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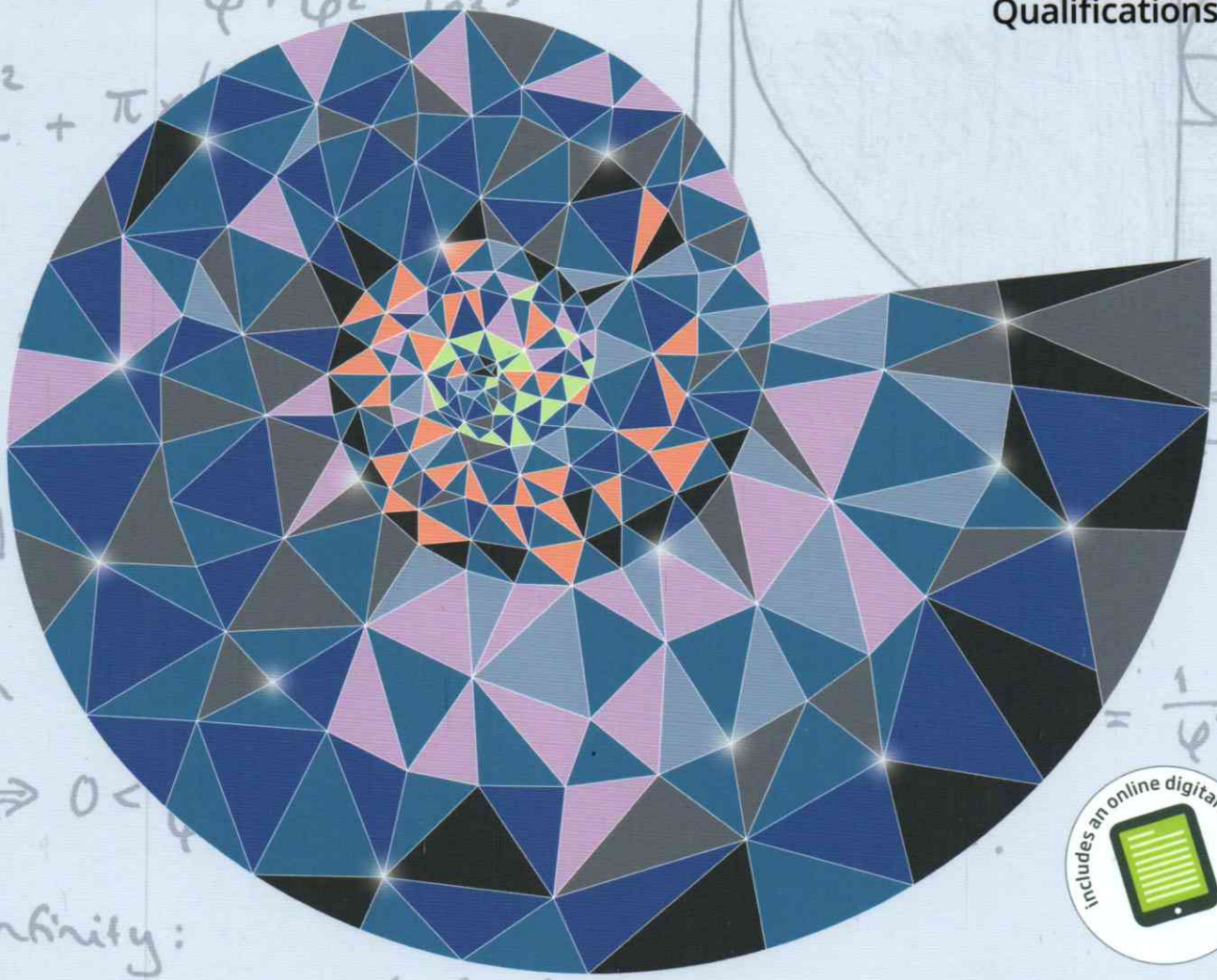

