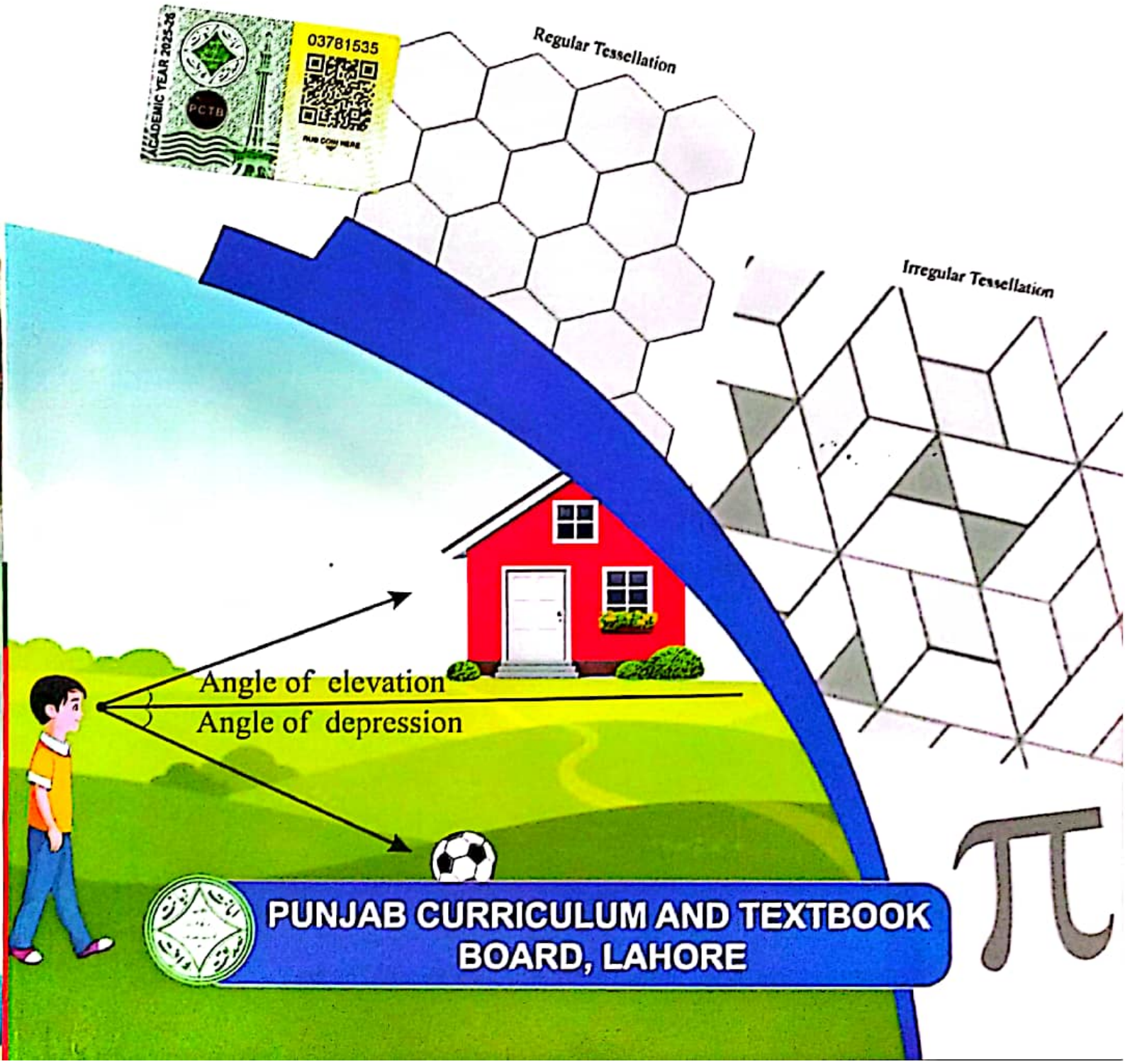
MATHEMATICS 9



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UNIT 10 GRAPHS OF FUNCTIONS

EXERCISE 10.1

Q.1. Sketch the graph of the following linear functions:

(i) $y = 3x - 5$

Sol. Put $x = 1 \Rightarrow y = 3(1) - 5 = -2$

Put $x = 2 \Rightarrow y = 3(2) - 5 = 6 - 5 = 1$

Put $x = 3 \Rightarrow y = 3(3) - 5 = 9 - 5 = 4$

Put $x = 4 \Rightarrow y = 3(4) - 5 = 12 - 5 = 7$

Put $x = -1 \Rightarrow y = 3(-1) - 5 = -3 - 5 = -8$

Put $x = -2 \Rightarrow y = 3(-2) - 5 = -6 - 5 = -11$

Put $x = -3 \Rightarrow y = 3(-3) - 5 = -9 - 5 = -14$

Put $x = -4 \Rightarrow y = 3(-4) - 5 = -12 - 5 = -17$

Table of values is

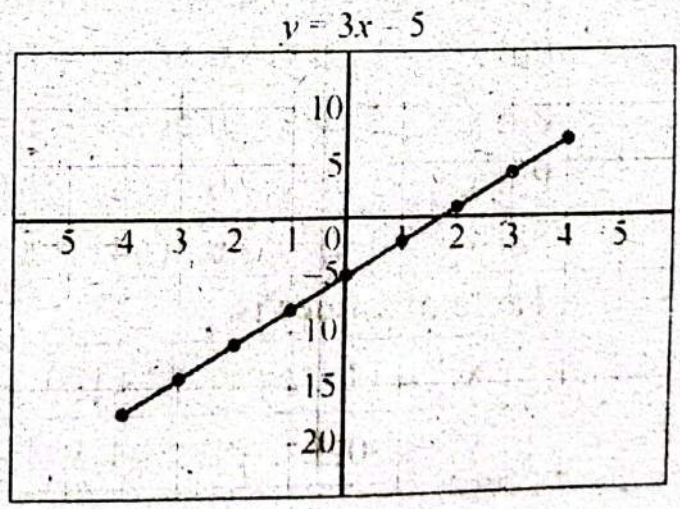
x	1	2	3	4	–1	–2	–3	–4
y	–2	1	4	7	–8	–11	–14	–17

Scale: Along x-axis:

1 big sq. = 1 unit

Along y-axis:

1 big sq. = 5 units



(ii) $y = -2x + 8$

Sol. Put $x = 2 \Rightarrow y = -2(2) + 8 = -4 + 8 = 4$

Put $x = 1 \Rightarrow y = -2(1) + 8 = 6$

Put $x = 3 \Rightarrow y = -2(3) + 8 = 2$

Put $x = 4 \Rightarrow y = -2(4) + 8 = 0$

Put $x = 5 \Rightarrow y = -2(5) + 8 = -2$

Put $x = 6 \Rightarrow y = -2(6) + 8 = -4$

Put $x = -1 \Rightarrow y = -2(-1) + 8 = 10$

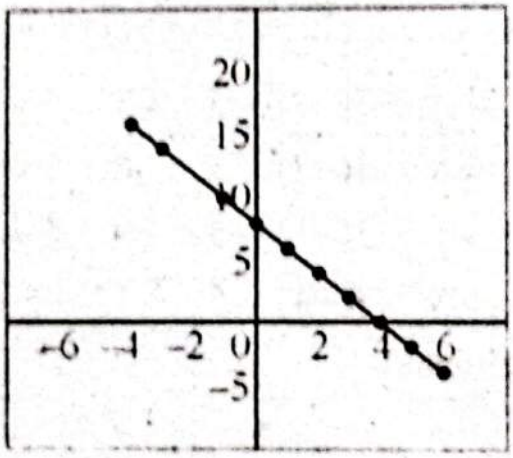
Put $x = -3 \Rightarrow y = -2(-3) + 8 = 14$

Put $x = -4 \Rightarrow y = -2(-4) + 8 = 16$

Table of values is

x	1	2	3	4	5	6	−1	−3	−4
y	4	6	2	0	−2	−4	10	14	16

$y = -2x + 8$



(iii) $y = 0.5x - 1$

Sol. Put $x = 1 \Rightarrow y = 0.5(1) - 1 = 0.5 - 1 = -0.5$

Put $x = -1 \Rightarrow y = 0.5(-1) - 1 = -0.5 - 1 = -1.5$

Put $x = -2 \Rightarrow y = 0.5(-2) - 1 = -1 - 1 = -2$

Put $x = -3 \Rightarrow y = 0.5(-3) - 1 = -1.5 - 1 = -2.5$

Put $x = -4 \Rightarrow y = 0.5(-4) - 1 = -2 - 1 = -3$

Table of values is

x	1	0	−1	−2	−3	−4
y	−0.5	−1	−1.5	−2	−2.5	−3

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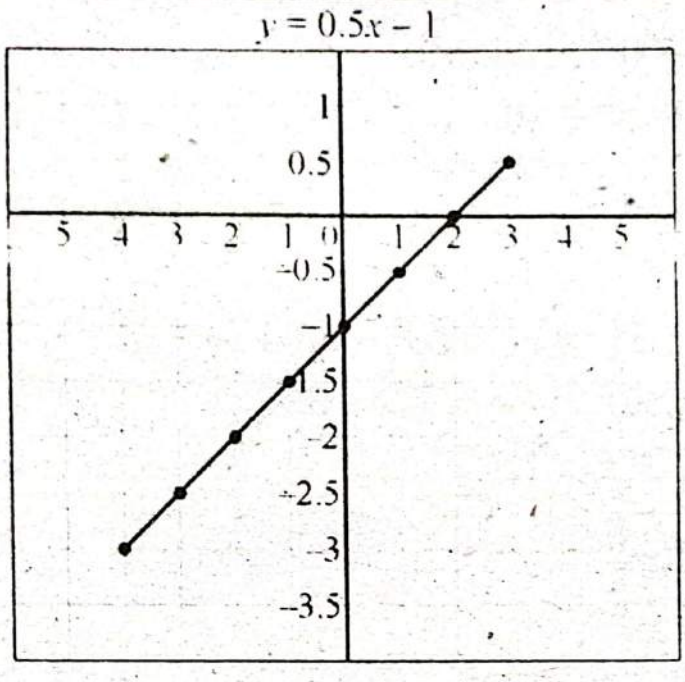

Q.2. Plot the graph of the following quadratic and cubic functions:

(i) $y = x^3 + 2x^2 - 5x - 6$; $-3.5 \le x \le 2.5$

Sol. x = –3.5, –3.0, –2.5, –2.0, –1.5, –1, –0.5, 0, 0.5, 1.0, 1.5, 2.0, 2.5

For $\boxed{x = -3.5}$

$y = (-3.5)^3 + 2(-3.5)^2 - 5(-3.5) - 6$

$y = -42.875 + 24.5 + 17.5 - 6$

$\boxed{y = -6.875}$

For x= –3.0

$y = (-3.0)^3 + 2(-3.0)^2 - 5(-3.0) - 6$

$y = -27 + 18 + 15 - 6$

$y = -33 + 33 = 0$

For $\boxed{x = -2.5}$

$y = (-2.5)^3 + 2(-2.5)^2 - 5(-2.5) - 6$

$y = -15.625 + 12.5 + 12.5 - 6$

$= -21.625 + 25$

$\boxed{y = 3.375}$

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For $x = -2.0$

$$y = (-2.0)^3 + 2(-2.0)^2 - 5(-2.0) - 6$$
$$= -8 + 8 + 10 - 6$$
$$\boxed{y = 4}$$

$x = -1.5$

$$y = (-1.5)^3 + 2(-1.5)^2 - 5(-1.5) - 6$$
$$= -3.375 + 4.5 + 7.5 - 6$$
$$= -9.375 + 12$$
$$\boxed{y = 2.625}$$

For $x = -1$

$$y = (-1)^3 + 2(-1)^2 - 5(-1) - 6$$
$$= -1 + 2 + 5 - 6$$
$$= 7 - 7 = 0$$
$$\boxed{y = 0}$$

For $x = -0.5$

$$y = (-0.5)^3 + 2(-0.5)^2 - 5(-0.5) - 6$$
$$= -0.125 + 0.5 + 2.5 - 6$$
$$\boxed{y = -3.125}$$

For $x = 0$

$$y = 0^3 + 2(0)^2 - 5(0) - 6$$
$$\boxed{y = -6}$$

For $x = 0.5$

$$y = (0.5)^3 + 2(0.5)^2 - 5(0.5) - 6$$
$$= 0.125 + 0.5 - 2.5 - 6$$
$$\boxed{y = -7.87}$$

