



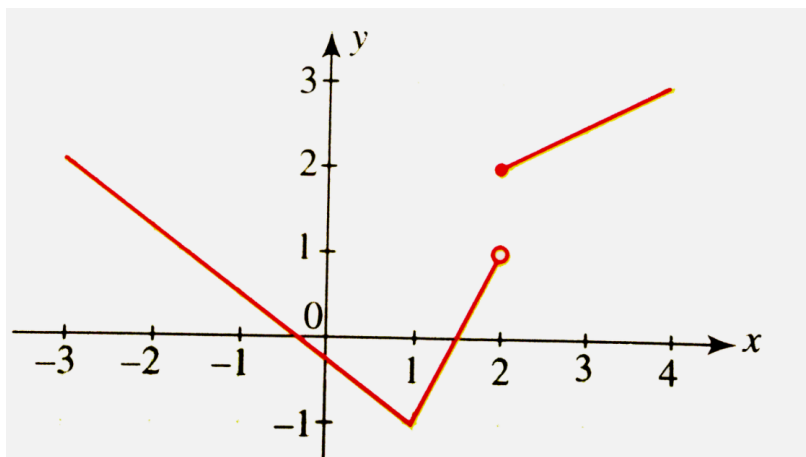
## MATHS

**BOOKS - CENGAGE PUBLICATION**

**GETTING STARTED WITH GRAPHS**

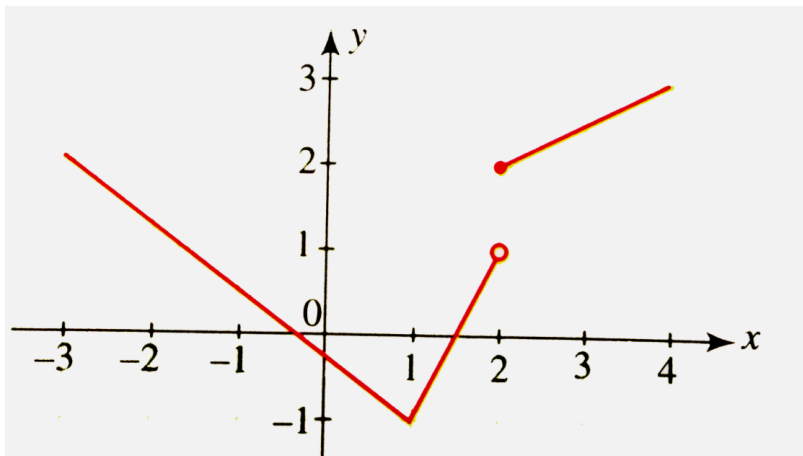
### Illustration 1 1

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



## Illustration 1 2

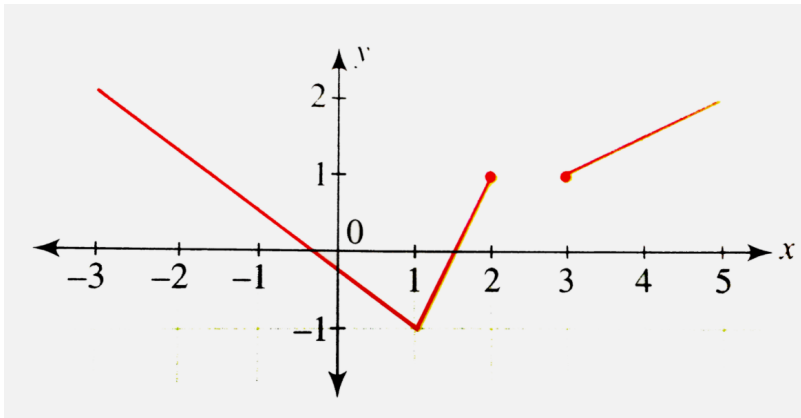
1. Does the following graph represent a function or a relation?



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## Illustration 1 3

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



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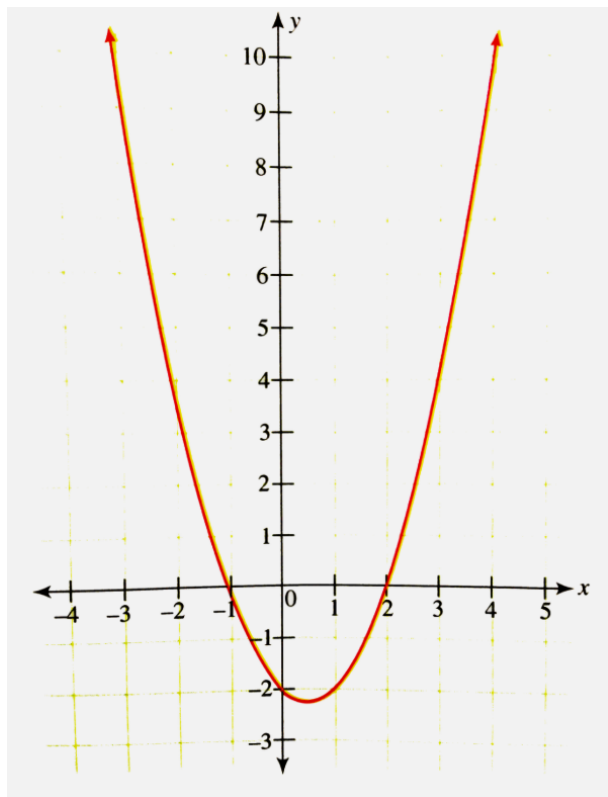
#### Illustration 1 4

