Year 11 Mathematics Advanced

Topic: Introduction to Differentiation (5 of 6)
Review Questions: Graphical Applications of the Derivative
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.
- Questions marked ★ reach into a **Year 12** topic: they are genuine cross-topic exam questions, flagged so you know.

Contents

Increasing, decreasing and stationary points

1. Where a function is increasing or decreasing
2. Stationary points (finding and justifying)

Graphs of the derivative

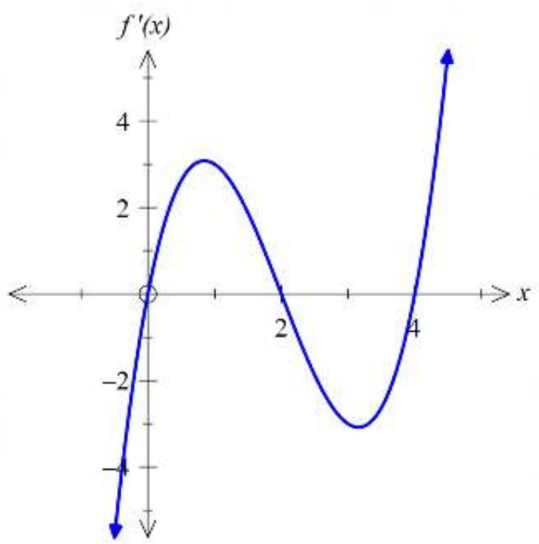
3. Interpreting a graph and its derivative
4. Sketching $y = f'(x)$ from $y = f(x)$

Increasing, decreasing and stationary points

1. Where a function is increasing or decreasing

Q1 Barker 2021 Prelim Q14(cii) · **1 mark**

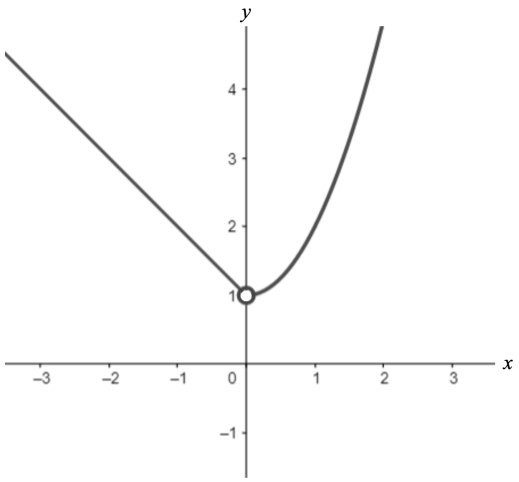
A function $y = f(x)$ has its gradient function $y = f'(x)$ graphed below.



For what values of x is the function $f(x)$ decreasing?

Q2 Fort St 2021 Prelim Q6(aii) · **1 mark**

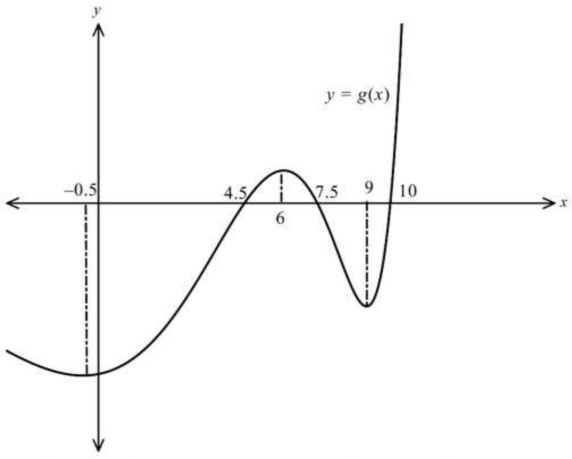
The graph of $y = f(x)$ where $x \neq 0$ is shown below.



For what values of x is $f(x)$ decreasing?

Q3 Moriah 2021 Prelim Q7 · **1 mark**

The graph of $y = g(x)$ is shown below.



For what values of x is $g'(x) > 0$?

