2021 BOMB – Page 1

School_____ Team_____

Instructions: Label answers with appropriate units
Do not round or approximate answers
Write fully simplified answers on the lines provided

1. A perfect number is a positive integer that is the sum of its positive divisors, excluding itself. Find the product of the first two perfect numbers.

Team member name:_____ Answer:_____

2. A car travels to Sacramento at 60 miles per hour and returns at 70 miles per hour. What was the average speed for the entire trip?

Team member name:_____ Answer:_____

3. A circle of diameter 4 inches has a regular hexagon circumscribed around it. What is the area of the hexagon?

Team member name:_____ Answer:_____

4. A fair eight-sided dice is rolled twice. What is the probability that the sum of the rolls is under 8?

Team member name:_____ Answer:_____

5. Find the area between the two curves $f(x) = \cos^2(x)$ and $g(x) = \sin^2(x) - 2$ on $[0, \pi]$.

Team member name:_____ Answer:_____

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6. Find the point(s) on the ellipse $4x^2 + 9y^2 = 1$ furthest from the point $(0,4)$.

Team member name:_____ Answer:_____

7. If $5x - 4y = 11$, what is the value of $\frac{32^x}{4^{2y}}$?

Team member name:_____ Answer:_____

8. A card is randomly drawn from a standard deck of 52 cards. Given that the card drawn is either red or a spade, what is the probability that the card drawn is black or an even number?

Team member name:_____ Answer:_____

9. Bob is 10 meters west of Sally. If Bob moves south at 1.5 meters/second, and Sally moves north at 2 meters/second, find the direct distance between them after 10 seconds. (Assume they are on level ground.)

Team member name:_____ Answer:_____

10. It takes Mark 5 hours to complete a task. It takes Eunice 4 hours to complete the same task. How long would it take them to complete the task together, assuming their rates stack completely?

Team member name:_____ Answer:_____

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11. Suppose it is known that 40% of a certain kind of transistors are defective. If 5 of these transistors are grabbed at random, find the probability that exactly 2 of them are defective.

Team member name:_____ Answer:_____

12. A Norman window is constructed from a rectangular pane of glass surmounted by a semicircle. (That means the semicircle sits flush on top of the rectangle.) If the total outside perimeter of the window is $100 + 20\pi$ cm, what radius chosen for the semicircle would maximize the area of the window?

Team member name:_____ Answer:_____

13. A ship leaves port and heads due east for 80 miles. It then changes heading to 60 degrees north of east for 60 miles. How far is the ship now from port?

Team member name:_____ Answer:_____

14. Solve for x: $\log_{12}(\log_6(\log_4 x)) = 0$.

Team member name:_____ Answer:_____

15. I have \$1.78 consisting of dimes, nickels, and pennies. There are 38 total coins. The number of nickels is one more than twice the number of dimes. How many pennies do I have?

Team member name:_____ Answer:_____

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16. Find the value of $1+\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2+\cdots}}}$

Team member name:_____ Answer:_____

17. A triangle has side lengths of 5, 9, and 12 centimeters. What is the area of the triangle?

Team member name:_____ Answer:_____

18. A circle with a radius of 3 inches can be transformed into a cone by removing a circle sector and then joining the radii of what remains of the circle. What angle θ should be removed to maximize the volume of the cone?

Team member name:_____ Answer:_____

19. A grain silo is to be constructed from a right cylinder and a hemisphere placed on top, both with a radius of 5 meters. What is the total volume of this structure if the total height is 20 meters?

Team member name:_____ Answer:_____

20. Solve for x: $\log_4 x + \log_{16} x + \log_{32} x = \frac{57}{40}$.

Team member name:_____ Answer:_____

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21. If $f(x) = \frac{5}{x+2}$ find the difference quotient $\frac{f(a+h)-f(a)}{h}$,

Team member name:_____ Answer:_____

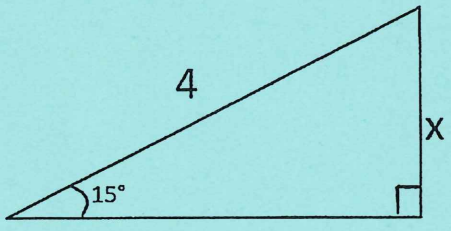
22. Find the distance between the vertex of $y^2 - x - 2 = 0$ and the center of $x^2 + y^2 + 14x + 24y + 157 = 0$,

Team member name:_____ Answer:_____

23. The half-life of Fractonium is 10 days. If you start with 32 grams of Fractonium, how many days will it take to decay to only $\frac{1}{128}$ grams?

Team member name:_____ Answer:_____

24. Find the value of x in the picture below. Simplify your answer.



Team member name:_____ Answer:_____

25. Find $\lim_{x \to 0^+} \left(\frac{1}{2} x^{\sin(x)}\right)$.

Team member name:_____ Answer:_____