



MATHS

BOOKS - CENGAGE MATHS (ENGLISH)

GETTING STARTED WITH GRAPHS

Illustration 1 1

1. Does the following graph represent a function or a relation?

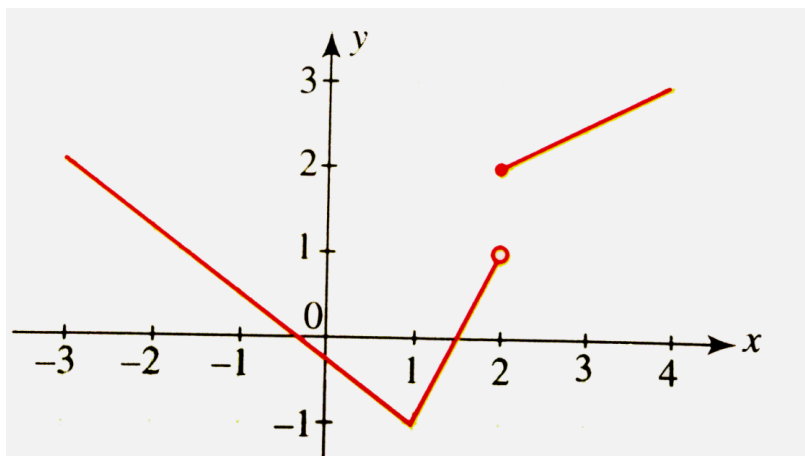


Illustration 1 2

1. Does the graph below represent a function or a relation?

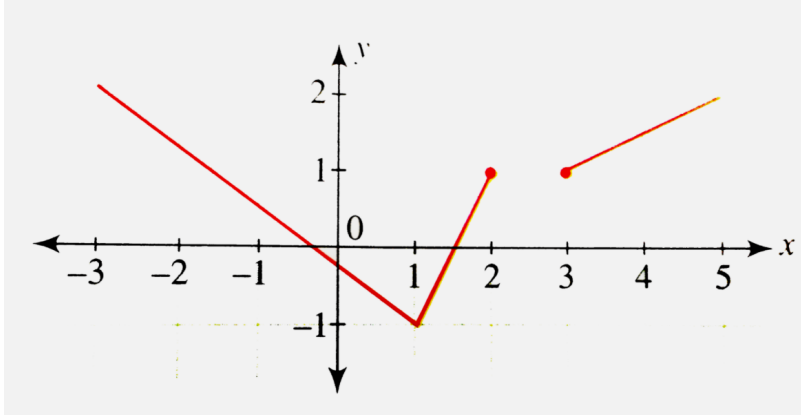
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Illustration 1 3

1. Does the following graph pass the vertical or horizontal line test?



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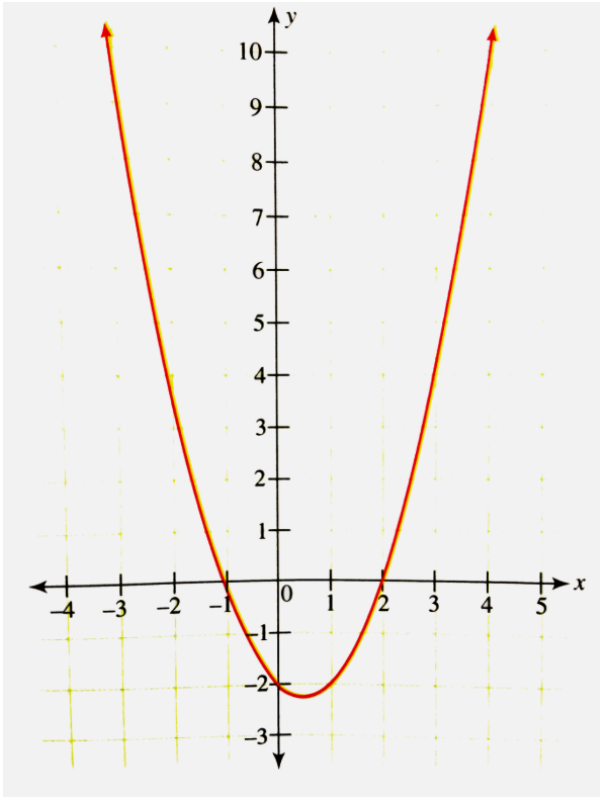
Illustration 1 4

1. In how many points graph of $y = x^3 - 3x^2 + 5x - 3$ interest the x-axis?

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Illustration 1 5

1. Following is the graph of $y = f(x)$.



Find the roots of the equation

$$f(x) = 0, f(x) = 4 \text{ and } f(x) = 10.$$



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1. Which of the following pair of graphs intersect ?

