

Write your answer in the box provided. Answers must be exact. Thus, if the answer is $1/3$, 0.33 will not be marked correct. You may not use a calculator. You may use scratch paper.

1. Suppose the sum of two numbers is 10 and the product is 16. What is the larger number?

8

2. Suppose that three consecutive whole numbers sum to 99. What is the first number?

32

3. If three cats can dig five holes in two days, how many days will it take four cats to dig thirty holes?

9 days

4. Last Saturday, Kathy the potter had 10 pots and today (Saturday) she has 31 pots. If she keeps making pots at the same rate, on what day of the week will she first have 64 pots?

Wednesday

5. We have a cube where each edge is of length 5 units. From each corner of this cube, we remove a cube with edge length two units. Find the volume of the remaining solid.

61 cubic units

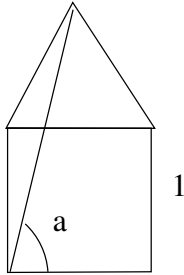
6. Today is Saturday. What day of the week will it be in 2011 days?

Monday

¹CATS stands for CATS¹ Are Top Solvers

7. A line passes through the points $A = (1, 1)$ and $B = (50, 78)$. How many points on the line have integer coordinates and lie between A and B ?

8. A triangle with each side of length 1 is placed on top of a square with each side of length 1. Find the degree measure of the angle marked a .



9. Simplify

$$\left(x + \frac{2}{x}\right)^2 - \left(x - \frac{2}{x}\right)^2.$$

10. The roots of the equation $x^2 + bx + c = 0$ are 5 and -3 . Find b .

11. Find the sum

$$21 + 23 + 25 + \dots + 199.$$

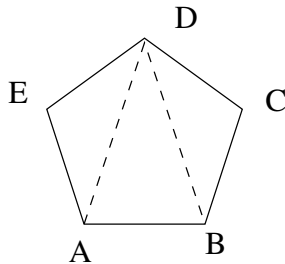
12. Express $0.1\bar{5} = 0.155555555555\dots$ as a fraction in lowest terms.

13. A rectangle has area 10 square units and perimeter 14 units. What is the length of the shortest side?

14. In a polygon, a diagonal is a line joining two non-adjacent vertices. Thus a square has two diagonals. How many diagonals does a regular pentagon have?

15. A decagon is a polygon with ten sides. How many diagonals does a regular decagon have?

16. The polygon $ABCDE$ is a regular pentagon. Find the measure in degrees of angle ADB .



17. Find the smallest prime factor of 123,456,789.

18. Find the smallest prime factor of 2011.

19. How many two digit numbers are even?

20. We say that the digits of a number are increasing if each digit is larger than the digit to the left. For example, the digits of 248 are increasing, but the digits of 228 are not increasing since the tens digit is not larger than the hundreds digit.

How many three digit numbers are even and have the digits increasing?

34

21. The arithmetic mean of x , y and z is 20 and the arithmetic mean of x , $2y$ and z is 24. What is y ?

12

22. What is the area of a regular octagon if each side is of length 1?

$2 + 2\sqrt{2}$

23. All angles in a triangle are acute and two sides of the triangle are 4 and 5. If the square of the area of the triangle is 96, find the length of the third side.

$\sqrt{33}$

24. Find the smallest positive integer n for which $n!$ is divisible by 3^{100} .

207

25. Factor $x^4 - x^2 + 1$ as a product of quadratic polynomials with real coefficients.

$$(x^2 - \sqrt{3}x + 1)(x^2 + \sqrt{3}x + 1)$$