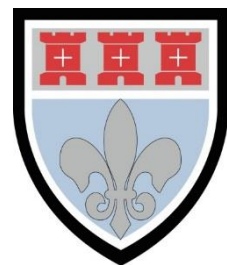


# St Mary's Catholic School



Nu**M**ber  
    **A**lgebra  
Da**T**a  
    **C**Hance  
    **G**Eometry  
    **M**easurement  
    **C**ALculus  
    **T**opology  
Ar**I**thmetic  
Spa**C**e  
    **S**tatistics

## Y11-12 transition

If you are thinking of studying A-Level Maths, you should be commended for your astute decision making. However A-level Maths and A-level Further Maths don't have the reputation for being some of the hardest A-Levels for nothing.

What can you do to ensure the best possible start to the course?

Well, it's pretty easy really - don't forget everything you studied for GCSE Maths, especially the Algebra.

Definitely read through your Algebra notes before September - there is a nice overlap between Grade 7-9 Algebra and the Year 12 course, so if you can keep those skills sharp you should have a good start. The same goes for your work on GCSE Statistics and Probability

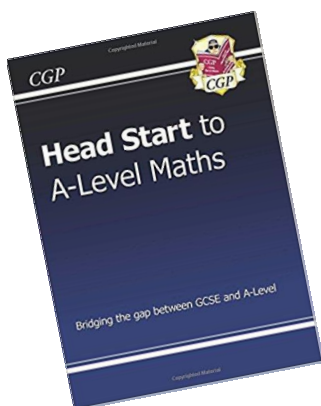
This booklet contains work that you will be **expected** to complete and hand in, along with additional ideas on where to go to keep your maths skills up to scratch over the Summer break

# Y11-12 Summer transition work

You **must** complete the following assessment sheets, re-capping important GCSE skills needed for the beginning of Year 12

Your **full worked** solutions must be completed on lined paper, self-marked using the answers provided, and handed to your teacher in the first maths lesson in September.

You are expected to achieve at least 80% upon handing your work in – you are given the answers, so it is expected that you do the necessary research or ask for help to correct any mistakes you make on your own.



**CGP do a good “bridging the gap” book, but revision techniques you used for GCSE will suffice – it’s about consolidating what you should already know so it is fresh in your mind for September**

# Diagnostic Test

This first exercise will help you find out which areas of maths you need to work on before you start your A-Level Maths course.

## Types of Number and Fractions

1) Which of the following are integers?

4      -3.5      0.3       $\frac{4}{5}$       8.99      -10      205      0

2) Which of the following values are rational, and which are irrational?

5.9       $\pi$        $\sqrt{7}$        $\frac{1}{5}$       -6       $\sqrt{4}$       13.978      2.1

3) Evaluate the following without using a calculator, giving your answers in their lowest terms. Give any answers larger than 1 as improper fractions.

a)  $\frac{2}{9} \times \frac{3}{5}$       b)  $\frac{1}{6} \div \frac{2}{3}$       c)  $\frac{1}{12} + \frac{5}{6}$       d)  $\frac{8}{5} - \frac{1}{7}$

## Indices, Multiplying Out Brackets and Factorising

4) Simplify the following:

a)  $x^7 \times x^2$       b)  $10y^3 \div 5y$       c)  $m^0$       d)  $(2n^2)^5$

5) Write  $5^{-2}$  as a fraction.

6) Evaluate the following without using a calculator:

a)  $\left(\frac{3}{4}\right)^2$       b)  $16^{\frac{1}{2}}$       c)  $8^{\frac{2}{3}}$       d)  $36^{-\frac{1}{2}}$

7) Multiply out the brackets and simplify your answers where possible.

a)  $(x + 4)(x - 6)$       b)  $(x + 5)^2$       c)  $(2x - 1)(x + 3)$       d)  $(x + 1)(x - 4)(x + 5)$

8) Factorise the following:

a)  $5x + 20$       b)  $3a + 12ab$       c)  $x^2 - 4$       d)  $9x^2 - 36$       e)  $x^2 - 5$

## Surds

9) Simplify the following:

a)  $\sqrt{3} \times \sqrt{2}$       b)  $(\sqrt{5})^2$       c)  $\frac{\sqrt{30}}{\sqrt{6}}$       d)  $\sqrt{12} + 2\sqrt{3}$       e)  $(1 + \sqrt{7})^2$

