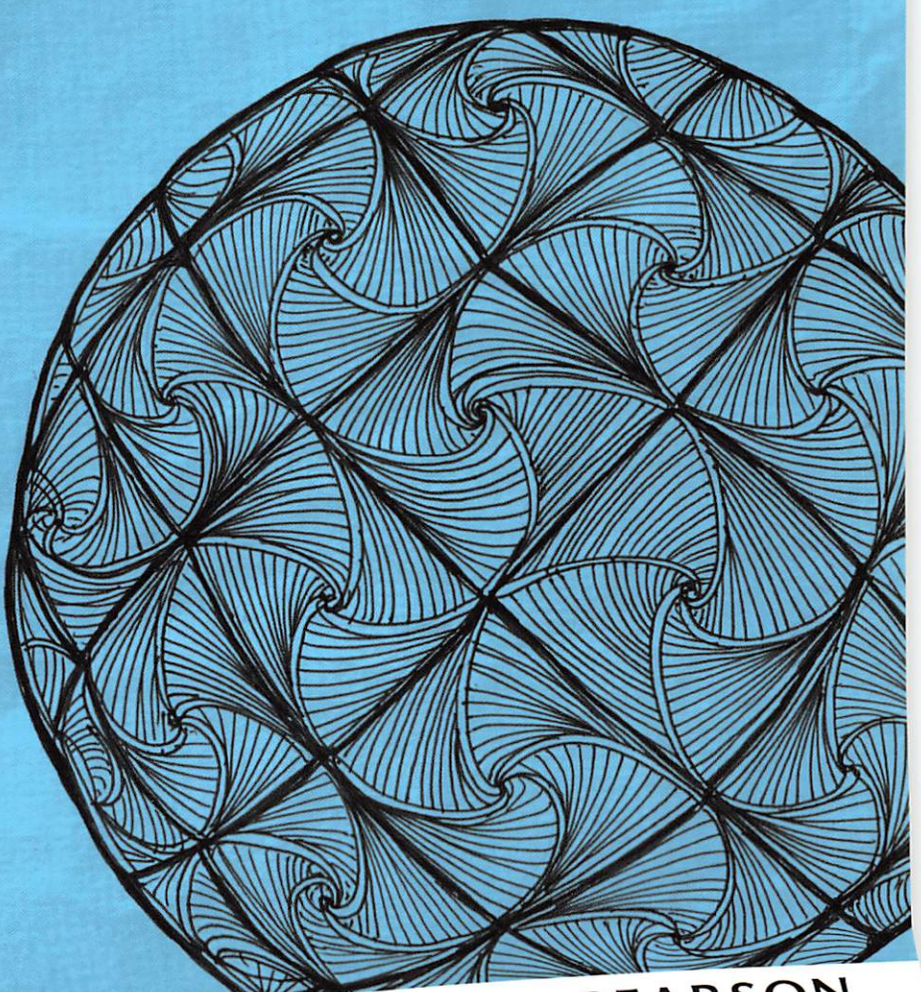
REVISE EDEXCEL GCSE (9–1)

Mathematics

REVISION WORKBOOK

Higher



For the (9–1) exams

PEARSON

Contents

Number

Algebra

Ratio & Proportion

Geometry & Measures

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Practice papers

137 Answers & Imprint

A small bit of small print
Edexcel publishes Sample Assessment Material and the Specification on its website. This is the official content and this book should be used in conjunction with it. The questions in 'Now try this' have been written to help you practise every topic in the book. Remember: the real exam questions may not look like this.

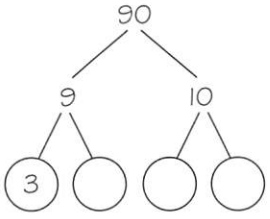
Factors and primes

Guided

1 (a) Write the following numbers as products of powers of their prime factors.

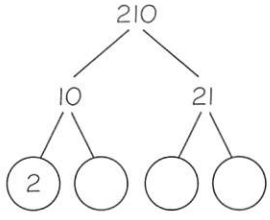
Circle any prime numbers – that's the end of a branch.

(i) 90



90 = ... × 3$^{\cdots}$ × ..... **(2 marks)**

(ii) 210



210 = 2 × ..... × ..... × ..... **(2 marks)**

(b) Find the highest common factor (HCF) of 90 and 210.

Circle all the prime numbers which are common to both products of prime factors. Multiply the circled numbers together to find the HCF.

90 = ... × 3 × ..... × .....

210 = 2 × ..... × ..... × .....

HCF = ... × ..... × ..... = ... **(1 mark)**

(c) Find the lowest common multiple (LCM) of 90 and 210.

LCM = ... × ..... × ..... = ... **(1 mark)**

To find the LCM, multiply the HCF by the numbers in both products that were not circled in part (b).

PROBLEM SOLVED!

2 n is a number. 100 is the LCM of 20 and n.
Work out two different possible values for n.

You will need to use problem-solving skills throughout your exam – **be prepared!**

n = ...

n = ... **(2 marks)**

3 The number 45 can be written as $3^m \times n$, where m and n are prime numbers.
Find the value of m and the value of n.

m = ...

n = ... **(3 marks)**

4 A ramblers club buys hats in packs of 12 and scarves in packs of 18. The club buys exactly the same number of hats and scarves.
What is the smallest number of packs of hats and the smallest number of packs of scarves the club buys?

