

Case Study for Class 10 Maths Chapter 3 Pair of Linear Equations in Two Variables

Case Study 5: Mobile Recharge Plans

Two friends, Ankit and Bhavna, compare mobile recharge plans from the same company. Plan A has a fixed monthly charge of ₹199 and charges ₹0.50 per minute of calls beyond the free limit. Plan B has a fixed monthly charge of ₹299 with free unlimited calls. Ankit uses Plan A and talks for x minutes beyond the limit. Bhavna uses Plan B. In a particular month, both pay the same total amount.

Questions:

- (i) Write expressions for the monthly bill of Ankit and Bhavna in terms of x .
- (ii) Form an equation when both pay the same amount and solve for x .
- (iii) How many minutes beyond the limit does Ankit talk in that month?
- (iv) If Ankit talks for 300 minutes beyond the limit next month, which plan is cheaper for him?
- (v) At what number of extra minutes does Plan B become more economical than Plan A?

Solution:

- (i) Ankit's bill = $199 + 0.5x$. Bhavna's bill = ₹299 (fixed, no extra charge).
- (ii) Set equal: $199 + 0.5x = 299$, $0.5x = 100$, $x = 200$ minutes.
- (iii) Ankit talks 200 minutes beyond the free limit that month.
- (iv) Ankit's bill at 300 minutes = $199 + 0.5(300) = 199 + 150 = ₹349$. Bhavna's (Plan B) = ₹299. Plan B is cheaper by ₹50 at 300 minutes.
- (v) Plan B is more economical when: $299 < 199 + 0.5x$, $100 < 0.5x$, $x > 200$. Plan B is better when extra usage exceeds 200 minutes.

Case Study 6: Comparing Two Business Plans

Simran is comparing two freelance payment structures offered by two clients. Client A pays a fixed amount of ₹5,000 per month plus ₹200 per project completed. Client B pays a fixed amount of ₹3,000 per month plus ₹400 per project completed. Simran wants to find the number of projects at which both clients pay the same monthly amount.

Questions:

- (i) Let the number of projects completed in a month be p . Write expressions for payment from Client A and Client B.
- (ii) Form and solve the equation for equal payment.
- (iii) At how many projects do both clients pay equally?
- (iv) If Simran completes 8 projects next month, which client pays more?
- (v) For what values of p does Client A pay more than Client B?

Solution:

- (i) Client A pays: $5000 + 200p$. Client B pays: $3000 + 400p$.
- (ii) Set equal: $5000 + 200p = 3000 + 400p$, $2000 = 200p$, $p = 10$.
- (iii) Both clients pay equally when Simran completes 10 projects.
- (iv) At $p = 8$: Client A = $5000 + 200(8) = 5000 + 1600 = ₹6,600$. Client B = $3000 + 400(8) = 3000 + 3200 = ₹6,200$. Client A pays more at 8 projects.
- (v) Client A pays more when: $5000 + 200p > 3000 + 400p$, $2000 > 200p$, $p < 10$. For fewer than 10 projects, Client A pays more.

Case Study 7: Water Consumption Analysis

A housing society has two water tanks Tank X and Tank Y. Tank X currently holds 400 litres and is being filled at 30 litres per hour. Tank Y currently holds 100 litres and is being filled at 50 litres per hour. The society wants to find after how many hours both tanks will have the same amount of water, and how much water that will be.

Questions:

- (i) Write expressions for the amount of water in Tank X and Tank Y after t hours.
- (ii) Form an equation and find the value of t when both tanks contain equal water.
- (iii) How much water will each tank contain at that time?
- (iv). Represent both equations on the same set of axes (describe the lines and their intersection).
- (v) If Tank X develops a leak and loses 5 litres per hour, rewrite its equation and find the new time when both tanks are equal.

Solution:

- (i) Water in Tank X after t hours: $W = 400 + 30t$. Water in Tank Y after t hours: $W = 100 + 50t$.
- (ii) A2. Set equal: $400 + 30t = 100 + 50t$, $300 = 20t$, $t = 15$ hours.
- (iii) At $t = 15$: Water in each tank = $400 + 30(15) = 400 + 450 = 850$ litres.
- (iv) Tank X line: $W = 400 + 30t$ starts at $(0, 400)$ with a gentle positive slope of 30. Tank Y line: $W = 100 + 50t$ starts at $(0, 100)$ with a steeper positive slope of 50. Since Tank Y has a higher slope, its line rises faster and crosses Tank X's line at the point $(t = 15, W = 850)$. Before $t = 15$, Tank X holds more water. After $t = 15$, Tank Y holds more.
- (v) New Tank X equation (filling at 30, losing 5, net gain 25): $W = 400 + 25t$. Set equal to Tank Y: $400 + 25t = 100 + 50t$, $300 = 25t$, $t = 12$ hours. The tanks equalise sooner after just 12 hours because Tank X now fills more slowly.