THE DUSTON SCHOOL
Knowledge itself is power

Year 10 Maths Higher 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: Higher

Overview	Learning Objectives		
Topic: Sequences, functions and graphs **Big Questions** - Show me an example of an equation of a quadratic curve which does not touch the x-axis. - Show me an example of an equation of a parabola (quadratic curve) which (i) is symmetrical about the y-axis, (ii) is not symmetrical about the y-axis	- Transform the graphs of y = f(x), such as linear, quadratic, cubic, sine and cosine functions, using the transformations y = f(x) + a, y = f(x + a), y = f (ax) and y = af(x). - Sketch graphs of exponential functions. - Recognise and use the equation of a circle centred at the origin. -	- Recognises the shapes of graphs of functions, including trigonometric functions. - Calculate the nth term of a quadratic sequence. - Recognise and use geometric sequences where the common ratio may be a surd. - Use y = mx + c to identify perpendicular lines.	- Interpret the reverse process as the 'inverse function'. - Interpret the succession of two functions as a 'composite function'. - Estimate gradients of graphs by drawing the tangent and calculating its gradient. - Estimate the area under a graph by calculating the area of the trapezium bounded by a chord. - Find an equation of a tangent to a circle at a given point, using the fact that it is perpendicular to the radius.
Topic: Ratio and Proportion **Big Questions** - Two similar shapes have volumes of 5m and 125m. The surface area of the smaller shape is 50m^2. What is the surface area of the larger shape? - 3 men take 4 days to complete a job. How long would the same job have taken 2 men?	-Similar shapes area & volume. - Solve ratio problems involving percentages & fractions.	- Use direct and inverse proportion graphically. - Calculate direct and inverse proportion algebraically.	
Topic: Transformations **Big Questions** - Show me an example of one vector which is a scalar multiple of another. - What do you think an enlargement with a scale factor of –1/4 would look like?	- 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.	- Enlarge a shape by a negative fractional scale factor. - Vectors. - Understand the relationship between parallel vectors. - Vector proofs.

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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