..... **(3 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Indices 1

1 Write as a single power of 4

(a) $4 \times 4 = 4^{\cdots}$ **(1 mark)**

(b) $4 \times 4 \times 4 \times 4 \times 4 =$ ..... **(1 mark)**

Guided

2 Work out the value of

(a) 4^2 ..... **(1 mark)**

(b) 2^3 ..... **(1 mark)**

(c) $\sqrt{64}$ ..... **(1 mark)**

(d) $\sqrt[3]{64}$ ..... **(1 mark)**

(e) $\sqrt[3]{27}$ ..... **(1 mark)**

(f) $\sqrt[3]{-64}$ ..... **(1 mark)**

3 Simplify and leave your answers in index form.

Guided

(a) $5^3 \times 5^6 = 5^{3+6} = 5^{\cdots}$ Add the powers. **(1 mark)**

(b) $5^9 \div 5^6 = 5^{9-6} = 5^{\cdots}$ Subtract the powers. **(1 mark)**

(c) $\dfrac{5^{12}}{5 \times 5^7} =$ ..... First work out the power of 5 in the denominator. **(2 marks)**

4 Simplify and leave your answers in index form.

(a) $\dfrac{3^2 \times 3^6}{3^5}$ ..... **(2 marks)**

(b) $\dfrac{3^{12}}{3^6 \times 3^4}$ ..... **(2 marks)**

(c) $\dfrac{3^7 \times 3^6}{3 \times 3^4}$ ..... **(2 marks)**

(d) $\dfrac{3^8 \times 3^{-6}}{3 \times 3^{-5}}$ ..... **(2 marks)**

5 Find the value of x.

Guided

(a) $11^3 \times 11^x = 11^{12}$

$11^{3+x} = 11^{12}$

$x =$ ..... **(1 mark)**

(b) $11^{12} \div 11^x = 11^8$

$x =$ ..... **(1 mark)**

6 $7^4 \times 7^x = \dfrac{7^9 \times 7^6}{7^3}$

Find the value of x.

$x =$ ..... **(2 marks)**

7 Tom carried out an investigation and concluded that, '6 is a cube number since $2^3 = 6$.'
Is he correct? Explain your answer.

Guided

You can explain your answer by writing a sentence with your reason, or by showing some neat working.

No, because $2 \times 2 \times 2 =$ ..... **(2 marks)**

8 $3^x \times 3^y = 3^{12}$ and $3^x \div 3^y = 3^2$
Work out the value of x and the value of y.

$x =$ ..... $y =$ ..... **(3 marks)**

Indices 2

1 Work out the value of

(a) 2^{-3} (b) 3^{-1} (c) 7^{-2} (d) $4^{-\frac{1}{2}}$

Guided

$\frac{1}{2^3} = \frac{\ldots\ldots}{\ldots\ldots}$ **(1 mark)** ..... **(1 mark)** $\frac{1}{\ldots\ldots^2} = \frac{\ldots\ldots}{\ldots\ldots}$ **(1 mark)** ..... **(1 mark)**

2 Work out the reciprocal of

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

..... **(1 mark)** ..... **(1 mark)** ..... **(1 mark)** ..... **(1 mark)**

3 Work out the value of

(a) $\left(\frac{2}{3}\right)^2$ (b) $\left(\frac{4}{3}\right)^3$ (c) $\left(\frac{4}{5}\right)^2$ (d) $\left(\frac{1}{5}\right)^3$

..... **(1 mark)** ..... **(1 mark)** ..... **(1 mark)** ..... **(1 mark)**

4 Work out the value of

Turn the fraction upside down, then change the negative power to a positive power.

Guided

(a) $\left(\frac{4}{3}\right)^{-2} = \left(\frac{3}{4}\right)^2 = \frac{3^2}{4^2} = \frac{\ldots\ldots}{\ldots\ldots}$ **(1 mark)** (b) $\left(\frac{1}{3}\right)^{-3} = \left(\frac{\ldots\ldots}{\ldots\ldots}\right)^3 = \frac{\ldots\ldots^3}{\ldots\ldots^3} = \ldots\ldots$ **(1 mark)**

(c) $\left(\frac{6}{5}\right)^{-2}$ (d) $\left(\frac{3}{5}\right)^{-3}$

..... **(1 mark)** ..... **(1 mark)**

5 Work out the value of

(a) $25^{\frac{1}{2}}$ (b) $8^{\frac{1}{3}}$ (c) $64^{\frac{1}{3}}$ (d) $81^{\frac{1}{4}}$

..... **(1 mark)** ..... **(1 mark)** ..... **(1 mark)** ..... **(1 mark)**

6 Work out the value of

(a) $16^{\frac{3}{2}}$ (b) $16^{\frac{3}{4}}$

Guided

$(16^{\frac{1}{2}})^3 = (\ldots\ldots)^3 = \ldots\ldots$ **(1 mark)** $(16^{\frac{1}{\ldots}})^{\ldots} = (\ldots\ldots)^{\ldots} = \ldots\ldots$ **(1 mark)**

(c) $25^{\frac{3}{2}}$ (d) $27^{\frac{2}{3}}$

$(25^{\frac{\ldots}{\ldots}})^{\ldots} = (\ldots\ldots)^{\ldots} = \ldots\ldots$ **(1 mark)** ..... **(1 mark)**

7 Show that $8^{\frac{2}{3}} = 16^{\frac{1}{2}}$

PROBLEM SOLVED!

You will need to use problem-solving skills throughout your exam – **be prepared!**

(2 marks)

8 $x = 3^m$ and $y = 3^n$

Express in terms of x and y

(a) 3^{m+n} (b) 3^{2n}

..... **(1 mark)** ..... **(1 mark)**

Calculator skills 1

1 Work out, in each case giving your answer correct to 3 significant figures

Guided

(a) $(11 + 8 \div 2)^3$

(11 + ...)^3 = ... **(1 mark)**

(b) $(2 + 9 \times 10 + 3)^{\frac{1}{2}}$

..... **(1 mark)**

(c) $(8 + (3 \times 20) \div 6)^{\frac{2}{3}}$

..... **(1 mark)**

Use BIDMAS to remember the correct order of operations:
Brackets
Indices
Division
Multiplication
Addition
Subtraction

2 Work out

(a) $\dfrac{(27 + 3 \times 3)^2}{3 \times 2}$

..... **(1 mark)**

(b) $\dfrac{(13 - \sqrt{12} \div 4)^3}{(4 + 3 \times 2)^2}$

..... **(1 mark)**

3 Find the value of $\dfrac{4.5 + 3.75}{3.2^2 - 5.53}$

Guided

Write down all the figures on your calculator display.

8.25 / ..... = ... **(2 marks)**

4 (a) Find the value of $\sqrt{30.25} + 1.75^2$

Use your calculator to work out $\sqrt{30.25}$ and 1.75^2 separately. Write your answers before adding them. You might need to press the S⇔D button to get your answer as a decimal number.

..... **(2 marks)**

(b) Write your answer to part (a) correct to 1 significant figure.

