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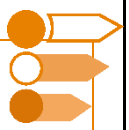
VCE Mathematical Methods ¾
Differentiation I [2.1]
Homework

Homework Outline:

Compulsory Questions	Pg 2 – Pg 16
Supplementary Questions	Pg 17 – Pg 29

Section A: Compulsory Questions



Sub-Section [2.1.1]: Find Instantaneous Rate of Change and Average Rate of Change

Question 1

Consider the function $f(x) = x^3 - x^2$.

a. Find the average rate of change of f over the interval $x \in [-2, 2]$.

b. Find $f'(x)$.

c. Find the gradient of f when $x = 2$.

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Question 2

a. Let $f(x) = x^2 \sin(3x) + \cos(x^2)$. Find $f'(x)$.

b. Let $f(x) = \log_e(x)\, e^{x^2}$. Find $f'(1)$.

c. Let $f(x) = \frac{x^3+3x}{x^2}$. Find the values of x for which the gradient is -5.

d. Let $f(x) = \frac{\log_e(x^2+3)}{x}$. Find $f'(x)$.

e. Let $f(x) = x^2e^x$. Find the values of x for which the gradient is $3e$.

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Question 3

a. Let $f(x) = \frac{\sin(3x)e^{2x}}{\sqrt{x}}$. Find $f'(x)$.

b. Let $f(x) = \sqrt{e^{2x} - \cos(x)}$. Find $f'(\pi)$.

c. Let $f(x) = \frac{x^2 e^x}{x^2+1}$. Find all x values where f has a stationary point.

d. Let $f(x) = \frac{\sin^3(x)+\sin(x)\cos^2(x)}{\cos(x)}$. Show that $f'(x) = \frac{1}{\cos^2(x)}$.

e. Let $f(x) = (x^3 + 3)(x^5 + 2)^5$. Find $f'(-1)$.

Question 4 Tech-Active.

Let $f(x) = \frac{1}{3}x^3 + x^2 - x + 3$. Find when f has a gradient of 3.

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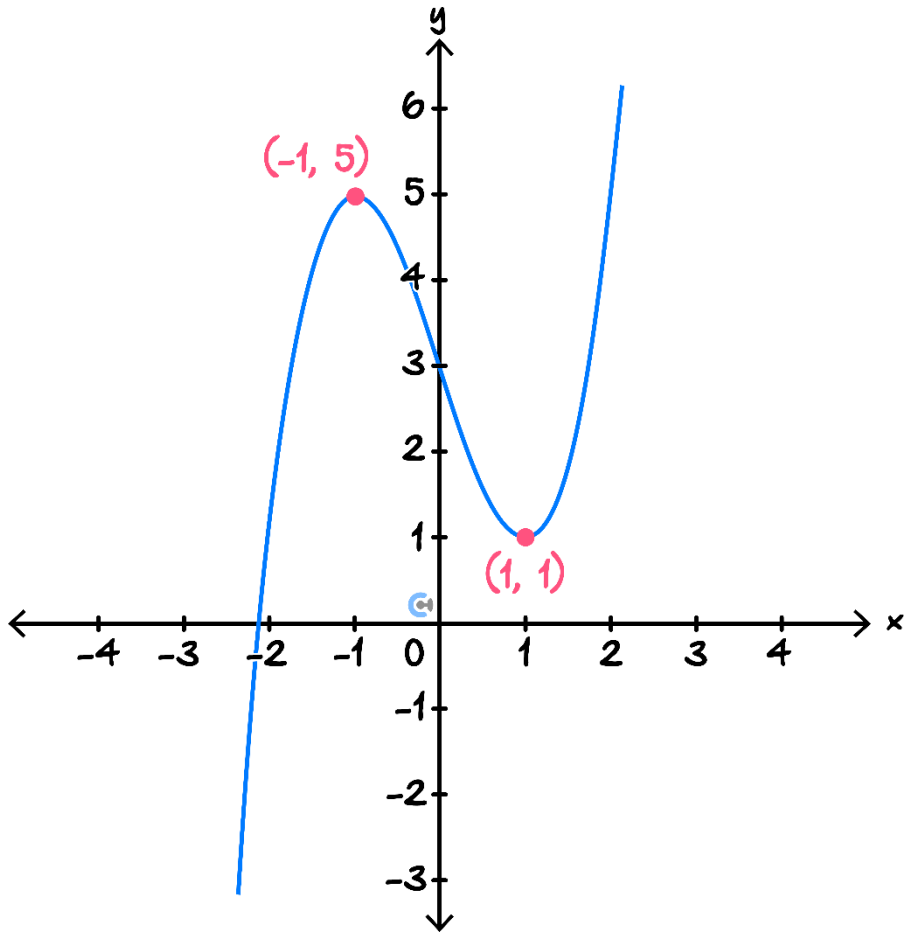
Sub-Section [2.1.2]: Identify the Nature of Stationary Points and Trend (Strictly Increasing and Decreasing)

Question 5

Consider the graph of f shown below.



a. State the nature of the stationary point when $x = 1$.