10) Rationalise the denominators of the following:

a)  $\frac{3}{\sqrt{2}}$       b)  $\frac{\sqrt{5}}{2\sqrt{2}}$       c)  $\frac{2}{3 + \sqrt{6}}$       d)  $\frac{\sqrt{2}}{1 - \sqrt{5}}$

# Diagnostic Test

## Solving Equations and Rearranging Formulas

11) Solve the following:

a)  $5x - 2 = 8$     b)  $3(x - 6) = 2(x - 4)$     c)  $\frac{x+2}{3} + \frac{2x}{5} = x + 2$     d)  $2x(x + 1) = 2x + 18$

12) Make  $x$  the subject of the following formulas:

a)  $y = mx + c$     b)  $y = \frac{3x+2}{5}$     c)  $y = 2x^2z + 1$     d)  $y = \frac{3x+1}{x-2}$

## Quadratic Equations

13) Solve the following by factorising:

a)  $x^2 - 3x + 2 = 0$     b)  $x^2 + 6x + 5 = 0$     c)  $2x^2 - 3x - 5 = 0$     d)  $3x^2 - 13x = -12$

14) Solve the following using the quadratic formula.

Give your answers to two decimal places.

a)  $x^2 + 2x - 10 = 0$     b)  $2x^2 - 5x - 1 = 0$

15) Solve the following by completing the square. Give your answers as surds.

a)  $x^2 - 4x - 2 = 0$     b)  $2x^2 + 4x - 7 = 0$

16) a) Complete the square for  $x^2 + 6x + 8$ .

b) Hence sketch the graph of  $y = x^2 + 6x + 8$ , labelling the turning point and intercepts with the  $x$ -axis.

## Algebraic Fractions, Inequalities and Simultaneous Equations

17) Simplify the following:

a)  $\frac{15a^3b^3}{5a^2b}$     b)  $\frac{2x^2y}{(4xy)^2}$     c)  $\frac{x^2 - 16}{x^2 - x - 20}$

18) Simplify the following:

a)  $\frac{9b^2}{a} \times \frac{2a^2}{3b}$     b)  $\frac{2(x-1)^2}{15} \times \frac{10}{4x-4}$     c)  $\frac{3x^2 - 21x}{x+2} \div \frac{x(x-7)}{9x+18}$     d)  $\frac{3}{x+1} + \frac{2x-3}{x^2}$

19) Solve the following inequalities:

a)  $7x + 5 \leq 2x$     b)  $2(10 - x) > 4$     c)  $2x^2 + 3 < 21$   
d)  $4x^2 - 9 \geq 7$     e)  $x^2 - 4x + 10 \geq 2x + 5$

20) Draw a set of axes with the  $x$ -axis from  $-2$  to  $3$  and the  $y$ -axis from  $0$  to  $6$ .

Show on these axes the region that satisfies the following inequalities:

$$y > 3x - 1, \quad y < x + 3 \quad \text{and} \quad y \geq \frac{x}{5} + 2$$

21) Solve the following simultaneous equations:

a)  $2x + y = 2$   
 $x - 3y = 8$     b)  $3x - 2y = 1$   
 $5x - 3y = 7$     c)  $y = x^2 + 3$   
 $y - 2x = 18$     d)  $3y = 2(x^2 - 3)$   
 $2x - y = 2$

# Diagnostic Test

## Proof and Functions

- 22) Prove that the sum of any three consecutive odd numbers is a multiple of 3.
- 23) Mia says, "for any integers  $x$  and  $y$ ,  $xy > y$ ". Prove that Mia is wrong.
- 24)  $f(x) = \frac{x+5}{3}$  and  $g(x) = x - 3$ .
- a) Evaluate  $f(4)$ .                      b) Find  $fg(x)$ .                      c) Find  $f^{-1}(x)$ .

