

GCSE MATHEMATICS

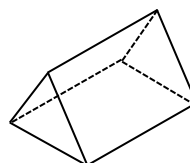
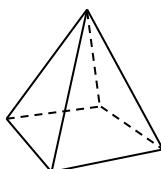
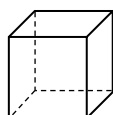
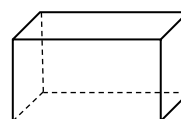
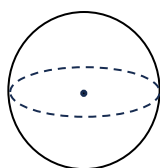
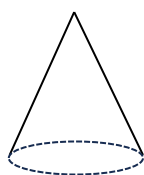
THE ULTIMATE REVISION GUIDE

HIGHER

3 QUESTIONS ON EVERY TOPIC

AT EVERY LEVEL

ALL EXAM-STYLE QUESTIONS



EMU Maths

Essential Maths Unlocked



This revision guide belongs to

HOW TO USE THIS REVISION GUIDE

*The following is guidance only – use the guide as you wish.

For context, every topic consists of three questions.

Q1 = easy. Q2 = medium difficulty. Q3 = challenging.

- a) In the RAG (red, amber, green) grid on the next few pages, start with topic number 1. If you are 100% confident with this topic, mark it as green, attempt Q3 and move to the next topic. For each topic you mark as green on the RAG grid, attempt Q3.

As soon as you reach a topic that you mark amber or red, go to the relevant page and attempt all questions (Q1, Q2 and Q3).

Check your answers at the back of the book. To see full working out, go to

website link available in paper copy of book

- b) Students aiming for grades 4/5 should focus on the questions with a green dot next to them. ●
- c) Students aiming for grades 6/7 should focus on the questions with green dots and yellow dots next to them. ● ●
- d) Students aiming for grades 8/9 should focus on every question in this book (questions with green dots, yellow dots and dark blue dots next to them). ● ● ●
- e) **Before you start answering questions, look through the first few pages as they contain past paper trackers, grade boundaries from previous years, handy formulae and more!**

NUMBER				
1	Fractions			
2	Prime factorisation			
3	HCF and LCM			
4	Rounding & estimation			
5	Error intervals & reciprocals			
6	Multiplying decimals			
7	Dividing decimals			
8	Standard form (with operations)			
9	Standard form (miscellaneous)			
10	Using a calculator			
11	Reverse percentages			
12	Percentage multipliers			
13	Percentages (worded questions)			
14	Percentage change			
15	Compound interest			
16	Recurring decimals			
17	Surds (simplifying)			
18	Surds (expanding brackets)			
19	Surds (rationalising the denominator)			
20	Bounds			
ALGEBRA				
21	Substitution			
22	Expanding single brackets			
23	Expanding double brackets			
24	Expanding triple brackets			
25	Factorising single brackets			
26	Factorising quadratics			
27	Linear sequences			
28	Fibonacci sequences			
29	Changing the subject			
30	Inequalities and number lines			
31	Solving linear inequalities			

ALGEBRA				
32	Drawing linear graphs			
33	Plotting quadratic graphs			
34	Plotting cubic and reciprocal graphs			
35	Recognising graphs			
36	Solving linear equations			
37	Forming and solving equations (from words)			
38	Forming and solving equations (one shape)			
39	Forming and solving equations (two shapes)			
40	Simultaneous equations (linear)			
41	Shading inequalities			
42	Coordinates			
43	Midpoint of a line			
44	Gradient of a straight line			
45	Parallel lines			
46	Perpendicular lines			
47	Equation of a straight line			
48	Gradient of a curve			
49	Speed-time graphs			
50	Distance-time graphs			
51	Index laws			
52	Fractional & negative powers			
53	Estimating powers and roots			
54	Index laws (change of base)			
55	Completing the square			
56	Solving quadratics			
57	Forming and solving quadratics			
58	Iteration			
59	General iterative processes			
60	Functions			
61	Quadratic sequences			
62	Geometric sequences			
63	Features of quadratic graphs			
64	Sketching non-linear graphs			