_____

b. State the values of x for which $f(x)$ is strictly increasing.

_____

_____

Question 6

Let $f(x) = x^3 - 4x^2 - 3x + 19$.

a. Find the stationary points of f.

b. State the nature of the stationary points of $f'(x)$.

c. Hence, state the values of x for which $f(x)$ is decreasing.

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Question 7

Let $f(x) = xe^{-x^2+x+2}$.

a. Find the stationary points of f.

b. State the nature of the stationary points of $f'(x)$.

c. Hence, state the values of x for which $f(x)$ is strictly increasing.

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Question 8 Tech-Active.

Let $f(x) = \frac{x^5}{5} - x^4 - \frac{7x^3}{3} + 17x^2 - 24x$.

Find the all values of x for which f is strictly increasing.

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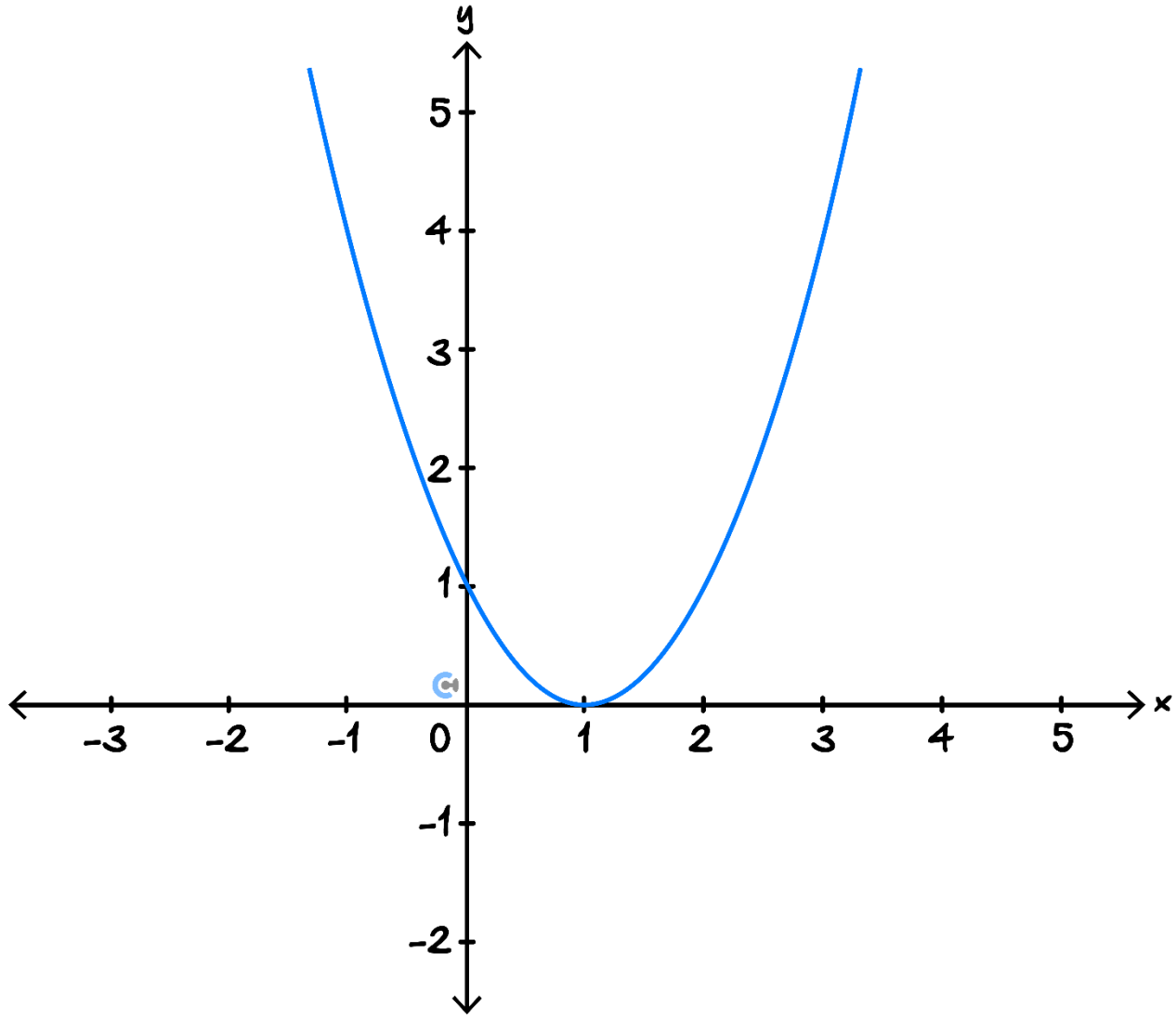
Sub-Section [2.1.3]: Graph Derivative Functions

Question 9

The graph of $f(x)$ is drawn below.

Sketch the graph of $f'(x)$ on the same axes.