## Straight Lines and Quadratic Graphs

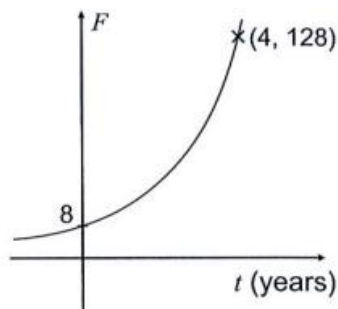
- 25) Give the gradient and  $y$ -intercept of the line  $x + 2y = 4$ .
- 26) Point A has coordinates (5, 2) and point B has coordinates (2, -4).
- a) Find the equation of the line passing through points A and B.
- b) Find the exact length of line AB.
- 27) Line A has equation  $y = 2x + 5$ .
- a) Find the equation of the line parallel to line A which passes through (3, 2).
- b) Find the equation of the line perpendicular to line A which passes through (2, 1).
- 28) Sketch the graph of  $y = x^2 - 8x + 15$ . Label the graph with the coordinates of the turning point and the points where the graph crosses the axes.

## Harder Graphs and Graph Transformations

29) Sketch the following graphs:

a)  $y = x^3$                       b)  $y = \frac{1}{x}$                       c)  $y = -\frac{1}{x}$

30) The graph on the right shows how the number of fish ( $F$ ) living in a river changes over time. The equation of the graph is  $F = mn^t$  where  $t$  is the number of years and  $m$  and  $n$  are positive constants. Find the values of  $m$  and  $n$ .



31) Find the equation of the tangent to  $x^2 + y^2 = 25$  at the point (3, 4).

Give your answer in the form  $ax + by + c = 0$ .

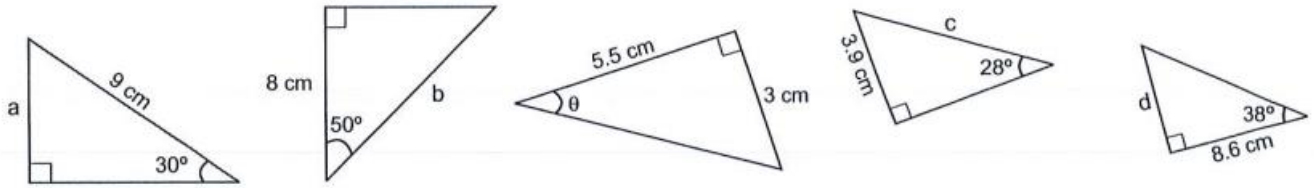
32)  $f(x) = x^2$ . For parts a) to c) below, sketch the graphs of  $y = f(x)$  and the given transformation.

a)  $y = f(x) + 3$                       b)  $y = f(x + 3)$                       c)  $y = -f(x)$

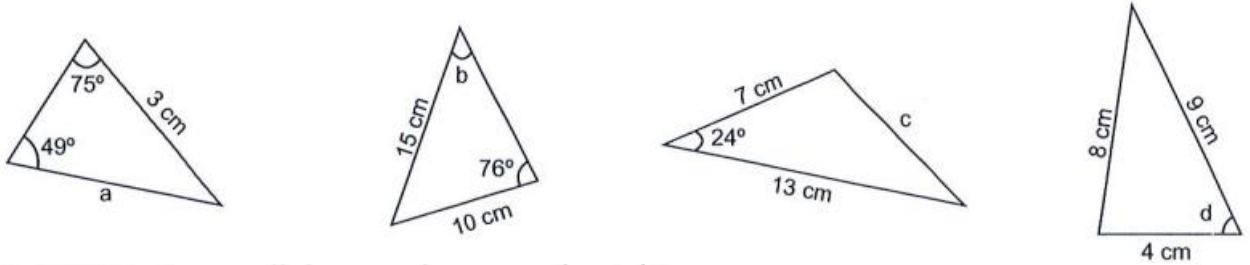
# Diagnostic Test

## Trigonometry and Vectors

33) Find the unknowns in each of these triangles. Give your answers to 1 decimal place.



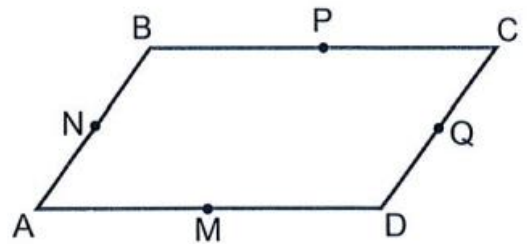
34) Find the unknowns in each of these triangles. Give your answers to 1 decimal place.



