



A Level Maths

Transition Booklet 2026 - 27



Full Name: _____

Key Areas of Focus	
Introduction to A Level Course	AS and A Level Mathematics Specification
GCSE Link	Transition worksheets (with videos) from GCSE to A level Maths
Skills	Transition to A level Mathematics: Essential Skills
Wider Reading	Further reading to enhance and enrich understanding of Maths

FT1: How do you find solutions/roots to a quadratic equation/function?

Resources:

Textbook (Pure Mathematics): pages 19 - 24

Website: <http://mrbartonmaths.com/topics/solving-equations/solving-quadratic-equations/>

You need to make notes on:

- The general form of a quadratic equation
- How to solve by factorising
- How to solve using the quadratic formula
- How to solve by completing the square
- What are the advantages/disadvantages of each method?

Key words to identify in your reading and record in your notes (highlight the ones you use):

Quadratic, equation, real constants, coefficient, real solution, factorising, complete the square, quadratic formula, factor, zero, root, surd, y-intercept, graph, turning point, maximum, minimum.

Exercise 2A - Q3

3 Solve the following equations:

- | | | | | |
|--------------------|----------------------------|---------------------------------|--------------|--------------|
| a $3x^2 + 5x = 2$ | b $(2x - 3)^2 = 9$ | c $(x - 7)^2 = 36$ | d $2x^2 = 8$ | e $3x^2 = 5$ |
| f $(x - 3)^2 = 13$ | g $(3x - 1)^2 = 11$ | h $5x^2 - 10x^2 = -7 + x + x^2$ | | |
| i $6x^2 - 7 = 11x$ | j $4x^2 + 17x = 6x - 2x^2$ | | | |

Exercise 2B - Q2

2 Solve the following equations using the quadratic formula.

Give your answers to three significant figures.

- | | | | |
|-----------------------|------------------------|-----------------------|----------------------------|
| a $x^2 + 4x + 2 = 0$ | b $x^2 - 8x + 1 = 0$ | c $x^2 + 11x - 9 = 0$ | d $x^2 - 7x - 17 = 0$ |
| e $5x^2 + 9x - 1 = 0$ | f $2x^2 - 3x - 18 = 0$ | g $3x^2 + 8 = 16x$ | h $2x^2 + 11x = 5x^2 - 18$ |

Exercise 2C - Q1, Q2 and Q3

1 Complete the square for the expressions:

- a $x^2 + 4x$ b $x^2 - 6x$ c $x^2 - 16x$ d $x^2 + x$ e $x^2 - 14x$

2 Complete the square for the expressions:

- a $2x^2 + 16x$ b $3x^2 - 24x$ c $5x^2 + 20x$ d $2x^2 - 5x$ e $8x - 2x^2$

3 Write each of these expressions in the form $p(x + q)^2 + r$, where p , q and r are constants to be found:

- a $2x^2 + 8x + 1$ b $5x^2 - 15x + 3$ c $3x^2 + 2x - 1$ d $10 - 16x - 4x^2$ e $2x - 8x^2 + 10$

Hint In question 3d, write the expression as $-4x^2 - 16x + 10$ then take a factor of -4 out of the first two terms to get $-4(x^2 + 4x) + 10$.

Challenge:

- By completing the square, show that the solutions to the equation $ax^2 + bx + c = 0$ can be written as $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

FT2: How many roots will a quadratic function have?

Resources:

Textbook (Pure Mathematics): pages 30 - 32

MathsWatch: Clip QF4 The Discriminant

You need to make notes on:

- The quadratic formula and the discriminant
- The three different cases for the discriminant and the number of real solutions/roots
- Implications for the graphs of quadratic functions in all three cases
- Using the discriminant to range of values for the coefficients of $ax^2 + bx + c = 0$.

Key words to identify in your reading and record in your notes (highlight the ones you use):

Quadratic, square, square root, positive, negative, real, imaginary, greater than or equal to, zero, function, distinct, repeated, discriminant, graph, values, range.

Exercises:

- Exercise 26 - Q1, Q2 and Q3

1 a Calculate the value of the discriminant for each of these five functions:

i $f(x) = x^2 + 8x + 3$

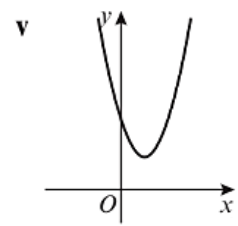
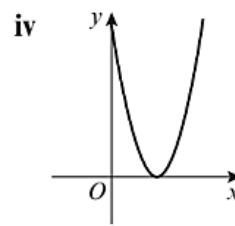
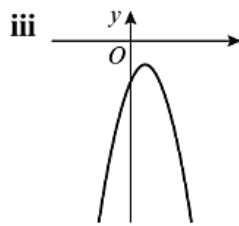
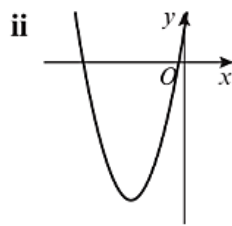
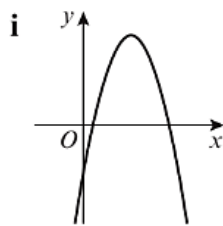
ii $g(x) = 2x^2 - 3x + 4$

iii $h(x) = -x^2 + 7x - 3$

iv $j(x) = x^2 - 8x + 16$

v $k(x) = 2x - 3x^2 - 4$

b Using your answers to part a, match the same five functions to these sketch graphs.



2 Find the values of k for which $x^2 + 6x + k = 0$ has two real solutions.

3 Find the value of t for which $2x^2 - 3x + t = 0$ has exactly one solution.

Challenge:

- Show that $x^2 + 2px + 2p^2$ is positive for all real values of x .

FT3: How do you find the equation of a straight line?