ALGEBRA				
65	Quadratic inequalities			
66	Algebraic proof (expanding brackets)			
67	Algebraic proof (odds/evens/multiples)			
68	Algebraic proof (squares/cubes)			
69	Algebraic proof (miscellaneous)			
70	Algebraic fractions (simplify)			
71	Algebraic fractions (multiply & divide)			
72	Algebraic fractions (add & subtract)			
73	Algebraic fractions (solve)			
74	Equation of a circle			
75	Coordinate geometry			
76	Equation of a tangent			
77	Simultaneous equations (linear, circle & quadratic)			
RATIO & PROPORTION				
78	Ratios (form $n:l$ or $l:n$)			
79	Ratios (changing ratios)			
80	Ratios (combining ratios)			
81	Ratios (problem solving)			
82	Mass, density, volume			
83	Distance, speed, time			
84	Force, pressure, area			
85	Proportion			
86	Direct proportion			
87	Inverse proportion			
88	Mixed proportion			
89	Recipes			
90	Conversion graphs			
91	Exchange rates			
92	Best buys			

GEOMETRY & MEASURE				
93	Converting between units			
94	Scale diagrams			
95	Constructing triangles			
96	Plans and elevations			
97	Transformations			
98	Describing transformations			
99	Area of shapes (proof)			
100	Circles			
101	Arcs and sectors			
102	Volume of prisms			
103	Surface area of prisms			
104	Angles in triangles			
105	Angles in parallel lines			
106	Angles in regular polygons			
107	Angles in irregular polygons			
108	Pythagoras' theorem			
109	Trigonometry			
110	Exact values			
111	Trigonometry and Pythagoras in 3D			
112	Similar shapes (2D)			
113	Similar shapes (3D)			
114	Proving similarity			
115	Proving congruency			
116	Sine rule (length & angles)			
117	Sine rule (area)			
118	Cosine rule			
119	Cosine and sine rule			
120	Circle theorems			
121	Circle theorems (proof)			

GEOMETRY & MEASURE				
122	Spheres and cones			
123	Frustums			
124	Loci & bisectors			
125	Bearings			
126	Trigonometric graphs			
127	Transforming graphical functions			
128	Solving trigonometric equations			
129	Vectors			
PROBABILITY				
130	Probability in tables			
131	Probability (mixture)			
132	Two-way tables			
133	Frequency trees			
134	Product rule			
135	Probability (tree diagrams)			
136	Probability (drawing tree diagrams)			
137	Probability (algebraic tree diagrams)			
138	Probability (venn diagrams)			
STATISTICS				
139	Averages			
140	Averages from tables			
141	Scatter graphs			
142	Frequency polygons			
143	Stem and leaf diagrams			
144	Box plots			
145	Pie charts			
146	Capture-recapture			
147	Cumulative frequency graphs			
148	Cumulative frequency graphs and box plots			

STATISTICS				
149	Histograms (drawing)			
150	Histograms (problem solving)			

A) THINGS TO NOTE

- a) The following revision guide has been produced in line with the Edexcel (Pearson) GCSE Maths syllabus.

Due to content overlap, content in the following revision guide also pertains significantly to the following exam boards: AQA, OCR and Edexcel IGCSE.

- b) All diagrams in the revision guide are not accurately drawn.

- c) Answers to all questions are at the back of the book. **Worked solutions can be accessed via the following weblink:** [website link available in paper copy of book](#)

- d) It is recommended that you use a pencil on the RAG grid so that you can edit as you improve.

B) GRADE BOUNDARIES (Higher Tier Edexcel entries only)

Year	Maximum mark	Grade 9	Grade 8	Grade 7	Grade 6	Grade 5	Grade 4
June 2017	240	190	157	124	96	68	41
November 2017	240	189	150	112	85	58	32

June 2018	240	202	170	139	109	79	50
November 2018	240	194	159	125	95	66	37

June 2019	240	198	167	137	108	80	52
November 2019	240	197	165	133	103	73	43

November 2020	240	189	157	126	96	66	37
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November 2021	240	187	154	122	93	65	37
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June 2022	240	194	165	137	104	71	38
November 2022	240	194	165	137	104	71	38

June 2023	240	203	174	145	112	79	47
November 2023	240	203	174	145	112	79	47

June 2024	240	197	167	137	105	73	42
November 2024	240	200	170	140	107	75	43

June 2025	240	217	186	156	121	87	53
November 2025	240	211	182	153	119	85	51

June 2026	240						
November 2026	240						

June 2027	240						
November 2027	240						

June 2028	240						
November 2028	240						

C) EXAM DATES

PAPER 1	PAPER 2	PAPER 3
Day: _____	Day: _____	Day: _____
Date: _____	Date: _____	Date: _____

D) NOTES

This image shows a full page of blank white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for writing or drawing. There are no margins, text, or other markings on the page.