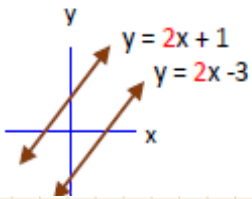
+6 +8 +10 First difference

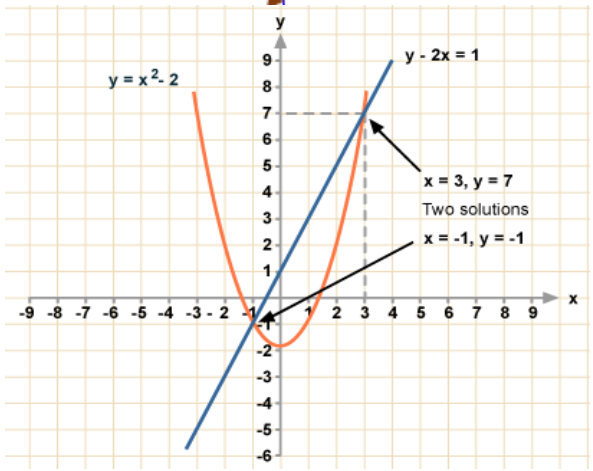
+2 +2 Second difference

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 $n^2 + 3n + 9$

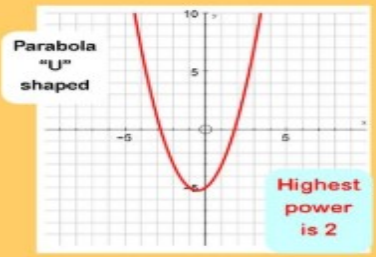
PARALLEL lines have the same gradient





Quadratic Graphs

$y = ax^2 + bx + c$

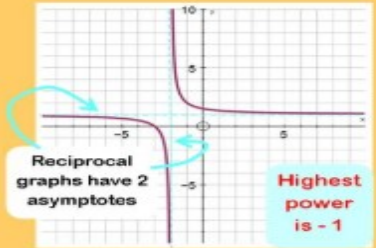


Cubic Graphs

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

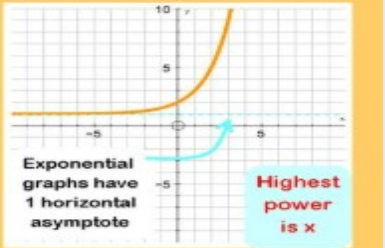
Reciprocal Graphs

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



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

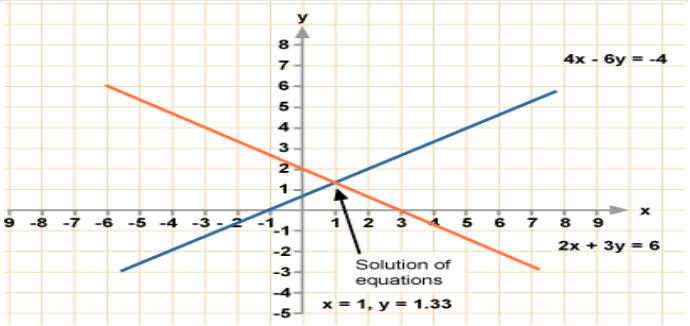
Now find 'c' value (y-intercept)

(4 ; 7)

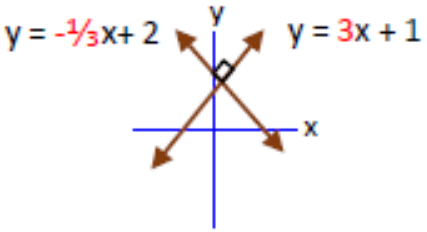
7 = 3 x 4 + c
7 = 12 + c
7-12 = c
-5 = c

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

Term3 HW: 1

Date Due: _____ **Score to beat:** _____

Section A:Number

1. Write $\frac{1}{3}$ as a recurring decimal

2. Write $0.\dot{5}$ as a fraction

3. Work out the balance for £400 invested for 6 years at 12% per annum

4. The value of a bike depreciates by 55% per year. Work out the current value of a bike bought 2 years ago for £1300.

5. In a '30% off' sale, a coat was £210. Work out the original price.

6. The cost of a phone has increased by 10% to £352. Work out the original price.

7. Write 475000 in standard form:

8. Write 5×10^{-3} as an ordinary number

9. Work out $(8 \times 10^{6}) \times (9 \times 10^{-2})$
Give your answer in standard form

10. Work out $(3.1 \times 10^{-4})^2$
Give your answer in standard form

Total (A)

Section B: Algebra Geometry & measures

11. Factorise: $a^2 - 17a + 30$

12. Factorise: $p^2 - 1$

14. Multiply & simplify: $(2a - 3)(2a + 1)$

14. Multiply & simplify: $(a + b)^2$

15. Make w the subject of the formula: $P = \frac{7w - 10}{60}$

16. Make a the subject of the formula:
$ab - cd = ac$

Give your answer correct to 3sf

17. $A = \pi r^2 - \pi rs$_ Find A when r = 2.7, s = 1.6

Give your answer correct to 3sf

18. $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ Find f when u=2½ & v=3⅓

19. If $\cos 35^0 = \frac{8}{x}$, find x (3sf)

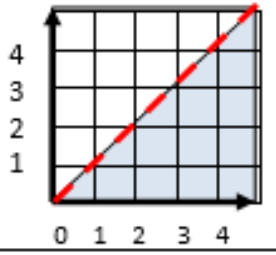
20. Each of these measures is rounded to nearest whole: **a = 8cm and b = 4cm**
Calculate the upper bound of a - b

Total (B)

Section C: Using and applying

21. Linear-Quadratic-Cubic-Reciprocal
Which function is represented by this graph?

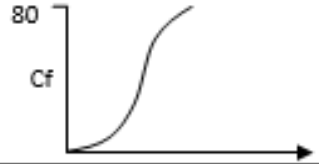
22. What inequality is represented here?



23. On a spinner:
P(3) = ⅕ and the p(4) = ⅕
What is the probability of getting 3 or 4

24. A courgette seed and a pumpkin seed is planted.
P(courgette seed germinates) =⅗
P(pumpkin seed germinates) = ⅗
What is the probability that BOTH seeds germinate?