1. In how many points graph of  $y = x^3 - 3x^2 + 5x - 3$  intersect 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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## Illustration 1 6

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  $y = x - 4$

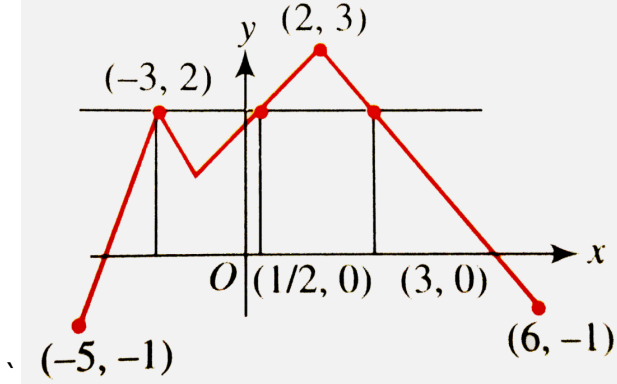


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## Illustration 1 7

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 the minimum number of roots of the equation  $f(x) = 0$  is

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### Illustration 1 12

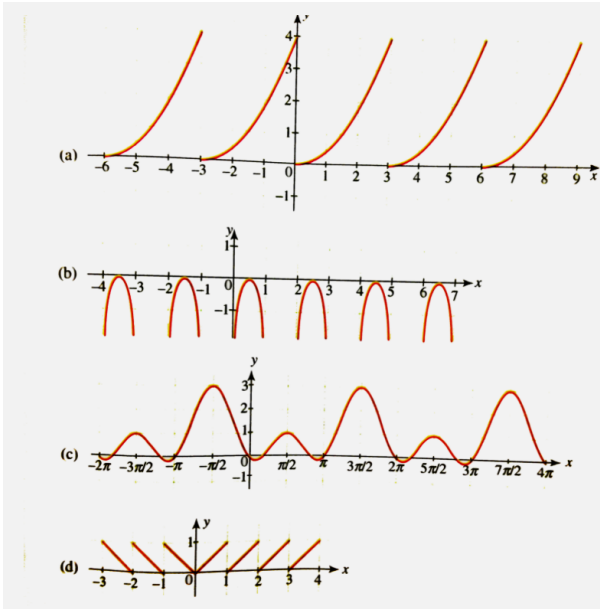
1. Let  $f: \vec{R} \rightarrow \vec{R}$  and  $g: \vec{R} \rightarrow \vec{R}$  be two one-one and onto function such that they are the mirror images of each other about the line  $y = x$ . If  $h(x) = f(x) + g(x)$ , then  $h(x)$  is one-one and onto only one-one and not onto only onto but not one-one neither one-one nor onto

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### Illustration 1 13



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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### 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)  $\lim_{x \rightarrow 4} f(x)$

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

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

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

(v)  $\lim_{x \rightarrow 0} f(x)$

(vi)  $f(-2)$

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

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

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

(x)  $f(0)$

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

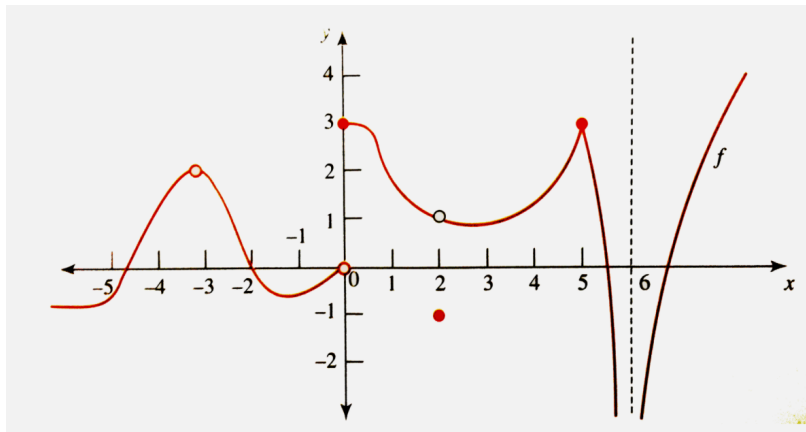
(xii)  $\lim_{x \rightarrow 1^-} f(x - 4)$