E) FORMULAE SHEET (OFFICIAL)

*The below formulae are on the Higher Tier formulae sheet for those sitting the Edexcel GCSE exams.

Area, volume and perimeter

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

$$\text{Volume of a prism} = \text{area of cross section} \times \text{length}$$

$$\text{Circumference of a circle } 2\pi r = \pi d$$

$$\text{Area of a circle} = \pi r^2$$

Quadratic formula

Where the quadratic equation is in the form $ax^2 + bx + c = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Pythagoras' Theorem and Trigonometry

$$a^2 + b^2 = c^2$$

$$\sin A = \frac{a}{c} \quad \cos A = \frac{b}{c} \quad \tan A = \frac{a}{b}$$

Non-right-angled triangles

$$\text{Sine rule: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{Cosine rule: } a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area of triangle: } \frac{1}{2} a b \sin C$$

Compound interest

Where P = the principal amount, r = the interest rate, n = the number of times that the interest is compounded

$$\text{Total accrued} = P \left(1 + \frac{r}{100} \right)^n$$

Probability

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A \text{ and } B) = P(A \text{ given } B) P(B)$$

F) HANDY THINGS TO KNOW (NOT OFFICIAL)

*The below are not on the official formulae sheet but are nonetheless useful to know.

UPPER AND LOWER BOUNDS

OPERATION	RULE
Adding	UB = UB + UB LB = LB + LB
Subtracting	UB = UB - LB LB = LB - UB
Multiplying	UB = UB X UB LB = LB X LB
Dividing	UB = UB ÷ LB LB = LB ÷ UB

LAWS OF INDICES

LAW	EXAMPLE
$y^a \times y^b = y^{a+b}$	$2^2 \times 2^3 = 2^5$
$y^a \div y^b = y^{a-b}$	$2^2 \div 2^3 = 2^{-1}$
$(y^a)^b = y^{a \times b}$	$(2^2)^3 = 2^6$
$(xy)^a = x^a y^a$	$(2a^2b)^3 = 2^3 \times (a^2)^3 \times b^3 = 8a^6b^3$
$y^{\frac{1}{a}} = \sqrt[a]{y}$	$64^{\frac{1}{2}} = \sqrt[2]{64} = 8$ $27^{\frac{1}{3}} = \sqrt[3]{27} = 3$
$y^{\frac{a}{b}} = (\sqrt[b]{y})^a$	$4^{\frac{3}{2}} = (\sqrt[2]{4})^3 = 2^3 = 8$
$y^{-a} = \frac{1}{y^a}$	$2^{-5} = \frac{1}{2^5} = \frac{1}{32}$
$y^{-\frac{a}{b}} = \frac{1}{y^{\frac{a}{b}}}$	$64^{-\frac{2}{3}} = \frac{1}{64^{\frac{2}{3}}} = \frac{1}{(\sqrt[3]{64})^2} = \frac{1}{4^2} = \frac{1}{16}$
$y^0 = 1$	$2^0 = 1$

COMPLETING THE SQUARE

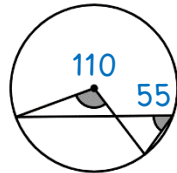
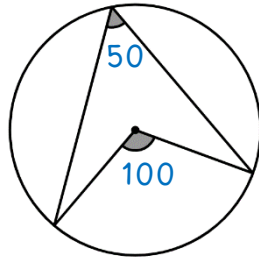
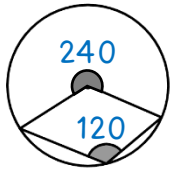
$$x^2 + bx + c = \left(x + \frac{b}{2}\right)^2 - \left(\frac{b}{2}\right)^2 + c$$

$$x^2 - bx + c = \left(x - \frac{b}{2}\right)^2 - \left(\frac{b}{2}\right)^2 + c$$

