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TUTGATHER PRACTICE PAPER

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2027

MATHEMATICS Extended Part Module M2
PAPER

Question-Answer Book

Candidate Number

TUTGATHER
PRACTICE PAPER · NOT AN OFFICIAL HKEAA PAPER

1 hour 5 minutes

This paper must be answered in English

Topic practice: The Binomial Theorem

INSTRUCTIONS

(1) This paper consists of THREE sections, A(1), A(2) and B.

(2) Attempt ALL questions in this paper. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins.

(3) Unless otherwise specified, all working must be clearly shown.

(4) Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.

(5) The diagrams in this paper are not necessarily drawn to scale.

(6) Calculators and mathematical drawing instruments may be used.

(7) The marks for each question are shown in brackets.

(8) No extra time will be given after the 'Time is up' announcement.

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SECTION A(1) (16 marks)

1. Expand $(2 - 3x)^4$ in ascending powers of x, simplifying each coefficient. **(3 marks)**

2. Evaluate $\binom{11}{3} + \binom{11}{4}$ and express your answer in the form $\binom{n}{r}$ with n and r stated. **(3 marks)**

3. Find the constant term in the expansion of $(2x - \frac{1}{x})^6$. **(4 marks)**

Answers written in the margins will not be marked.
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4. (a) Expand $(1 + 2x)^5$ in ascending powers of x up to and including the term in x^3. **(6 marks)**

(b) Hence find the coefficient of x^3 in the expansion of $(1 + 2x)^5 (1 - x)^2$.

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SECTION A(2) (24 marks)

5. It is given that the coefficient of x^2 in the expansion of $(1 + ax)^n$ is 54 and the coefficient of x^3 is −108, where n is a positive integer and a is a non-zero constant. **(7 marks)**

(a) Show that $a = -\frac{2}{3}$ and find n.

(b) Hence find the coefficient of x in the expansion.

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6. (a) Using the binomial theorem, expand $(1 + x)^n$ and hence show that **(8 marks)**

$$\sum_{k=0}^{n} \binom{n}{k} = 2^n .$$

(b) By substituting a suitable value of x, find the value of

$$\binom{10}{0} - \binom{10}{1} + \binom{10}{2} - \cdots + \binom{10}{10}.$$

(c) Hence, or otherwise, find the value of

$$\binom{10}{0} + \binom{10}{2} + \binom{10}{4} + \cdots + \binom{10}{10}.$$

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7. (a) Write down the term in x^3 and the term in x^4 in the expansion of $(2 + \frac{x}{2})^n$, where $n \geq 4$ is a positive integer. **(9 marks)**

(b) It is given that the ratio of the coefficient of x^4 to the coefficient of x^3 is $\frac{3}{2}$. Find n.

(c) For this value of n, find the term independent of x in the expansion of $(2 + \frac{x}{2})^n (1 - \frac{2}{x})^3$.

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SECTION B (10 marks)

8. Let n be a positive integer. Define **(10 marks)**

$$S = \sum_{k=0}^{n} \binom{n}{k}, \qquad T = \sum_{k=0}^{n} k\binom{n}{k}, \qquad U = \sum_{k=0}^{n} k(k-1)\binom{n}{k}.$$

(a) By considering $(1 + x)^n$ and differentiating, or otherwise, show that $T = n\,2^{n-1}$.

(b) Show that $U = n(n-1)\,2^{n-2}$.

(c) Hence, or otherwise, evaluate $\sum_{k=0}^{n} k^2 \binom{n}{k}$ in terms of n, and find its value when $n = 8$.

END OF PAPER

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