For $x = 1$

$$y = 1^3 + 2(1)^2 - 5(2) - 6$$
$$= 1 + 2 - 10 - 6$$
$$\boxed{y = -13}$$

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For $x = 1.5$

$y = (1.5)^3 + 2(1.5)^2 - 5(1.5) - 6$

$= 3.37 + 4.5 - 7.5 - 6$

$\boxed{y = -5.625}$

For $x = 2.0$

$y = (2.0)^3 + 2(2.0)^2 - 5(2.0) - 6$

$= 8 + 8 - 10 - 6$

$\boxed{y = 0}$

For $x = 2.5$

$y = (2.5)^3 + 2(2.5)^2 - 5(2.5) - 6$

$= 15.625 + 12.5 - 15 - 6$

$\boxed{y = 7.125}$

Table of values is

x	y
−3.5	−6.875
−3.0	0
−2.5	3.375
−2.0	4
−1.5	2.625
−1.0	0
−0.5	−3.125
0	−6
0.5	−7.875
1.0	−13
1.5	−5.625
2.0	0
2.5	7.125

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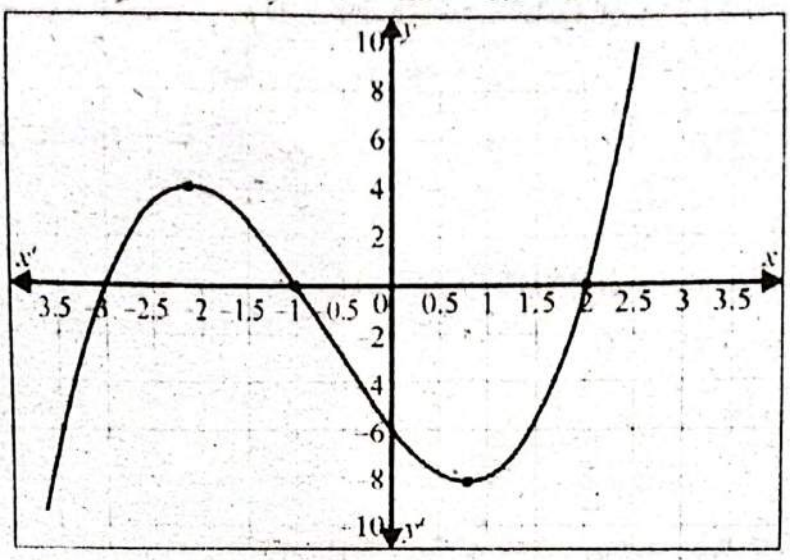
$y = x^3 + 2x^2 - 5x - 6$



(ii) $\mathbf{y = x^2 + x - 2}$

Sol. For $x = -3$

$$y = (-3)^2 + (-3) - 2$$
$$= 9 - 3 - 2$$
$$\boxed{y = 4}$$

For $x = -2$

$$y = (-2)^2 + (-2) - 2$$
$$= 4 - 2 - 2$$
$$\boxed{y = 0}$$

For $x = 0$

$$y = 0^2 + 0 - 2$$
$$\boxed{y = -2}$$

For $x = 2$

$$y = 2^2 + 2 - 2$$
$$\boxed{y = 4}$$

For $x = 1$

$$y = 1^2 + 1 - 2$$
$$\boxed{y = 0}$$

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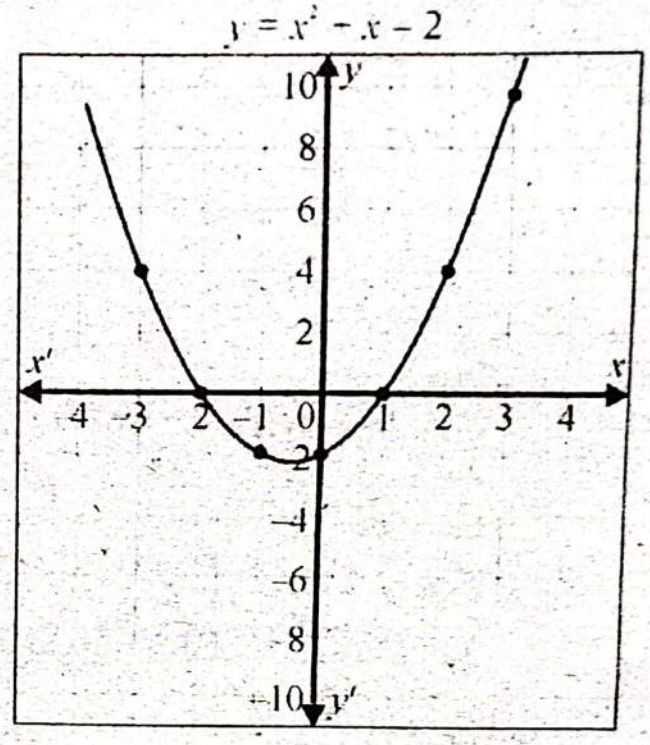
For x = 3,

$$y = 3^2 + 3 - 2$$
$$= 9 + 3 - 2$$

$$\boxed{y = 10}$$

Table of values is

x	y
–3	4
–2	0
0	–2
1	0
2	4
3	10



(iii) $\mathbf{y = x^3 + 3x^2 + 2x; -2.5 \le x \le 0.5}$

Sol. For x = –2.5

$$y = (-2.5)^3 + 3(-2.5)^2 + 2(-2.5)$$
$$= -15.625 + 18.75 - 5$$
$$y = -20.625 + 18.75$$
$$\boxed{y = -1.875}$$

For x = –2.0

$$y = (-2.0)^3 + 3(-2.0)^2 + 2(-2.0)$$
$$= -8 + 12 - 4$$
$$\boxed{y = 0}$$

For x = –1.5

$$y = (-1.5)^3 + 3(-1.5)^2 + 2(-1.5)$$
$$= -3.375 + 6.75 - 3$$
$$= -6.375 + 6.75$$
$$\boxed{y = 0.375}$$

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For $x = -1.0$

$y = (-1.0)^3 + 3(-1.0)^2 + 2(-1.0)$

$= -1 + 3 - 2$

$\boxed{y = 0}$

For $x = -0.5$

$y = (-0.5)^3 + 3(-0.5)^2 + 2(-0.5)$

$= -0.125 + 0.75 - 1$

$\boxed{y = -0.375}$

For $x = 0$

$y = 0^3 + 2(0)^2 + 2(0)$

$\boxed{y = 0}$

For $x = 0.5$

$y = (0.5)^3 + 2(0.5)^2 + 2(0.5)$

$= 0.125 + 0.5 + 1$

$\boxed{y = 1.625}$

For $x = 1.0$

$y = (1.0)^3 + 3(1.0)^2 + 2(1.0)$

$= 1 + 3 + 2$

$\boxed{y = 6}$

Table of values

x	y
−2.5	−1.875
−2.0	0
−1.5	0.375
−1.0	0
−0.5	−0.375
0	0
0.5	1.625
1.0	6

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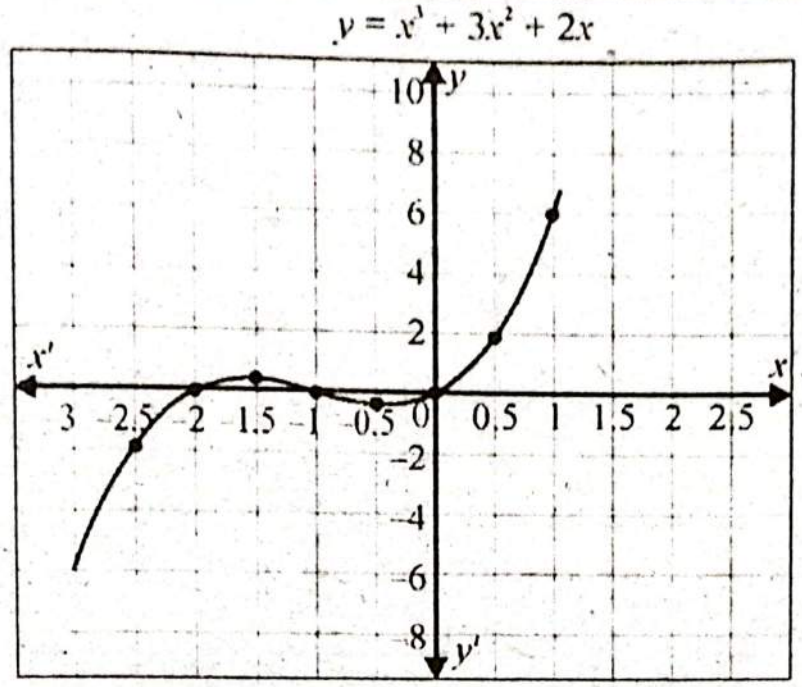

(iv) $\mathbf{y = 5x^2 - 2x - 3}$

Sol. For $x = 0$

$y = 5(0)^2 - 2(0) - 3$

$\boxed{y = -3}$

For $x = 1$

$y = 5(1)^2 - 2(1) - 3$

$= 5 - 5$

$\boxed{y = 0}$

For $x = -1$

$y = 5(-1)^2 - 2(-1) - 3$

$= 5 + 2 - 3$

$\boxed{y = 4}$

Table of values is

x	y
0	−3
1	0
−1	4
2	13

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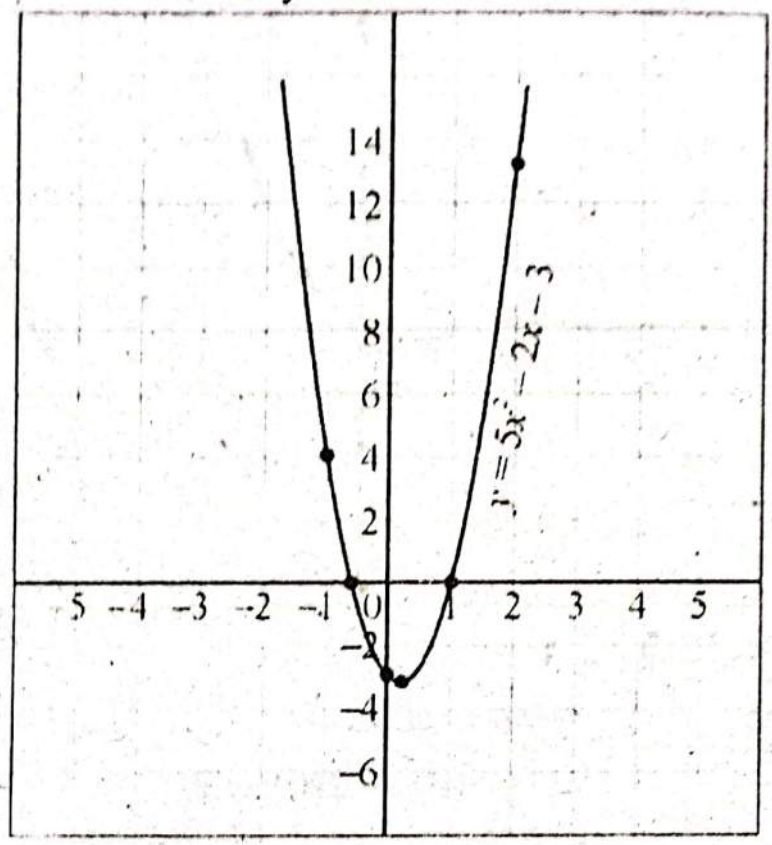
$y = 5x^2 - 2x - 3$



Q.3. Plot the graph of the following functions:

(i) $y = 4^x$

Sol.

