THE DUSTON SCHOOL 4-19
Knowledge itself is power

Year 10 Maths INTERMEDIATE Knowledge Booklet Term 3

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 1/7	Decimals/powers as multipliers, calculating/understanding fractions as parts.
9	Transformations	Unit 2/8	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 1/7	Calculating, multiplying decimals and powers of 10 for metric conversions.
13	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.
14	Probability	Unit 1/7	Types of numbers, calculating with fractions & decimals.
15	Inequalities	Unit 12/8/5/7	Solving equations, rounding, plotting graphs for regions, calculating with fractions.
16	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	

Year 10 - Term 3: Intermediate

Overview	**Learning Objective**		
Topic: Sequences, functions and graphs **Big Questions** - Show me an example of a quadratic graph. - Show me a coordinate that lies on the graph $y=2x^2- 2$ - Convince me that there are no coordinates on the graph of $y=3x^2+4$ which lie below the x-axis	- Solve simultaneous equations graphically. - Recognise and use sequences of triangular, square and cube numbers and Fibonacci type sequences. -Calculate the mid-point of a line.	-Use y=mx+c to identify the equation of a line. - Use y = mx + c to identify parallel lines. - Find the equation of a line through two points or one point with a given gradient. - Sketch graphs of cubic and reciprocal functions from a table of values. - Identify the turning point of a quadratic by sketching the graph.	- Complete the square of a quadratic to calculate its turning point. -Geometric progression.
Topic: Ratio and Proportion **Big Questions** - Ratios related to age and how they change over time: e.g. if Josh and Beth are 1 and 4, £200 will be split in the ratio 1:4 now. What about next year etc. etc.?	- Divide quantities by simple ratios. - Write ratios as a fraction. - Use ratio to convert between currencies. Use ratio to solve problems about exchange rates. -Ratio/fractions/graphs.	-Similar shapes length. - Similar shapes with area & volume.	-Similar shapes area & volume. - Solve ratio problems involving percentages & fractions.
Topic: Transformations **Big Questions** - True/Never/Sometimes: - Reflected shapes are the same size and shape as the original shape. - Rotated shapes are the same size and shape as the original shape. - Translated shapes are the same size and shape as the original shape.	- Enlarge a shape by a positive integer scale factor from a given centre. - Enlarge a shape by a positive fractional scale factor given a centre.	- Describe all four transformations. - Combined transformations. (Rotations which is the same as an enlargement.) - Introduction to vectors. (Add, subtract and multiply vectors)	- Enlarge a shape by a negative scale factor given a centre - Describe the changes and invariance achieved by combinations of rotations, reflections and transformations.

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Sequences, Functions and Graphs

$y = mx + c$

How to find the nth term in a Quadratic Sequence

13 19 27 37

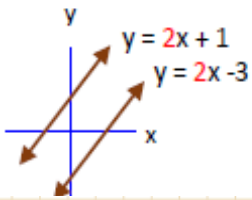
+6 +8 +10 First difference

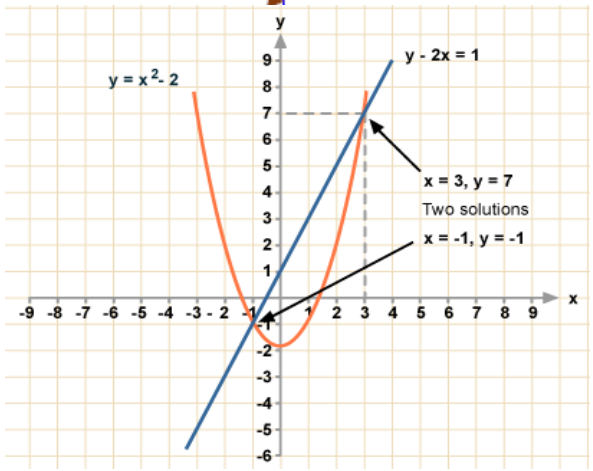
+2 +2 Second difference

1. Find the second difference.
   Because the second difference is 2, the sequence is based around the n^2 sequence. (1, 4, 9, 16, 25)
2. Subtract the n^2 sequence from the original sequence: 12, 15, 18, 21
3. This new is itself a linear sequence with rule: 3n + 9