(A) $(-0.5, 6) \cup (9, \infty)$

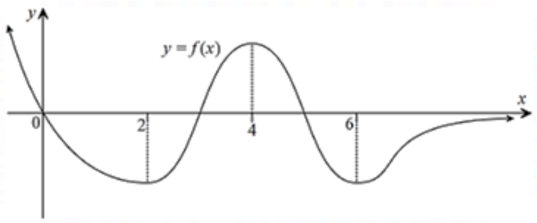
(B) $(-0.5, 4.5) \cup (7.5, \infty)$

(C) $(4.5, 7.5) \cup (10, \infty)$

(D) $(-\infty, -0.5) \cup (6, 9)$

Q4 Pymble 2022 Prelim Q18 · **2 marks**

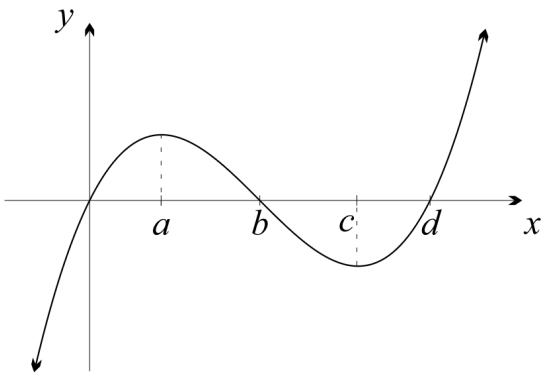
Consider the function $y = f(x)$ shown below.



For which values of x is the function increasing?

Q5 Sydney Grammar 2023 Prelim Q4 · **1 mark**

The graph of the curve $y = f(x)$ is shown below. For what values of x will the tangent to the curve have a negative gradient?



(A) $x < a$

(B) $a < x < b$

(C) $a < x < c$

(D) $x > c$

Q6 Sydney Girls 2020 Trial Q22 · **2 marks**

Show that $f(x) = -x^3 - 5x + 1$ is always decreasing.

Q7 Girraween 2020 Trial Q31 · **2 marks**

Let $f(x) = x^3 - 3x^2 + kx + 8$, where k is a constant. Find the values of k for which $f(x)$ is an increasing function.

2. Stationary points (finding and justifying)

Q8 Knox 2021 Prelim Q12(biii) · **1 mark**

The share price P after t hours of an exchange opening was $P = -t^3 + 6t^2$ for $0 \leq t \leq 6$. When is the share price a maximum?

Q9 Baulkham Hills 2022 Prelim Q15 · **3 marks**

For what values of x is the function $y = x^3 + x^2 - x - 2$ stationary?

Q10 North Sydney Girls 2021 Prelim Q2(bii) · **2 marks**

Given that $f(x) = (5x + 1)^3$ and $g(x) = x^2$, let $h(x) = f(x)\,g(x)$. Find the x-coordinate(s) of the point(s) where the tangent to $y = h(x)$ is horizontal.

Q11 Loreto Kirribilli 2022 Prelim Q29(b) · **2 marks**

It is given that $y = \dfrac{2x + 1}{3x^2 + 6}$ and that $\dfrac{dy}{dx} = \dfrac{6\left(2 - x - x^2\right)}{\left(3x^2 + 6\right)^2}$. Hence, find the values of x where the tangent to the curve $y = \dfrac{2x + 1}{3x^2 + 6}$ is horizontal.

Q12 Kambala 2023 Prelim Q23(a) · **3 marks**

Consider the curve $f(x) = x^3 - 6x^2 + 9x - 4$. Find any stationary points and determine the nature.

Q13 North Sydney Boys 2024 Prelim Q13 · **2 marks**

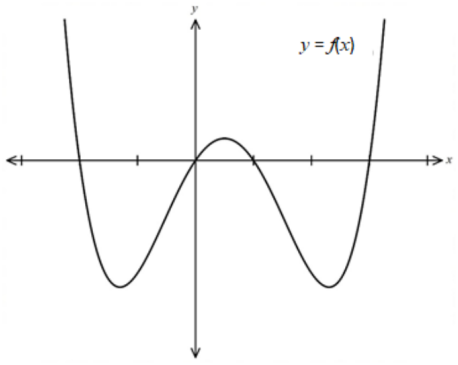
Find the coordinates of the points on the curve $y = (x^2 - 1)^3$ where the tangent to the curve is parallel to the x-axis.