..... **(1 mark)**

5 $m = 7.1 \times 10^6$ and $n = 3.2 \times 10^{-3}$

Work out, in each case giving your answer in standard form correct to 3 significant figures

(a) mn

..... **(2 marks)**

(b) $\dfrac{m}{n}$

..... **(2 marks)**

6 Work out, in each case giving your answer correct to 3 significant figures

(a) $\sqrt{5.3 + \tan 38°}$

..... **(2 marks)**

(b) $\dfrac{288.3 \times \cos 58°}{(4.23 - 1.13)^3}$

..... **(2 marks)**

7 $t^3 = \dfrac{mn}{m - n}$ $m = 4 \times 10^{12}$ $n = 3 \times 10^9$

Work out t. Give your answer in standard form correct to 3 significant figures.

t = ... **(3 marks)**

Fractions

1 Work out

Add the whole numbers first.

(a) $3\frac{4}{5} + 2\frac{3}{4} = 3 + 2 + \frac{4}{5} + \frac{3}{4}$

$= \ldots\ldots + \frac{\ldots\ldots}{20} + \frac{\ldots\ldots}{20} = \ldots\ldots + \frac{\ldots\ldots}{20} = \ldots\ldots + \ldots\ldots\frac{\ldots\ldots}{20} = \ldots\ldots\frac{\ldots\ldots}{20}$ **(3 marks)**

(b) $4\frac{2}{5} - 2\frac{3}{10} = \frac{\ldots\ldots}{5} - \frac{\ldots\ldots}{10}$

You can also add or subtract mixed numbers by converting them into improper fractions first.

$= \frac{\ldots\ldots}{10} - \frac{\ldots\ldots}{10} = \frac{\ldots\ldots}{10}$

$= \ldots\ldots\ldots\ldots$ **(3 marks)**

2 Work out

(a) $1\frac{2}{3} \times 2\frac{3}{10} = \frac{\ldots\ldots}{3} \times \frac{\ldots\ldots}{10} = \frac{\ldots\ldots\ldots}{\ldots\ldots\ldots} = \ldots\ldots\ldots\ldots$ **(3 marks)**

Replace the ÷ with × and then flip the second fraction over.

(b) $4\frac{2}{3} \div 1\frac{2}{5} = \frac{\ldots\ldots}{3} \div \frac{\ldots\ldots}{5} = \frac{\ldots\ldots}{3} \times \frac{\ldots\ldots\ldots}{\ldots\ldots\ldots} = \frac{\ldots\ldots\ldots}{\ldots\ldots\ldots} = \ldots\ldots\ldots\ldots$ **(3 marks)**

3 Work out

(a) $3\frac{1}{2} \times 2\frac{4}{7}$

..... **(3 marks)**

(b) $5\frac{1}{3} \div 1\frac{4}{9}$

..... **(3 marks)**

4 A man wins £300 and decides to give it to his three children. He gives $\frac{2}{5}$ of his money to Andrew, $\frac{1}{3}$ to Ben, and the rest to Carla.

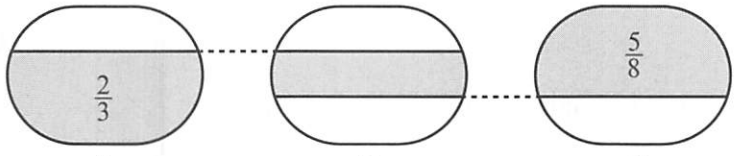
Write 1 as a fraction with the same numerator and denominator. $1 = \frac{15}{15}$

Work out how much money Carla receives.

$\frac{2}{5} + \frac{1}{3} = \frac{\ldots\ldots}{15} + \frac{\ldots\ldots}{15} = \frac{\ldots\ldots}{15}$ $\quad 1 - \frac{\ldots\ldots}{15} = \frac{\ldots\ldots}{15}$ $\quad £300 \times \frac{\ldots\ldots}{15} = £\ldots\ldots\ldots\ldots$ **(3 marks)**

5 The diagram shows three identical shapes. $\frac{2}{3}$ of shape A is shaded and $\frac{5}{8}$ of shape C is shaded.

You will need to use problem-solving skills throughout your exam – **be prepared!**



What fraction of shape **B** is shaded? ..... **(3 marks)**

6 Roadstone Limited can resurface $\frac{7}{8}$ km of a road in a day. How many days will it take to resurface a road of length 14 km?

..... days **(2 marks)**

7 It takes $4\frac{2}{3}$ hours to paint a room, and $1\frac{1}{4}$ hours for all the paint to dry. How long does it take altogether?

Remember to give units with your answer.

..... hours **(3 marks)**

8 A rectangular garden has a length of $6\frac{2}{3}$ m and a width of $2\frac{1}{2}$ m. Work out the area of the garden.

Area of rectangle = length × width

..... m^2 **(3 marks)**

Decimals

1 Write these numbers in order of size. Start with the smallest number.

$\frac{1}{3}$ 0.3 $\frac{18}{50}$ 0.35

..... **(1 mark)**

Guided

2 Show that $\frac{3}{20}$ can be written as a terminating decimal.

Write $\frac{3}{20}$ as an equivalent fraction with denominator 100.

$\frac{3}{20} = \frac{.....}{100} = ...$ **(2 marks)**

Guided

3 Show that $\frac{7}{30}$ cannot be written as a terminating decimal.

Write 30 as a product of its prime factors.

If the denominator contains a factor other than 2 or 5 then the fraction cannot be written as a terminating decimal.

30 = ... × ..... × ..... **(2 marks)**

4 By writing the denominator in terms of its prime factors, state whether the following fractions convert to recurring or terminating decimals.

(a) $\frac{11}{40}$ **(1 mark)**

(b) $\frac{15}{32}$ **(1 mark)**

(c) $\frac{22}{39}$ **(1 mark)**

(d) $\frac{9}{42}$ **(1 mark)**

5 Write down $\frac{2}{11}$ as recurring decimal.

..... **(1 mark)**

6 Convert the following fractions into decimals using short or long division.

(a) $\frac{11}{40}$ ..... **(1 mark)**

(b) $\frac{6}{25}$ ..... **(1 mark)**

(c) $\frac{11}{30}$ ..... **(1 mark)**

7 The time taken to travel 12 metres by a toy car is 5 seconds.
Sandeep says that the speed of the car is 2.375 m/s.
Is he correct? Give reasons for your answer.

