1. Find the sum of all solutions of the equation $4^{2x-1}-4^{x+\frac{2}{3}}-4^{x-\frac{5}{3}}+1=0$. **(2.5 Marks)**

2. Find the sum of all solutions to the equation $\cos x-\cos 2x=0$ on the interval $\left[0^\circ,360^\circ\right]$, where $x$ is measured in degrees. **(2.5 Marks)**

3. Determine the value of $\log_b\left(\frac{\sqrt{a+b}}{b}-\frac{1}{\sqrt{a}+\sqrt{a+b}}\right)$, where $\log_b a=5$.

**(2.5 Marks)**

4. Find $\sum_{n=1}^{20}\left(\frac{1+i}{\sqrt{2}}\right)^{4n}$. **(2.5 Marks)**



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5. Evaluate $\sin^{-1}\left(\cos\frac{23\pi}{6}\right)$. Answer in degrees. **(2.5 Marks)**

6. Given that $f(0)=\frac{1}{2}$ and $f(k)=\frac{f(k-1)}{1+f(k-1)}$, for all $k\geq 1$. Find the value of $9\sqrt{f(2023)}$. **(2.5 Marks)**

7. Find the coefficient of $\frac{Y^4}{X^{16}}$ from the distribution of $\left(\frac{Y}{X^2}-\frac{1}{Y^2}\right)^{10}$. **(2.5 Marks)**

8. Let $A$ be the solution set of the inequality $\left|x^2-2x-1\right|<x-1$, and let $B$ be the solution set of the inequality $\frac{24}{x^2}-\frac{10}{x}+1>0$. If $A\cap B$ is the interval $(a,b)$, find the value of $a+b$. **(4.5 Marks)**


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9. Given that $y=10^{\log_5(x+1)}$ and $x>0$, find the value of $\left|x^2+2x-5^{\log y^2}\right|$. **(4.5 Marks)**

10. Find the value of $\ln(\cot 1°)+\ln(\cot 2°)+\ln(\cot 3°)+\ldots+\ln(\cot 88°)+\ln(\cot 89°)$.

**(4.5 Marks)**

11. Define the matrix $M=\begin{bmatrix}-7A+2B & 7A\\ 3 & B\end{bmatrix}$, where $A$ is the sum of the solutions to the following system of equations:

$$\begin{aligned}x+2y+z&=0\\2x+y-3z&=4\\3x-3y+2z&=2\end{aligned}$$

Determine the sum of all values of $B$ such that $M$ is a singular matrix.

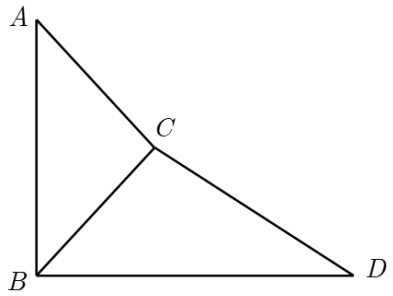
**(4.5 Marks)**

12. Let $z$ be a complex number such that $z^2=5+12i$. Find the value of $\left|z^2\right|$.

**(4.5 Marks)**


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13. In the diagram, angle $ABD$ is a right angle and angle $ACB = 106^\circ$. If $AB = 20$ cm, $BD = 18$ cm and $BC = 12.5$ cm, then find the area of the quadrilateral $ABDC$. (Given that $\cos 53^\circ = 0.60$ and $\cos 16^\circ = 0.96$.) **(4.5 Marks)**




14. There are $4$ coins, each different color. Pick coins $3$ times by putting each one back after picking. Find the number of ways to pick coins such that no more than $2$ coins of the same color are picked. **(4.5 Marks)**

15. In the O-net exam for $6$ th-grade students, the test scores of male and female students are normally distributed with the same mean, but the standard deviation of male students is $10$ points higher than that of female students. If in this exam, both Poonpan and Yayi are in the $97$ th percentile, how many more points did Poonpan score than Yayi? (Given $Z = 1.88, A = 0.47$.)
**(4.5 Marks)**


