Further Maths

Transition Work

Complete by Sept 2025

Name:_____

Reading List

As a student who is choosing to study A level Further Maths, it's logical to assume you have an interest in the subject. The following books are interesting for additional reading to learn beyond the subject. If you are looking at doing a Maths based degree these are some of the books you can read in preparation.

- Simon Singh – Fermat's Last Theorem
- Simon Singh – The Codebook
- Simon Singh – The Simpsons and their Mathematical Secrets
- Alex Bellos – Alex Adventure's in Numberland
- Alex Bellos – Alex through the Looking Glass
- Matt Parker – Humble Pi
- Matt Parker – Things to make and do in the fourth dimension
- Jordan Ellenberg – How Not to be Wrong: The hidden Maths of everyday life
- Ian Stewart – Seventeen Equations that Changed the World

If you want more websites to look at with interesting articles/videos and problems then you should look at the following:

- http://dailydesmos.com/
- www.numberphile.com
- https://oeis.org/
- www.puzzgrid.com

Graphing Software

If you didn't know already there are lots of websites that have graphical software to allow you to graph lots of different functions. We recommend:

www.desmos.com

www.geogebra.org

Task 1 :- https://undergroundmathematics.org/quadratics/inequalities-for-some-occasions

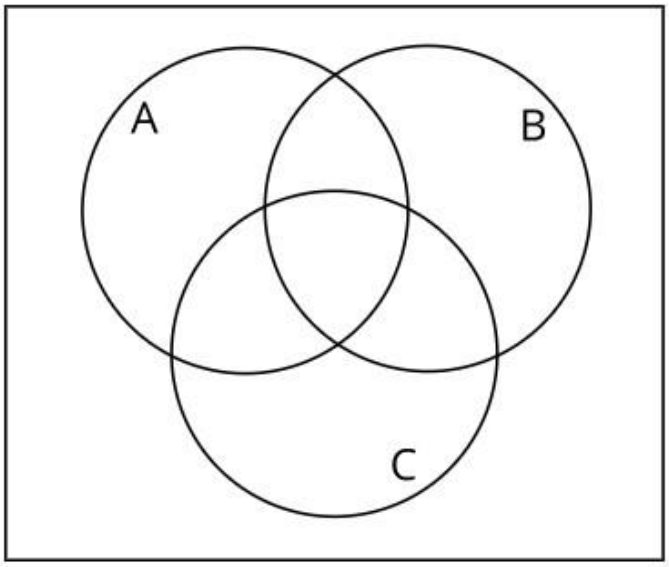
Can you find the quadratic inequality for each region on the Venn diagram?

The regions are defined as follows.

A: The solution set is a subset of $x \leq 1$.

B: The solutions are given by $a \leq x \leq b$ where a and b are real numbers.