The n^{th} term is $n^2 + 3n + 9$

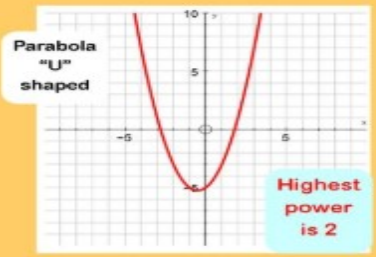
PARALLEL lines have the same gradient





Quadratic Graphs

$y = ax^2 + bx + c$

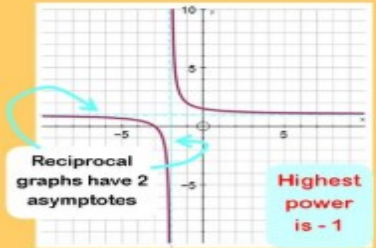


Cubic Graphs

$y = ax^3 + bx^2 + cx + d$

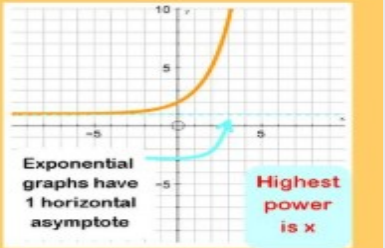
Reciprocal Graphs

$y = \frac{a}{x}$



Exponential Graphs

$y = a^x$



Key Points

1. A function only has an inverse if it is a one-one mapping
2. The graph of the inverse is the reflection of the graph of the function in the line $y = x$
3. The domain of the inverse function is the same as the range of the function
4. The range of the inverse function is the same as the domain of the function
5. We find the inverse function by putting the original function equal to y and rearranging to make x the subject
6. We use the notation $f^{-1}(x)$ for the inverse function

An exponential function is a function of the form $y = a \cdot b^x$, where $a \neq 0, b > 0, b \neq 1$, and x is a real number.

Key Facts - How to work out the Equation of a Line

A line passes through two points (4 ; 7) and (8; 19)
Work out the EQUATION of the line

E

Find the difference between the two y-coordinates
19 – 7 = 12

Find the difference between the two x-coordinates
8 – 4 = 4

The gradient is $\frac{12}{4} = 3$

$y = 3x + c$

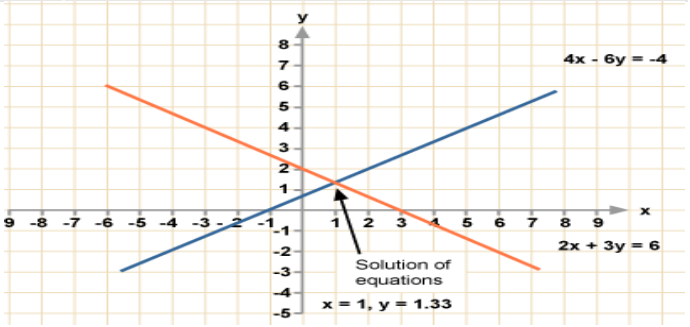
Now find 'c' value (y-intercept)

(4 ; 7)

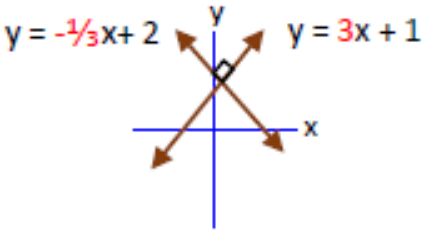
7 = 3 x 4 + c
7 = 12 + c
7-12 = c
-5 = c

Substitute *either* of the sets of coordinates into the equation (go for the easiest): y = 3x ± c

Write the full equation: y = 3x – 5



PERPENDICULAR lines have a negative reciprocal gradient and opposite sign (+ or -)



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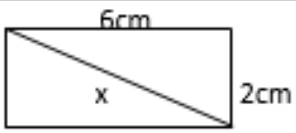
Knowledge Recall **Term 3 HW: 1**

