THE DUSTON SCHOOL
Knowledge itself is power

Year 10 Maths Intermediate Knowledge Booklet Term 1

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	FDP	Unit 1	Using powers, understanding lowest common multiples.
7	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.
8	Ratio & Proportion	Unit 1/6	Decimals/powers as multipliers, calculating/understanding fractions as parts.
9	Transformations	Unit 2/7	Identifying 90/180/270 degrees, plotting mirror lines of basic functions.
10	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.
11	Forming and solving	Unit 3/4	Properties of 2d shapes, angle facts including polygons & parallel lines, algebraic notation and simplifying, forming expressions.
12	Measures	Unit 1/6	Calculating, multiplying decimals and powers of 10 for metric conversions.
13	Volume and Surface area	Unit 4/5/12	Area of 2d shapes, rounding/calculating with bounds, conversion of units (length/area/volume), calculating missing sides using Pythagoras/ trigonometry.
14	Probability	Unit 1/6	Types of numbers, calculating with fractions & decimals.
15	Inequalities	Unit 11/7/5/6	Solving equations, rounding, plotting graphs for regions, calculating with fractions.
16	Statistics	Unit 1/8/15	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**		
Topic: Integers, Powers and Roots **Big Questions** What's the same and what's different about 3×10^6 and 3×10^{-6}? Convince me that $\sqrt{72} = 6\sqrt{2}$ - Explain why $w^3 \times w^5 = w^8$	- Convert from ordinary to standard form. Both positive & negative powers. - Convert from Standard form to ordinary numbers. - Know that $(a^b)^c = a^{bc}$	- 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 $16^{3/4}$. - Simplify surds to the form $a\sqrt{b}$ -multiplying surds
Topic: Lines, angles and shapes **Big Questions** - Which of these shapes are congruent? - Show me an example of two triangles which are similar but not congruent. - Can two triangles be congruent if they are not also similar?	- Recognise tangents, arcs, sectors and segments of circles.	- Congruent triangles and formal geometrical proofs.	- Use the tangent/radius properties of a circle. - Apply circle theorems.
Topic: Simplifying and substituting **Big Questions** List all the factors of 24 / 13 / 60 What is x multiplied by x ? What is 2x multiplied by 2x ? - Can you have a negative square root? - What is a quadratic	- Expand and simplify - Expand quadratics - Interpret basis functions. - Factorise quadratics in the form $ax^2 + bx + c = 0$ where a = 1. - Recognise and factorise the difference of two squares.		

INTEGERS, POWERS & ROOTS KNOWLEDGE ORGANISER

Prime Number	A positive integer greater than 1 that can only be divided by itself and 1 without leaving a remainder.	7, 23, and 67 are examples. 1 is **not** a prime number.
Base	The big number on the left; the number that will be multiplied by itself.	5 is the base in 5^3
Index	The small number on the top-right; the number of times a value is multiplied by itself.	3 is the index in 5^3
Power of exponent	Another word for index.	3 to the power of 2 = 3^2
Indices	Plural of index	
Reciprocal	The reciprocal of a number is one divided by that number	The reciprocal of 4 is $\frac{1}{4}$ which is equal to 0.25
Steps to estimate a square root	1: Identify the **square on either side**. 2: Place the squares and their roots at **eit 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.	

Integers

"Integer" is just a posh word for whole number.
The thing to remember is that integers can be positive or negative
So: 1, 7, 298, -3, 0 and -49 are all integers, but 2.5 is not and neither is $3\frac{5}{8}$!

