Cambridge International AS & A Level

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Mathematics 9709/12

Paper 1 Pure Mathematics 1 **May/June 2020**

Question No(1)

1 **(a)** Find the coefficient of x^2 in the expansion of $\left(x-\frac{2}{x}\right)^6$.

(b) Find the coefficient of x^2 in the expansion of $(2+3x^2)\left(x-\frac{2}{x}\right)^6$.

Solution:

(a)

General Term formula in Binomial Expansion

General term

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

$$\left(x-\frac{2}{x}\right)^6$$

$$= C_r^6 (x)^{6-r}\left(-\frac{2}{x}\right)^r$$

$$= C_r^6 (x)^{6-r}(-2)^r\left(\frac{1}{x}\right)^r$$

$$= C_r^6 (x)^{6-r}(-2)^r (x^{-1})^r$$

$$= C_r^6 (x)^{6-r}(-2)^r x^{-r}$$

$$= C_r^6 (-2)^r x^{6-2r}$$

$$= C_r^6 (-2)^r x^{6-2r} \qquad \rightarrow (1)$$

For the coefficient of x^2*, compare power of* x^{6-2r} *with* x^2

$$=> \ x^{6-2r} = x^2$$

$$6-2r = 2$$

$$-2r = 2-6$$

$$-2r = -4$$

$$r = 2$$

putting value of $r = 2$ *in* (1)

$$T_{2+1} = C_2^6(-2)^2 x^{6-2(2)}$$

$$= C_2^6\, 4\, x^2$$

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

$$= 60\, x^2$$

$$coefficient\ of\ x^2\ is\ 60$$

$(\boldsymbol{b})$

Binomial Expansion formula

$$(a+b)^n = \sum_{k=0}^{n} \binom{n}{k} a^{n-k}\, b^k$$

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

$$\left(x - \frac{2}{x}\right)^6, By\ Binomial\ expansion$$

$$= C_0^6 x^6 \left(-\frac{2}{x}\right)^0 + C_1^6 (x)^5 \left(-\frac{2}{x}\right)^1 + C_2^6 (x)^4 \left(-\frac{2}{x}\right)^2 + C_3^6 (x)^3 \left(-\frac{2}{x}\right)^3 + C_4^6 (x)^2 \left(-\frac{2}{x}\right)^4 |$$

$$+ C_5^6 x^1 \left(-\frac{2}{x}\right)^5 + C_6^6 (x)^0 \left(-\frac{2}{x}\right)^6$$

$$= x^6 - 12x^4 + 60x^2 - 160 + \frac{240}{x^2} - \frac{192}{x^4} + \frac{64}{x^6}$$

Now

$$(2 + 3x^2)\left(x - \frac{2}{x}\right)^6$$

$$= (2 + 3x^2)\left[x^6 - 12x^4 + 60x^2 - 160 + \frac{240}{x^2} - \frac{192}{x^4} + \frac{64}{x^6}\right]$$

$$terms\ involving\ x^2\ are$$

$$= 120x^2 - 480\, x^2$$

$$= -360x^2$$

$$So\ the\ coefficient\ of\ x^2\ is\ -360$$