Year 11 Mathematics Advanced

Topic: Introduction to Differentiation (1 of 6)
Review Questions: The Derivative and the Power Rule
Term 3, 2026

How to use this review set

These are real past-paper questions, grouped by question pattern. The grey label on each question shows where it is from and its marks.

- The questions are grouped by the pattern that keeps coming up in exams, a few of each in a row, running from the plainer patterns into the harder ones near the end. Work through them and you will meet every type an exam can throw at you.
- This set **is your diagnostic**. Working through it shows you exactly which patterns are solid and which need work. Attempt every question properly in your own book, and go back to your notes to help you work through tough questions if needed.
- Every question you get wrong, need help with or struggle with goes in your **Mistakes Log**, which you should be working on daily to get you exam-ready.

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Understanding the derivative

1. Average rate of change

Q1 Hurlstone 2021 Prelim Q11 · **1 mark**

A particle's speed decreases from 34 ms^{-1} to 8 ms^{-1} in 4 seconds. What was the average rate of change of its speed?

(A) 6.5 ms^{-2}

(B) -6.5 ms^{-2}

(C) -13 ms^{-2}

(D) 13 ms^{-2}

Q2 Hornsby Girls 2021 Prelim Q17(c) · **2 marks**

The population of a town is given by $P = 45\,000(3t + 2)^2$, where t is the time in years. Calculate the average rate of change of the population in the first five years.

Q3 Moriah 2021 Prelim Q18(b) · **2 marks**

Sophie is breeding mice for a laboratory. The number of mice M she has after t months is given by the equation $M = 12 + 5t + 4t^2$. Find the average rate of increase in her mouse population in the first six months.

Q4 Kambala 2023 Prelim Q9 · **1 mark**

The height of a ball thrown in the air is given by the formula $h = 10t - 3t^2$ in metres, where t is measured in seconds. When the ball is thrown, what is the average rate of change of the height in the first second?

(A) 4 metres per second

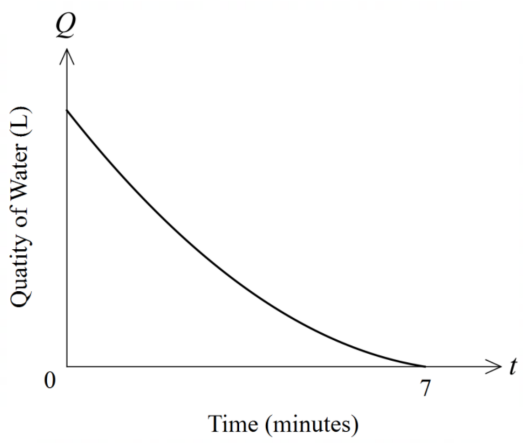
(B) 7 metres

(C) $10 - 6t$

(D) 7 metres per second

Q5 Killara 2022 Prelim Q16(a) · **2 marks**

A tank of water is being drained, and the quantity (Q) of water remaining in the tank after t minutes can be shown by the graph. It takes 7 minutes to completely drain the tank. The graph has the equation $Q(t) = 20(t-8)^2 - 20$. Show that the average rate of change is -180 L/min.



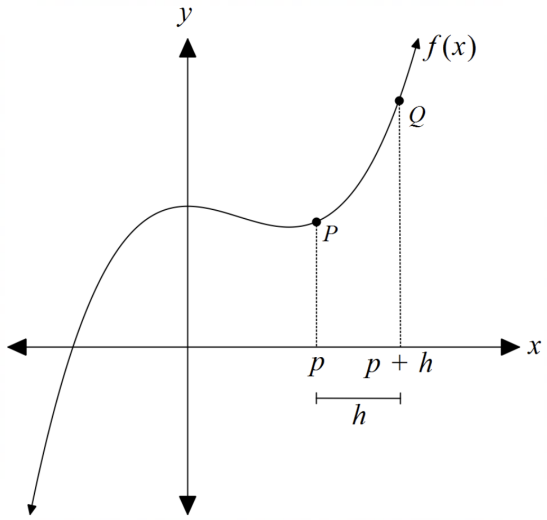
Q6 Loreto Kirribilli 2022 Prelim Q30(c) · **3 marks**

A city's population is experiencing exponential growth such that the population P at time t in years can be given by $P = 50\,000e^{at}$, where a is a positive constant. Given that the population is 52 400 after 1 year, so that $a = 0.0469$ (to 4 decimal places), find the average rate of growth of the population in the first 5 years, correct to 1 decimal place.