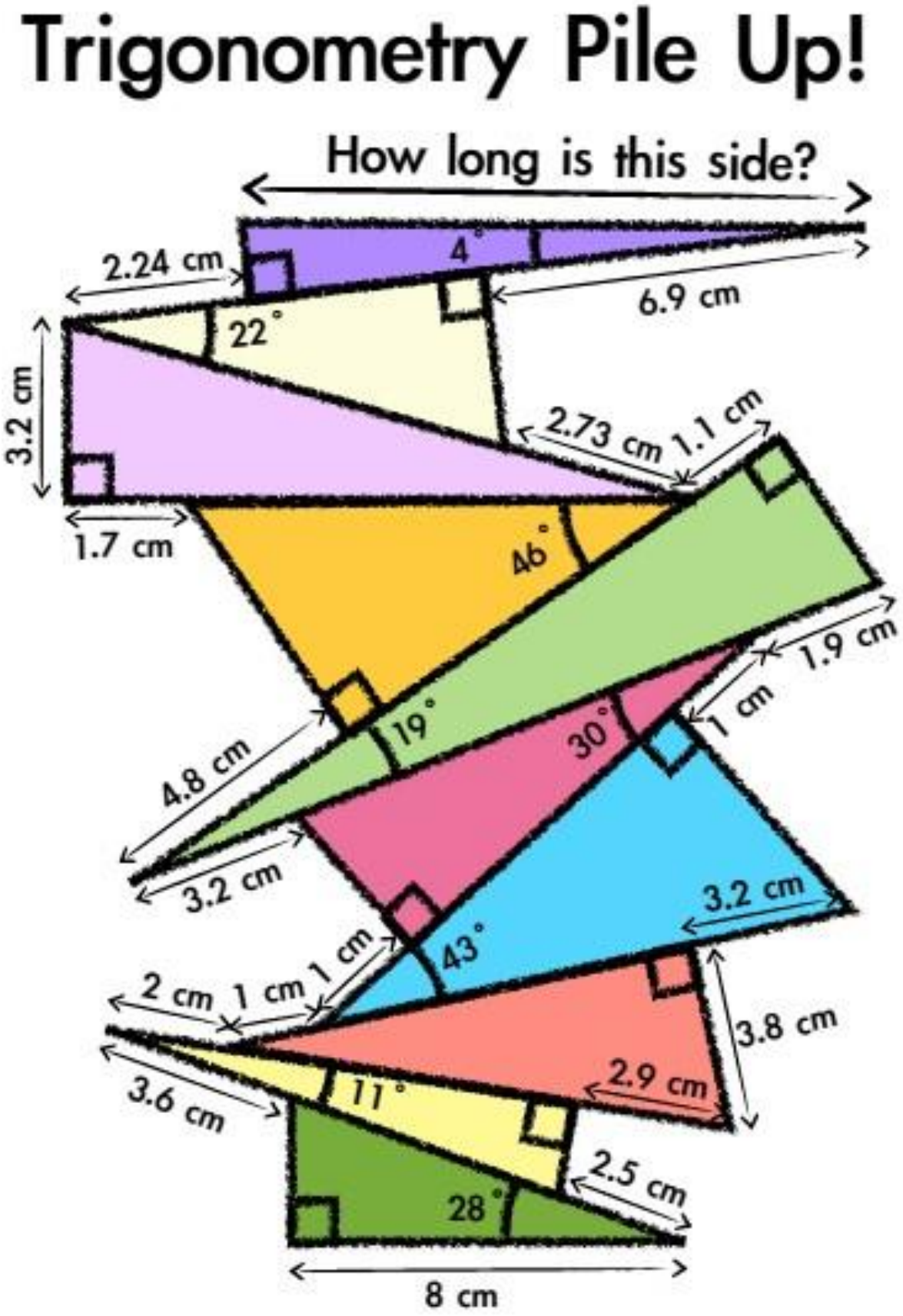
C: The inequality is satisfied by $x = 4$, e.g. $x = 4$ satisfies the inequality $x \geq 2$.



Here are some possible inequalities. Start by placing these into the correct region of the Venn diagram.

① $x^2 \leq 9$	② $11x \geq 2x^2$	③ $x^2 + 3 \geq 2$	④ $3x^2 \geq 21x - 30$
⑤ $x^2 \leq -x$	⑥ $x^2 \leq x - 2$	⑦ $6x^2 - 1 \geq 5x$	⑧ $-2x^2 \leq x - 6$

Task 2:- https://brainly.com/question/22725767



Task 3:- https://nrich.maths.org/5970 Simultaneous Equations Sudoku

c		m				h			19
	f						e		10
			m						
			k		g	m	c		23
g				p					11
							h	f	14
	g				m				13
	a			e			k	h	11
k			c		f	a			22
17	19		16	5	22	14	16	14	

Rules of Equation Sudoku

Like the standard sudoku, this sudoku variant has two basic rules:

1. Each column, each row and each box (3x3 subgrid) must have the numbers 1 through 9.
2. No column, row or box can have two squares with the same number.
3. The puzzle can be solved by finding the values of the 9 given variables in the squares of the 9x9 grid. At the bottom and right side of the 9x9 grid are numbers, each of which is the sum of a column or row of variables. Altogether a set of 16 equations can be formed from the columns and rows of variables and constants.

Task 4:-

What's different and what's the same about the equations below, give as many reasons as possible.

What's the Difference?

