

MONTANA COUNCIL OF TEACHERS OF MATHEMATICS  
2012 MATH CONTEST

Senior Test

DIRECTIONS: DO NOT WRITE ON THIS TEST. Place the best answer for each question on the separate answer sheet.

- If  $f(x) = 3x^3 - 7x^2 + 5x - 3$ , which of the following is FALSE?  
A) The value of the first derivative at  $x = 5$  is 160.      B) The 2<sup>nd</sup> derivative is linear.  
C) The 2<sup>nd</sup> derivative has an  $x$ -intercept at  $\frac{8}{9}$       D) The 2<sup>nd</sup> derivative has a  $y$ -intercept of -14
- Find the value of the second derivative in the function above at  $x = -3$   
A) -128      B) -162      C) -68      D) 40
- If you know an  $x$ -intercept of the first derivative of a function is 2, what do you know about the original function?  
A) its slope is 2 at  $x = 0$       B) it has a relative max or min at 2  
C) its  $y$ -intercept is 2      D) it has an inflection point at  $x = 2$
- If  $f(x) = \frac{1}{x}$  and  $g(x) = 3x + 2$ , what is the domain of  $f(g(x))$ .  
A)  $x \neq 0$       B)  $x \neq \frac{-2}{3}$       C) all real numbers      D) positive real numbers
- Find  $\lim_{x \rightarrow 3} \left( \frac{x^2 - x - 6}{x - 3} \right)$ . A) 0      B) 5      C) undefined      D) all real numbers
- Find the area of a triangular region with coordinates (6, 2), (10, 4) and (7, 8) to the nearest unit.  
A) 3      B) 4      C) 10      D) 11
- What is the SUM of the solutions to  $\sqrt{x+10} = 5 - \sqrt{3-x}$ .  
A) -7      B) 6      C) -6      D) undefined
- Find the angle between the vectors  $\langle 4, 3 \rangle$  and  $\langle 3, 5 \rangle$  to the nearest tenth.  
A)  $22.2^\circ$       B)  $69.3^\circ$       C)  $67.8^\circ$       D) not possible
- Which is the equation for a hyperbola with focal points of  $(5 \pm \sqrt{13}, 3)$ ?  
A)  $4x^2 - 9y^2 - 40x - 54y + 145 = 0$       B)  $-4x^2 + 9y^2 + 40x - 54y + 17 = 0$   
C)  $4x^2 - 9y^2 - 40x + 54y - 17 = 0$       D)  $4x^2 + 9y^2 - 40x - 54y + 145 = 0$
- Which equation has one real solution and two imaginary solutions?  
A)  $x^3 - 6x^2 + 25x = -150$       B)  $x^3 + x^2 = 2x + 2$   
C)  $x^4 - 13x^2 + 36 = 0$       D)  $x^2 + 6 = x$
- Which equation of the sine function has a period of  $\frac{3\pi}{4}$  and phase shift  $\frac{\pi}{2}$ .  
A)  $y = \frac{3\pi}{4} \sin\left(\theta - \frac{\pi}{2}\right)$       B)  $y = \frac{\pi}{2} \sin\left(\theta - \frac{3\pi}{4}\right)$       C)  $y = \sin\left(\frac{8}{3}\theta - \frac{4\pi}{3}\right)$       D)  $y = \sin\left(\frac{8}{3}\theta + \frac{4\pi}{3}\right)$



**Senior Test 2012: Page 2**

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## Senior Test 2012: Answer Key

1. C
2. C
3. B
4. B
5. B
6. D
7. A
8. A
9. C
10. A
11. C
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.

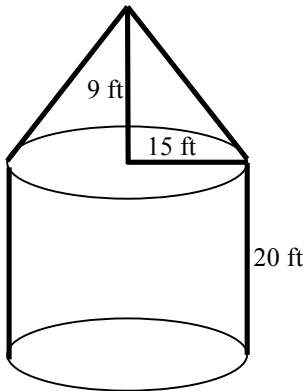
Senior Test 2012: Page 2

12. A surveyor identifies a landmark at the point with rectangular coordinates (75, 125). What are the polar coordinates of this point?  
 A)  $(25\sqrt{34}, 31^\circ)$       B)  $(25\sqrt{34}, 59^\circ)$       C)  $(100, 37^\circ)$       D)  $(100, -59^\circ)$

13. Simplify  $\frac{4+2i}{5-2i}$ .  
 A)  $\frac{34i}{29}$       B)  $\frac{42i}{29}$       C)  $\frac{24+18i}{29}$       D)  $\frac{16+18i}{29}$

14. Consider the point  $P(t, 3t^2 - 12)$ . Describe the figure formed for all values of  $t$ .  
 A) a line with slope 3 and  $y$ -intercept -12  
 B) a cubic with relative max @  $(-1, 9)$  and relative min @  $(1, -9)$   
 C) a quadratic with vertex at  $(0, -12)$   
 D) a circle with center  $(3, -12)$

15. A silo in the shape shown can be filled within two feet of the top. What is the maximum volume of grain that can be stored in the silo to the nearest cubic foot?



- A) 16188 ft<sup>3</sup>      B) 14137 ft<sup>3</sup>  
 C) 16258 ft<sup>3</sup>      D) 16234 ft<sup>3</sup>

16. Which statement is NOT true for the system?  

$$\begin{cases} x^2 + y^2 \leq 16 \\ x \geq y^2 - 4 \end{cases}$$

- A) The vertex of the parabola is a point on the circle.  
 B) The point  $(2, 0)$  is in the solution set.  
 C) The circle and the parabola intersect the  $y$ -axis at the same places.  
 D) The circle has a radius of 4 and the parabola is opening to the right.

17. State the radius and the coordinates of the center of the circle:  $6x^2 - 12x + 6y^2 + 36y = 36$   
 A) Center:  $(2, -6)$ , radius 16      B) Center:  $(2, -6)$ , radius 4  
 C) Center:  $(1, -3)$ , radius 16      D) Center:  $(1, -3)$ , radius 4

18. Solve the following for  $x$ :  $2|x+3| < 6$   
 A)  $-6 < x < 0$       B)  $0 < x < 6$       C)  $x < 0$  or  $x > -6$       D) no solution

## Senior Test 2012: Answer Key

1. C
2. C
3. B
4. B
5. B
6. D
7. A
8. A
9. C
10. A
11. C
12. B
13. C
14. C
15. D
16. C
17. D
18. A