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# INTRODUCTION TO BIOSTATISTICS AND RESEARCH METHODS



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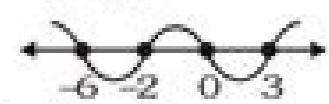
**Illustration 11** :  $(x^2 - x - 6)(x^2 + 6x) \geq 0$

**Solution** :  $(x-3)(x+2)(x)(x+6) \geq 0$

Consider  $E = x(x-3)(x+2)(x+6)$ ,  $E = 0 \Rightarrow x = 0, 3, -2, -6$  (all are simple points)



For  $x \geq 3$   $E = \underset{+ve}{x} \underset{+ve}{(x-3)} \underset{+ve}{(x+2)} \underset{+ve}{(x+6)}$   
= positive



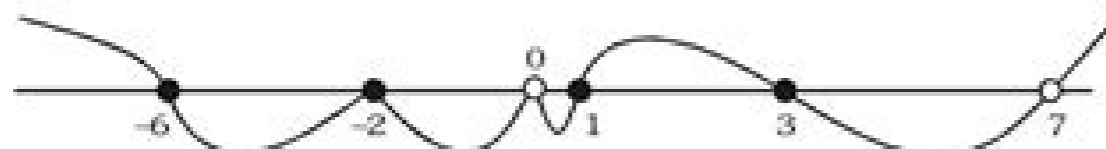
Hence for  $x(x-3)(x+2)(x+6) \geq 0$

$$x \in (-\infty, -6] \cup [-2, 0] \cup [3, \infty)$$

**Illustration 12** : Let  $f(x) = \frac{(x-1)^2(x+2)^2(x-3)^2(x+6)}{x^2(x-7)^2}$ . Solve the following inequality

(i)  $f(x) > 0$  (ii)  $f(x) \geq 0$  (iii)  $f(x) < 0$  (iv)  $f(x) \leq 0$

**Solution** : We mark on the number line zeros of the function : 1, -2, 3 and -6 (with black circles) and the points of discontinuity 0 and 7 (with white circles), isolate the double points : -2 and 0 and draw the wavy curve :



From graph, we get

(i)  $x \in (-\infty, -6) \cup (1, 3) \cup (7, \infty)$

(ii)  $x \in (-\infty, -6] \cup [-2] \cup [1, 3] \cup (7, \infty)$

(iii)  $x \in (-6, -2) \cup (-2, 0) \cup (0, 1) \cup (3, 7)$

(iv)  $x \in [-6, 0] \cup (0, 1] \cup [3, 7)$

**Do yourself - 5 :**

(i) Find range of  $x$  such that

(a)  $(x-2)(x+3) \geq 0$

(b)  $\frac{x}{x+1} > 2$

(c)  $\frac{3x-1}{4x+1} \leq 0$

(d)  $\frac{(2x-1)(x+3)(2-x)(1-x)^2}{x^2(x+6)(x-9)(2x^2+4x+9)} < 0$

(e)  $\frac{7x-17}{x^2-3x+4} \geq 1$

(f)  $x^2 + 2 \leq 3x \leq 2x^2 - 5$

## 9. QUADRATIC EXPRESSION AND ITS GRAPHS :

Consider the quadratic expression,  $y = ax^2 + bx + c$ ,  $a \neq 0$  &  $a, b, c \in \mathbb{R}$  then :

(a) The graph between  $x, y$  is always a parabola. If  $a > 0$  then the shape of the parabola is concave upwards & if  $a < 0$  then the shape of the parabola is concave downwards.

(b) The graph of  $y = ax^2 + bx + c$  can be divided in 6 broad categories which are as follows :

(Let the real roots of quadratic equation  $ax^2 + bx + c = 0$  be  $\alpha$  &  $\beta$  where  $\alpha \leq \beta$ ).





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