CIRCLE THEOREMS

Angle at the centre theorem

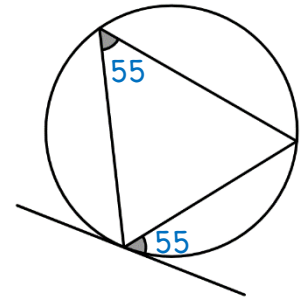
The angle at the centre is double the angle at the circumference



Alternate segment theorem

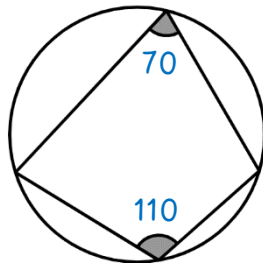
The angle between a chord and a tangent is equal to the angle subtended by the chord in the alternate segment

Alternate segment theorem



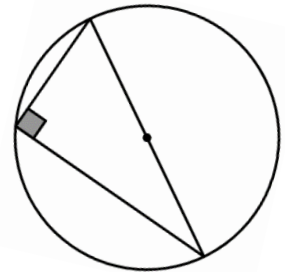
Cyclic quadrilateral

Opposite angles in a cyclic quadrilateral sum to 180°



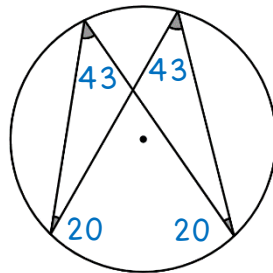
Angles in a semicircle

The angle at the circumference in a semicircle is 90°



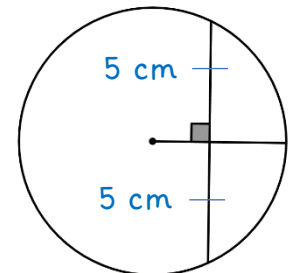
Angles in the same segment theorem

Angles in the same segment are equal



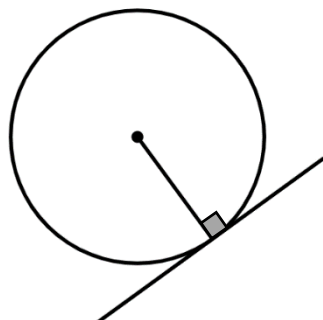
Chords of a circle

The perpendicular from the centre of a circle to a chord bisects the chord



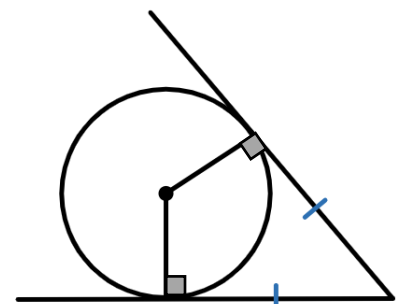
Tangent and radius

The angle between a tangent and a radius is 90°



Tangents that meet

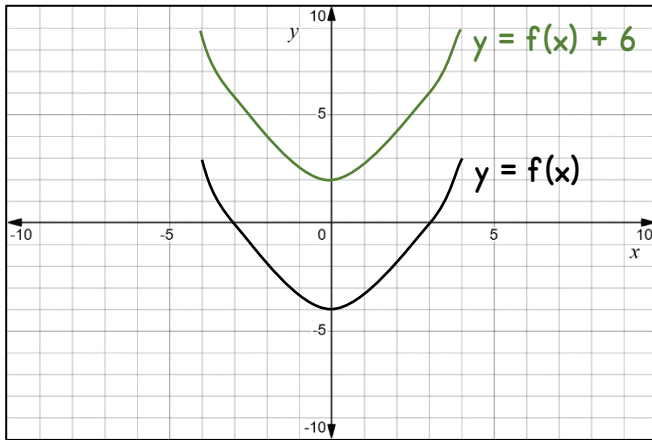
Tangents which meet at the same point are equal in length