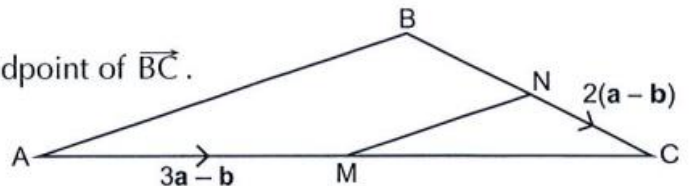
35) ABCD is the parallelogram shown on the right. M, N, P and Q are the midpoints of the sides.  $\overrightarrow{AB} = \mathbf{a}$  and  $\overrightarrow{BC} = \mathbf{b}$ .

Find the following vectors in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

- a)  $\overrightarrow{AC}$     b)  $\overrightarrow{DQ}$     c)  $\overrightarrow{CM}$   
 d)  $\overrightarrow{QP}$     e)  $\overrightarrow{MB}$     f)  $\overrightarrow{PA}$



36) The diagram shows triangle ABC. M is the midpoint of  $\overrightarrow{AC}$  and N is the midpoint of  $\overrightarrow{BC}$ .  $\overrightarrow{AM} = 3\mathbf{a} - \mathbf{b}$  and  $\overrightarrow{NC} = 2(\mathbf{a} - \mathbf{b})$ . Show that  $\overrightarrow{AB}$  and  $\overrightarrow{MN}$  are parallel.



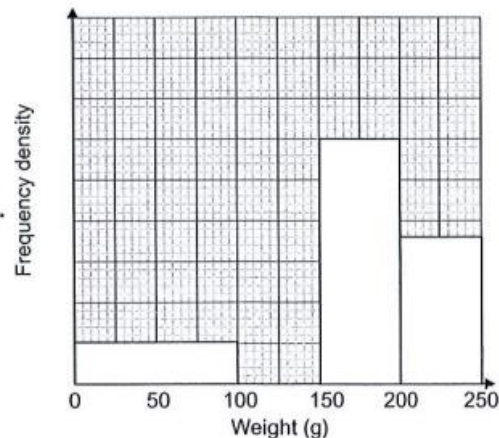
## Sampling and Histograms

37) Describe how a simple random sample of size 20 can be selected from a population of 200.

38) The weights of the chocolate bars in a shop storeroom are shown in the table and histogram below.

- a) Use the information in the table and the histogram to label the vertical axis.  
 b) Use the histogram to complete the table.  
 c) Use the table to add the missing bar to the histogram.

Weight ( $w$ , in grams)	Frequency
$0 < w \leq 100$	50
$100 < w \leq 150$	100
$150 < w \leq 200$	150
$200 < w \leq 250$	



# Diagnostic Test

## Averages and Cumulative Frequency

39) Find the mean, median and mode(s) of these numbers:

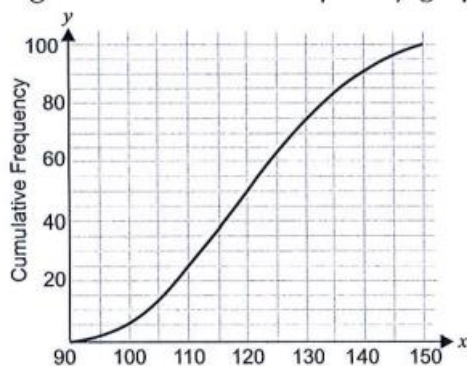
5    3    -2    0    -3    2    1    1    4    2    6    11    -4

40) The table shows the journey times between home and school for 60 students.

- Write down the modal class.
- Which group contains the median?
- Estimate the mean value.
- Draw a cumulative frequency graph for the data in the table.

Time ( $m$ minutes)	Frequency
$5 < m \leq 10$	4
$10 < m \leq 15$	25
$15 < m \leq 20$	18
$20 < m \leq 25$	8
$25 < m \leq 30$	5

41) Using this cumulative frequency graph, find the:



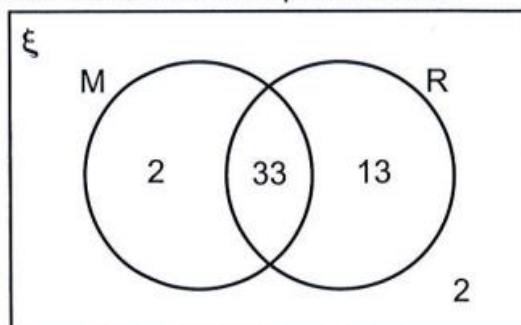
- median
- lower quartile
- upper quartile
- interquartile range

## Probability and Tree Diagrams

42) Lewis asked 50 people if they like mashed potatoes (M) and roast potatoes (R). The Venn diagram shows the results.

