



AS Mathematics Exam Questions by Topic
Chapter 10c: Differentiation from first principles

These questions are taken from the Specimen Exam materials and the real 2018 papers for the new syllabus AS and A-level mathematics courses and arranged by chapter of the textbooks by Goldie et al (available here: <https://amzn.to/39umfr5> and <https://amzn.to/3hE8kBL>). There are a mixture of questions from OCR A, OCR B (MEI), Edexcel and AQA. Although the style of questions varies a little across the exam boards the content of the syllabus is almost identical so these are suitable for students preparing for any exam board.

Free problem sets for all other chapters, as well as video solutions, full past papers and other content for GCSE and A-level maths can be found at:

<https://mathsaurus.com/>

Edexcel AS Sample Paper 1 Question 6:

6. Prove, from first principles, that the derivative of $3x^2$ is $6x$. (4)
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Edexcel AS 2018 Paper 1 Question 10:

10. Prove, from first principles, that the derivative of x^3 is $3x^2$ (4)
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OCR A AS Sample Paper 2 Question 7:

- 7 Differentiate $f(x) = x^4$ from first principles. [5]
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AQA 2018 Paper 1 Question 15:

15 A curve has equation $y = x^3 - 48x$

The point A on the curve has x coordinate -4

The point B on the curve has x coordinate $-4 + h$

15 (a) Show that the gradient of the line AB is $h^2 - 12h$

[4 marks]

15 (b) Explain how the result of part (a) can be used to show that A is a stationary point on the curve.

[2 marks]

AQA AS 2018 Paper 1 Question 9:

9 Craig is investigating the gradient of chords of the curve with equation $f(x) = x - x^2$

Each chord joins the point $(3, -6)$ to the point $(3 + h, f(3 + h))$

The table shows some of Craig's results.

| x | $f(x)$ | h | $x + h$ | $f(x + h)$ | Gradient |
|-----|--------|--------|---------|------------|----------|
| 3 | -6 | 1 | 4 | -12 | -6 |
| 3 | -6 | 0.1 | 3.1 | -6.51 | -5.1 |
| 3 | -6 | 0.01 | | | |
| 3 | -6 | 0.001 | | | |
| 3 | -6 | 0.0001 | | | |

9 (a) Show how the value -5.1 has been calculated.

[1 mark]

9 (b) Complete the third row of the table above.

[2 marks]

9 (c) State the limit suggested by Craig's investigation for the gradient of these chords as h tends to 0

[1 mark]

9 (d) Using differentiation from first principles, verify that your result in part (c) is correct.

[4 marks]

AQA AS Sample Paper 1 Question 9:

9 (a) Given that $f(x) = x^2 - 4x + 2$, find $f(3+h)$

Express your answer in the form $h^2 + bh + c$, where b and $c \in \mathbb{Z}$.

[2 marks]

9 (b) The curve with equation $y = x^2 - 4x + 2$ passes through the point $P(3, -1)$ and the point Q where $x = 3 + h$.

Using differentiation from first principles, find the gradient of the tangent to the curve at the point P .

[3 marks]
