Rochester Grammar School
Year 12 A-level maths

A-level Maths Booster Pack

GCSE Maths topics to review:

- ❑ Fractions
- ❑ Indices
- ❑ Expanding brackets
- ❑ Factorising
- ❑ Surds
- ❑ Solving equations
- ❑ Rearranging
- ❑ Completing the square
- ❑ Algebraic fractions
- ❑ Inequalities
- ❑ Simultaneous equations
- ❑ Proof
- ❑ Functions
- ❑ Straight line graphs
- ❑ Harder graphs
- ❑ Graph Transformations
- ❑ Trigonometry
- ❑ Trigonometric graphs
- ❑ Vectors
- ❑ Mean. Median, mode
- ❑ Histograms
- ❑ Cumulative frequency
- ❑ Probability

Using your GDC:

Please watch this video on how to use the catalogue feature to find any function on your GDC:

Please watch this video on how to solve equations on your GDC:

Please watch this video on how to draw graphs and find intersection points

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How to use this booklet:

This booklet is to help you identify which areas of maths you need to work on before you start the A-level course. If you struggle with any of the questions, follow the link in the further support section to recap and review each topic on Maths Genie. You can then go on to practice more of these questions using the links to worksheets below each video if needed.

All of these useful GCSE topics lead into your A-level work and the **students who do well at A-level have a solid foundation of this work**. Good luck!

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?

$5.\dot{9}$ π $\sqrt{7}$ $\frac{1}{5}$ −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) $\frac{8}{5} - \frac{1}{7}$

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Further support:

Types of number	https://youtu.be/JXgduTLVjdg?si=XiGamJtPx7C55jIC
Calculating with fractions	https://youtu.be/HmjCV7iOd1s https://youtu.be/uELAh-WQam4 https://youtu.be/QSENvjw7lmo

Indices, Expanding 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) $x^2 - 5$

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Further support:

Indices	https://youtu.be/D_Q2R-I0Q1Y https://youtu.be/omY_kulfPPg
Expanding and factorising	https://youtu.be/E88KDkXeJrA https://youtu.be/iDZeDqsLPQY https://youtu.be/xQ2z7YuKkAc
Difference of two squares	https://youtu.be/IqN8Z1-nlsY?si=7HTlAUWE8OA3cIlV

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) $\frac{\sqrt{2}}{1-\sqrt{5}}$

Further support:

Simplifying surds	https://youtu.be/2_LkSaP2Vv8 https://youtu.be/Bqx5gYfsEGI
Rationalising the denominator	https://youtu.be/t9iFBDHc-nA

Solving equations and rearranging

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) $y = \frac{3x+1}{x-2}$

Further support:

Linear equations	https://youtu.be/vNDpWDlWaRI https://youtu.be/hLN-gqadwpY?si=MlI0TZx_bWKxZeLT
Rearranging formulae	https://youtu.be/uLDLmsok-38 https://youtu.be/tQb9cF4xVeA

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) $2x^2 - 5x - 1 = 0$

The formula is: $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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.

Further support:

Factorising quadratics	https://youtu.be/FRRkLZt31S0 https://youtu.be/v2sPNXdabI0
Solving quadratics by factorising	https://youtu.be/m-qyV6C56ec
Solving quadratics by using the formula	https://youtu.be/hoy6dE0plLw
Completing the square	https://youtu.be/9_2DYOfHxyk

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:

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

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) $3y = 2(x^2 - 3)$, $2x - y = 2$

Further support:

Simplifying algebraic fractions	https://youtu.be/gMojR-U4NDQ
Calculations with algebraic fractions	https://youtu.be/YtHMjuB9f_g?si=txx2i2Z4fW5NCmGY https://youtu.be/2pKrSEVk-Uk?si=Y3CBMLiJFUi6i_W_
Linear inequalities	https://youtu.be/bGps9ut59QM
Quadratic inequalities	https://youtu.be/tTyOlCwgBLY
Regions	https://youtu.be/yiIcL1-9FUI
Linear simultaneous equations	https://youtu.be/FcYeDDlgNMs
Quadratic simultaneous equations	https://youtu.be/KSS0nLu5PnE

Proof and functions

22) Prove that the sum of any three consecutive odd numbers is a multiple of 3.

23) Naveen says, "for any integers x and y, $xy > y$". Prove that Naveen is wrong.

24) $f(x) = \frac{x+5}{3}$ and $g(x) = x - 3$.

a) Evaluate $f(4)$. b) Find $fg(x)$. c) Find $f^{-1}(x)$.

Further support:

Proof	https://youtu.be/Z6Cuamz3uj8
Functions	https://youtu.be/N8y6DUHQd2c
Inverse functions	https://youtu.be/kMxquEZQRgE
Composite functions	https://youtu.be/5UJgjQRPCzk

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.