A person is chosen at random.  
Find the probability that they:

- like mashed potatoes
- like neither mashed nor roast potatoes
- like both types of potatoes
- don't like roast potatoes
- don't like mashed potatoes



43) Mona's purse contains two £5 notes, four £10 notes and three £20 notes. It also contains five 20p coins, four 50p coins and three £1 coins.

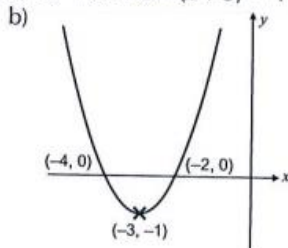
- Mona picks one note and one coin at random from her purse. Find the probability that she picks a £5 note and a 20p coin.
- Mona picks two coins at random without replacement. Use a tree diagram to find the probability she picks a 50p coin and a £1 coin.

# Answers

## Page 1 – Diagnostic Test

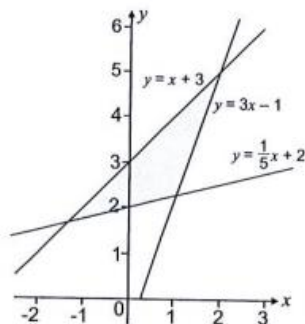
- 1 4, -10, 205 and 0 are integers.
- 2  $5.9$ ,  $\frac{1}{5}$ ,  $-6$ ,  $\sqrt{4}$ ,  $13.978$  and  $2.1$  are rational.  
 $\pi$  and  $\sqrt{7}$  are irrational.
- 3 a)  $\frac{2}{15}$   
 b)  $\frac{1}{4}$   
 c)  $\frac{11}{12}$   
 d)  $\frac{51}{35}$
- 4 a)  $x^9$   
 b)  $2y^2$   
 c) 1  
 d)  $32n^{10}$
- 5  $\frac{1}{25}$
- 6 a)  $\frac{9}{16}$   
 b) 4  
 c) 4  
 d)  $\frac{1}{6}$
- 7 a)  $x^2 - 2x - 24$   
 b)  $x^2 + 10x + 25$   
 c)  $2x^2 + 5x - 3$   
 d)  $x^3 + 2x^2 - 19x - 20$
- 8 a)  $5(x + 4)$   
 b)  $3a(1 + 4b)$   
 c)  $(x + 2)(x - 2)$   
 d)  $9(x + 2)(x - 2)$   
 e)  $(x + \sqrt{5})(x - \sqrt{5})$
- 9 a)  $\sqrt{6}$   
 b) 5  
 c)  $\sqrt{5}$   
 d)  $4\sqrt{3}$   
 e)  $8 + 2\sqrt{7}$
- 10 a)  $\frac{3\sqrt{2}}{2}$   
 b)  $\frac{\sqrt{10}}{4}$   
 c)  $\frac{6 - 2\sqrt{6}}{3}$   
 d)  $\frac{\sqrt{2} + \sqrt{10}}{-4}$
- 11 a)  $x = 2$   
 b)  $x = 10$   
 c)  $x = -5$   
 d)  $x = -3$  or  $x = 3$
- 12 a)  $x = \frac{y-c}{m}$   
 b)  $x = \frac{5y-2}{3}$   
 c)  $x = \pm\sqrt{\frac{y-1}{2z}}$   
 d)  $x = \frac{2y+1}{y-3}$

- 13 a)  $x = 2$  or  $x = 1$   
 b)  $x = -5$  or  $x = -1$   
 c)  $x = 2.5$  or  $x = -1$   
 d)  $x = \frac{4}{3}$  or  $x = 3$
- 14 a)  $x = 2.32$  or  $x = -4.32$   
 b)  $x = 2.69$  or  $x = -0.19$
- 15 a)  $x = 2 + \sqrt{6}$  or  $x = 2 - \sqrt{6}$   
 b)  $x = -1 + \frac{3}{\sqrt{2}}$  or  $x = -1 - \frac{3}{\sqrt{2}}$
- 16 a)  $x^2 + 6x + 8 = (x + 3)^2 - 1$



