



FORMULAS YOU MUST KNOW

$r(c-1) + c(r-1) = 2rc - r - c$ total adjacent pairs in an $r \times c$ grid.

$$\frac{\binom{n}{r} \binom{n-r}{r} \cdots}{k!} = \frac{n!}{(r!)^k}$$

$$n_1 \times n_2 \times \cdots \times n_k$$

$$n! = n(n-1) \cdots 2 \cdot 1$$

$$\frac{n!}{(n-r)!}$$

$$\frac{n!}{r!(n-r)!}$$

$$\binom{n}{r} + \binom{n}{r-1} = \binom{n+1}{r}$$

$$\frac{n!}{(r!)^k \cdot k!}$$

$$\binom{n}{r}$$

$${}^n P_r$$

$$n!$$

KEY METHODS

- Increasing order = combination. "Distinct digits in increasing order" — once you choose which digits to use, there is exactly one arrangement, so use $\binom{n}{k}$, not ${}^n P_k$. Example: 6-digit integers, distinct digits, increasing, from $\{1, \dots, 9\}$: $\binom{9}{6} = 84$.
- Symmetry for "anywhere after". "Jack finishes anywhere after Andrea" (not immediately after). By symmetry, exactly half of all $n!$ arrangements have Jack after Andrea: answer = $\frac{n!}{2} = \frac{8!}{2} = 20160$.

EXAM TRAPS TO AVOID

- The leading zero. For k -digit integers from $\{0, \dots, 9\}$, the first digit has only 9 choices (not 10 — zero would make it a $(k-1)$ -digit number). Handle position 1 separately, then continue.
- Same-row only vs all adjacent. In desk/seat arrangements, always check whether the constraint is same row (horizontal only) or any adjacent (horizontal + vertical). Read the question carefully.
- Common induction mistakes: not evaluating both LHS and RHS at base case numerically (loses R1); writing "let $n = k$ " instead of "assume true for $n = k$ " (loses M1); forgetting the conclusion sentence (loses final R1 — most common dropout); not stating $k \in \mathbb{Z}^+$ in the assumption.
- Paper 2 GDC traps: always write the setup expression before quoting GDC output: " ${}^{10}C_3 \times {}^7C_4 = 720 \times 35 = 25\,200$ ". The GDC gives a decimal for $n!$ when n is large — check it matches your algebraic expression. solve may give non-integer or negative roots — always verify $n \in \mathbb{Z}^+$ and check the domain.

