Name: _____

School: _____

# Calculator Exam – UH Math Contest 2018 – Version B

**Directions:** Write your name and school name on every sheet, and write your answers on the answer sheet. **DO NOT detach the answer sheet from your exam.** Answers can be given as integers, fractions or in decimal form. Answers given in decimal form should include no more than 4 places after the decimal, and the answer should be **accurate to 4 places *after* the decimal**.

**DO NOT ROUND YOUR ANSWERS!!**

**Example 1:** You work on a problem, and your calculator gives the value 0.9092974268.
**Correct Answer:** 0.9092
**Incorrect Answer:** 0.9093 **DO NOT ROUND.**

**Example 2:** You determine that the answer to a question is 1/2.
**Correct Answer:** 1/2
**Correct Answer:** 0.5

**Example 3:** You determine that the answer to a question is 10/11, and your calculator tells you this has a decimal expansion 0.90909090…
**Correct Answer:** 10/11
**Correct Answer:** 0.9090
**Incorrect Answer:** 0.9091 **DO NOT ROUND.**

**Good Luck!!**

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1. Give the number of minutes in the year 2016.

2. Give the circumference of a circle with diameter 3.

3. Simplify
$$\frac{\left(4^{-6.1}+6.43\sqrt{3.21+\frac{2}{13}}\right)^{4.13}}{22.73-\frac{11.46}{5}}$$

4. Give the value of $x$ where the function $f(x)=x^4-5x^3+2x-1$ has its smallest value.

5. Give the distance between the points $(-2,4)$ and $(13,15)$.

6. Give the sum of the two largest $x$ coordinates for the points of intersection of the line $y=-x$ and the graph of $f(x)=x^4-6x^3+4x-1$.

7. Find 10% of 30% of 40% of 50% of … of 190% of 1,731.

8. $\begin{pmatrix}13x-19y=67\\43x+71y=21\end{pmatrix}$. Give the value of $x+y$.

9. Give the slope of a line that is perpendicular to the line that passes through the points $(241.23,-337.22)$ and $(311.47,-743.36)$.

10. $g(x)=\frac{1}{3x+2}$. Give the average of the numbers in the set
$$\{g(1),g(2),g(3),\dots,g(100)\}$$

11. $f(x)=4x-x^2$ and $x_0=1.1$. Also, $x_1=f(x_0)$, $x_2=f(x_1)$, $x_3=f(x_2)$, … , $x_{100}=f(x_{99})$. Give the value of $x_{100}$.

Name: _____

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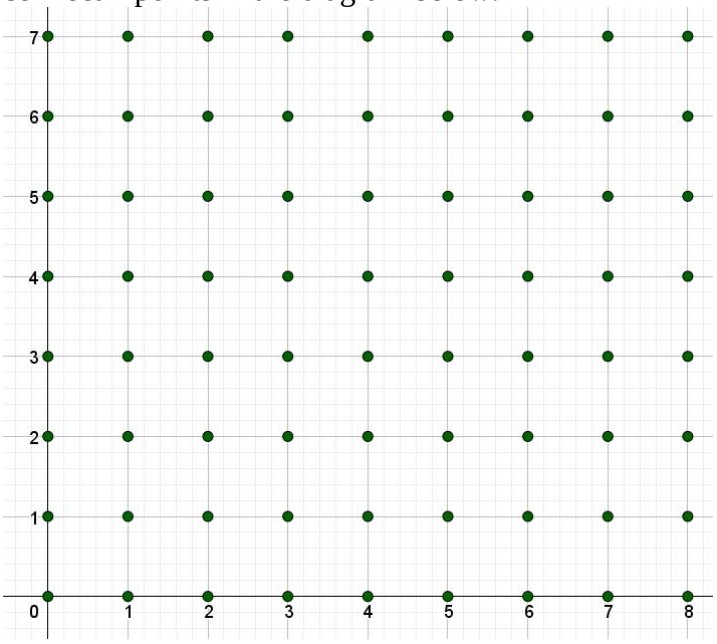
12. Give the sum of the reciprocals of the solutions to
$$x^4 + 105x^3 - 972x^2 - 901x + 21 = 0$$

13. Write the base 7 representation of the base 10 number 53,452.

14. If $p > 3$ is a prime number, then $F_p = \{0,1,2, \dots, p-1\}$. It is known that 937 is a prime number. There is a unique number $x \in F_{937}$ so that $23x = 1 \bmod 937$. Give the value of $x$.

15. The set $F_p$ was defined in the previous problem. There are unique values $x, y \in F_{47}$ so that $\begin{pmatrix} 3x + 11y = 23 \bmod 47 \\ -29x + 36y = 11 \bmod 47 \end{pmatrix}$. Give the value of $x$.

16. Give the sum of the lengths of all of the line segments with slope 1 or $-1$ that connect 2 points in the diagram below.




17. Give the slope of the line of best fit (least squares method) for the data $(-1,-3)$, (2,1), (4,5) and (7,11).

18. Give the sum of the numbers in the set $\{1,2,3, \dots, 859\}$ that are not integer multiples of 2, 5 or 11.

Name: _____

School: _____

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19. Two circles of radius 3 are centered at $(0,0)$ and $(3,0)$ respectively. What is the area of the region that lies inside the circle centered at $(0,0)$ and outside the circle centered at $(3,0)$?

20. A point $(a, b)$ is an integer point if both $a$ and $b$ are integers. Give the number of integer points that lie strictly inside the ellipse $x^2 + \frac{101,761}{47,089} y^2 = 101,761$.

21. Give the smallest integer $n$ so that

$$1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n} > 8.4$$

22. A curve is parameterized by $x(t) = 3t^2 - 9$ and $y(t) = 3t - t^3$ for $-2 \leq t \leq 2$. There are three values of $b$ so that the line $y = x + b$ intersects the graph of this parameterized curve in two points, with one of the points having $y$-coordinate 1. Give the value of $b$ so that the distance between these 2 points is as large as possible.

23. $m < 2$, and the lines $y = 2x - 1$, $y = 3x + 2$ and $y = mx + 1$ are used to form a triangle with area $7.2571$. Give the value of $m$.

24. Four integers are chosen at random from the set {1, 2, 3, …, 23}. The values do not have to be distinct. What is the probability that the sum of the chosen values is strictly greater than 59?

25. Give the average of the answers to problems 1 through 24.