

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 gradient.

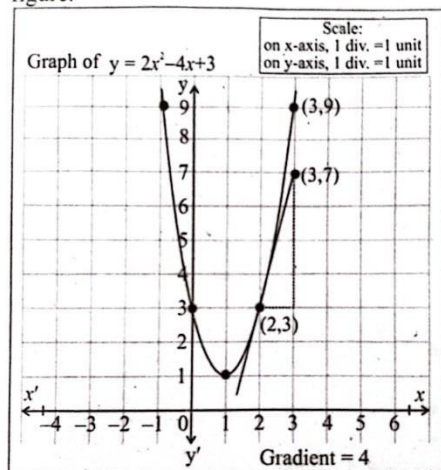
Solution

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

Step-I: Substitute the values of x in the given equation and find the corresponding values of y , as given below.

x	y	(x, y)
-1	9	(-1,9)
0	3	(0,3)
1	1	(1,1)
2	3	(2,3)
3	9	(3,9)

Step-II Select a suitable scale for graph like On x-Axis, 1 division = 1 unit
On y-Axis, 1 division = 1 unit
Step-III Plot the points on the grid and join them to get the required graph as shown in figure.



Gradient:

Draw a tangent line at point (2,3). Take any two points on the tangent line. Let two points on the tangent line are: A(2,3) and B(3,7)

We know that

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

$$m = \frac{7 - 3}{3 - 2} = \frac{4}{1} = 4$$

Thus gradient of tangent line is 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. 09310030

Solution:

$$y = 3x^2 + x + 1$$

Step-I: Substitute the values of x in the given equation and find the corresponding values of y , as given below.

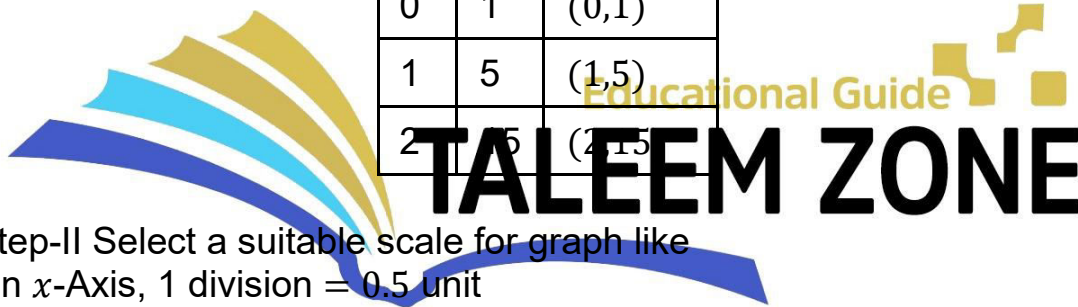
x	y	(x, y)
-2	11	(-2,11)
-1	3	(-1,3)
0	1	(0,1)
1	5	(1,5)
2	15	(2,15)

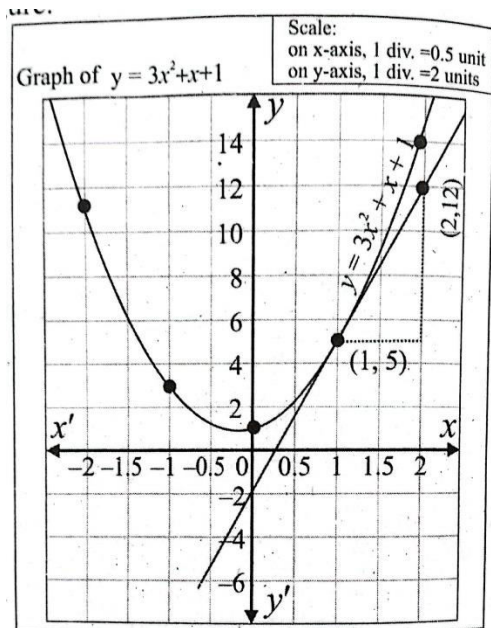
Step-II Select a suitable scale for graph like

On x -Axis, 1 division = 0.5 unit

On y -Axis, 1 division = 2 unit

Step-III Plot the points on the grid and join them to get the required graph as shown in figure.





