Year 10 Maths Higher Knowledge Booklet Term 4

THE DUSTON SCHOOL 4-19
Knowledge itself is power

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	

Year 10 - Term 4: Higher

Overview	Learning Objective		
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.
Topic: Pythagoras and Trigonometry **Big Questions** • Show me a question which can be solved using: - the sine rule. - the cosine rule. - ½ a b sin C - How does the mnemonic - SOHCAHTOA help you remember equations?	- Use Pythagoras Theorem to calculate the length of the hypotenuse fo a right angles triangle. - Use Pythagoras Theorem to calculate the length of any side of a right angled triangle. - Use Pythagoras Theorem to calculate the height of an isosceles triangle. - Use Pythagoras Theorem in practical problems -Find the distance between two coordinates.	- Know the exact values of sine, cosine and tangent at key angles (0, 30, 45, 60, 90 degrees). - SOHCAHTOA to calculate missing sides in right-angled triangles. - SOHCAHTOA to calculate missing angles in right-angled triangles. - Use SOHCAHTOA in practical problems. - Use the formula for area of a non-right-angled triangle.	- Use the sine rule to find missing sides and angles in non-right-angled triangles. - Use the cosine rule to find missing sides and angles in non-right-angled triangles. -Use Sine & Cosine combined in non-right angled triangles. - Sketch the graphs of: - y = sin x - y = cos x - y = tan x - Use Pythagoras' Theorem in 3D. -Use 3D trigonometry.

RATIO & PROPORTION KNOWLEDGE ORGANISER

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

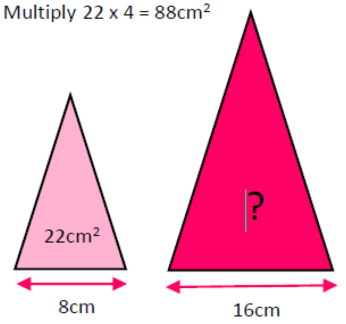
Key Facts	
Direct proportion	If two quantities are in direct proportion, as one increases, the other increases by the **same multiplier/scale factor.**
Inverse proportion	Inverse proportion is when one value increases as the other value decreases.
K is the constant of proportionality	

How to Calculate Area & Volume using SIMILARITY

AREA (ASF)

FIND the missing **area**

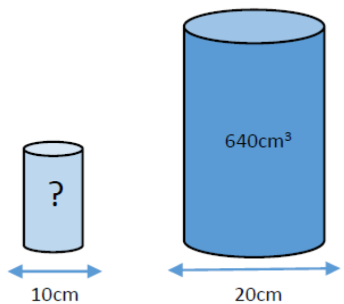
1. Find LSF: 16/8 = 2
2. **Square linear scale factor to find the ASF:** $2^2 = 4$
3. Multiply 22 x 4 = 88cm²



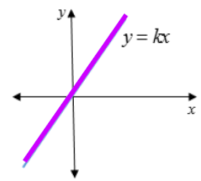
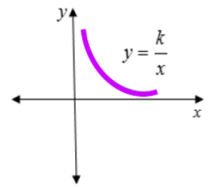
VOLUME (VSF)

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**: *Divide both sides by 4*	$20 = k2^2$ $20 = k4$ $5 = k$ $D=5t^2$

(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

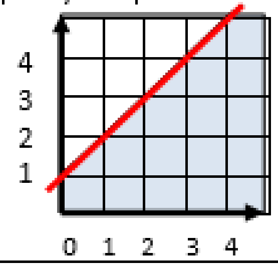
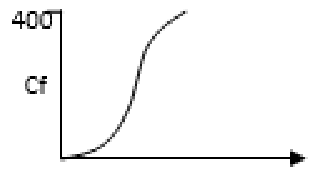
Curriculum Flowchart