Resources:

Textbook (Pure Mathematics): pages 90 - 97

MathsWatch: Clip CG3 Gradient of a Line / Clip CG4 $y = mx + c$ / Clip CG5 Finding the Equation of a Straight Line

You need to make notes on:

- Calculating the gradient of a line joining two points
- The link between the equation of a line in the form $y = mx + c$, and its gradient and intercept.
- Finding the equation of a line given (i) the gradient and one point on the line or (ii) two points on the lines (this should be done without using $y = mx + c$ but an alternative).
- Be able to express the equation of a line in a number of two main forms.
- The relationship between parallel and perpendicular lines.

Key words to identify in your reading and record in your notes (highlight the ones you use):

Gradient, coordinates, change, straight line, vertical distance, horizontal distance, form, y-intercept, meets, intersects.

Exercise 5A - Q1(f,i,l,m,n), Q6 and Q7

- f** $(-12, 3), (-2, 8)$ **i** $(\frac{1}{4}, \frac{1}{2}), (\frac{1}{2}, \frac{2}{3})$ **l** $(0, 5a), (10a, 0)$
m $(3b, -2b), (7b, 2b)$ **n** $(p, p^2), (q, q^2)$

- 6** The line joining $(-3, -2)$ to $(2e, 5)$ has gradient 2. Work out the value of e .
7 The line joining $(7, 2)$ to $(f, 3f)$ has gradient 4. Work out the value of f .

Exercise 5B - Q6 and Q9

- 6** The line $5x - 4y + 20 = 0$ meets the y -axis at the point A and the x -axis at the point B . Work out the coordinates of A and B .
9 Show that the line with equation $ax + by + c = 0$ has gradient $-\frac{a}{b}$ and cuts the y -axis at $-\frac{c}{b}$

Exercise 5C - Q1(a,c,e) Q2(g,i)

- 1** Find the equation of the line with gradient m that passes through the point (x_1, y_1) when:
a $m = 2$ and $(x_1, y_1) = (2, 5)$
c $m = -1$ and $(x_1, y_1) = (3, -6)$
e $m = \frac{1}{2}$ and $(x_1, y_1) = (-4, 10)$
2 Find the equations of the lines that pass through these pairs of points:
g $(-1, -5)$ and $(-3, 3)$
i $(\frac{1}{3}, \frac{2}{5})$ and $(\frac{2}{3}, \frac{4}{5})$

Challenge:

- The lines $y = -4x + 1$ and $y = x + 5$ intersect at the point L . The point M has coordinates $(-3, 1)$. Find the equation of the line that passes through L and M .

FT4: How do you find linear factors of a polynomial?

Resources:

Textbook (Pure Mathematics): pages 143 - 145

MathsWatch: Clip P3 The Factor Theorem

You need to make notes on:

- The Factor Theorem
- Why the Factor Theorem is useful
- Steps on how to use it to factorise a cubic function.

Key words to identify in your reading and record in your notes (highlight the ones you use):

The Factor Theorem, linear, factors, polynomial, substitute, function, quadratic, cubic, factorise. Product, algebraic division, sketch, graph, positive, negative.

Exercise 7C - Q1, Q3, Q5 and Q6

1 Use the factor theorem to show that:

a $(x - 1)$ is a factor of $4x^3 - 3x^2 - 1$

b $(x + 3)$ is a factor of $5x^4 - 45x^2 - 6x - 18$

c $(x - 4)$ is a factor of $-3x^3 + 13x^2 - 6x + 8$.

3 Show that $(x + 1)$ is a factor of $x^3 + 3x^2 - 33x - 35$ and hence factorise the expression completely.

5 Show that $(x - 2)$ is a factor of $2x^3 + 3x^2 - 18x + 8$ and hence factorise the expression completely.

6 Each of these expressions has a factor $(x \pm p)$. Find a value of p and hence factorise the expression completely.

a $x^3 - 10x^2 + 19x + 30$

b $x^3 + x^2 - 4x - 4$

c $x^3 - 4x^2 - 11x + 30$

Challenge:

- A pyramid has a rectangular base. Its volume is given by $V = x^3 + 7x^2 + 14x + 8 \text{ cm}^3$.
(a) Work out the possible values for its dimensions. (b) What is the range of values of x ?
- A sphere, radius $(x + 5) \text{ cm}$, has a concentric sphere, radius $(x - 3) \text{ cm}$ removed. Use the identity $A^3 - B^3 \equiv (A^2 + AB + B^2)$ to work out the volume of the shell. Give the volume in expanded form.

FT5: How do you solve problems involving triangles?

Resources:

Textbook (Pure Mathematics): pages 174 - 186

MathsWatch: Clip TG1 Sine and Cosine Rules

You need to make notes on:

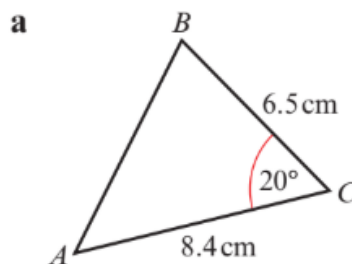
- Using the cosine rule to find missing angles and lengths
- Using the sine rule to find missing angles and lengths
- Explain and exemplify the ambiguous case for sine rule
- Finding the area of a triangle using an appropriate formula

Key words to identify in your reading and record in your notes (highlight the ones you use):

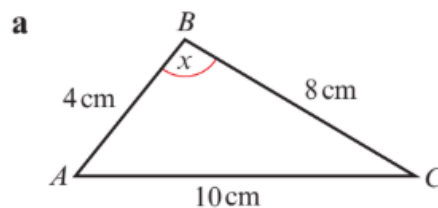
Trigonometry, dimensions, length, side, triangle, angle, bearing, distance, sine, cosine, area, expression, inverse, significant figure.