For $x = -3$

$$y = 4^{-3} = \frac{1}{64}$$

$$\boxed{y = 0.016}$$

For $x = -2$

$$y = 4^{-2} = \frac{1}{16}$$

$$\boxed{y = 0.0625}$$

For $x = -1$

$$y = 4^{-1} = \frac{1}{4}$$

$$\boxed{y = 0.25}$$

For $x = 0$

$$y = 4^0$$

$$\boxed{y = 1}$$

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For x = 1

$y = 4^1$

$\boxed{y = 4}$

For x = 2

$y = 4^2$

$\boxed{y = 16}$

For x = 3

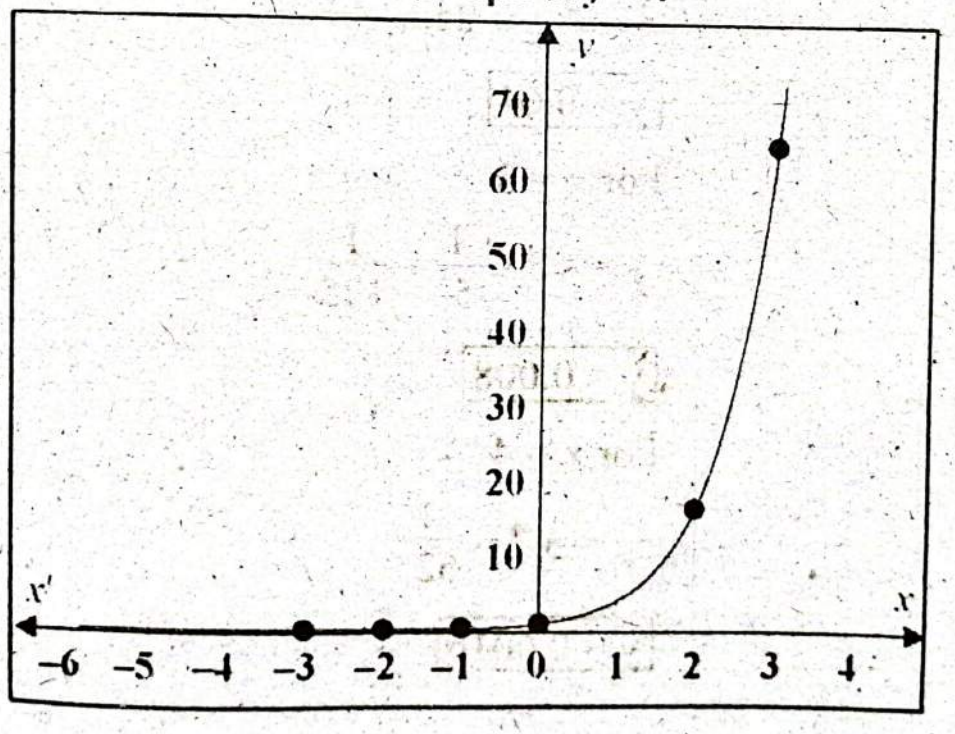
$y = 4^3$

$\boxed{y = 64}$

Table of values is

x	y
−3	0.016
−2	0.0625
−1	0.25
0	1
1	4
2	16
3	64

Graph of $y = 4^x$



(ii) $y = 5^{-x}$

Sol.

For $x = -1$

$$y = 5^{-(-1)} = 5^1$$

$$\boxed{y = 5}$$

For $x = -2$

$$y = 5^{-(-2)} = 5^2$$

$$\boxed{y = 25}$$

For $x = 0$

$$y = 5^{-0} = 5^0$$

$$\boxed{y = 1}$$

For $x = 1$

$$y = 5^{-1} = \frac{1}{5}$$

$$\boxed{y = 0.20}$$

For $x = 2$

$$y = 5^{-2} = \frac{1}{25}$$

$$\boxed{y = 0.04}$$

For $x = 3$

$$y = 5^{-3} = \frac{1}{5^3} = \frac{1}{125}$$

$$\boxed{y = 0.008}$$

For $x = 4$

$$y = 5^{-4} = \frac{1}{625}$$

$$\boxed{y = 0.0016}$$

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For x = 5

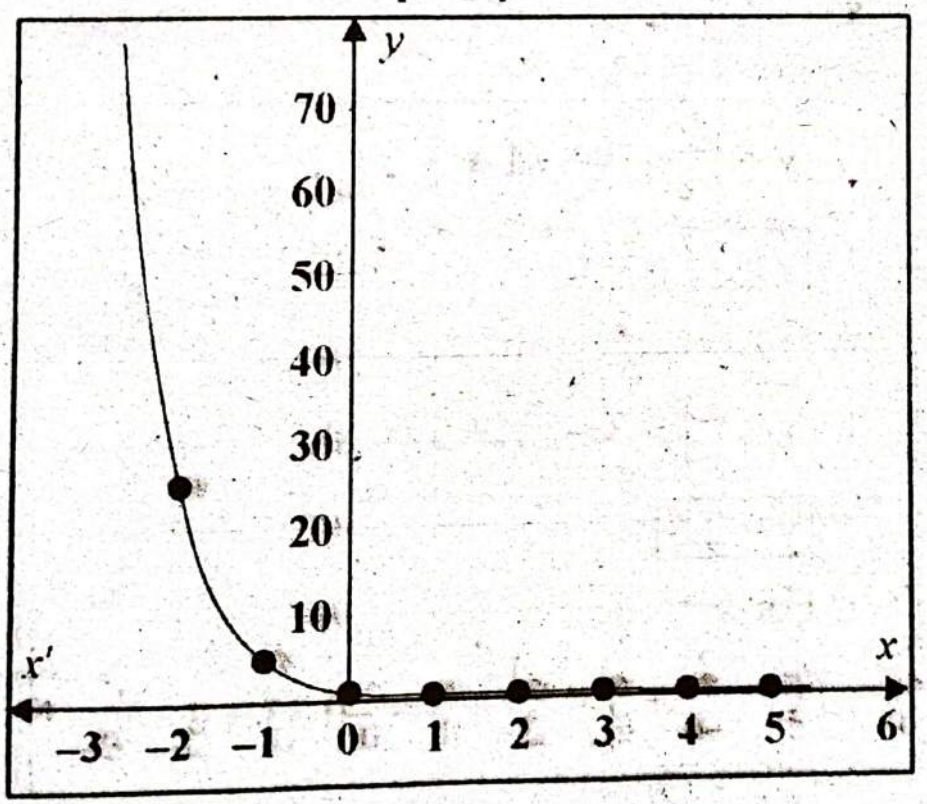
$$y = 5^{-5} = \frac{1}{5^5} = \frac{1}{3125} = 0$$

$$\boxed{y = 0.00032}$$

Table of values of

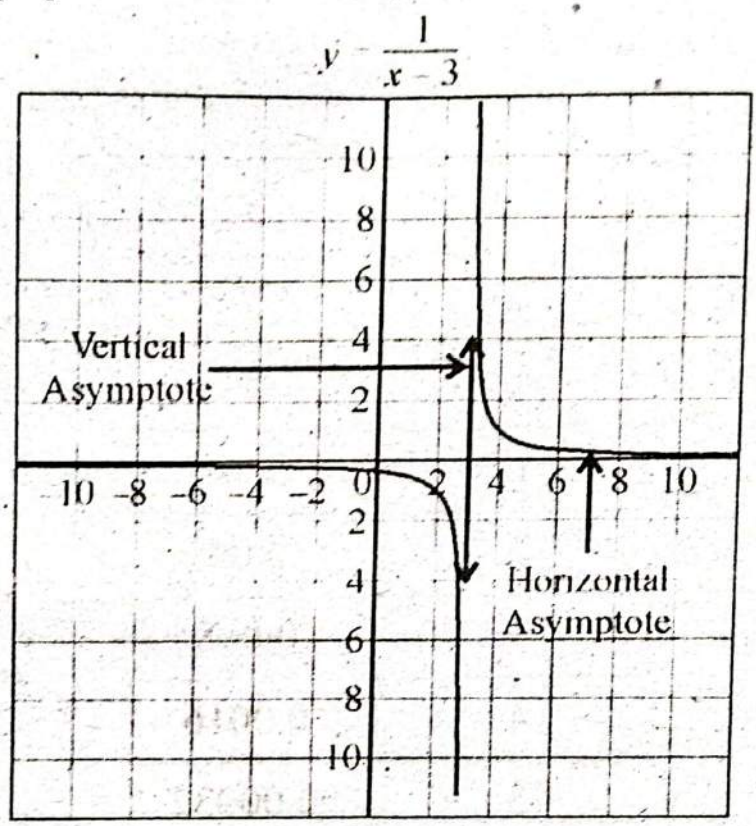
x	y
−1	5
−2	25
0	1
1	0.20
2	0.04
3	0.008
4	0.0016
5	0.00032

Graph of $y = 5^{-x}$



(iii) $y = \dfrac{1}{x-3}, x \neq 3$

Sol. There is no need to plot graph by taking points.
As x approaches 3, y approaches ∞.
So graph is shown below.



(iv) $y = \dfrac{2}{x} + 3, x \neq 0$

Sol. For $x = -2$

$$y = \frac{2}{-2} + 3 = -1 + 3$$

$$\boxed{y = 2}$$

For $x = -4$

$$y = \frac{2}{-4} + 3 = \frac{-1}{2} + 3 = -0.5 + 3$$

$$\boxed{y = 2.5}$$

For $x = -6$

$$y = \frac{2}{-6} + 3 = \frac{-1}{3} + 3 = -0.33 + 3$$

$$\boxed{y = 2.67}$$

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For $x = -8$

$$y = \frac{2}{-8} + 3 = -\frac{1}{4} + 3 = -0.25 + 3$$

$$\boxed{y = 2.75}$$

For $x = -10$

$$y = \frac{2}{-10} + 3 = -\frac{1}{5} + 3 = -0.2 + 3$$

$$\boxed{y = 2.80}$$

Similarly,

For $x = 2$

$$y = \frac{2}{2} + 3 = 1 + 3$$

$$\boxed{y = 4}$$

For $x = 4$

$$y = \frac{2}{4} + 3 = \frac{1}{2} + 3 = 0.5 + 3$$

$$\boxed{y = 3.5}$$

For $x = 6$

$$y = \frac{2}{6} + 3 = \frac{1}{3} + 3 = 0.33 + 3$$

$$\boxed{y = 3.33}$$

For $x = 8$

$$y = \frac{2}{8} + 3 = \frac{1}{4} + 3 = 0.25 + 3$$

$$\boxed{y = 3.25}$$

For $x = 0$

$$y = \frac{2}{10} + 3 = \frac{1}{5} + 3 = 0.2 + 3$$

$$\boxed{y = 3.2}$$

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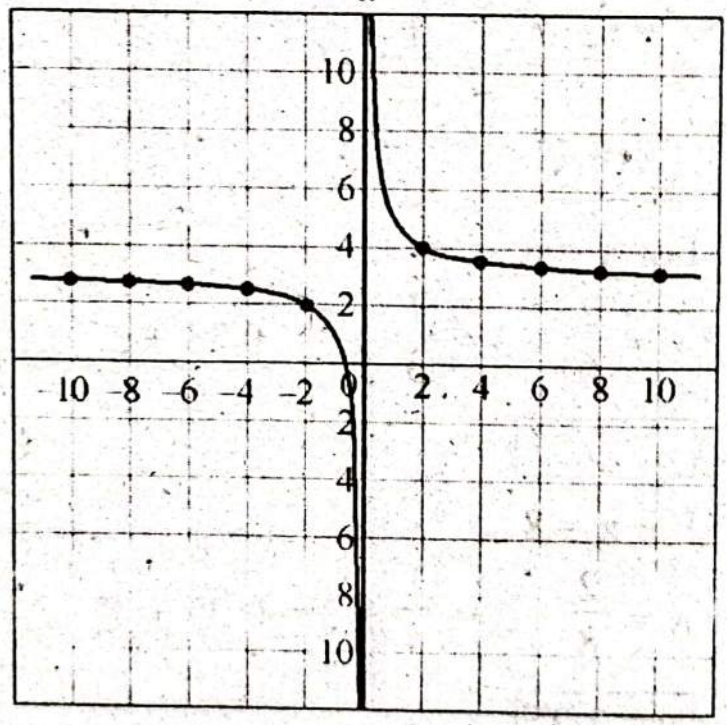
Table of values

x	y
–2	2
–4	2.5
–6	2.67
–8	2.75
–10	2.80
2	4
4	3.5
6	3.33
8	3.25
10	3.2

$y = \frac{2}{x} + 3$



(v) $y = x^{\frac{1}{2}}$

Sol.

