Math Superbowl
Level 5 Huddle: Secondary Math III - 2018

Directions:

1. Select the most correct answer for each question and mark it on your answer form
2. No calculators of any sort are allowed
3. Note that N.O.T. means "None of these"

1. Solve for x: $e^{3x-1} = 18$

a) $x = \frac{\ln(19)}{3}$ b) $x = \frac{1+\ln(18)}{3}$ c) $x = 1 + \ln(6)$ d) $x = \frac{3}{1-\ln(18)}$ e) N.O.T.

2. Which one of the following equations is a hyperbola?

a) $x + 3y^2 = 7$ b) $2x^2 = -3y^2 + 5$

c) $x - 3y = 5$ d) $x^2 = -y^2 + \pi$ e) N.O.T.

3. Find the solution set for the inequality $-2x^2 + 7x - 6 > 0$

a) $\left(-\infty, -\frac{3}{2}\right) \cup (2, \infty)$ b) $\left(\frac{3}{2}, 2\right)$

c) $\left(-\infty, -\frac{3}{2}\right] \cup (2, \infty)$ d) $\left[\frac{3}{2}, 2\right]$ e) N.O.T.

4. Which one of the following trig functions has period 5 and amplitude π?

a) $f(x) = \pi \sin\left(\frac{2\pi x}{5}\right) + 2$ b) $f(x) = 2 \sin\left(\frac{5x}{2\pi}\right) + \pi$

c) $f(x) = \pi \sin\left(\frac{5x}{2\pi}\right) + 2$ d) $f(x) = 2 \sin\left(\frac{2\pi x}{5}\right) + \pi$ e) N.O.T.

5. The expression $\ln\left(\frac{ab}{c^3}\right)$ is equivalent to which of the following?

a) $-3\ln(c) + \ln(a) + \ln(b)$ b) $\ln(a) - \ln(b) + \ln(c^3)$

c) $\ln(a) + \ln(b) + 3\ln(c)$ d) $\ln(a) + \ln(b) - c\ln 3$ e) N.O.T.

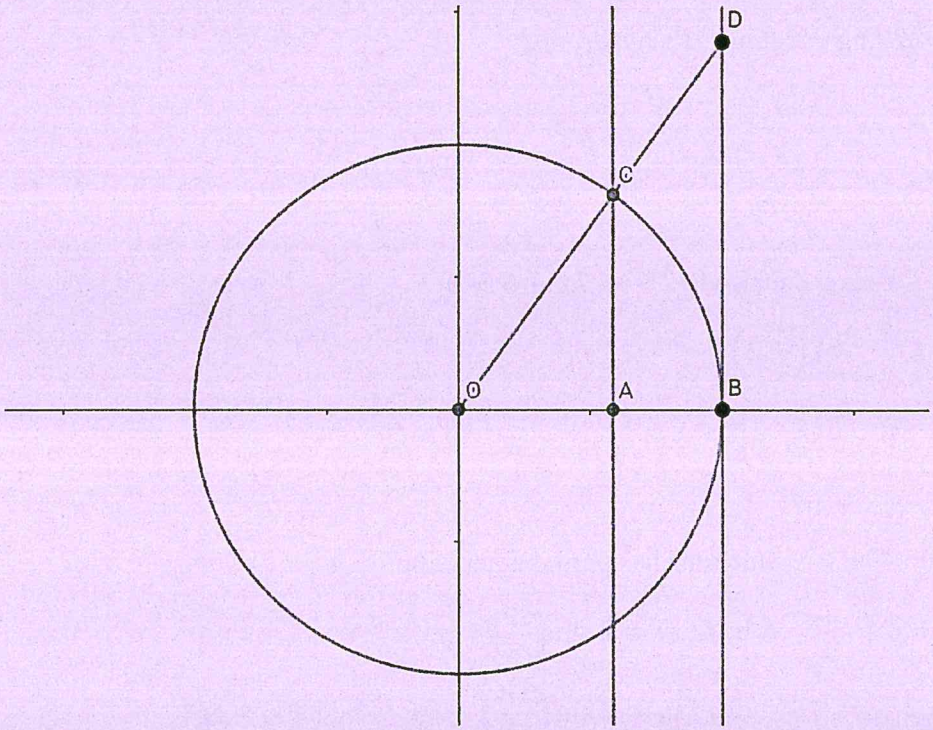
6. In the binomial expansion of $(2x-1)^7$, what is the 2^{nd} degree term?

