numbers, like "23 849".

Variables are symbols that stand for numbers that vary. A variable is usually written as a letter, such as "x", "y", or "z".

The difference between constants and variables is that the value of a variable can change, while the value of a constant stays the same.

SIMPLIFYING AND SUBSTITUTION KNOWLEDGE ORGANISER

EXPANDING

EXPANDING means multiplying all terms together and simplifying.

Single brackets

$$3(a + 4) = 3a + 4$$

means: "3 times (a + 4)"

$$= 3a + 12$$

Double brackets

$$(a + 2)(a + 3) = a^2 + 2a + 3a + 6$$

$$= a^2 + 5a + 6$$

means: "(a + 2) times (a + 3)"

Multiple binomials - using a grid.

Example of expanding more than two binomials:

$$(x + 3)(x - 5)(x + 4)$$

First two brackets expand to $x^2 + 3x - 5x - 15 = x^2 - 2x - 15$

$$= (x^2 - 2x - 15)(x + 4)$$

We now must multiply everything in the left hand bracket by x and then by 4

$$= x^3 - 2x^2 - 15x + 4x^2 - 8x - 60 = x^3 - 2x^2 - 23x - 60$$

If you have three binomials times together, you will end up with a cubic expression, 4 will make a quartic expression and so on.

$$(x + 3)(x - 5)(x + 4) = x^3 - 2x^2 - 23x - 60$$

x	x ²	x ³
+4	-2x	-15x
-5	-8x	-60

Multiply (x² - 2x - 15) by (x + 4)

Key Facts - Adding and Subtracting

Consider the family meal below.

We need to group the same items together, so when we order through the drive-through its simple.



$$3b + f + 5c + 3b + s + 2f + m + 2m + mf + c + z + 2b$$

This would be a mouthful to say into the microphone when ordering ... so lets group all the same items together.

3b + 2b + 3b = 8 burgers

s + s = 2 salads

5c + c = 6 cokes

f + 2f = 3 fries

m + 2m = 3 milkshakes

1 McFlurry

If the coefficient is 1 we don't write it.

$$8b + 2s + 6c + 3f + 3m + mf$$

Key Facts - Multiplying

$$5 \times 2 = 10$$

$$5b \times 2c = 10bc$$

$$3 \times 7 = 21$$

$$3pi \times 7c = 21pic$$

FUNCTIONS

Function f(x) or x: → or y =

A function is a special relationship where each input has a single output.

It is often written as: "f(x)" where x is the input value.

A function put inside another function e.g. f(g(x))

An inverse function goes the other way e.g. if f(x) = 2x + 3 then f⁻¹(x) = $\frac{x-3}{2}$

SUBSTITUTION

SUBSTITUTION means putting numbers where the letters are.

$$x + \frac{x}{z}$$

$$x = 5 \quad z = 5$$

$$5 + \frac{5}{5}$$

How to Factorise a Single Bracket

$$14y^2 + 21y$$

- Find the highest common factor of 14 and 21
- 7 is the highest common factor
- y is the common factor letter
- Factorise... 14y² ÷ 7y and 21y ÷ 7y

$$7y(2y + 3)$$

FACTORISING

How to Factorise a Quadratic Equation

A) How to factorise when the coefficient of x² is = 1

$$x^2 + 8x + 15$$

- Find the factors of 15 which sum to 8.

Factors of 15 are:

1, 15, 3, 5

- Only 3 and 5 sum to 8 and multiply to give 15

$$3 + 5 = 8$$

$$3 \times 5 = 15$$

$$(x + 3)(x + 5)$$

B) How to factorise when the coefficient of x² is > 1

$$2x^2 - 5x - 12$$

Multiply 2 x -12 = -24

- Find the factors of -24 which sum to give you -5 and multiply to give you -24

$$3 \times -8 = -24$$

$$3 + -8 = -5$$

$$2x^2 - 8x + 3x - 12$$

- Factorise the first two terms and the last two terms

$$2x^2 - 8x + 3x - 12$$

$$2x(x - 4) + 3(x - 4)$$

- Use the 'common factor term' of (x - 4) as the first bracket

Use what is 'left over'

$$2x + 3$$

$$(2x + 3)(x - 4)$$

Difference of Squares

$$25v^4 - 16u^4 = \sqrt{25(v^4)} - \sqrt{16(u^4)}$$

$$= \sqrt{4(a^2)} - \sqrt{4(b^2)}$$

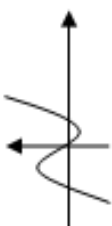
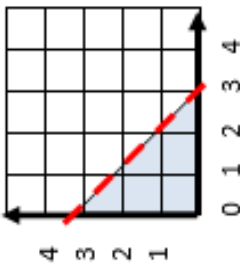

$$= 2a^2 - 2b^2$$

$$= (2a + 2b)(2a - 2b)$$

$$= (5v^2 + 4u^2)(5v^2 - 4u^2)$$

Date Due:

Score to beat:

Section A: Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
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2. Write 0.23 as a fraction		12. Factorise: $x^2 - 81$		22. What inequality is represented here?	
3. Work out the balance for £5000 invested for 5 years at 7% per annum		14. Multiply & simplify: $(x - 2)(2x + 1)$		23. On a spinner: $P(3) = \frac{2}{5}$ and the $p(4) = \frac{1}{5}$ What is the probability of getting 3 or 4	
4. The value of a car depreciates by 18% per year. Work out the current value of a car bought 4 years ago for £20000.		14. Multiply & simplify: $(2x - 7)^2$		24. A courgette seed and a pumpkin seed is planted. $P(\text{courgette seed germinates}) = \frac{1}{5}$ $P(\text{pumpkin seed germinates}) = \frac{3}{4}$ What is the probability that BOTH seeds germinate?	
5. In a '20% off' sale, a coat was £120. Work out the original price.		15. Make u the subject of the formula: $v^2 = u^2 + 2as$		25. Show on the cumulative frequency graph how to take the lower quartile reading	
6. The cost of a lamp has increased by 30% to £65. Work out the original price.		16. Make y the subject of the formula: $A = xy + yz$			
7. Write 0.0028 in standard form:		17. $S = \frac{u^2 + v^2}{2a}$ Find S when, $u = -3$ $v = -1$ $a = 5$			
8. Write 4.2×10^4 as an ordinary number		18. $D = ut + kt^2$ Find D when $u = 20$ $t = \frac{3}{5}$ $k = -5$			
9. Work out $(9 \times 10^7) \div (3 \times 10^4)$ Give your answer in standard form		19. If $\sin x = \frac{3}{4}$, find x (3sf)			
10. Work out $(6.2 \times 10^5) \times (3.8 \times 10^7)$ Give your answer in standard form		20. Each of these measures is rounded to nearest whole: $a = 5\text{cm}$ and $b = 3\text{cm}$ Calculate the upper bound of $a - b$			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	