Year 11 Mathematics Advanced

Topic: Introduction to Differentiation (6 of 6)

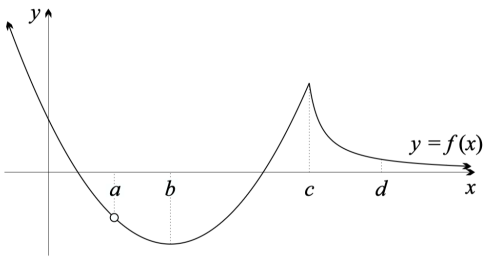
Review Questions (Worked Solutions): Mixed One-off Exam Questions

Term 3, 2026

Mixed one-off exam questions

Q1 Sydney Grammar 2021 Prelim Q5 · 1 mark

The diagram below shows the graph of $y = f(x)$.



At which value of x is the graph continuous but not differentiable?

(A) a

(B) b

(C) c

(D) d

Criteria	Marks
Correct option	1

Solution.

A function is continuous at a point when the curve joins up there with no gap or jump, and differentiable when it has a single well-defined tangent (a smooth slope) there. The point that is continuous but not differentiable is the one where the curve is unbroken but has a sharp corner, so the gradient jumps from one value to another and no single tangent exists. Read the graph and select the labelled x-value at which the curve is joined but forms a corner (rather than a smooth turn or a break); that is the answer.

Q2 Shore 2023 Prelim Q25 · **1 mark**

On a set of axes, draw a graph that is continuous, but not differentiable at $x = 1$.

Criteria	Marks
Draws a continuous curve with a sharp corner (or cusp) at $x = 1$	1

Solution.

The graph must be joined up at $x = 1$ (continuous: no gap or jump) but have no single tangent there (not differentiable), which means a sharp corner or cusp at $x = 1$. Any such curve is acceptable; the simplest example is $y = |x - 1|$, a V-shape with its vertex at $(1, 0)$. The two straight branches meet at $x = 1$ so the curve is continuous, but the gradient is -1 just to the left of $x = 1$ and $+1$ just to the right, so the slopes do not agree and no tangent exists at $x = 1$. The graph is therefore continuous but not differentiable at $x = 1$.

Q3 Killara 2021 Prelim Q16 · **3 marks**

Sketch the function $y = f(x)$ on the coordinate axes below, given the following information:

- $f(0) = 3$, $f'(2) = 0$, $f(2) = 6$
- $f'(x) > 0$ for $x < 2$
- $f'(x) < 0$ for $x > 2$
- $f'(x) \to 0$ as $x \to \infty$

Criteria	Marks
Plots the key points $(0, 3)$ and $(2, 6)$	1
Correct gradient behaviour: increasing for $x < 2$, decreasing for $x > 2$	1
Gradient approaching 0 as $x \to \infty$ (curve flattening to the right)	1

Solution.

This question runs in reverse: reconstruct $y = f(x)$ from information about f and its derivative. First mark the given points $(0, 3)$ (the y-intercept) and $(2, 6)$. Since $f'(2) = 0$, the curve has a stationary point at $x = 2$; because $f'(x) > 0$ for $x < 2$ (increasing) and $f'(x) < 0$ for $x > 2$ (decreasing), this stationary point is a maximum turning point at $(2, 6)$. To the left of $x = 2$ the curve rises up to the maximum, passing through $(0, 3)$. To the right of $x = 2$ the curve falls, and since $f'(x) \to 0$ as $x \to \infty$ the curve flattens out (its slope tends to horizontal) as x increases, so it decreases towards a horizontal asymptote-like tail. The final sketch is a smooth curve through $(0, 3)$, rising to a maximum turning point at $(2, 6)$, then decreasing and levelling off (gradient tending to 0) for large x.

Q4 Hornsby Girls 2021 Prelim Q16 · **3 marks**

In an assessment task, Jack was asked to find the derivative of the function $y = \dfrac{4x-1}{3-2x^2}$. His first line of working was as follows:

$$\frac{dy}{dx} = \frac{(3-2x^2)(4)-(4x-1)(-4)}{(3-2x^2)^2}$$

(a) Explain the mistake that Jack made in his first line of working.