Pearson Edexcel AS and A level Mathematics

Pure Mathematics

Year 1/AS

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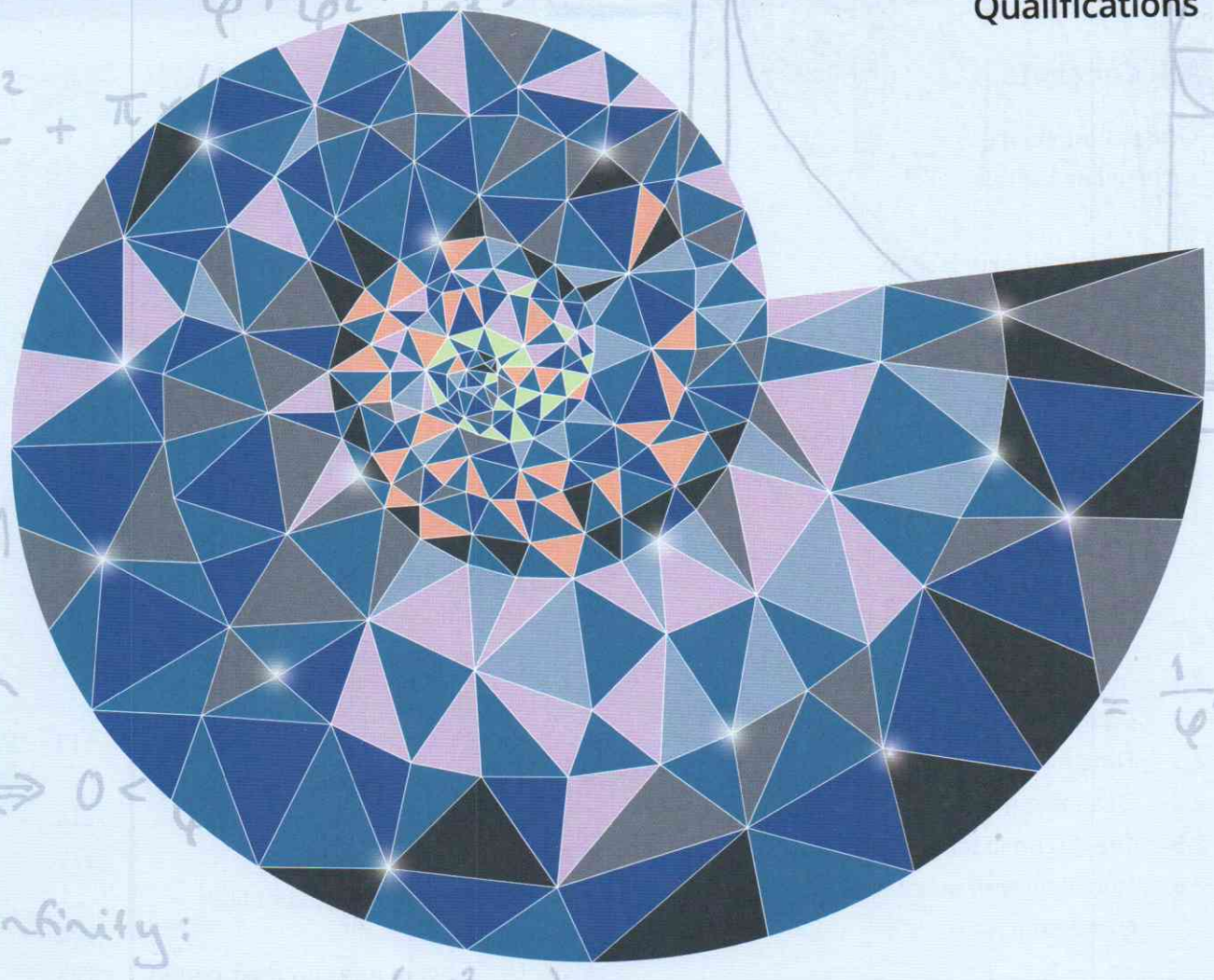

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Pure Mathematics

Year 1/AS

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Overarching themes

The following three overarching themes have been fully integrated throughout the Pearson Edexcel AS and A level Mathematics series, so they can be applied alongside your learning and practice.

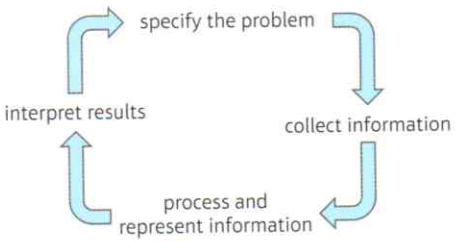
1. Mathematical argument, language and proof

- Rigorous and consistent approach throughout
- Notation boxes explain key mathematical language and symbols
- Dedicated sections on mathematical proof explain key principles and strategies
- Opportunities to critique arguments and justify methods