$2x^2 = 18$

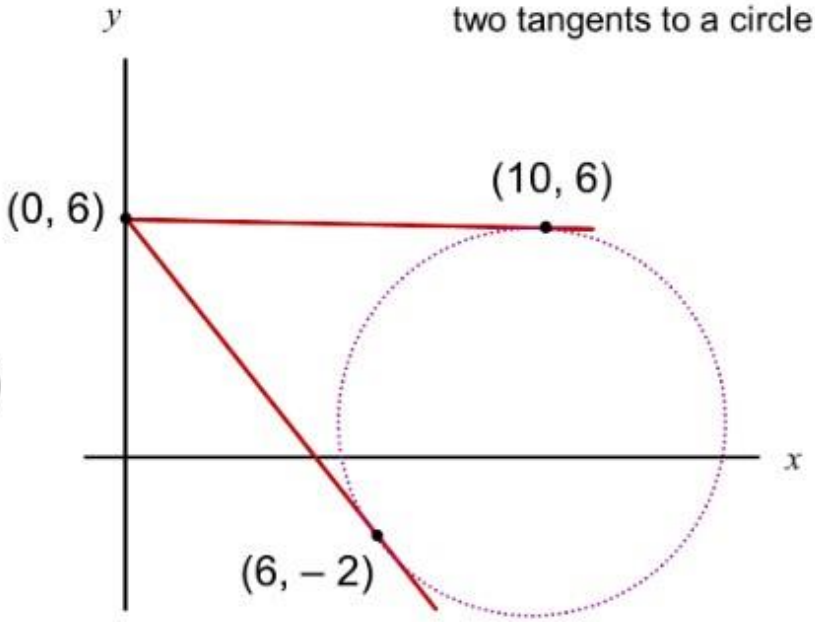
$(2x)^2 = 18$

$2x^2 + 1 = 18$

$(2x + 1)^2 = 18$

$2(x + 1)^2 = 18$

Task 5:- https://donsteward.blogspot.com/2017/11/two-tangents-meet-on-y-axis.html



two tangents to a circle meet at (0, 6)

what are the coordinates of the centre of the circle?

Task 6:- https://www.openmiddle.com/perfect-squares/

PERFECT SQUARES

Directions: Using the digits 1- 9, at most one time each, to fill in the boxes to make each expression evaluate to a perfect square number.

Extension/Challenge: What is the largest/smallest square number you can make? How many different perfect square numbers could be made?

$18 \times \square \times 2$

$\square \times 14 \times \square$

$\square \times 15 \times 3$

$2 \times \square$

$6 \times \square \times 2 \times \square$

Task 7:- https://undergroundmathematics.org/thinking-about-numbers/absurd

Ab-surd!

Each line is a set of equivalent fractions. Fill in the blanks in the fractions to make each line complete, including the multiplier used to get from one fraction to the next.

(1) $\frac{1}{\sqrt{2}}\left(\times\ \_\_\_\right) = \frac{\sqrt{2}}{\ \ }\left(\times\ \_\_\_\right) = \frac{\sqrt{6}}{\ \ }\left(\times\ \_\_\_\right) = \frac{\ \ }{6}$

(2) $\frac{2}{5\sqrt{3}}\left(\times\ \_\_\_\right) = \frac{\ \ }{15}\left(\times\ \_\_\_\right) = \frac{2\sqrt{6}}{\ \ }\left(\times\ \_\_\_\right) = \frac{\ \ }{60}$

(3) $\frac{5}{2+\sqrt{2}}\left(\times\ \_\_\_\right) = \frac{10-5\sqrt{2}}{\ \ }\left(\times\ \_\_\_\right) = \frac{\ \ }{20+10\sqrt{2}}$

(4) $\frac{2-\sqrt{3}}{4}\left(\times\ \_\_\_\right) = \frac{\ \ }{8+4\sqrt{3}}\left(\times\ \_\_\_\right) = \frac{\ \ }{16}$

✱ A *rationalised fraction* is one whose denominator is a whole number. These are usually easier to work with than fractions with square roots in their denominators.