(i) $y = x^2 - x$ and $y = 1$

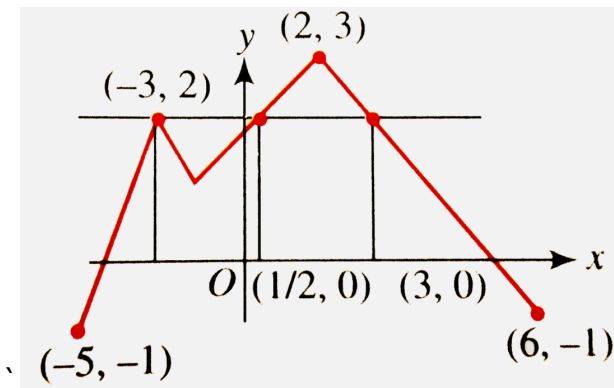
(ii) $y = x^2 - 2x + 3$ and $y = \sin x$

(iii) $y = x^2 - x + 1$ and $y = x - 4$

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Illustration 17

1. The graph of $y = f(x)$ is shown, find the number of solution of $f(f(x)) = 2$.



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Illustration 1 8

1. Does the graph of the function $f(x) = x^2 - 3$ have y - axis symmetry?

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Illustration 1 9

1. Does the graph of the function $f(x) = 1/x^3$ have origin symmetry?

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Illustration 1 10

1. Check whether the function has (have) y-symmetry or origin symmetry: $f(x) = x^2 \sin x$.

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Illustration 1 11

1. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a continuous onto function satisfying $f(x) + f(-x) = 0, \forall x \in \mathbb{R}$. If $f(-3) = 2$ and $f(5) = 4$ in $[-5, 5]$, then what is the minimum number of roots of the equation $f(x) = 0$?

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Illustration 1 12

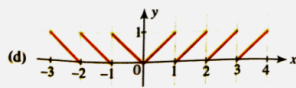
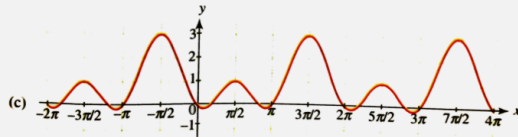
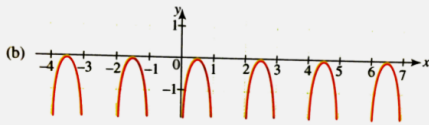
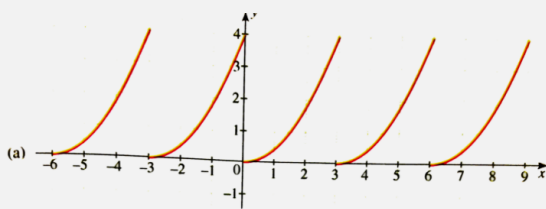
1. Let $f: R \rightarrow R$ and $g: R \rightarrow R$ be two one-one and onto functions such that they are mirror images of each other about the line $y = a$. If $h(x) = f(x) + g(x)$, then $h(x)$ is (A) one-one onto (B) one-one into (C) many-one into (D) many-one onto



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Illustration 1 13

1. Check weather the following function/functions is/are periodic or not? Find the period in case the function is periodic.



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Illustration 1 14

1. Draw the graph of

$$f(x) = \begin{cases} (x - 2n, 2n \leq x < 2n + 1), & \left(\frac{1}{2}, 2n + 1 \leq x < 2n + 2\right) \end{cases}$$

periodic? If yes, what is its period?

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Illustration 1 15

1. The graph of $y = f(x)$ is as shown in the following figure.



Find the following values:

$$(i) \lim_{x \rightarrow 4} f(x) \qquad (ii) \lim_{x \rightarrow -3} f(x)$$

$$(iii) \lim_{x \rightarrow 0^+} f(x) \qquad (iv) \lim_{x \rightarrow 0^-} f(x)$$

$$(v) \lim_{x \rightarrow 0} f(x) \qquad (vi) f(-2)$$

$$(vii) \lim_{x \rightarrow 2^-} f(x) \qquad (viii) \lim_{x \rightarrow -2^-} f(x)$$

$$(ix) \lim_{x \rightarrow 0} f(x + 1) \qquad (x) f(0)$$

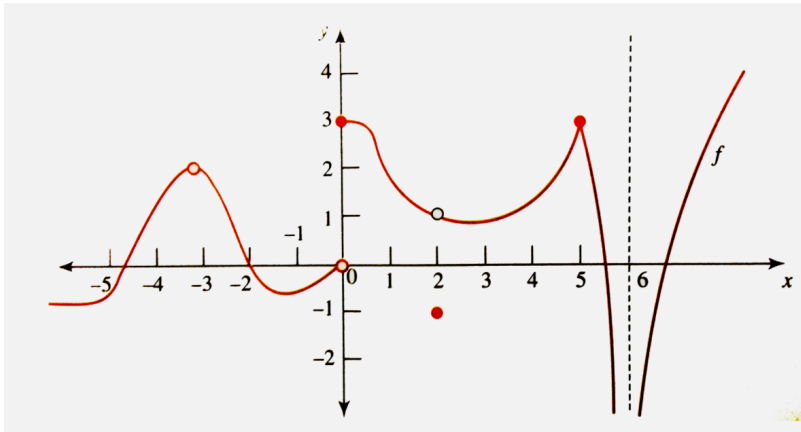
$$(xi) \lim_{x \rightarrow 0^+} f(x - 2) \qquad (xii) \lim_{x \rightarrow 1^-} f(x - 4)$$



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Illustration 1 16

1. The graph of $y = f(x)$ is as shown in the following figure.

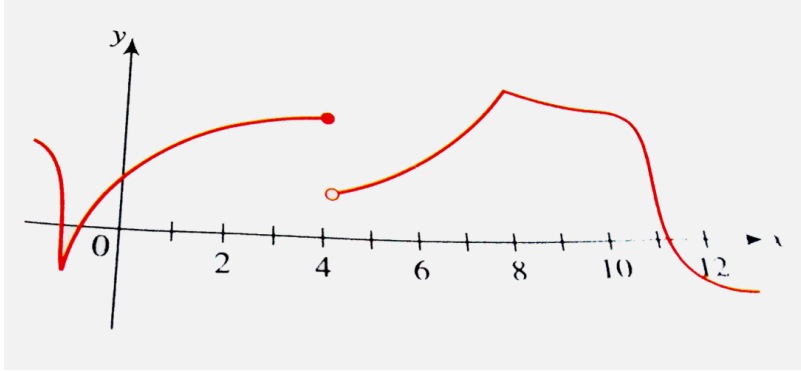


Identify the points of discontinuity and give the reason for the same.