Graphs of the derivative

3. Interpreting a graph and its derivative

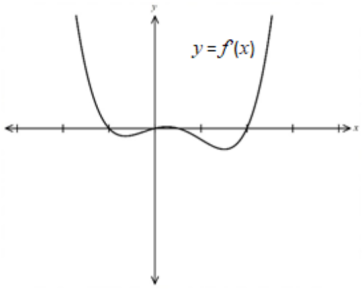
Q14 Cherrybrook Tech 2021 Prelim Q8 · 1 mark

The graph of $y = f(x)$ is shown below. Which graph could represent $y = f'(x)$?

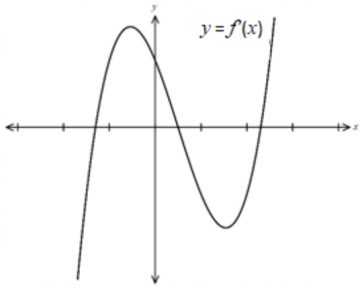


Which graph could represent $y = f'(x)$?

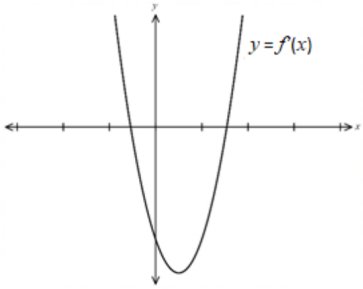
(A)



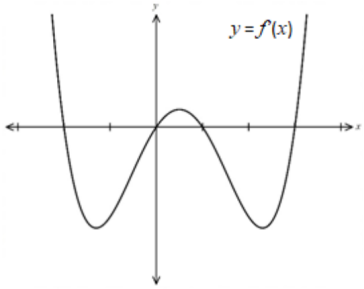
(B)



(C)

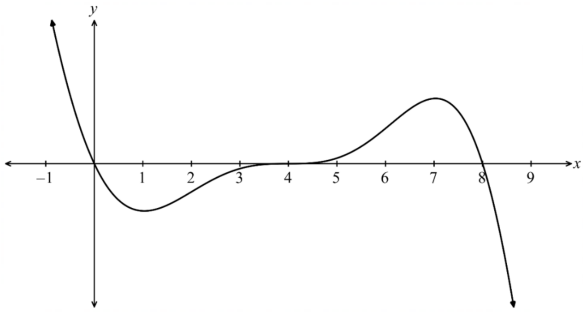


(D)



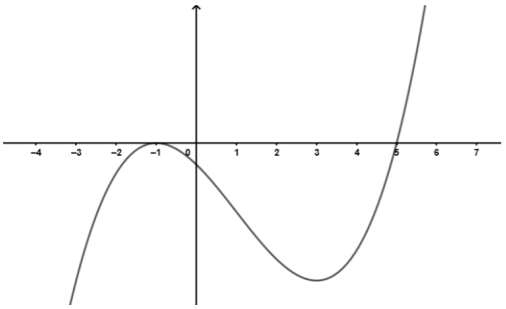
Q15 Hurlstone 2024 Prelim Q26(a) · **1 mark**

The function $y = f(x)$ is shown below. For what values of x is $f'(x) > 0$?

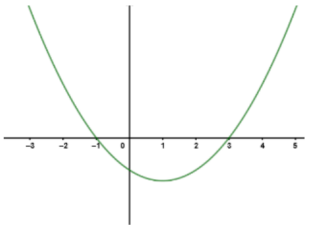


Q16 Hurlstone 2021 Prelim Q16 · **1 mark**

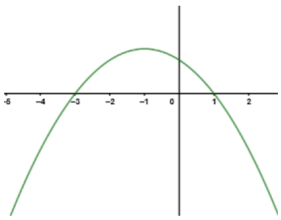
Which of the following is the graph of $\dfrac{dy}{dx}$ for the graph shown below?



