

Armadale Academy

National 5 Mathematics



S4 Prelim

Revision Booklet

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Rounding to Significant Figures

1. Round the following to 1 significant figure:

- (a) 2.9 (b) 3.2 (c) 5.7 (d) 46.81 (e) 57.25 (f) 80.96 (g) 94.9

2. Round the following to 2 significant figures:

- (a) 844 (b) 665 (c) 129 (d) 2840 (e) 9250 (f) 1359 (g) 298

3. Round the following to 3 significant figures:

- (a) 9433 (b) 1891 (c) 2496 (d) 3.226 (e) 37756 (f) 57147 (g) 7.0078



Rounding to
Significant Figures

Percentages (Compound Interest, Appreciation, Depreciation)

Compound Interest

Question 1: Paul leaves £4000 in the bank for two years.



It earns compound interest of 5% per year.

Calculate the total amount Paul has in the bank at the end of the two years.

Question 2: The population of birds on an island is estimated to increase by 10% every year.



The population of birds on the island is 20000.

Calculate an estimate for the population of birds in three years time.

Question 3: The value of a car decreases by 5% each year.



Sophie bought a car two years ago for £10000

Work out the value now.

Question 4: Sam invests £1800 in the bank for four years.



It earns compound interest of 4% each year.

Calculate the total amount Sam has in the bank at the end of four years.



Question 5: A full water tank holds 500 litres.



The tank begins to leak water and is losing 14% of its contents every hour.

Find how much water is left in the tank after 8 hours.

Question 6: The height of a tree increases by 60% each year.



When planted the tree was 40cm tall.

How tall will the tree be in 5 years time.

Question 7: Carrie invests £800 for 4 years at 3% interest per year.



How much interest does she earn?

Question 8: A house was bought for £100,000





Its value appreciates by 7.5% each year for the first three years.



What was its value at the end of the three years?





Calculating
Compound
Interest %



Question 9:  The number of people living on a remote island decreases by 9% every 10 years. In 1950 there were 18000 living on the island. Calculate how many less people will be living on the island in 2020.

Question 10:  A car was bought for £20,000. Its value depreciates by 31% each year for the first four years. What is its values at the end of the four years?


Question 11:  A tree is 80cm when planted. Each year the height of the tree increases by 22%. After how many complete years will the height of tree be at least 3m? 


Question 12:  The number of polar bears in a region is decreasing by 5% per year. There are 3000 polar bears in the region in 2017. What year will be the first year with less than 1000 polar bears in the region?


Question 13:  Michael has started working for a company on a salary of £15000. Each year he will be given a 6% pay rise. How many years will it take for Michael's salary to exceed £30000?


Question 14:  The value of a car decreases by 7.2% each year. When bought the car cost £6200. How many years will it take the car to have a value less than £1000? 

Reverse Percentages

Question 1:  20% of all the children in a class are left handed. 4 children are left handed. How many children are there in the class altogether?


Question 2:  30% of the members of a tennis club are pensioners. 36 members are pensioners.
(a) How many members are there in total?
(b) How many members are not pensioners?


Question 3:  A group of people sit their driving theory test and 24 people passed. 80% of the people passed the driving theory test. How many people sat the test altogether?


Question 4:  An energy bar contains 2.1g of protein. 6% of the bar is protein. What is the total mass of the bar?




Reverse Percentages

Question 5: Swansea is a city in Wales.
 The population of Swansea is 240,000
 This population is 7.5% of the total population of Wales.
 What is the total population of Wales?

Question 6: Heather invested money into a savers bank account.
 Each year the money in the account earns 10% interest.
 After one year, the total amount of money in the account was £2200
 How much did Heather invest?

Question 7: A chair is on sale at a price of £20.80
 This is a 20% reduction of the normal price.
 What was the price of the chair before the reduction?

Question 8: The population of an island has decreased by 40% over 50 years.
 The population in 2018 was 360
 What was the population in 1968?

Fractions

1. Simplify fully:

(a) $\frac{14}{35}$ (b) $\frac{8}{64}$ (c) $\frac{18}{24}$ (d) $\frac{75}{100}$ (e) $\frac{24}{80}$ (f) $\frac{6}{42}$

(g) $\frac{36}{66}$ (h) $\frac{18}{45}$ (i) $\frac{70}{120}$ (j) $\frac{49}{56}$ (k) $\frac{22}{110}$ (l) $\frac{18}{72}$

(m) $\frac{60}{140}$ (n) $\frac{45}{135}$ (o) $\frac{40}{360}$ (p) $\frac{64}{100}$ (q) $\frac{85}{35}$ (r) $\frac{48}{36}$



Simplifying Fractions

2. Calculate the following, simplify your answers where possible:

(a) $1\frac{1}{2} + \frac{2}{3}$ (b) $\frac{7}{9} + 1\frac{1}{3}$ (c) $1\frac{3}{5} - \frac{3}{4}$ (d) $1\frac{5}{8} - 1\frac{1}{4}$

(e) $2\frac{1}{2} + 1\frac{1}{3}$ (f) $2\frac{2}{9} - 1\frac{1}{3}$ (g) $2\frac{2}{9} + \frac{5}{6}$ (h) $1\frac{5}{12} + 1\frac{5}{8}$

(i) $3\frac{1}{10} + 2\frac{2}{3}$ (j) $1\frac{8}{9} - \frac{4}{7}$ (k) $3\frac{2}{3} - 1\frac{11}{20}$ (l) $4\frac{8}{15} + 3\frac{1}{3}$



Adding and Subtracting Fractions

3. Calculate the following, simplify your answers where possible:

(a) $1\frac{2}{3} \times \frac{1}{4}$ (b) $\frac{2}{5} \times 1\frac{1}{4}$ (c) $\frac{3}{4} \times 1\frac{1}{2}$ (d) $2\frac{1}{2} \times \frac{7}{10}$

(e) $\frac{1}{4} \times 3\frac{1}{3}$ (f) $1\frac{2}{3} \times 1\frac{1}{4}$ (g) $4\frac{3}{5} \times 1\frac{2}{3}$ (h) $1\frac{2}{11} \times \frac{8}{9}$



Multiplying Fractions

4. Calculate the following, simplify your answers where possible:

(a) $\frac{2}{3} \div 1\frac{4}{5}$ (b) $1\frac{1}{2} \div 1\frac{9}{10}$ (c) $2\frac{3}{7} \div \frac{1}{2}$ (d) $2\frac{1}{3} \div 5\frac{1}{2}$
 (e) $3 \div 2\frac{1}{8}$ (f) $4\frac{1}{3} \div 2\frac{9}{10}$ (g) $6\frac{5}{6} \div 2$ (h) $1\frac{5}{12} \div 2\frac{2}{11}$



Dividing Fractions

Median and Interquartile Range

Find the median and IQR:

- 2, 4, 5, 7, 9, 10, 12
- 13, 14, 14, 15, 15, 18, 21
- 11, 18, 12, 15, 12, 23, 25, 21, 20
- 1, 7, 2, 11, 9, 3, 1, 6, 10, 7, 8
- 53, 52, 34, 25, 57, 44, 58, 37, 54
- 51, 48, 50, 54, 37, 33



Median and IQR

APPLYING QUESTION

The time taken, in minutes, for members of a new running club to complete a 5km run is shown:

34	42	28	45	36	40
48	23	30	39	38	26



- (a) Calculate the median and the interquartile range.