- 17 a)  $3ab^2$   
 b)  $\frac{1}{8y}$   
 c)  $\frac{x-4}{x-5}$
- 18 a)  $6ab$   
 b)  $\frac{x-1}{3}$   
 c) 27  
 d)  $\frac{5x^2 - x - 3}{x^2(x+1)}$
- 19 a)  $x \leq -1$   
 b)  $x < 8$   
 c)  $-3 < x < 3$   
 d)  $x \leq -2$  or  $x \geq 2$   
 e)  $x \leq 1$  or  $x \geq 5$

20



- 21 a)  $x = 2$ ,  $y = -2$   
 b)  $x = 11$ ,  $y = 16$   
 c)  $x = -3$ ,  $y = 12$  or  $x = 5$ ,  $y = 28$   
 d)  $x = 0$ ,  $y = -2$  or  $x = 3$ ,  $y = 4$
- 22 Take three consecutive odd numbers:  
 $2n + 1$ ,  $2n + 3$  and  $2n + 5$ , where  $n$  is an integer.  
 $2n + 1 + 2n + 3 + 2n + 5 = 6n + 9 = 3(2n + 3)$   
 The sum of three consecutive odd numbers can be written as  $3x$ , where  $x = 2n + 3$ .  
 Therefore it is a multiple of 3.
- 23 E.g. Let  $x = 3$  and  $y = -1$ . So  $xy = -3 \Rightarrow xy < y$ .  
 So Mia is wrong.

# Answers

24 a) 3

b)  $fg(x) = \frac{x+2}{3}$

c)  $f^{-1}(x) = 3x - 5$

25 Gradient = -0.5, y-intercept = 2

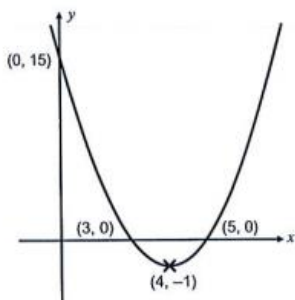
26 a)  $y = 2x - 8$

b)  $3\sqrt{5}$

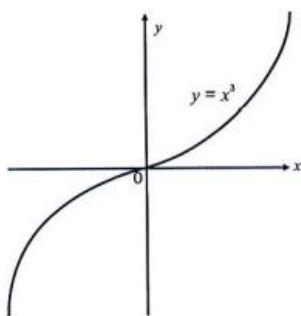
27 a)  $y = 2x - 4$

b)  $y = -\frac{1}{2}x + 2$

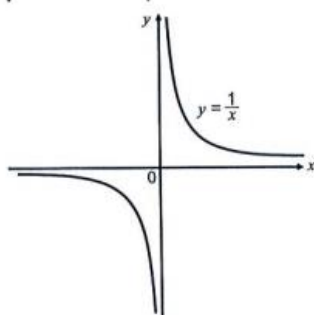
28



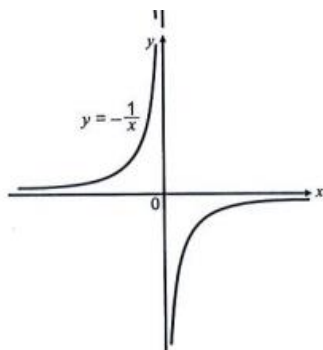
29 a)



b)



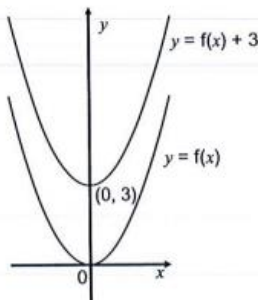
c)



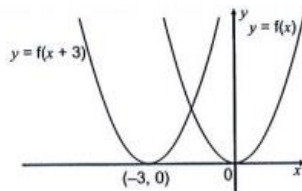
30  $m = 8, n = 2$

31  $3x + 4y - 25 = 0$

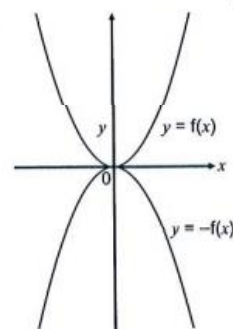
32 a)



b)



c)



33  $a = 4.5$  cm,  $b = 12.4$  cm,  $\theta = 28.6^\circ$ ,  
 $c = 8.3$  cm,  $d = 6.7$  cm

