

Cambridge International AS & A Level

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Mathematics 9709

Paper 1 Pure Mathematics 1

Topic 6-Binomial Expansion

Question No (1)

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**Question No (1)**

The first three terms in the expansion of  $(2 + ax)^n$ , in ascending powers of  $x$ , are  $32 - 40x + bx^2$ . Find the values of the constants  $n$ ,  $a$  and  $b$ .

**Solution**

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### Binomial Theorem

$$(a+b)^n = {}^nC_0 a^n + {}^nC_1 a^{n-1} b^1 + {}^nC_2 a^{n-2} b^2 + \dots + {}^nC_n a^0 b^n$$

$$(2+ax)^n$$

using the Binomial expansion

$$\begin{aligned} (2+ax)^n &= 2^n (ax)^0 + n (2)^{n-1} (ax)^1 + \frac{n(n-1)}{2!} (2)^{n-2} (ax)^2 + \dots \\ &= 2^n + n 2^{n-1} ax + \frac{n(n-1)}{2!} 2^{n-2} (ax)^2 + \dots \end{aligned}$$

As given in question statement

$$2^n + n 2^{n-1} (ax) + \frac{n(n-1)}{2!} 2^{n-2} (ax)^2 = 32 - 40x + bx^2$$

comparing the coefficients

$$2^n = 32 \quad (\text{For constant})$$

$$2^n = 2^5$$

$$\Rightarrow n = 5$$

For coefficient of  $x$

$$2^{n-1} (na) = -40$$

$$\text{As } n = 5$$

$$2^{5-1} 5a = -40$$

$$2^4 5a = -40$$

$$16(5a) = -40$$

$$80a = -40$$

$$a = -\frac{40}{80} = -\frac{1}{2}$$

For coefficient of  $x^2$

$$\frac{n(n-1)}{2!} 2^{n-2} a^2 = b$$

$$\text{As } n=5, a = -\frac{1}{2}$$

$$\Rightarrow \frac{5(5-1)}{2!} \times 2^{5-2} \left(-\frac{1}{2}\right)^2 = b$$

$$\frac{5(4)}{2} \times 2^3 \times \left(\frac{1}{4}\right) = b$$

$$\frac{20}{2} \times 8 \times \frac{1}{4} = b$$

$$b = 20$$

$$\therefore n=5, b=20, a=-\frac{1}{2}$$