Further support:

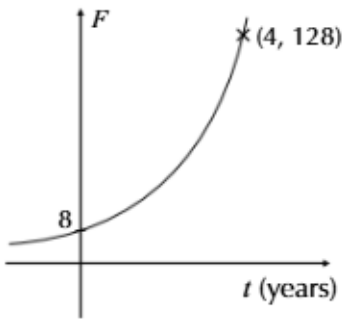
Straight line graphs	https://youtu.be/fn10eAtEX30 https://youtu.be/powhADI9SwA
Parallel and perpendicular lines	https://youtu.be/eFjXfm6vQY8
Sketching quadratic graphs	https://youtu.be/bpZ-BdEh_lM

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 $ax + by + c = 0$.

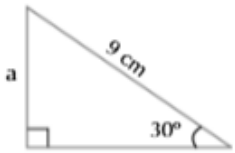
32) $f(x) = x^2$. For parts a) to c) below, sketch the graphs of $y = f(x)$ and the given transformation.

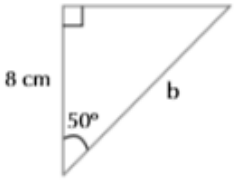
a) $y = f(x) + 3$ b) $y = f(x + 3)$ c) $y = -f(x)$

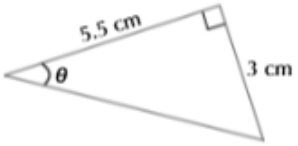
Further support:

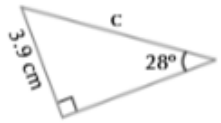
Further graphs	https://youtu.be/P11WAJoBCVY https://youtu.be/P11WAJoBCVY https://youtu.be/sYNYNE7ZLV8
Transformations	https://youtu.be/8URwwX6PIQI

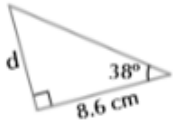
33) Find the unknowns in each of these triangles. Give your answers to 1 decimal place.



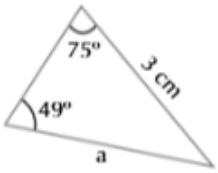


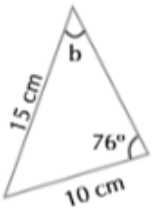


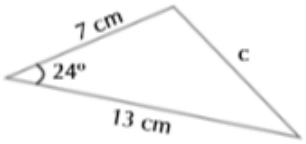


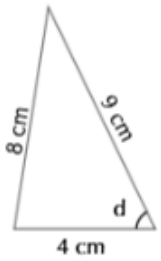


34) Find the unknowns in each of these triangles. Give your answers to 1 decimal place.





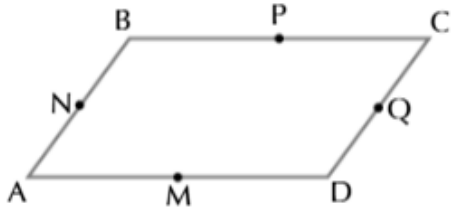




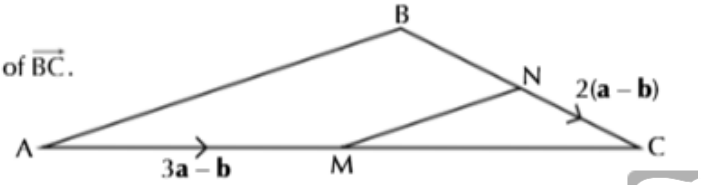
35) ABCD is the parallelogram shown on the right.
M, N, P and Q are the midpoints of the sides.
$\overrightarrow{AB} = \mathbf{a}$ and $\overrightarrow{BC} = \mathbf{b}$.
Find the following vectors in terms of **a** and **b**.

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.



Further support:

SOHCAHTOA	https://youtu.be/Ka7KyDTMuKA https://youtu.be/ag7B4PEAmKw
Sine and cosine rule	https://youtu.be/4vQqDLu86qg https://youtu.be/ud8fUf7Wlzc https://youtu.be/U2sNPD7KOyw
Vectors	https://youtu.be/11CpPVEo23Q https://youtu.be/KJyEQ9ORdk0 https://youtu.be/gvTcsbvZEbY https://youtu.be/GMgJwk1QveI

Sampling and histograms

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

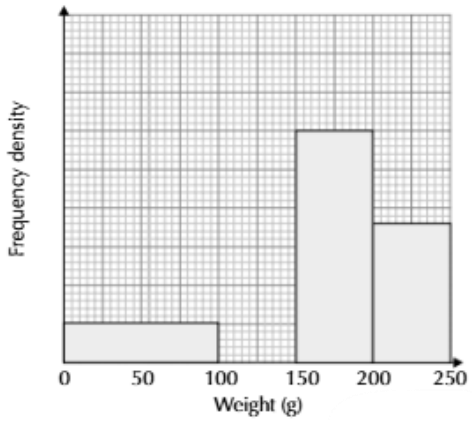
38) The weights of the chocolate bars in a shop storeroom are shown in the table and histogram below.