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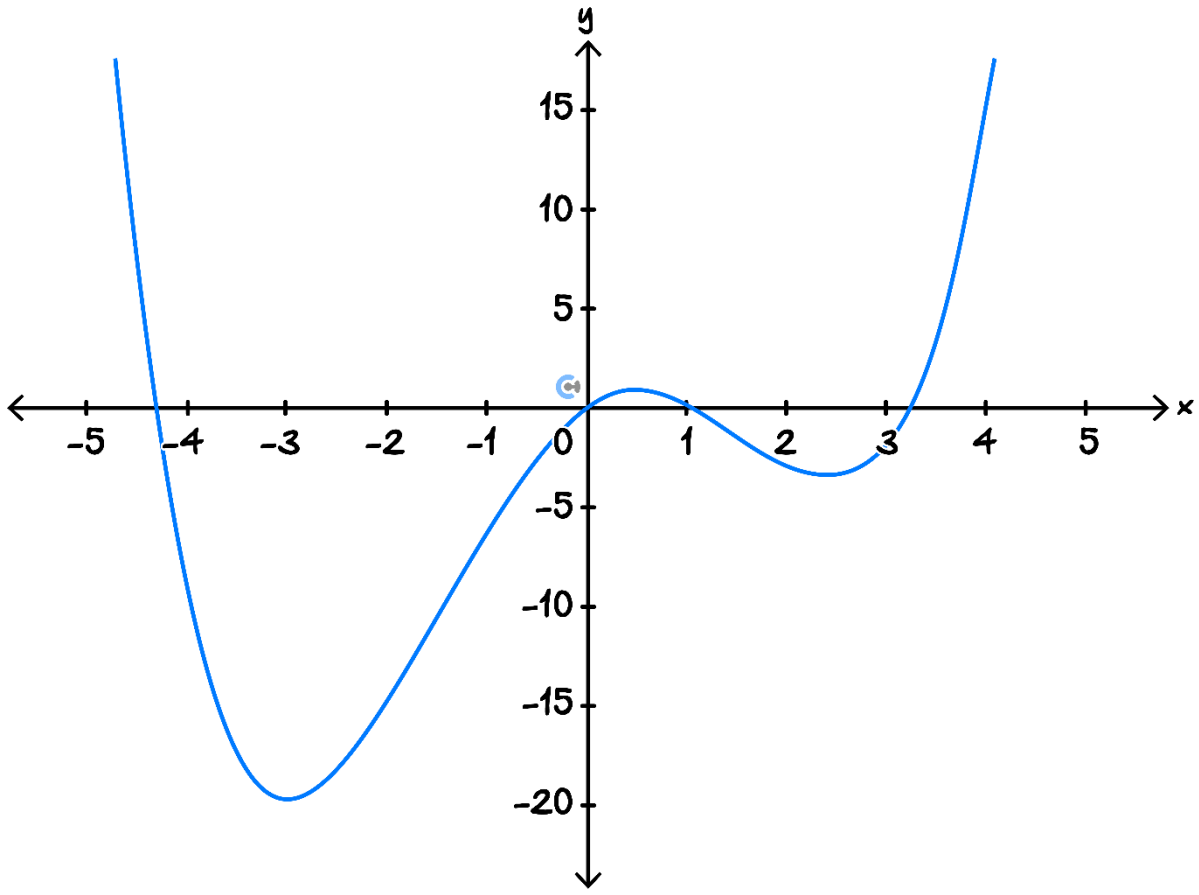
Question 10

The graph of $f(x)$ is drawn below.

Sketch the graph of $f'(x)$ on the same axes.