25. Show on the cumulative frequency graph how to take the inter-quartile range reading



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

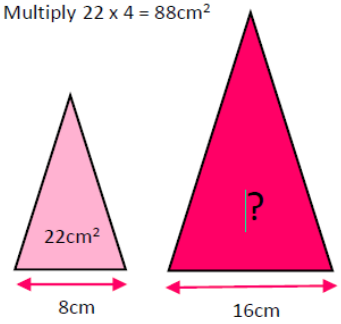
Key Facts	
Direct proportion	If two quantities are in direct proportion, as one increases, the other increases by the **same multiplier/scale factor.**
Inverse proportion	Inverse proportion is when one value increases as the other value decreases.
K is the **constant** of proportionality	

How to Calculate Area & Volume using SIMILARITY

AREA (ASF)

FIND the missing **area**

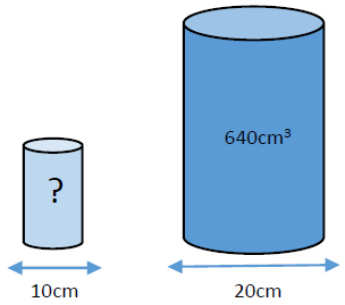
1. Find LSF: 16/8 = 2
2. **Square linear scale factor to find the ASF:** $2^2 = 4$
3. Multiply 22 x 4 = 88cm²



VOLUME (VSF)

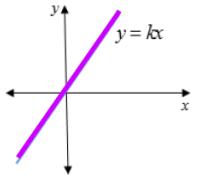
FIND the missing **volume**

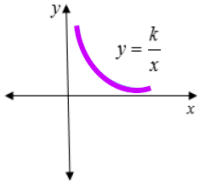
1. Find LSF: 20/10 = 2
2. **Cube the linear scale factor to find the volume SF:** $2^3 = 8$
3. Divide 640 ÷ 8 = 80cm³



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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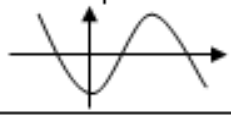
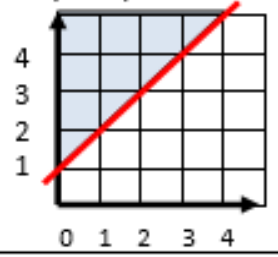
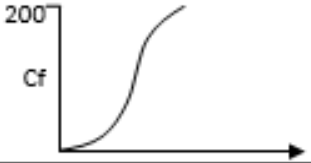
Knowledge Recall