a) $28x^2$ b) $-28x^2$ c) $-84x^2$ d) $84x^2$ e) N.O.T.

7. Fractonium has a half-life of 50 days. If there are 200 kg of Fractonium to start with, how much remains in 225 days?

a) $200e^{4\ln(0.5)}$ b) $200\left(\frac{1}{2}\right)^{225}$ c) $200e^{4.5}$ d) $200(0.5)^4$ e) N.O.T.

8. The diagram below shows the unit circle with radius OC. The line segments $\overline{AC}$ and $\overline{BD}$ are perpendicular to the horizontal axis.



If $\theta = \angle AOC$ which of the following line segments is equivalent to $\sin(\theta)$?

a) $\overline{AB}$ b) $\overline{AO}$ c) $\overline{AC}$ d) $\overline{BD}$ e) N.O.T.

9. Solve for x: $\sqrt{5x-6}-3=0$

a) $x=\frac{9}{5}$ b) $x=4$ c) $x=\frac{3}{5}$ d) $x=9$ e) N.O.T.

10. The zombie virus takes a mean time of 18 hours to fully infect the host with a standard deviation of 3 hours, and is approximately normal. If 1000 people are bitten, approximately how many are fully infected in under 21 hours?

a) 500 b) 680 c) 340 d) 840 e) N.O.T.

11. Find the period of $y = 8\tan(3\pi x + 2) + 11$

a) 3 b) $\frac{1}{3\pi}$ c) 3π d) $\frac{1}{3}$ e) N.O.T.

12. Find the radius of a circle if a central angle of $\frac{5\pi}{6}$ subtends an arc of length 20π.

a) 24 b) $\frac{50}{3}$ c) $\frac{50\pi^2}{3}$ d) $\frac{1}{24}$ e) N.O.T.

13. A region is bounded by the lines $y = x$, $x = 0$, and $y = 4$. What 3D shape is formed when you rotate that bounded region around the y-axis?

a) A cone b) A cylinder

c) A pyramid d) A rectangular prism e) N.O.T.

14. For which value of x would the function $f(x) = \frac{\cos(x)}{1-2\sin(x)}$ be undefined?

a) $x = 60°$ b) $x = 90°$ c) $x = 210°$ d) $x = 300°$ e) N.O.T.

15. Find the domain of the function $f(x) = \frac{x+3}{x^2+3x+2} + \sqrt{x+2}$

a) $[-2, \infty)$ b) $(-1, \infty)$ c) $(-2, -1)$ d) $(-2, -1) \cup (-1, \infty)$ e) N.O.T.

16. Simplify the expression: $\dfrac{\frac{1}{x+y} - \frac{1}{x}}{y}$

a) $\frac{-y}{x(x+y)}$ b) $-\frac{1}{y^2}$ c) $-\frac{1}{x(x+y)}$ d) $-\frac{1}{xy}$ e) N.O.T.

17. Use the following two-way table comparing favorite animal to favorite color to find the probability of a favorite color of red given that the favorite animal is a dog.

	Blue	Green	Red
Cat	1	7	6
Dog	3	4	2
Parrot	5	8	4

a) $\frac{3}{4}$ b) $\frac{2}{9}$ c) $\frac{1}{6}$ d) $\frac{9}{40}$ e) N.O.T.

18. For $0 \leq \theta \leq 2\pi$, find all θ values for which $-2\sin(\theta) = \sqrt{3}$. The largest value minus the smallest equals:

a) $\frac{2\pi}{3}$ b) $\frac{\pi}{2}$ c) $\frac{5\pi}{6}$ d) $\frac{\pi}{3}$ e) N.O.T.