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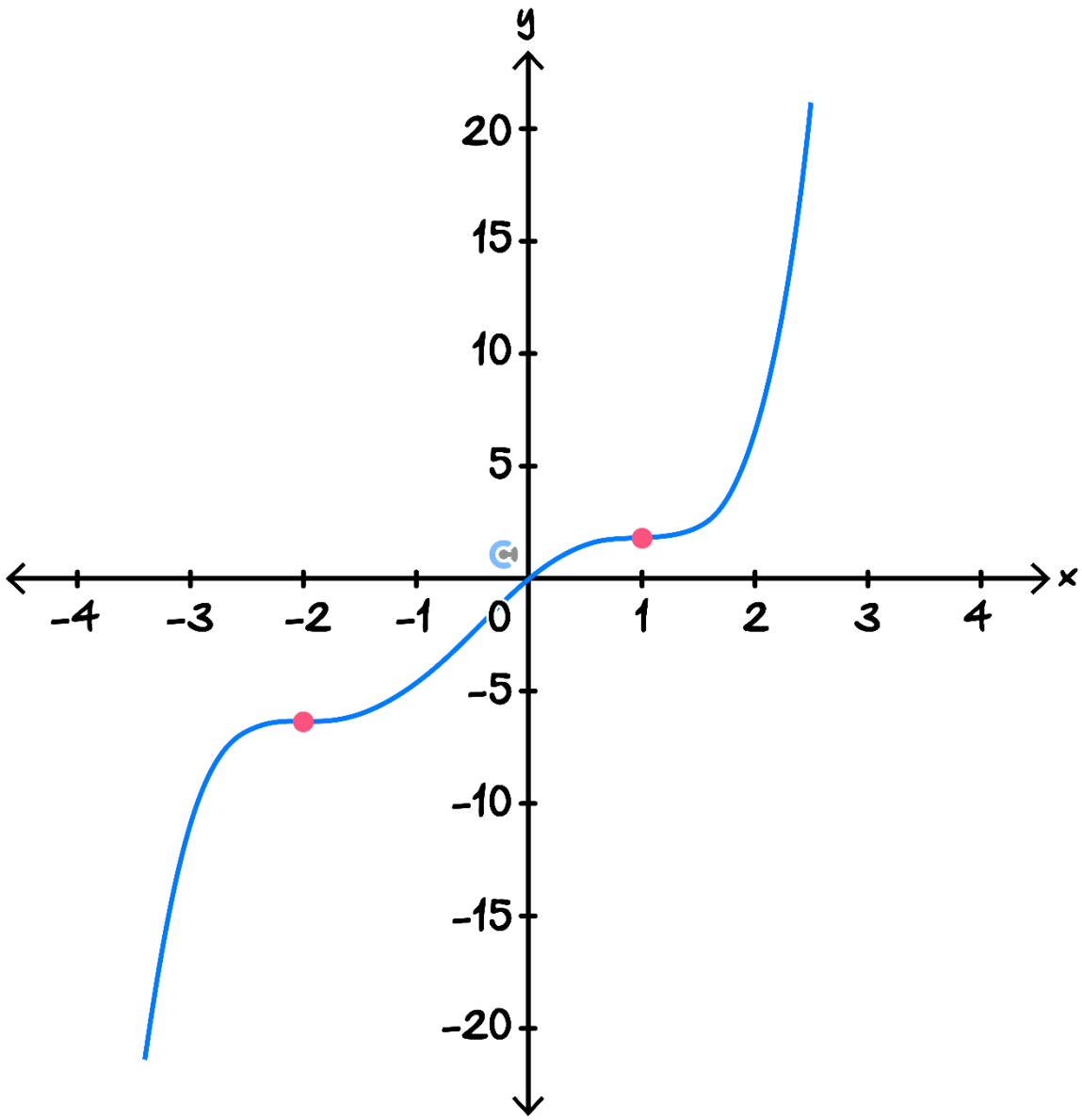
Question 11

The graph of $f(x)$ is drawn below.

Sketch the graph of $f'(x)$ on the same axes.



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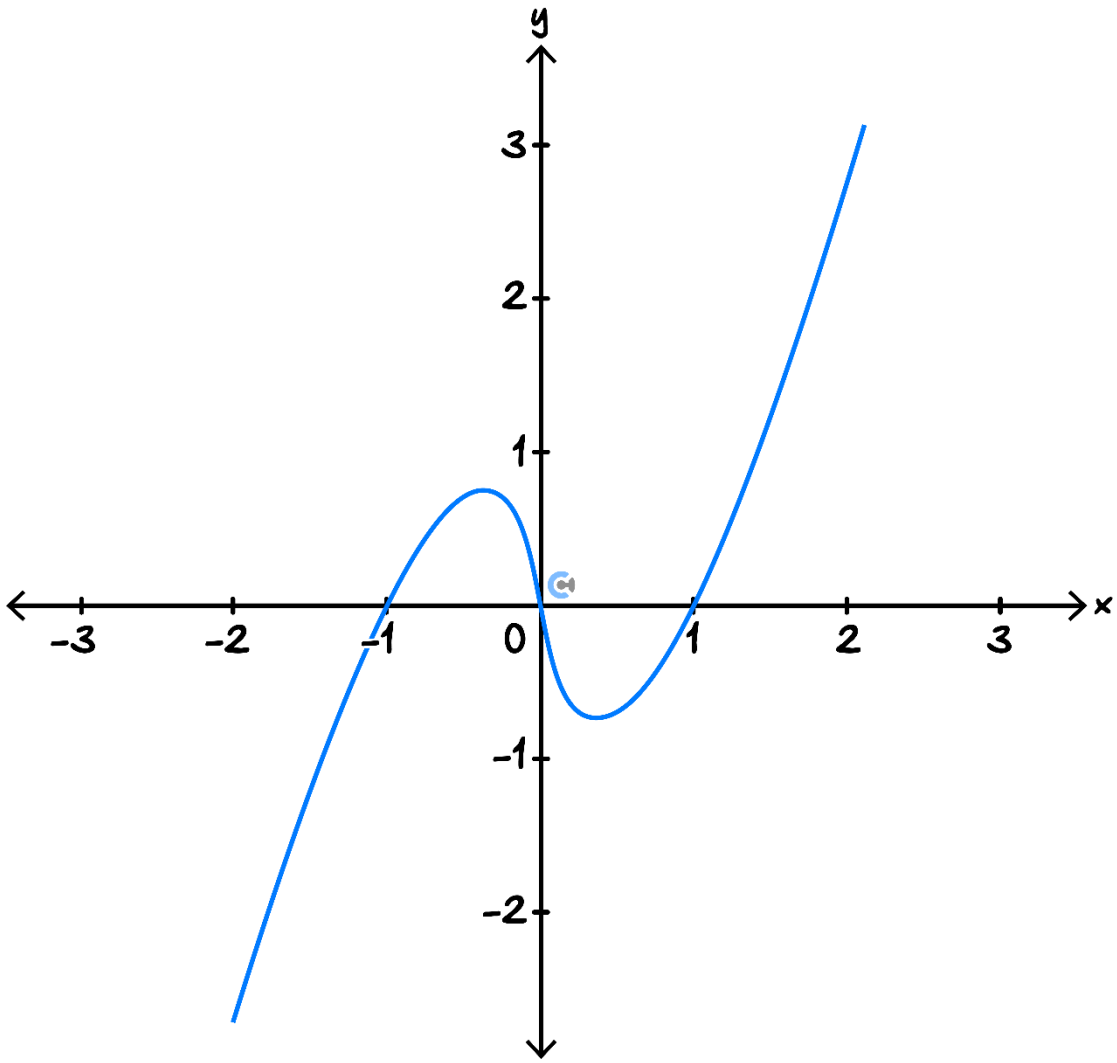
Sub-Section: The 'Final Boss'