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Illustration 1 17

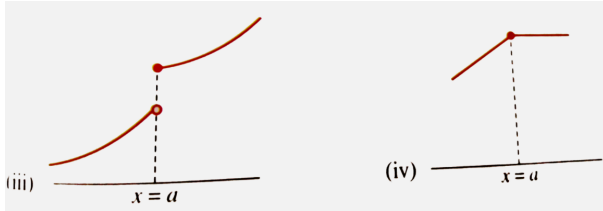
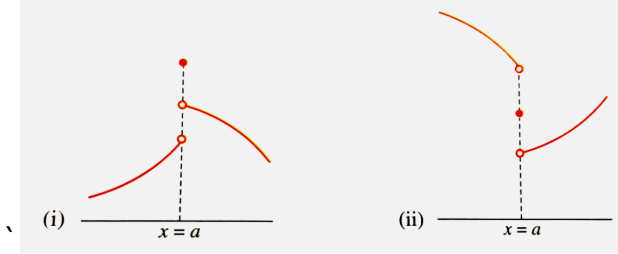
1. The graph of $f(x)$ is given. State with reasons the number at which the function is non-differentiable.



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Illustration 1 18

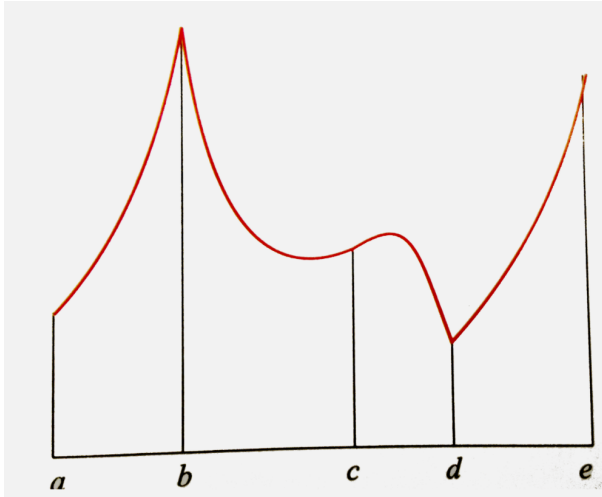
1. For each of the following graphs, comment whether $f(x)$ is increasing or decreasing or neither increasing nor decreasing at $x = a$.



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Illustration 1 19

1. The graph of a function is shown in the following figure.



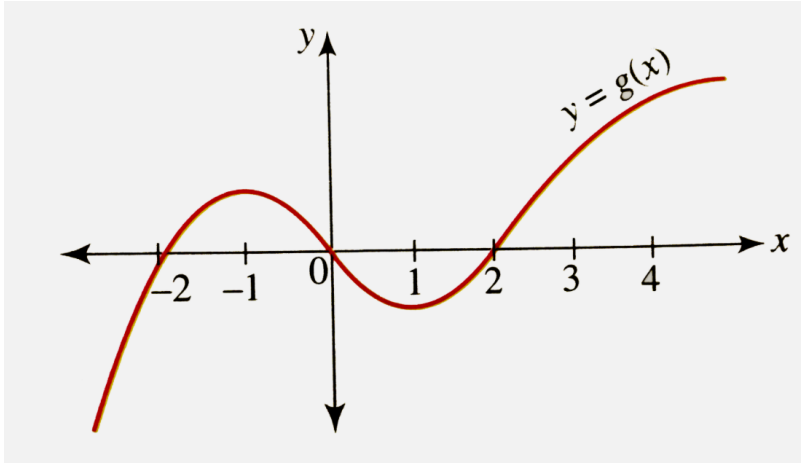
Determine the intervals on which the function is concave up and the intervals on which it is concave down. Find the x - coordinates of any inflection points.

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Illustration 1 20

1. For the function g whose graph is given. Arrange the following numbers in increasing order and explain your reasoning.

$$g(0), g'(-2), g'(0), g'(2), g'(4)$$

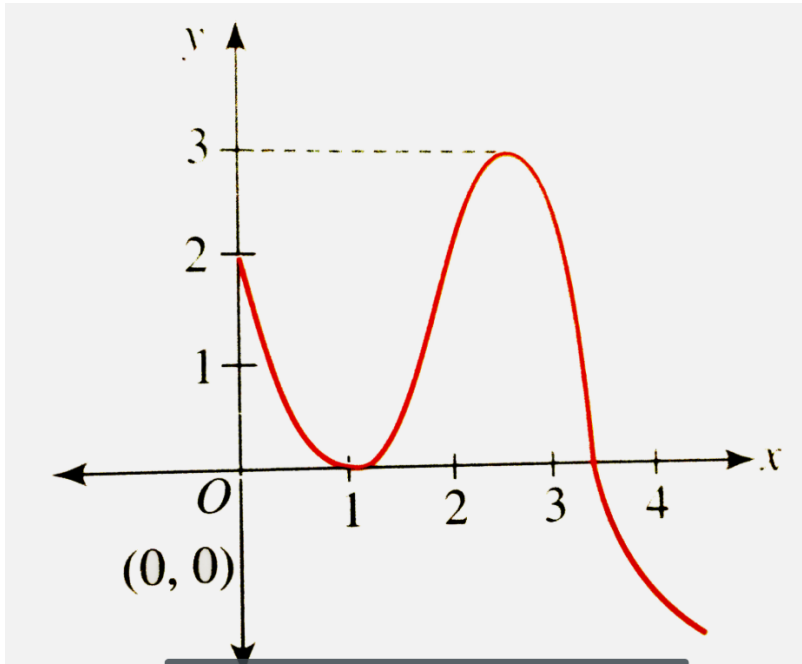


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Illustration 1 21

1. The diagram shows the graph of the derivative of a function $f(x)$ for $0 \leq x \leq 4$ with $f(0) = 0$. Which of the following could be