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16. A box is formed by cutting out square corners from a rectangular sheet of cardboard of size $m \times n$ square inches and folding up the sides. If squares with side length $2$ inches are cut from each corner, the resulting box has a volume of $832$ cubic inches. If squares with side length $3$ inches are cut from each corner, the resulting box has a volume of $1,008$ cubic inches. What is the length of the diagonal of the rectangular of paper? (Given that $\sqrt{5} \approx 2.24$, $\sqrt{7} \approx 2.65$ and $\sqrt{13} \approx 3.61$.) **(6 Marks)**

17. Jason deposits $\$300$ on the $1$st of each month in the bank at a monthly interest rate of $2\%$, compounded per month. He plans to withdraw all money from his account after a year. The amount of interest received can be calculated using the formula $A\left(\frac{B^C - 1}{D}\right)$, where $A, B, C, D$ are real numbers. Find the value of $A\left(B + D\right) + C$. **(6 Marks)**


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18. Nami stands on a lighthouse, which is on top of a $300$-meter-high cliff above sea level. Two boats are observed. The first boat is located to the west, and the second boat is located to the southeast. Both boats are observed with angles of depression of $30^\circ$ and $45^\circ$, respectively. What is the distance between these ships? (Given that $\sqrt{2} \approx 1.4$, $\sqrt{3} \approx 1.7$, $\sqrt{6.38} \approx 2.53$ and $\sqrt{6.48} \approx 2.55$.) **(6 Marks)**

19. A boy is playing dice. If he rolls a number greater than $4$ two times consecutively, he will win. He stops playing once he wins. If the probability that he wins more than $3$ rolls is $\frac{A}{B}$, where $\gcd(A,B)=1$, find the value of $A+B$. **(6 Marks)**

20. The mean and standard deviation of the mathematics exam scores of $72$ students are $24.5$ points and $8.6$ points, respectively. If the scores of $30$ more students are added, whose arithmetic mean of the same mathematics exam is $25$ points and the total variance of all the students is $115$, find the variance of the scores of the additional $30$ students. **(6 Marks)**


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21. Let $a, \frac{1}{2}, -1, 2, -4, b$ be a geometric sequence. Find the value of

$(a+b)+(2a+b)+(a+2b)+(3a+b)+(a+3b)+\ldots+(7a+b)+(a+7b)$. **(2.5 Marks)**

22. Given that $A^t = \begin{pmatrix} a_n & a_{n+2} \\ a_{n+1} & a_{n+3} \end{pmatrix}$ where $a_n$ is an arithmetic sequence with a common difference of 2. Determine the value of $\det(2A^2)$. **(4.5 Marks)**

23. Given $y = \frac{\sin 4\theta}{2\cos\theta\cos 2\theta}$, where $0 \le \theta \le 4\pi$. How many solutions $(\theta)$ are there if $y$ is an integer? **(2.5 Marks)**


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24. A set of data is ordered as follows.

$$x \ 29 \ 32 \ 38 \ 42 \ 50 \ y \ 53 \ 60$$

If the values of $P_{15}$ and $D_7$ of this data set equal to $24.5$ and $52$, respectively. Find the average of this data set. **(2.5 Marks)**

25. There are three mailboxes, each of a different color. Find the total number of different ways in which $8$ identical letters can be placed in these three mailboxes, provided that each box contains at least one letter. **(4.5 Marks)**


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# GRADE 11 ANSWER KEY

| No. | Answer | No. | Answer |
|---|---|---|---|
| 1 | 1 | 14 | 60 |
| 2 | 720 | 15 | 18.8 |
| 3 | 1.5 | 16 | 36.1 |
| 4 | 0 | 17 | 330.24 |
| 5 | 60 | 18 | 759 |
| 6 | 0.2 | 19 | 49 |
| 7 | 45 | 20 | 9.5 |
| 8 | 5 | 21 | 263.5 |
| 9 | 1 | 22 | **256 |
| 10 | 0 | 23 | 17 |
| 11 | 0.5 | 24 | 41.78 |
| 12 | 13 | 25 | 21 |
| 13 | 165 | | |

** Note: Question 22 had a printing error. All examinees will receive full marks for this question as decided by the exam committee.


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