2. Evaluating limits

Q7 International Grammar 2021 Prelim Q7 · **1 mark**

The graph of the function $f(x)$ is shown below, with points P and Q on the graph. The coordinates of P are $(p, f(p))$, and point Q's x-coordinate is h to the right of p, hence Q's coordinates are $(p+h, f(p+h))$.



Which of the following would give the gradient of the tangent at point P?

(A) $\lim\limits_{h\to 0} \dfrac{f(p)-f(p+h)}{h}$

(B) $\lim\limits_{h\to 0} \dfrac{f(p-h)+f(p)}{h}$

(C) $\lim\limits_{h\to 0} \dfrac{f(p+h)-f(p)}{h}$

(D) $\lim\limits_{h\to 0} \dfrac{f(p-h)-f(p)}{h}$

Q8 Sydney Grammar 2023 Prelim Q12(a) · **1 mark**

Evaluate $\lim\limits_{h\to 0} \dfrac{h^2-4h}{h}$.

Q9 Hornsby Girls 2021 Prelim Q2 · **1 mark**

Find $\lim_{x \to -4} \dfrac{2x+8}{3x^2-48}$.

(A) $\dfrac{1}{12}$

(B) $-\dfrac{1}{12}$

(C) 12

(D) Undefined

Q10 North Sydney Girls 2022 Prelim Q8 · **1 mark**

What is the value of $\lim_{x \to -3} \dfrac{2x+6}{x^2-9}$?

(A) $-\dfrac{1}{3}$

(B) 0

(C) $\dfrac{2}{3}$

(D) 1

Q11 North Sydney Girls 2023 Prelim Q14 · **2 marks**

Find $\lim_{x \to 2} \dfrac{2x^2-3x-2}{x-2}$.

Q12 Killara 2024 Prelim Q15 · **2 marks**

Evaluate $\lim_{x \to 4} \dfrac{x^2-x-12}{x-4}$.

Q13 Manly 2022 Trial Q10 · **1 mark**

On a continuous function $f(x)$, h is a positive number which represents the horizontal difference between two points on the function. Which of the following would NOT give the derivative of $f(x)$?

(A) $\lim_{h\to 0} \dfrac{f(x+h)-f(x)}{h}$

(B) $\lim_{h\to 0} \dfrac{f\left(x+\frac{h}{2}\right)-f\left(x-\frac{h}{2}\right)}{h}$

(C) $\lim_{h\to 0} \dfrac{f(x)-f(x-h)}{h}$

(D) $\lim_{h\to 0} \dfrac{f(x-h)-f(x)}{h}$

3. Differentiation from first principles

Q14 Sydney Grammar 2021 Prelim Q13(ai) · **1 mark**

Consider the function $f(x) = x^2 - 3x + 7$. Write down an expression for $f(x+h)$.

Q15 St George Girls 2021 Prelim Q3(a) · **3 marks**

Differentiate $f(x) = 4x^2 - 5x$, using the method of first principles.

Q16 Pymble 2022 Prelim Q15 · **3 marks**

Find the derivative of $f(x) = 5x^2 - 2x$ by first principles.

Q17 Baulkham Hills 2024 Prelim Q20 · **2 marks**

Differentiate $y = x^2 + 6x$ from first principles.

Q18 Fort St 2023 Trial Q9 · 1 mark

Which of the following is the correct expression for differentiating $f(x) = x^2 - 2x$ with first principles?

(A) $f'(x) = \lim_{h\to 0} \dfrac{(x-h)^2 - 2(x-h) - (x^2-2x)}{h}$

(B) $f'(x) = \lim_{h\to 0} \dfrac{(x-h)^2 - (x-h) - (x^2-2x)}{h}$

(C) $f'(x) = \lim_{h\to 0} \dfrac{(x+h)^2 - 2(x+h) - (x^2-2x)}{h}$

(D) $f'(x) = \lim_{h\to 0} \dfrac{(x+h)^2 - 2(x+h) + (x^2-2x)}{h}$

Q19 Penrith 2023 Trial Q11 · 3 marks

A student was asked to differentiate $f(x) = 2x^2 + x$ using the first Principles of Differential Calculus. The student began the solution as shown below.

$$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$$

Complete the solution.

Q20 North Sydney Girls 2022 Prelim Q19 · 2 marks

Differentiate $f(x) = 3x - 4x^2$ using first principles, given $f'(x) = \lim_{h\to 0} \dfrac{f(x+h) - f(x)}{h}$.

