

Case Study 2

A tech company, "FutureBotix," is designing a new portable gaming console. The production cost involves several components. The cost of the outer plastic shell is represented by the expression $12a + 5b - 10$ rupees, where a is the cost per unit of premium polymer and b is the labor cost index. The internal circuit board cost is given by $8a - 3b + 22$ rupees.

During a quality check, the engineering team found that the cooling fan's efficiency reduces the overall cost overhead, which can be expressed as a subtraction of $2a - b + 5$ from the total production cost. The marketing department also needs to understand the structure of these expressions to set a selling price. They identified that in the expression for the circuit board, certain parts are constants which do not change regardless of material price fluctuations. To optimize the assembly line, the manager needs to add the costs of the shell and the circuit board first and then subtract the efficiency savings. This mathematical modeling helps the company maintain a competitive edge in the market by simplifying complex financial data into manageable algebraic forms.

Questions

1. What is the sum of the costs of the outer plastic shell and the internal circuit board?

- (a) $20a + 2b + 12$
- (b) $20a + 8b + 32$
- (c) $4a + 8b - 32$
- (d) $20a - 2b + 12$

Answer: (a) $20a + 2b + 12$

Solution: Sum = $(12a + 5b - 10) + (8a - 3b + 22)$

Grouping like terms: $(12a + 8a) + (5b - 3b) + (-10 + 22) = 20a + 2b + 12$.

2. In the expression for the internal circuit board, $8a - 3b + 22$, which term is the constant?

- (a) $8a$
- (b) $-3b$
- (c) 22
- (d) 8

Answer: (c) 22

Solution: A constant is a term in an algebraic expression that does not contain any variables. In $8a - 3b + 22$, the number 22 is independent of a and b .

3. Find the simplified expression for the final production cost after subtracting the cooling fan efficiency ($2a - b + 5$) from the combined cost found in Question 1.

- (a) $18a + b + 7$
- (b) $18a + 3b + 7$
- (c) $22a + 3b + 17$
- (d) $18a + 3b + 17$

Answer: (b) $18a + 3b + 7$

Solution: Final Cost = $(20a + 2b + 12) - (2a - b + 5)$

= $20a + 2b + 12 - 2a + b - 5$

Grouping like terms: $(20a - 2a) + (2b + b) + (12 - 5) = 18a + 3b + 7$.

4. Identify the numerical coefficient of the term b in the expression for the outer plastic shell $(12a + 5b - 10)$.

- (a) 12
- (b) 10
- (c) -10
- (d) 5

Answer: (d) 5

Solution: The numerical coefficient is the number multiplied by the variable. In the term $5b$, the coefficient is 5.

5. If a and b are replaced by x , such that the expression for the circuit board becomes $8x - 3x + 22$, which of the following is the simplified version?

- (a) $5x + 22$
- (b) $11x + 22$
- (c) $27x$
- (d) $5 + 22x$

Answer: (a) $5x + 22$

Solution: $8x$ and $-3x$ are like terms. $8x - 3x = 5x$. Adding the constant, we get $5x + 22$.