Exercise 9A - Q1a, Q2a, Q4, Q10, Q14

- 1 Calculate the length of the missing side.



- 2 Calculate the size of the angle marked x :



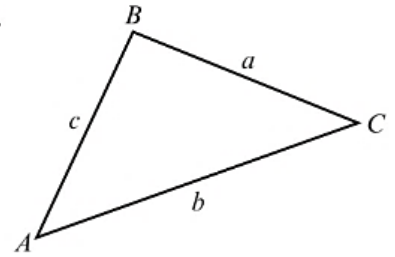
- 4 From a point A a boat sails due north for 7 km to B . The boat leaves B and moves on a bearing of 100° for 10 km until it reaches C . Calculate the distance of C from A .
- 10 In $\triangle ABC$, $AB = 9.3\text{ cm}$, $BC = 6.2\text{ cm}$ and $AC = 12.7\text{ cm}$. Calculate the size of the largest angle.
- 14 In $\triangle ABC$, $AB = (5 - x)\text{ cm}$, $BC = (4 + x)\text{ cm}$, $\angle ABC = 120^\circ$ and $AC = y\text{ cm}$.
- Show that $y^2 = x^2 - x + 61$.
 - Use the method of completing the square to find the minimum value of y^2 , and give the value of x for which this occurs.

Exercise 9B - Q1a-d, Q2(a-b), Q4(a-e), Q7(a-e)

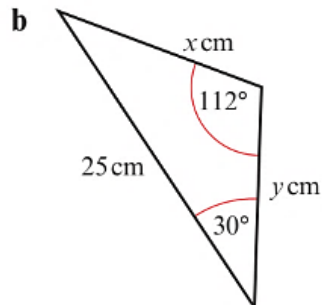
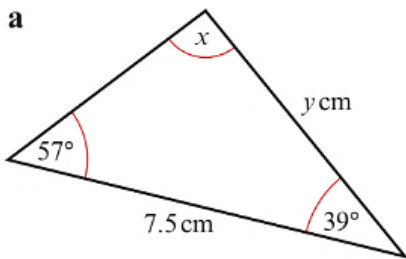
Give answers to 3 significant figures, where appropriate.

1 In each of parts a to d, the given values refer to the general triangle.

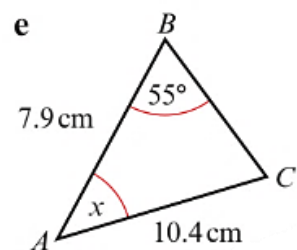
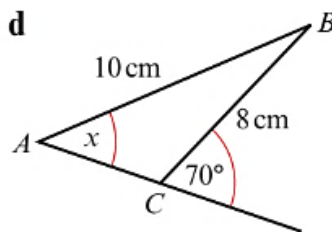
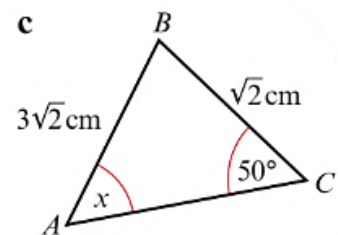
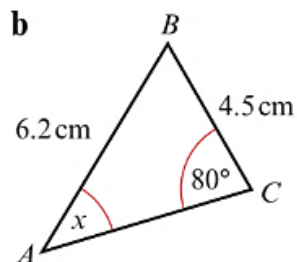
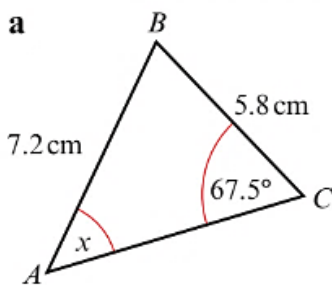
- a Given that $a = 8$ cm, $A = 30^\circ$, $B = 72^\circ$, find b .
- b Given that $a = 24$ cm, $A = 110^\circ$, $C = 22^\circ$, find c .
- c Given that $b = 14.7$ cm, $A = 30^\circ$, $C = 95^\circ$, find a .
- d Given that $c = 9.8$ cm, $B = 68.4^\circ$, $C = 83.7^\circ$, find a .



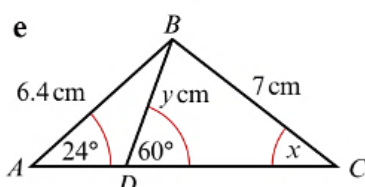
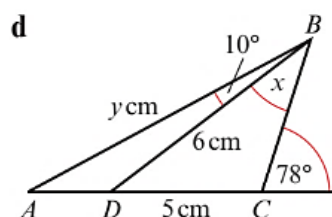
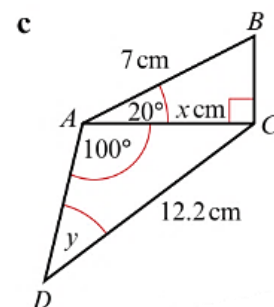
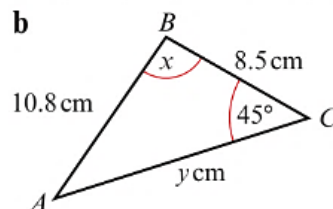
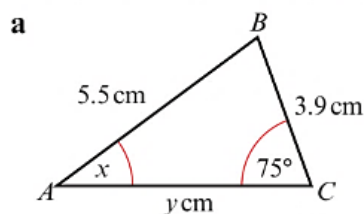
2 In each of the following triangles calculate the values of x and y .