For $x = 0$

$y = 0^{\frac{1}{2}}$

$\boxed{y = 0}$

For x = 1

$$y = 1^{\frac{1}{2}}$$

$$\boxed{y = 1}$$

For x = 2

$$y = 2^{\frac{1}{2}}$$

$$\boxed{y = 1.414}$$

For x = 3

$$y = 3^{\frac{1}{2}}$$

$$\boxed{y = 1.732}$$

For x = 4

$$y = 4^{\frac{1}{2}}$$

$$\boxed{y = 2}$$

For x = 5

$$y = 5^{\frac{1}{2}}$$

$$\boxed{y = 2.346}$$

For x = 6

$$y = 6^{\frac{1}{2}}$$

$$\boxed{y = 2.449}$$

Table of values is

x	y
0	0
1	1
2	1.414
3	1.732
4	2.000
5	2.346
6	2.449

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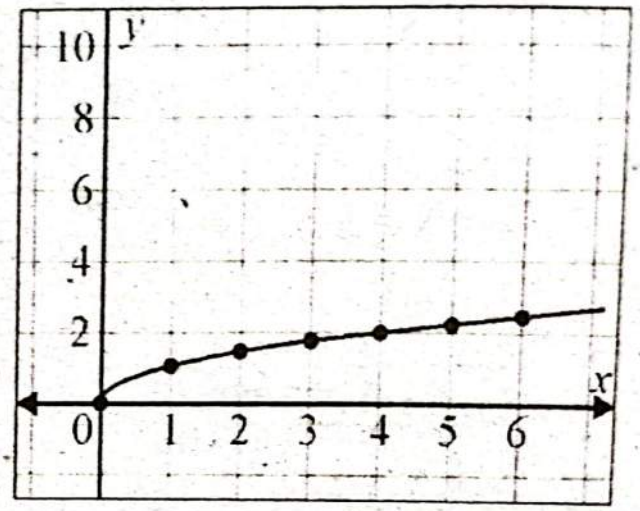
$y = x^{\frac{1}{2}}$



(vi) $\mathbf{y = 3x^{\frac{1}{3}}}$

Sol.

For $x = 0$

$y = 3(0)^{\frac{1}{3}} = 3(0) = 0$

$\boxed{y = 0}$

For $x = 1$

$y = 3(1)^{\frac{1}{3}} = 3 \times 1 = 3$

$\boxed{y = 3}$

For $x = 2$

$y = 3(2)^{\frac{1}{3}} = 3(1.259) = 3.777$

$\boxed{y = 3.777}$

For $x = 3$

$y = 3(3)^{\frac{1}{3}} = 3(1.4422)$

$\boxed{y = 4.3266}$

For $x = 4$,

$y = 3(4)^{\frac{1}{3}} = 3(1.3333) = 3.999 \approx 4$

$\boxed{y = 4}$

For $x = -1$

$y = 3(-1)^{\frac{1}{3}} = 3(-1)$

$\boxed{y = -3}$

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For $x = -2$

$$y = 3(-2)^{\frac{1}{3}} = 3(-1.259)$$

$$\boxed{y = -3.777}$$

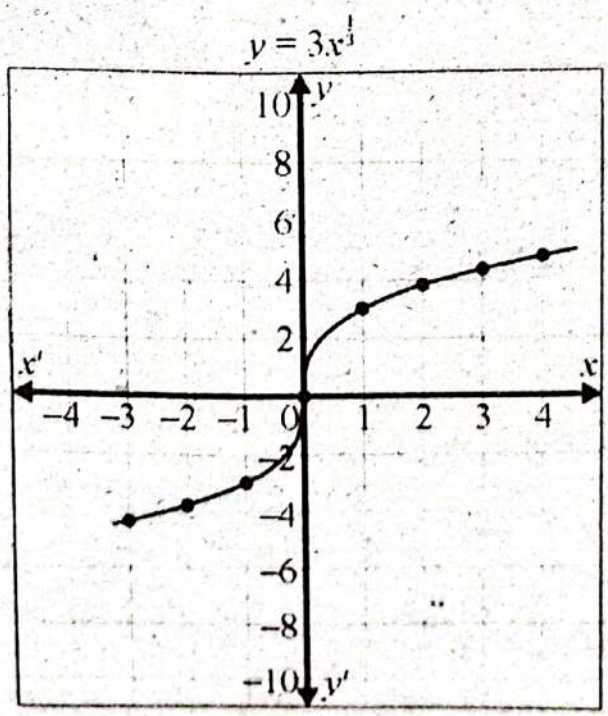
For $x = -3$

$$y = 3(-3)^{\frac{1}{3}}$$

$$\boxed{y = -4.3266}$$

Table of values is

x	y
0	0
1	3
2	3.777
3	4.3266
4	4
−1	−3
−2	−3.777
−3	−4.3266



(vii) $y = 2x^{-2}$

Sol. For $x = 1$

$$y = 2(1)^{-2} = 2(1)$$

$$\boxed{y = 2}$$

For $x = -1$

$$y = 2(-1)^{-2} = 2(1)$$

$$\boxed{y = 2}$$

For $x = -2$

$$y = 2(-2)^{-2} = 2\left(\frac{1}{(-2)^2}\right) = \frac{2}{4}$$

$$\boxed{y = 0.5}$$

For $x = -3$

$$y = 2(-3)^{-2} = 2\frac{1}{(-3)^2} = \frac{2}{9} = 0.222$$

$$\boxed{y = 0.222}$$

For $x = 2$

$$y = 2(2)^{-2} = \frac{2}{2^2}$$

$$\boxed{y = 0.5}$$

For $x = 3$

$$y = 2(3)^{-2} = \frac{2}{9}$$

$$\boxed{y = 0.222}$$

For $x = 4$

$$y = 2(4)^{-2} = \frac{2}{4^2} = \frac{2}{16} = \frac{1}{8}$$

$$\boxed{y = 0.125}$$

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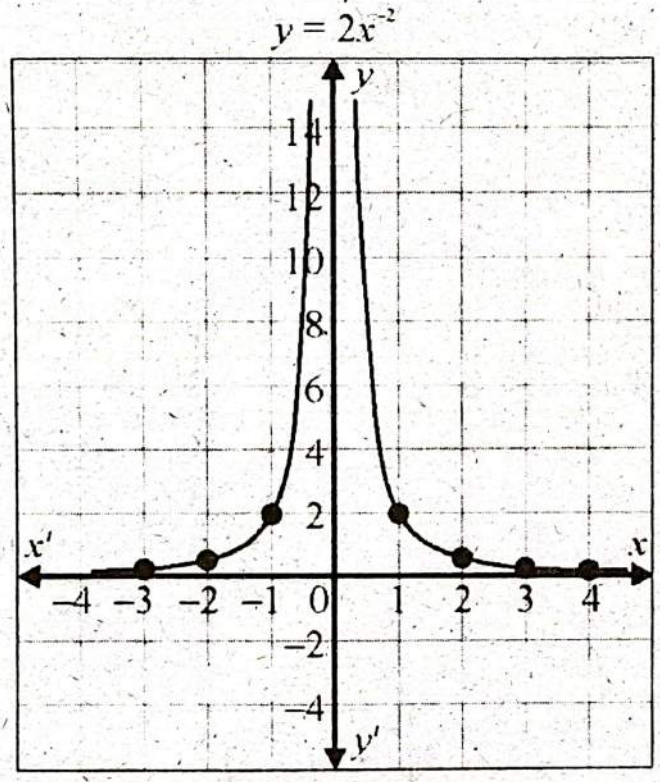
Table of values of

x	y
1	2
−1	2
−2	0.5
−3	0.222
2	0.5
3	0.222
4	0.125



EXERCISE 10.2

Q.1. Plot the graph of $y = 2x^2 - 4x + 3$ from −1 to 3. Draw tangent at (2, 3) and find the gradient.

Sol.

For $x = 1$

$y = 2(1)^2 - 4(1) + 3$

$y = 2 - 4 + 3$

$y = 5 - 4$

$\boxed{y = 1}$

CamScanner

For $x = 2$

$y = 2(2)^2 - 4(2) + 3$

$y = 2(4) - 8 + 3$

$y = 8 - 8 + 3$

$\boxed{y = 3}$

For $x = 3$

$y = 2(3)^2 - 4(3) + 3$

$y = 18 - 12 + 3$

$y = 21 - 12$

$\boxed{y = 9}$

For $x = -1$

$y = 2(-1)^2 - 4(-1) + 3$

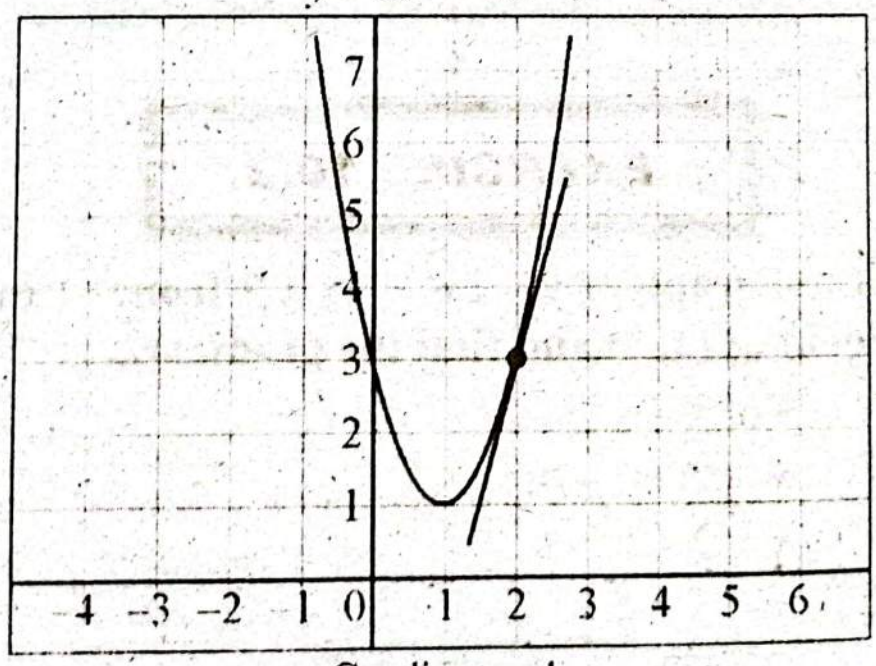
$y = 2 + 4 + 3$

$\boxed{y = 9}$

Table of values of

x	y
0	3
1	1
2	3
3	9
−1	9

$y = 2x^2 - 4x + 3$



Gradient = 4

Let's find another point on the tangent line.

From graph drawn above two points are (2, 3) and (1.5, 1)

Slope of tangent line

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{3-1}{2-1.5} = \frac{2}{0.5}$$

$$= \frac{2}{\frac{5}{10}} = \frac{2 \times 10}{5} = \frac{20}{5}$$

Gradient = 4

Q.2. Plot the graph of $y = 3x^2 + x + 1$ and draw tangent at (1, 5). Also find gradient of the tangent line at this point.

Sol.

For $x = 1$

$y = 3(1)^2 + 1 + 1$

$y = 3 + 2$

$\boxed{y = 5}$

For $x = 1.5$

$y = 3(1.5)^2 + 1.5 + 1$

$y = 3(2.25) + 2.5$

$y = 6.75 + 2.5$

$\boxed{y = 9.25}$

For $x = -1.5$

$y = 3(-1.5)^2 + (-1.5) + 1$

$y = 3(2.25) - 1.5 + 1$

$y = 6.75 - 0.5$

$\boxed{y = 6.25}$

For $x = -1.0$

$y = 3(-1.0)^2 + (-1.0) + 1$

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$y = 3(1) - 1 + 1$

$\boxed{y = 3}$

For $x = -2$

$y = 3(-2)^2 + (-2) + 1$

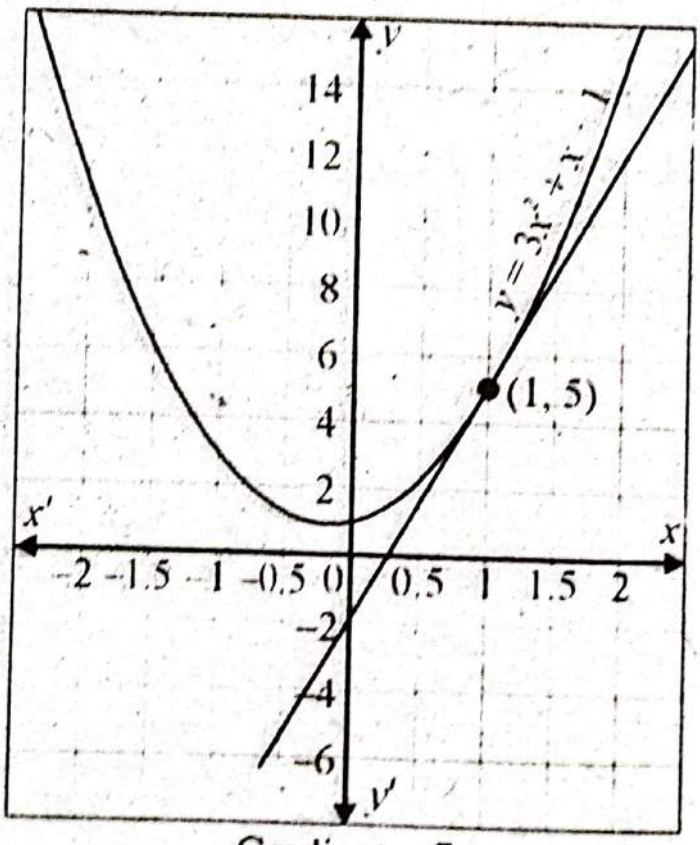
$y = 3(4) - 2 + 1$

$y = 12 - 1$

$\boxed{y = 11}$

Table of values of

x	y
1.0	5
1.5	9.25
−1.5	6.25
−1.0	3
−2.0	11



Gradient = 7

We find another point on tangent line.