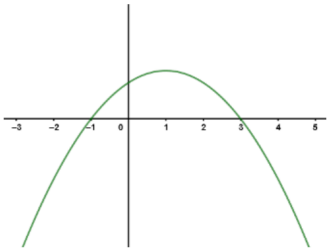
A



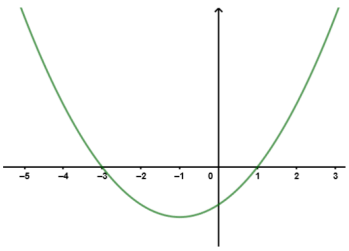
B



C

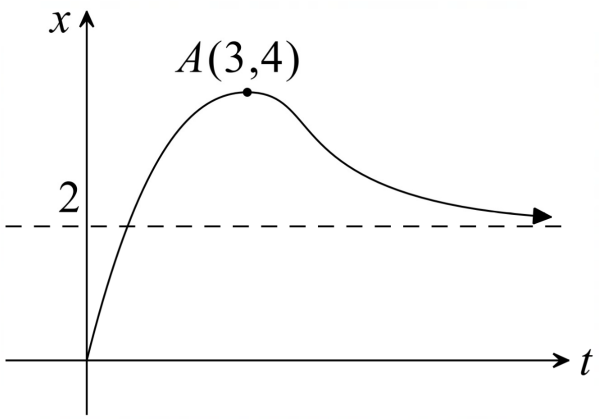


D



Q17 Baulkham Hills 2022 Prelim Q28 · **3 marks**

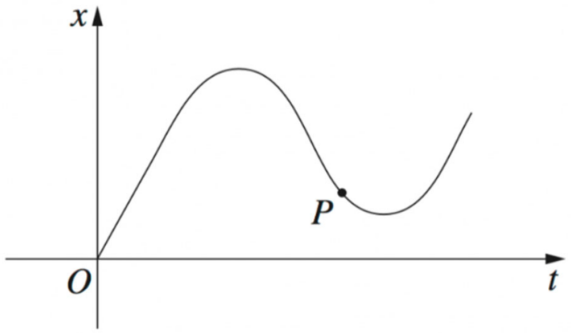
The graph below shows the displacement of a particle over time. Sketch a possible graph of the particle's velocity, $\frac{dx}{dt}$, on the axes above.



Q18 ★ Penrith 2022 Prelim Q10 · **1 mark**

★ *Involves acceleration, a Year 12 topic (the second derivative).*

The graph shows the displacement x of a particle moving along a straight line as a function of time t, where $t \geq 0$. Which statement describes the motion of the particle at the point P?



(A) The velocity is negative, and acceleration is positive.

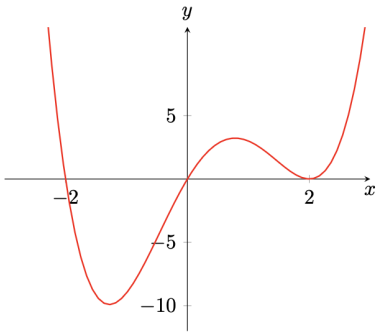
(B) The velocity is negative, and acceleration is negative.

(C) The velocity is positive, and acceleration is positive.

(D) The velocity is positive, and acceleration is negative.

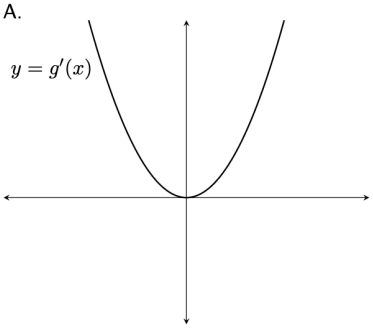
Q19 Kambala 2024 Prelim Q10 · **1 mark**

The graph below shows the curve $y = g(x)$. Which of the graphs below shows the curve $y = g'(x)$?

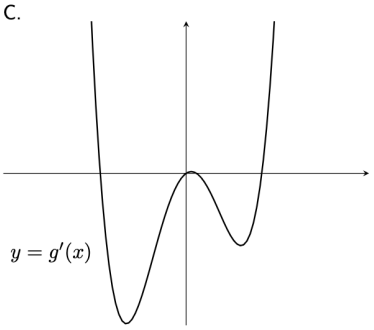


Which of the graphs below shows the curve $y = g'(x)$?

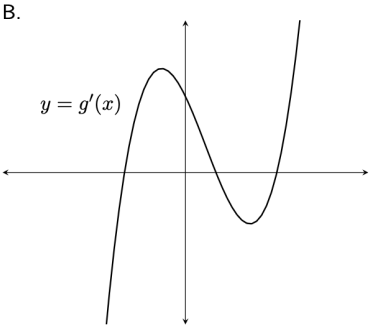
A.