Date Due _____ **Score to beat** _____

Section A:Number		Section B: Algebra		Section C: Using and applying	
1. To increase an amount by 85%, what single multiplier would you use?		11. Expand & simplify: $x(x-5)+x(2x-3)$		21.  To find 'x' choose one calculation: $\sqrt{6^2+2^2}$ OR $\sqrt{6^2-2^2}$	
2. Decrease 200g by 85%		12. Factorise: $10+5d$			
3. Divide 124 in the ratio of 3:1		13. Simplify: $\frac{q^8}{q^3}$		22. 39 is rounded to the nearest whole. Write down the maximum possible length it could have been.	
4. Eric and Fatima share some mon in the ratio 5:7. Fatima gets £140 more than Eric. How much does Eric get?		14. Solve: $3x+1<10$			
5. Work out: $\frac{5}{7} \times \frac{1}{4}$		15. Make b the subject of the formula: $P=2a+b$		23. Jane cycles 27km at 12km/h. How long does she take?	
6. Work out: $\frac{5}{7} - \frac{1}{4}$		16. Work out the value of: $xy-3$ When $x=-2$ and $y=-4$			
7. Round off 0.043 to one significant figure		17. Write down the nth term of this sequence: 12 15 18 21 ...		24. The relative frequency of blue on a spinner is $\frac{3}{5}$. How many times would you expect a blue in 250 spins?	
8. Estimate the answer to: 423×0.18		18. Write down the 3rd term in the sequence given by: $T(n)=n^2-2n$			
9. Give the first 3 multiples of 14		19. If $y=x^2-x-3$, find the value of y when $x=3$		25. Work out the volume of this prism? 	
10. Give the LCM of 14 and 35		20. Give the equation of a graph that goes through the origin and has a gradient of 2			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	

RATIO & PROPORTION KNOWLEDGE ORGANISER

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Curriculum Flowchart - Similarity

Calculate the linear scale factor ↔ Calculate the area and volume scale factor ↔ Calculate corresponding side lengths/areas/volumes

The exchange rate is £1 to $1.70. I need to convert my £56 into US Dollars.

£56 x 1.7 = $95.20

X 1.70

£1 = $1.70

÷ 1.70

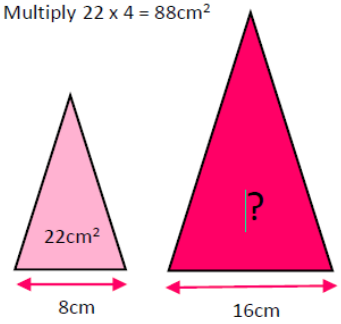
Key Facts	
Direct proportion	If two quantities are in direct proportion, as one increases, the other increases by the **same multiplier/scale factor.**
Inverse proportion	Inverse proportion is when one value increases as the other value decreases.
K is the **constant** of proportionality	

How to Calculate Area & Volume using SIMILARITY

AREA (ASF)

FIND the missing **area**

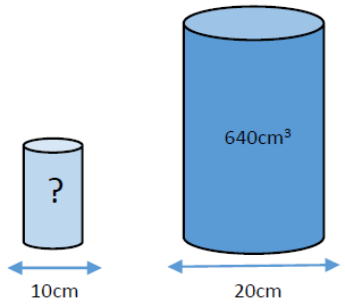
1. Find LSF: 16/8 = 2
2. **Square linear scale factor to find the ASF:** $2^2 = 4$
3. Multiply 22 x 4 = 88cm²



VOLUME (VSF)

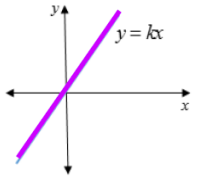
FIND the missing **volume**

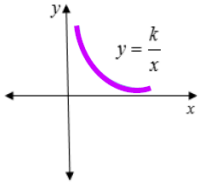
1. Find LSF: 20/10 = 2
2. **Cube the linear scale factor to find the volume SF:** $2^3 = 8$
3. Divide 640 ÷ 8 = 80cm³



What do I need to know?

Statement: y **directly proportional** to x	$y \propto x$
Equation	$y = kx$
Statement: y **inversely proportional** to square of x	$y \propto \frac{1}{x^2}$
Equation	$y = \frac{k}{x^2}$





How do I answer the question?

A ball falls vertically after being dropped.
The ball falls a distance d metres in a time of t seconds.
d is directly proportional to the square of t.

The ball falls 20 metres in a time of 2 seconds.

(a) Find a formula for d in terms of t.

Write a **statement** — $d \propto t^2$

Write a formula (**equation**) — $d = kt^2$

Find k by **substituting**: — $20 = k2^2$

Divide both sides by 4 — $20 = k4$

$5 = k$

$D=5t^2$

(b) Calculate the distance the ball falls in 3 seconds.