34  $a = 3.8$  cm,  $b = 40.3^\circ$ ,  $c = 7.2$  cm,  $d = 62.7^\circ$

35 a)  $\mathbf{a + b}$

b)  $\frac{1}{2}\mathbf{a}$

c)  $-\mathbf{a} - \frac{1}{2}\mathbf{b}$

d)  $\frac{1}{2}\mathbf{a} - \frac{1}{2}\mathbf{b}$

e)  $\mathbf{a} - \frac{1}{2}\mathbf{b}$

f)  $-\mathbf{a} - \frac{1}{2}\mathbf{b}$

36  $\overline{AB} = 2(3\mathbf{a} - \mathbf{b}) - 2(2(\mathbf{a} - \mathbf{b}))$

$$= 6\mathbf{a} - 2\mathbf{b} - 4\mathbf{a} + 4\mathbf{b} = 2\mathbf{a} + 2\mathbf{b} = 2(\mathbf{a} + \mathbf{b})$$

$$\overline{MN} = 3\mathbf{a} - \mathbf{b} - 2(\mathbf{a} - \mathbf{b}) = 3\mathbf{a} - \mathbf{b} - 2\mathbf{a} + 2\mathbf{b} = \mathbf{a} + \mathbf{b}$$

$$\overline{AB} = 2\overline{MN} \Rightarrow \overline{AB} \text{ and } \overline{MN} \text{ are parallel.}$$

37 First assign a unique number between 1 and 200 to every member of the population. Then create a list of 20 random numbers between 1 and 200. Finally, match the random numbers to members of the population.

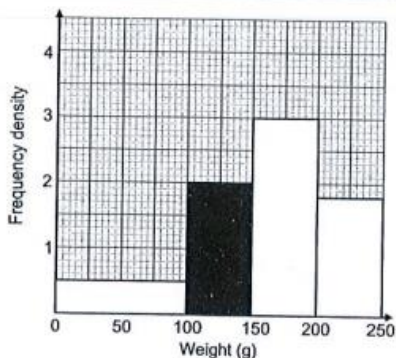
# Answers

38 a) See histogram in part c).

b)

Weight ( $w$ , in grams)	Frequency
$0 < w \leq 100$	50
$100 < w \leq 150$	100
$150 < w \leq 200$	150
$200 < w \leq 250$	<b>90</b>

c)



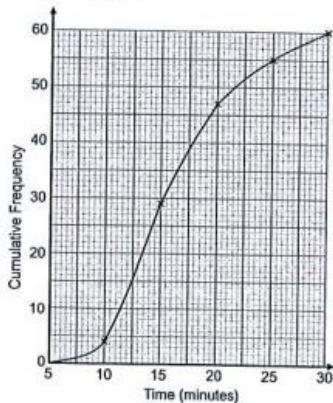
39 mean = 2, median = 2, mode = 1 and 2

40 a)  $10 < m \leq 15$

b)  $15 < m \leq 20$

c) 16.25 minutes

d)



41 a) 120

b) 110

c) 130

d) 20

42 a)  $\frac{7}{10}$  (or 0.7)

b)  $\frac{1}{25}$  (or 0.04)

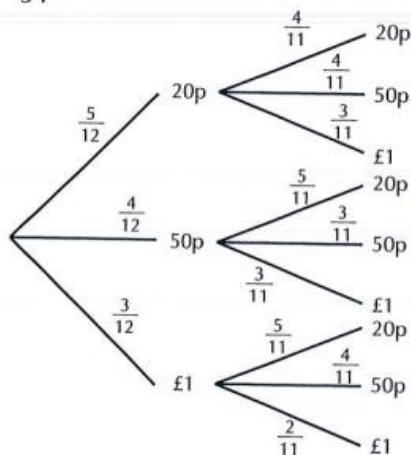
c)  $\frac{33}{50}$  (or 0.66)

d)  $\frac{2}{25}$  (or 0.08)

e)  $\frac{3}{10}$  (or 0.3)

43 a)  $\frac{5}{54}$

b)



Probability of a 50p coin and a £1 coin

$$= \frac{2}{11}$$

# Y11-12 Summer transition

There are many other ways you can keep your maths skills sharp, in addition to traditional revision;

## Try the free Sumaze apps

Number and logic problems in a maze-style game. If you have a lot of free time Sumaze 1 can be done in under two days



## Investigate YouTube

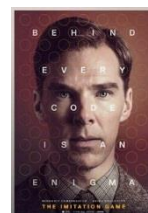
Look for the Numberphile channel or videos by the 'Festival of the Spoken' nerd team