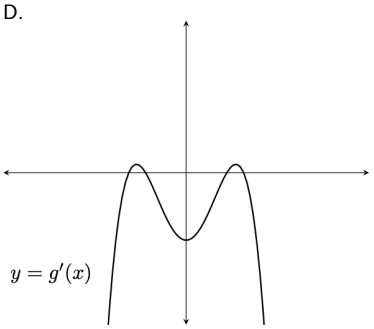
C.



B.

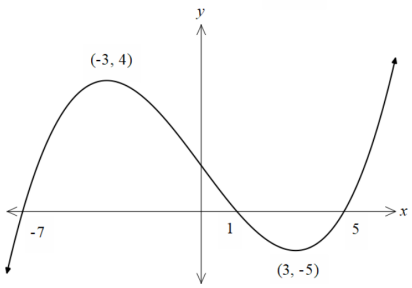


D.



Q20 North Sydney Boys 2024 Prelim Q4 · **1 mark**

The graph of $y = f(x)$ is shown below. For what values of x is $f(x) < 0$ and $f'(x) < 0$?



(A) $(-\infty, -7) \cup (1, 5)$

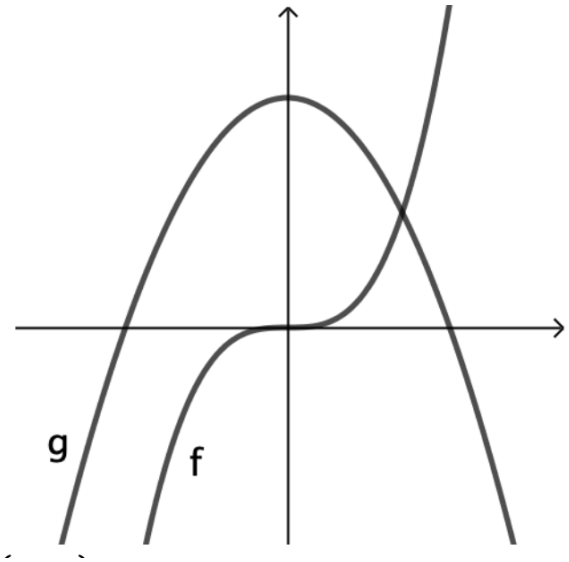
(B) $(-\infty, -3) \cup (3, \infty)$

(C) $(-3, 3)$

(D) $(1, 3)$

Q21 Knox 2021 Prelim Q10 · **1 mark**

The graph shows two functions $y = f(x)$ and $y = g(x)$.



Define $h(x) = f(g(x))$. How many stationary points does $y = h(x)$ have?