After 6 months training the median time was 29 minutes and the interquartile range was 17.

- (b) Make **two** valid statements to compare the performance before and after training.

Mean and Standard Deviation

Calculate the mean and standard deviation of each:

- 14, 17, 15, 23, 20, 19
- 8, 13, 7, 6, 8, 9, 5
- 1.8, 3.7, 4, 2.6, 5.9
- 102, 108, 112, 109, 110, 107
- 47, 56, 61, 52, 59
- 1, 2, 4, 1, 3, 2, 1

Formulae

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Or

$$= \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n - 1}}$$



Mean and Standard Deviation

APPLYING QUESTION



The prices, in pence, at five petrol stations around Airdrie for a litre of unleaded are:

121 119 120 117 118

- Calculate the mean and standard deviation.
- Why do you think the standard deviation must be so low?
- If each petrol station had to put their price up by 4 pence what effect would it have on the mean and standard deviation?



Algebra - Expanding Brackets

A) Expand and Simplify:

- $3(x - 3) + 2(x - 5)$
- $-7(2t - 3w) - 11(t - 1)$
- $(x + 4)(x + 6)$
- $(x - 8)(x - 7)$
- $(3x + 4)(2x - 1)$
- $(5x - 3)(x - 2)$



B) Expand and simplify:

- $(x + 3)(x^2 + 2x + 1)$
- $(x + 2)(3x^2 + 5x - 1)$
- $(2x + 1)(x^2 - 3x + 4)$
- $(x - 2)(x^2 + 5x + 2)$
- $(x - 5)(x^2 - 3x - 10)$
- $(2x + 3)(x^2 - 4x + 3)$

Volume

Formulae

Volume of a sphere

$$V = \frac{4}{3}\pi r^3$$

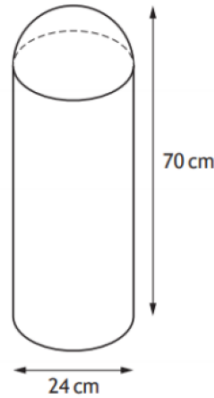
Volume of a cone

$$V = \frac{1}{3}\pi r^2 h$$

Volume of a pyramid

$$V = \frac{1}{3}Ah$$

1. A traffic bollard is in the shape of a cylinder with a hemisphere on top. The bollard has
- diameter 24 centimetres
 - height 70 centimetres.



Volume of Cylinder



Volume of Cone



Volume of Pyramid



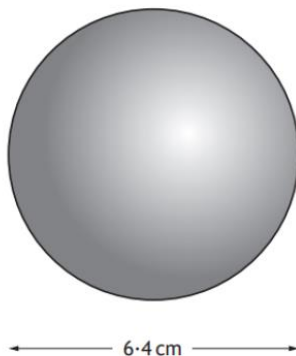
Volume of Sphere



Composite Volume

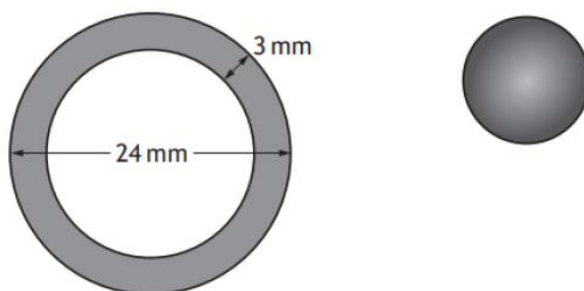
Calculate the volume of the bollard.
Give your answer correct to 3 significant figures.

2. A toy company makes juggling balls in the shape of a sphere with a diameter of 6.4 centimetres.



Calculate the volume of one juggling ball.
Give your answer correct to 2 significant figures.

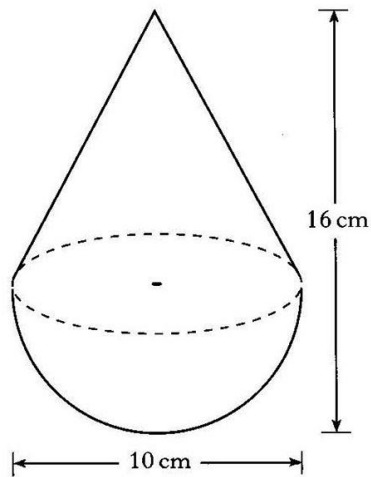
3. A spherical sweet is made by coating a caramel sphere evenly with chocolate. A cross-section of the sweet is shown below.



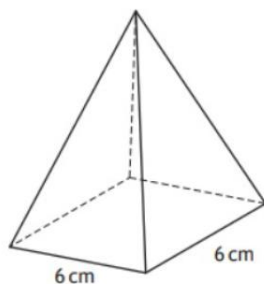
The diameter of the sweet is 24 millimetres and the thickness of the chocolate coating is 3 millimetres.

Calculate the volume of the chocolate coating.
Give your answer correct to 3 significant figures.

4. A child's toy is in the shape of a hemisphere with a cone on top, as shown in the diagram.
The toy is 10 centimetres wide and 16 centimetres high.
Calculate the volume of the toy.
Give your answer correct to 2 significant figures.



5. A square based pyramid is shown in the diagram below.



The square base has length 6 centimetres.
The volume is 138 cubic centimetres.
Calculate the height of the pyramid.



Reverse Volume

Factorising

HCF

Question 1: Factorise the following expressions

- (a) $4x + 6$ (b) $15x + 20$ (c) $9y - 12$ (d) $5x + 15$
(e) $6x - 3$ (f) $4x + 8$ (g) $5y - 25$ (h) $8w + 24$

Question 2: Factorise the following expressions

- (a) $x^2 + 7x$ (b) $x^2 - 3x$ (c) $y^2 + y$ (d) $w^2 + 9w$
(e) $x^2 - 7x$ (f) $4w^2 + 10w$ (g) $6x^2 - 8x$ (h) $9y^2 - 6y$



Highest Common Factor

DOTS

Question 1: Factorise each of the following

- (a) $x^2 - 25$ (b) $y^2 - 49$ (c) $w^2 - 100$ (d) $x^2 - 4$
(e) $c^2 - 64$ (f) $x^2 - 1$ (g) $x^2 - 900$ (h) $y^2 - 9$
(i) $16 - x^2$ (j) $1 - y^2$ (k) $81 - x^2$ (l) $144 - h^2$
(m) $x^2 - y^2$ (n) $a^2 - c^2$ (o) $9x^2 - 25$ (p) $4y^2 - 1$



Difference of Two Squares

Question 2: Factorise **fully** each of the following

- (a) $2x^2 - 32$ (b) $2y^2 - 18$ (c) $2x^2 - 200$ (d) $3x^2 - 75$
(e) $5c^2 - 20$ (f) $18x^2 - 2$ (g) $12x^2 - 147$ (h) $20y^2 - 320$

Trinomials (unitary x^2)

Question 1: Factorise each of the following

- (a) $x^2 + 7x + 12$ (b) $x^2 + 6x + 8$ (c) $x^2 + 5x + 6$ (d) $x^2 + 8x + 7$
(e) $x^2 + 4x + 4$ (f) $x^2 + 8x + 15$ (g) $x^2 + 6x + 9$ (h) $x^2 + 11x + 28$