2. Mathematical problem solving

- Hundreds of problem-solving questions, fully integrated into the main exercises
- Problem-solving boxes provide tips and strategies
- Structured and unstructured questions to build confidence
- Challenge boxes provide extra stretch

The Mathematical Problem-solving cycle



3. Mathematical modelling

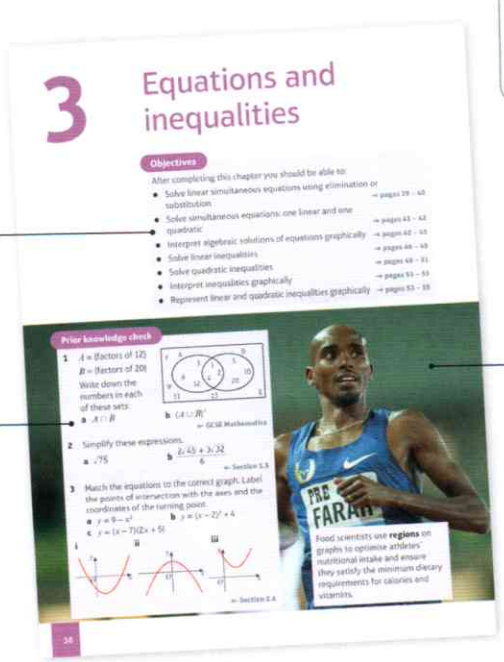
- Dedicated modelling sections in relevant topics provide plenty of practice where you need it
- Examples and exercises include qualitative questions that allow you to interpret answers in the context of the model
- Dedicated chapter in Statistics & Mechanics Year 1/AS explains the principles of modelling in mechanics

Finding your way around the book

Access an online digital edition using the code at the front of the book.

Each chapter starts with a list of objectives

The *Prior knowledge check* helps make sure you are ready to start the chapter



The real world applications of the maths you are about to learn are highlighted at the start of the chapter with links to relevant questions in the chapter

Exercise questions are carefully graded so they increase in difficulty and gradually bring you up to exam standard

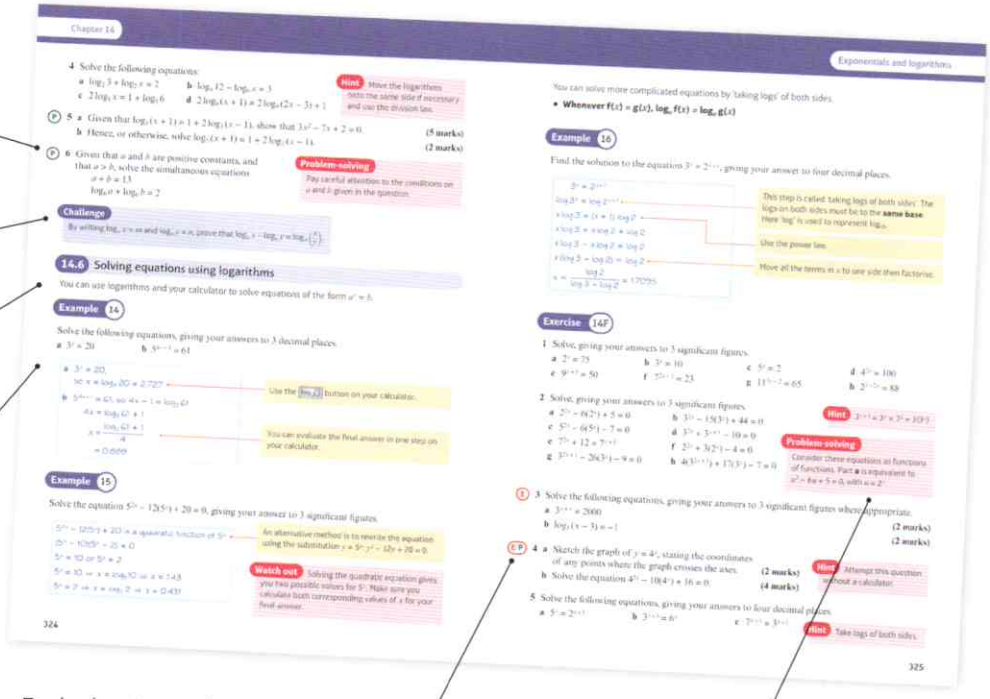
Challenge boxes give you a chance to tackle some more difficult questions