$\text{speed} = \frac{\text{distance}}{\text{time}}$

Use long or short division.

(3 marks)

8 Use the information that 138 × 85 = 11 730 to find the value of

(a) 1380 × 85 ..... **(1 mark)**

(b) 0.138 × 8.5 ..... **(1 mark)**

(c) 11 730 ÷ 1.38 ..... **(1 mark)**

Estimation

1 Work out an estimate for the value of

(a) $188 \times 69 \approx 200 \times 70 =$ ..... **(1 mark)**

(b) $28.9 \div 4.85 \approx$ ..... $\div$ ..... = ... **(1 mark)**

(c) $(51.2)^3 \approx$ (.....)^3 = ... **(1 mark)**

Round both values to 1 significant figure.

2 Work out an estimate for the value of $\dfrac{4826}{4.1 \times 9.72}$

$\approx \dfrac{5000}{4 \times .....} = \dfrac{.....}{.....} =$ .....

1. Round all values to 1 significant figure.
2. Multiply the numbers in the denominator.
3. Cancel if possible, then divide.

(2 marks)

3 Work out an estimate for the value of $\dfrac{8.92 \times 408}{0.506}$

Do not round 0.506 to 1 as this is incorrect.

If you need to divide by a decimal you can multiply top and bottom by 10 or 100 to simplify the calculation.

..... **(2 marks)**

4 Work out an estimate for the value of $\dfrac{716 \times 5.13}{0.191}$

$\approx \dfrac{700 \times 5}{0.2} = \dfrac{3500}{0.2} = \dfrac{.....}{2} =$ ..... **(2 marks)**

5 Work out an estimate for the value of $\dfrac{29 \times 4.90}{0.204}$

..... **(2 marks)**

6 The radius of a sphere is 6.2 cm.

(a) Work out an estimate for the surface area of the sphere.

You will need to use problem-solving skills throughout your exam – **be prepared!**

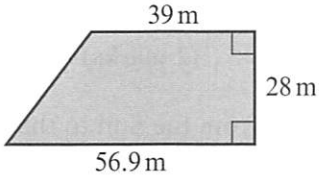
Surface area of a sphere = $4\pi r^2$

..... cm^2 **(2 marks)**

(b) Without further calculation, explain whether your method gives you an overestimate or an underestimate for the surface area of the sphere.

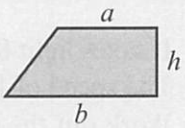
..... **(1 mark)**

7 Karl has a field in the shape of a trapezium.



(a) Work out an estimate for the area of the field.

You need to learn the formula for the area of a trapezium for your exam:



Area = $\frac{1}{2}(a + b)h$

..... m^2 **(3 marks)**

(b) Is your answer an overestimate or underestimate? Explain your answer.

..... **(1 mark)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Standard form

1 (a) Write 45 000 in standard form.

Count decimal places from the right. How many jumps do you need to make to get 4.5?

Guided

$45\,000 = 4.5 \times 10^{\cdots\cdots}$ **(1 mark)**

(b) Write 3.4×10^{-5} as an ordinary number.

The power of 10 is negative so the number is less than 1.

$3.4 \times 10^{-5} = 0.0\ldots\ldots\ldots\ldots$ **(1 mark)**

(c) Write 28×10^{6} in standard form. ..... **(1 mark)**

2 Write in standard form

(a) 567 000 ..... **(1 mark)**

(b) 0.000 056 7 ..... **(1 mark)**

(c) 567×10^{8} ..... **(1 mark)**

3 In 2014 the population of the United Kingdom was 6.5×10^{7}.
In 2014 the population of the Russia was 1.4×10^{8}.

(a) Work out the combined population of the United Kingdom and Russia.
Give your answer in standard form.

..... **(2 marks)**

(b) Work out the difference between the population of the United Kingdom and the population of Russia. Give your answer in standard form.

..... **(2 marks)**

4 Work out, giving your answers in standard form

Try this question without a calculator. Multiply the number parts then add the powers.

Guided

(a) $(3 \times 10^{6}) \times (6 \times 10^{-3})$

$(3 \times \ldots\ldots) \times (10^{6} \times 10^{\cdots}) = \ldots\ldots \times 10^{\cdots}$

$= \ldots\ldots \times 10^{\cdots}$ **(2 marks)**

(b) $(8 \times 10^{6}) \div (4 \times 10^{-14})$

$(8 \div \ldots\ldots) \times (10^{6} \div 10^{\cdots}) = \ldots\ldots \times 10^{\cdots}$ **(2 marks)**

5 Work out, giving your answers in standard form

Guided

(a) $5.1 \times 10^{3} + 6.5 \times 10^{4}$

$5100 + 65000 = \ldots\ldots$ **(2 marks)**

(b) $7.6 \times 10^{5} - 8 \times 10^{3}$

$760000 - 8000 = \ldots\ldots$ **(2 marks)**

6 It takes light 8 minutes to travel from the Sun to the Earth.
The speed of light is 3×10^{8} m/s.
Work out the distance, in km, from the Sun to the Earth.
Give your answer in standard form.

Distance (in km) = speed (in km/s) × time (in seconds)

..... **(3 marks)**

Recurring decimals

1 Show that $0.\dot{7}$ can be written as the fraction $\frac{7}{9}$

Guided

Let $x = 0.777\,777\,7...$

$10x = 7.777\,777\,7...$ — Multiply by 10.

$-$

$x = 0.777\,777\,7...$

.....x = ...

x = ... **(3 marks)**

2 Prove that the recurring decimal $0.\dot{4}\dot{2}$ has the value $\frac{14}{33}$

Guided

Let $x = 0.424\,242\,42...$

$100x = 42.424\,242\,42...$ — Multiply by 100.

$-$

$x = 0.424\,242\,42...$

.....x = ...

x = ... Cancel down. **(3 marks)**

3 (a) Show that the recurring decimal $0.\dot{8}\dot{1}$ can be written as $\frac{9}{11}$

..... **(3 marks)**

(b) Hence, or otherwise, write the recurring decimal $0.4\dot{8}\dot{1}$ as a fraction.