correct statements for $y = f(x)$?

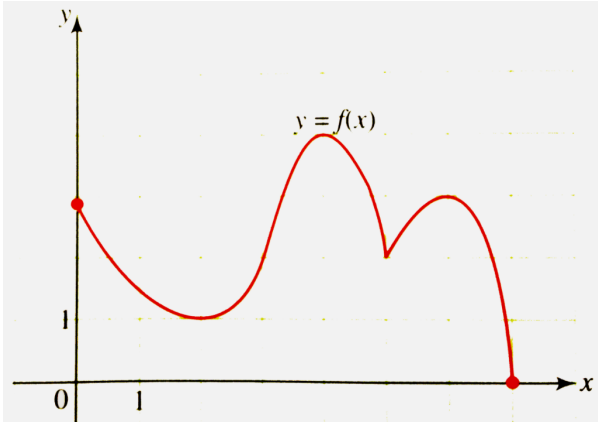


- (a) Tangent line to $y = f(x)$ at $x = 0$ makes an angle of $\sec^{-1} \sqrt{5}$ with the x -axis.
- (b) f is increasing in $(0, 3)$.
- (c) $x = 1$ is both an inflection point and the point of local extremum.
- (d) Number of critical point on $y = f(x)$ is two.

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Illustration 1 22

1. In the following graph, state the absolute and local maximum and minimum values of the function.



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Illustration 1 23

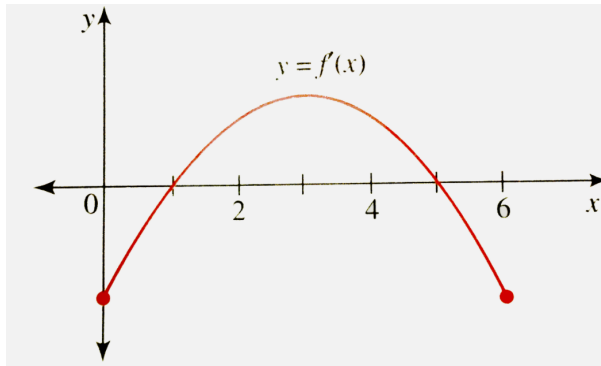
1. The graph of the derivative $f'(x)$ is given in the following figure.

(b) Find the values of x for which f has local maximum or

minimum.

(c) Find the intervals in which f is concave upward or downward.

(d) Find the point of inflection.

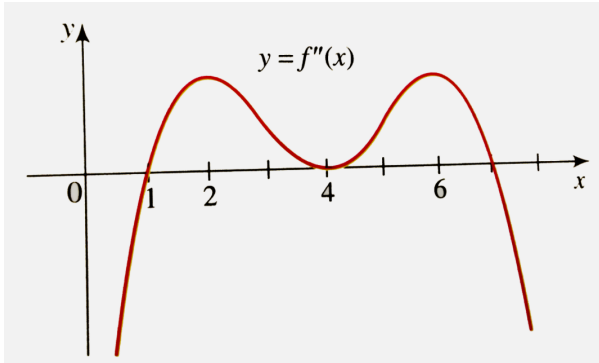


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Illustration 1 24

1. The graph of the second derivation $f''(x)$ is given in the following figure. State the x - coordinate of the point of inflection

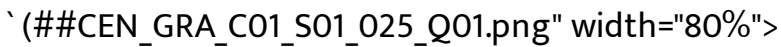
of f . Given reasons for your answer.



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Illustration 1 25

1. The figure shows the graphs of f , f' and f'' . Identify each curve and explain your choices.

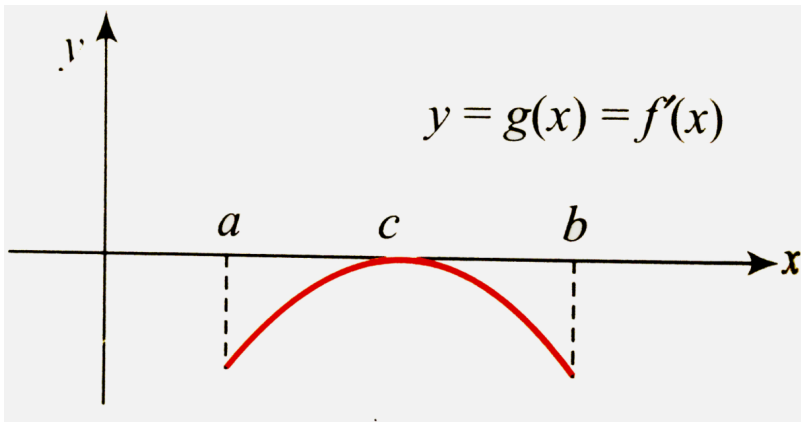
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Illustration 1 26

1. Following is the graph of $y = f'(x)$, given that $f(c) = 0$. Analyse the graph and answer the following questions.

- How many times the graph of $y = f(x)$ will intersect the x -axis?
- Discuss the type of roots of the equation $f(x) = 0$, $a \leq x \leq b$.
- How many points of inflection the graph of $y = f(x)$, $a \leq x \leq b$, has?
- Find the points of local maxima/minima of $y = f(x)$, $a < x < b$.
- How many roots equation $f''(x) = 0$ has?