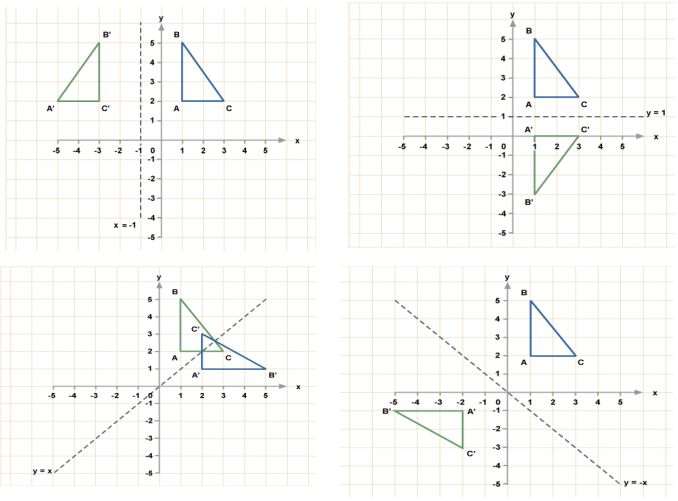
Term3 HW: 2

Date Due: _____ **Score to beat:** _____

Section A:Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
1. Write $\frac{2}{3}$ as a recurring decimal		11. Factorise: $a^2 - 3a - 28$		21. Linear-Quadratic-Cubic-Reciprocal Which function is represented by this graph? 	
2. Write 0. $\dot{0}\dot{6}$ as a fraction		12. Factorise: $p^2 - q^2$			
3. Work out the balance for £500 invested for 3 years at 4.2% per annum		14. Multiply & simplify: $(b + 5)(2b + 3)$		22. What inequality is represented here? 	
4. The value of a Wii depreciates by 24% per year. Work out the current value of a Wii bought 3 years ago for £240.		14. Multiply & simplify: $(a - b)^2$			
5. In a '40% off' sale, a dress was £36. Work out the original price.		15. Make w the subject of the formula: $P=\frac{2w + 7}{12}$		23. On a spinner: P(3) = ⅜ and the p(4) = ⅜ What is the probability of getting 3 or 4	
6. The cost of a phone has increased by 15% to £161. Work out the original price.		16. Make d the subject of the formula: $ad = dx + cx$			
7. Write 0.076 in standard form:		**Give your answer correct to 3sf** 17. $A = \pi r^2 - \pi rs$ Find A when r = 4.2, s = 3.8		24. A courgette seed and a pumpkin seed is planted. P(courgette seed germinates) =⅞ P(pumpkin seed germinates) = ⅛ What is the probability that BOTH seeds germinate?	
8. Write 4.44×10^7 as an ordinary number		**Give your answer correct to 3sf** 18. $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ Find f when u=1⅛ & v=2⅛			
9. Work out $(4 \times 10^8) \div (8 \times 10^2)$ Give your answer in standard form		19. If $\sin 52^0 = \frac{x}{10}$, find x (3sf)		25. Show on the cumulative frequency graph how to take the inter-quartile range reading 	
10. Work out $(3.72 \times 10^6) - (2.8 \times 10^4)$ Give your answer in standard form		20. Each of these measures is rounded to nearest whole: **a = 8cm and b = 4cm** 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)	

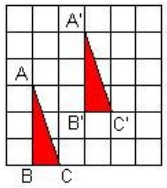
TRANSFORMATIONS KNOWLEDGE ORGANISER

REFLECTION



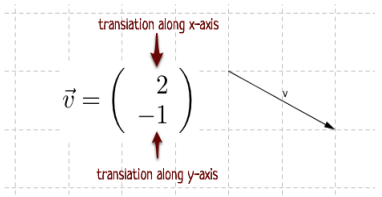
Name	Shape	Order of Rotational Symmetry
Parallelogram		2
Regular Polygon with n sides	Examples:	n
Rhombus		2
Circle		Unlimited
Trapezium		None
Kite		None

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**.

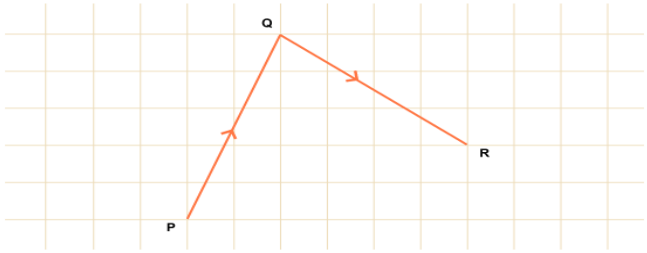
$\begin{pmatrix} a \\ b \end{pmatrix} + \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a+c \\ b+d \end{pmatrix}$

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

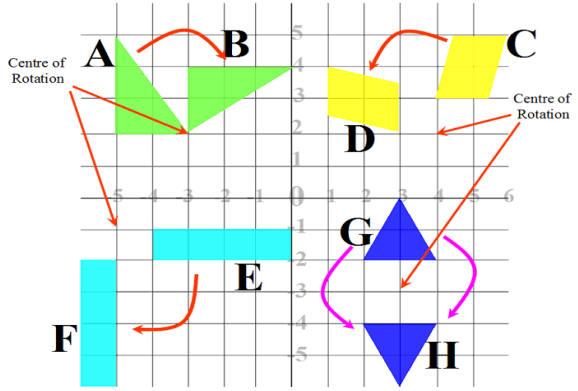
$\overrightarrow{PQ} + \overrightarrow{QR} = \overrightarrow{PR}$

Written out the vector addition looks like this

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



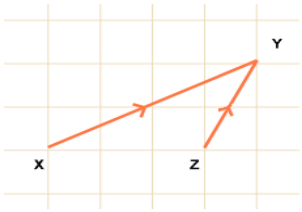
ROTATION



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 $\overrightarrow{ZY}$.