..... **(1 mark)**

4 Work out the recurring decimal $0.6\dot{1}\dot{7}$ as a fraction in its simplest form.

PROBLEM SOLVED!

You will need to use problem-solving skills throughout your exam – **be prepared!**

..... **(3 marks)**

5 Express the recurring decimal $5.2\dot{3}7\dot{1}$ as a fraction.

..... **(3 marks)**

6 Prove that the recurring decimal $6.43\dot{2}$ can be written as the fraction $\frac{5789}{900}$

(3 marks)

7 x is an integer such that $1 \leqslant x \leqslant 9$

Prove that $0.\dot{0}\dot{x} = \frac{x}{99}$

(3 marks)

Upper and lower bounds

Guided

1 The mass of a bag of cement is 20 kg, correct to the nearest kg.

What is half of 1 kg?

(a) Write down the smallest possible mass of the bag of cement.

20 − 0.5 = ... kg **(1 mark)**

(b) Write down the largest possible mass of the bag of cement.

20 + ... = ... kg **(1 mark)**

Guided

2 The length of a piece of string is 52.3 cm, correct to 1 decimal place.

(a) Write down the greatest possible length of the piece of string.

52.3 + 0.05 = ... cm **(1 mark)**

(b) Write down the least possible length of the piece of string.

52.3 − ..... = ... cm **(1 mark)**

Guided

3 The kinetic energy, in joules (J), of a moving object is calculated using the formula

$$\text{kinetic energy} = \frac{1}{2}mv^2$$

Use the rules of multiplication when finding upper and lower bounds.

The mass of the object is 2.6 kg, to the nearest tenth of a kilogram.
The velocity of the object is 32.7 m/s, correct to 3 significant figures.
Find the lower bound and the upper bound of the kinetic energy, in joules, of the object.
Give your answer correct to 3 significant figures.

Lower bound of mass = ...

Upper bound of mass = ...

Lower bound of velocity = ...

Upper bound of velocity = ...

$\frac{1}{2}mv^2$ = ... = ... J

$\frac{1}{2}mv^2$ = ... = ... J **(3 marks)**

4 An experiment is carried out to measure the density of rolled lead, in g/cm^3.
The mass of the rolled lead is 572 grams, correct to the nearest gram.
The volume of the rolled lead is 50.2 cm^3, correct to 3 significant figures.
Use the formula density = $\frac{\text{mass}}{\text{volume}}$ to find the range of possible values for the density of rolled lead, in g/cm^3.
Give your answers correct to 4 significant figures.

..... **(3 marks)**

5 A ball is thrown vertically upwards with a speed v metres per second.
The height, H metres, to which it rises is given by the formula

$$H = \frac{v^2}{2g}$$

where g m/s^2 is the acceleration due to gravity.
v = 35.3 m/s correct to 3 significant figures and g = 9.8 m/s^2 correct to 2 significant figures.

Calculate the upper bound of H. Give your answer correct to 3 significant figures.

..... **(2 marks)**

Accuracy and error

1 The length of a rod is measured as 33.4 cm. Complete the inequality for the length.

Guided

33.3 ..... cm ⩽ length of rod < ..... cm **(2 marks)**

2 A bottle of lemonade is labelled with a volume of 1.75 litres.
Complete the inequality for the volume.

..... litres ⩽ volume of lemonade < ..... litres **(2 marks)**

3 The area of a circle is given as 132 cm², correct to 3 significant figures.
Find the radius of the circle to an appropriate degree of accuracy.
You must explain why your answer is to an appropriate degree of accuracy.

Guided

PROBLEM SOLVED!

Find the upper and lower bound of the radius.

UB = $\sqrt{\frac{\ldots\ldots}{\pi}}$ = ... LB = ...

Radius = ...

You will need to use problem-solving skills throughout your exam – **be prepared!**

To how many significant figures do the two answers agree?

..... **(4 marks)**

4 A crane uses a cable with a breaking strain of 2800 kg measured to 2 significant figures.
It is used to lift pallets with a mass of 50 kg measured to 2 significant figures.
What is the greatest number of pallets that can safely be lifted at one time without the cable breaking?

..... **(4 marks)**

5 Ravina measured her handspan with a ruler and found it was 15 cm to the nearest centimetre. Anjali measured her handspan more accurately and found it was 148 mm to the nearest millimetre.
Use the upper and lower bounds of the measurements to show whether it is possible that Anjali's handspan is larger than Ravina's.

(4 marks)

6 An object is projected vertically upwards.
The energy, E, of the object is 18.3 J, correct to 3 significant figures.
The mass, m, of the object is 3.8 kg, correct to 1 decimal place.
The velocity, v, of the object is given by the formula $v = \sqrt{\frac{2E}{m}}$

(a) Find the upper and lower bounds of the velocity, in m/s.
Give your answers correct to 4 significant figures.

(4 marks)

(b) Use your answers to part (a) to write down the value of v to a suitable degree of accuracy.
You must explain your answer.

..... **(1 mark)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Surds 1

Guided

1 Express the following surds in the form $a\sqrt{b}$, where a and b are integers.

(a) $\sqrt{12} = \sqrt{\ldots\ldots} \times \sqrt{3} = \ldots\ldots\sqrt{3}$ **(1 mark)**

Think of two numbers which, when multiplied, give 12, one of which is a square number.