Multiples

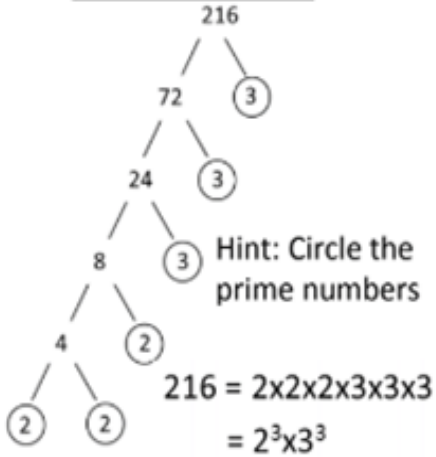
The Multiples of a number are all the numbers in your number's times table.
Don't forget: you must count the number itself!
e.g. Some multiples of 7 are: 7, 14, 21, 28... but there are loads more, like 700 and 4445

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, 4x4x4 is 4^3
Expand	Write in a **longer form, without indices**	7^3 expands to give 7x7x7
Evaluate	**Find the value**; work out	I would 2^5 to get 32
Simplify	Write in the **simplest**, neatest **form**	$2^3 \times 2^5$ simplifies to 2^8

Prime Factor Tree



Hint: Circle the prime numbers

$216 = 2x2x2x3x3x3$
$= 2^3x3^3$

Standard Form

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

A number between 1 and 10 × A power of 10

2×10^{15} and 1.5×10^{-12}

Going from standard form to ordinary numbers

5×10^{10} = 50 000 000 000 | 0.0006 = 6×10^{-4}

7.1×10^{6} = 7 100 000 | 0.00000072 = 7.2×10^{-7}

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

Multiplying Standard Form

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

$(2\times10^6)\times(4\times10^4) = 2\times4\times10^6\times10^4$
$= 8\times10^{6+4}$

Dividing Standard Form

$\frac{a\times10^n}{a\times10^m} = \frac{a}{b} \times \frac{10^n}{10^m}$

$(8\times10^{13})\div(2\times10^7) = (8\div2)\times(10^{13}\div10^7)$
$= 4\times10^{13-7}$

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

Surds

1. $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$
2. $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$
3. $\sqrt{a} + \sqrt{a} = 2\sqrt{a}$
4. $0 = \sqrt{a} - \sqrt{a}$

	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	$(x^n)^m = x^{n\times m}$	$(x^3)^2 = x^{3\times2} = x^6$
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

$a^2 + a^2 = 2a^2$ **BUT** $a^2 \times a^2 = a^4$

Simplify $\sqrt{72}$

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

$= \sqrt{36} \times \sqrt{2}$
$= 6 \times \sqrt{2}$
$= 6\sqrt{2}$

Rationalise the denominator

Example:

This is the same as multiplying by 1

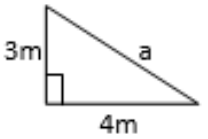
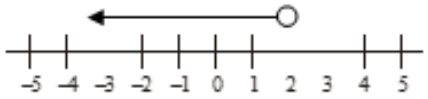
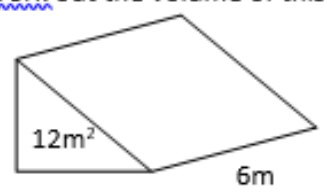
$\frac{1}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{1 \times \sqrt{5}}{\sqrt{5} \times \sqrt{5}}$