Other point on tangent line is (2, 12), slope of tangent line through (1, 5) and (2, 12) is

$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{12-5}{2-1} = \frac{7}{1}$$

$$\text{Gradient} = 7$$

Q.3. The strength of students in a school was 1000 in 2016. If the strength decay according to the equation $S = 1000\ e^{-t}$, where S is the number of student at time t.

(a) Graph the given equation for t = 0 (in 2016) to t = 9 (in 2025).

(b) From the graph, estimate the student's strength in 2019 and in 2023.

Sol. Given that

$$S = 1000\ e^{-t}$$

Where S is the number of students at time t.

For t = 0

$$S = 1000\ e^{-0}$$

$$= 1000 \times e^{0}$$

$$S = 1000 \times 1 = 1000$$

For t = 1

$$S = 1000\ e^{-1}$$

$$= 1000 \times \frac{1}{e}$$

$$S = \frac{1000}{2.718} \qquad \because\ e = 2.718$$

$$= 368$$

For t = 2

$$S = 1000\, e^{-2}$$

$$= \frac{1000}{e^2}$$

$$S = \frac{1000}{(2.718)^2}$$

$$= \frac{1000}{7.387524}$$

$$S \approx 135$$

For $t = 3$

$$S = 1000\, e^{-3}$$

$$= \frac{1000}{e^3}$$

$$S = \frac{1000}{(2.718)^3}$$

$$= \frac{1000}{20.07929}$$

$$S \approx 50$$

For $t = 4$

$$S = 1000\, e^{-4}$$

$$= \frac{1000}{e^4}$$

$$S = \frac{1000}{(2.718)^4}$$

$$= \frac{1000}{54.5755}$$

$$S \approx 18$$

For $t = 5$

$$S = 1000\, e^{-5}$$

$$= \frac{1000}{e^5}$$

$$S = \frac{1000}{(2.718)^5}$$

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$$= \frac{1000}{148.3362}$$

$S \approx 7$

For $t = 6$

$S = 1000\, e^{-6}$

$$= \frac{1000}{e^{6}}$$

$$S = \frac{1000}{(2.718)^{6}}$$

$$= \frac{1000}{403.1779}$$

$S \approx 2.5$

$= 3$

For $t = 7$

$S = 1000\, e^{-7}$

$$= \frac{1000}{e^{7}}$$

$$S = \frac{1000}{(2.718)^{7}}$$

$$= \frac{1000}{1095.8375}$$

$S = 0.91$

$S \approx 1$

For $t = 8$

$S = 1000\, e^{-8}$

$$= \frac{1000}{e^{8}}$$

$$S = \frac{1000}{(2.718)^{8}}$$

$$= \frac{1000}{2978.4864}$$

$S = 0.3351$

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For t = 9

$$S = 1000\, e^{-9}$$

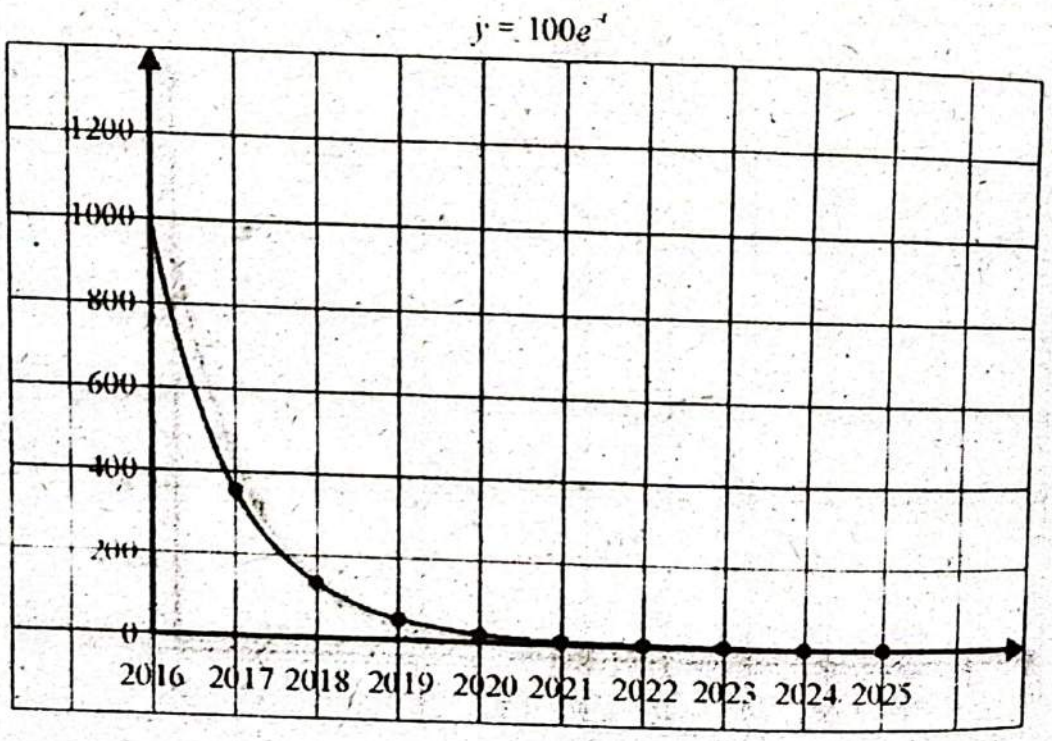
$$= \frac{1000}{e^{9}}$$

$$S = \frac{1000}{(2.718)^{9}}$$

$$= \frac{1000}{8095.5259}$$

$$S = 0.1235$$

(a)



(b) Estimated student's strength in 2019 = 50 students

Estimated student's strength in 2023 = 1 student

Q.4. The demand and supply functions for a product are given by the equations $P_d = 400 - 5Q$, $P_s = 3Q + 24$. Plot the graph of each function over the interval Q = 0 to Q = 300.

Sol. Given that

For Q = 0

$$P_d = 400 - 5(0)$$

$$= 400$$

For Q = 40

$P_d = 400 - 5(40)$

$= 400 - 200$

$P_d = 200$

For Q = 100

$P_d = 400 - 5(100)$

$= 400 - 500$

$P_d = -100$

For Q = 200

$P_d = 400 - 5(200)$

$= 400 - 1000$

$P_d = -600$

For Q = 300

$P_d = 400 - 5(300)$

$= 400 - 1500$

$P_d = -1100$

Now consider

$P_s = 3Q + 24$

For Q = 0

$P_s = 3(0) + 24$

$\boxed{P_s = 24}$

For Q = 50

$P_s = 3(50) + 24$

$P_s = 150 + 24$

$\boxed{P_s = 174}$

For Q = 100

$P_s = 3(100) + 24$

$P_s = 300 + 24$

$\boxed{P_s = 324}$

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For Q = 200

$P_s = 3(200) + 24$

$P_s = 600 + 24$

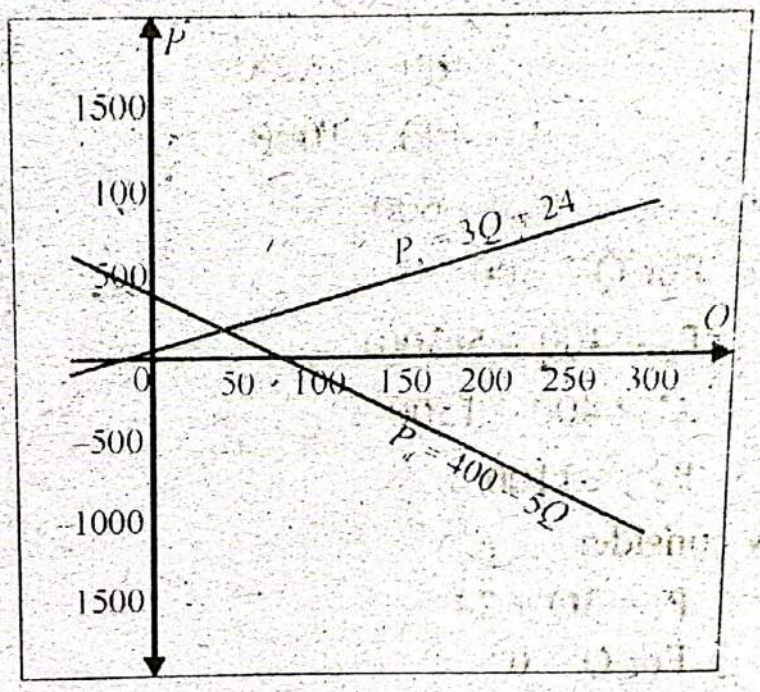
$\boxed{P_s = 624}$

For Q = 300

$P_s = 3(300) + 24$

$P_s = 900 + 24$

$\boxed{P_s = 924}$



Q.5. Shahid's salary S(x) in rupees is based on the following formula:

$$S(x) = 45000 + 4500\,x,$$

where x is the number of years he has been with the company. Sketch and interpret the graph of salary function for $0 \le x \le 5$.

Sol. $S(x) = 45000 + 4500x$

$0 \le x \le 5$

For x = 0

$S(0) = 45000 + 4500(0)$

$S(0) = \text{Rs.}45000$

For x = 1

S(1) = 45000 + 4500(1)

S(1) = 45000 + 4500

= Rs.49500

For x = 2

S(2) = 45000 + 4500(2)

S(2) = 45000 + 9000

= Rs.54000

For x = 3

S(3) = 45000 + 4500(3)

S(3) = 45000 + 13500

= Rs.58500

For x = 4

S(4) = 45000 + 4500(4)

S(4) = 45000 + 18000

= Rs.63000

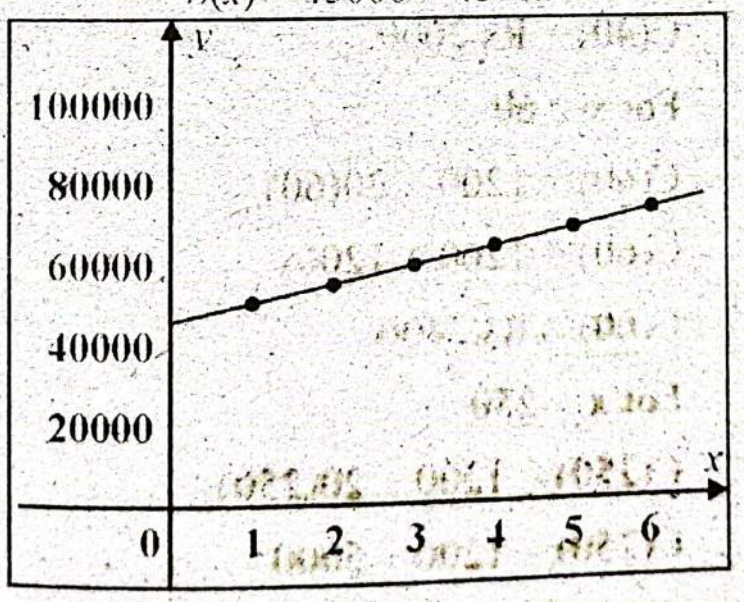
For x = 5

S(5) = 45000 + 4500(5)

S(5) = 45000 + 22500

= Rs.67500

$S(x) = 45000 + 4500x$



Shahid's salary increases line only with years of service and rises by Rs.4500 for every year.

Q.6. A company manufactures school bags. The cost function of producing x bags is $C(x) = 1200 + 800x$ and the revenue from selling x bags is $R(x) = 25x$.

a) Find the break-even point.

b) Determine the profit or loss when 250 bags are sold.

c) Plot the graphs of both the functions and identify the break-even point.