(b) $\sqrt{20} = \sqrt{4} \times \sqrt{\ldots\ldots} = \ldots\ldots$ **(1 mark)**

(c) $\sqrt{48} = \sqrt{\ldots\ldots} \times \sqrt{\ldots\ldots} = \ldots\ldots$ **(1 mark)**

(d) $\sqrt{3} \times \sqrt{27}$ ..... **(2 marks)**

(e) $\sqrt{98} - \sqrt{18}$ ..... **(2 marks)**

(f) $5\sqrt{28} - \sqrt{63}$ ..... **(2 marks)**

Guided

2 Rationalise the denominator.

(a) $\frac{3}{\sqrt{5}}$

$\frac{3}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} =$ ..... **(1 mark)**

(b) $\frac{2}{\sqrt{6}}$

$\frac{2}{\sqrt{6}} \times \frac{\sqrt{\ldots}}{\sqrt{\ldots}} =$ ..... = ... **(1 mark)**

(c) $\frac{2}{\sqrt{8}}$

..... **(1 mark)**

(d) $\frac{21}{\sqrt{7}}$

..... **(1 mark)**

(e) $\frac{1+\sqrt{3}}{\sqrt{12}}$

..... **(2 marks)**

(f) $\frac{\sqrt{18}+10}{\sqrt{2}}$

..... **(2 marks)**

3 Solve the following equations where x is an integer.

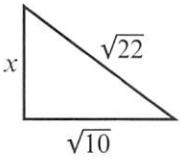
(a) $\sqrt{45} \times x = \sqrt{180}$

$x =$ ..... **(3 marks)**

(b) $\frac{\sqrt{x} \times \sqrt{24}}{2\sqrt{3}} = \sqrt{20}$

$x =$ ..... **(4 marks)**

4 Find the length of the side labelled x in the form $a\sqrt{b}$, where a and b are integers.



$x =$ ..... **(3 marks)**

5 Show that $\frac{1}{1+\frac{1}{\sqrt{3}}}$ can be written as $\frac{3-\sqrt{3}}{2}$

(3 marks)

Counting strategies

1 Emily has four tiles.

W	X	Y	Z

Emily chooses two of these tiles.
Write down all the possible combinations she can get.

(2 marks)

Guided

2 Asha, Bev, Chloe and Dan are playing in a competition.
Each player must play each other once.
How many games will be played in total?

Label Asha, Bev, Chloe and Dan as A, B, C and D respectively.

Remember (A, B) is the same as (B, A).

(A, ...) (A, ...) (A, ...) (B, ...) ..... **(2 marks)**

3 Craig has a black shirt (BS), a white shirt (WS) and a pink shirt (PS).
He also has a yellow tie (YT), a red tie (RT) and an orange tie (OT).
Craig picks a shirt and a tie combination at random.
How many combinations can Craig choose?

..... **(2 marks)**

Guided

4 Jack has a code for his money box. The code consists of two digits followed by three letters. The digits and the letters can be repeated. The digits are the numbers 0 to 9.
Jack says that there are more than one million different possible codes.
Is he correct? You must show your working.

How many digits are there?

How many letters are there?

digit digit letter letter letter

10 × ..... × 26 × ..... × ..... = ...

Jack is ..... **(2 marks)**

PROBLEM SOLVED!

5 The diagrams show keypads for two different types of alarm.
Each keypad has a four-key code.

You will need to use problem-solving skills throughout your exam – **be prepared!**

Classic alarm keypad

1	2	3	4	5
6	7	8	9	0

Premier alarm keypad

1	2	3	4	5
6	7	8	9	0
A	B	C		

(a) How many different codes are possible for the

(i) Classic alarm keypad ..... (ii) Premier alarm keypad? ..... **(2 marks)**

(b) The Premier alarm keypad is then programmed so that the four-key code must start with two letters, followed by two digits.
Show that there are fewer than 1000 codes possible.

(2 marks)

Had a go ☐ Nearly there ☐ Nailed it! ☐

Problem-solving practice 1

1 A machine makes 48 bolts every hour.
The machine makes bolts for $7\frac{1}{2}$ hours each day, on 5 days of the week.
The bolts are packed into boxes. Each box holds 30 bolts.
How many boxes are needed for all the bolts made each week?

..... boxes **(4 marks)**

2 Ethan bought some food for a party. He is going to make some hot dogs.
He needs a bread roll, a sausage and a sachet of ketchup for each hot dog.
There are 40 bread rolls in a pack, 24 sausages in a tray and 15 sachets of ketchup in a packet.
Ethan buys exactly the same number of bread rolls, sausages and sachets of ketchup.

(a) What is the smallest number of packs of bread rolls, trays of sausages and packets of ketchup Ethan could have bought?

..... packs of bread rolls

..... trays of sausages

..... packets of ketchup **(3 marks)**

(b) How many hot dogs can he make?

..... **(1 mark)**

3 (a) A code for a mobile phone is made up of three digits.
The digits use the numbers 0 to 9. The digits can be repeated.
How many different possible codes are there?

..... **(1 mark)**

(b) If the digits cannot be repeated, how many different possible codes are there?

..... **(2 marks)**

A different code has x digits. The digits use the numbers 1 to 8. The digits can be repeated.
There are about 260 000 different possible codes.

(c) Work out the value of x. You must show all your working.

$x =$ ..... **(2 marks)**

Problem-solving practice 2

4 One sodium atom has a mass of 3.82×10^{-23} grams.

(a) Work out an estimate for the number of sodium atoms in 1 kg of sodium.

..... **(3 marks)**

(b) Is your answer to part (a) an underestimate or an overestimate?
Give a reason for your answer.

.....

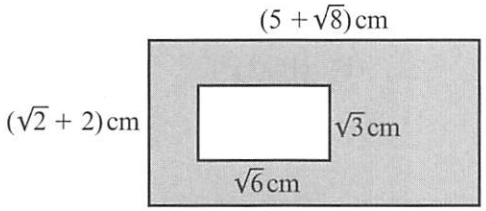
..... **(1 mark)**

5 $t = \dfrac{d}{2\sqrt{f}}$

$d = 9.82$ correct to 3 significant figures
$f = 2.46$ correct to 3 significant figures
By considering bounds, work out the value of t to a suitable degree of accuracy.
Give a reason for your answer.

(5 marks)

6 A large rectangular piece of card is $(5 + \sqrt{8})$ cm long and $(\sqrt{2} + 2)$ cm wide.
A small rectangle $\sqrt{6}$ cm long and $\sqrt{3}$ cm wide is cut out of the piece of card.



Work out the shaded area, in cm^2. Give your answer in the form $a\sqrt{2} + b$ where a and b are integers.