TRANSFORMING GRAPHS

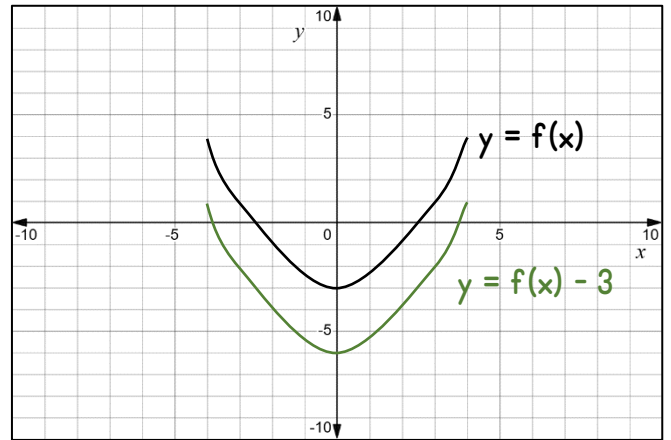
$$y = f(x) + k$$

(graph moves up 'k' units)



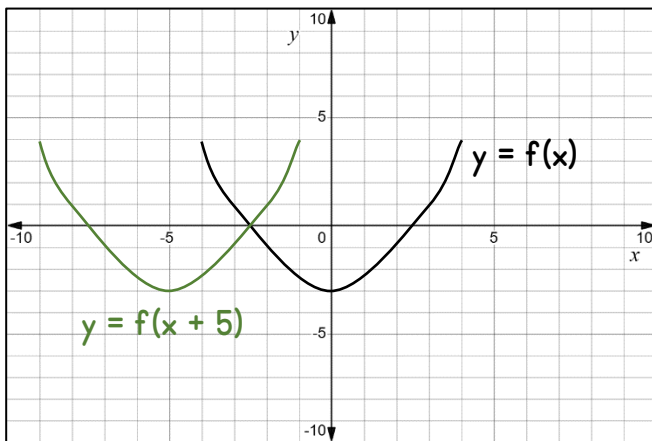
$$y = f(x) - k$$

(graph moves down 'k' units)



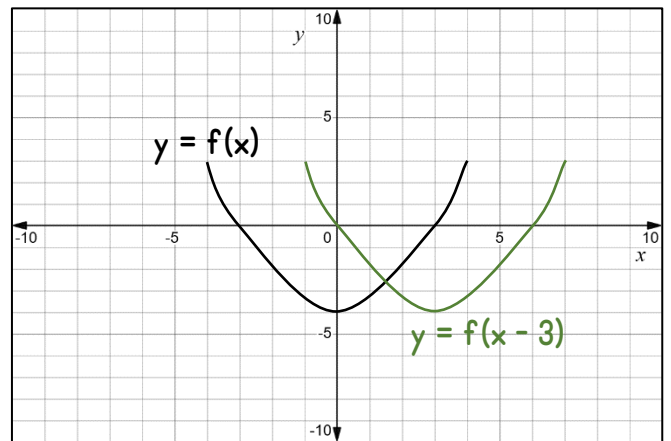
$$y = f(x + k)$$

(graph moves left 'k' units)



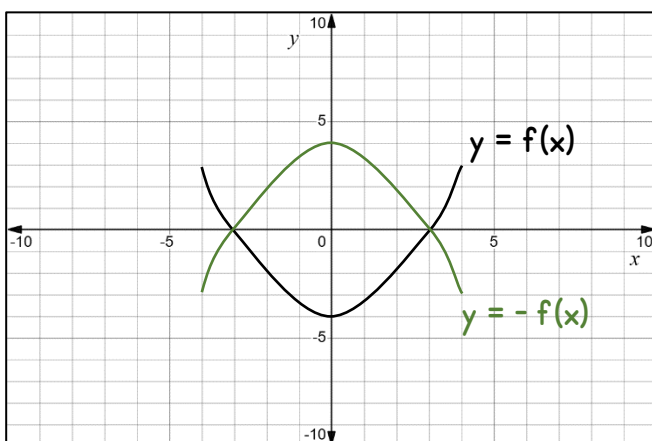
$$y = f(x - k)$$

(graph moves right 'k' units)