4 In each of the diagrams shown below, work out the size of angle x .

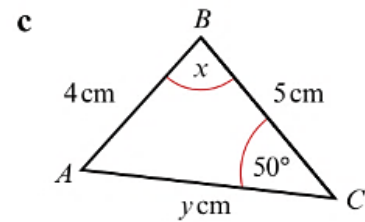
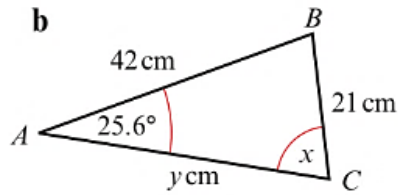
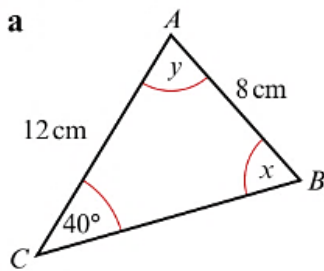


7 In each of the following diagrams work out the values of x and y .



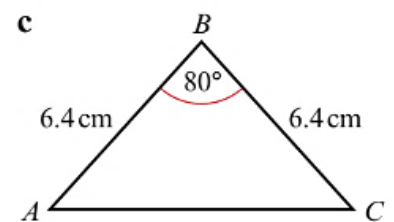
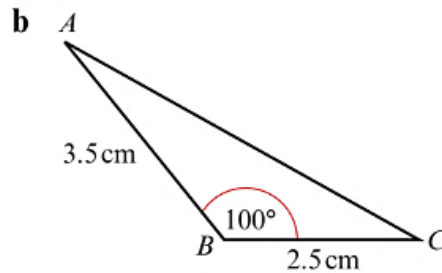
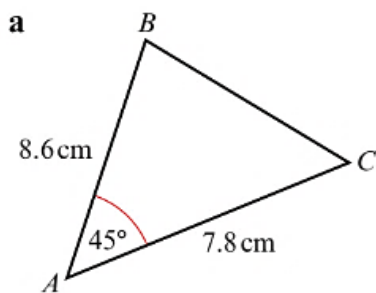
Exercise 9C - Q2

2 In each of the diagrams shown below, calculate the possible values of x and the corresponding values of y .

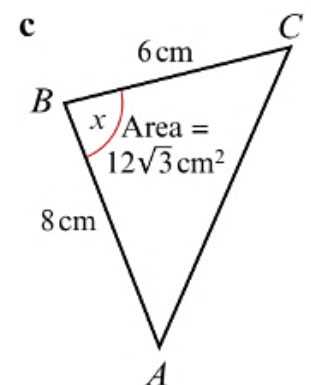
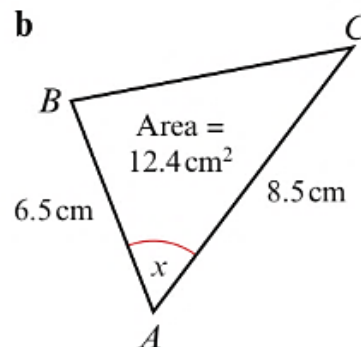
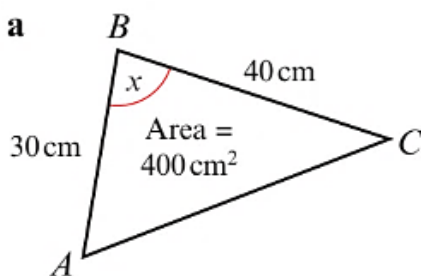


Exercise 9D Q1 and Q2

1 Calculate the area of each triangle.



2 Work out the possible sizes of x in the following triangles.



Challenge:

- In $\triangle XYZ$, $x = n^2 - 1$, $y = n^2 - n + 1$, $z = n^2 - 2n$

Prove that angle $Y = 60^\circ$

FT10: What do you need to know about data collection?

Resources:

Textbook (Statistics and Mechanics): pages 2 - 8

You need to make notes on:

- Understanding the meaning of 'population', 'sample' and 'census'
- Commenting on the advantages and disadvantages of each of the above
- Understanding the simple random sampling, systematic sampling, stratified sampling, quota sampling and opportunity sampling.
- Commenting on the advantages and disadvantages of each of the above

Key words to identify in your reading and record in your notes (highlight the ones you use):

Populations, samples, statistics, items, raw data, census, observes, measures, member, selection, observations, subset, whole, accurate, result, time consuming, expensive, process, destroys, quantity, data, individual units, sampling frame, sampling units, representative, bias, simple random sample, lottery, equal chance, systematic sampling, stratified sampling, mutually exclusive, strata, stratum, datum.

Exercise 1A - Q1, Q2, Q3, Q4 and Q5

- 1 A school uses a census to investigate the dietary requirements of its students.
 - a Explain what is meant by a census.
 - b Give one advantage and one disadvantage to the school of using a census.
- 2 A factory makes safety harnesses for climbers and has an order to supply 3000 harnesses. The buyer wishes to know that the load at which the harness breaks exceeds a certain figure.
 - a Suggest a reason why a census would not be used for this purpose.

The factory tests four harnesses and the load for breaking is recorded:

320 kg	260 kg	240 kg	180 kg
--------	--------	--------	--------
 - b The factory claims that the harnesses are safe for loads up to 250 kg. Use the sample data to comment on this claim.
 - c Suggest one way in which the company can improve their prediction.

- 3** A city council wants to know what people think about its recycling centre. The council decides to carry out a sample survey to learn the opinion of residents.
- Write down one reason why the council should not take a census.
 - Suggest a suitable sampling frame.
 - Identify the sampling units.
- 4** A manufacturer of microswitches is testing the reliability of its switches. It uses a special machine to switch them on and off until they break.
- Give one reason why the manufacturer should use a sample rather than a census.
- The company tests a sample of 5 switches, and obtains the following results:
- 23 150 25 071 19 480 22 921 7455
- The company claims that its switches can be operated an average of 20 000 times without breaking. Use the sample data above to comment on this claim.
 - Suggest one way the company could improve its prediction.
- 5** A manager of a garage wants to know what their mechanics think about a new pension scheme designed for them. The manager decides to ask all the mechanics in the garage.
- Describe the population the manager will use.
 - Write down the main advantage in asking all of their mechanics.