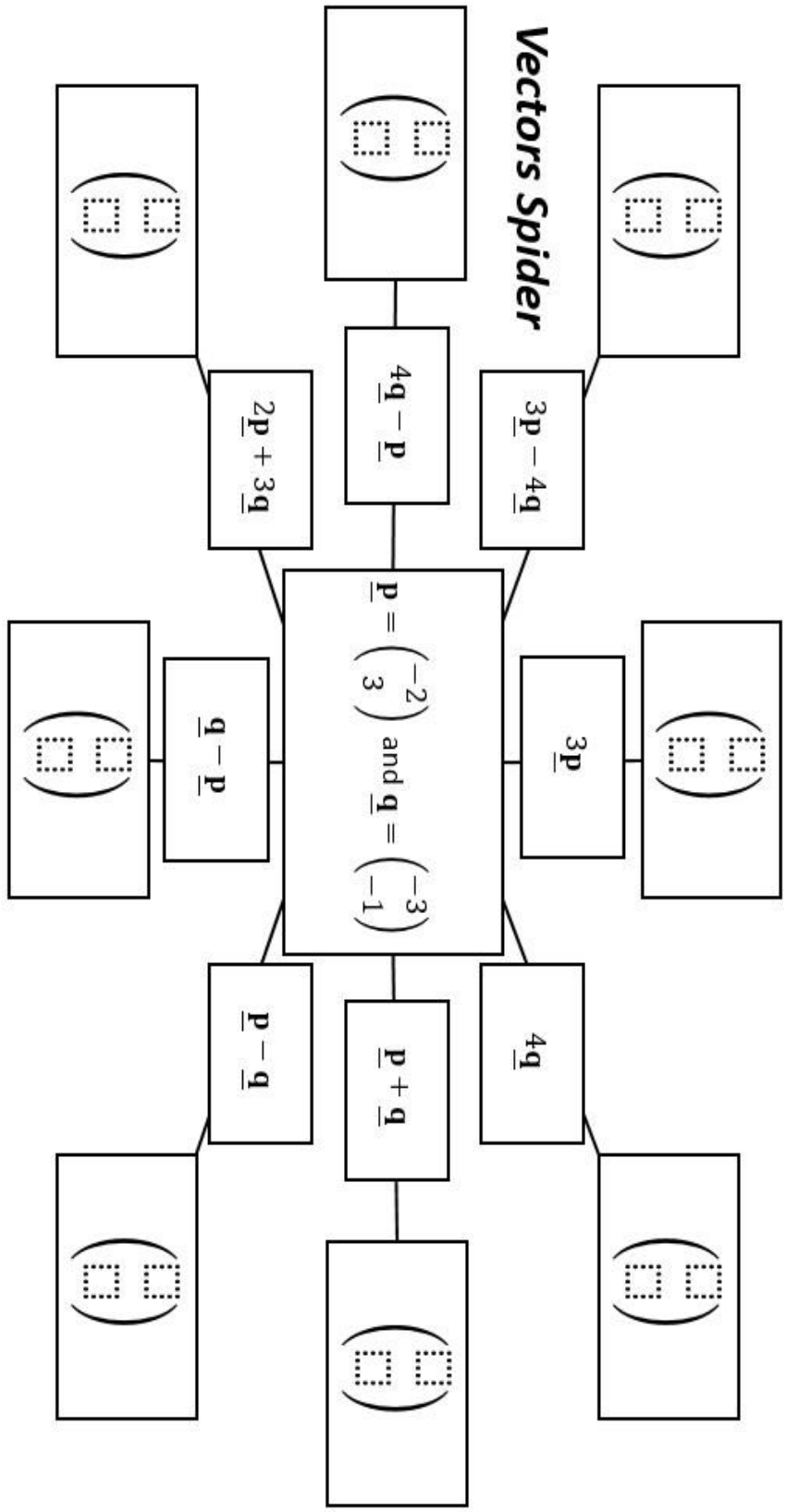
- Identify the rationalised fractions in the above lines. What do you notice about the multipliers when moving from a fraction with a surd (square root) in the denominator to a rationalised fraction?
- How would you rationalise fractions in the following form: $\frac{a}{\sqrt{b}}$, $\frac{a}{b\sqrt{c}}$ and $\frac{a}{b+\sqrt{c}}$?
- Is there more than one way to rationalise a fraction?

Task 8:-

Fill in the grid with different quadratics, noticing the objectives you have to meet. For example, the box labelled A, must have a y-coordinate less than the middle quadratic and the y intercept must be less as well.

		y coordinate of turning point	
y intercept	Less	Same	More
Less	A		
Same		$y = x^2 + 4x - 6$	
More			

Task 9:-


Vectors Spider
$\underline{\mathbf{p}} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and $\underline{\mathbf{q}} = \begin{pmatrix} -3 \\ -1 \end{pmatrix}$
$3\underline{\mathbf{p}} - 4\underline{\mathbf{q}}$
$4\underline{\mathbf{q}} - \underline{\mathbf{p}}$
$2\underline{\mathbf{p}} + 3\underline{\mathbf{q}}$
$3\underline{\mathbf{p}}$
$\underline{\mathbf{q}} - \underline{\mathbf{p}}$
$4\underline{\mathbf{q}}$
$\underline{\mathbf{p}} + \underline{\mathbf{q}}$
$\underline{\mathbf{p}} - \underline{\mathbf{q}}$

Task 10:-
https://undergroundmathematics.org/geometry-of-equations/r5281

Can we find an integer solution to three simultaneous inequalities?