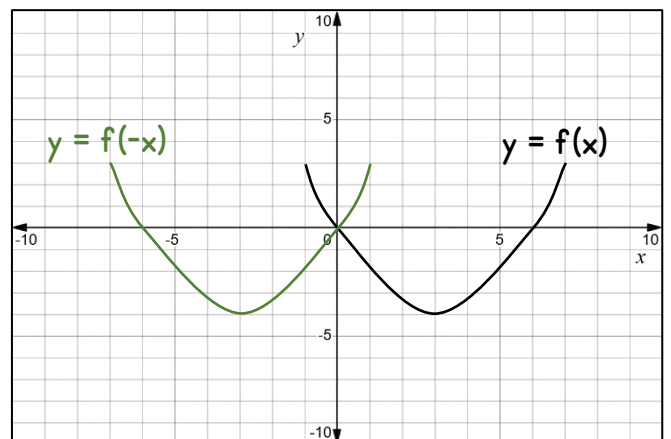
$$y = -f(x)$$

(reflects the graph about the x-axis)



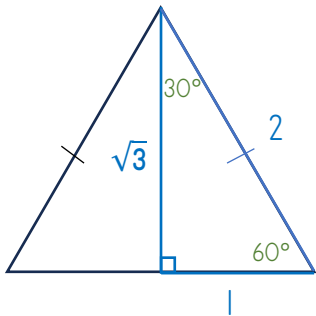
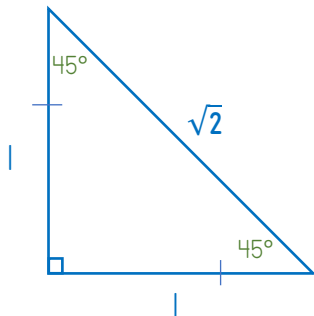
$$y = f(-x)$$

(reflects the graph about the y-axis)



EXACT VALUES

	0°	30°	45°	60°	90°
$\sin\theta$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	undefined

Special triangle 1	Special triangle 2
- Equilateral triangle - Side lengths of 2  Can use to work out: - $\sin(30^\circ)$ $\sin(60^\circ)$ - $\cos(30^\circ)$ $\cos(60^\circ)$ - $\tan(30^\circ)$ $\tan(60^\circ)$	- Isosceles, right-angled triangle - Shorter sides with lengths of 1  Can use to work out: - $\sin(45^\circ)$ - $\cos(45^\circ)$ - $\tan(45^\circ)$

G) REVISION TRACKER (PAST PAPERS)

Month	Year	Paper	Mark out of 80	Grade		Topics to revise
May/June	2017	Paper 1			Marks away from desired grade:	
May/June	2017	Paper 2				
May/June	2017	Paper 3				
November	2017	Paper 1			Marks away from desired grade:	
November	2017	Paper 2				
November	2017	Paper 3				

May/June	2018	Paper 1			Marks away from desired grade:	
May/June	2018	Paper 2				
May/June	2018	Paper 3				
November	2018	Paper 1			Marks away from desired grade:	
November	2018	Paper 2				
November	2018	Paper 3				

May/June	2019	Paper 1			Marks away from desired grade:	
May/June	2019	Paper 2				
May/June	2019	Paper 3				
November	2019	Paper 1			Marks away from desired grade:	
November	2019	Paper 2				
November	2019	Paper 3				

Month	Year	Paper	Mark out of 80	Grade		Topics to revise
November	2020	Paper 1			Marks away from desired grade:	
November	2020	Paper 2				
November	2020	Paper 3				

November	2021	Paper 1			Marks away from desired grade:	
November	2021	Paper 2				
November	2021	Paper 3				

May/June	2022	Paper 1			Marks away from desired grade:	
May/June	2022	Paper 2				
May/June	2022	Paper 3				
November	2022	Paper 1			Marks away from desired grade:	
November	2022	Paper 2				
November	2022	Paper 3				

May/June	2023	Paper 1			Marks away from desired grade:	
May/June	2023	Paper 2				
May/June	2023	Paper 3				
November	2023	Paper 1			Marks away from desired grade:	
November	2023	Paper 2				
November	2023	Paper 3				