Each section begins with explanation and key learning points

Step-by-step worked examples focus on the key types of questions you'll need to tackle

Exam-style questions are flagged with (E)

Problem-solving questions are flagged with (P)

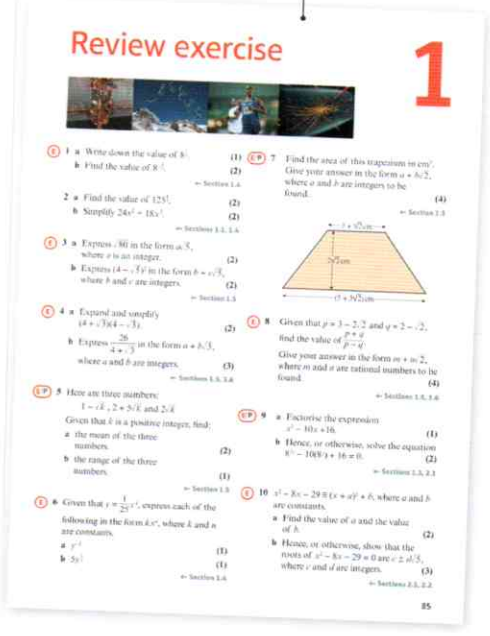


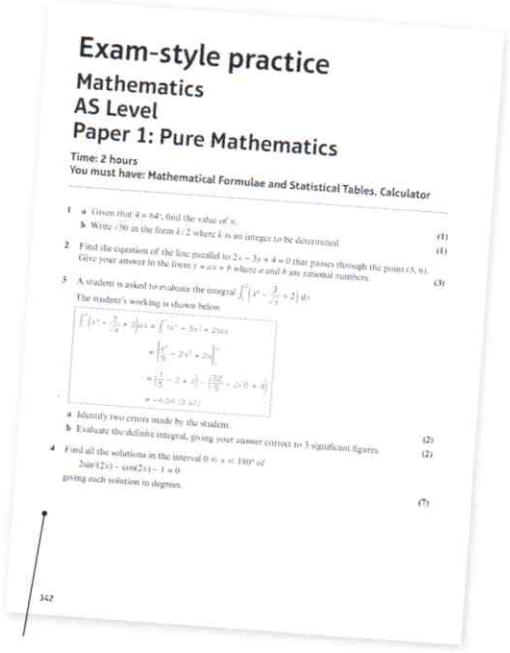
Each chapter ends with a *Mixed exercise* and a *Summary of key points*

Exercises are packed with exam-style questions to ensure you are ready for the exams

Problem-solving boxes provide hints, tips and strategies, and *Watch out* boxes highlight areas where students often lose marks in their exams

Every few chapters a *Review exercise* helps you consolidate your learning with lots of exam-style questions





A full AS level practice paper at the back of the book helps you prepare for the real thing

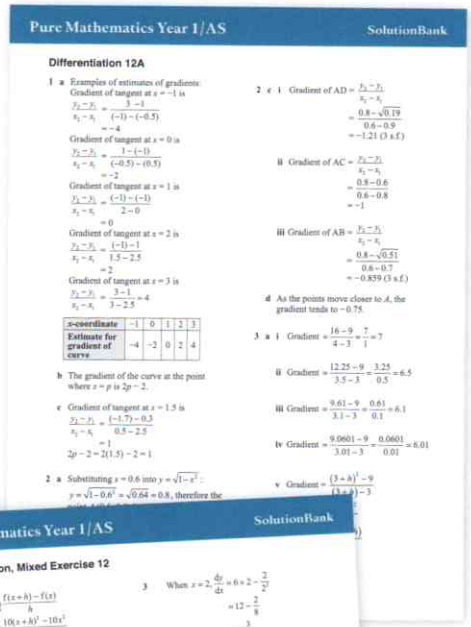
Extra online content

Whenever you see an *Online* box, it means that there is extra online content available to support you.

SolutionBank

SolutionBank provides a full worked solution for every question in the book.