Q21 North Sydney Girls 2023 Prelim Q21 · 3 marks

Differentiate $f(x) = \dfrac{1}{x}$ from first principles, given that $f'(x) = \lim_{h\to 0} \dfrac{f(x+h) - f(x)}{h}$.

Q22 Kambala 2024 Prelim Q25 · 3 marks

Differentiation from first principles is defined by $f'(x) = \lim_{h\to 0} \dfrac{f(x+h) - f(x)}{h}$. Use differentiation from first principles to find the derivative of $x^2 + 3x - 4$.

Q23 Hornsby Girls 2021 Prelim Q14 · 2 marks

Find the derivative of $f(x) = \dfrac{6}{x}$ using the first principles method.

The power rule

4. The power rule: polynomials, sums and multiples

Q24 Hornsby Girls 2021 Prelim Q13(a) · **1 mark**

Differentiate $y = 3x^3 + 4x^5$.

Q25 Cherrybrook Tech 2022 Prelim Q18(a) · **1 mark**

Differentiate the following with respect to x. Leave your answer in simplified form with positive indices: $y = 7x^3 - 5x + 2$.

Q26 Hurlstone 2021 Prelim Q7 · **1 mark**

Given the function $y = 4x^5$, which one of the following is correct?

(A) $\dfrac{dy}{dx} = 4x^4$

(B) $\dfrac{dy}{dx} = 5x^4$

(C) $\dfrac{dy}{dx} = 1024x^4$

(D) $\dfrac{dy}{dx} = 20x^4$

Q27 Shore 2023 Prelim Q16(a) · **1 mark**

Differentiate the following with respect to x: $y = 15x^3 - x^2 - 2$.

Q28 St George Girls 2023 Prelim Q8 · **1 mark**

Find $\dfrac{dy}{dx}$, if $y = 6x^3 - 5x - 1$.

Q29 Killara 2022 Prelim Q12(a) · **1 mark**

Differentiate the following function: $f(x) = x^{15}$.

Q30 Glenwood 2020 Trial Q1 · **1 mark**

If $f(x) = x^2 - 2x$, what is the value of $f'(3)$?

(A) 0

(B) 6

(C) 3

(D) 4

Q31 Gosford 2024 Prelim Q14(b) · **3 marks**

Differentiate the following, simplifying fully where possible: $f(x) = 3x(4x + 5)$.

5. The power rule: negative and fractional indices

Q32 Kambala 2021 Prelim Q3(a) · **1 mark**

Find $f'(x)$ where $f(x) = x^2 + \dfrac{3}{x}$.

Q33 Sydney Grammar 2022 Prelim Q10(bi) · **1 mark**

Differentiate $y = \dfrac{3}{x}$ with respect to x.

Q34 Killara 2021 Prelim Q11(a) · **2 marks**

Differentiate $y = \dfrac{x^3 - 3x}{x^2}$.

Q35 Presbyterian 2022 Prelim Q7 · **1 mark**

What is the derivative of $-\dfrac{3}{x^2}$?

(A) $-\dfrac{3}{x}$

(B) $-\dfrac{6}{x^3}$

(C) $-\dfrac{3}{x^3}$

(D) $\dfrac{6}{x^3}$

Q36 St George Girls 2023 Prelim Q17(a(ii)) · **2 marks**

Differentiate the following with respect to x: $f(x) = \sqrt{x} + \dfrac{3}{x}$.

Q37 Barker 2021 Prelim Q12(bγ) · **2 marks**

Differentiate the following. Leave your answer with a positive, non-fractional index, where necessary: $f(x) = 5x^{-2} - 6x^2$.

Q38 Presbyterian 2023 Prelim Q23(a) · **2 marks**

Differentiate the following with respect to x: $y = \sqrt[3]{x^2}$.

Q39 North Sydney Girls 2023 Prelim Q19(b) · **2 marks**

Differentiate $y = \dfrac{-x^2 + 10x - 16}{x^2}$.

Q40 North Sydney Girls 2022 Prelim Q10 · **1 mark**

Let $g(x) = x^3 + 3$ and $f(x) = \sqrt{x}$. What is the simplified expression for $f'(g(x))$?

(A) $x\sqrt{3}$

(B) $\dfrac{1}{2\sqrt{x^3+3}}$

(C) $\sqrt{x^3+3}$

(D) $x\sqrt{x+3}$