Gradient:

Draw a tangent line at point (1,5). Take any two points on the tangent line. Let two points on the tangent line are: A(1,5) and B (2,12)

We know that

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

TALEEM ZONE

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

Thus gradient of tangent line is 7 .

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

Solution: (a)

$$S = 1000e^{-1} \text{ Or } S = \frac{1000}{e^1}$$

Step-1: Substitute the values of " t " in the given equation and find the corresponding values of S , as given below

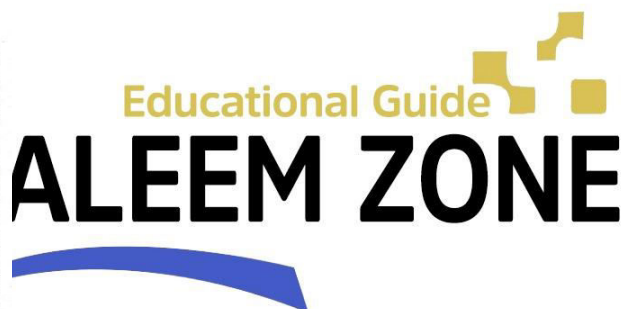
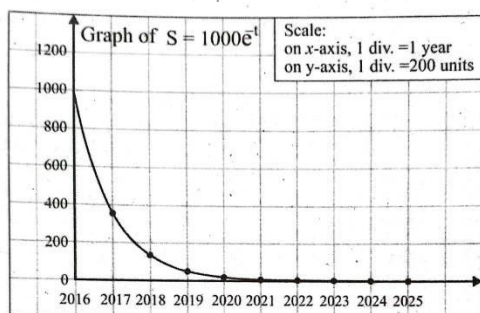
2016, ($t = 0$)	1000
2017, ($t = 1$)	$367.9 \approx 368$
2018, ($t = 2$)	$135.3 \approx 135$

2019, ($t = 3$)	$49.8 \approx 50$
2020, ($t = 4$)	$18.3 \approx 18$
2021, ($t = 5$)	$6.7 \approx 7$
2022, ($t = 6$)	$2.48 \approx 3$
2023, ($t = 7$)	$0.91 \approx 1$
2024, ($t = 8$)	$0.33 \approx 0$
2025, ($t = 9$)	$0.12 \approx 0$

Step-II Select a suitable scale for graph like On x -Axis, 1 division = $t = 1$ unit (year)

On y -Axis, 1 division = 200 units

Step-III Plot the points on the grid and join them to get the required graph as shown in figure



Solution: (b)

The estimated students' strength in 2019 is 50 .

The estimated students' strength in 2023 is 1 .

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 $Q = 300$.

Solution:

$$P_d = 400 - 5Q \text{ and } P(s) = 3Q + 24$$

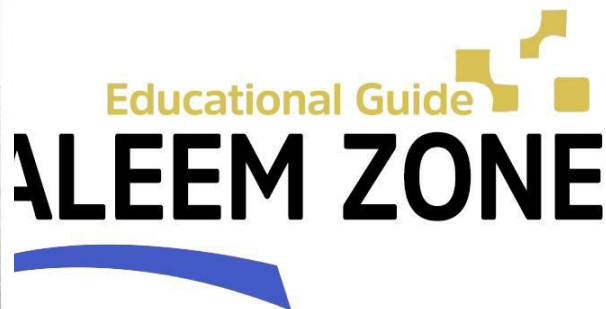
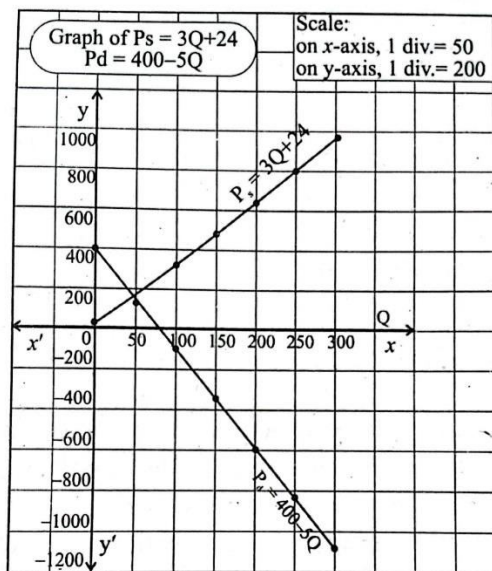
The interval ($Q = 0$ to $Q = 300$)