Online Full worked solutions are available in SolutionBank.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Differentiation 12A

1 a Examples of estimates of gradients:
Gradient of tangent at $x = -1$ is $\frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - -1}{(-1) - (-0.5)} = -4$
Gradient of tangent at $x = 0$ is $\frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - (-1)}{(-0.5) - (0.5)} = -2$
Gradient of tangent at $x = 1$ is $\frac{y_2 - y_1}{x_2 - x_1} = \frac{(-1) - (-1)}{2 - 0} = 0$
Gradient of tangent at $x = 2$ is $\frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 1}{1.5 - 2.5} = 2$
Gradient of tangent at $x = 3$ is $\frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 1}{3 - 2.5} = 4$

x-coordinate	−1	0	1	2	3
Estimate for gradient of curve	−4	−2	0	2	4

b The gradient of the curve at the point where $x = p$ is $2p - 2$.

c Gradient of tangent at $x = 1.5$ is $\frac{y_2 - y_1}{x_2 - x_1} = \frac{(-1.7) - 0.3}{0.5 - 2.5} = 1$
$2p - 2 = 2(1.5) - 2 = 1$

2 a Substituting $x = 0.6$ into $y = \sqrt{1 - x^2}$:
$y = \sqrt{1 - 0.6^2} = \sqrt{0.64} = 0.8$, therefore the

2 c i Gradient of AD $= \frac{y_2 - y_1}{x_2 - x_1} = \frac{0.8 - \sqrt{0.19}}{0.6 - 0.9} = -1.21$ (3 s.f.)

ii Gradient of AC $= \frac{y_2 - y_1}{x_2 - x_1} = \frac{0.8 - 0.6}{0.6 - 0.8} = -1$

iii Gradient of AB $= \frac{y_2 - y_1}{x_2 - x_1} = \frac{0.8 - \sqrt{0.51}}{0.6 - 0.7} = -0.859$ (3 s.f.)

d As the points move closer to A, the gradient tends to -0.75.

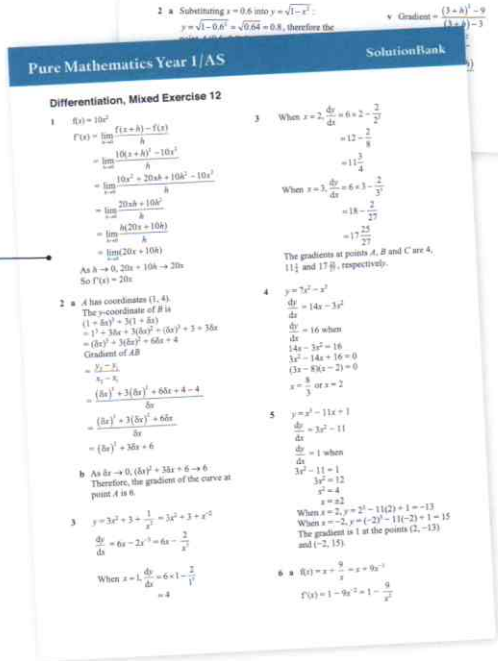
3 a i Gradient $= \frac{16 - 9}{4 - 3} = \frac{7}{1} = 7$

ii Gradient $= \frac{12.25 - 9}{3.5 - 3} = \frac{3.25}{0.5} = 6.5$

iii Gradient $= \frac{9.61 - 9}{3.1 - 3} = \frac{0.61}{0.1} = 6.1$

iv Gradient $= \frac{9.0601 - 9}{3.01 - 3} = \frac{0.0601}{0.01} = 6.01$

v Gradient $= \frac{(3 + h)^2 - 9}{(3 + h) - 3}$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Differentiation, Mixed Exercise 12

1 $f(x) = 10x^2$
$f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}$
$= \lim_{h \to 0} \frac{10(x + h)^2 - 10x^2}{h}$
$= \lim_{h \to 0} \frac{10x^2 + 20xh + 10h^2 - 10x^2}{h}$
$= \lim_{h \to 0} \frac{20xh + 10h^2}{h}$
$= \lim_{h \to 0} \frac{h(20x + 10h)}{h}$
$= \lim_{h \to 0} (20x + 10h)$
As $h \to 0$, $20x + 10h \to 20x$
So $f'(x) = 20x$

2 a A has coordinates $(1, 4)$.
The y-coordinate of B is
$(1 + \delta x)^3 + 3(1 + \delta x)$
$= 1^3 + 3\delta x + 3(\delta x)^2 + (\delta x)^3 + 3 + 3\delta x$
$= (\delta x)^3 + 3(\delta x)^2 + 6\delta x + 4$
Gradient of AB
$= \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{(\delta x)^3 + 3(\delta x)^2 + 6\delta x + 4 - 4}{\delta x}$
$= \frac{(\delta x)^3 + 3(\delta x)^2 + 6\delta x}{\delta x}$
$= (\delta x)^2 + 3\delta x + 6$

b As $\delta x \to 0$, $(\delta x)^2 + 3\delta x + 6 \to 6$
Therefore, the gradient of the curve at point A is 6.