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

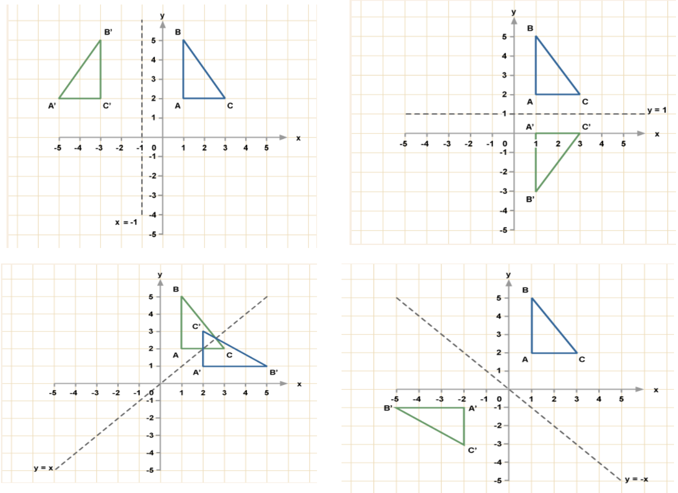
Knowledge Recall **Term4 HW: 1**

Date Due: ____________ **Score to beat:** ____________

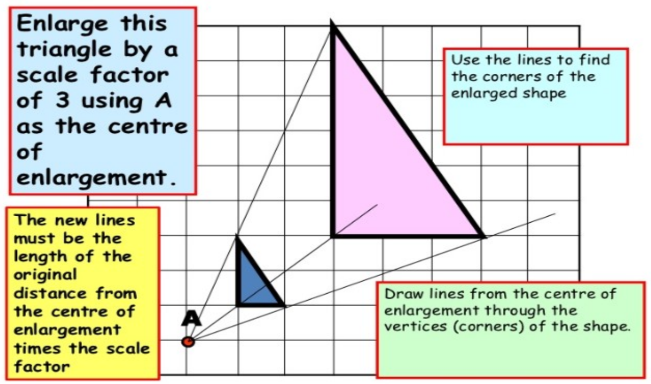
Section A: Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
1. Write $\frac{4}{9}$ as a recurring decimal		11. Factorise: $a^2 - 9a + 20$		21. Linear-Quadratic-Cubic-Reciprocal Which type of graph is represented by this equation? $Y = 3-2x$	
2. Write $0.\dot{2}$ as a fraction		12. Factorise: $x^2 – y^2$			
3. Work out the balance for £600 invested for 3 years at 4.5% per annum		14. Multiply & simplify: $(3x + 2)(2x - 5)$		22. What inequality is represented here? 	
4. The value of a DS depreciates by 30% per year. Work out the current value of a DS bought 4 years ago for £99.		14. Multiply & simplify: $(a - 3b)^2$			
5. In a '60% off' sale, a dress was £26. Work out the original price.		15. Make r the subject of the formula: $S= 5r^2 + 7$		23. P(Jack is late to school any day) = 0.7 What is the probability that Jack will be late 2 days running?	
6. A computer has increased by 8% to £351. Work out the original price.		16. Make c the subject of the formula: $a^2 = b^2 + c^2$			
7. Write 0.00000834 in standard form:		17. $h = ut - ½gt^2$ Find h when u = 100, t=1⅗ & g=6.4		24. Alf & Amy but tickets in a raffle P(Alf wins 1st prize) = 0.3 P(Amy wins 1st prize) = 0.25 What is the probability that Alf or Amy win 1st prize?	
8. Write 6.72×10^4 as an ordinary number		**Give your answer correct to 3sf** 18. $T = 2\pi\sqrt{\frac{l}{8}}$ Find T when l = 4⅗			
9. Work out $(7\times10^{-4}) \times (8 \times 10^{-3})$ Give your answer in standard form		19. If $\sin x^o = \frac{7}{9}$, find x (3sf)		25. Show on the cumulative frequency graph how to take the lower quartile reading 	
10. Work out $(5.63 \times10^{-3}) - (4.28 \times 10^{-4})$ Give your answer in standard form		20. Each of these measures is rounded to 1dp: a = 8.3cm and b = 4.2cm 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

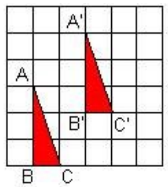
REFLECTION



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

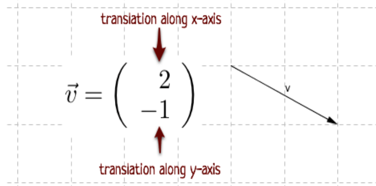


TRANSLATION



Each point moved 2 to the right and 2 up.

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



$$\vec{v} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$$

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**.