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## Illustration 1 16

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

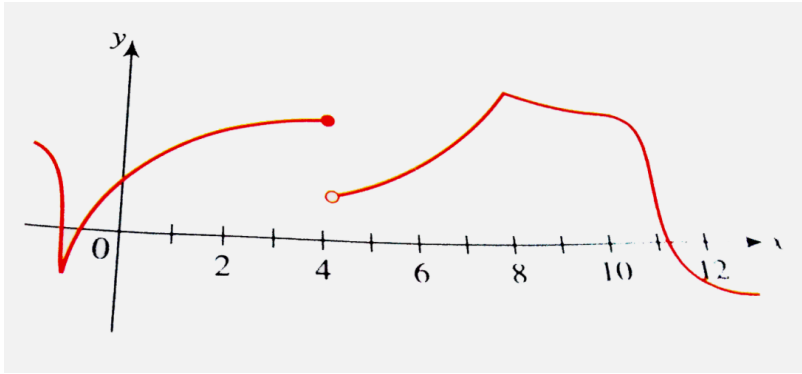


Identify the points of discontinuity and give the reason for the same.

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## Illustration 1 17

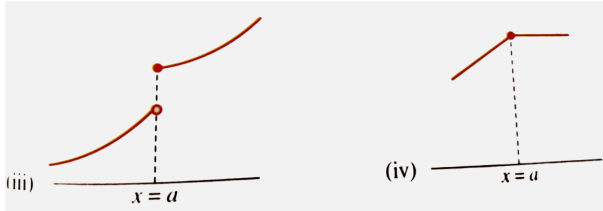
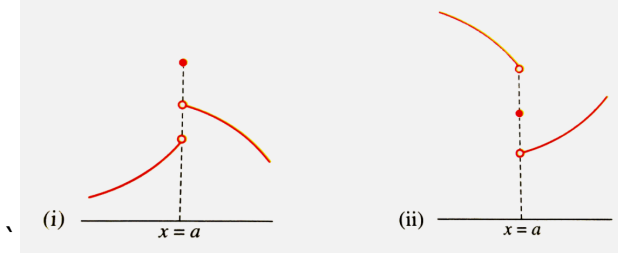
1. The graph of  $f(x)$  is given. State with reasons the number at which the function is non-differentiable.



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### Illustration 1 18

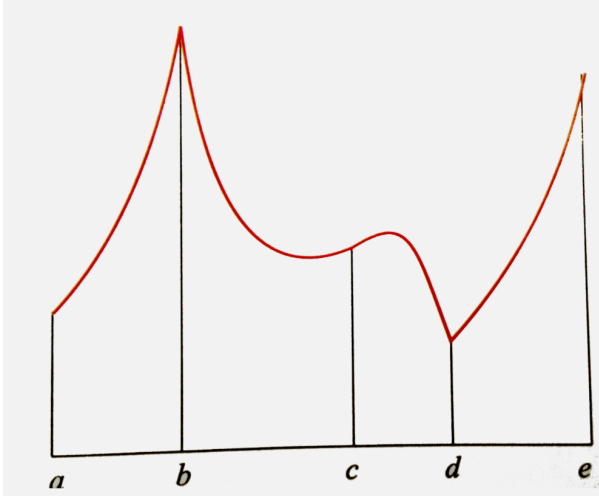
1. For each of the following graphs, comment whether  $f(x)$  is increasing or decreasing or neither increasing nor decreasing at  $x = a$ .



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Illustration 1 19

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



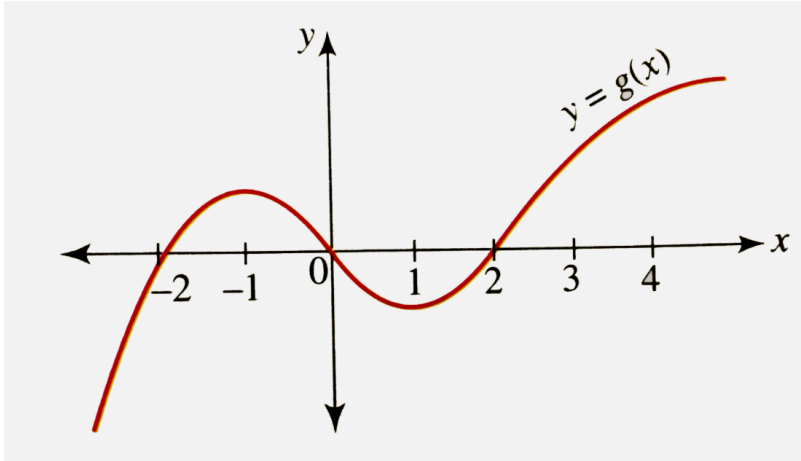
Determine the intervals on which the function is concave up and the intervals on which it is concave down. Find the x - coordinates of any inflection points.

