**Binomial Expansion**

Expand:

|  |  |
| --- | --- |
| $$\left(2x+3\right)^{4}$$ | $$\left(\frac{3}{2}-x^{2}\right)^{4}$$ |

Find the coefficient of the $x^{5}$ term:

|  |  |  |
| --- | --- | --- |
| $$\left(x+2\right)^{11}$$ | $$\left(\frac{2}{3}-\frac{x}{2}\right)^{7}$$ | $$\left(x+5\right)^{3}\left(2-x\right)^{4}$$ |

**Binomial Expansion - Answers**

Expand:

|  |  |
| --- | --- |
| $$\left(2x+3\right)^{4}$$ | $$\left(\frac{3}{2}-x^{2}\right)^{4}$$ |
| =$$1∙\left(2x\right)^{4}∙3^{0}$$$$+4∙\left(2x\right)^{3}∙3^{1}$$$$+6∙\left(2x\right)^{2}∙3^{2}$$$$+4∙\left(2x\right)^{1}∙3^{3}$$$$+1∙\left(2x\right)^{0}∙3^{4}$$=$16x^{4}+96x^{3}+216x^{2}+216x+81$ |

|  |  |
| --- | --- |
| =$$1∙\left(\frac{3}{2}\right)^{4}∙\left(-x^{2}\right)^{0}$$$$+4∙\left(\frac{3}{2}\right)^{3}∙\left(-x^{2}\right)^{1}$$$$+6∙\left(\frac{3}{2}\right)^{2}∙\left(-x^{2}\right)^{2}$$$$+4∙\left(\frac{3}{2}\right)^{1}∙\left(-x^{2}\right)^{3}$$$$+1∙\left(\frac{3}{2}\right)^{0}∙\left(-x^{2}\right)^{4}$$ | =$$1∙\frac{81}{16}∙1$$$$+4∙\frac{27}{8}∙-x^{2}$$$$+6∙\frac{9}{4}∙x^{4}$$$$+4∙\frac{3}{2}∙-x^{6}$$$$+1∙1∙x^{8}$$ |

$$=\frac{81}{16}-\frac{27}{2}x^{2}+\frac{27}{2}x^{4}-6x^{6}+x^{8}$$ |

Find the coefficient of the $x^{5}$ term:

|  |  |  |
| --- | --- | --- |
| $$\left(x+2\right)^{11}$$ | $$\left(\frac{2}{3}-\frac{x}{2}\right)^{7}$$ | $$\left(x+5\right)^{3}\left(2-x\right)^{4}$$ |
| $$\begin{matrix}11\\5\end{matrix}∙x^{5}∙2^{6}$$$$=462∙64∙x^{5}$$$$=29568 x^{5}$$Coefficient is $29568$ | $$\begin{matrix}7\\5\end{matrix}∙\left(-\frac{x}{2}\right)^{5}∙\left(\frac{2}{3}\right)^{2}$$$$=21∙\frac{-x^{5}}{32}∙\frac{4}{9}$$$$=\frac{-7}{24}x^{5}$$Coefficient is $\frac{-7}{24}$ | See table below. |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $x^{5}$ features in the following terms only:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | $$x^{3}$$ | $$15x^{2}$$ | $$75x$$ | $$125$$ |
| $$16$$ |  |  |  |  |
| $$-32x$$ |  |  |  |  |
| $$24x^{2}$$ | $$24x^{5}$$ |  |  |  |
| $$-8x^{3}$$ |  | $$-120x^{5}$$ |  |  |
| $$x^{4}$$ |  |  | $$75x^{5}$$ |  |

$$24x^{5}-120x^{5}+75x^{5}=-21x^{5}$$Coefficient is $-21$ |