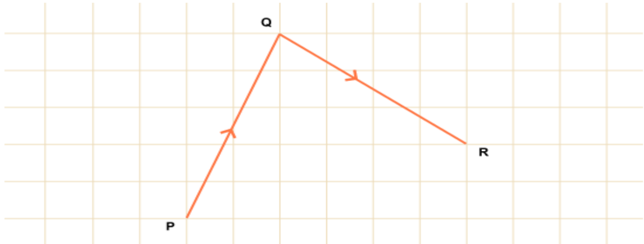
$\binom{a}{b} + \binom{c}{d} = \binom{a+c}{b+d}$

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

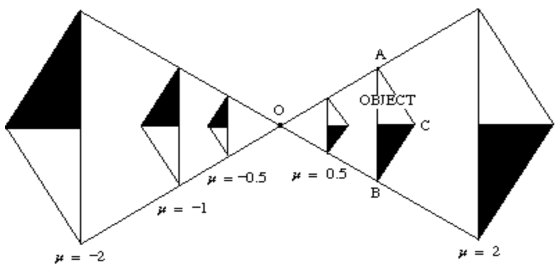
$\overrightarrow{PQ} + \overrightarrow{QR} = \overrightarrow{PR}$

Written out the vector addition looks like this

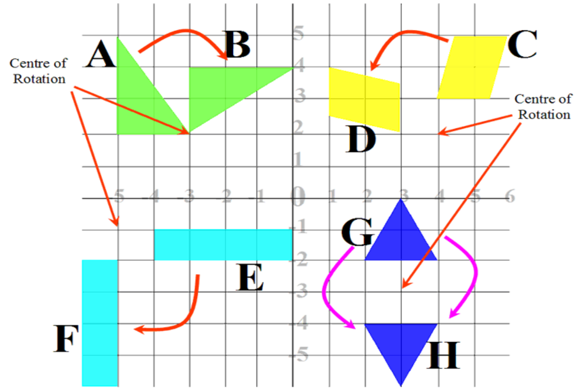
$\binom{2}{5} + \binom{4}{-3} = \binom{6}{2}$



ENLARGEMENT



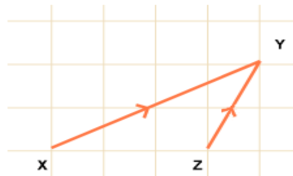
ROTATION



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).

$\binom{a}{b} - \binom{c}{d} = \binom{a-c}{b-d}$



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 $\overrightarrow{ZY}$.

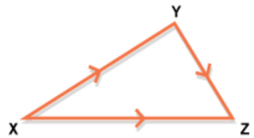
So we can write the path from X to Z as

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

Written out in numbers it looks like this:

$\binom{4}{2} - \binom{1}{2} = \binom{3}{0}$

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 $\overrightarrow{YZ}$.

Fractional scale factors

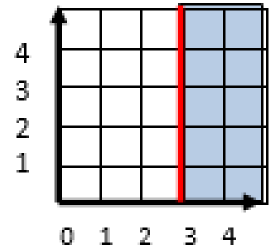
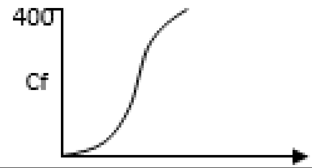
If we 'enlarge' a shape by a scale factor that is between -1 and 1, the image will be **smaller** than the object

Negative scale factors

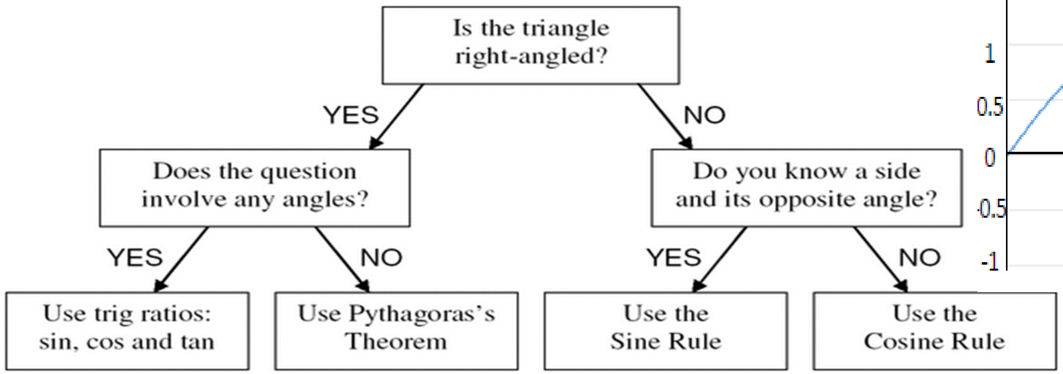
An enlargement using a negative scale factor is similar to an enlargement using a positive scale factor, but this time the image is on the other side of the centre of enlargement, and it is upside down.