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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.

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

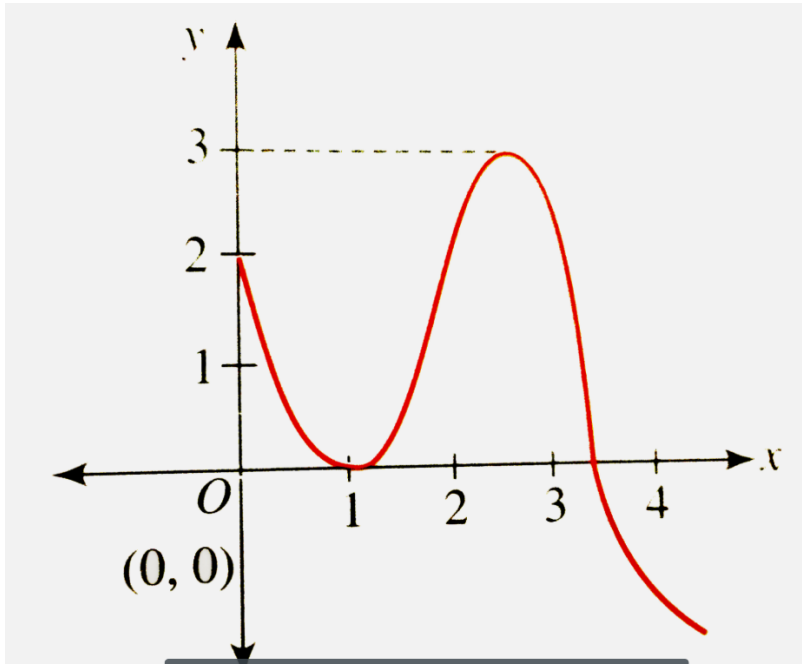


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### Illustration 1 21

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.

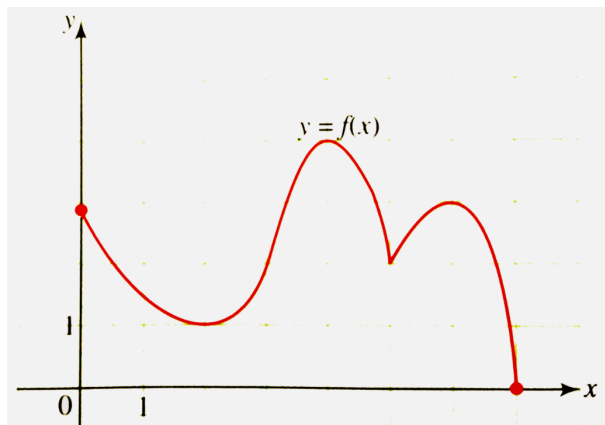


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## Illustration 1 22

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



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## Illustration 1 23

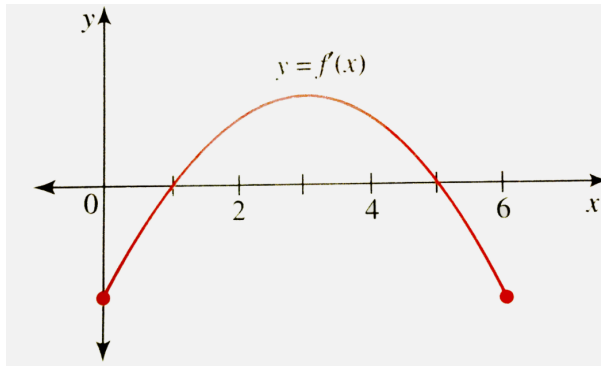
1. The graph of the derivative  $f'(x)$  is given in the following figure.

(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.



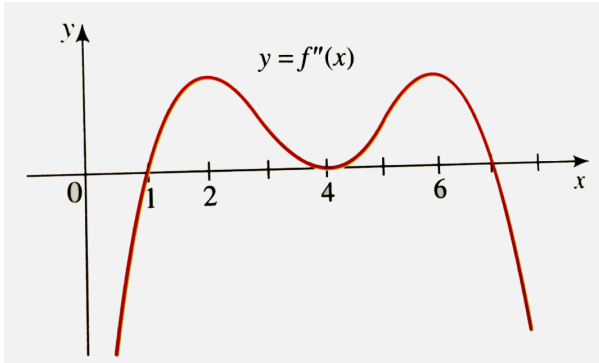
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### Illustration 1 24

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

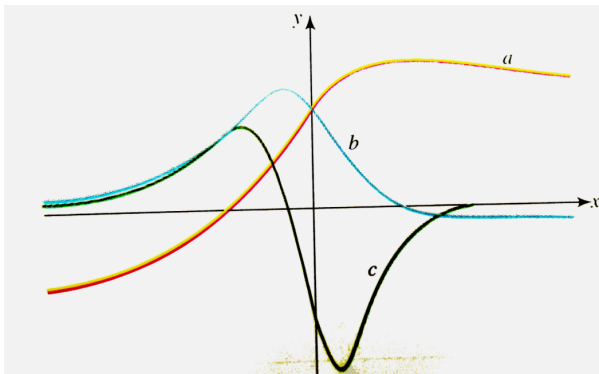
reasons for your answer.