Step-I: Substitute the values of " Q " in the given functions and find the corresponding values of P_d and p_s , as given below

Q	$P_d = 400 - 5Q$	$P_s = 3Q + 24$
-----	------------------	-----------------

0	400	24
50	150	174
100	-100	324
150	-350	474
200	-600	624
250	-850	774
300	-1100	924

Step-II Select a suitable scale for graph like On x -Axis, 1 division = 50 units On y -Axis, 1 division = 200 units Step-III Plot the points on the grid and join them to get the required graph as shown in figure.



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

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

where x is the number of years he has been with the company.

Sketch and interpret the graph of salary function for $0 \leq x \leq 5$.

Solution:

$$S(x) = 45000 + 4500x \text{ and } 0 \leq x \leq 5$$

Step-I: Substitute the values of " x " in the given function $S(x)$ and find the corresponding values of $S(x)$, as given below.

x	$S(x)$
-----	--------

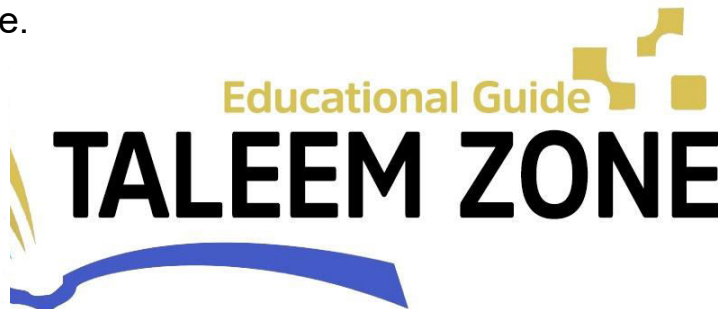
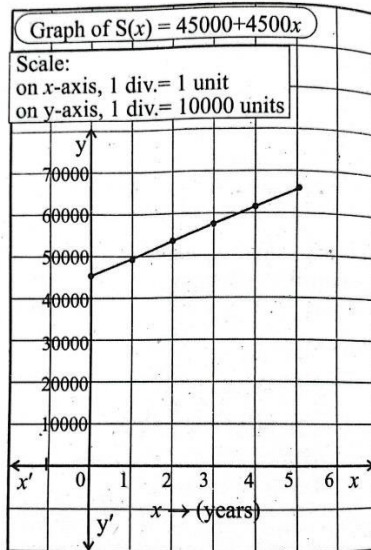
0	45000
1	49,500
2	54,000

3	58,500
4	63,000
5	67,500

Step-II Select a suitable scale for graph like On x -Axis, 1 division = 1 unit

On y -Axis, 1 division = 10000 units

Step-III Plot the points on the grid and join them to get the required graph as shown in figure.



Interpretation of Salary Graph:

The graph shows that Shahid's starting salary is Rs, 45,000 . After every 1 year Shahid's salary increases by Rs, 4,500 .

Q. 6 A company manufactures school bags. The cost function of producing x bags is $C(x) = 1200 + 20x$ and the revenue from selling x bags is $R(x) = 50x$.

(a) Find the break-even point.

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

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

Solution(a):

The break-even point is no profit or loss.

