# Binomial Theorem

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

## Section A — Choose the correct answer — 8 × 1 = 8 marks

**1.** How many terms are there in the expansion of $(x + y)^5$?

**(a)** 7 **(b)** 5 **(c)** 10 **(d)** 6

**2.** The coefficient of $x^5$ in the expansion of $(x + 4)^8$ is:

**(a)** 56 **(b)** 57,344 **(c)** 3,584 **(d)** −3,584

**3.** The coefficient of the middle term of $(x - 1)^4$ is:

**(a)** −6 **(b)** 7 **(c)** −4 **(d)** 6

**4.** The sum of the coefficients in the expansion of $(4x - 2)^5$ is:

**(a)** 33 **(b)** 32 **(c)** 992 **(d)** 7,776

**5.** The number of terms in the expansion of $(a + b)^n$ is:

**(a)** 2n **(b)** n **(c)** n + 1 **(d)** n − 1

**6.** The 4th term of $(x - 3)^7$ is:

**(a)** $-945x^3$ **(b)** $2{,}835x^3$ **(c)** $35x^4$ **(d)** $-945x^4$

**7.** Using the binomial theorem, $(98)^4$ equals:

**(a)** 92,236,716 **(b)** 92,236,824 **(c)** 92,236,816 **(d)** 96,059,600

**8.** Assertion (A): In the expansion of $(1 + x)^{14}$, the coefficients of $x^4$ and $x^{10}$ are equal.
Reason (R): ${}^nC_r = {}^nC_{n-r}$, so terms equidistant from the two ends have equal coefficients.

**(a)** Both A and R are true, and R is the correct explanation of A.

**(b)** Both A and R are true, but R is not the correct explanation of A.

**(c)** A is true, but R is false.

**(d)** A is false, but R is true.

## Section B — Short answer — 8 × 2 = 16 marks

**9.** Expand $(3x + 2)^4$.

**10.** Find the coefficient of x in $(2x + 4)^6$.

**11.** Use the binomial theorem to evaluate $(103)^3$.

**12.** Find the term independent of x in $(x^2 + 3/x)^3$.

**13.** Find the middle terms of $(x - 4)^5$.

**14.** Simplify $(x + 1)^6 - (x - 1)^6$.

**15.** Find the 5th term of $(x - 3)^5$.

**16.** Find ${}^{19}C_0 + {}^{19}C_1 + \ldots + {}^{19}C_{19}$, and ${}^{19}C_1 + {}^{19}C_3 + {}^{19}C_5 + \ldots$.

## Section C — Word problems — 4 × 4 = 16 marks

**17.** Expand $(3x + 3)^5$ fully. What is the coefficient of $x^4$, and what is the sum of all the coefficients?

**18.** Find $(\sqrt{6} + \sqrt{7})^4 + (\sqrt{6} - \sqrt{7})^4$.

**19.** Using the binomial theorem, find the remainder when $5^{28}$ is divided by 6.

**20.** Using the first three terms of the binomial expansion, find an approximate value of $(1.01)^4$.

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# Answer key

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| Q | Answer | Working |
|---|---|---|
| 1 | **(d) 6** | — |
| 2 | **(c) 3,584** | term with $x^5$: $^8C_3 \times (4)^3$ |
| 3 | **(d) 6** | term 3: $^4C_2 \times (-1)^2$ |
| 4 | **(b) 32** | put x = 1: $(2)^5$ |
| 5 | **(c) n + 1** | — |
| 6 | **(d) $-945x^4$** | $T_{r+1} = {}^nC_r\, x^{7-r}\, a^r$ with r = 3 |
| 7 | **(c) 92,236,816** | $(100 - 2)^4$ |
| 8 | **(a) Both A and R are true, and R is the correct explanation of A.** | A is true: $^{14}C_4$ = 1,001; $^{14}C_{10}$ = 1,001. R is true and explains A. |
| 9 | **$81x^4 + 216x^3 + 216x^2 + 96x + 16$** | coefficients $^4C_0$, $^4C_1$, $^4C_2$, $^4C_3$, $^4C_4$ |
| 10 | **12,288** | $^6C_5 \times (2)^1 \times (4)^5$ |
| 11 | **1,092,727** | $(100 + 3)^3 = {}^3C_0 \times 100^3 \times (3)^0 + {}^3C_1 \times 100^2 \times (3)^1 + {}^3C_2 \times 100^1 \times (3)^2 +$ … |
| 12 | **27** | x^(2(3 − r) − r) = $x^0$ when r = 2 |
| 13 | **$160x^3$ and $-640x^2$** | n = 5 is odd: terms 3 and 4 |
| 14 | **$12x^5 + 40x^3 + 12x$** | terms with even powers of the second term cancel |
| 15 | **405x** | $T_5 = {}^5C_4\, x^1\, (-3)^4$ |
| 16 | **524,288; 262,144** | put x = 1 in $(1 + x)^{19}$; odd and even terms split the total equally |
| 17 | **$243x^5 + 1215x^4 + 2430x^3 + 2430x^2 + 1215x + 243$; coefficient of $x^4$: 1,215; sum 7,776** | $T_{r+1} = {}^nC_r\, (px)^{n-r}\, q^r$ |
| 18 | **674** | the odd terms cancel: $2(a^4 + 6a^2b^2 + b^4)$ with $a^2 = 6$, $b^2 = 7$ |
| 19 | **1** | $5^{28} = (6 - 1)^{28}$: every term except the last has a factor 6; the last is $(-1)^{28} = 1$ |
| 20 | **1.0406** | $(1 + 0.01)^4 \approx 1 + 4 \times 0.01 + 6 \times 0.0001$ |



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