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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.





## 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.

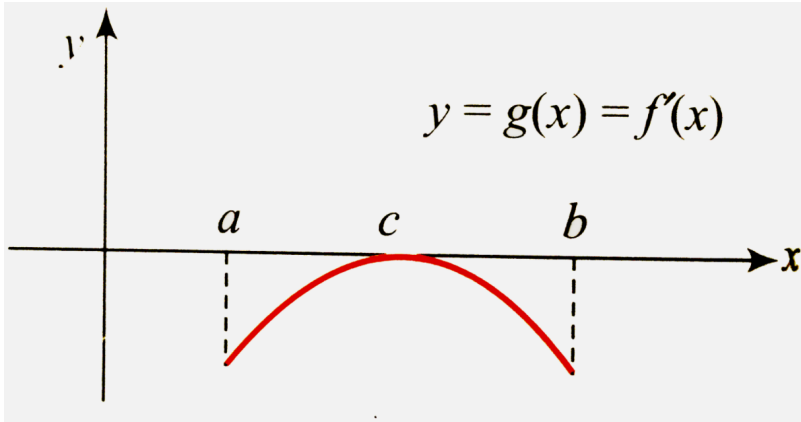
(a) How many times the graph of  $y = f(x)$  will intersect the  $x$ -axis?

(b) Discuss the type of roots of the equation  $f(x) = 0$ ,  $a \leq x \leq b$ .

(c) How many points of inflection the graph of  $y = f(x)$ ,  $a \leq x \leq b$ , has?

(d) Find the points of local maxima/minima of  $y = f(x)$ ,  $a \leq x \leq b$ ,

, (e)  $f''(x)=0$  has how many roots?



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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.

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

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

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

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

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

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

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

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

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



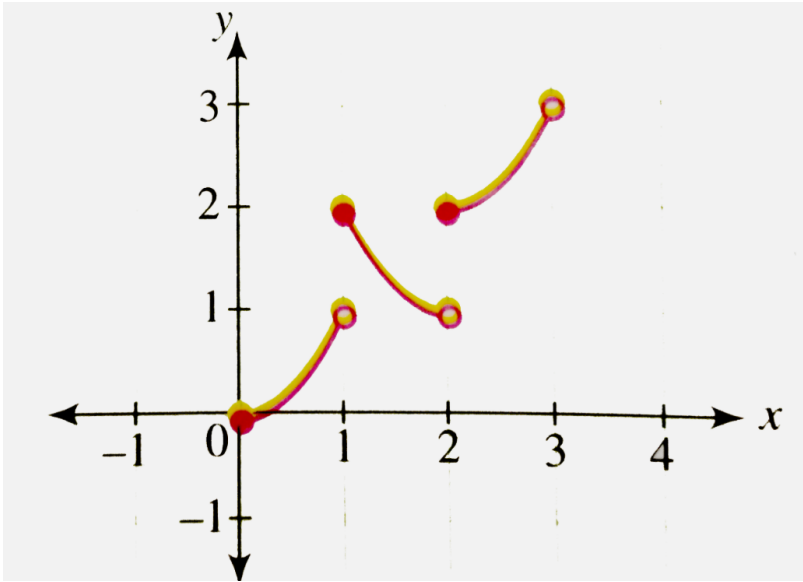
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## Exercises 1 1

1.