Question 12

Let $f(x) = x \log_e(x^2)$. The graph of f is shown on the axes below.



a. Find $f'(x)$.

b. Find all stationary points of f and state their nature.

c. State the values of x for which $f(x)$ is strictly decreasing.

d. Sketch the graph of $f'(x)$ alongside the graph of f at the start of the question. Label any axes intercepts.

e. Let $g(x) = \cos(x)$. Find $f'(g(x))$.

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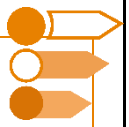
Section B: Supplementary Questions



Sub-Section [2.1.1]: Find Instantaneous Rate of Change and Average Rate of Change

Question 13

a. Find the average rate of change of $f(x) = x^3 + 3x - 2$ over the interval $[0, 2]$.

b. Let $f(x) = \sqrt{x} - e^x$. Find $f'(x)$.

c. Find the gradient of the graph of $y = \sin(x) + 3\cos(x)$ at the point $\left(\frac{\pi}{3}, \frac{3+\sqrt{3}}{2}\right)$.

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Question 14

a. Let $y = \tan(x)$, use the quotient rule to show that $\frac{dy}{dx} = \frac{1}{\cos^2(x)}$.

b. Find the gradient of $y = \sqrt{4 - x^2}$ at the point $(-1, \sqrt{3})$.

c. Let $f(x) = -x \log_e(x)$. At what point is the gradient of f equal to 2?

d. Let $f(x) = e^{x^2+2}$, find $f'(x)$.

e. Let $f(x) = \cos^2(x)$. Find $f'\left(\frac{\pi}{3}\right)$.

Question 15

a. Let $y = \frac{e^{-x}}{\sin(2x^2)}$. Find and simplify $\frac{dy}{dx}$.

b. Let $f(x) = (x-3)^4(x^3 - 5x^2 + 1)$. Find $f'(2)$.

c. Let $f(x) = \sqrt{\sin(4x) + 2}$. Find all values of $x \in [0, \pi]$ such that $f'(x) = 0$.

d. Evaluate $\frac{d}{dx}(\log_e(x)\log_e(x^2 + 3x + 4))$.

e. Let $f(x) = \frac{(xe^x)^2}{x-1} + 2x$. Solve $f'(x) = 2$ for x.

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Question 16

Let $f(x) = \frac{\cos(e^{-x}\log_e(x))}{\sin(e^{-x}\log_e(x))}$.

Show that $f'(a) = 0$ implies that $\frac{1}{a} = \log_e(a)$.

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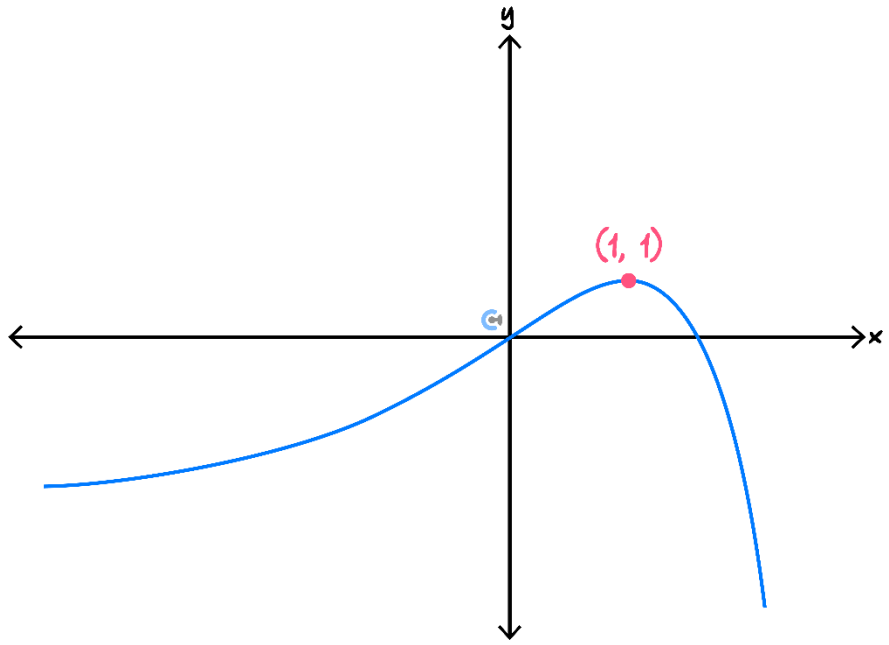
Sub-Section [2.1.2]: Identify the Nature of Stationary Points and Trend