Question 2: Factorise each of the following

- (a) $x^2 + x - 12$ (b) $x^2 + 5x - 6$ (c) $x^2 + 3x - 10$ (d) $x^2 + 3x - 4$
(e) $x^2 + 2x - 48$ (f) $x^2 + 4x - 32$ (g) $x^2 + 2x - 35$ (h) $x^2 + 8x - 33$

Question 3: Factorise each of the following

- (a) $x^2 - 3x - 10$ (b) $x^2 - x - 20$ (c) $x^2 - 6x - 27$ (d) $x^2 - 2x - 3$
(e) $x^2 - x - 12$ (f) $x^2 - 4x - 12$ (g) $x^2 - 4x - 21$ (h) $x^2 - 6x - 55$

Trinomials (non-unitary x^2)

Question 1: Factorise each of the following

- (a) $2x^2 + 7x + 5$ (b) $2x^2 + 11x + 15$ (c) $2x^2 + 9x + 10$
(d) $3x^2 + 13x + 4$ (e) $3x^2 + 4x + 1$ (f) $3x^2 + 8x + 4$

Question 2: Factorise each of the following

- (a) $3x^2 + x - 4$ (b) $7x^2 + 20x - 3$ (c) $2x^2 - 13x + 15$
(d) $3x^2 - 17x + 10$ (e) $3x^2 - 16x - 12$ (f) $3x^2 - x - 4$



Trinomials



Harder Trinomials

Completing the Square

Question 1: Write the following expressions in the form $(x + a)^2 + b$

- (a) $x^2 + 8x + 1$ (b) $x^2 + 10x + 3$ (c) $x^2 + 2x - 1$
(d) $x^2 - 6x - 10$ (e) $x^2 - 4x - 13$ (f) $x^2 - 12x + 3$
(g) $x^2 + 14x + 3$ (h) $x^2 - 2x - 15$ (i) $x^2 + 4x - 11$
(j) $x^2 + x - 8$ (k) $x^2 + 3x + 1$ (l) $x^2 - 7x - 2$
(m) $x^2 - 9x - 1$ (n) $x^2 + 11x + 3$ (o) $x^2 - 100x - 25$



Completing
the Square

Surds

1. Simplify the following:

- (a) $\sqrt{8}$ (b) $\sqrt{75}$ (c) $\sqrt{20}$ (d) $\sqrt{32}$ (e) $\sqrt{48}$ (f) $\sqrt{200}$
(g) $\sqrt{300}$ (h) $\sqrt{80}$ (i) $\sqrt{50}$ (j) $\sqrt{98}$ (k) $\sqrt{63}$ (l) $\sqrt{800}$
(m) $\sqrt{180}$ (n) $\sqrt{220}$ (o) $\sqrt{96}$ (p) $\sqrt{175}$ (q) $\sqrt{1000}$ (r) $\sqrt{60}$



Intro and simplifying

2. Simplify the following:

- (a) $5\sqrt{8}$ (b) $2\sqrt{20}$ (c) $4\sqrt{50}$ (d) $3\sqrt{98}$ (e) $15\sqrt{32}$ (f) $10\sqrt{75}$

3. Simplify the following:

- (a) $\sqrt{8} + \sqrt{18}$ (b) $\sqrt{50} + \sqrt{8}$ (c) $\sqrt{75} + \sqrt{27}$ (d) $\sqrt{200} - \sqrt{32}$
(e) $\sqrt{8} + \sqrt{2} + \sqrt{72}$ (f) $\sqrt{300} - \sqrt{48}$ (g) $\sqrt{1000} + \sqrt{90}$ (h) $\sqrt{28} + \sqrt{63}$



Adding and Subtracting

4. Simplify:

- (a) $3\sqrt{8} + \sqrt{2}$ (b) $4\sqrt{27} - \sqrt{75}$ (c) $2\sqrt{50} + 5\sqrt{32}$ (d) $\sqrt{200} - 3\sqrt{18}$
(e) $4\sqrt{80} + 3\sqrt{45}$ (f) $6\sqrt{75} - 2\sqrt{12}$ (g) $10\sqrt{7} + 2\sqrt{175}$

5. Simplify:

- (a) $\sqrt{2}(\sqrt{3} + 5)$ (b) $\sqrt{3}(\sqrt{5} + \sqrt{2})$ (c) $\sqrt{6}(2 - \sqrt{3})$ (d) $\sqrt{10}(5 + \sqrt{10})$
(e) $\sqrt{2}(\sqrt{18} - \sqrt{2})$ (f) $\sqrt{5}(3\sqrt{2} - \sqrt{5})$ (g) $2\sqrt{3}(3\sqrt{2} + \sqrt{3})$ (h) $4\sqrt{11}(5\sqrt{2} + 2\sqrt{11})$
(i) $\sqrt{27}(\sqrt{2} + \sqrt{3})$ (j) $\sqrt{12}(7 - \sqrt{3})$



Expanding Brackets with Surds

6. Express the following with a rational denominator:

- (a) $\frac{2}{\sqrt{3}}$ (b) $\frac{5}{\sqrt{2}}$ (c) $\frac{7}{\sqrt{6}}$ (d) $\frac{1}{\sqrt{10}}$
(e) $\frac{4}{\sqrt{2}}$ (f) $\frac{9}{\sqrt{6}}$ (g) $\frac{\sqrt{2}}{\sqrt{3}}$ (h) $\frac{3}{2\sqrt{5}}$
(i) $\frac{\sqrt{5}}{\sqrt{80}}$ (j) $\frac{5\sqrt{5}}{\sqrt{20}}$



Rationalising the denominator

Indices

Q1 Fully simplify, expressing your answer with a positive power:

a) $\frac{x^2 \times x^5}{x^3}$

b) $\frac{x \times x^5}{x^8}$

c) $\frac{x^3 \times x^{-5}}{x^4}$

d) $\frac{3x^{-3} \times 4x^7}{2x^3}$

e) $\frac{6x^2}{3x^{-2} \times 3x^6}$

f) $\frac{x^{-3} \times 2x^4}{4x^5 \times x^{-1}}$



Laws of Indices

Q2 Fully simplify, expressing your answer with no brackets or negative powers:

- | | | |
|----------------------------------|-------------------------------|---------------------------------------|
| a) $(xy)^3$ | b) $(4x^2y)^3$ | c) $\left(\frac{2}{3}x^2y^4\right)^3$ |
| d) $(x^4)^2 \times x^3$ | e) $(x^{-4})^2 \times x^{-2}$ | f) $x^{-6} \times (x^3)^2$ |
| g) $(2x^3)^2 \times (3x^{-4})^2$ | h) $(x^3 \times x^{-5})^{-3}$ | i) $(x^{-4} \div x^{-1})^2$ |



Negative Indices

Q3 Express each of these expressions in the form x^n .