Does the following graph pass the vertical or horizontal line test

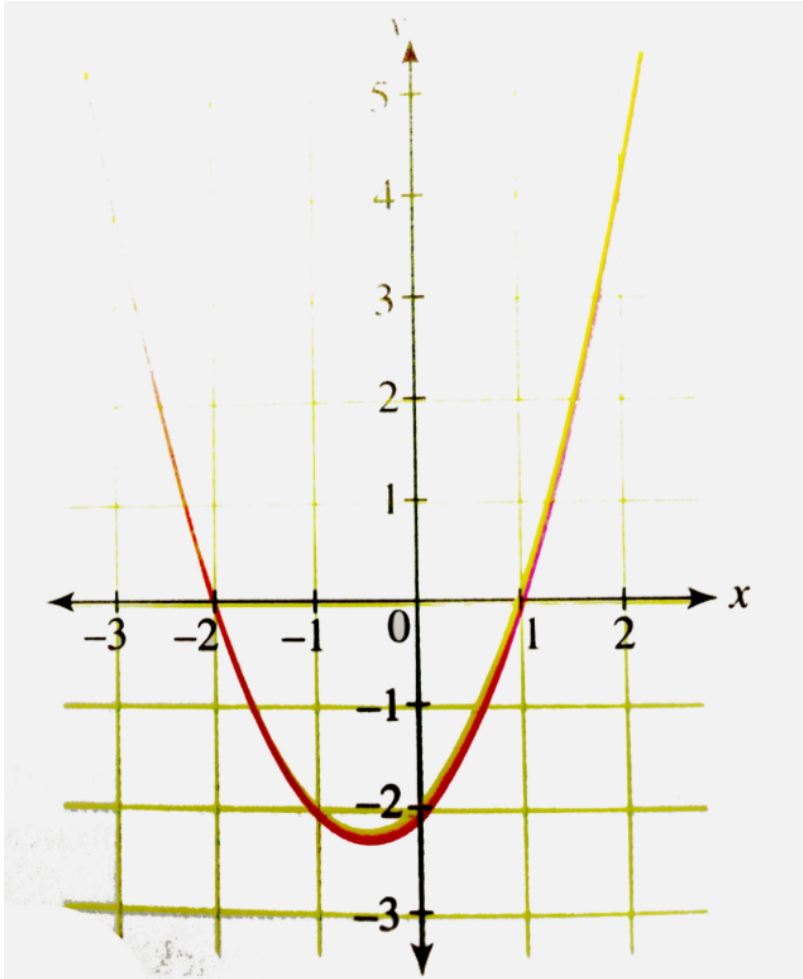
?



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

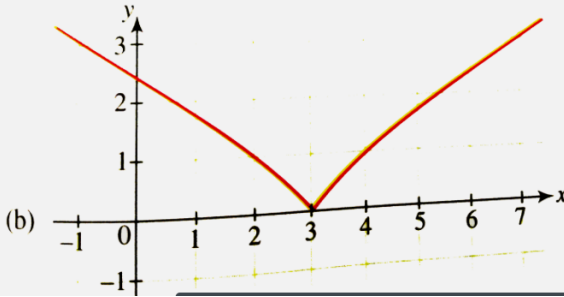
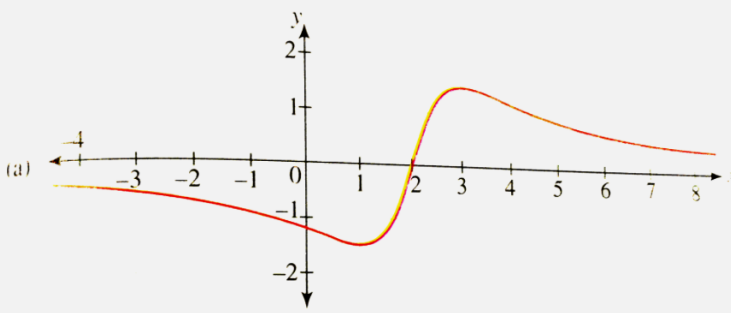


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### Exercises 1 4

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

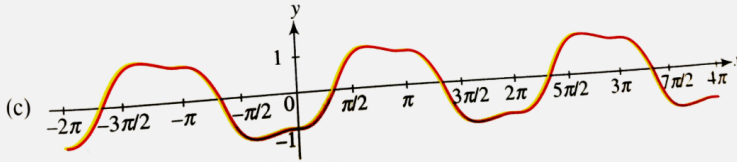
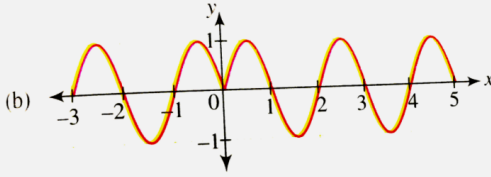
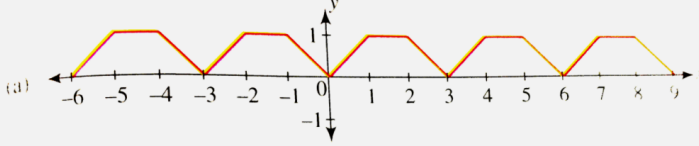
Discuss the symmetry.



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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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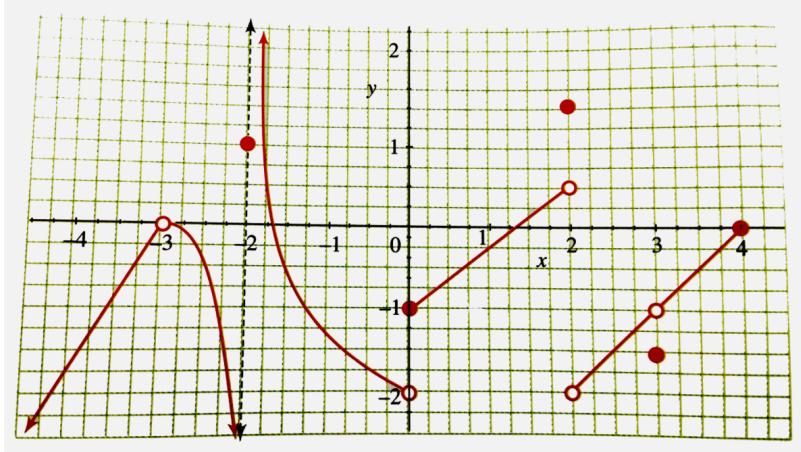
## Exercises 1 6