Question 17

The graph of $f(x)$ is drawn below.



a. State the nature of the stationary point when $x = 1$.

b. State the values of x for which $f(x)$ is strictly increasing.

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Question 18

Let $f(x) = 2x^3 + 3x^2 - 12x + 5$.

a. Find the stationary points of f.

b. State the nature of the stationary points.

c. Hence, state the values of x for which $f(x)$ is strictly decreasing.

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Question 19

Let $f(x) = e^{1+4x-3x^2}$.

a. Find the stationary points of $f'(x)$.

b. State the nature of the stationary points of $f'(x)$.

c. Hence, state the values of x for which $f'(x)$ is strictly increasing.

Question 20

Let $f(x) = x^{\frac{10}{3}}$.

State the values for which $g(x) = f'(x) - f(x)$ is strictly increasing.

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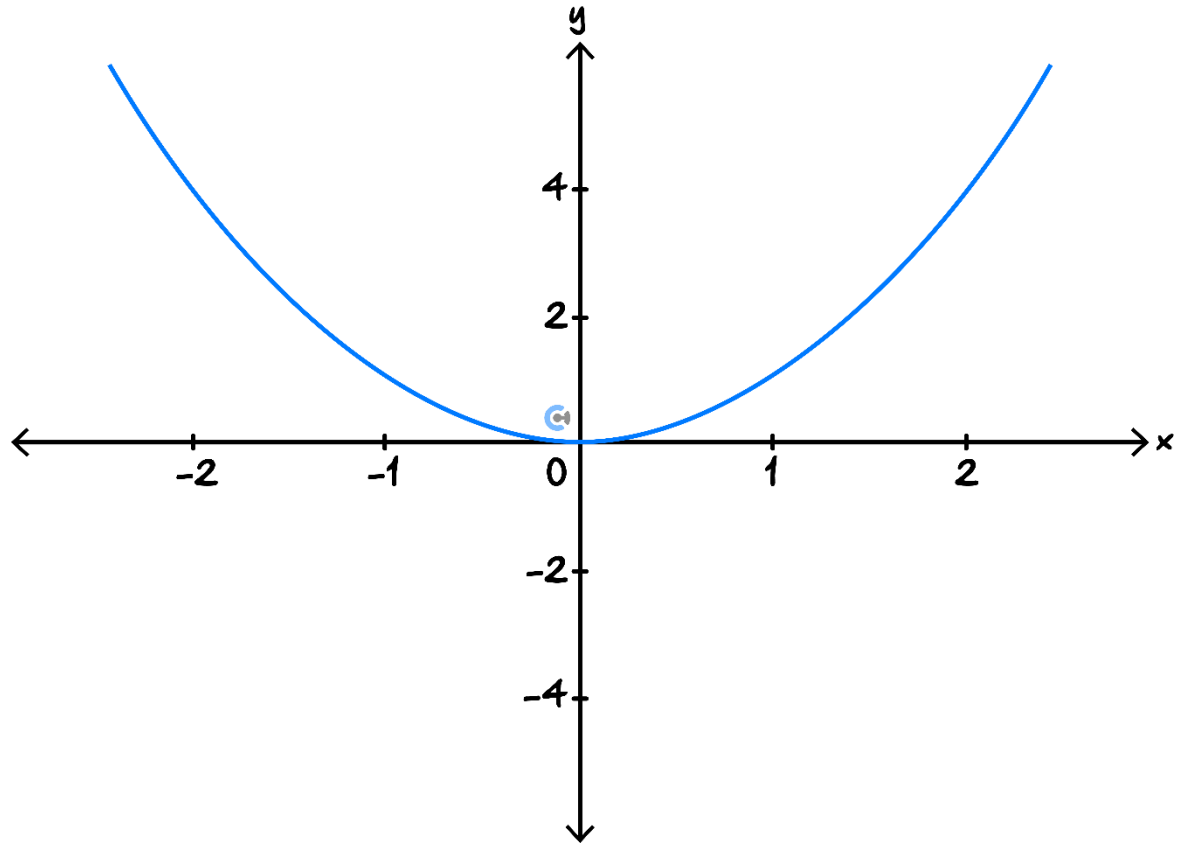
Sub-Section [2.1.3]: Graph Derivative Functions

Question 21

The graph of $f(x)$ is drawn below.

Draw the graph of $f'(x)$ on the same axes.