(b) Write the correct first line of working, and then complete the solution for the derivative of the function.

Criteria	**Marks**
(a) Identifies that Jack used -4 instead of $\frac{d}{dx}(3-2x^2) = -4x$	1
(b) Writes the correct first line using $v' = -4x$	1
(b) Simplifies to the correct derivative	1

Solution.

(a) In the quotient rule $\dfrac{vu'-uv'}{v^2}$ with $u = 4x-1$ and $v = 3-2x^2$, the derivative of the denominator is $v' = \dfrac{d}{dx}(3-2x^2) = -4x$, not -4. Jack differentiated $-2x^2$ incorrectly, using -4 instead of $-4x$.
(b) With $u = 4x-1$, $u' = 4$, $v = 3-2x^2$, $v' = -4x$:

$$\frac{dy}{dx} = \frac{(3-2x^2)(4)-(4x-1)(-4x)}{(3-2x^2)^2}.$$

Expanding the numerator: $(3-2x^2)(4)-(4x-1)(-4x) = 12-8x^2+16x^2-4x = 8x^2-4x+12$. Therefore

$$\frac{dy}{dx} = \frac{8x^2-4x+12}{(3-2x^2)^2} = \frac{4(2x^2-x+3)}{(3-2x^2)^2}.$$

Q5 St George Girls 2021 Prelim Q8(aii) · **1 mark**

Let $f(x) = |x-2|$. Is this function differentiable at $x = 2$? Explain your answer.

Criteria	**Marks**
States not differentiable, justified by the corner / unequal one-sided gradients at $x = 2$	1

Solution.

No, $f(x) = |x-2|$ is not differentiable at $x = 2$. For $x > 2$, $f(x) = x-2$ with gradient $+1$, while for $x < 2$, $f(x) = -(x-2) = 2-x$ with gradient -1. The gradient approaching $x = 2$ from the right is $+1$ but from the left is -1, so the one-sided gradients disagree. The graph has a sharp corner at $(2, 0)$, so there is no single tangent line and $f'(2)$ does not exist.

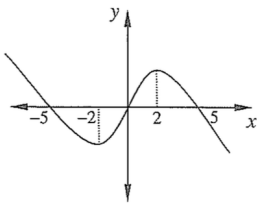
Q6 Abbotsleigh 2024 Prelim Q10 · **1 mark**

Consider a function $y = g(x)$ with the following properties:

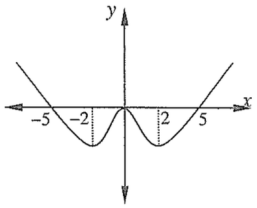
- $g(x)$ is odd.
- $g(5) = 0$ and $g'(2) = 0$.
- $g'(x) > 0$ for $x > 2$.

Which of the following could be the graph of $y = g(x)$?

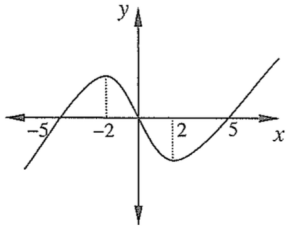
A.



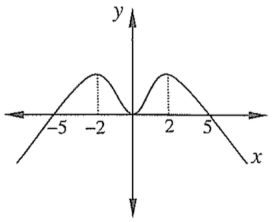
B.



C.



D.



Criteria	Marks
Correct option	1

Solution.

The conditions pin the graph down as follows. Because g is odd, the graph has point symmetry about the origin, so it passes through the origin and $g(-5) = -g(5) = 0$; also g' is even, so $g'(-2) = g'(2) = 0$. Since $g'(2) = 0$ with $g'(x) > 0$ for $x > 2$, there is a local minimum turning point at $x = 2$ (and, by symmetry, a local maximum at $x = -2$). Finally $g(5) = 0$, so the curve crosses the x-axis at $x = 5$ (and at $x = -5$). The correct option is the odd graph that passes through the origin, has a minimum turning point at $x = 2$, is increasing for $x > 2$, and cuts the x-axis at $x = \pm 5$.