Month	Year	Paper	Mark out of 80	Grade		Topics to revise
May/June	2024	Paper 1			Marks away from desired grade:	
May/June	2024	Paper 2				
May/June	2024	Paper 3				
November	2024	Paper 1			Marks away from desired grade:	
November	2024	Paper 2				
November	2024	Paper 3				

May/June	2025	Paper 1			Marks away from desired grade:	
May/June	2025	Paper 2				
May/June	2025	Paper 3				
November	2025	Paper 1			Marks away from desired grade:	
November	2025	Paper 2				
November	2025	Paper 3				

May/June	2026	Paper 1			Marks away from desired grade:	
May/June	2026	Paper 2				
May/June	2026	Paper 3				
November	2026	Paper 1			Marks away from desired grade:	
November	2026	Paper 2				
November	2026	Paper 3				

Month	Year	Paper	Mark out of 80	Grade		Topics to revise
		Paper 1			Marks away from desired grade:	
		Paper 2				
		Paper 3				

		Paper 1			Marks away from desired grade:	
		Paper 2				
		Paper 3				

		Paper 1			Marks away from desired grade:	
		Paper 2				
		Paper 3				

		Paper 1			Marks away from desired grade:	
		Paper 2				
		Paper 3				

		Paper 1			Marks away from desired grade:	
		Paper 2				
		Paper 3				

H) MOCK EXAMS TRACKER

MOCK 1

Paper	Mark out of 80	Topics to revise
Paper 1		
Paper 2		
Paper 3		
Final grade:		
Marks away from desired grade:		

MOCK 2

Paper	Mark out of 80	Topics to revise
Paper 1		
Paper 2		
Paper 3		
Final grade:		
Marks away from desired grade:		

PERCENTAGE MULTIPLIERS (12)

- 1 Some people were asked if they wanted new headphones.

85% of the people said yes.

72% of the people who said yes wanted wireless headphones.

What percentage of the people asked said they wanted wireless headphones?

Give your answer to the nearest percent.



.....

(Total for Question 1 is 2 marks)

- 2 Here are three rectangles.



The area of rectangle **R** is 5% greater than the area of rectangle **Q**.

The area of rectangle **S** is 30% greater than the area of rectangle **R**.

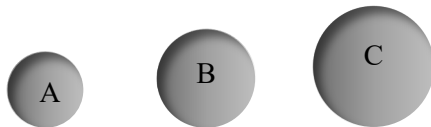
By what percentage is the area of rectangle **S** greater than the area of rectangle **Q**?



.....

(Total for Question 2 is 3 marks)

- 3 Here are three spheres.



The volume of sphere **B** is 40% more than the volume of sphere **A**.

The volume of sphere **C** is 40% more than the volume of sphere **B**.

Find the volume of sphere **A** as a fraction of the volume of sphere **C**.

Give your answer in its simplest form.



.....

(Total for Question 3 is 3 marks)

RECURRING DECIMALS (16)

- 1 Prove algebraically that $0.2\dot{1}\dot{8}$ can be written as $\frac{12}{55}$



(Total for Question 1 is 3 marks)

- 2 Express $0.0\dot{1}5\dot{3}$ as a fraction.
You must show all your working.



.....

(Total for Question 2 is 3 marks)

3 (a) $m = 0.\dot{2}\dot{7}$ $n = 0.1\dot{3}$

Work out the value of mn .

Give your answer as a fraction in its simplest form.



.....
(5)

(b) $x = 0.\dot{3}1$ $y = 2.4\dot{6}$

Work out the value of $x + y$.

Give your answer as a mixed number in its simplest form.



.....