Sol. $C(x) = 1200 + 20x$

For $x = 0$

$C(0) = 1200 + 20(0)$

$C(0) = \text{Rs.}1200$

For $x = 20$

$C(20) = 1200 + 20(20)$

$C(20) = 1200 + 400$

$C(20) = \text{Rs.}1600$

For $x = 40$

$C(40) = 1200 + 20(40)$

$C(40) = 1200 + 800$

$C(40) = \text{Rs.}2000$

For $x = 60$

$C(60) = 1200 + 20(60)$

$C(60) = 1200 + 1200$

$C(60) = \text{Rs.}2400$

For $x = 250$

$C(250) = 1200 + 20(250)$

$C(250) = 1200 + 5000$

$C(250) = \text{Rs.}6200$

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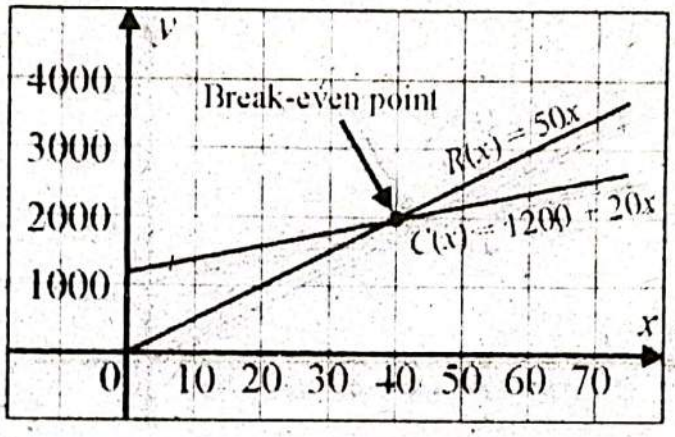
Table of values

No. of bags	Cost (Rs.)
0	1200
20	1600
40	2000
60	2400
250	6200



From graph

Break-Even point (40, 2000)

i.e. $\boxed{\text{At } x = 40 \text{ bags}}$

$$C.P = 1200 + 20 \times 250$$
$$= 1200 + 5000$$
$$= \text{Rs.}6200 \text{ (for } x = 250)$$

Sale price (S.P) $= 50 \times 250$

$= \text{Rs.}12500$

Since S.P > C.P so

Profit is realized

$$\text{Profit} = \text{Rs.}12500 - \text{Rs.}6200$$
$$= \text{Rs.}6300$$

Q.7: A newspaper agency fixed cost of Rs.70 per edition and marginal printing and distribution costs of Rs.40 per copy. Profit function is p(x) = 0.10x + 70,

where x is the number of newspapers. Plot the graph and find profit for 500 newspapers.

$P(x) = 10x - 70$

Put $x = 7$

$P(7) = 10 \times 7 - 70$

$P(7) = 70 - 70$

$P(7) = 0$

Put $x = 14$

$P(14) = 10 \times 14 - 70$

$P(14) = 140 - 70$

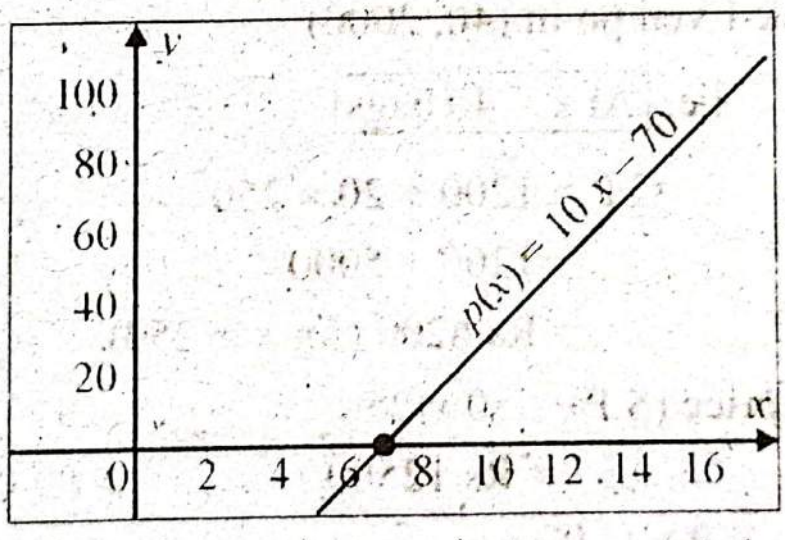
$P(14) = 70$

Put $x = 21$

$P(21) = 21 \times 7 - 70$

$P(21) = 210 - 70$

$P(21) = 140$



Now profit for 500 newspaper

$P(x) = 10x - 70$

$= 10 \times 500 - 70$

$= 5000 - 70$

$= \text{Rs } 4930$

Q.8. Ali manufactures expensive shirts for sale to a school. Its cost (in rupees) for x shirts is $C(x) = 1500 + 10x + 0.2x^2$, $0 \le x \le 150$. Plot the graph and find the cost of 200 shirts.

Sol. Cost function

$$C(x) = 1500 + 10x + 0.2\,x^2$$

$$0 \le x \le 150$$

Here x denotes no. of shirts

For $x = 0$

$C(0) = 1500 + 0 + 0$

$C(0) = \text{Rs.}1500$

For $x = 100$

$C(100) = 1500 + 10(100) + 0.2(100)^2$

$= 1500 + 1000 + 2000$

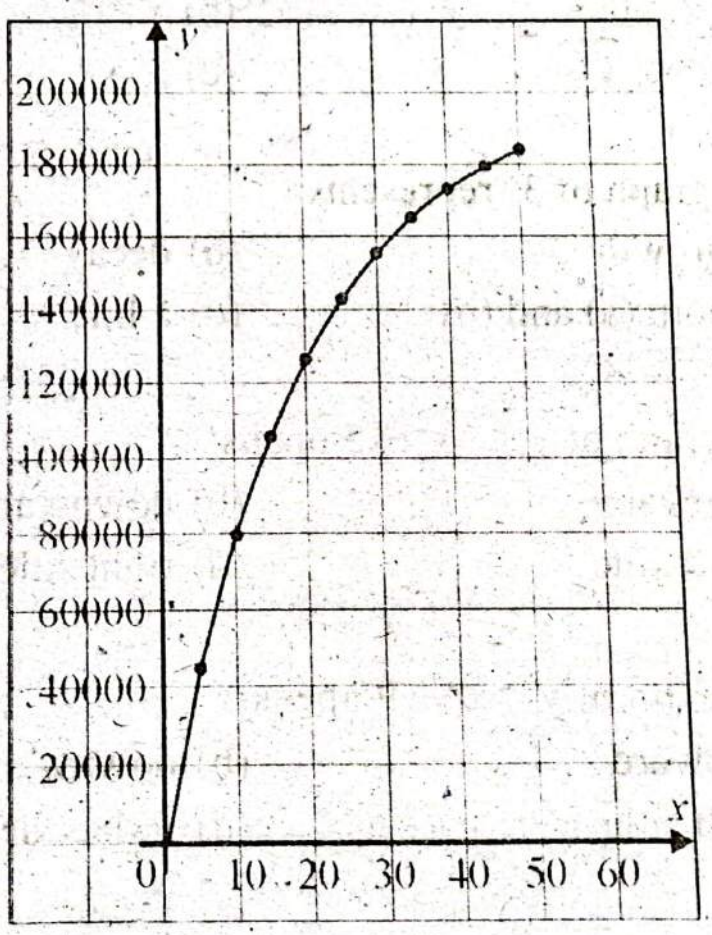
$C(100) = \text{Rs.}4500$

For $x = 200$

$C(200) = 1500 + 10(200) + 0.2(200)^2$

$= 1500 + 2000 + 8000$

$C(200) = \text{Rs.}11{,}500$



REVIEW EXERCISE 10

Q.1. Four options are given against each statement. Encircle the correct one.

(i) $x = 5$ represents:

(a) x-axis (b) y-axis

(c) line || to x-axis (d) line || to y-axis

Sol. **(d)**

(ii) Slope of the line $y = 5x + 3$ is:

(a) 3 (b) -3

(c) 5 (d) -5

Sol. **(c)**

(iii) The y-intercepts of $y = -2x - 1$ is:

(a) -2 (b) 2

(c) -1 (d) 1

Sol. **(c)**

(iv) The graph of $y = x^3$, cuts the x-axis at:

(a) $x = 0$ (b) $x = 1$

(c) $x = -1$ (d) $x = 2$

Sol. **(a)**

(v) The graph of 3^x represents:

(a) growth (b) decay

(c) both (a) and (b) (d) a line

Sol. **(a)**

(vi) The graph of $y = -x^2 + 5$ opens:

(a) upward (b) downward

(c) left side (d) right side

Sol. **(b)**

(vii) The graph of $y = x^2 - 9$ opens:

(a) upward (b) downward

(c) left side (d) right side

Sol. **(a)**

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(viii) $y = 5^x$ is _____ function.

(a) linear (b) quadratic

(c) cubic (d) exponential

Sol. **(d)**

(ix) Reciprocal function is:

(a) $y = 7^x$ (b) $y = \frac{2}{x}$

(c) $y = 2x^2$ (d) $y = 5x^3$

Sol. **(b)**

(x) $y = -3x^3 + 7$ is _____ function.

(a) exponential (b) cubic

(c) linear (d) reciprocal

Sol. **(b)**

Q.2. Plot the graph of the following functions:

(i) $y = 3^{-x}$ for x from –2 to 4

Sol.

Put $x = -2$

$y = 3^{-(-2)} = 3^2$

$\boxed{y = 9}$

Put $x = -1$

$y = 3^{-(-1)} = 3$

$\boxed{y = 3}$

Put $x = 0$

$y = 3^{-0} = 3^0$

$\boxed{y = 1}$

Put $x = 1$

$y = 3^{-1} = \frac{1}{3}$

$\boxed{y = 0.3333}$

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Put $x = 2$

$$y = 3^{-2} = \frac{1}{9}$$

$$\boxed{y = 0.1111}$$

Put $x = 3$

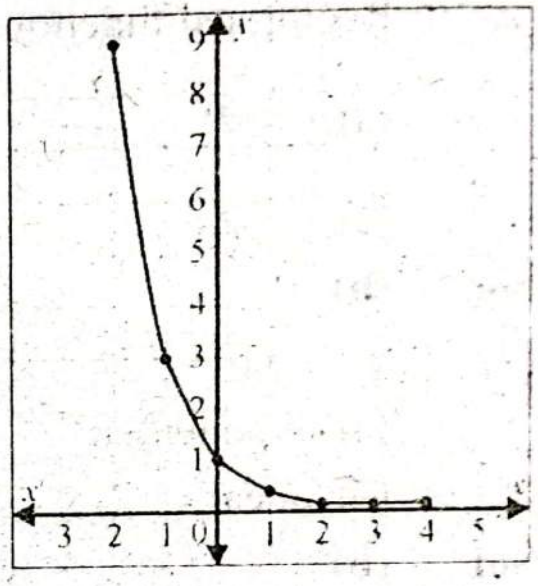
$$y = 3^{-3} = \frac{1}{27}$$

$$\boxed{y = 0.03}$$

Put $x = 4$

$$y = 3^{-4} = \frac{1}{3^4} = \frac{1}{81}$$

$$\boxed{y = 0.0123}$$



(ii) $\mathbf{y = \frac{2}{x+7}, x \neq -7}$

Sol. For $x = 1$

$$y = \frac{2}{1+7} = \frac{2}{8} = \frac{1}{4}$$

$$\boxed{y = 0.25}$$

For $x = 2$

$$y = \frac{2}{2+7} = \frac{2}{9}$$

$$\boxed{y = 0.2222}$$

For $x = 4$

$$y = \frac{2}{4+7} = \frac{2}{11}$$

$$\boxed{y = 0.1818}$$

For $x = 6$

$$y = \frac{2}{6+7} = \frac{2}{13}$$

$$\boxed{y = 0.1538}$$

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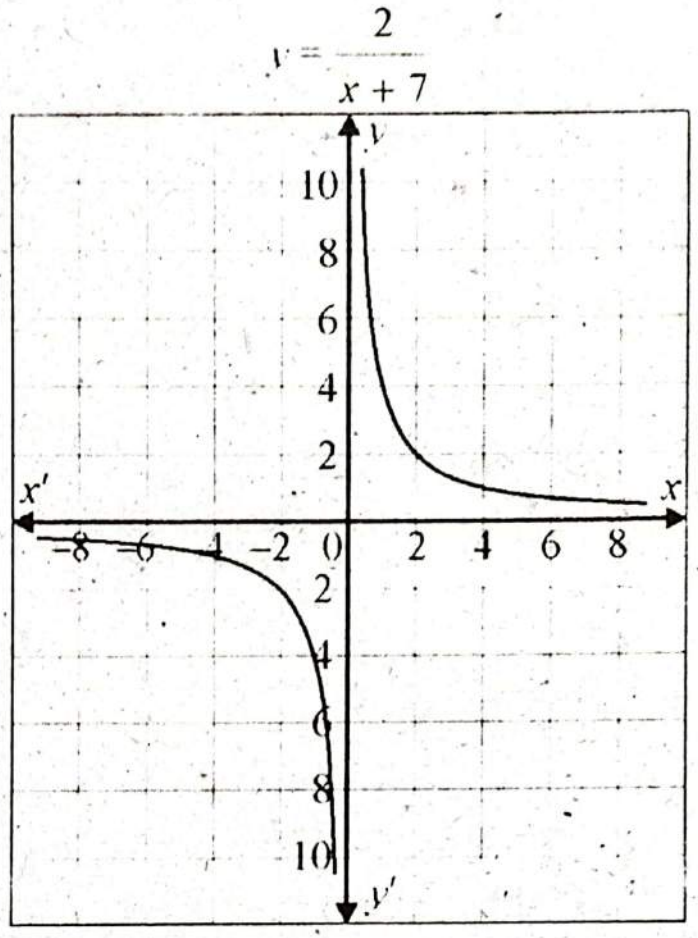
For x = 8

$$y = \frac{2}{8+7} = \frac{2}{15}$$

$$\boxed{y = 0.1333}$$

Similarly for negative values of x.