Exercise 1B - Q1, Q2, Q3, Q4, Q5 and Q6

- 1 a** The head teacher of an infant school wishes to take a stratified sample of 20% of the pupils at the school. The school has the following numbers of pupils.

Year 1	Year 2	Year 3
40	60	80

Work out how many pupils in each age group will be in the sample.

- Describe one benefit to the head teacher of using a stratified sample.
- 2** A survey is carried out on 100 members of the adult population of a city suburb. The population of the suburb is 2000. An alphabetical list of the inhabitants of the suburb is available.
- Explain one limitation of using a systematic sample in this situation.
 - Describe a sampling method that would be free of bias for this survey.
- 3** A gym wants to take a sample of its members. Each member has a 5-digit membership number, and the gym selects every member with a membership number ending 000.
- Is this a systematic sample? Give a reason for your answer.
 - Suggest one way of improving the reliability of this sample.

- 4** A head of sixth form wants to get the opinion of year 12 and year 13 students about the facilities available in the common room. The table shows the numbers of students in each year.

	Year 12	Year 13
Male	70	50
Female	85	75

- a** Suggest a suitable sampling method that might be used to take a sample of 40 students.
- b** How many students from each gender in each of the two years should the head of sixth form ask?
- 5** A factory manager wants to get information about the ways their workers travel to work. There are 480 workers in the factory, and each has a clocking-in number. The numbers go from 1 to 480. Explain how the manager could take a systematic sample of size 30 from these workers.
- 6** The director of a sports club wants to take a sample of members. The members each have a unique membership number. There are 121 members who play cricket, 145 members who play hockey and 104 members who play squash. No members play more than one sport.
- a** Explain how the director could take a simple random sample of 30 members and state one disadvantage of this sampling method.
- The director decides to take a stratified sample of 30 members.
- b** State one advantage of this method of sampling.
- c** Work out the number of members who play each sport that the director should select for the sample.

Exercise 1C - Q1, Q2, Q3, Q4, Q5 and Q6.

- 1** Interviewers in a shopping centre collect information on the spending habits from a total of 40 shoppers.
- a** Explain how they could collect the information using:
- i** quota sampling **ii** opportunity sampling
- b** Which method is likely to lead to a more representative sample?
- 2** Describe the similarities and differences between quota sampling and stratified random sampling.
- 3** An interviewer asks the first 50 people he sees outside a fish and chip shop on a Friday evening about their eating habits.
- a** What type of sampling method did he use?
- b** Explain why the sampling method may not be representative.
- c** Suggest two improvements he could make to his data collection technique.
- 4** A researcher is collecting data on the radio-listening habits of people in a local town. She asks the first 5 people she sees on Monday morning entering a supermarket. The number of hours per week each person listens is given below:
- 4 7 6 8 2
- a** Use the sample data to work out a prediction for the average number of hours listened per week for the town as a whole.
- b** Describe the sampling method used and comment on the reliability of the data.
- c** Suggest two improvements to the method used.
- 5** In a research study on the masses of wild deer in a particular habitat, scientists catch the first 5 male deer they find and the first 5 female deer they find.
- a** What type of sampling method are they using?
- b** Give one advantage of this method.
- The masses of the sampled deer are listed below.

Male (kg)	75	80	90	85	82
Female (kg)	67	72	75	68	65

- c** Use the sample data to compare the masses of male and female wild deer.
- d** Suggest two improvements the scientists could make to the sampling method.
- 6** The heights, in metres, of 20 ostriches are listed below:
- 1.8, 1.9, 2.3, 1.7, 2.1, 2.0, 2.5, 2.7, 2.5, 2.6, 2.3, 2.2, 2.4, 2.3, 2.2, 2.5, 1.9, 2.0, 2.2, 2.5
- a** Take an opportunity sample of size five from the data.
- b** Starting from the second data value, take a systematic sample of size five from the data.
- c** Calculate the mean height for each sample.
- d** State, with reasons, which sampling method is likely to be more reliable.

FT11: What is an outlier?

Resources:

Textbook (Statistics and Mechanics): pages 41 - 45

You need to make notes on:

- Identifying outliers in data sets
- Identifying anomalies in data
- How to clean data
- How to draw boxplots including outliers
- Choice of where to plot max/min value when an outlier is present
- Comparing distributions

Key words to identify in your reading and record in your notes (highlight the ones you use):

Outlier, extreme value, overall pattern, data, process, removing, anomalies, cleaning, significant, error, quartiles, maximum, minimum.

Exercise 3A - Q1, Q2, Q3 and Q4.

- 1 Some data is collected. $Q_1 = 46$ and $Q_3 = 68$.

A value greater than $Q_3 + 1.5 \times (Q_3 - Q_1)$ or smaller than $Q_1 - 1.5 \times (Q_3 - Q_1)$ is defined as an outlier.

Work out whether the following are outliers using this rule:

- a 7 b 88 c 105

- 2 The masses of male and female turtles are given in grams. For males, the lower quartile was 400 g and the upper quartile was 580 g. For females, the lower quartile was 260 g and the upper quartile was 340 g.

An outlier is an observation that falls either $1 \times$ (interquartile range) above the upper quartile or $1 \times$ (interquartile range) below the lower quartile.

- a Which of these male turtle masses would be outliers?

400 g 260 g 550 g 640 g

- b Which of these female turtle masses would be outliers?

170 g 300 g 340 g 440 g

- c What is the largest mass a male turtle can be without being an outlier?

- 3 The masses of arctic foxes are found and the mean mass was 6.1 kg. The variance was 4.2.