- | | | |
|-------------------------|----------------------------|---|
| a) \sqrt{x} | b) $\sqrt[3]{x}$ | c) $(\sqrt[3]{x})^5$ |
| d) $\frac{1}{\sqrt{x}}$ | e) $\frac{1}{\sqrt[3]{x}}$ | f) $\left(\frac{1}{\sqrt[3]{x}}\right)^2$ |

Q4 Evaluate:

- | | | |
|---|---|--|
| a) $9^{\frac{1}{2}}$ | b) $9^{-\frac{1}{2}}$ | c) $8^{\frac{1}{3}}$ |
| d) $8^{-\frac{1}{3}}$ | e) $16^{\frac{3}{2}}$ | f) $27^{-\frac{4}{3}}$ |
| g) $16^{\frac{3}{4}}$ | h) $64^{-\frac{2}{3}}$ | i) $100^{-\frac{3}{2}}$ |
| j) $\left(\frac{1}{4}\right)^{\frac{3}{2}}$ | k) $\left(\frac{25}{9}\right)^{-\frac{1}{2}}$ | l) $\left(\frac{27}{64}\right)^{-\frac{2}{3}}$ |



Fractional Indices

Q5 Expand and simplify:

- | | | |
|--|--|---|
| a) $x^2(x^2 + 3)$ | b) $x^2(x^{-4} + x^{-2})$ | c) $2x^2\left(\frac{1}{x} + \frac{1}{2}x^{-2}\right)$ |
| d) $x^{\frac{1}{2}}\left(x^{\frac{1}{2}} - 5x^{-\frac{1}{2}}\right)$ | e) $2x^{-\frac{1}{2}}\left(x^{\frac{3}{2}} - 3x^{-\frac{1}{2}}\right)$ | f) $3x^{-\frac{1}{4}}\left(x^{\frac{9}{4}} + 2x^{\frac{1}{2}}\right)$ |

Algebraic Fractions

Q1 Simplify:

- | | | |
|------------------------|-----------------------|-----------------------|
| a) $\frac{6x}{8}$ | b) $\frac{x^3}{x}$ | c) $\frac{xy}{x}$ |
| d) $\frac{12x^2}{15x}$ | e) $\frac{6ab}{9a}$ | f) $\frac{8}{12x}$ |
| g) $\frac{2x^2y}{3xy}$ | h) $\frac{18p^3}{6p}$ | i) $\frac{2n}{10n^3}$ |



Simplifying Algebraic Fractions

Q2 Fully factorise the numerator and denominator, and then simplify:

- | | | |
|--|---|----------------------------------|
| a) $\frac{2a - 10}{3a - 15}$ | b) $\frac{x^2 - 9}{x + 3}$ | c) $\frac{4c + 1}{12c + 3}$ |
| d) $\frac{x^2 + 5x + 4}{x^2 + 2x + 1}$ | e) $\frac{x^3 + 5x^2 + 4x}{x^2 + 2x + 1}$ | f) $\frac{5q + 5}{q^2 - 6q - 7}$ |

Q3 Express the answer to each addition or subtraction as a single fraction, fully simplified:

a) $\frac{4x}{9} + \frac{5x}{6}$

b) $\frac{4}{5x} + \frac{2x}{3}$ ($x \neq 0$)

c) $\frac{1}{x-2} + \frac{3}{x+3}$ ($x \neq 2, x \neq -3$)

d) $\frac{4}{n+1} - \frac{2}{n-3}$ ($n \neq -1, n \neq 3$)

e) $\frac{a-1}{3} - \frac{a}{6}$

f) $\frac{3}{x^2} - \frac{x+2}{5x}$ ($x \neq 0$)



Adding and Subtracting Algebraic Fractions

Q4 Multiply, giving your answers in their lowest terms:

a) $\frac{2x}{3} \times \frac{9}{4x}$ ($x \neq 0$)

b) $\frac{5x^2}{7} \times \frac{21}{10x}$ ($x \neq 0$)

c) $\frac{7}{n^3} \times \frac{2n}{35}$ ($n \neq 0$)

d) $\frac{6y^3}{y-1} \times \frac{1}{4y}$ ($y \neq 0, y \neq 1$)



Multiplying Algebraic Fractions

Q5 Divide, giving each answer in its simplest form:

a) $\frac{2}{x} \div \frac{3}{x}$ ($x \neq 0$)

b) $\frac{3}{a-5} \div \frac{6a}{5}$ ($a \neq 5$)

c) $\frac{28}{xy} \div \frac{7}{3y^2}$ ($x \neq 0, y \neq 0$)

d) $\frac{49x}{4y^2} \div \frac{35y}{28x^2}$ ($x \neq 0, y \neq 0$)



Dividing Algebraic Fractions

Scientific Notation (Standard Form)

Writing a number in Scientific Notation

1. Write the following in Scientific Notation

(a) 40000

(b) 2000000

(c) 8000000

(d) 7000

(e) 100000000

(f) 900

(g) 250000

(h) 1900

(i) 54000000

(j) 11000000

(k) 89000

(l) 3600000000



Standard Form

2. Write the following in Scientific Notation

(a) 0.002

(b) 0.0005

(c) 0.9

(d) 0.00000004

(e) 0.00065

(f) 0.0022

(g) 0.0361

(h) 0.000558

(i) 0.00000423

(j) 0.0000000981

(k) 0.00407

(l) 0.02052

Calculations involving Scientific Notation

Question 1: The distance between London and New York is 5,567,000 metres.
Write this number in standard form.

Question 2: The distance from the Sun to Pluto is 3.67 billion miles.
Write this number in standard form.



Question 3: The length of a cell is 0.016 mm
Write this number in standard form.

Question 4: The population of a country is 6.51×10^5
Write the population of the country as an ordinary number.

Question 5: 32,010 people attend a football match between West Ham and Southampton.
Write this number in standard form.



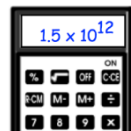
Question 6: There are approximately 5×10^4 grains of rice in a one kilogram bag of rice.
Approximately how many grains of rice will be in 20 one kilogram bags of rice?

Question 7: A penny weighs 0.0036kg.
Find the total mass of £400 worth of pennies.

Question 8: $A = 6 \times 10^5$ $B = 30000$ $C = 5 \times 10^{-2}$
(a) Work out AB
(b) Work out C^2

Question 9: The population of the United Kingdom in 1950 was 5.06×10^7
The population of the United Kingdom in 2015 was 6.47×10^7
Work out how many more people live in the United Kingdom in 2015 than 1950.
Give your answer as an ordinary number.

Question 10: Peter has multiplied two numbers using his calculator.
The calculator shows the answer.
He can remember that one number was 5000.
What was the other number used in the multiplication?