Knowledge Recall | **Term4 HW: 2**

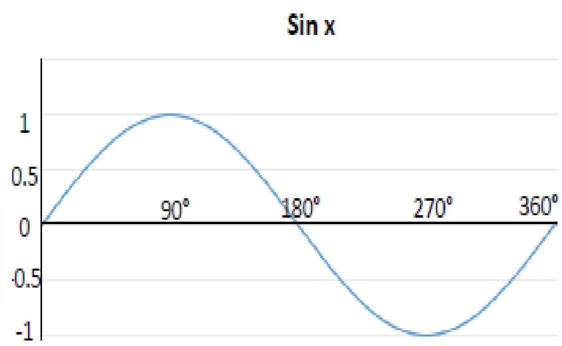
Date Due: ______________ **Score to beat:** ______________

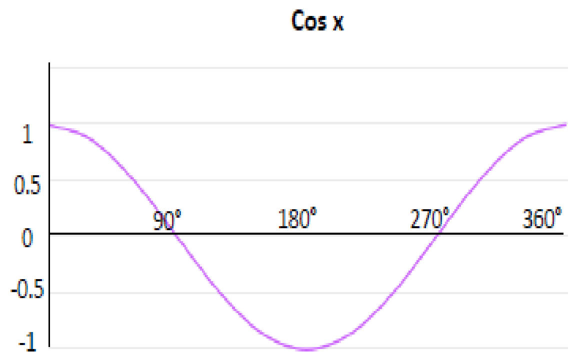
Section A: Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
1. Write $\frac{7}{15}$ as a recurring decimal		11. Factorise: $a^2 - 2a - 15$		21. Linear-Quadratic-Cubic-Reciprocal Which type of graph is represented by this equation? $y = \frac{10}{x}$	
2. Write $0.\dot{7}$ as a fraction		12. Factorise: $4x^2 - 9y^2$			
3. Work out the balance for £600 invested for 5 years at 7.5% per annum		14. Multiply & simplify: $(3x - 2)(2x - 5)$		22. What inequality is represented here?  	
4. The value of a mobile depreciates by 40% per year. Work out the current value of a mobile bought 3 years ago for £124.		14. Multiply & simplify: $(2a + 3)^2$			
5. In a '60% off' sale, an outfit was £86. Work out the original price.		15. Make r the subject of the formula: $S = r^2 - 2t$		23. P(Jack is late to school any day) = 0.1 What is the probability that Jack will be late 2 days running?	
6. A fuel bill has increased by 16% to £139.20. Work out the original cost.		16. Make b the subject of the formula: $a^2 = b^2 - c^2$			
7. Write 280 in standard form:		17. $v=\sqrt{u^2 + 2as}$ Find v when $u = 20$, $a=6$ & $s=52$		24. Alf & Amy but tickets in a raffle P(Alf wins 1st prize) = 0.7 P(Amy wins 1st prize) = 0.12 What is the probability that Alf or Amy win 1st prize?	
8. Write 5.6×10^{-4} as an ordinary number		Give your answer correct to 3sf 18. $v=\sqrt{u^2 + 2as}$ Find v when $u = 2.4$, $a=3.2$ & $s=5.25$			
9. Work out $(5\times10^{-5}) \times (2 \times 10^{4})$ Give your answer in standard form		19. If $\tan x^0 = \frac{12}{5}$, find x (3sf)		25. Show on the cumulative frequency graph how to take the upper quartile reading  	
10. Work out $(6.72 \times10^{-3})+(2.84 \times 10^{-5})$ Give your answer in standard form		20. Each of these measures is rounded to 1dp: $a = 8.3$cm and $b = 4.2$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)