19. The remainder of the polynomial division $\frac{4x^3-2x^2+7}{2x+1}$ is:

a) 1 b) 6 c) 5 d) -1 e) N.O.T.

20. If $f(x) = x^2 - 1$, then $\frac{f(x)-f(4)}{x-4} =$

a) $x - 4$ b) $\frac{x^2-15}{x+4}$ c) $4 + x$ d) 1 e) N.O.T.

21. A quadratic equation of the form $y = ax^2 + bx + c$ is tangent to the x-axis. What is always true about the roots of the equation?

a) The sum of the roots is a real number.

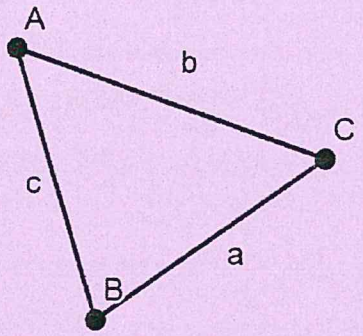
b) There are two distinct roots.

c) The sum of the roots is always a rational number.

d) The roots are opposites of one another.

e) N.O.T.

22. If angle $A = 45°$, side a= $6\sqrt{2}$, and $\sin(B) = \frac{3}{7}$, find the length of b in the triangle below.



a) $b = \frac{9}{7}$ b) $b = \frac{36\sqrt{3}}{7}$ c) $b = \frac{9\sqrt{2}}{7}$ d) $b = \frac{36}{7}$ e) N.O.T.

23. Find the inverse function for $f(x) = \frac{5x-7}{x+2}$

a) $f^{-1}(x) = \frac{2x-7}{5-x}$ b) $f^{-1}(x) = \frac{2x+7}{5-x}$

c) $f^{-1}(x) = \frac{2x-7}{5+x}$ d) $f^{-1}(x) = \frac{7-2x}{5-x}$ e) N.O.T.

24. The equation $x^2 + y^2 - 8x + 10y + 5 = 0$ defines a circle. The sum of the x and y coordinates of the center of the circle minus the radius of the circle is equal to what?

a) -5 b) -35 c) -7 d) 3 e) N.O.T.

25. For $0 \leq \theta \leq 6\pi$, how many angles θ would have $\tan(\theta) = 1$?

a) 2 b) 6 c) 3 d) 1 e) N.O.T.

26. A polynomial is of the form $ax^3 + bx^2 + cx + d$ where a, b, c, d are all real numbers. At most how many of the roots can be complex with no real part?

a) 0 b) 1 c) 2 d) 3 e) N.O.T.

27. Identify the random variable and classify it as discrete or continuous.

The number of fires in a certain city block on Fridays from 5pm-11pm.

a) City block; discrete random variable.

b) Time interval; discrete random variable.

c) Time interval; continuous random variable.

d) Number of fires; continuous random variable.

e) N.O.T.

28. For the trig function defined as $f(x) = \sin(x) + \sin(3x)$, what is the period?

a) $\frac{2\pi}{3}$ b) 2π c) $\frac{8\pi}{3}$ d) $\frac{4\pi}{3}$ e) N.O.T.

29. The equation $H = 20 + 128t - 32t^2$ models the height H (in feet) of a projectile in terms of the time after launch t (in seconds). What is the maximum height the projectile obtains on its path?

a) 116 feet b) 76 feet c) 20 feet d) 148 feet e) N.O.T.

30. A goat is tied with a rope to the outside corner of a rectangular pen. The pen has dimensions 10 feet by 20 feet, and the rope is 15 feet long. Find the total area the goat can cover outside the pen.

a) $125\pi\ ft^2$ b) $225\pi\ ft^2$ c) $175\pi\ ft^2$ d) $\frac{225\pi}{2}\ ft^2$ e) N.O.T.