*Multiplying
in Standard
Form*



*Dividing in
Standard
Form*

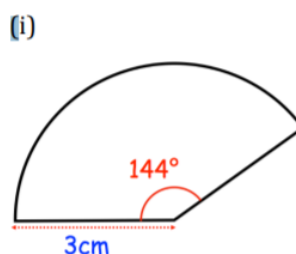
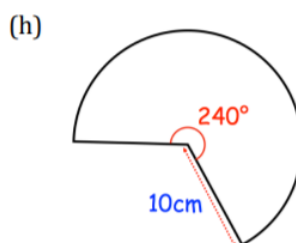
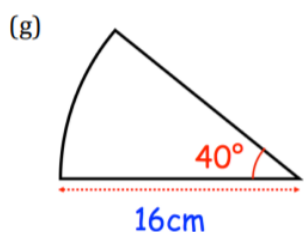
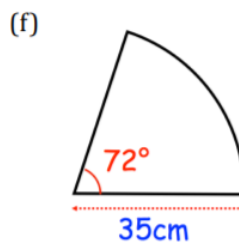
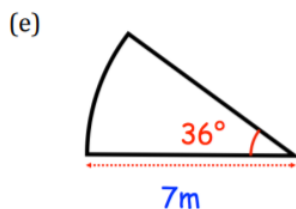
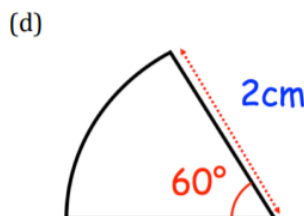
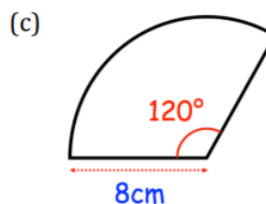
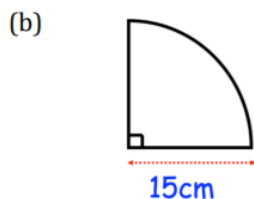
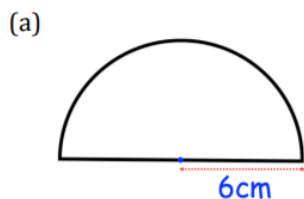
Arc Length and Sector Area

Sector Area

Question 1: Calculate the area of each of the following sectors.
Give each answer to one decimal place and include units.



Calculating
Sector Area

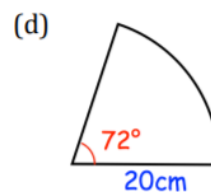
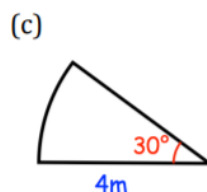
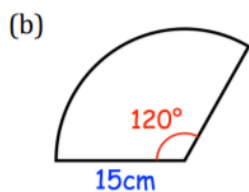
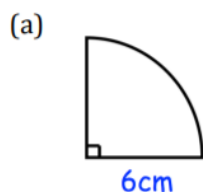


Arc Length

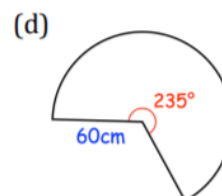
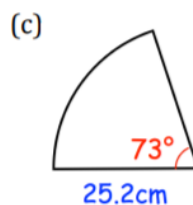
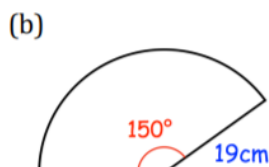
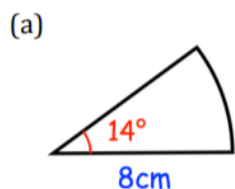
Question 1: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.



Calculating
Arc Length



Question 2: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.



Straight Line

Calculating the Gradient

1. Find the gradient of the line passing through each pair of points

- (a) (1, 4) and (3, 10) (b) (0, 0) and (3, 12) (c) (5, -2) and (9, 14)
(d) (-8, 6) and (0, -2) (e) (-5, -9) and (1, 3) (f) (-7, -2) and (1, -4)



Finding the gradient between two points

Equation of a Straight Line

Question 1: Write down the gradient of each of these lines.

- (a) $y = 3x + 1$ (b) $y = 2x - 5$ (c) $y = 7x + 4$ (d) $y = 10x + 5$
(e) $y = x - 2$ (f) $y = 6x$ (g) $y = -4x + 3$ (h) $y = -3x - 7$
(i) $y = \frac{1}{2}x + 3$ (j) $y = -\frac{4}{5}x - 9$



Identifying features of the equation of a line

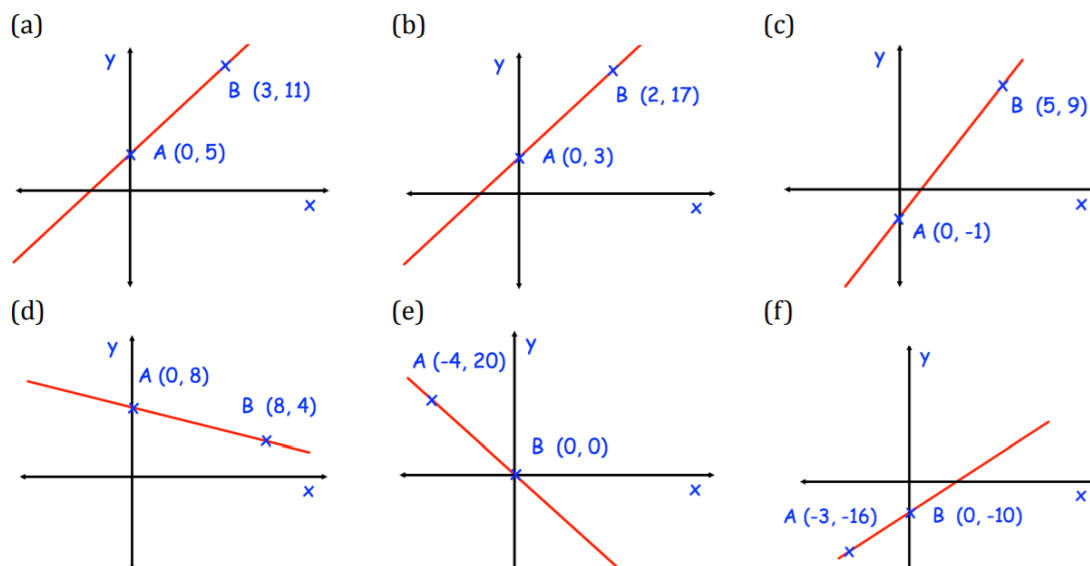
Question 2: Write down where each of these lines cross the y-axis (y-intercept)

- (a) $y = 2x + 3$ (b) $y = 7x + 1$ (c) $y = 3x - 2$ (d) $y = x - 5$
(e) $y = 2x$ (f) $y = -4x + 6$ (g) $y = -5x - 3$ (h) $y = -3x$
(i) $y = \frac{4}{3}x + \frac{2}{5}$ (j) $y = -\frac{2}{3}x - \frac{1}{2}$

Question 3: Write down the equation of the lines below

- (a) gradient of 3 and y-intercept of 6 (b) gradient of 2 and y-intercept of -1
(c) gradient of -4 and y-intercept of 3 (d) gradient of 8 and y-intercept of 4
(e) gradient of 1 and passing through (0, 4) (f) passing through (0, -2) with gradient 4
(g) gradient of -5 and passing through the origin.