It happens when total cost and revenue are equal.

$$R(x) = C(x)$$

$$50x = 1200 + 20x$$

$$50x - 20x = 1200$$

$$30x = 1200$$

$$x = \frac{1200}{30} = 40$$

The company reaches at breakeven point at the production of 40 bags.

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

Solution:

Since break-even is at 40 bags. Surely it will be profit at 250 bags.

$$\text{Profit} = R(x) - C(x)$$

$$\text{Profit} = 50x - (1200 + 20x)$$

$$\text{Profit} = 50x - 1200 - 20x$$

$$\text{Profit} = 30x - 1200$$

Put $x = 250$ in profit function

$$\text{Profit} = 30(250) - 1200$$

$$\text{Profit} = 7,500 - 1,200$$

$$\text{Profit} = 6,300.$$

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

Solution:

$$R(x) = 50x \text{ and } C(x) = 1200 + 20x$$

Step-I: Substitute the values of " x " in the given function $S(x)$ and find the corresponding values of $S(x)$, as given below.

x	$R(x) = 50x$	$C(x) = 1200 + 20x$
0	0	1200
10	500	1400
20	1000	1600
30	1500	1800
40	2000	2000
50	2500	2200
60	3000	2400

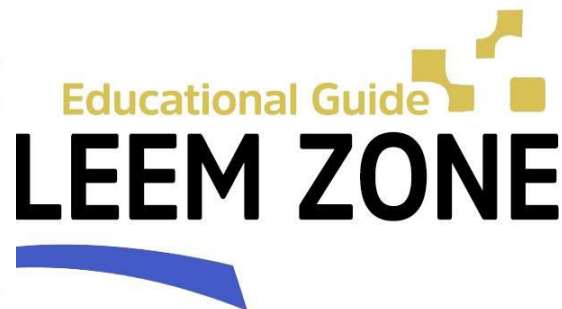
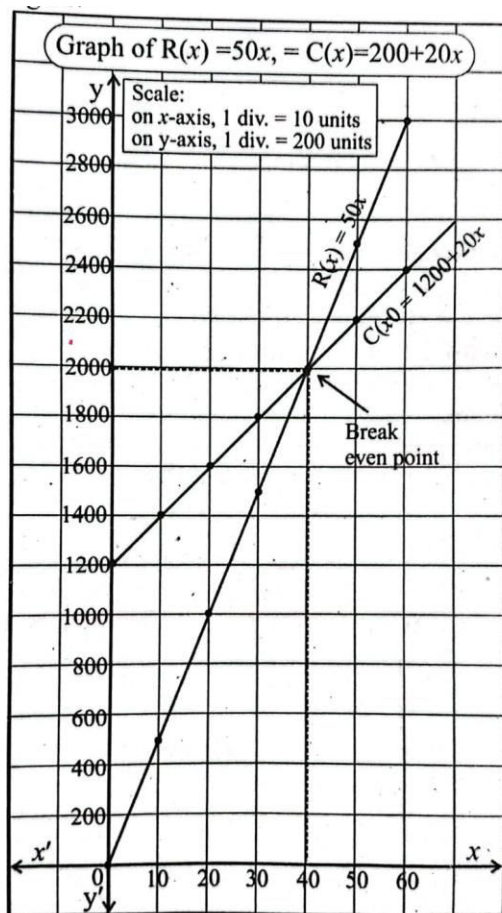
Educational Guide

TALEEM ZONE

Step-II Select a suitable scale for graph like On x -Axis, 1 division = 10 units

On y -Axis, 1 division = 200 units

Step-III Plot the points on the grid and join them to get the required graph as shown in figure.