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Illustration 1 27

1. Find the asymptote of the function $y = \frac{2x^2 + 3x + 1}{x}$ if any.



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Illustration 1 28

1. Find the horizontal, vertical and oblique asymptotes of each of the curves.

$$(a) \quad y = \frac{x}{x+4}$$

$$(b) \quad y = \frac{x^2+4}{x^2-1}$$

$$(c) \quad y = \frac{x^3}{x^2+3x-10}$$

$$(d) \quad y = \frac{x^3+1}{x^3+x}$$

$$(e) \quad y = \frac{x}{\sqrt[4]{x^4+1}}$$

$$(f) \quad y = \frac{x-9}{\sqrt{4x^2+3x+2}}$$

$$(g) \quad y = \frac{1}{2^x-1}$$

$$(h) \quad y = \frac{1}{\log_e x}$$

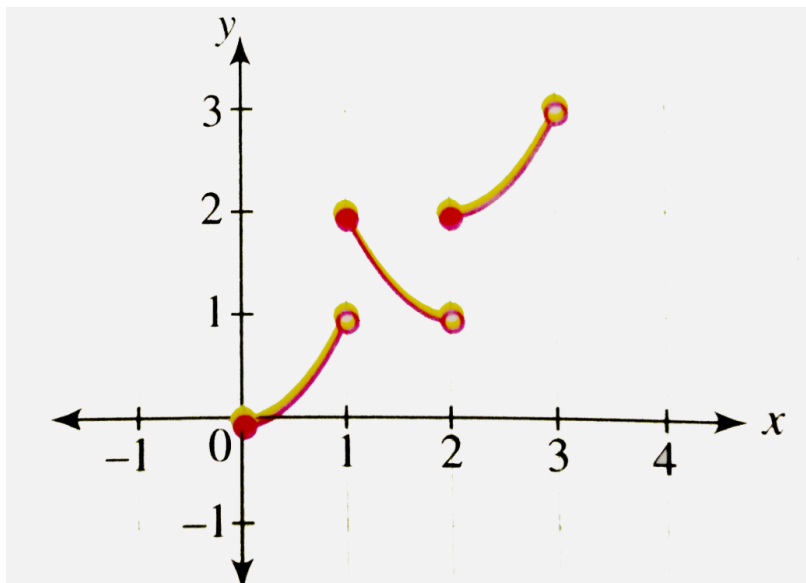
$$(i) \quad y = \frac{1}{2^x-1}$$



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Exercises 1 1

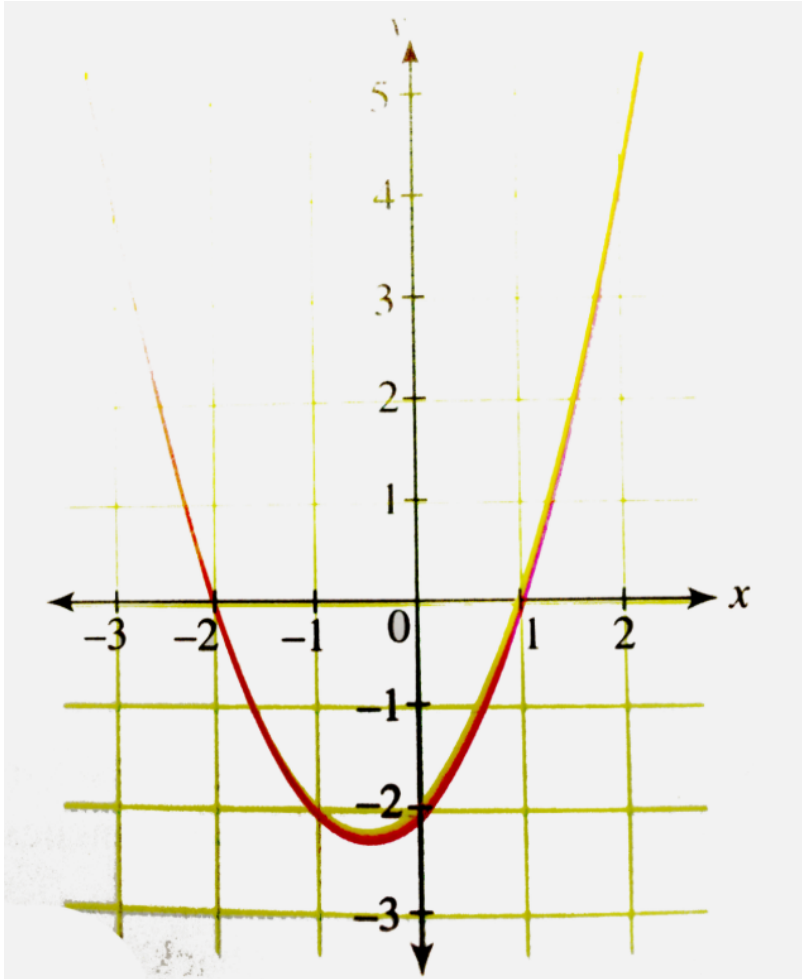
1. Does the following graph pass the vertical or horizontal line test ?