..... cm^2 **(4 marks)**

Answers

NUMBER

1. Factors and primes

1 (a) (i) $2 \times 3^2 \times 5$
(ii) $2 \times 3 \times 5 \times 7$
(b) 30 (c) 630
2 25, 50
3 $m = 3, n = 5$
4 3 packs of hats, 2 packs of scarves

2. Indices 1

1 (a) 4^2 (b) 5
2 (a) 16 (b) 8 (c) 8
(d) 4 (e) 3 (f) −4
3 (a) 5^9 (b) 5^3 (c) 5^4
4 (a) 3^3 (b) 3^2 (c) 3^8 (d) 3^6
5 (a) 9 (b) 4
6 8
7 $2^3 = 8$ not 6
8 $x = 7$ and $y = 5$

3. Indices 2

1 (a) $\frac{1}{8}$ (b) $\frac{1}{3}$ (c) $\frac{1}{49}$ (d) $\frac{1}{2}$
2 (a) $\frac{1}{3}$ (b) 4 (c) $\frac{5}{3}$ (d) $\frac{7}{9}$
3 (a) $\frac{8}{9}$ (b) $\frac{64}{27}$ (c) $\frac{16}{25}$ (d) $\frac{1}{125}$
4 (a) $\frac{9}{16}$ (b) 27 (c) $\frac{25}{36}$ (d) $\frac{125}{27}$
5 (a) 5 (b) 2 (c) 4 (d) 3
6 (a) 64 (b) 8 (c) 125 (d) 9
7 $8^{\frac{1}{3}} = 2$ so $8^{\frac{2}{3}} = 2^2 = 4$
$16^{\frac{1}{2}} = 4$
8 (a) xy (b) y^2

4. Calculator skills 1

1 (a) 3380 (b) 9.75 (c) 6.87
2 (a) 216 (b) 17.9
3 1.751 592 357
4 (a) 8.5625 (b) 9
5 (a) 2.27×10^4 (b) 2.22×10^9
6 (a) 2.47 (b) 5.13
7 3.00×10^9

5. Fractions

1 (a) $6\frac{11}{20}$ (b) $2\frac{1}{10}$
2 (a) $3\frac{5}{6}$ (b) $3\frac{1}{3}$
3 (a) 9 (b) $3\frac{9}{13}$
4 £80
5 $\frac{1}{24}$
6 16
7 $5\frac{11}{12}$ hours
8 $16\frac{2}{3}$ m²

6. Decimals

1 0.3, $\frac{1}{3}$, 0.35, $\frac{18}{50}$
2 0.15
3 $2 \times 3 \times 5$
4 (a) $2^3 \times 5$ terminating (b) 2^5 terminating
(c) 3×13 recurring (d) $2 \times 3 \times 7$ recurring
5 0.181 818 181 8
6 (a) 0.275 (b) 0.24 (c) 0.367
7 No, because $12 \div 5 = 2.4$ not 2.375
8 (a) 11 7300 (b) 1.173 (c) 8500

7. Estimation

1 (a) 14 000 (b) 6 (c) 125 000
2 125
3 7200
4 17 500
5 750
6 (a) 432 cm²
(b) Underestimate, because the original values have been rounded down
7 (a) 1500 m²
(b) Overestimate, because the original values have been rounded up

8. Standard form

1 (a) 4.5×10^4 (b) 0.000 034 (c) 2.87×10^7
2 (a) 5.67×10^5 (b) 5.67×10^{-5} (c) 5.67×10^{10}
3 (a) 2.05×10^8 (b) 7.5×10^7
4 (a) 1.8×10^4 (b) 2×10^{20}
5 (a) 7.01×10^4 (b) 7.52×10^5
6 1.44×10^8 km

9. Recurring decimals

1 $x = 0.777\,77$
$10x = 7.777\,77$
Subtracting,
$9x = 7$ so $x = \frac{7}{9}$
2 $x = 0.424\,242\,42$
$100x = 42.424\,242$
Subtracting,
$99x = 42$ so $x = \frac{42}{99} = \frac{14}{33}$
3 (a) $x = 0.818\,181\,81$
$100x = 81.818\,181$
Subtracting,
$99x = 81$ so $x = \frac{81}{99} = \frac{9}{11}$
(b) $\frac{53}{110}$
4 $\frac{611}{990}$
5 $\frac{52\,319}{9990}$
6 $x = 6.432\,222\,22$
$100x = 643.222\,22$
$1000x = 6432.222\,22$
Subtracting,
$900x = 5789$ so $x = \frac{5789}{900}$
7 $y = 0.0x0x0x0x$
$100y = 00x.0x0x0x$
Subtracting,
$99y = x$ so $y = \frac{x}{99}$

10. Upper and lower bounds

1 (a) 19.5 kg (b) 20.5 kg
2 (a) 52.35 cm (b) 52.25 cm
3 LB = 1360 J; UB = 1420 J
4 11.37 to 11.42 g/cm³
5 64.1 m

11. Accuracy and error

1 33.35 cm ≤ length of rod < 33.45 cm
2 1.745 litres ≤ volume < 1.755 litres
3 6.5 cm (LB = 6.46..., UB = 6.49... both round to 6.5 to 2 s.f.)
4 54 is the safest maximum
5 Yes. Ravina's handspan could be as small as 145 mm whereas Anjali's could be as large as 148.5 mm
6 (a) 3.079 and 3.128 (b) 3.1 m/s

12. Surds 1

1 (a) $2\sqrt{3}$ (b) $2\sqrt{5}$ (c) $4\sqrt{3}$
(d) 9 (e) $4\sqrt{2}$ (f) $7\sqrt{7}$
2 (a) $\frac{3\sqrt{5}}{5}$ (b) $\frac{\sqrt{6}}{3}$ (c) $\frac{\sqrt{2}}{2}$
(d) $3\sqrt{7}$ (e) $\frac{3+\sqrt{3}}{6}$ (f) $3 + 5\sqrt{2}$
3 (a) 2 (b) 10
4 $2\sqrt{3}$

5 $\dfrac{1}{1+\dfrac{1}{\sqrt{3}}} = \dfrac{1}{\dfrac{\sqrt{3}+1}{\sqrt{3}}} = \dfrac{\sqrt{3}}{\sqrt{3}+1}$

$= \dfrac{\sqrt{3}(\sqrt{3}-1)}{(\sqrt{3}+1)(\sqrt{3}-1)} = \dfrac{3-\sqrt{3}}{3-1} = \dfrac{3-\sqrt{3}}{2}$