Question 4: Find the equation of each line below



Finding the equation of a straight line

Question 5: Find the equation of the line passing through each pair of points

- (a) (0, 3) and (4, 19) (b) (0, 2) and (6, 20) (c) (0, 0) and (1, 4)
(d) (0, -9) and (9, 0) (e) (0, -6) and (7, 8) (f) (-8, -10) and (0, 14)
(g) (0, 2) and (10, 7) (h) (-4, 1) and (0, 7) (i) (-4, 0) and (0, 18)

Rearranging the Equation

1. Rearrange the equation to find the gradient and y-intercept

- (a) $x + y = 10$ (b) $x - y = 4$ (c) $2x + y = 6$
(d) $3x - y = -1$ (e) $8x + 2y + 9 = 0$ (f) $5x - 2y - 4 = 0$
(g) $7x = 1 - 2y$ (h) $15y - 6x = 8$ (i) $\frac{2}{3}x + 2y = 5$
(j) $\frac{1}{5}y - \frac{1}{2}x = 1$ (k) $\frac{2}{3}x + \frac{3}{4}y = 1\frac{1}{2}$

Answers

Rounding

1. (a) 3 (b) 3 (c) 6 (d) 50 (e) 60 (f) 80 (g) 90 2. (a) 840 (b) 670 (c) 130 (d) 2800 (e) 9300 (f) 1400 (g) 300
3. (a) $\frac{9430}{7.01}$ (b) 1890 (c) 2500 (d) 3.23 (e) 37800 (f) 57100 (g)

Percentages (Comp Int, App, Dep)

- Question 1: £4410
Question 2: 26620
Question 3: £9025
Question 4: £2105.74 or £2105.75
Question 5: 149.609 litres
Question 6: 419.4 cm or 4.194 m
Question 7: £100.40 or £100.41
Question 8: £124229.69
Question 9: 8698
Question 10: £4533.42
Question 11: 7 years
Question 12: 2039
Question 13: 12 years
Question 14: 25 years

Reverse Percentages

1. 20 2. a) 120, b) 84 3. 30 4. 35g 5. 3 200 000 6. £2000 7. £26 8. 600

Fractions

1. a) $\frac{2}{5}$ b) $\frac{1}{8}$ c) $\frac{3}{4}$ d) $\frac{3}{4}$ e) $\frac{3}{10}$ f) $\frac{1}{7}$ g) $\frac{6}{11}$ h) $\frac{2}{5}$ i) $\frac{7}{12}$
 j) $\frac{7}{8}$ k) $\frac{1}{5}$ l) $\frac{1}{4}$ m) $\frac{3}{7}$ n) $\frac{1}{3}$ o) $\frac{1}{9}$ p) $\frac{16}{25}$ q) $\frac{17}{7}$ r) $\frac{4}{3}$
2. (a) $2\frac{1}{6}$ (b) $2\frac{1}{9}$ (c) $\frac{17}{20}$ (d) $\frac{3}{8}$
 (e) $3\frac{5}{6}$ (f) $\frac{8}{9}$ (g) $3\frac{1}{18}$ (h) $3\frac{1}{24}$
 (i) $5\frac{23}{30}$ (j) $1\frac{20}{63}$ (k) $2\frac{7}{60}$ (l) $7\frac{13}{15}$
3. (a) $\frac{5}{12}$ (b) $\frac{1}{2}$ (c) $1\frac{1}{8}$ (d) $1\frac{3}{4}$
 (e) $\frac{5}{6}$ (f) $2\frac{1}{12}$ (g) $7\frac{2}{3}$ (h) $1\frac{5}{99}$
 (i) $6\frac{7}{30}$ (j) $3\frac{2}{3}$ (k) $7\frac{13}{16}$ (l) $9\frac{1}{7}$
4. (a) $\frac{10}{27}$ (b) $\frac{15}{19}$ (c) $4\frac{6}{7}$ (d) $\frac{14}{33}$
 (e) $1\frac{7}{17}$ (f) $1\frac{43}{87}$ (g) $3\frac{5}{12}$ (h) $\frac{187}{288}$

Median and IQR

1. Median = 7, IQR = 6 2. Median = 15, IQR = 4 3. Median = 18, IQR = 10 4. Median = 7, IQR = 7 5. Median = 52, IQR = 20
 6. Median = 49, IQR = 14 Applying Question. (a) $Q_2=37$, $Q_1=29$ & $Q_3=41$ IQR = 12
 (b) median lower, more spread of times

Mean and SD

1. Mean = 18, SD = 3.35 2. Mean = 8, SD = 2.58 3. Mean = 3.6, SD = 1.56 4. Mean 108, SD = 3.4 5. Mean = 55, SD = 5.6
 6. Mean = 18, SD = 3.35 Applying Question = $\bar{x} = 119$, $s = 1.58$ (b) Competition (c) Mean up by 4, Standard deviation the same.

Algebra

- A) 1. $5x - 19$ 2. $21w - 25t + 11$ 3. $x^2 + 10x + 24$ 4. $x^2 - 15x + 56$ 5. $6x^2 + 5x - 4$ 6. $5x^2 - 13x + 6$
- B) 1. $x^3 + 5x^2 + 7x + 3$ 2. $3x^3 + 11x^2 + 9x - 2$ 3. $2x^3 - 5x^2 + 5x + 4$ 4. $x^3 + 3x^2 - 8x - 4$ 5. $x^3 - 8x^2 + 5x + 50$
 6. $2x^3 - 5x^2 - 6x + 9$ 7. $6x^3 + 10x^2 - 7x + 1$ 8. $x^3 - 8x^2 + 13x - 6$

Volume

1. $V = 29\,900\text{ cm}^3$ 2. 140 cm^3 3. 4180 mm^3 4. 550 cm^3 5. 11.5 cm

Factorising

HCF - Question 1

- | | | | | | | | | |
|--------|-----------------|-----------------|-----------------|----------------|----------------|------------------|------------------|------------------|
| | (a) $2(2x + 3)$ | (b) $5(3x + 4)$ | (c) $3(3y - 4)$ | (d) $5(x + 3)$ | Question 2 | | | |
| DOTS - | (e) $3(2x - 1)$ | (f) $4(x + 2)$ | (g) $5(y - 5)$ | (h) $8(w + 3)$ | (a) $x(x + 7)$ | (b) $x(x - 3)$ | (c) $y(y + 1)$ | (d) $w(w + 9)$ |
| | | | | | (e) $x(x - 7)$ | (f) $2w(2w + 5)$ | (g) $2x(3x - 4)$ | (h) $3y(3y - 2)$ |

Question 1

- | | |
|------------------------|------------------------|
| (a) $(x - 5)(x + 5)$ | (i) $(4 - x)(4 + x)$ |
| (b) $(y - 7)(y + 7)$ | (j) $(1 - y)(1 + y)$ |
| (c) $(w - 10)(w + 10)$ | (k) $(9 - x)(9 + x)$ |
| (d) $(x - 2)(x + 2)$ | (l) $(12 - h)(12 + h)$ |
| (e) $(c - 8)(c + 8)$ | (m) $(x - y)(x + y)$ |
| (f) $(x - 1)(x + 1)$ | (n) $(a - c)(a + c)$ |
| (g) $(x - 30)(x + 30)$ | (o) $(3x - 5)(3x + 5)$ |
| (h) $(y - 3)(y + 3)$ | (p) $(2y - 1)(2y + 1)$ |

Question 2

- | | |
|-------------------------|-------------------------|
| (a) $2(x - 4)(x + 4)$ | (e) $5(c - 2)(c + 2)$ |
| (b) $2(y - 3)(y + 3)$ | (f) $2(3x - 1)(3x + 1)$ |
| (c) $2(x - 10)(x + 10)$ | (g) $3(2x - 7)(2x + 7)$ |
| (d) $3(x - 5)(x + 5)$ | (h) $20(y - 4)(y + 4)$ |