An outlier is an observation which lies ± 2 standard deviations from the mean.

- a Which of these arctic fox masses are outliers?

2.4 kg 10.1 kg 3.7 kg 11.5 kg

- b What are the smallest and largest masses that an arctic fox can be without being an outlier?

- 4 The ages of nine people at a children's birthday party are recorded. $\Sigma x = 92$ and $\Sigma x^2 = 1428$.
- Calculate the mean and standard deviation of the ages.
- An outlier is an observation which lies ± 2 standard deviations from the mean.
- One of the ages is recorded as 30.
- State, with a reason, whether this is an outlier.
 - Suggest a reason why this age could be a legitimate data value.
 - Given that all nine people were children, clean the data and recalculate the mean and standard deviation.

Exercise 3B - Q1, Q2, Q3 and Q4.

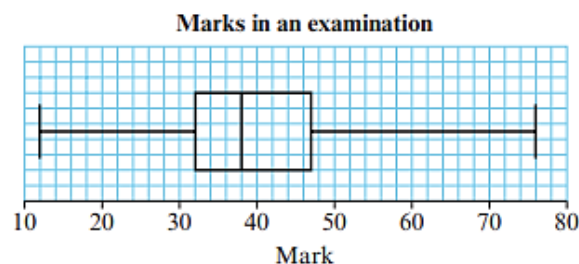
- 1 A group of students did a test. The summary data is shown in the table.

Lowest value	Lower quartile	Median	Upper quartile	Highest value
5	21	28	36	58

Given that there were no outliers, draw a box plot to illustrate this data.

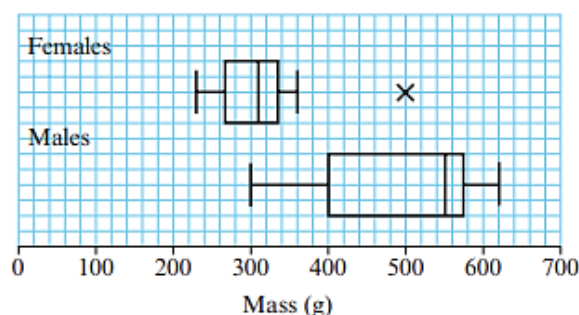
- 2 Here is a box plot of marks in an examination.

- Write down the upper and lower quartiles.
- Write down the median.
- Work out the interquartile range.
- Work out the range.



- 3 The masses of male and female turtles are given in grams. Their masses are summarised in the box plots.

- Compare and contrast the masses of the male and female turtles.
- A turtle was found to have a mass of 330 grams. State whether it is likely to be a male or a female. Give a reason for your answer.
- Write down the size of the largest female turtle.



- 4 Data for the maximum daily gust (in knots) in Camborne in September 1987 is taken from the large data set:

13	17	19	20	21
21	22	23	24	25
25	25	26	26	26
27	29	30	30	30
33	35	38	46	78

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- Calculate Q_1 , Q_2 and Q_3 .

An outlier is defined as a value which lies either $1.5 \times$ the interquartile range above the upper quartile or $1.5 \times$ the interquartile range below the lower quartile.

- Show that 46 and 78 are outliers.
- Draw a box plot for this data.

Challenge:

- A biologist recorded the heights, x cm, of 20 plant seedlings. She calculated the mean and standard deviation of her results:

$$\bar{x} = 3.8\text{cm} \quad \sigma = \frac{167}{15} \text{ cm } (\approx 11.13\text{cm})$$

The biologist subsequently discovered she had written down two values incorrectly. For one value she replaced a value of 2.3cm with a value of 3.2cm. For another value she has written 17.8cm which she knows is impossible.

An outlier is defined as an observation $\pm 2\sigma$ from the mean. By cleansing and correcting the data first, calculate the new mean and standard deviation of her data.

Answers - Pure

Exercise 2A

- 3 **a** $x = \frac{1}{3}$ or $x = -2$ **b** $x = 3$ or $x = 0$
 c $x = 13$ or $x = 1$ **d** $x = 2$ or $x = -2$
 e $x = \pm\sqrt{\frac{5}{3}}$ **f** $x = 3 \pm \sqrt{13}$
 g $x = \frac{1 \pm \sqrt{11}}{3}$ **h** $x = 1$ or $x = -\frac{7}{6}$
 i $x = -\frac{1}{2}$ or $x = \frac{7}{3}$ **j** $x = 0$ or $x = -\frac{11}{6}$

Exercise 2B

- 2 **a** $x = -0.586$ or $x = -3.41$ **b** $x = 7.87$ or $x = 0.127$
 c $x = 0.765$ or $x = -11.8$ **d** $x = 8.91$ or $x = -1.91$
 e $x = 0.105$ or $x = -1.90$ **f** $x = 3.84$ or $x = -2.34$
 g $x = 4.77$ or $x = 0.558$ **h** $x = 4.89$ or $x = -1.23$

Exercise 2C

- 1 **a** $(x + 2)^2 - 4$ **b** $(x - 3)^2 - 9$
 c $(x - 8)^2 - 64$ **d** $(x + \frac{1}{2})^2 - \frac{1}{4}$
 e $(x - 7)^2 - 49$
2 **a** $2(x + 4)^2 - 32$ **b** $3(x - 4)^2 - 48$
 c $5(x + 2)^2 - 20$ **d** $2(x - \frac{5}{4})^2 - \frac{25}{8}$
 e $-2(x - 2)^2 + 8$
3 **a** $2(x + 2)^2 - 7$ **b** $5(x - \frac{3}{2})^2 - \frac{33}{4}$
 c $3(x + \frac{1}{3})^2 - \frac{4}{3}$ **d** $-4(x + 2)^2 + 26$
 e $-8(x - \frac{1}{8})^2 + \frac{81}{8}$

