Chapter 2: Introduction to Linear Polynomials Case Study for Class 9

Case Study 1: The Delivery Rider's App

A food-delivery rider's app tracks his total distance covered (in km) since his shift began using the rule $D(t) = 6t + 3$, where t is the number of hours since the shift started, and the 3 km accounts for the fixed distance from the warehouse to his first delivery zone.
Questions:
(i) What is the degree of the polynomial $6t + 3$? Name this type of polynomial.
(ii) Find the distance covered after $t = 2$ hours.
(iii) After how many hours will the rider have covered exactly 39 km?
(iv) Identify the coefficient of t and the constant term in $D(t) = 6t + 3$.
OR
If the app instead used $D(t) = 6t^2 + 3$, would this still be a linear polynomial? Justify your answer.

Solution:
(i) Degree = 1; it is a linear polynomial.

(ii) $D(2) = 6(2) + 3 = 12 + 3 = 15$ km.

(iii) $6t + 3 = 39 \Rightarrow 6t = 36 \Rightarrow t = 6$ hours.

(iv) Coefficient of $t = 6$; constant term = 3.

OR: No. Once t is squared, the highest power becomes 2, which makes $D(t) = 6t^2 + 3$ a quadratic polynomial, not a linear one.

Case Study 2: Meera's Tulsi Sapling (Linear Growth)

Meera plants a tulsi sapling that is 12 cm tall on the day she plants it. Under her care, it grows at a steady rate of 2.5 cm every week.

Questions:
(i) Write a linear expression for the height h (in cm) of the plant after t weeks.
(ii) Find the plant's height after 8 weeks.
(iii) Is this an example of linear growth or linear decay? Justify your answer using the coefficient of t.
(iv) After how many complete weeks will the plant's height first exceed 50 cm?
OR
Complete the table of heights for t = 0, 2, 4 and 6 weeks.

Solution:
(i) $h = 12 + 2.5t$

(ii) $h(8) = 12 + 2.5(8) = 12 + 20 = 32$ cm.

(iii) Linear growth: the coefficient of t (2.5) is positive, so the height increases by a fixed amount every week.

(iv) $12 + 2.5t > 50 \Rightarrow 2.5t > 38 \Rightarrow t > 15.2$, so the height first crosses 50 cm during the 16th week.

OR: $t = 0 \rightarrow 12$ cm, $t = 2 \rightarrow 17$ cm, $t = 4 \rightarrow 22$ cm, $t = 6 \rightarrow 27$ cm.

Case Study 3: The Print Shop Bill

A print shop bills customers using a linear relationship between the number of pages printed (x) and the total bill in rupees (y), written as $y = ax + b$. One customer who printed 20 pages was billed ₹140. Another customer who printed 50 pages was billed ₹290.
Questions:
(i) Form two equations in a and b using the given information.
(ii) Solve the equations to find the values of a and b.
(iii) What do the values of a and b represent in this situation?
(iv) Use the relationship to find the bill for 35 pages.
OR
What would the bill be for 0 pages printed, and how does this connect to the meaning of b?

Solution:

(i) 20a + b = 140 ... (1) and 50a + b = 290 ... (2)

(ii) Subtracting (1) from (2): 30a = 150 ⇒ a = 5.
Substituting back: 20(5) + b = 140 ⇒ b = 40.

(iii) a = 5 is the cost per page (₹5/page); b = 40 is a fixed base charge (such as setup or binding cost) that applies no matter how many pages are printed.

(iv) y = 5(35) + 40 = 175 + 40 = ₹215.

OR: y = 5(0) + 40 = ₹40. This matches b exactly, confirming that b is the bill amount when no pages have been added yet.