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 $p(x) = 10x - 70$, where x

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

Solution:

Plotting the Graph:

$$p(x) = 10x - 70$$

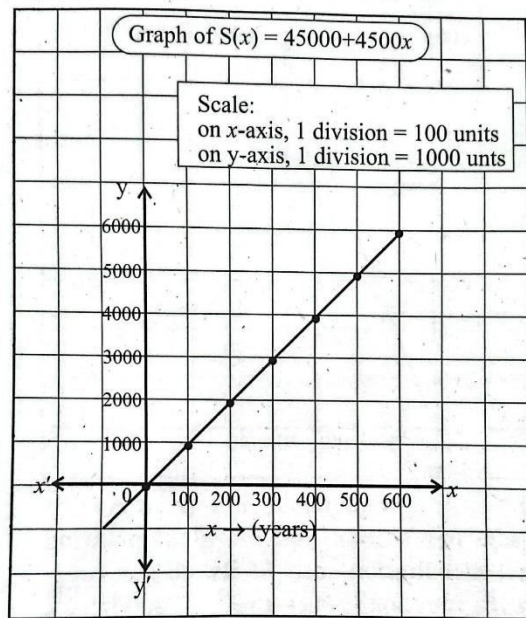
Step-I: Substitute the values of " x " in the given function $S(x)$ and find the corresponding values of $S(x)$, as given below.

x	$p(x)$
0	-70
100	930
200	1930
300	2930
400	3930
500	4930
600	5930

Step-II Select a suitable scale for graph like On x -Axis, 1 division = 100 units

On y -Axis, 1 division = 1000 units

Step-III Plot the points on the grid and join them to get the required graph as shown in figure.



Educational Guide
LEEM ZONE

Finding the profit:

Profit function is $p(x) = 10x - 70$,

Put $x = 500$ in $p(x)$

$$p(500) = 10(500) - 70$$

$$p(500) = 5000 - 70$$

$$p(500) = 4,930$$

Thus profit for 500 news papers is Rs. 4,930.

Q. 8 Ali manufacturers expensive shirts for sale to a school. Its cost (in rupees) for x shirts is $C(x) = 1500 + 10x + 0.2x^2, 0 \leq x \leq 150$.

Plot the graph and find the cost of 200 shirts.

Solution:

Plotting the Graph:

Step-1: Substitute the values of " x " in the given function $C(x)$ and find the corresponding values of $C(x)$, as given below.

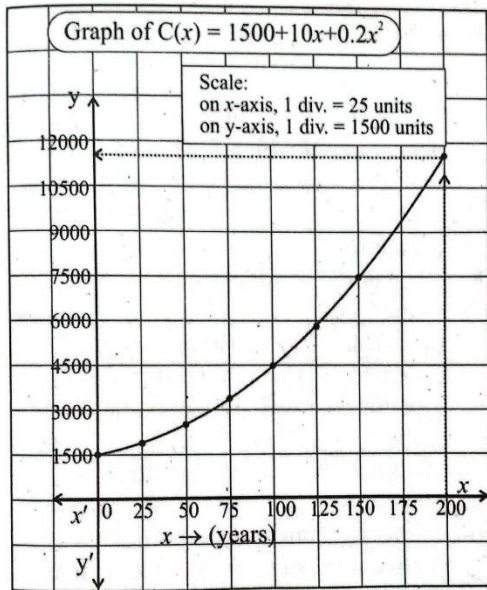
$$C(x) = 1500 + 10x + 0.2x^2 \text{ and } 0 \leq x \leq 1500$$

x	$C(x)$
0	1,500
25	1,875
50	2500
75	3375
100	4500
125	5875
150	7,500



Step-II Select a suitable scale for graph like On x -Axis, 1 division = 25 units On y -Axis, 1 division = 1500 units

Step-III Plot the points on the grid and join them to get the required graph as shown in figure.



Finding the Cost:

Cost function is $C(x) = 1500 + 10x + 0.2x^2$

Put $x = 200$ in $C(x)$

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

$$C(200) = 1500 + 2000 + 8000$$

$$C(200) = 11,500$$

Thus cost for 200 shirts is Rs.11,500.

Educational Guide
TALEEM ZONE