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Exercises 1 2

1. Consider the graph of $y = f(x)$ as shown in the following figure.



(i) Find the sum of the roots of the equation $f(x) = 0$.

(ii) Find the product of the roots of the equation $f(x) = 4$.

(iii) Find the absolute value of the difference of the roots of the equation $f(x) = x + 2$.

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Exercises 1 3

1. Determine whether the function has y-symmetry or origin

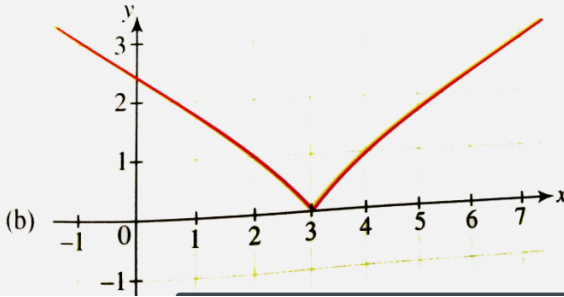
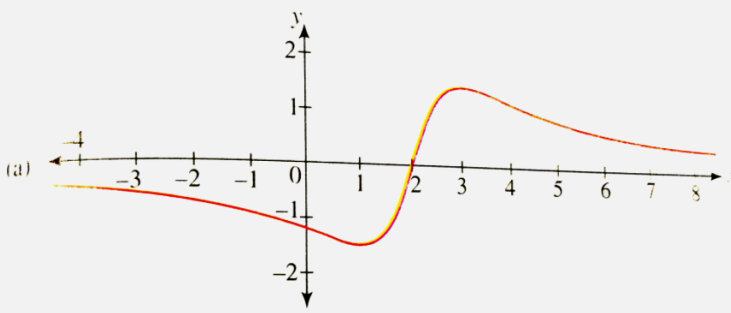
symmetry : $f(x) = \frac{x}{e^x - 1} + \frac{x}{2} + 1$

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Exercises 1 4

1. The graph of functions are given in the following figure.

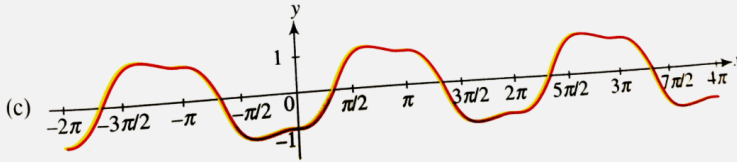
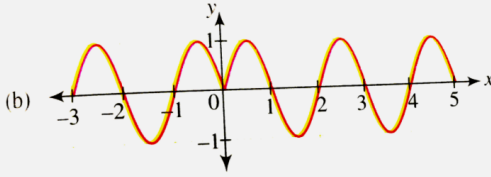
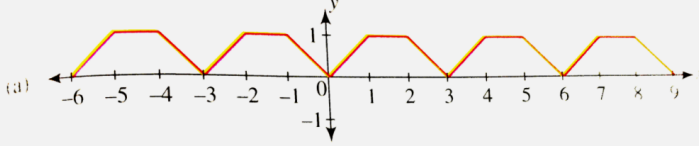
Discuss the symmetry.



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Exercises 15

1. Check whether the following function/functions is/are periodic or not? Find the period in case the function is periodic.



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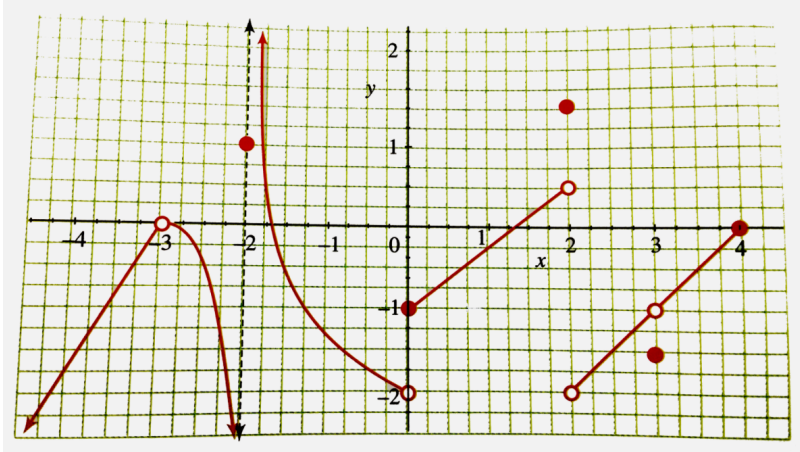
Exercises 1 6

1. Suppose that f is even, periodic function with period 2, and that $f(x) = x$ for all x in the interval $[0, 1]$. Then draw the graph of $y = f(x)$.

