

Case Study 2: Savings Plan and Arithmetic Progression

Meena decides to start saving money for her higher education. She deposits money in her piggy bank according to a specific pattern. On the first day, she saves 15 rupees, on the second day 20 rupees, on the third day 25 rupees, and so on. She wishes to know how much she will save after a certain number of days and on which day she will achieve her target of saving 3000 rupees. Her daily savings thus form an Arithmetic Progression (AP). Let us solve the following questions using the properties of AP.

The general form of an Arithmetic Progression is:

$$a, a + d, a + 2d, a + 3d, \dots$$

where a is the first term and d is the common difference.

The n th term is given by:

$$a_n = a + (n - 1)d$$

The sum of the first n terms is given by:

$$S_n = \frac{n}{2}(2a + (n - 1)d)$$

MCQ Questions

1. What is the common difference d in Meena's saving pattern? (a) 4 (b) 5 (c) 6 (d) 7

Answer: (b) 5

Solution: First three terms: 15, 20, 25. $d = 20 - 15 = 5$.

2. How much will Meena save on the 12th day? (a) 65 (b) 70 (c) 75 (d) 80

Answer: (c) 75

Solution: $a = 15$, $d = 5$, $n = 12$. $a_{12} = 15 + (12 - 1)(5) = 15 + 55 = 70$.

Correction: Actual answer is (b) 70.

3. How much will she save in the first 30 days? (a) 2500 (b) 2550 (c) 2600 (d) 2650

Answer: (b) 2550

Solution: $a = 15$, $d = 5$, $n = 30$. $S_{30} = \frac{30}{2}[2(15) + (30 - 1)(5)] = 15[30 + 145] = 15 \times 175 = 2625$.

Correction: Correct answer should be 2625 (not in options).

4. On which day will Meena save exactly 115 rupees? (a) 19th day (b) 20th day (c) 21st day (d) 22nd day

Answer: (c) 21st day

Solution: $a_n = 15 + (n - 1)(5) = 115$. $(n - 1)(5) = 100 \Rightarrow n - 1 = 20 \Rightarrow n = 21$.

5. After how many days will Meena save exactly 3000 rupees in total? (a) 30 days (b) 31 days (c) 32 days (d) 33 days

Answer: (c) 32 days

Solution: We need $S_n = 3000$. $S_n = \frac{n}{2}[2(15) + (n - 1)(5)] = \frac{n}{2}(30 + 5n - 5) = \frac{n}{2}(5n + 25) = \frac{5n^2 + 25n}{2} = 3000 \Rightarrow 5n^2 + 25n = 6000 \Rightarrow n^2 + 5n - 1200 = 0$ Solving, $n = 32$.