13. Counting strategies

1 WX, WY, WZ, XY, XZ, YZ
2 (A,B) (A,C) (A,D) (B,C) (B,D) (C,D) 6 games
3 9
4 Yes, there are 1 757 600 different possible codes
5 (a) (i) 10 000 (ii) 28 561
(b) There are 900 possible codes

14. Problem-solving practice 1

1 60
2 (a) 3 packs of bread rolls, 5 packs of sausages, 8 packs of ketchup
(b) 120
3 (a) 1000 (b) 720
(c) $8^6 = 262\,144$ so 260 000 possible codes

15. Problem-solving practice 2

4 (a) 2.5×10^{25}
(b) Underestimate, because you are dividing by a number that has been rounded up
5 3.1, because both values of UB and LB are the same for 2 s.f.
6 $6\sqrt{2} + 14$

ALBEBRA

16. Algebraic expressions

1 (a) m^3 (b) d^4 (c) e^5
2 (a) x^{11} (b) y^5 (c) t^4
3 (a) x^6 (b) y^{15} (c) t^{21}
4 (a) x^5 (b) y^9 (c) t^6
5 (a) $28x^3y^7$ (b) $2x^3y$ (c) $81x^8y^{20}z^{12}$
6 (a) $5x^3$ (b) $64x^{4.5}y^6$ (c) $3x^{1.25}y^{0.75}$
7 (a) $9x^8$ (b) $\dfrac{8x^2y^5}{5}$ (c) $\dfrac{16x^2y^6}{9}$

17. Expanding brackets

1 (a) $x^2 + 7x + 12$ (b) $x^2 + 2x - 15$ (c) $x^2 - 8x + 12$
2 (a) $x^2 + 6x + 9$ (b) $x^2 - 8x + 16$ (c) $4x^2 + 4x + 1$
3 (a) $x^3 + 8x^2 + 15x$ (b) $x^3 + 2x^2 - 8x$ (c) $x^3 - 10x^2 + 21x$
4 (a) $x^3 + 9x^2 + 27x + 27$
(b) $x^3 - 12x^2 + 48x - 64$
(c) $8x^3 + 12x^2 + 6x + 1$
5 (a) $6x^2 + 12x - 20$ (b) $x^3 + 3x^2 - 10x - 24$

18 Factorising

1 (a) $3(x + 2)$ (b) $2(p - 3)$ (c) $5(y - 3)$
2 (a) $x(x + 6)$ (b) $x(x + 4)$ (c) $x(x - 12)$
3 (a) $3p(p + 2)$ (b) $8y(y - 3)$
4 (a) $4d(d + 3)$ (b) $6x(x - 3)$
5 (a) $(x + 3)(x + 1)$ (b) $(x + 10)(x + 1)$
6 (a) $(x + 7)(x - 1)$ (b) $(x + 5)(x - 1)$ (c) $(x - 5)(x + 3)$
7 (a) $(x - 3)(x + 3)$ (b) $(x - 12)(x + 12)$
8 (a) $(3x - 1)(x - 2)$ (b) $(2x - 3)(x + 1)$ (c) $(3x + 2)(x - 6)$

19. Linear equations 1

1 (a) 4 (b) 6 (c) 5
(d) 4 (e) 60 (f) −18
2 (a) 3 (b) 2 (c) −2
(d) $-\frac{3}{5}$ (e) 1 (f) $-\frac{5}{4}$
3 (a) 4 (b) −7 (c) 12
(d) 4 (e) 13 (f) 2
4 12

20. Linear equations 2

1 (a) $\frac{14}{3}$ (b) 4 (c) 3
2 (a) 1 (b) 12
3 (a) $\frac{55}{4}$ (b) 3
4 34

21. Formulae

1 (a) 8 (b) −19
2 (a) 23 (b) $\frac{35}{2}$
3 (a) 3500 (b) −200 (c) 8.84 (d) 19.8
4 26 000
5 $A = 2\pi r^2 + \dfrac{2V}{r}$

22. Arithmetic sequences

1 (a) $4n + 1$ (b) $3n - 1$ (c) $7n - 5$
2 $3n + 1$
3 $5n + 1$
4 (a) $4n - 1$ (b) Yes, because $n = 50$
5 (a) $6n - 3$
(b) No, because n is not a whole number

23. Solving sequence problems

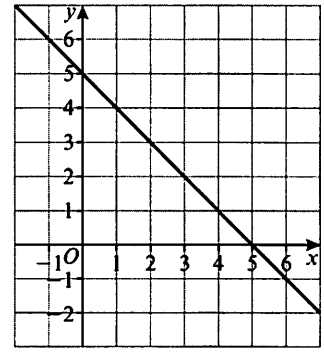
1 (a) $a = 3$ and $b = -1$
2 (a) 9 (b) $U_{n+1} = 2U_n + 3$
3 39
4 (a) 55 (b) $2x + 3y$ (c) $x = 5$ and $y = 6$
5 $27\sqrt{3}$, 81

24. Quadratic sequences

1 2, 7, 14, 23, 34, 47
2 (a) $n^2 + 2$ (b) $2n^2 + 4n - 3$
(c) $2n^2 + 2$ (d) $3n^2 - 2n + 1$
(e) $2n^2 + 4n - 4$ (f) $3n^2 - 5n + 3$
3 (a) $2n^2$
(b) No; if $2n^2 = 75$ then n is not a whole number
4 $n^2 + 3$

25. Straight-line graphs 1

1 y values: 7, 6, 5, 4, 3, 2, 1, 0



2 $y = 2x + 4$
3 $y = -\frac{20}{9}x + \frac{200}{9}$

26. Straight-line graphs 2

1 (a) $y = 3x - 1$
(b) $y = -2x + 12$
(c) $y = 4x + 15$
(d) $y = 4x - 2$
2 (a) $y = 2x - 4$
(b) $y = 2x + 1$
(c) $y = 2x$
3 $y = 4x + 5$
4 $k = 5$

27. Parallel and perpendicular

1 (a) R (b) S
2 (a) $y = 3x - 7$ (b) $y = 4 - \frac{1}{3}x$
3 $y = -\frac{1}{3}x + 8$
4 (a) $y = 2x + 6$ (b) $y = -\frac{1}{2}x + 6$
5 $y = -2x$