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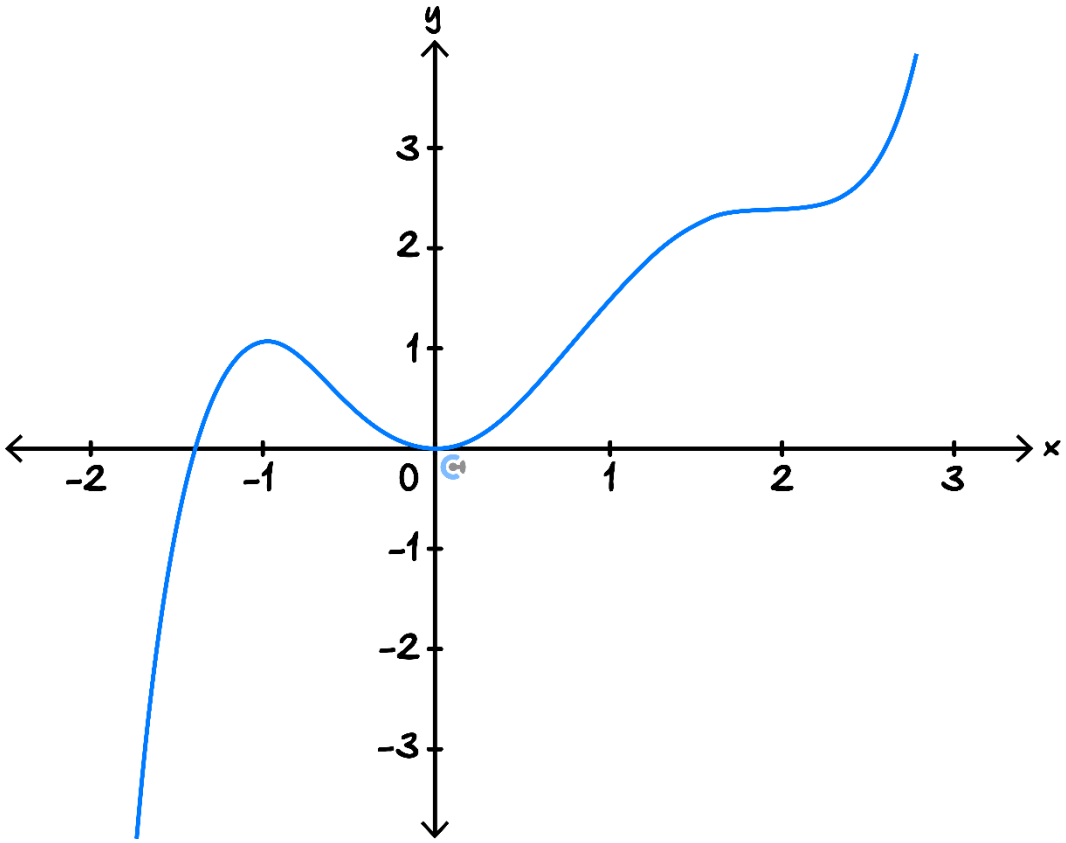
Question 22

The graph of $f(x)$ is drawn below.

Draw the graph of $f'(x)$ on the same axes.



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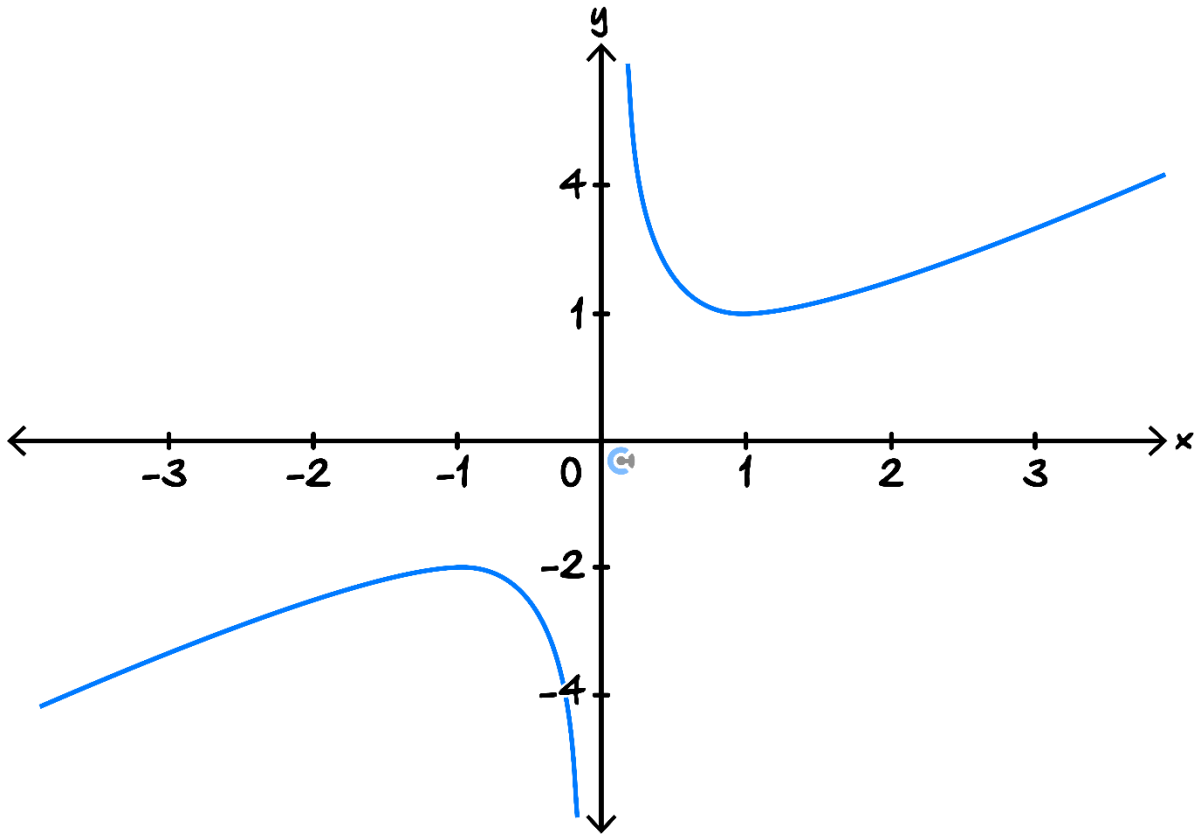
Question 23