Q.3. Sales for a new magazine are expected to grow according to the equation:

$S = 200000\,(1 - e^{-0.05t})$, where t is given in weeks.

(a) Plot graph of sales for the first 50 weeks.

(b) Calculate the number of magazines sold, when t = 5 and t = 35.

Sol.(a) For t = 0

$$S = 200000\,(1 - e^{-0.05\times 0})$$

$$S = 200000\,(1 - e^{0})$$

$$S = 200000\,(1 - 1)$$

$$S = 200000\,(0)$$

$$\boxed{S = 0}$$

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For t = 5

$S = 200000\,(1 - e^{-0.05\times5})$

$S = 200000\,(1 - e^{-0.25})$

$S = 200000\,(1 - (2.718)^{-0.25})$

$S = 200000\,(1 - 0.7788)$

$S = 200000\,(0.2212)$

$\boxed{S = 44240}$

For t = 10

$S = 200000\,(1 - e^{-0.05\times10})$

$S = 200000\,(1 - e^{-0.5})$

$S = 200000\,(1 - 0.6065)$

$S = 200000 \times 0.3935$

$\boxed{S = 78700}$

For t = 20

$S = 200000\,(1 - e^{-0.05\times20})$

$S = 200000\,(1 - e^{-1})$

$S = 200000\,(1 - 0.3679)$

$S = 200000\,(0.6321)$

$\boxed{S = 126420}$

For t = 40

$S = 200000\,(1 - e^{-0.05\times40})$

$S = 200000\,(1 - e^{-2})$

$S = 200000\,(1 - 0.1353)$

$S = 200000\,(0.8647)$

$\boxed{S = 172940}$

For t = 50

$S = 200000\,(1 - e^{-0.05\times50})$

$S = 200000\,(1 - e^{-2.5})$

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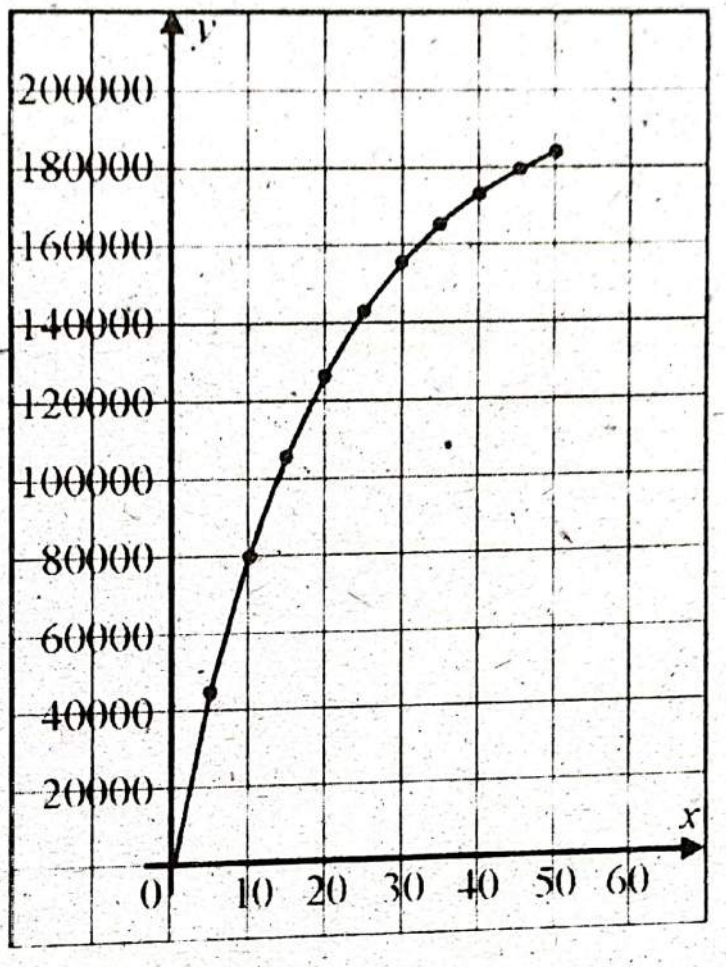
$S = 200000\ (1 - 0.2183)$

$S = 200000\ (0.7817)$

$\boxed{S = 156340}$



(b) For $t = 5$

$S = 200000\ (1 - e^{-0.05\times5})$

$S = 200000\ (1 - e^{-0.25})$

$S = 200000\ (1 - 0.7788)$

$S = 200000\ (0.2212)$

$\boxed{S = 44240}$

For $t = 35$

$S = 200000\ (1 - e^{-0.05\times35})$

$S = 200000\ (1 - e^{-1.75})$

$S = 200000\ (1 - 0.1738)$

$S = 200000\ (0.8262)$

$\boxed{S = 165240}$

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Q.4. Plot the graph of following for x from –5 to 5:

(i) $y = x^2 - 3$

Sol. $x = -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5$

$y = (-5)^2 - 3 = 25 - 3 = 22$

$y = (-4)^2 - 3 = 16 - 3 = 13$

$y = (-3)^2 - 3 = 9 - 3 = 6$

$y = (-2)^2 - 3 = 4 - 3 = 1$

$y = (-1)^2 - 3 = 1 - 3 = -2$

$y = 0^2 - 3 = -3$

$y = (1)^2 - 3 = 1 - 3 = -2$

$y = (2)^2 - 3 = 4 - 3 = 1$

$y = (3)^2 - 3 = 9 - 3 = 6$

$y = (4)^2 - 3 = 16 - 3 = 13$

$y = (5)^2 - 3 = 25 - 3 = 22$

Table of values

x	y
–5	22
–4	13
–3	6
–2	1
–1	–2
0	–3
1	–2
2	1
3	6
4	13
5	22

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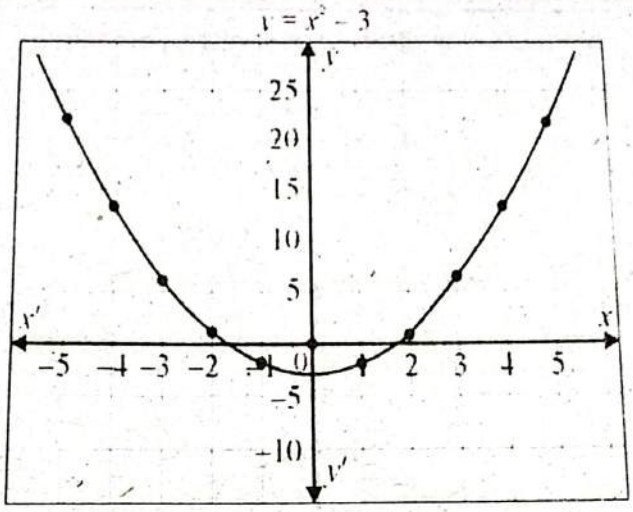

(ii) $\mathbf{y = 15 - x^2}$

Sol. $x = -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5$

$y = 15 - (-5)^2 = 15 - 25 = -10$

$y = 15 - (-4)^2 = 15 - 16 = -1$

$y = 15 - (-3)^2 = 15 - 9 = 6$

$y = 15 - (-2)^2 = 15 - 4 = 11$

$y = 15 - (-1)^2 = 15 - 1 = 14$

$y = 15 - (0)^2 = 15 - 0 = 15$

$y = 15 - (1)^2 = 15 - 1 = 14$

$y = 15 - (2)^2 = 15 - 4 = 11$

$y = 15 - (3)^2 = 15 - 9 = 6$

$y = 15 - (4)^2 = 15 - 16 = -1$

$y = 15 - (5)^2 = 15 - 25 = -10$

Table of values

x	y
−5	−10
−4	−1
−3	6
−2	11
−1	14
0	15
1	14

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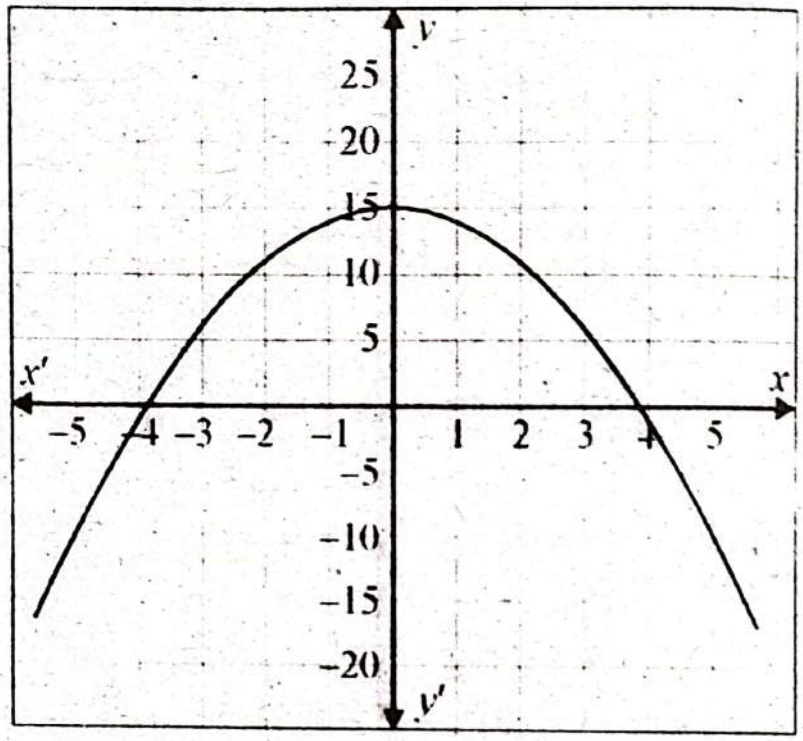
2	11
3	6
4	−1
5	−10

(c)

$y = 15 - x^2$



Q.5. Plot the graph of $y = \frac{1}{2}(x + 4)(x - 1)(x - 3)$ from −5 to 4.