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
$200 < w \leq 250$	



Further support:

Sampling	https://youtu.be/d6-i1Z7LHtY
Histograms	https://youtu.be/DMgczUH9U0Q

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.

a) Write down the modal class.

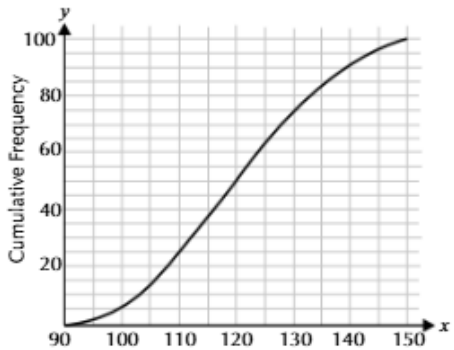
b) Which group contains the median?

c) Estimate the mean value.

d) 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:



a) median

b) lower quartile

c) upper quartile

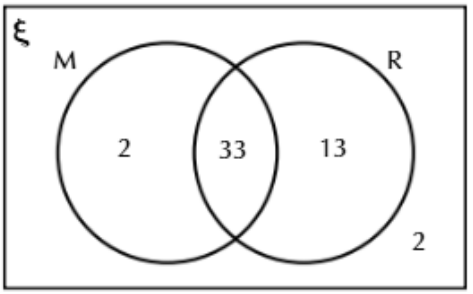
d) interquartile range

Further support:

Mean. Median and mode	https://youtu.be/vwMSeqDky3I
Cumulative frequency	https://youtu.be/bJbJ_GElF80

Probability

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:

a) like mashed potatoes
b) like neither mashed nor roast potatoes
c) like both types of potatoes
d) don't like roast potatoes
e) 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.

a) 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.

b) 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.

Further support:

Probability	https://youtu.be/QDnDtxDEHWg
Venn diagrams	https://youtu.be/FZhYJb48vn0
Tree diagrams	https://youtu.be/aEPBad8dd8k https://youtu.be/gRL9FFOS8f8

Answers - Diagnostic Test

1 4, –10, 205 and 0 are integers.

2 $5.\dot{9}$, $\frac{1}{5}$, –6, $\sqrt{4}$, 13.978 and 2.1 are rational.
π 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 $x = 3$

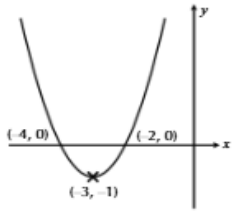
12 a) $x = \frac{y-c}{m}$
b) $x = \frac{5y-2}{3}$
c) $x = \pm\sqrt{\frac{y-1}{2z}}$
d) $x = \frac{2y+1}{y-3}$

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) $x^2 + 6x + 8 = (x + 3)^2 - 1$
b)

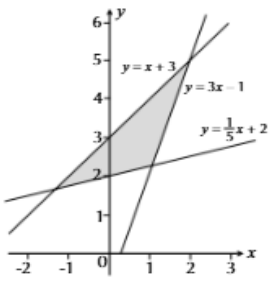


17 a) $3ab^2$
b) $\frac{1}{8y}$
c) $\frac{x-4}{x-5}$

18 a) $6ab$
b) $\frac{x-1}{3}$
c) 27
d) $\frac{5x^2-x-3}{x^2(x+1)}$

19 a) $x \le -1$
b) $x < 8$
c) $-3 < x < 3$
d) $x \le -2$ or $x \ge 2$
e) $x \le 1$ or $x \ge 5$

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 Naveen is wrong.