(A) 0

(B) 1

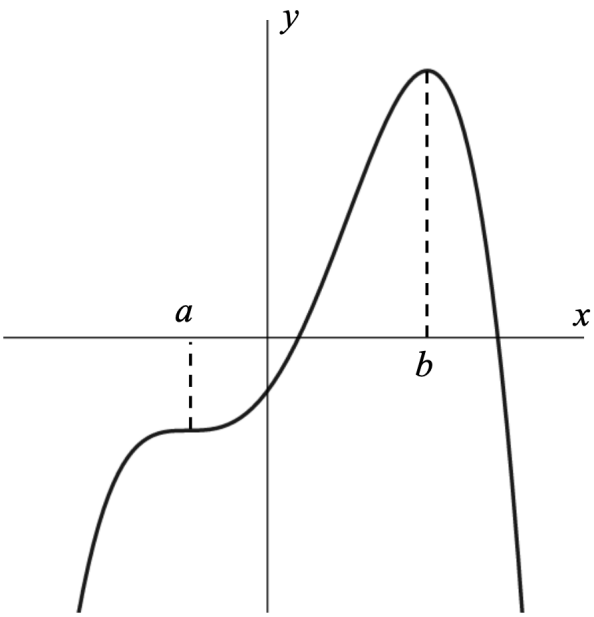
(C) 2

(D) 3

4. Sketching $y = f'(x)$ from $y = f(x)$

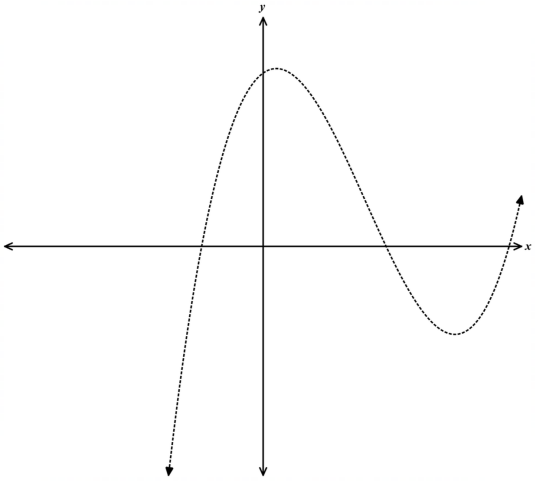
Q22 SCEGGS 2022 Prelim Q19 · **2 marks**

The graph of $y = f(x)$ is shown below. On the number plane below sketch $y = f'(x)$.



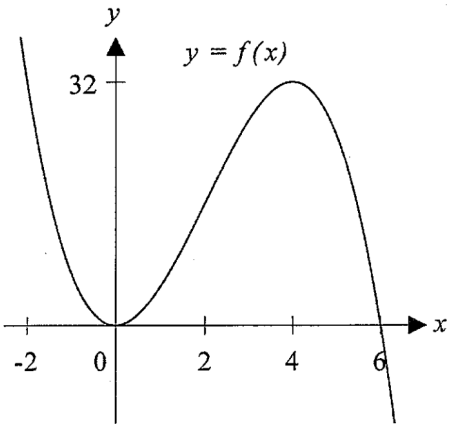
Q23 Killara 2023 Prelim Q26 · **2 marks**

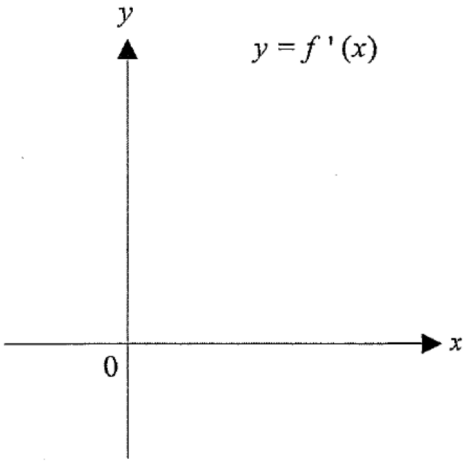
The function $f(x)$ is given on the axis below. Hence sketch the gradient function on the same axis.



Q24 St George Girls 2023 Prelim Q12 · **2 marks**

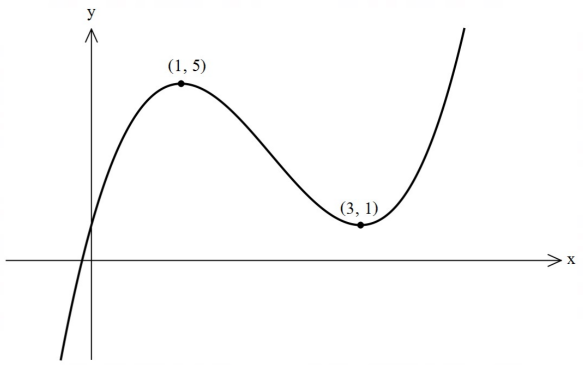
The diagram shows the graph of the curve $y = f(x)$. Sketch the graph of the curve $y = f'(x)$ showing the shape of the curve and the x-intercepts.





Q25 North Sydney Girls 2022 Prelim Q23(b) · **2 marks**

The graph of a function $y = f(x)$ passes through the points $(1, 5)$ and $(3, 1)$ as shown below. On the number plane above, sketch the gradient function $y = f'(x)$, indicating all necessary features.



Q26 North Sydney Boys 2024 Prelim Q16 · **2 marks**

The diagram above on the left shows the graph of the curve $y = f(x)$. On the set of axes above on the right, sketch the graph of the curve $y = f'(x)$ showing the shape of the curve and its x intercepts.