Exercise 2G

- 1 **a** **i** 52 **ii** -23 **iii** 37
 iv 0 **v** -44
 b **i** $h(x)$ **ii** $f(x)$ **iii** $k(x)$
 iv $j(x)$ **v** $g(x)$
2 $k < 9$
3 $t = \frac{9}{8}$

Exercise 5A

- 1 **a** $\frac{1}{2}$ **b** $\frac{1}{6}$ **c** $-\frac{3}{5}$ **d** 2
 e -1 **f** $\frac{1}{2}$ **g** $\frac{1}{2}$ **h** 8
 i $\frac{2}{3}$ **j** -4 **k** $-\frac{1}{3}$ **l** $-\frac{1}{2}$
 m 1 **n** $\frac{q^2 - p^2}{q - p} = q + p$
- 6 $\frac{1}{4}$
7 26

Exercise 5B

- 6 (0, 5), (-4, 0)
9 $ax + by + c = 0$
 $by = -ax - c$
 $y = \left(-\frac{a}{b}\right)x - \left(\frac{c}{b}\right)$

Exercise 5C

- 1 **a** $y = 2x + 1$ **b** $y = 3x + 7$ **c** $y = -x - 3$
 d $y = -4x - 11$ **e** $y = \frac{1}{2}x + 12$ **f** $y = -\frac{2}{3}x - 5$
 g $y = 2x$ **h** $y = -\frac{1}{2}x + 2b$
- 2 **a** $y = 4x - 4$ **b** $y = x + 2$ **c** $y = 2x + 4$
 d $y = 4x - 23$ **e** $y = x - 4$ **f** $y = \frac{1}{2}x + 1$
 g $y = -4x - 9$ **h** $y = -8x - 33$ **i** $y = \frac{6}{5}x$
 j $y = \frac{2}{7}x + \frac{5}{14}$

Exercise 7C

- 1 **a** $f(1) = 0$ **b** $f(-3) = 0$ **c** $f(4) = 0$
- 3 $(x + 1)(x + 7)(x - 5)$
- 5 $(x - 2)(2x - 1)(x + 4)$
- 6 **a** $(x + 1)(x - 5)(x - 6)$ **b** $(x - 2)(x + 1)(x + 2)$
 c $(x - 5)(x + 3)(x - 2)$

Exercise 9A

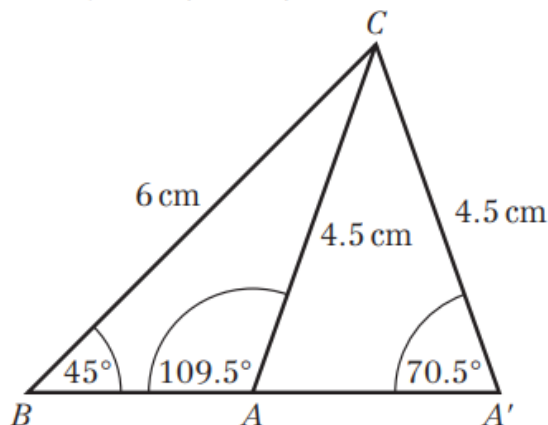
- 1 **a** 3.19 cm **b** 1.73 cm ($\sqrt{3}$ cm) **c** 9.85 cm
 d 4.31 cm **e** 6.84 cm **f** 9.80 cm
- 2 **a** $108(.2)^\circ$ **b** 90° **c** 60°
 d 52.6° **e** 137° **f** 72.2°
- 4 11.2 km
- 10 $ABC = 108(.4)^\circ$
- 14 **a** $y^2 = (5 - x)^2 + (4 + x)^2 - 2(5 - x)(4 + x) \cos 120^\circ$
 $= 25 - 10x + x^2 + 16 + 8x + x^2 - 2(20 + x - x^2) \left(-\frac{1}{2}\right)$
 $= x^2 - x + 61$
 b Minimum $AC^2 = 60.75$; it occurs for $x = \frac{1}{2}$

Exercise 9B

- 1 a 15.2 cm b 9.57 cm c 8.97 cm d 4.61 cm
- 2 a $x = 84^\circ, y = 6.32$
b $x = 13.5, y = 16.6$
c $x = 85^\circ, y = 13.9$
d $x = 80^\circ, y = 6.22$ (isosceles triangle)
e $x = 6.27, y = 7.16$
f $x = 4.49, y = 7.49$ (right-angled)
- 3 a 36.4° b 35.8° c 40.5° d 130°
- 4 a 48.1° b 45.6° c 14.8° d 48.7°
e 86.5° f 77.4°
- 5 a 1.41 cm ($\sqrt{2}$ cm) b 1.93 cm
- 6 $QPR = 50.6^\circ, PQR = 54.4^\circ$
- 7 a $x = 43.2^\circ, y = 5.02$ cm b $x = 101^\circ, y = 15.0$ cm
c $x = 6.58$ cm, $y = 32.1^\circ$ d $x = 54.6^\circ, y = 10.3$ cm
e $x = 21.8^\circ, y = 3.01$ f $x = 45.9^\circ, y = 3.87^\circ$

Exercise 9C

- 1 a $70.5^\circ, 109^\circ$ (109.5°)
b



- 2 a $x = 74.6^\circ, y = 65.4^\circ$
 $x = 105^\circ, y = 34.6^\circ$
b $x = 59.8^\circ, y = 48.4$ cm
 $x = 120^\circ, y = 27.3$ cm
c $x = 56.8^\circ, y = 4.37$ cm
 $x = 23.2^\circ, y = 2.06$ cm