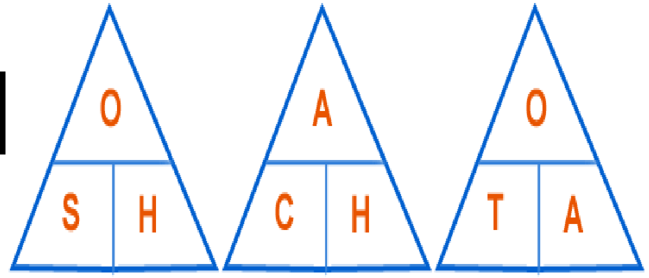
Pythagoras' and Trigonometry



BASIC Sine and Cosine Graphs







Cosine Rule

The Cosine Rule can be used in any triangle

$a^2 = b^2 + c^2 - 2bc \cos A$ — Used to calculate an unknown SIDE

$\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$ — Used to calculate an unknown ANGLE

Key Facts - Exact Trigonometric Values

	0°	30°	45°	60°	90°
sin θ	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
cos θ	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
tan θ	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	$\pm\infty$

Sine Rule

The Sine Rule can be used in any triangle

Used to calculate an unknown SIDE

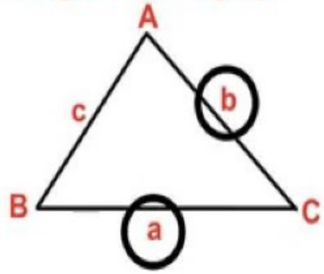
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Used to calculate an unknown ANGLE

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

Area of a Triangle (Non Right-Angled Triangle)

$$\boxed{\text{Area} = \tfrac{1}{2}ab\sin C}$$



This formula finds the area of a non right-angled triangle from 2 sides

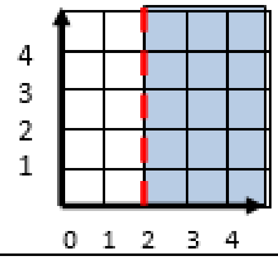
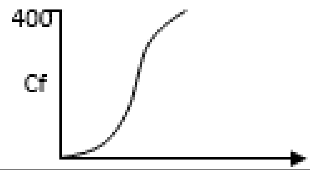
Key Facts – Pythagoras' Theorem

$a^2 + b^2 = c^2$	Where C is the hypotenuse
$c^2 - a^2 = b^2$	Where the unknown side is the shorter side (aka 'leg')

Knowledge Recall

Term4 HW: 3

Date Due: ____________ **Score to beat:** ____________

Section A:Number		Section B: Algebra Geometry & measures		Section C: Using and applying	
1. Write $\frac{11}{15}$ as a recurring decimal		11. Factorise: $x^2 + 2x + 1$		21. Linear-Quadratic-Cubic-Reciprocal Which type of graph is represented by this equation? $Y=2x^3 - 5x^2$	
2. Write $0.\dot{5}$ as a fraction		12. Factorise: $x^2 - 16y^2$			
3. Work out the balance for £1500 invested for 3 years at 6.5% per annum		14. Multiply & simplify: $(x + 2)(5x - 3)$		22. What inequality is represented here? 	
4. The value of a mobile depreciates by 40% per year. Work out the current value of a mobile bought 3 years ago for £225.		14. Multiply & simplify: $(2a - 3)^2$			
5. In a '60% off' sale, an outfit was £144. Work out the original price.		15. Make r the subject of the formula: $S = r^2 - t^2$		23. P(Jack is late to school any day) = 0.6 What is the probability that Jack will be late 2 days running?	
6. A fuel bill has increased by 18% to £141.60. Work out the original cost.		16. Make c the subject of the formula: $a^2 = b^2 - c^2$			
7. Write 0.056 in standard form:		17. $v=\sqrt{u^2 + 2as}$ Find v when $u = 16$, $a=8$ & $s=33$		24. Alf & Amy but tickets in a raffle P(Alf wins 1st prize) = 0.28 P(Amy wins 1st prize) = 0.02 What is the probability that Alf or Amy win 1st prize?	
8. Write 4.651×10^6 as an ordinary number		**Give your answer correct to 3sf** 18. $v=\sqrt{u^2 + 2as}$ Find v when $u = 9.1$, $a=-4.7$ & $s=3.04$			
9. Work out $(4 \times 10^3) + (6 \times 10^4)$ Give your answer in standard form		19. If $\tan 18^0 = \frac{x}{12}$, find x (3sf)		25. Show on the cumulative frequency graph how to take the inter-quartile range reading 	
10. Work out $(4.32 \times 10^{-3})-(4.28 \times 10^{-5})$ Give your answer in standard form		20. Each of these measures is rounded to 1dp: a = 8.3cm and b = 4.2cm 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)	