MATHS AA SL

June Exam

PAPER I

Friday 13 June 2025

Duration : 90 min

7 questions

Total : / 50 marks

Calculator not allowed !

Nom/Name ______________

Problem 1 *(may 2025 !)* **[/7 marks]**

The sum of the first n terms of an arithmetic sequence is given by $S_n = pn^2 - qn$,

where p and q are positive constants.

It is given that $S_4 = 40$ and $S_5 = 65$.

(a) Find the value of p and the value of q. [5]

(b) Find the value of u_5. [2]

Problem 2 **[/5 marks]**

The general term of sequence is given by $u_n = \frac{25}{3}\left(-\frac{2}{5}\right)^n$

i) It that a *geometric* or *arithmetic* sequence ? [1]

ii) What is the exact expression of u_3 ? [2]

iii) For what value of n, we have $3u_n = 4$? [2]

Problem 3 *(may 2023)* **[/6 marks]**

(a) Show that the equation $\cos(2x) = \sin(x)$ can be written in the form $2\sin^2(x) + \sin(x) - 1 = 0$ [1]

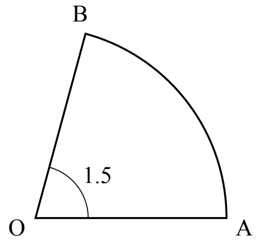
(b) Hence, solve $\cos(2x) = \sin(x)$, where $-\pi \leq x \leq \pi$. [5]

Problem 4 *(may 2025 !)* *[/5 marks]*

Points A and B lie on a circle with centre O and radius r cm, where $A\hat{O}B = 1.5$ radians.

This is shown on the following diagram.

diagram not to scale



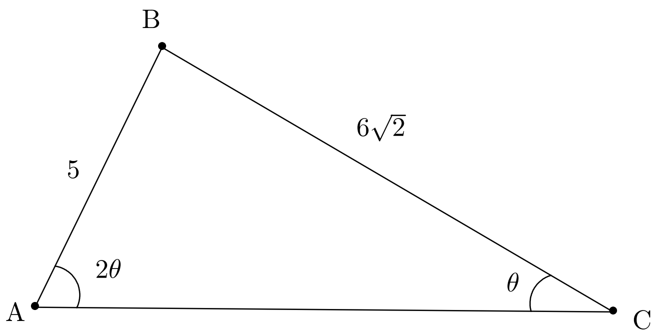
The area of sector OAB is $48\,\text{cm}^2$.

(a) Find the value of r. [3]

(b) Hence, find the perimeter of sector OAB. [2]

Problem 5 *(may 2025 !)* *[/7 marks]*

The following diagram shows a non-right angled triangle ABC



$AB = 5$, $BC = 6\sqrt{2}$ $\quad \widehat{ACB} = \theta$ and $\widehat{BAB} = 2\theta$ where $0 < \theta < \frac{\pi}{2}$.

(a) Using the sine rule, show that $\cos\theta = \frac{3\sqrt{2}}{5}$. [3]

(b) Hence, find $\sin\theta$. [2]

Point D is loacted on [AC] such that the areau of triangle BCD is $6\sqrt{14}$.

(b) Find DC. [2]

Problem 6 *[/7 marks]*

(a) Show that the equation $\sin^2 x = \frac{4-5\cos x}{2}$ may be written in the form [2]

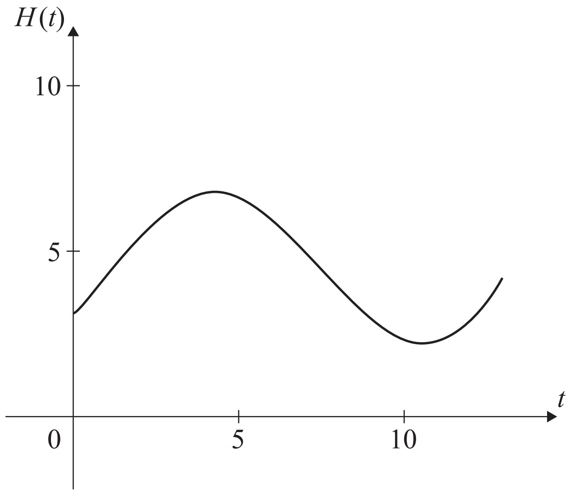
$2\cos^2 x - 5\cos x + 2 = 0$.

(b) Hence, solve the equation $\sin^2 x = \frac{4-5\cos x}{2}$ $\quad 0 \le x \le 2\pi$. [5]

Problem 7 *[/13 marks]*

The height of water, in metres, in Dungeness harbour is modelled by the function $H(t) = a\sin\big(b(t-c)\big) + d$, where t is the number of hours after midnight, and a, b, c and d are constants, where $a > 0$, $b > 0$ and $c > 0$.

The following graph shows the height of the water for 13 hours, starting at midnight.



The first high tide occurs at 04:30 and the next high tide occurs 12 hours later. Throughout the day, the height of the water fluctuates between $2.2\,\text{m}$ and $6.8\,\text{m}$.

All heights are given correct to one decimal place.

(a) Show that $b = \frac{\pi}{6}$. [1]

(b) Find the value of a. [2]

(c) Find the value of d. [2]

(d) Find the smallest possible value of c. [3]

(e) Find the height of the water at 12:00. [2]

(f) Determine the number of hours, over a 24-hour period, for which the tide is higher than 5 metres. [3]