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

THE DUSTON SCHOOL

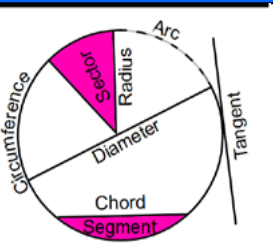
Knowledge Recall **Term 1 HW: 1**

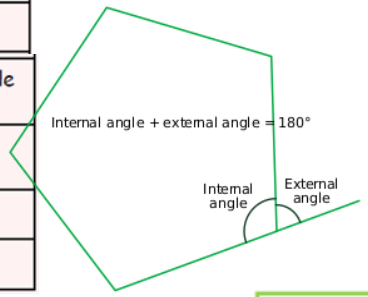
Date Due_____ **Score to beat**_____

Section A:Number		Section B: Algebra		Section C: Using and applying	
1. To increase an amount by 7%, what single multiplier would you use?		11. Expand & simplify: $3(x+2)+2(x-1)$		21.  To find 'a' choose one calculation: $\sqrt{4^2+3^2}$ OR $\sqrt{4^2-3^2}$	
2. Increase £48 by 7%		12. Factorise $a^2 - a$			
3. Divide £21 in ratio 3:4		13. Simplify $2c^4 \times 3c^5$		22. 123 grams is rounded to nearest whole. Write down the maximum possible mass it could have been	
4. Amy and Bob share money in the ratio 6:4. Amy gets £40 more than Bob, how much does Bob get?		14. Give the inequality 			
5. Work out: $2\frac{1}{2} \times 1\frac{3}{5}$		15. Make n the subject of the formula: M=3n		23. A plane flies 1440miles at a speed of 240mph. How long does it take?	
6. Work out: $3\frac{2}{5} - 1\frac{3}{4}$		16. Work out the value of: 3x + 2y When x = 5 and y = -4			
7. Round off 17.2 to one significant figure		17. Write down the nth term of this sequence: 1 4 7 10 13		24. If the relative frequency of getting a 'six' on a dice is 0.2, how many sixes would you expect to get in 200 throws of the dice?	
8. Estimate the answer to: 0.17 x 193		18. Write down the 1st term in the sequence given by: $T(n) = n^2 + 3$			
9. Give the first 3 multiples of 12		19. If $y = 3x^2 + 4$, find the value of y when x = 2		25. Work out the volume of this prism?  6m	
10. Give the LCM of 12 and 9		20. The equation of a graph is y = 3x – 1 Give the gradient & y-intercept			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	

LINES, ANGLES AND SHAPES KNOWLEDGE ORGANISER

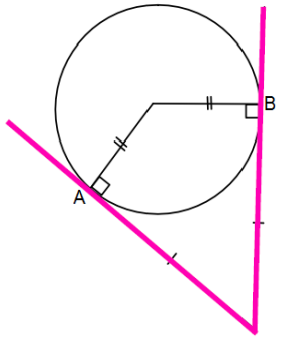
Circumference	The distance around the edge of the circle
Radius	The distance from the centre of the circle to the edge of the circle
Diameter	The distance across the circle from edge to edge, going through the centre
Tangent	A straight line that touches the circle
Chord	A line that touches each edge 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!





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



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

Exterior Angles

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

Interior Angles

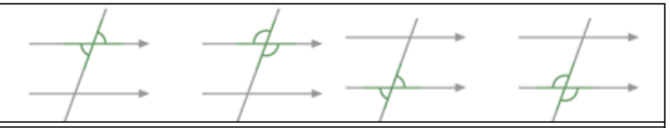
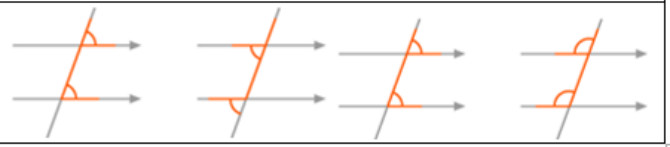
For n sides

Sum of interior angles

= (n – 2) x 180

Each interior angle

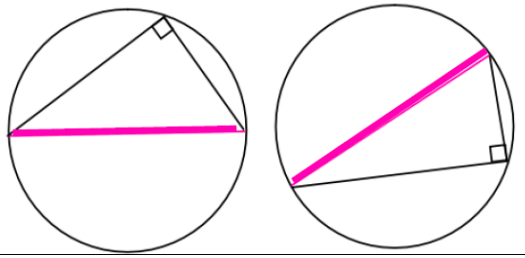
$= \frac{(n-2) \times 180}{N}$

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.	

