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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^4 in the expansion of $(3+x)^5$ is equal to the coefficient of x^2 in the expansion of $\left(2x + \frac{a}{x}\right)^6$.

Find the value of the positive constant a .

Solution:

Binomial Formula

$$(a+b)^n = C_0^n a^n + C_1^n a^{n-1} b^1 + C_2^n a^{n-2} b^2 + \dots + C_n^n b^n$$

General term formula

$$T_{r+1} = C_r^n a^{n-r} b^r$$

$$(3+x)^5 = C_0^5 (x)^5 + C_1^5 (3)^1 (x)^4 + \dots + C_5^5 (3)^5 x^0$$

As we need coefficient of x^4 , So

$$C_1^5 3 x^4$$

$$5 (3) x^4$$

$$15 x^4 \Rightarrow \text{coefficiat? } x^4 \text{ is } 15$$

Now the expansion of $\left(2x + \frac{a}{x}\right)^6$

$$C_0^6 (2x)^0 \left(\frac{a}{x}\right)^{6-0} + C_1^6 (2x)^1 \left(\frac{a}{x}\right)^{6-1} + C_2^6 (2x)^2 \left(\frac{a}{x}\right)^{6-2} + C_3^6 (2x)^3 \left(\frac{a}{x}\right)^{6-3} + C_4^6 (2x)^4 \left(\frac{a}{x}\right)^{6-4} + \dots + C_6^6 (2x)^6 \left(\frac{a}{x}\right)^0$$

By observing above expression x^2 coefficient lie in term

$$C_4^6 (2x)^4 \left(\frac{a}{x}\right)^2 = \frac{6 \times 5 \times 4 \times 3}{4 \times 3 \times 2 \times 1} 2^4 x^4 \left(\frac{a^2}{x^2}\right)$$

$$= 15 \times 16 a^2 x^2$$

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

As the coefficient of x^4 and x^2 are equal

So,

$$240a^2 = 15$$

$$a^2 = \frac{15}{240}$$

$$a^2 = \frac{1}{16}$$

$$\Rightarrow a = \pm \frac{1}{4}$$

positive values $\frac{1}{4}$.