Trinomials (unitary) -

Question 1:

- a) $(x+3)(x+4)$ b) $(x+2)(x+4)$ c) $(x+2)(x+3)$ d) $(x+7)(x+1)$
e) $(x+2)(x+2)^*$ f) $(x+5)(x+3)$ g) $(x+3)(x+3)^*$ h) $(x+7)(x+4)$

Question 2:

- a) $(x-3)(x+4)$ b) $(x+6)(x-1)$ c) $(x-2)(x+5)$ d) $(x+4)(x-1)$
e) $(x-6)(x+8)$ f) $(x+8)(x-4)$ g) $(x+7)(x-5)$ h) $(x+11)(x-3)$

Question 3

- a) $(x+2)(x-5)$ b) $(x+4)(x-5)$ c) $(x-9)(x+3)$ d) $(x-3)(x+1)$
e) $(x-4)(x+3)$ f) $(x+2)(x-6)$ g) $(x-7)(x+3)$ h) $(x-11)(x+5)$

Trinomials (non-unitary)

Question 1:

- (a) $(2x + 5)(x + 1)$ (b) $(2x + 5)(x + 3)$ (c) $(2x + 5)(x + 2)$
(d) $(3x + 1)(x + 4)$ (e) $(3x + 1)(x + 1)$ (f) $(3x + 2)(x + 2)$

Question 2:

- (a) $(3x + 4)(x - 1)$ (b) $(7x - 1)(x + 3)$ (c) $(2x - 3)(x - 5)$
(d) $(3x - 2)(x - 5)$ (e) $(3x + 2)(x - 6)$ (f) $(3x - 4)(x + 1)$

Completing the Square

Question 1

- (a) $(x + 4)^2 - 15$ (b) $(x + 5)^2 - 22$ (c) $(x + 1)^2 - 2$
(d) $(x - 3)^2 - 19$ (e) $(x - 2)^2 - 17$ (f) $(x - 6)^2 - 33$
(g) $(x + 7)^2 - 46$ (h) $(x - 1)^2 - 16$ (i) $(x + 2)^2 - 15$
(j) $(x + 0.5)^2 - 8.25$ (k) $(x + 1.5)^2 - 1.25$ (l) $(x - 3.5)^2 - 14.25$
(m) $(x - 4.5)^2 - 21.25$ (n) $(x + 5.5)^2 - 27.25$ (o) $(x - 50)^2 - 2525$

Surds

1. a) $2\sqrt{2}$ b) $5\sqrt{3}$ c) $2\sqrt{5}$ d) $4\sqrt{2}$ e) $4\sqrt{3}$ f) $10\sqrt{2}$
g) $10\sqrt{3}$ h) $4\sqrt{5}$ i) $5\sqrt{2}$ j) $7\sqrt{2}$ k) $3\sqrt{7}$ l) $20\sqrt{2}$
m) $6\sqrt{5}$ n) $2\sqrt{55}$ o) $4\sqrt{6}$ p) $5\sqrt{7}$ q) $10\sqrt{10}$ r) $2\sqrt{15}$
2. a) $10\sqrt{2}$ b) $4\sqrt{5}$ c) $20\sqrt{2}$ d) $21\sqrt{2}$ e) $60\sqrt{2}$ f) $50\sqrt{3}$
3. a) $5\sqrt{2}$ b) $7\sqrt{2}$ c) $8\sqrt{3}$ d) $6\sqrt{2}$
e) $9\sqrt{2}$ f) $6\sqrt{3}$ g) $13\sqrt{10}$ h) $5\sqrt{7}$
4. a) $7\sqrt{2}$ b) $7\sqrt{3}$ c) $30\sqrt{2}$ d) $\sqrt{2}$
e) $25\sqrt{5}$ f) $26\sqrt{3}$ g) $20\sqrt{7}$

5. a) $\sqrt{6} + 5\sqrt{2}$ b) $\sqrt{15} + \sqrt{6}$ c) $2\sqrt{6} - 3\sqrt{2}$ d) $5\sqrt{10} + 10$

e) 4 f) $3\sqrt{10} - 5$ g) $6\sqrt{6} + 6$ h) $20\sqrt{22} + 88$

i) $3\sqrt{6} + 9$ j) $14\sqrt{3} - 6$

a) $\frac{2\sqrt{3}}{3}$ b) $\frac{5\sqrt{2}}{2}$ c) $\frac{7\sqrt{6}}{6}$ d) $\frac{\sqrt{10}}{10}$

e) $2\sqrt{2}$ f) $\frac{3\sqrt{6}}{2}$ g) $\frac{\sqrt{6}}{3}$ h) $\frac{3\sqrt{5}}{10}$

In: i) $\frac{1}{4}$ j) $\frac{5}{2}$

Q1 a) x^4 b) $\frac{1}{x^2}$ c) $\frac{1}{x^6}$

d) $6x$ e) $\frac{2}{3x^2}$ f) $\frac{1}{2x^3}$

Q2 a) x^3y^3 b) $64x^6y^3$ c) $\frac{8}{27}x^6y^{12}$

d) x^{11} e) $\frac{1}{x^{10}}$ f) 1

g) $\frac{36}{x^2}$ h) x^6 i) $\frac{1}{x^6}$

Q3 a) $x^{\frac{1}{2}}$ b) $x^{\frac{1}{3}}$ c) $x^{\frac{5}{3}}$

d) $x^{-\frac{1}{2}}$ e) $x^{-\frac{1}{3}}$ f) $x^{-\frac{2}{3}}$

Q4 a) 3 b) $\frac{1}{3}$ c) 2

d) $\frac{1}{2}$ e) 64 f) $\frac{1}{81}$

g) 8 h) $\frac{1}{16}$ i) $\frac{1}{1000}$

j) $\frac{1}{8}$ k) $\frac{3}{5}$ l) $\frac{16}{9}$

Q5 a) $x^4 + 3x^2$ b) $x^{-2} + 1$ c) $2x + 1$

d) $x - 5$ e) $2x - 6x^{-1}$ f) $3x^2 + 6x^{\frac{1}{4}}$

Algebraic Fractions

Q1 a) $\frac{3x}{4}$ b) x^2 c) y

d) $\frac{4x}{5}$ e) $\frac{2b}{3}$ f) $\frac{2}{3x}$

g) $\frac{2x}{3}$ h) $3p^2$ i) $\frac{1}{5n^2}$

Q2 a) $\frac{2}{3}$ b) $x - 3$ c) $\frac{1}{3}$

d) $\frac{x+4}{x+1}$ e) $\frac{x(x+4)}{x+1}$ f) $\frac{5}{q-7}$

Q3 a) $\frac{23x}{18}$

b) $\frac{12 + 10x^2}{15x}$

c) $\frac{4x - 3}{(x - 2)(x + 3)}$

d) $\frac{2(n - 7)}{(n + 1)(n - 3)}$

e) $\frac{a - 2}{6}$

f) $\frac{15 - 2x - x^2}{5x^2}$ or $\frac{-(x - 3)(x + 5)}{5x^2}$

Q4 a) $\frac{3}{2}$

b) $\frac{3x}{2}$

Q5 a) $\frac{2}{3}$

b) $\frac{5}{2a(a - 5)}$

c) $\frac{2}{5n^2}$

d) $\frac{3y^3}{2(y - 1)}$

c) $\frac{12y}{x}$

d) $\frac{49x^3}{5y^3}$

Scientific Notation

Writing in scientific notation

1.