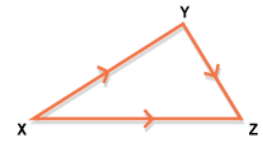
So we can write the path from X to Z as

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

Written out in numbers it looks like this:

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

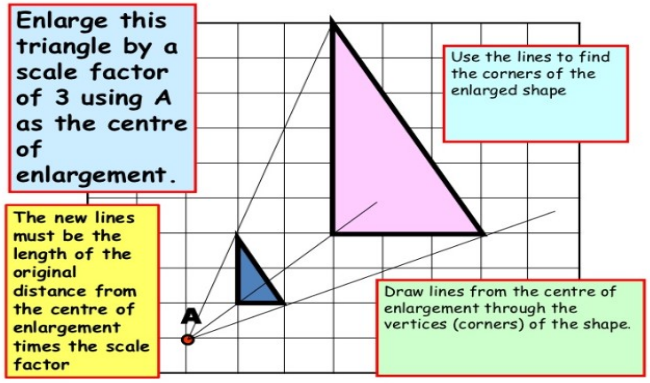
Resultant vectors

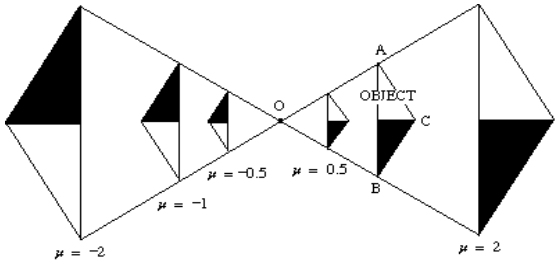


To travel from **X** to **Z**, it is possible to move along vector $\overrightarrow{XY}$ followed by $\overrightarrow{YZ}$. It is also possible to go directly along $\overrightarrow{XZ}$.

$\overrightarrow{XZ}$ 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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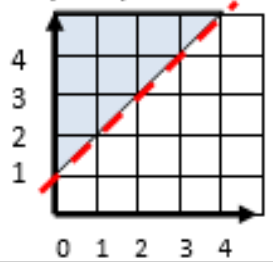
Knowledge Recall

Term3 HW: 3

Date Due: _____ **Score to beat:** _____

Section A:Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
1. Write $\frac{4}{11}$ as a recurring decimal		11. Factorise: $a^2 - 3a - 40$		21. Linear-Quadratic-Cubic-Reciprocal Which type of graph is represented by this equation? $y = x^2 - 2x - 3$	
2. Write 0.$\dot{0}\dot{3}$ as a fraction		B.4 12. Factorise: $a^2 - b^2$			
3. Work out the balance for £1500 invested for 2 years at 3.7% per annum		B.5 14. Multiply & simplify: $(4b - 3)(2b + 1)$		22. What inequality is represented here?  	
4. The value of a TV depreciates by 42% per year. Work out the current value of a TV bought 4 years ago for £425.		B.5 14. Multiply & simplify: $(2a - b)^2$			
5. In a '40% off' sale, a dress was £45. Work out the original price.		B.6 15. Make r the subject of the formula: $S = 2r^2 - 1$		23. P(Jack is late to school any day) = 0.4 What is the probability that Jack will be late 2 days running?	
6. The cost of a TV has increased by 15% to £437. Work out the original price.		B.6 16. Make c the subject of the formula: $a = b + c^2$			
7. Write 765000 in standard form:		B.7 17. $h = ut - \frac{1}{2}gt^2$ Find h when u = 200 t=1⅔ & g=9.8		24. Alf & Amy but tickets in a raffle P(Alf wins 1st prize) = 0.4 P(Amy wins 1st prize) = 0.1 What is the probability that Alf or Amy win 1st prize?	
8. Write 1.9×10^{-1} as an ordinary number		B.7 **Give your answer correct to 3sf** 18. $T = 2\pi\sqrt{\frac{l}{8}}$ Find T when l = 1½			
9. Work out $(4 \times 10^3) \times (1.3 \times 10^4)$ Give your answer in standard form		B.14 19. If $\sin 52^0 = \frac{7}{x}$, find x (3sf)		25. Show on the cumulative frequency graph how to take the median reading  	
10. Work out $(7.63 \times 10^5) + (3.89 \times 10^4)$ Give your answer in standard form		B.15 20. Each of these measures is rounded to 1dp: **a = 8.3cm and b = 4.2cm** 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)	