You've worked out k — $k = 5$

Substitute 3 into equation — $d = 5$

$d = 5 \times 3^2$

$d = 5 \times 9$

$d = 45$

Key Facts – Write a Ratio as a Fraction

Bill and Mary share £50 in the ratio 2 : 3

Write Bill's share as a fraction: $\frac{2}{5}$

Bill's fraction

1.2kg for £3.89

700g for £2.14

What is the price per gram?

1200g = 389p
÷ 1200 ÷ 1200
1g = 0.324p

700g = 214p
÷ 700 ÷ 700
1g = 0.305p

This is less money per gram, so it is the best buy

Curriculum Flowchart

Solve equations
Substitution
Rearranging formula

Direct proportion Write a statement and solve the equation

Indirect proportion Write a statement and solve the equation

Represent graphically

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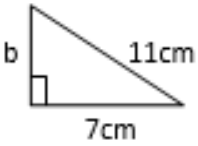
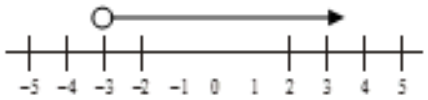
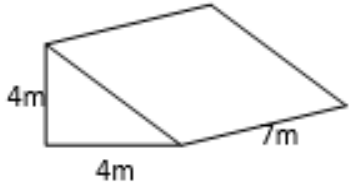
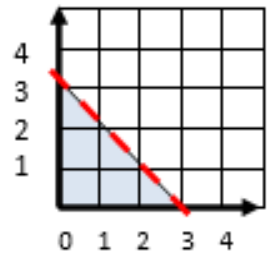
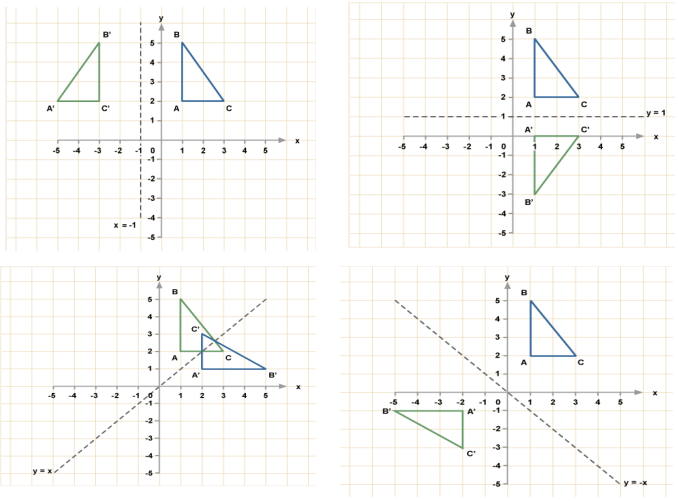
Knowledge Recall **Term 3 HW: 2**

Date Due _____ **Score to beat** _____

Section A:Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
1. To decrease an amount by 30%, what single multiplier would you use?		11. Expand & simplify: $3(x-5)+2(x-1)$		21.  Find 'b' to 1DP:	
2. Divide £28 in ratio 3 : 4		12. Give the inequality 			
3. Work out : $12\frac{1}{2} \div \frac{5}{8}$		13. Work out the value of: 3x + 2y When x = -3 and y = -4		22. Work out the volume of this prism? 	
4. Without a calculator work out: $40 \div 0.2$		14. Write down the nth term of this sequence: -1 2 5 8 11			
5. Give the LCM of 8 and 12		15. If $y = 3x^2 + 4$, find the value of y when x = -2		23. 44cm is rounded to nearest whole cm. Write down the maximum possible length it could have been.	
2. Write $0.\dot{2}\dot{3}$ as a fraction		16. Factorise: $x^2 - 6x + 8$			
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.		17. Multiply & simplify: $(x-2)(2x+1)$		24. On a spinner: P(3) = ⅗ and the p(4) = ⅛ What is the probability of getting 3 or 4	
6. The cost of a lamp has increased by 30% to £65. Work out the original price.		18. Make u the subject of the formula: $v^2 = u^2 + 2as$			
7. Write 0.0028 in standard form:		19. $S = \frac{u^2 + v^2}{2a}$ Find S when, u = -3, v = -1, a = 5		25.What inequality is represented here? 	
9. Work out $(9\times10^7) \div (3\times10^4)$ Give your answer in standard form		20. If $\sin x = \frac{3}{4}$, find x (3sf)			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	

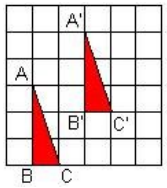
TRANSFORMATIONS KNOWLEDGE ORGANISER

REFLECTION



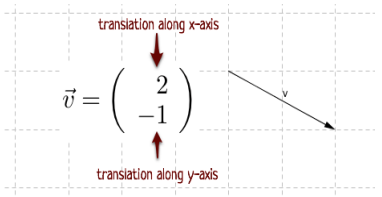
Name	Shape	Order of Rotational Symmetry
Parallelogram		2
Regular Polygon with n sides	Examples:	n
Rhombus		2
Circle		Unlimited
Trapezium		None
Kite		None

TRANSLATION



Each point moved 2 to the right and 2 up.