The graph of $f(x)$ is drawn below.

Draw the graph of $f'(x)$ on the same axes.



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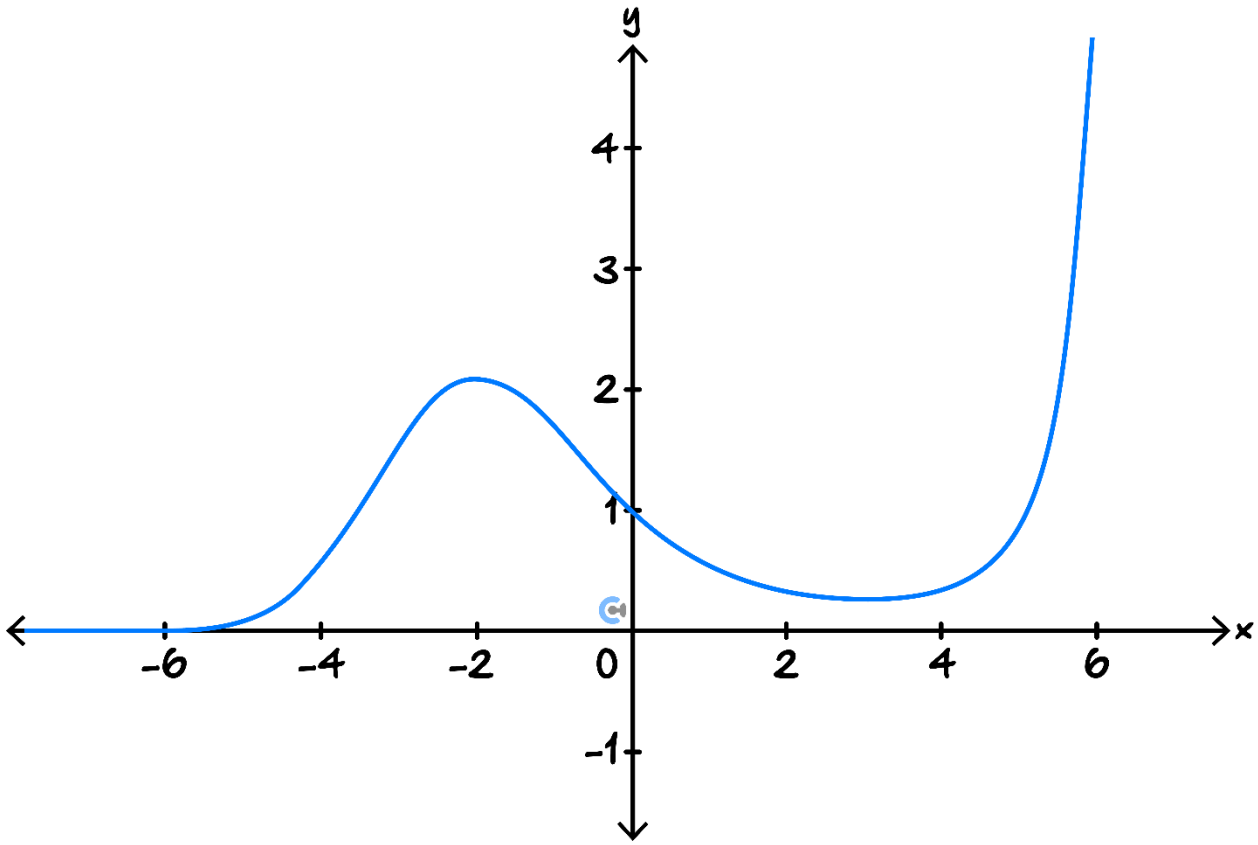
Question 24

The graph of $f(x)$ is drawn below.

Draw the graph of $f'(x)$ on the same axes.



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