Theorems

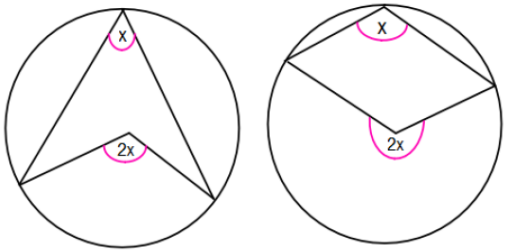
1. Angle in a Semi Circle

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



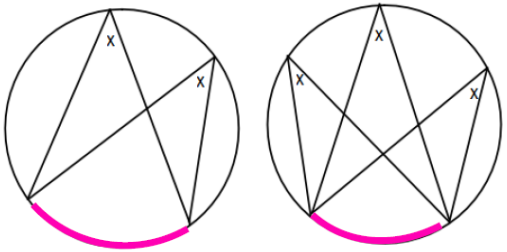
2. Angle at the Centre

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



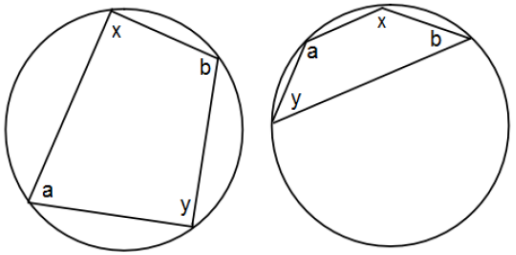
3. Angles on the Same Arc

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



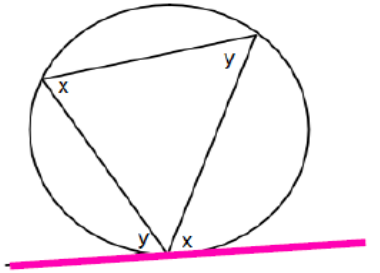
4. Cyclic Quadrilateral

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



5. Alternate Segment

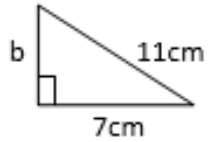
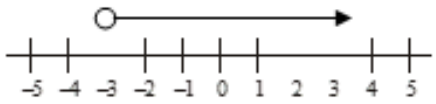
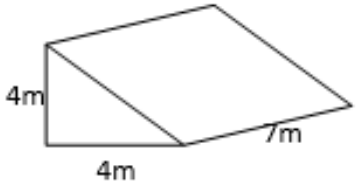
- ✓ The angle between a tangent and a chord is equal to any angle made by that chord in the alternate segment



THE DUSTON SCHOOL

Knowledge Recall **Term 1 HW: 2**

Date Due_____ **Score to beat**_____

Section A:Number		Section B: Algebra		Section C: Using and applying	
1. To increase an amount by 30%, what single multiplier would you use?		11. Expand & simplify: $3(x-5)+2(x-1)$		21.  To find 'b' choose one calculation: $\sqrt{11^2-7^2}$ OR $\sqrt{11^2+7^2}$	
2. Decrease £84 by 30%		12. Factorise: $4y+12$			
3. Divide £28 in ratio 3 : 4		13. Simplify: $10b^4 \div 2b$		22. 44cm is rounded to nearest whole cm. Write down the maximum possible length it could have been.	
4. Amy and Bob share money in the ratio 3:5. Amy gets £100 less than Bob, how much does Bob get?		14. Give the inequality 			
5. Work out : $12\frac{1}{2} \div \frac{5}{8}$		15. Make a the subject of the formula: $T = a + 4$		23. A runner runs at 7.6mph for 3 ½ hours. How many miles did he run?	
6. Work out : $2\frac{2}{3} \times 3\frac{1}{2}$		16. Work out the value of: $3x + 2y$ When $x = -3$ and $y = -4$			
7. Round off 863 to one significant figure		17. Write down the nth term of this sequence: -1 2 5 8 11		24. If the relative frequency of getting a 'red' on a spinner is 0.4, how many reds would you expect to get in 300 spins?	
8. Without a calculator work out: $40 \div 0.2$		18. Write down the 3rd term in the sequence given by: $T(n) = n^2 + 4$			
9. Give the first 3 multiples of 8		19. If $y = 3x^2 + 4$, find the value of y when $x = -2$		25. Work out the volume of this prism? 	
10. Give the LCM of 12 and 24		20. A graph has a gradient of 5 and cuts the y-axis at -1. Give its equation.			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	

SIMPLIFYING AND SUBSTITUTION KNOWLEDGE ORGANISER

THE DUSTON SCHOOL

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 *(Show)* of the variables.

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

Function: An expression for which inputs *(Substitute)* 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.