3 $y = 3x^2 + 3 + \frac{1}{x^2} = 3x^2 + 3 + x^{-2}$
$\frac{dy}{dx} = 6x - 2x^{-3} = 6x - \frac{2}{x^3}$
When $x = 1$, $\frac{dy}{dx} = 6 \times 1 - \frac{2}{1^3}$
$= 4$

3 When $x = 2$, $\frac{dy}{dx} = 6 \times 2 - \frac{2}{2^3}$
$= 12 - \frac{2}{8}$
$= 11\frac{3}{4}$
When $x = 3$, $\frac{dy}{dx} = 6 \times 3 - \frac{2}{3^3}$
$= 18 - \frac{2}{27}$
$= 17\frac{25}{27}$
The gradients at points A, B and C are 4, $11\frac{3}{4}$ and $17\frac{25}{27}$, respectively.

4 $y = 7x^2 - x^3$
$\frac{dy}{dx} = 14x - 3x^2$
$\frac{dy}{dx} = 16$ when
$14x - 3x^2 = 16$
$3x^2 - 14x + 16 = 0$
$(3x - 8)(x - 2) = 0$
$x = \frac{8}{3}$ or $x = 2$

5 $y = x^2 - 11x + 1$
$\frac{dy}{dx} = 3x^2 - 11$
$\frac{dy}{dx} = 1$ when
$3x^2 - 11 = 1$
$3x^2 = 12$
$x^2 = 4$
$x = \pm 2$
When $x = 2$, $y = 2^2 - 11(2) + 1 = -13$
When $x = -2$, $y = (-2)^2 - 11(-2) + 1 = 15$
The gradient is 1 at the points $(2, -13)$ and $(-2, 15)$.

6 a $f(x) = x + \frac{9}{x} = x + 9x^{-1}$
$f'(x) = 1 - 9x^{-2} = 1 - \frac{9}{x^2}$

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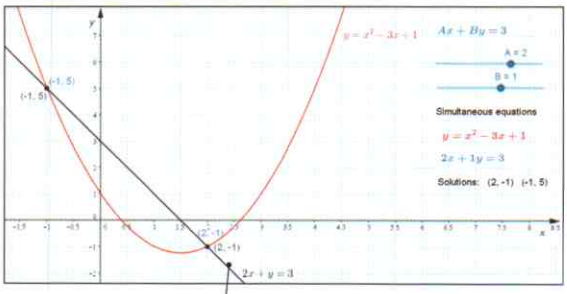

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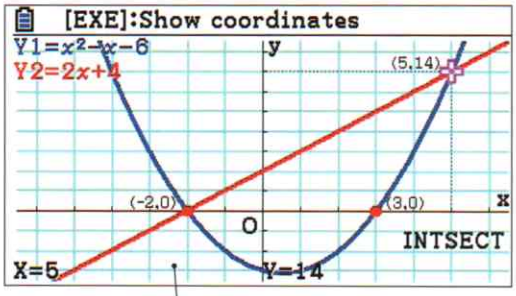

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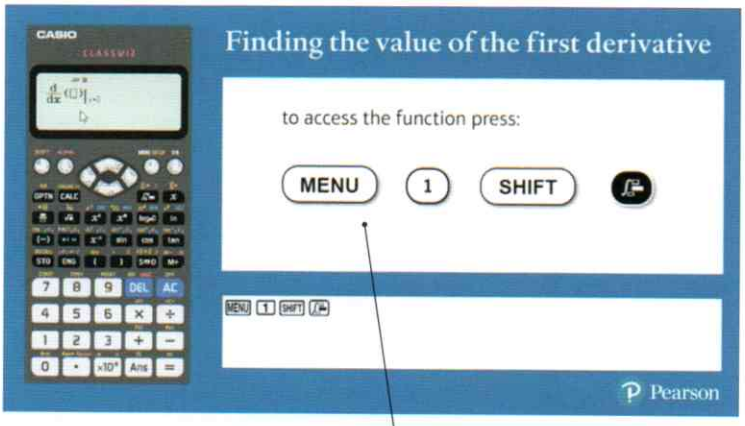

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