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)  $\lim_{x \rightarrow 3} f(x)$

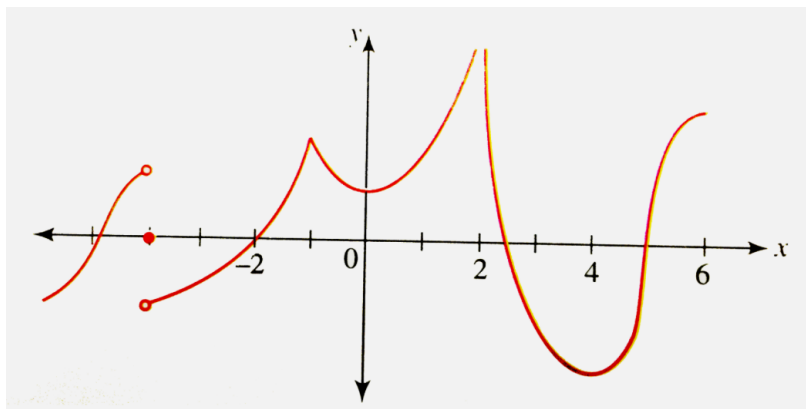
(x)  $\lim_{x \rightarrow 2^-} f(x)$       (xi)  $\lim_{x \rightarrow -2^+} f(x)$       (xii)  $\lim_{x \rightarrow 0^-} f(x)$

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

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## Exercises 1 8

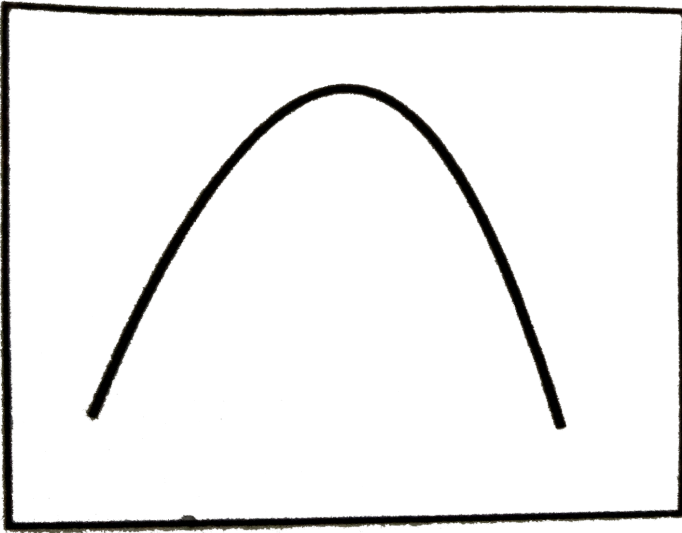
1. The graph of  $f$  is shown. State, with reason, the numbers at which  $f$  is not differentiable.



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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?



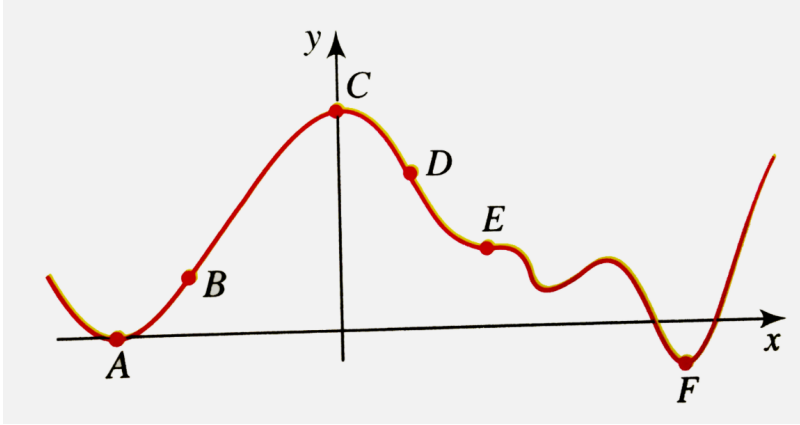
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## Exercises 1 11

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 inflection?

