

TEAM MATH QUEST SCORE SHEET

2013 Senior MESA Day

TEAM INFORMATION			
School: _____	Center: _____		
Student Names:	Grade:	Current Math Class:	
1 _____	_____	_____	
2 _____	_____	_____	
3 _____	_____	_____	
4 _____	_____	_____	

Note: All answers must be in reduced form and include appropriate units of measurement.

#	Team Answer	#	Team Answer	#	Team Answer
1		11		21	
2		12		22	
3		13		23	
4		14		24	
5		15		25	
6		16		26	
7		17		27	
8		18		28	
9		19		29	
10		20		30	

FOR JUDGE'S USE ONLY				
# Correct answers		x 4 pts	=	
			<i>minus</i>	
# Incorrect answers <i>(do not include non-responses)</i>		x 1 pt	=	
			TOTAL SCORE	

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1. Solve for z .

$$(2 - 3i)z = i + 4i^3 - 6$$

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2. Solve for θ , where $(0 \leq \theta \leq 2\pi)$:

$$2\cos^2\theta + 9\cos\theta = 5$$

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3. Find the polynomial equation of lowest degree that has roots $i\sqrt{2}$ and $-7i$ and only real coefficients.

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4. An old wooden flagpole breaks at a point 8 feet above the ground. The top of the pole then falls to the ground, landing 15 feet from the bottom. If the pole stays connected at the breaking point, so that it forms a right triangle with the ground, how tall was the pole before it broke?

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5. What is an algebraic expression for:

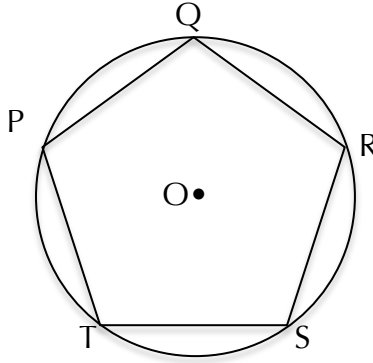
$$\cot[\arcsin x]$$

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6. The water temperature for a manufacturing process should be kept at 150° F. A computer program uses the inequality $|t - 150| < 5$ which describes the acceptable water temperature, t , in degrees. What is the range of acceptable temperature for the water?

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7. In the figure below, the equilateral polygon $PQRST$ is inscribed in circle O . If the diameter of circle O is 10, what is the length of arc PQR in terms of π ?



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8. Vector $v = 3i + 7j$ is written in matrix form as $v = \begin{bmatrix} 3 \\ 7 \end{bmatrix}$. This vector is transformed into a second vector by the following matrix multiplication, $2A \cdot v$, where $A = \begin{bmatrix} -2 & 5 \\ 3 & 1 \end{bmatrix}$. The resultant vector written in $xi + yj$ form is _____.

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9. A mason stacks $25k$ bricks in such a way that there are 15 bricks in the top layer and k layers altogether. If each layer contains two more bricks than the layer immediately above, find the total number of bricks in the stack.

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10. The coordinates of the midpoint of \overline{EF} are $(1,1)$. If the coordinates of E are $(-7,-5)$ and the coordinates of F are $(9,k)$, what is the value of k ?

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11. Find an equation of the circle for which a diameter contains the segment of the graph of $y - x = 10$ cut off by the coordinate axes.

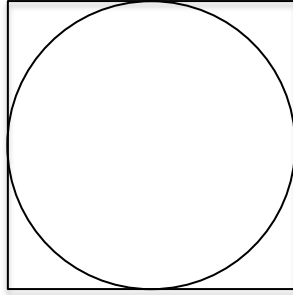
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12. Find the limit:

$$\lim_{x \rightarrow \pi^-} \frac{\cos x}{x - \pi}$$

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13. In the figure below, a circle is inscribed in a square. If the diagonal of the square is 10, what is the radius of the circle?



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14. By applying the Intermediate Value Theorem, choose the interval over which $\sin(\ln(x)) = e^{2x} - 2$ will have a solution.

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15. A theater contains 500 seats. For an upcoming talent show, the theater manager plans to sell \$4 and \$5 tickets. He must sell at least 200 \$4 tickets and 100 \$5 tickets for the show to be produced, and he must bring in at least \$2000 to break even. How many tickets at each price should be sold to maximize income? What is the maximum income?

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16. The cost of 250 bricks, delivered to a worksite, is \$170. The cost of 400 bricks delivered is \$245. How much would it cost to have 320 bricks delivered (assuming a linear relationship)?

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17. A spherical balloon is inflated at the rate of $6 \text{ ft}^3/\text{min}$. What is the volume of the balloon when the radius is increasing at the rate of $3 \text{ in}/\text{min}$? Give the exact answer.

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18. Let R be the first quadrant region enclosed by the graphs of $y = e^{-x^4}$ and $y = 1 - \cos x$. Find the volume of the solid generated when R is revolved about the x - axis. Round to the nearest thousandth.

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19. Find the equation of the line perpendicular to the line passing through the coordinates $(-2,4)$ and $(1,1)$ with the same y -intercept.

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20. In $\triangle VWX$, $m\angle W = 90^\circ$, $VW = 1$, and $VX = \sqrt{2}$. Find $\csc \angle X$.

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21. If $F(x) = \int_{2x+3}^5 f(t)dt$ and $f(17) = 4$, then $F'(7) =$

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22. Rafael has 8 sacks of flour. Some of his sacks weigh 3 pounds, and the others weigh 7 pounds. The total weight of his flour is 36 pounds. How many 7-pound sacks does he have?

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23. A cubic foot of liquid is poured into a rectangular box whose base is 18 inches by 12 inches. How high up will the water rise?

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24. A classroom has 20 student chairs with writing arms. Two of the chairs are for left-handers and 18 are for right-handers. Assume that 10% of the students in the school are left-handed. If 20 students are randomly assigned to this classroom, what is the probability that at least one left-hander will have to use a right-handed chair? Round your answer to the nearest thousandth.

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25. Two planes, one flying at 300 miles per hour and the other at 450 miles per hour, left the same airport at noon. At 3pm they were 1200 miles apart. What was the measure of the angle between their flight paths? (round your answer to the nearest tenth of a degree)

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26. Two complementary angles measure x° and y° . If $2x - y = 60$, then the value of x is:

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27. Find y' given $y^2 - 3xy + x^2 = 7$.

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28. State the limit of $a_n = \frac{n^3+4}{n^2+7}$ as $n \rightarrow \infty$

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29. Solve for x : $2x^2 + 5x - 1 = 0$

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30. How many milliliters of water should be evaporated from a 10 milliliters mixture that is 30% salt in order to be left with one that is 50% salt?