

ROUND ONE

1. Find the slope of the line which is perpendicular to the line through $(-2, 1)$ and $(3, 5)$.

Give your answer as a fraction in its simplest form

2. $\int (3x - 2)dx =$

ROUND TWO

1. Given that $f(x) = 3x - x^2$, express $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ in the form $a + bx$, where $a, b \in \mathbf{Z}$.

2. Find the equation of the tangent to the circle $x^2 + y^2 = 13$ at the point $(-2, 3)$.

Answer in the form $ax + by + c = 0$, where $a, b, c \in \mathbf{Z}$.

ROUND THREE

1. In how many ways can 5 students be seated in a row if 2 particular students never sit together? Answer as a single whole number.

2. C is an angle in the fourth quadrant such that $\cos C = \frac{5}{13}$.

Express $\tan C$ in the form $\frac{a}{b}$, where $a, b \in \mathbf{Z}$.

ROUND FOUR

1. Solve for x , given that the logarithms are real numbers,

$$\log_3(x+4) + \log_3(6-x) = 2.$$

2. Express $\frac{1}{x+1} + \frac{3}{x-1} + \frac{2x}{1-x^2}$ in the form $\frac{a}{x+b}$, where $a, b \in \mathbf{Z}$.

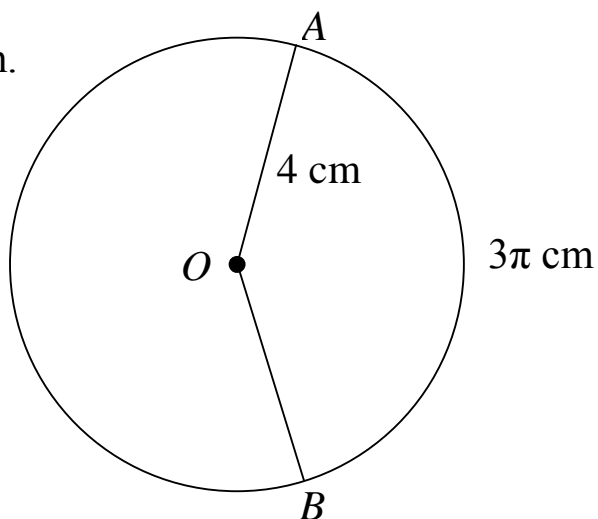
ROUND FIVE

1. What is the probability that two cards randomly selected from a standard pack of 52 cards are neither of the same value nor of the same suit?
2. Write $6\sin 8x\cos 8x$ in the form $a\sin bx$, where $a, b \in \mathbb{N}$.

ROUND SIX

1. The circle has a radius of 4 cm.
The length of the arc AB is 3π cm.

Find the measure of the angle AOB in radians.



2. Express $\sum_{k=3}^5 \log k$ in the form $\log n$, where $n \in \mathbb{N}$.

ROUND SEVEN

1. Express $\frac{(n-2)!}{(n-1)!}$ in its simplest form.
2. Let $z = 2 + i$ and $w = 1 - i$. Express $z\bar{w}$ in the form $x + yi$.
3. Find the equation of the tangent to the curve $y = \cos 2x$ at the point whose x -coordinate is $\frac{\pi}{6}$.
4. Let α and β be the roots of $x^2 - 3x + 1 = 0$. Find the value of $\alpha + \frac{1}{\alpha}$.

ROUND EIGHT

1. The line $y - 2 = 0$ is a tangent to the circle with equation $x^2 + y^2 + 8x - 2y + k = 0$. Find the value of k .
2. $A = \begin{pmatrix} 2 & 0 \\ 1 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 0 & 1 \\ 1 & 4 \end{pmatrix}$. Evaluate $(BA)^{-1}$.
3. Given that $y = \log_e(\cos x)$, evaluate $\frac{dy}{dx}$ at $x = \frac{\pi}{4}$.
4. Find the values of k for which $y = 2x + 1$ does **not** intersect $y = 2x^2 + kx + 9$.