1. Let $x \in \mathbb{R}$ satisfies the equation $5-\sqrt{2x}=\sqrt{31-10\sqrt{6}}$. Find the value of x.

(2.5 Marks)

2. Let $A=\begin{bmatrix} a & 1 & 2 \\ 1 & a & 2 \\ 1 & 2 & a \end{bmatrix}$. Find the sum of all real values of a for which the matrix A is singular.

(2.5 Marks)

3. Let f be a function such that $D_f \in \mathbb{R}$, $f(1)=3$ and $f(x-y)=f(x)-(x+y^2)f(y)$ for all integers x and y. Find the value of $f(21)$.

(2.5 Marks)

4. Find the sum of the solutions of the equation $2^{2x^2-4x+2}=3^{4x+9}$, where $\frac{\ln 3}{\ln 2}=1.58$.

(2.5 Marks)

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5. Let $f(x)$ be a differentiable function such that $xf(\sqrt{x}+1)=27$ for all $x>0$.
Find the value of $f'(4)-f'(2)$. **(2.5 Marks)**

6. Let $S=\sum_{n=0}^{2025}\sin(\frac{2^n\pi}{3})$ find S^2. **(2.5 Marks)**

7. A box contains 8 balls, each labeled with a number from 1 to 8. Two balls are randomly drawn from the box. Let $\frac{A}{B}$ be the probability that the sum of two balls is divisible by 5, where $\gcd(A,B)=1$. Find the value of $B-A$. **(2.5 Marks)**

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8. Find the value of $\sum_{n=1}^{2022} \frac{3}{n(n+3)} + \sum_{n=2022}^{2024} \frac{1}{n+1}$. **(4.5 Marks)**

9. Find the sum of all solutions to the equation $\log_{\sqrt{2}\cos 2x}(1+\sin 2x) = 2$ on the interval $\left[0, 360^\circ\right]$, where x is measured in degrees. **(4.5 Marks)**

10. Find $\sum_{n=0}^{9} \left(-\frac{1}{2} + \frac{\sqrt{3}}{2} i \right)^n$. **(4.5 Marks)**

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11. Given that $f(5)=0$ and $\lim_{h\to 0}\frac{f(5+h)}{h}=10$. If $g(x)=\left(x^2-x\right)f(x)$, find the value of $g'(5)$. **(4.5 Marks)**

12. Let $f(x)=x^3-9x^2+24x-10$ be a decreasing function on the interval (a,b). Determine the value of $\int_a^b f(x)dx$. **(4.5 Marks)**

13. Find the sum of all solutions in degree units of the equation $\cos 3\theta+2=2\sin^2 3\theta$, where $0\le\theta\le 180^\circ$. **(4.5 Marks)**

14. In solving 10 out of a total of 15 exercises, if no more than 4 odd-numbered exercises are to be selected, how many ways are there to choose the exercises? **(4.5 Marks)**

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15. If two coins are tossed five times, then the probability of getting both heads at least once is $\frac{A}{B}$ when the GCD $(A,B)=1$. Find $B-A$. **(4.5 Marks)**

16. Bambam deposits some money in the bank at a monthly interest rate of 10%, compounded per month. He would like to withdraw $\$146.41$ each month for 4 months. What is the minimum amount, as an integer, that he deposits initially? **(6 Marks)**

17. A theater has 14 rows of seats: 16 seats in the first row, 18 seats in the second row, 20 seats in the third row, and so on. If the first three rows of seats cost $\$3$ each and the remaining rows cost $\$2.2$ each, how much does the theater earn if 90% of the seats in each row are sold? **(6 Marks)**

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18. Let the path of a basketball shot follow a parabolic trajectory. A player, who is 1.8 meters tall, shoots the ball toward a hoop that is 5 meters away and 3 meters above the ground. Suppose that the ball is moving at a distance of 1 meter in front of the player and 3 meters above the ground. How many meters above the ground will it be when the ball floats at its maximum point?

(6 Marks)

19. Long jump athletes can only jump distances of 1 meter, 2 meters, and 3 meters. Suppose the athlete wants to jump a distance of 7 meters with no limit on the number of jumps. Find the probability that this athlete will jump no more than 4 times.

(6 Marks)

20. In the winter weather forecast of Japan, it is found that

- If it snows on one day, the probability of snowing the next day is $\frac{1}{2}$.
- If it doesn't snow that day, the probability of it snowing the next day is $\frac{3}{4}$.

If it snows on Monday this week, find the probability that it will snow on Wednesday and Thursday.

(6 Marks)

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21. Evaluate $\dfrac{1}{1+\dfrac{2^{2028}}{(1+i)^{4056}}}$. **(2.5 Marks)**

22. Find the value of x that satisfies the equation

$\log_5 x+\log_{5^3} x+\log_{5^9} x+\log_{5^{27}} x+\ldots=3$. **(4.5 Marks)**

23. Given that $\vec{u}=2\vec{i}-\vec{j}+5\vec{k}$, $\vec{v}=a\vec{i}-2\vec{j}+2\vec{k}$ and $\vec{w}=b\vec{i}+c\vec{j}-4\vec{k}$. Suppose that $\vec{u}$ is perpendicular to $\vec{v}$ and $(\vec{u}+\vec{v})\times\vec{w}=19\vec{i}+19\vec{j}+19\vec{k}$. Find the value of $|7bc-10a|$.

(2.5 Marks)

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24. In the sports competition between two siblings, Vasu and Vasin, the probability that Vasu loses the basketball game is 0.3. The probability that Vasin wins in swimming or Vasu wins in basketball is 0.9. Find the probability that Vasin wins in swimming after Vasu wins in basketball. **(2.5 Marks)**

25. From a total of 24 boxes, two boxes are randomly selected.
There are 6 colors of dolls, with 4 dolls of each color.
Each colored doll has 4 different scents: orange, lemon, strawberry, and grape.
Find the probability that the two selected boxes contain dolls of different colors but the same scent. **(4.5 Marks)**

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GRADE 12 ANSWER KEY

No.	Answer	No.	Answer
1	3	14	546
2	0	15	243
3	753	16	465
4	5.16	17	842.76
5	52	18	3.96
6	0.75	19	0.5
7	11	20	0.31
8	1.83	21	0.5
9	15	22	25
10	1	23	25
11	200	24	0.67
12	16	25	0.22
13	550		

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