From the inequalities

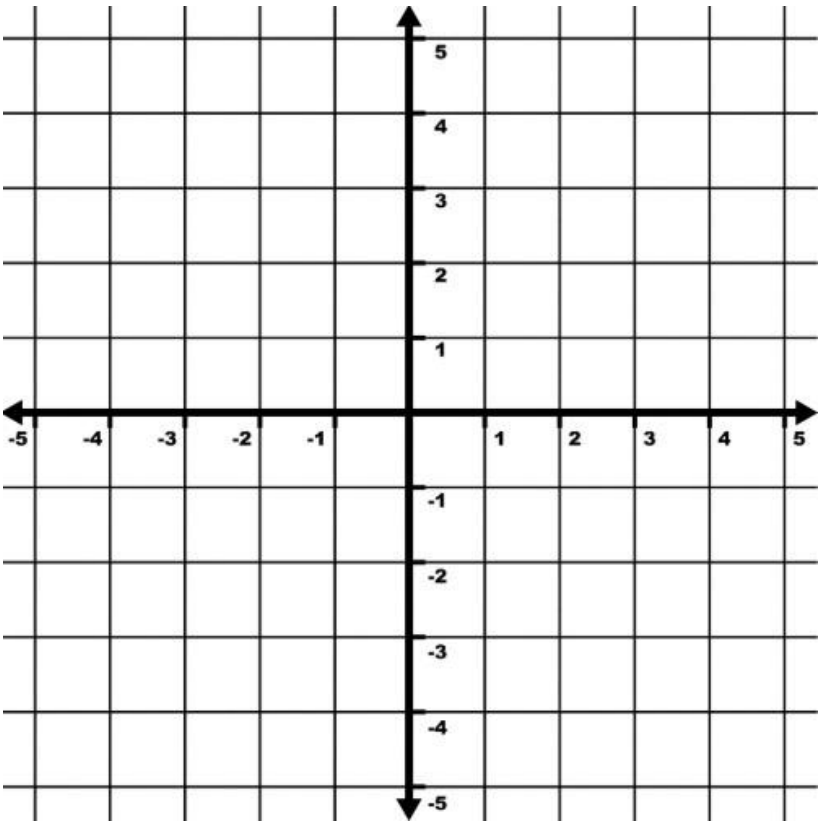
$$y-2x>0, \qquad x+y>3, \qquad 2y-x<5$$

deduce that

$$\frac{1}{3}<x<\frac{5}{3}, \qquad 2<y<\frac{10}{3},$$

and hence that the given inequalities cannot be satisfied simultaneously by integral values of x and y.

[*The phrase 'integral values' means the same as 'integer values'.*]



Task 11:-

Start at A, answer the question 8^{-1} and then find the answer in the top row for your new letter and question. The letters will spell out a phrase.

... ever wondered why?

START	$\left(\frac{7}{2}\right)$	4	0.027	$\frac{16}{9}$	$\frac{2}{5}$	$-\frac{1}{8}$	$\frac{1}{400}$	1	27
A	T	P	N	1	S	T	R	H	F
8^{-1}	$\left(\frac{1}{7}\right)^{-2}$	$4^{\frac{3}{2}}$	$\left(\frac{1}{3}\right)^{-1}$	FINISH	$\left(\frac{27}{64}\right)^{-\frac{2}{3}}$	$(-3)^{-2}$	$\left(\frac{5}{3}\right)^{-2}$	$\left(\frac{9}{5}\right)^{-1}$	$36^{\frac{3}{2}}$

16	8	$\frac{1}{8}$	$\frac{9}{25}$	216	$\frac{1}{64}$	64	1000	$\frac{8}{3}$	$\frac{1}{36}$
I	O	N	O	Z	Y	T	O	I	E
$(0.3)^3$	$27^{\frac{2}{3}}$	8^{-2}	$\left(\frac{9}{64}\right)^{-\frac{1}{2}}$	6^{-2}	$(-2)^{-3}$	$\left(\frac{5}{3}\right)^{0}$	$81^{\frac{3}{4}}$	$\left(\frac{25}{4}\right)^{-\frac{1}{2}}$	20^{-2}

125	3	9	49	$\frac{1}{9}$	$\left(\frac{5}{9}\right)$	$\left(\frac{1}{1000}\right)$
E	G	W	O	H	E	R
$100^{-\frac{3}{2}}$	$\left(\frac{2}{7}\right)^{-1}$	$25^{\frac{3}{2}}$	$\left(\frac{1}{4}\right)^{-3}$	$(0.25)^{-2}$	$8^{\frac{2}{3}}$	$100^{\frac{3}{2}}$

Task 12:-

Five children (Ahmed, Bachendri, Charlie, Daniel and Emily) raced each other. First they raced to the spreading chestnut tree, and then they raced back to their starting point. The following facts are known:

(i) Ahmed was fourth in the race to the tree.

(ii) The person who was last to the tree managed to win the race back.

(iii) The person who won the race to the tree was third on the way back.

(iv) The person who was third in the race to the tree was second on the way back.

(v) Bachendri was fourth on the way back.

(vi) Charlie reached the tree before Daniel.

(vii) Charlie got back to the start before Emily.

For each race (to the tree and back again), write down the order in which the children finished.