a) 4×10^4

b) 2×10^6

c) 8×10^6

d) 7×10^3

e) 1×10^8

f) 9×10^2

g) 2.5×10^5

h) 1.9×10^3

i) 5.4×10^7

j) 1.1×10^7

k) 8.9×10^4

l) 3.6×10^9

2.

a) 2×10^{-3}

b) 5×10^{-4}

c) 9×10^{-1}

d) 4×10^{-8}

e) 6.5×10^{-4}

f) 2.2×10^{-3}

g) 3.61×10^{-2}

h) 5.58×10^{-4}

i) 4.23×10^{-6}

j) 9.81×10^{-8}

k) 4.07×10^{-3}

l) 2.052×10^{-2}

Calculations

Question 1: 5.567×10^6

Question 2: 3.67×10^9

Question 3: 1.6×10^{-2}

Question 4: 651,000

Question 5: 3.201×10^4

Question 6: $20 \times 5 \times 10^4 = 1,000,000$

Question 7: $400 \times 100 \times 0.0036 = 144\text{kg}$

Question 8: a) 1.8×10^{10}

b) 2.5×10^{-3}

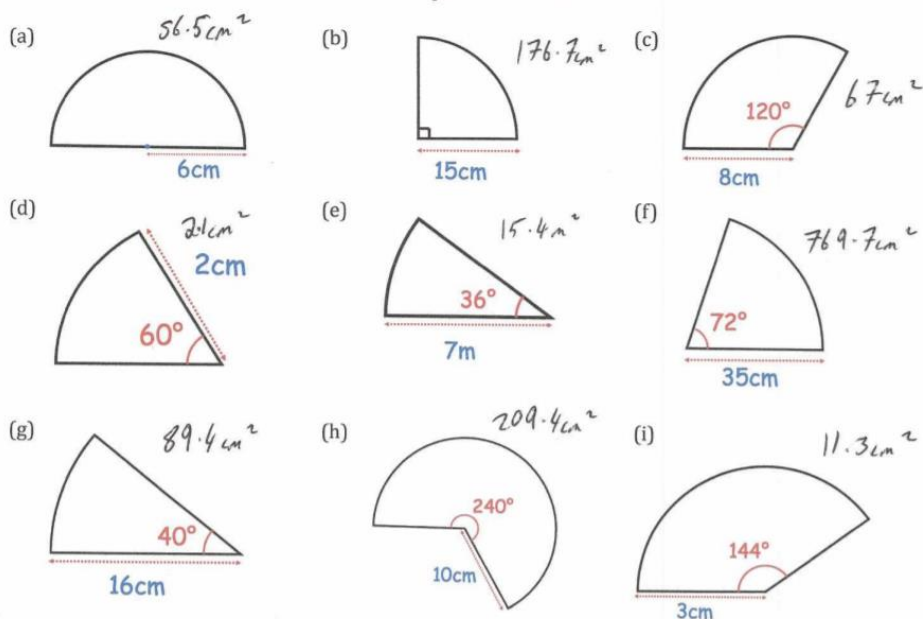
Question 9: 14,100,000

Question 10: 3,000,000,000 or 3×10^9

Arc Length and Sector Area

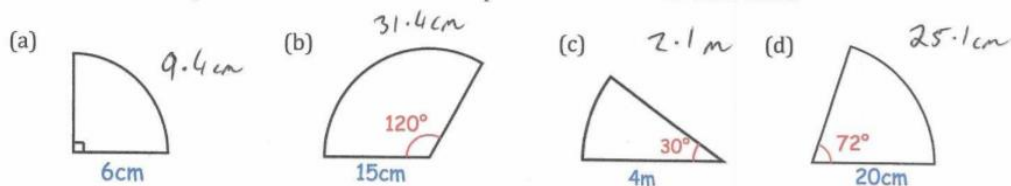
Sector Area

Question 1: Calculate the area of each of the following sectors.
Give each answer to one decimal place and include units.

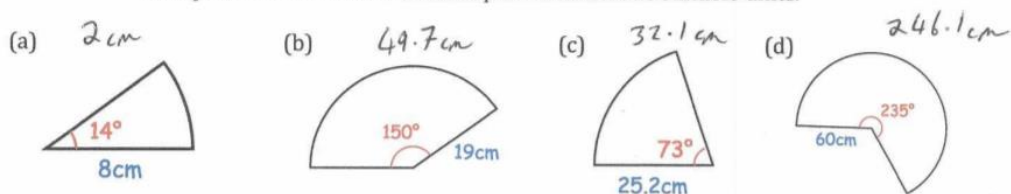


Arc Length

Question 1: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.



Question 2: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.



Straight Line

Gradient

(a) 3

(b) 4

(c) 4

(d) -1

(e) 2

(f) $-\frac{1}{4}$

Equation of a straight line

Question 1:

- (a) 3 (b) 2 (c) 7 (d) 10
(e) 1 (f) 6 (g) -4 (h) -3
(i) $\frac{1}{2}$ (j) $-\frac{4}{5}$

Question 2:

- (a) (0,3) (b) (0,1) (c) (0,-2) (d) (0,-5)
(e) (0,0) (f) (0,6) (g) (0,-3) (h) (0,0)
(i) $(0, \frac{2}{5})$ (j) $(0, -\frac{1}{2})$

Question 3:

- (a) $y = 3x + 6$ (b) $y = 2x - 1$
(c) $y = -4x + 3$ (d) $y = 8x + 4$
(e) $y = x + 4$ (f) $y = 4x - 2$
(g) $y = -5x$

Question 4:

- (a) $y = 2x + 5$ (b) $y = 7x + 3$ (c) $y = 2x - 1$
(d) $y = -\frac{1}{2}x + 8$ (e) $y = -5x$ (f) $y = 2x - 10$

Question 5:

- (a) $y = 4x + 3$ (b) $y = 3x + 2$ (c) $y = 4x$
(d) $y = x - 9$ (e) $y = 2x - 6$ (f) $y = 3x + 14$
(g) $y = \frac{1}{2}x + 2$ (h) $y = 1.5x + 7$ (i) $y = 4.5x + 18$

Rearranging the equation

- (a) gradient = -1 y-intercept = 10 (b) gradient = 1 y-intercept = 4
(c) gradient = -2 y-intercept = 6 (d) gradient = 3 y-intercept = 1
(e) gradient = -4 y-intercept = $-\frac{9}{2}$ (f) gradient = $\frac{5}{2}$ y-intercept = -2
(g) gradient = $-\frac{7}{2}$ y-intercept = $\frac{1}{2}$ (h) gradient = $\frac{6}{15}$ y-intercept = $\frac{8}{15}$
(i) gradient = $-\frac{1}{3}$ y-intercept = $\frac{5}{2}$ (j) gradient = $\frac{5}{2}$ y-intercept = 5
(k) gradient = $-\frac{4}{3}$ y-intercept = 2