Sol. $x = -5, -4, -3, -2, -1, 0, 1, 2, 3, 4$

$$y = \frac{1}{2}(-5 + 4)(-5 - 1)(-5 - 3)$$

$$y = \frac{1}{2}(-1)(-6)(-8)$$

$$\boxed{y = -24}$$

$$y = \frac{1}{2}(-4 + 4)(-4 - 1)(-4 - 3)$$

$$y = \frac{1}{2}(0)(-5)(-7)$$

$$\boxed{y = 0}$$

$$y = \frac{1}{2}(-3 + 4)(-3 - 1)(-3 - 3)$$

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$$y = \frac{1}{2}(1)(-4)(-6)$$

$$\boxed{y = 12}$$

$$y = \frac{1}{2}(-2+4)(-2-1)(-2-3)$$

$$y = \frac{1}{2}(2)(-3)(-5)$$

$$\boxed{y = 15}$$

$$y = \frac{1}{2}(-1+4)(-1-1)(-1-3)$$

$$y = \frac{1}{2}(3)(-2)(-4)$$

$$\boxed{y = 12}$$

$$y = \frac{1}{2}(0+4)(0-1)(0-3)$$

$$y = \frac{1}{2}(4)(-1)(-3)$$

$$\boxed{y = 6}$$

$$y = \frac{1}{2}(1+4)(1-1)(1-3)$$

$$y = \frac{1}{2}(5)(0)(-2)$$

$$\boxed{y = 0}$$

$$y = \frac{1}{2}(2+4)(2-1)(2-3)$$

$$y = \frac{1}{2}(6)(1)(-1)$$

$$\boxed{y = -3}$$

$$y = \frac{1}{2}(3+4)(3-1)(3-3)$$

$$y = \frac{1}{2}(7)(2)(0)$$

$$\boxed{y = 0}$$

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$$y = \frac{1}{2}(4+4)(4-1)(4-3)$$

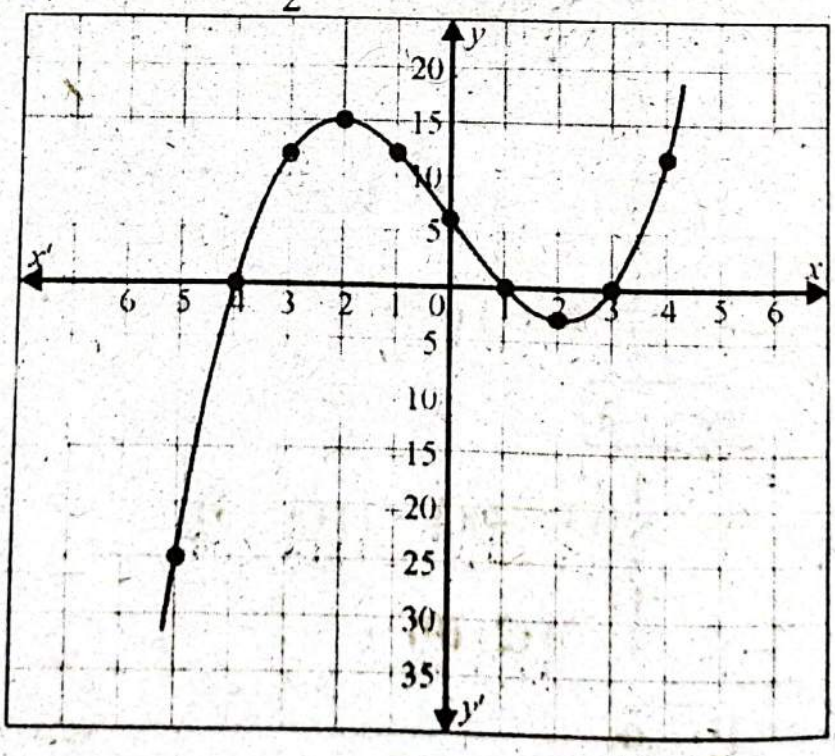
$$y = \frac{1}{2}(8)(3)(1)$$

$$\boxed{y = 12}$$

Table of values

x	y
−5	−24
−4	0
−3	12
−2	15
−1	12
0	6
1	0
2	−3
3	0
4	12

$$y = \frac{1}{2}(x+4)(x-1)(x-3)$$



Q.6. The supply and demand functions for a particular market are given by the equations:

$P_s = Q^2 + 5$ and $P_d = Q^2 - 10Q$, where P represents price and Q represents quantity,

Sketch the graph of each function over the interval $Q = -20$ to $Q = 20$.

Sol. $Q = -20, -15, -10, -5, 0, 5, 10, 15, 20$

$P_s = (-20)^2 + 5 = 400 + 5 = 405$

$P_s = (-15)^2 + 5 = 225 + 5 = 230$

$P_s = (-10)^2 + 5 = 100 + 5 = 105$

$P_s = (-5)^2 + 5 = 25 + 5 = 30$

$P_s = 0^2 + 5 = 5$

$P_s = (5)^2 + 5 = 25 + 5 = 30$

$P_s = (10)^2 + 5 = 100 + 5 = 105$

$P_s = (15)^2 + 5 = 225 + 5 = 230$

$P_s = (20)^2 + 5 = 400 + 5 = 405$

Now $P_d = Q^2 - 10Q$

$P_d = (-20)^2 - 10(-20)$

$P_d = 400 + 200 = 600$

$P_d = (-15)^2 - 10(-15)$

$P_d = 225 + 150 = 375$

$P_d = (-10)^2 - 10(-10)$

$P_d = 100 + 100 = 200$

$P_d = (-5)^2 - 10(-5)$

$P_d = 25 + 50 = 75$

$P_d = 0^2 - 10(0)$

$P_d = 0$

$P_d = (5)^2 - 10(5)$

$P_d = 25 - 50 = -25$

$P_d = (10)^2 - 10(10)$

$P_d = 100 - 100 = 0$

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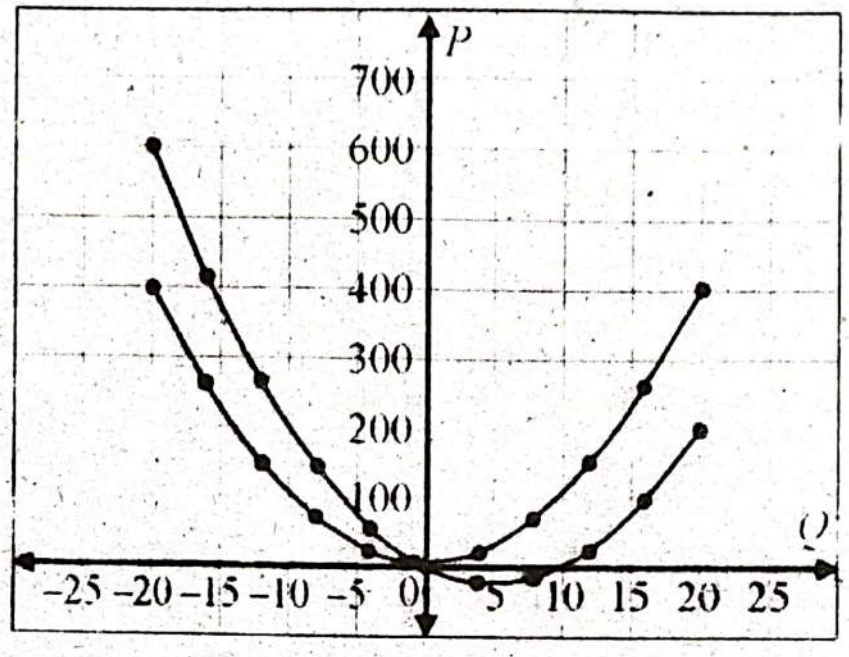
$P_d = (15)^2 - 10(15)$

$P_d = 225 - 150 = 75$

$P_d = (20)^2 - 10(20)$

$P_d = 400 - 200 = 200$



Q.7. A television manufacturer company make 40 inches LEDs. The cost of manufacturing x LEDs is C(x) = 60,000 + 250x and the revenue from selling x LEDs is R(x) = 1200x. Find the break-even point and find the profit or loss when 100 LEDs are sold. Identify the break-even point graphically.

Sol. $C(x) = 60000 + 250\,x$

Where x is no. of LEDs

and $R(x) = 1200\,x$

Put $x = 0$

$C(0) = 60000 + 250(0)$

$C(0) = \text{Rs.}60000$

For $x = 20$

$C(20) = 60000 + 250(20)$

$C(20) = 60000 + 5000$

$C(20) = \text{Rs.}65000$

For $x = 40$

$C(40) = 60000 + 250(40)$

$C(40) = 60000 + 10000$

$C(40) = Rs.70000$

For $x = 60$

$C(60) = 60000 + 250(60)$

$C(60) = 60000 + 15000$

$C(60) = Rs.75000$

For $x = 80$

$C(80) = 60000 + 250(80)$

$C(80) = 60000 + 20000$

$C(80) = Rs.80000$

Now $R(x) = 1200\,x$

For $x = 0$

$R(0) = 1200 \times 0$

$R(0) = 0$

For $x = 20$

$R(20) = 1200 \times 20$

$R(20) = Rs.24000$

For $x = 40$

$R(40) = 1200 \times 40$

$R(40) = Rs.48000$

For $x = 60$

$R(60) = 1200 \times 60$

$R(60) = Rs.72000$

For $x = 80$

$R(80) = 1200 \times 80$

$R(80) = Rs.96000$

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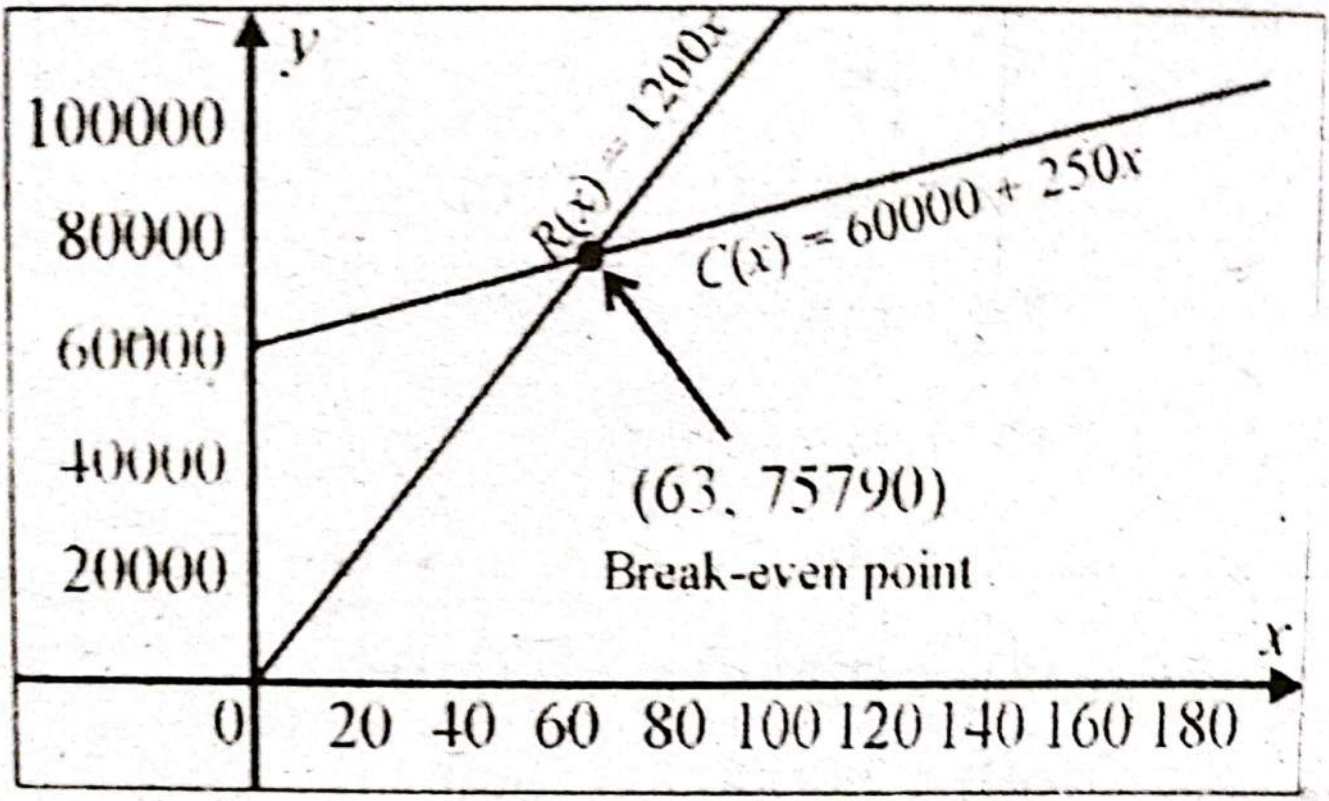

Break-even point is (63, 75790)

If profit is realized then S.P > C.P

Profit $= 1200x - (60000 + 250x)$

$= 1200x - 60000 - 250x$

$= 1200x - 250x - 60000$

$= 950x - 60000$

For 100 LEDs, $x = 100$

Profit $= 950 \times 100 - 60000$

$= 95000 - 60000$

$=$ Rs.35000

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