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Exercises 17

1. The graph of $y = f(x)$ is as shown in the following figure.



Find the following values

(i) $f(-3)$ (ii) $f(-2)$ (iii) $f(0)$

(iv) $f(2)$ (v) $f(3)$ (vi) $\lim_{x \rightarrow -3} f(x)$

(vii) $\lim_{x \rightarrow 0} f(x)$ (viii) $\lim_{x \rightarrow 2} f(x)$ (ix) $\lim_{x \rightarrow 3} f(x)$

(x) $\lim_{x \rightarrow 2^-} f(x)$ (xi) $\lim_{x \rightarrow -2^+} f(x)$ (xii) $\lim_{x \rightarrow 0^-} f(x)$

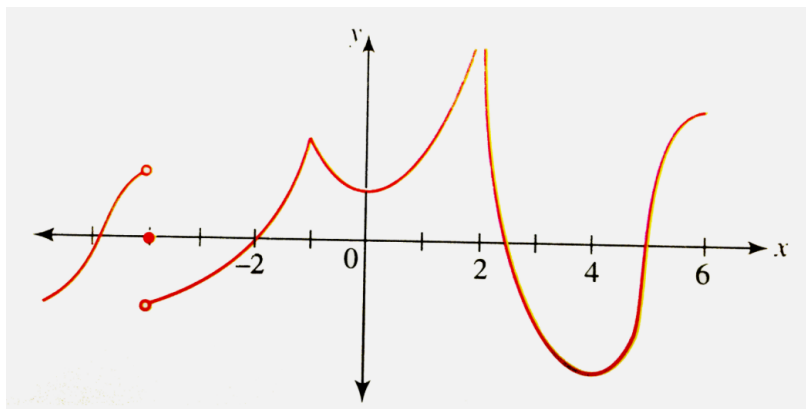
(xiii) $\lim_{x \rightarrow 0^+} f(x)$



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Exercises 1 8

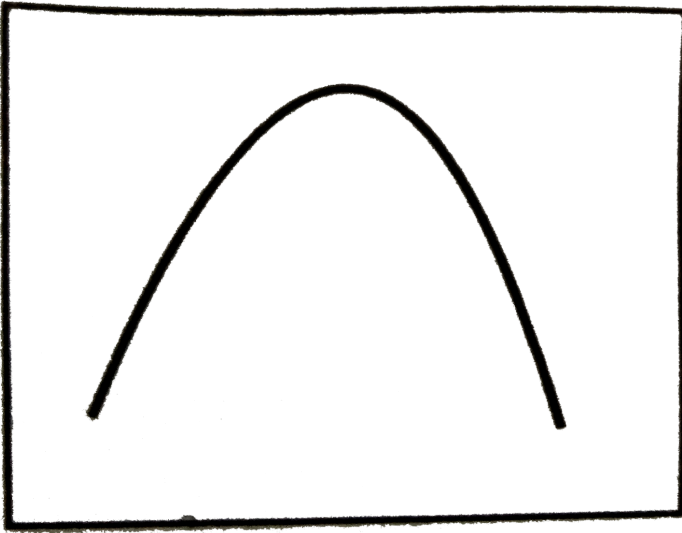
1. The graph of f is shown. State, with reason, the numbers at which f is not differentiable.



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Exercises 1 9

1. Select the right option regarding the given graph.



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Exercises 1 10

1. (a) Can the graph of the function intersect the horizontal asymptote?

(b) Can the graph of the function intersect the vertical asymptote?



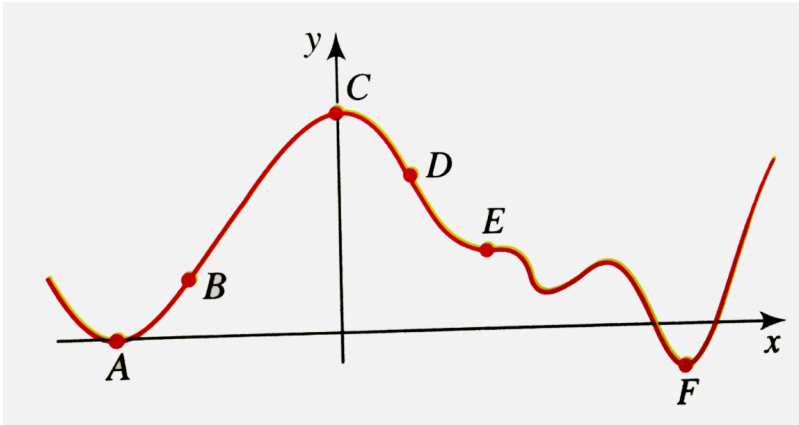
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Exercises 1 11

1. The graph of $y = f(x)$ is given with six labelled points. Answer the following questions.

- (a) At which point $f'(x)$ has the greatest value?
- (b) At which point $f(x)$ and $f'(x)$ both are zero?
- (c) At how many point $f'(x)$ is negative ?

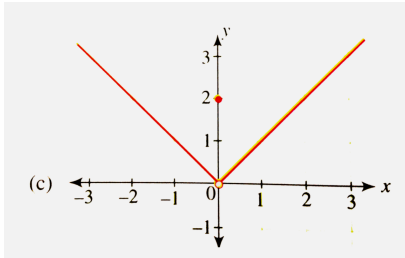
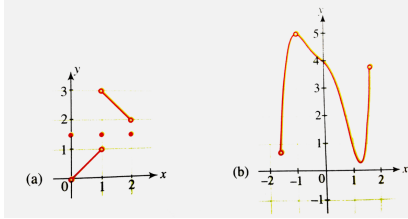
(d) Which is the point of infection?