(5)

(Total for Question 3 is 10 marks)

FUNCTIONS (60)

1 The functions f , g and h are given by

$$f(x) = 5x + 2$$

$$g(x) = (3x - 1)^2$$

$$h(x) = \frac{4}{x^2 - 10}$$

(a) Find $f(11)$



.....
(1)

(b) Find $g(7)$



.....
(1)

(c) Find $h(-3)$



.....
(1)

(d) Find $gf(6)$



.....
(2)

(e) Find $fg(-2)$



.....
(2)

(f) Find $hf(x)$



.....
(2)

(g) Find $f^{-1}(x)$



$f^{-1}(x)$
(2)

(h) Find $g^{-1}(x)$



$g^{-1}(x)$
(2)

(Total for Question 1 is 13 marks)

2 The functions f , g and h are given by

$$f(x) = 10x + 3$$

$$g(x) = \frac{\sqrt{x} - 2}{5}$$

$$h(x) = \sqrt[3]{4x - 1}$$

(a) Find $g^{-1}(x)$



$g^{-1}(x)$
(2)

(b) Find $h^{-1}(x)$



$h^{-1}(x)$
(2)

(c) Solve $h^{-1}(x) = -31$



$x =$
(3)

(d) Solve $gf(x) = 2$



$x = \dots\dots\dots$
(3)

(e) Solve $hf(x) = 5$



$x = \dots\dots\dots$
(3)

(Total for Question 2 is 13 marks)

3 The functions f , g and h are given by

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

$$g(x) = 4 - 5x$$

$$h(x) = \frac{8}{x^2}$$

(a) Solve $f(x) = g(x)$



(4)

(b) Find $hf^{-1}(x)$. Give your answer in terms of x in its simplest form.



(4)

(c) Find the values of x for which $fg(x) = 5$



.....

(4)

(d) Show that $fg(x) + 2gf(x) = 3$ has two solutions for x .



.....
(5)

(Total for Question 3 is 17 marks)

ANSWERS

BEFORE YOU MARK YOUR WORK...

a) Answers for all questions are below

b) **Answers with working out** for each question can be accessed via the following link website link available in paper copy of book

c) Look out for the following below: **oe** means or equivalent, and **SWO** means see working out via the above weblink

FRACTIONS (1)

1a) $1\frac{5}{18}$

b) $2\frac{7}{30}$

2) SWO.

3) 24 cm

PRIME FACTORISATION (2)

1) $2^4 \times 7$

2) $2^2 \times 3 \times 5 \times 7$

3) $2^2 \times 11 \times 13$

HCF AND LCM (3)

1a) 8

b) 560

2a) 24

b) 10,080

3) 32 and 48

ROUNDING & ESTIMATION (4)

1a) 9000

b) 200

c) 4.5

d) 90

2a) 600 cm^2

b) Underestimate as all numbers (21 cm, 32cm and π) have been rounded down

3) 240 cm

ERROR INTERVALS & RECIPROCAL (5)

1a) $24.5 \leq p < 25.5$

b) $2.55 \leq x < 2.65$

c) $6.75 \leq m < 6.85$

2) $5.4 \leq B < 5.5$

3a) 0.25 (oe)

b) $\frac{40}{17}$

MULTIPLYING DECIMALS (6)

1) 15.12

2) 1382.94

3) 2.66×10^{-3}

DIVIDING DECIMALS (7)

1) 52.7

2) 64.3

3) 0.08

STANDARD FORM (WITH OPERATIONS) (8)

1a) 8.13×10^5

b) 2.47×10^{-3}

c) 0.05409

d) 63,000

2a) 1.8×10^{-2}

b) 3.66×10^{-1}

c) 4.96×10^4

3a) 4.825×10^{-2}

b) 6×10^{-2}

STANDARD FORM (MISCELLANEOUS) (9)

1) 0.000851, 85.1×10^{-3} , 8510, 8.51×10^4 , 851×10^3

2) $1 : 0.106$

3) 1.07×10^9

USING A CALCULATOR (10)

1a) 5.196361539

b) 5.2

2a) 0.4600983843

b) 0.460

3) 1.104×10^2

REVERSE PERCENTAGES (11)

1) 70 fondants

2) £6.00

3) £310,680

PERCENTAGE MULTIPLIERS (12)

1) 61%

2) 36.5%

3) $\frac{25}{49}$

PERCENTAGES (WORDED QUESTIONS) (13)

1a) 9173g

b) He will need less coffee.

2) $n = 10$

3) Correct as $64.6\% > 60\%$. SWO.

PERCENTAGE CHANGE (14)

1) 300%

2) 111%

3) 61.6%