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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: Introduction to Vectors

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. Let $a = 3i - 2j$ and $b = -i + 5j$. Find the vector $2a - 3b$ in the form $xi + yj$. **(3 marks)**

2. Given that $p = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$ and $q = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$, find the vector $3p - 2q$. **(3 marks)**

3. The position vectors of points A and B with respect to the origin O are $\vec{OA} = 2i + 3j$ and $\vec{OB} = 5i - j$. Find the position vector of the point M which is the midpoint of AB. **(4 marks)**

Answers written in the margins will not be marked.

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4. Let $u = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ and $v = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$. **(6 marks)**

(a) Find the magnitudes $|u|$ and $|v|$.

(b) Find the unit vector in the direction of $u + v$.

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SECTION A(2) (24 marks)

5. In triangle OAB, $\vec{OA} = a$ and $\vec{OB} = b$. The point C lies on OA such that $OC : CA = 2 : 1$. The point D lies on OB such that $OD : DB = 1 : 3$. The lines AD and BC intersect at P. **(7 marks)**

(a) Express $\vec{AD}$ and $\vec{BC}$ in terms of a and b.

(b) Given that $\vec{AP} = \lambda\vec{AD}$ and $\vec{BP} = \mu\vec{BC}$, find the values of λ and μ.

(c) Hence find the ratio $AP : PD$.

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6. The position vectors of points A, B and C relative to the origin O are $\vec{OA} = i + 2j$, $\vec{OB} = 4i - j$ and $\vec{OC} = 2i + 5j$. **(8 marks)**

(a) Find the position vector of the point D such that $ABCD$ is a parallelogram.

(b) Show that $ABCD$ is a rhombus.

(c) Find the position vector of the point E on AB such that $AE : EB = 2 : 1$.

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7. Let a and b be two non-zero vectors such that $|a| = 2$, $|b| = 3$ and the angle between a and b is 60°. **(9 marks)**

(a) Find $a \cdot b$.

(b) Find $|a + b|$.

(c) Find the angle between $a + b$ and $a - b$, giving your answer correct to 1 decimal place.

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SECTION B (10 marks)

8. In triangle OAB, $\vec{OA} = a$ and $\vec{OB} = b$. The point M is the midpoint of OA and the point N is the midpoint of OB. The lines AN and BM intersect at G. **(10 marks)**

(a) Express $\vec{AG}$ in terms of a and b, and show that $\vec{OG} = \frac{1}{3}(a + b)$.

(b) The line OG is produced to meet AB at P. Show that P is the midpoint of AB.

(c) Hence show that $OG : GP = 2 : 1$.

END OF PAPER

Answers written in the margins will not be marked.

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