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Exercises 1 12

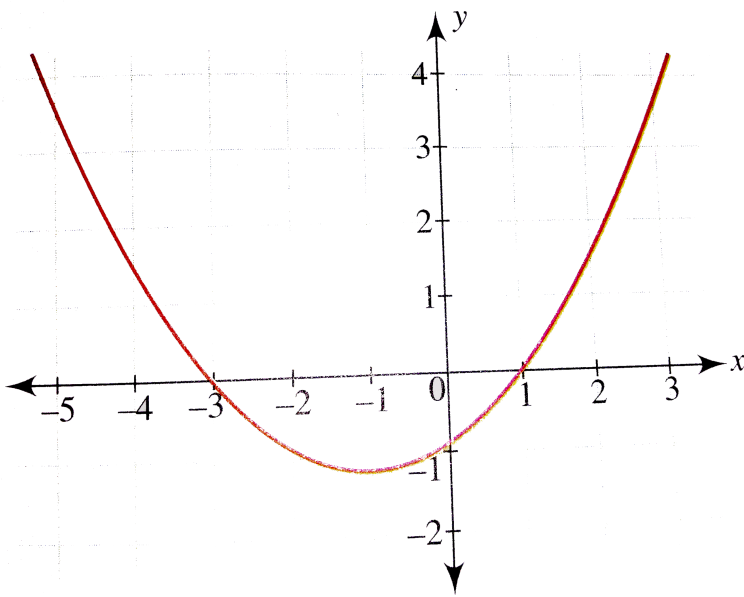
1. Graph of functions are given in the following figure. Check the functions for absolute extremum.



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Exercises 1 13

- Given the graph of the function $y = f(x)$, draw the graph of $y = \text{sgn}(x)$.



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Exercises 1 14

1. Find the intervals in which $f(x) = x^2 + 2x - 5$ is increasing or decreasing.

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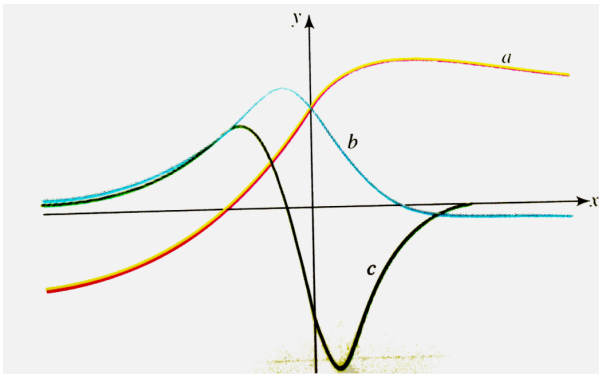
Exercises 1 15

1. Find all the points of local maxima and local minima of the function $f(x) = x^3 - 6x^2 + 12x - 8$.

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Exercises 1 16

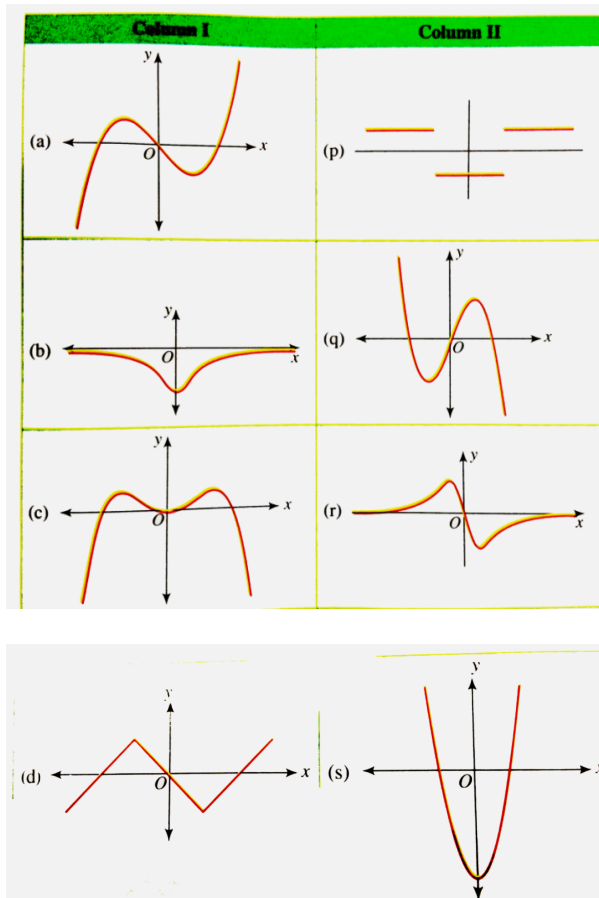
1. The figure shows the graphs of f , f' and f'' . Identify each curve and explain your choices.



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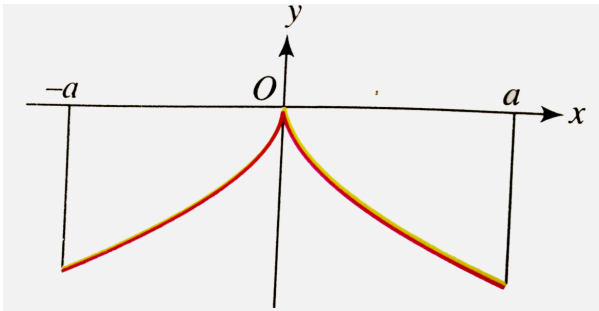
Exercises 1 17

1. Match the graph of $y = f(x)$ in Column I with the corresponding graph of $y = f'(x)$ in Column II.



Exercises 1 18

1. Following is the graph of $y = f'(x)$ and $f(0) = 0$.



(a) What type of function $y = f'(x)$ is? Odd or even?

(b) What type of function $y = f(x)$ is? Odd or even?

(c) What is the value of $\int_{-a}^a f(x) dx$?

(d) Has $y = f(x)$ point of inflection?

(e) What is the nature of $y = f(x)$? Monotonic or non-monotonic?