The vector describing this translation is: $\begin{pmatrix} 2 \\ 2 \end{pmatrix}$



Equal vectors

If two vectors have the **same magnitude** and **direction**, then they are **equal**.

Adding vectors

Look at the graph below to see the movements between **PQ**, **QR** and **PR**.

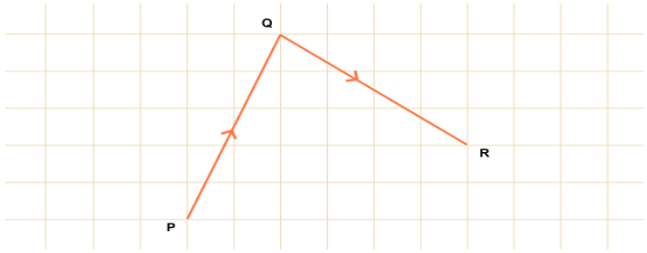
$\begin{pmatrix} a \\ b \end{pmatrix} + \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a+c \\ b+d \end{pmatrix}$

Vector $\overrightarrow{PQ}$ followed by vector $\overrightarrow{QR}$ represents a movement from **P** to **R**.

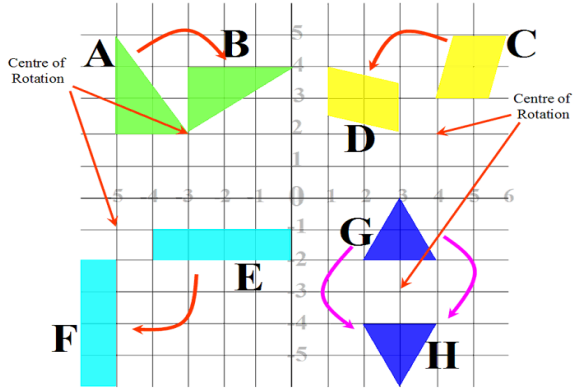
$\overrightarrow{PQ} + \overrightarrow{QR} = \overrightarrow{PR}$

Written out the vector addition looks like this

$\begin{pmatrix} 2 \\ 5 \end{pmatrix} + \begin{pmatrix} 4 \\ -3 \end{pmatrix} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$



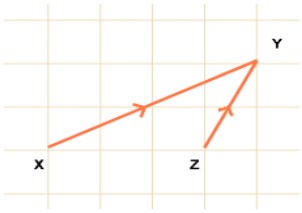
ROTATION



Subtracting vectors

Subtracting a vector is the same as adding a negative version of the vector (remember that making a vector negative means reversing its direction).

$\begin{pmatrix} a \\ b \end{pmatrix} - \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a-c \\ b-d \end{pmatrix}$



Look at the diagram and imagine going from X to Z. How would you write the path in vectors using only the vectors $\overrightarrow{XY}$ and $\overrightarrow{ZY}$?

You could say it is vector $\overrightarrow{XY}$ followed by a backwards movement along $\overrightarrow{ZY}$.

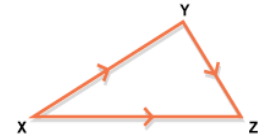
So we can write the path from X to Z as

$\overrightarrow{XY} - \overrightarrow{ZY} = \overrightarrow{XZ}$

Written out in numbers it looks like this:

$\begin{pmatrix} 4 \\ 2 \end{pmatrix} - \begin{pmatrix} 1 \\ 2 \end{pmatrix} = \begin{pmatrix} 3 \\ 0 \end{pmatrix}$