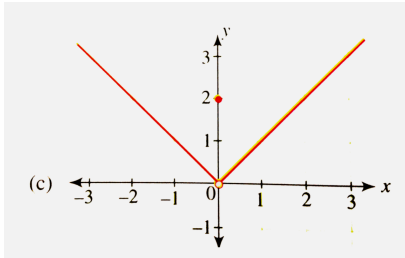
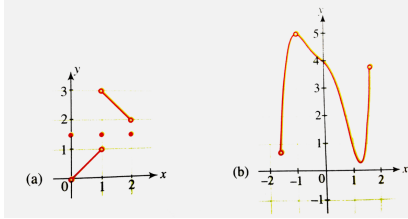


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## Exercises 1 12

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

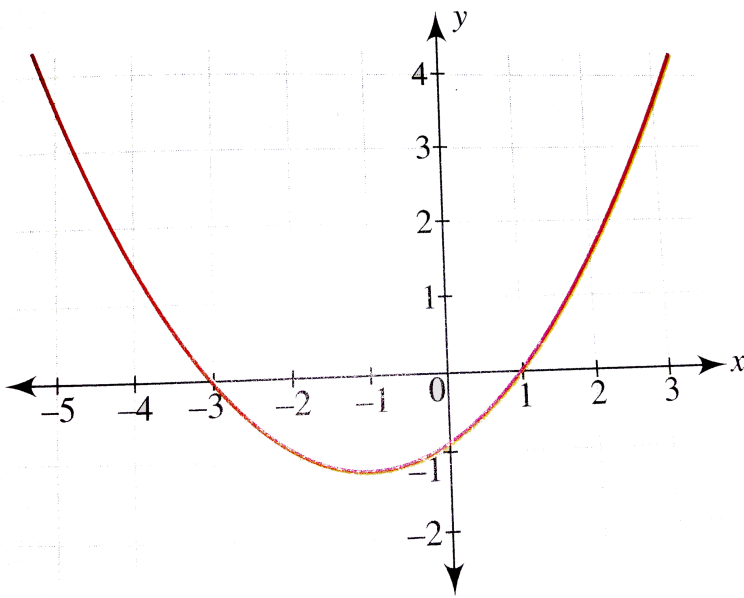




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## Exercises 1 13

- 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

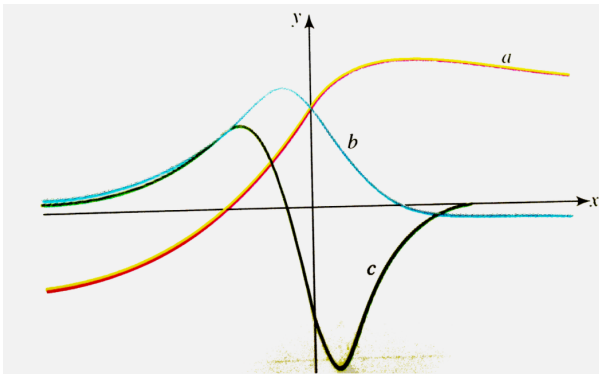
1. Determine the local maxima and local minima of

$$f(x) = x^3 - 6x^2 + 12x - 8$$

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## Exercises 1 16

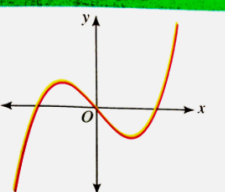

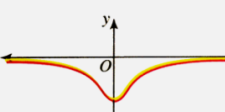
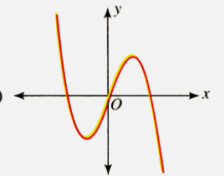
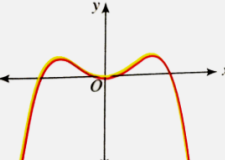
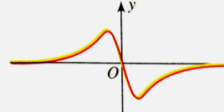
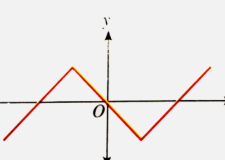
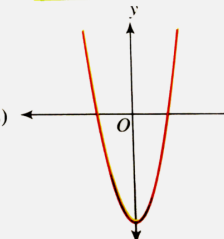
1. The figure shows the graphs of  $f$ ,  $f'$  and  $f''$ . Identify each curve and explain your choices.



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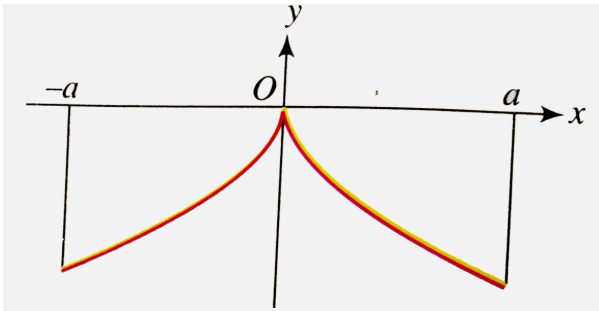
## Exercises 1 17

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

Column I	Column II
<p>(a) </p>	<p>(p) </p>
<p>(b) </p>	<p>(q) </p>
<p>(c) </p>	<p>(r) </p>
<p>(d) </p>	<p>(s) </p>

## 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?