## Read a review and watch a film

'Hidden Figures' PG

'Beautiful Mind' 12

'The Imitation Game' 12



You'll be surprised how many results you get if you Google 'maths films on Netflix', however they aren't all available on the UK service

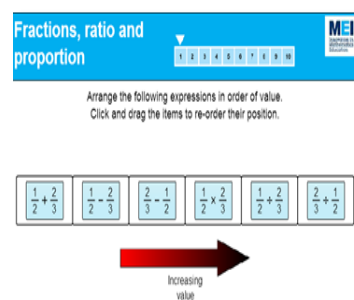
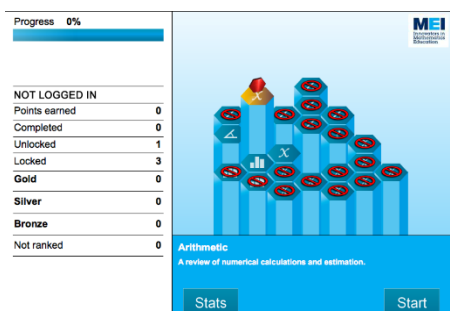
## Go to an event

If you get the opportunity to, go to a popular Maths or Science lecture. You'll be surprised where they pop up - even the famous Hay Literary festival has a maths lecture! Don't worry if you don't understand all of it, you won't be alone, but you'll start to see the links between different areas

## Try "Bridge It" by MEI

An online, flash-based quiz game to support preparation for Post-GCSE maths.

Google "Bridge It MEI"



# Y11-12 Summer transition

Read a book and follow the authors on social media

'Alex's Adventures in Numberland' by Alex Bellos

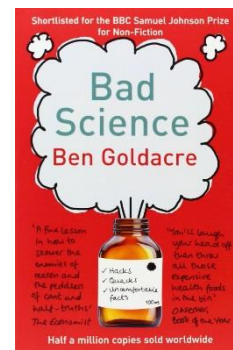
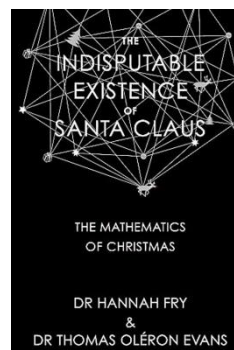
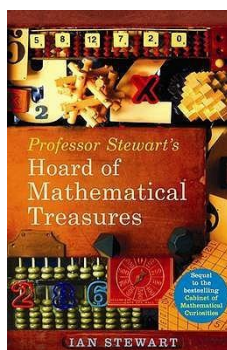
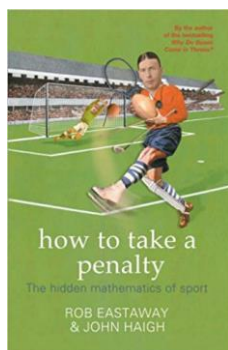
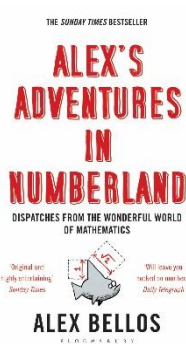
'Bad Science' by Ben Goldacre

'Professor Stewart's hoard of mathematical treasures' by Ian Stewart

(one of many titles)

'The indisputable existence of Santa Claus: The mathematics of Christmas' by Dr Hannah Fry & Dr Thomas Oleron Evans

Anything by Rob Eastaway or Danica McKellar

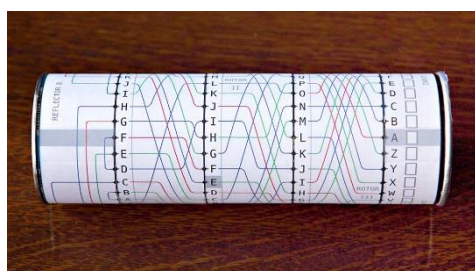


## Puzzles

Invest in some Maths related puzzle books:

Sudoku, mathdoku, menseki meiro (books are in other languages, but you don't need the instructions, just the pictures), logic problems

They'll all keep your brain alert



Eat some tubes of Pringles with friends

- Then Google Pringles Enigma machine
- Make enigma machines out of the tubes
- Text each other coded messages whilst sunbathing (in the rain)