24 a) 3

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

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

25 Gradient = –0.5, y-intercept = 2

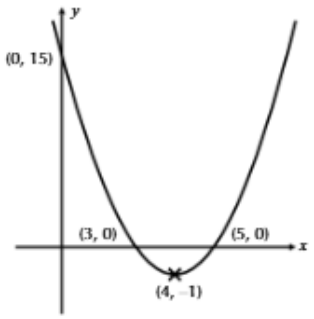
26 a) $y = 2x - 8$

b) $3\sqrt{5}$

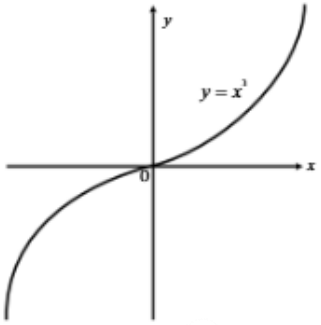
27 a) $y = 2x - 4$

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

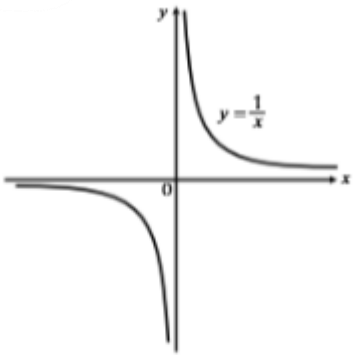
28



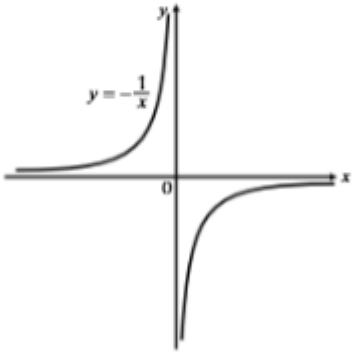
29 a)



b)



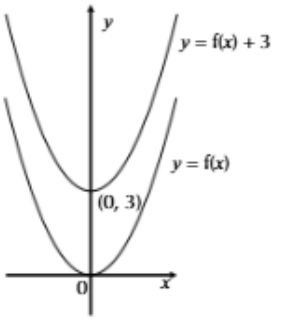
c)



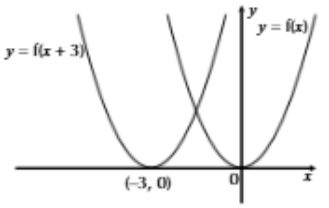
30 $m = 8, n = 2$

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

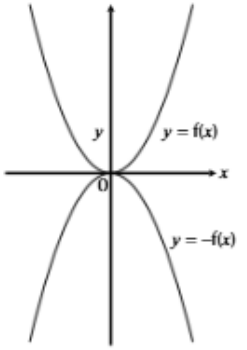
32 a)



b)



c)



33 a = 4.5 cm, b = 12.4 cm, θ = 28.6
c = 8.3 cm, d = 6.7 cm

34 a = 3.8 cm, b = 40.3°, c = 7.2 cm, d = 62.7°

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

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 $\overrightarrow{AB} = 2(3\mathbf{a} - \mathbf{b}) - 2(2(\mathbf{a} - \mathbf{b}))$
$= 6\mathbf{a} - 2\mathbf{b} - 4\mathbf{a} + 4\mathbf{b} = 2\mathbf{a} + 2\mathbf{b} = 2(\mathbf{a} + \mathbf{b})$

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

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

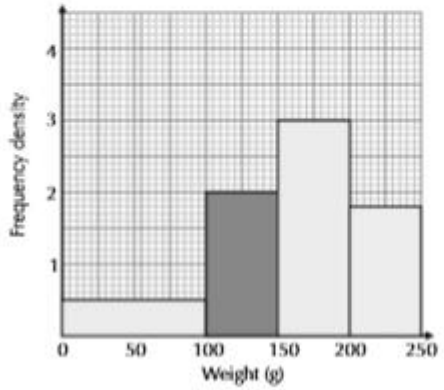
37 First assign a unique number between 1 and 200 to every member of the population. Then create a list of 20 random numbers between 1 and 200. Finally, match the random numbers to members of the population.

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
$200 < w \leq 250$	**90**

c)



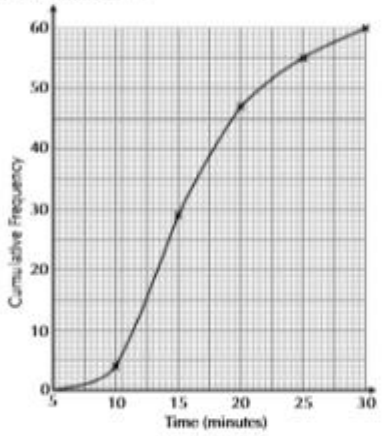
39 mean = 2, median = 2, mode = 1 and 2

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)

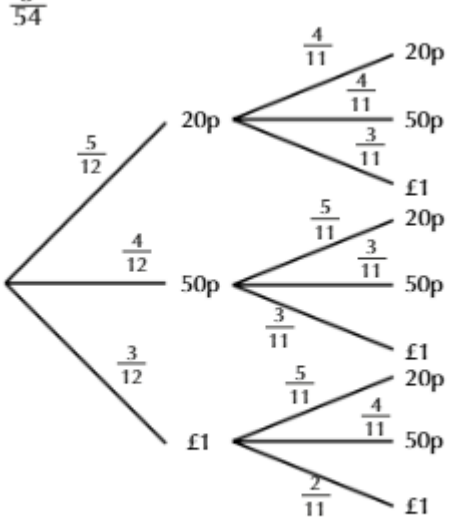
c) $\frac{33}{50}$ (or 0.66)

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 = $\frac{2}{11}$