SUBSTITUTION

SUBSTITUTION means putting numbers where the letters are.

$$x + \frac{x}{2}$$

$x = 5$

$$5 + \frac{5}{2}$$

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 + s + 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

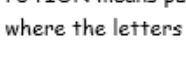
5 x 2 = 10

5b x 2c = 10bc ✓

3 x 7 = 21

3pl x 7c = 21plc ✓

FUNCTIONS

Function $f(x)$ or $x \to$ 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.
Composite Function	A function put inside another function e.g. fg(x)
Inverse Function $f^{-1}(x)$	An inverse function goes the other way. e.g. if f(x) = 2x + 3 then $f^{-1}(x) = \frac{x-3}{2}$

EXPANDING

EXPANDING means multiplying all terms together and simplifying.

Single brackets

$3(a + 4) = 3$

a	+4
3a	+12

means: "3 times (a + 4)" $= 3a + 12$

Double brackets

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

	a	+2
a	a^2	+2a
+3	+3a	+6

means: "(a + 2) times (a + 3)" $= a^2 + 5a + 6$

Example of expanding more than two binomials:

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

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

$\rightarrow (x^2 - 2x - 15)(x + 4)$

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

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

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

Multiple binomials - using a grid.

Multiply $(x^2 - 2x - 15)$ by $(x + 4)$

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

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

FACTORISING

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... $14y^2 + 7y$ and $21y + 7y$

$7y(2y + 3)$

How to Factorise a Quadratic Equation

A)
How to factorise when the coefficient of x^2 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 x 5 = 15

(x + 3)(x + 5)

B)
How to factorise when the coefficient of x^2 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 x -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** as the other bracket

(2x + 3) (x - 4)

Difference of Squares

$25v^4 - 16u^4$

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

$5v^{\frac{4}{2}} - 4u^{\frac{4}{2}}$

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

$4a^4 - 9b^4$

$\sqrt{4(a^4)} - \sqrt{9(b^4)}$

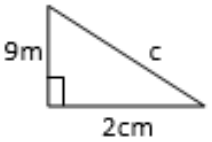
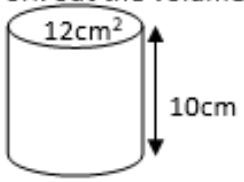
$2a^{\frac{4}{2}} - 3b^{\frac{4}{2}}$

$(2a^2 + 3b^2)(2a^2 - 3b^2)$

THE DUSTON SCHOOL

Knowledge Recall **Term 1 HW:3**

Date Due **Score to beat**

Section A:Number		Section B: Algebra		Section C: Using and applying	
1. To increase an amount by 24%, what single multiplier would you use?		11. Expand & simplify: $2(2x + 3) - 2(x - 2)$		21.  To find 'c' choose one calculation: $\sqrt{9^2 + 2^2}$ OR $\sqrt{9^2 - 2^2}$	
2. Increase 2800kg by 24%		12. Factorise: $2b^2 - 2b$			
3. Divide 72 in the ratio of 7 : 2		13. $\frac{y^4 \times y^3}{y^5}$		22. 5.7 is rounded to one decimals place. Write down the maximum possible it could have been.	
4 Amy and Bob share £520 in the ratio 11:2. How much more does Amy get than Bob?		14. Solve: $x + 8 \geq 5$			
5. Work out: $1\frac{2}{3} - \frac{3}{4}$		15. Make a the subject of the formula: $T = a - 2$		23. The mass of a bar of chocolate is 1800g. The density of the chocolate is $9g/cm^3$ What is its volume?	
6. Work out: $1\frac{2}{3} \div \frac{3}{4}$		16. Work out the value of: $5x - 2y$ When $x = 3$ and $y = -4$			
7. Round off 0.67 to one significant figure		17. Write down the nth term of this sequence: -1 3 7 11 15 ...		24. If the relative frequency of a train being late is 0.15, how often could you expect the train to be late in 100days?	
8. Estimate the answer to: 7.9×0.67		18. Write down the 1st term in the sequence given by: $T(n) = n^2 - 4$			
9. Write down the first 3 multiples of 6		19. If $y = x^2 + 2x$, find the value of y when $x = -1$		25. Work out the volume of this cylinder  10cm	
10. Work out the LCM of 6 and 9		20. The equation of a line is $y=x + 7$ Give the gradient and y-intercept			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	