Exercise 9D

- 1 a 23.7 cm^2 b 4.31 cm^2 c 20.2 cm^2
- 2 a $x = 41.8^\circ$ or $138(.2)^\circ$
b $x = 26.7^\circ$ or $153(.3)^\circ$
c $x = 60^\circ$ or 120°

Answers – Applied

Exercise 1A

- 1 **a** A census observes or measures every member of a population.
b Advantage: will give a completely accurate result.
Disadvantage: ANY ONE FROM: time consuming, expensive.
- 2 **a** The testing process will destroy the harness, so a census would destroy *all* the harnesses.
b 250 kg is the median load at which the harnesses in the sample break. This means that half of the harnesses will break at a load less than 250 kg.
c Test a larger number of harnesses.
- 3 **a** ANY ONE FROM:
It would be expensive.
It would be time consuming.
It would be difficult.
b A list of residents. **c** A resident.
- 4 **a** The testing process will destroy the microswitches, so a census would destroy *all* the switches.
b The mean is less than the stated average but one of the switches lasted a significantly lower number of operations which suggests the median might be a better average to take – not affected by outliers. The data supports the company claim.
c Test a larger number of microswitches.
- 5 **a** All the mechanics in the garage.
b Everyone's views will be known.

Exercise 1B

- 1
 - a Year 1: 8, Year 2: 12, Year 3: 16
 - b ANY ONE FROM: sample accurately reflects the population structure of the school; guarantees proportional representation of different year groups in the sample.
- 2
 - a Patterns in the sample data might occur when taking every 20th person.
 - b A simple random sample using the alphabetical list as the sampling frame.
- 3
 - a No: A systematic sample requires the first selected person to be chosen at random.
 - b Take a simple random sample using the list of members as the sampling frame.
- 4
 - a Stratified sampling.
 - b Male Y12: 10, Male Y13: 7, Female Y12: 12, Female Y13: 11
- 5 $k = \frac{480}{30} = 16$
Randomly select a number between 1 and 16. Starting with the worker with this clocking-in number, select the workers that have every 16th clocking-in number after this.
- 6
 - a Any method in which every member of the population has an equal chance of being selected, e.g. lottery. Disadvantage: the sample may not accurately reflect the proportions of members at the club who play each sport.
 - b The sample will have proportional representation of the members who play the different sports.
 - c Cricket: 10, Hockey: 12, Squash: 8

Exercise 1C

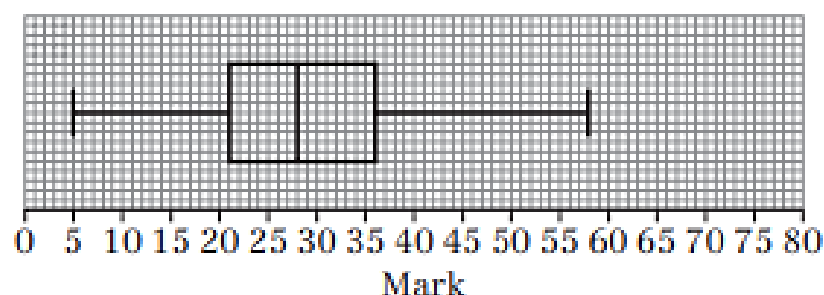
- 1 a i Divide the population into groups according to given characteristics. The size of each group determines the proportion of the sample that should have that characteristic. The interviewer assesses which group people fall into as part of the interview. Once a quota has been filled, no more people in that group are interviewed.
ii Opportunity sampling consists of taking the sample from the people who are available at the time the study is carried out, e.g. the first 40 shoppers who are available to be interviewed.
b Quota sampling.
- 2 Similarities: The population is divided according to the characteristics of the whole population (into strata for stratified sampling, and groups for quota sampling)
Differences: Stratified sampling uses random sampling whereas quota sampling does not.
- 3 a Opportunity sampling
b Sample is likely to be biased towards people who eat fish and chips on a Friday.
c Survey people at different times of day. Survey people in other parts of the town, not outside the fish and chip shop.
- 4 a 5.4 hours
b Opportunity sampling; unlikely to provide a representative sample of the town as a whole
c Increase the number of people asked. Ask people at different times/in different locations.
- 5 a Quota sampling.
b ANY ONE FROM: no sampling frame required, quick, easy, inexpensive, allows for comparison between male and female deer.
c Males are on average heavier and have a greater spread.
d Increase the sample size. Catch deer at random times during the day.
- 6 a Student's opportunity sample: For example, first five values
b 1.9, 2.0, 2.6, 2.3, 2.0
c 1.96 m, 2.16 m
d Systematic sample – is random and likely to be more representative. Opportunity sample might get all the small values, for example.

Exercise 3A

- 1 **a** 7 is an outlier **b** 88 is not an outlier
c 105 is an outlier
- 2 **a** No outliers **b** 170 g and 440 g
c 760 g
- 3 **a** 11.5 kg
b Smallest 2.0 kg, largest 10.2 kg
- 4 **a** Mean 10.2, standard deviation 7.36
b It is an outlier as it is more than 2 standard deviations above the mean.
c e.g. It could be the age of a parent at the party.
d Mean 7.75, standard deviation 2.44

Exercise 3B

- 1 Marks in a test



- 2 **a** 47, 32 **b** 38 **c** 15 **d** 64
- 3 **a** The male turtles have a higher median mass, a greater interquartile range and a greater total range.
b It is more likely to have been female. Very few of the male turtles had a mass this low, but more than a quarter of the female turtles had a mass of more than this.
c 500 g
- 4 **a** $Q_1 = 22$ knots, $Q_2 = 26$ knots, $Q_3 = 30$ knots
b $IQR = 8$
 $1.5 \times IQR$ above $Q_3 = 42$
 $46 > 42$ and $78 > 42$, so 46 and 78 are outliers.
c Maximum daily gust in Camborne, September 1987

