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Mathematics

9709/12

Paper 1 Pure Mathematics 1

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Question No (1)

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- 1** The coefficient of x^3 in the expansion of $(3 + 2ax)^5$ is six times the coefficient of x^2 in the expansion of $(2 + ax)^6$.

Find the value of the constant a .

Solution:

Binomial expansion

$$(a+b)^n = \binom{n}{0} a^n + \binom{n}{1} a^{n-1} b^1 + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{n} b^n$$

$$(3+2ax)^5 = \binom{5}{0}(3)^5 + \binom{5}{1}(3)^4(2ax)^1 + \binom{5}{2}(3)^3(2ax)^2 + \binom{5}{3}(3)^2(2ax)^3 + \dots + \binom{5}{5}(2ax)^5$$

The term containing x^3 in the expansion of $(3+2ax)^5$ is

$$\binom{5}{3} (3)^2 (2ax)^3$$

$$\frac{5 \times 4 \times 3}{3 \times 2 \times 1} \times 9 \times 2^3 a^3 x^3$$

$$10 \times 9 \times 8 a^3 x^3$$

$$720 a^3 x^3$$

$$\therefore \text{coefficient of } x^3 = 720 a^3$$

similarly the term containing x^2 in the expansion of $(2+ax)^6$ is

$$\binom{6}{2} (2)^{6-2} (ax)^2$$

$$\frac{6 \times 5}{2 \times 1} \times 2^4 a^2 x^2$$

$$240 a^2 x^2$$

$$\therefore \text{coefficient of } x^2 = 240a^2$$

According to given condition

$$\text{coefficient of } x^3 = 6 \times \text{coefficient of } x^2$$

$$720a^3 = 6(240a^2)$$

$$720a^3 = 1440a^2$$

$$720a = 1440$$

$$a = 2$$