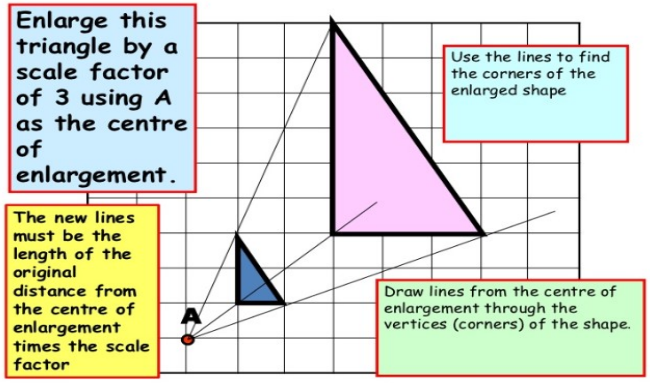
Resultant vectors

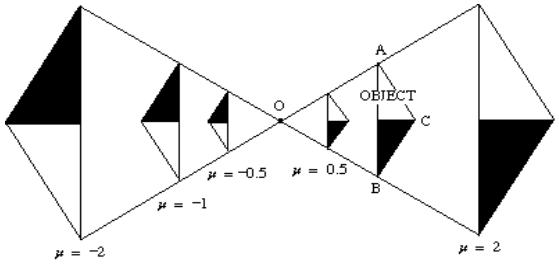


To travel from **X** to **Z**, it is possible to move along vector $\overrightarrow{XY}$ followed by $\overrightarrow{YZ}$. It is also possible to go directly along $\overrightarrow{XZ}$.

$\overrightarrow{XZ}$ is therefore known as the **resultant** of $\overrightarrow{XY}$ and $\overrightarrow{YZ}$.

ENLARGEMENT





Fractional scale factors

If we 'enlarge' a shape by a scale factor that is between -1 and 1, the image will be **smaller** than the object

Negative scale factors

An enlargement using a negative scale factor is similar to an enlargement using a positive scale factor, but this time the image is on the other side of the centre of enlargement, and it is upside down.

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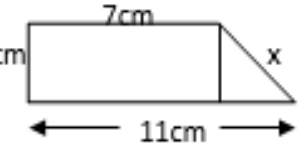
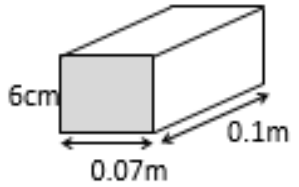
Knowledge Recall **Term 3 HW: 3**

Date Due _____ **Score to beat** _____

Section A:Number		Section B: Algebra		Section C: Using and applying	
1. To increase an amount by 35%, what single multiplier would you use?		11. Expand & simplify: $3(2p - 3) + 2(3p + 3)$		21.  To find 'x' choose one calculation: $\sqrt{4^2 + 5^2}$ OR $\sqrt{11^2 + 5^2}$ OR $\sqrt{7^2 + 5^2}$	
2. Increase 620ml by 4%		12. Factorise: $6ab - 2b^2$			
3. Divide 48 in the ratio of 2:4		13. Simplify $4x^2 \times 4x^2$		22. 320 is rounded to the nearest ten. Write down the maximum possible length it could have been.	
4. Eric and Fatima share money in the ratio 8:3. Fatima gets £4.50. How much do they get in total?		14. Solve: $4x - 1 \leq 13$			
5. Work out: $2\frac{1}{8} - 1\frac{2}{3}$		15. Make x the subject of the formula: $T = 2x + 2y$		23. A metal bar has a mass of 960g and a volume of $120cm^3$. Find the density of the metal in the bar.	
6. Work out: $2\frac{1}{8} \times 1\frac{2}{3}$		16. Work out the value of: $xy - y$ When $x = 5$ and $y = -4$			
7. Round off 6831 to one significant figure		17. Write down the nth term of this sequence: 3 6 11 18 ...		24. The relative frequency that the traffic lights will show GREEN at road works is 0.7. Estimate how many times they would be RED over the next 40 journeys?	
8. Estimate the answer to: $635 \div 0.027$		18. Write down the 3rd term in the sequence given by: $T(n) = 2n^2 + n$			
9. Write down the first 3 multiples of 18		19. If $y = x^2 + 2x + 3$, find the value of y when $x = -1$		25. Calculate the volume in cm^3? 	
10.Write down the LCM of 18 and 30		20. A graph has a gradient of 4 and intercepts the y-axis at -4. What is its equation?			
Total (A)		Total (B)		Total (C)	
Test Total (A+B+C)		R (0-9)	Y (10-19)	G (20-25)	