

MONTANA COUNCIL OF TEACHERS OF MATHEMATICS
2017 MATH CONTEST
TEAM 11-12

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

1. $\sqrt[4]{(x-1)^3} \sqrt[6]{(x-1)^{-1}} =$

- A) $\sqrt[12]{(x-1)^7}$ B) $\sqrt[10]{(x-1)^2}$ C) $\sqrt[24]{(x-1)^{-3}}$ D) $x-1$ E) none of these

2. $\frac{1}{x} + \frac{1}{x-1} - \frac{x}{x^2-x} =$

- A) $\frac{2-x}{x^2+x-1}$ B) $\frac{2-x}{x^2-x}$ C) 1 D) $\frac{1}{x}$ E) none of these

3. The equation $y^2 - 4y + x^2 + 2x = 4$ represents a circle with:

- A) center at (-1,2) and radius of 3 B) center at (-2,1) and radius of 1 C) center at (1,-2) and radius of 3
D) center at (2,-1) and radius of 2 E) none of these

4. If $f(x) = x^2 + 3x - 7$, then $f(a+1) =$

- A) $a^2 + 3a - 6$ B) $a^2 + 4a - 6$ C) $a^2 + 6a + 5$ D) $a^2 + 5a - 3$ E) none of these

5. Find $f(x)$ such that $(f \circ g)(x) = f(g(x)) = \frac{1}{x^2-2x+6}$ and $g(x) = x^2 - 2x$.

- A) $f(x) = \frac{1}{x}$ B) $f(x) = x + 6$ C) $f(x) = \frac{1}{\frac{x^2-2x+6}{x^2-2x}}$ D) $f(x) = \frac{1}{x+6}$ E) none of these

For questions 6 - 9, let $f(x) = 2x - 1$. Solve each equation exactly for x .

6. $f(x) = 5$

- A) $x = 2$ B) $x = 3$ C) $x = 9$ D) $x = 11$ E) none of these

7. $f^{-1}(x) = 5$

- A) $x = \frac{1}{11}$ B) $x = \frac{1}{3}$ C) $x = 3$ D) $x = 9$ E) none of these

8. $(f(x))^{-1} = 5$

- A) $x = \frac{1}{11}$ B) $x = \frac{1}{5}$ C) $x = \frac{3}{9}$ D) $x = \frac{3}{5}$ E) none of these

9. $f(x^{-1}) = 5$

- A) $x = \frac{1}{11}$ B) $x = \frac{1}{9}$ C) $x = \frac{1}{3}$ D) $x = \frac{1}{2}$ E) none of these

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10. Find a trigonometric function f that has a period of 6 with a minimum value of -2 at $t = 0$ and a maximum value of 2 at $t = 3$.

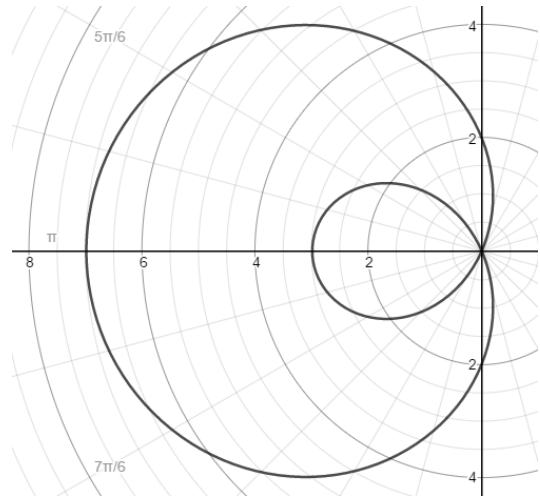
- A) $f = 2 \sin(x - 1.5)$ B) $f = -2 \cos\left(\frac{\pi}{3}x\right)$ C) $f = -2 \sin(\pi x)$ D) $f = 2 \cos(6x)$ E) none of these

11. Simplify $\cos(\sin^{-1} x)$.

- A) $\frac{1}{x}$ B) $\frac{1}{\sqrt{1-x^2}}$ C) $\sqrt{1-x^2}$ D) x E) none of these

12. The graph at right is an example of a:

- A) Lemniscate B) Limaçon
C) Rose D) Spiral of Archimedes
E) none of these



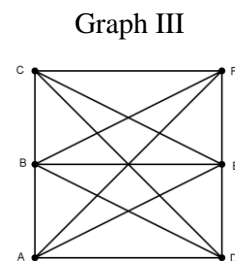
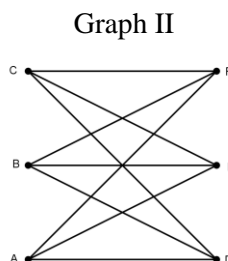
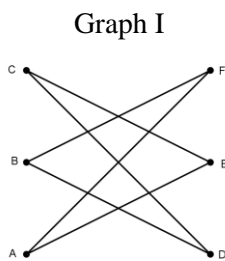
13. The equation for the graph at right is:

- A) $r = \frac{1}{2}\theta$ B) $r = 3 \cos 2\theta$
C) $r = 4 \cos \theta$ D) $r = 2 + 5 \cos \theta$
E) none of these

14. An ant moves in a straight line with the velocity $v(t) = \cos t$ meters per second. Find the distance travelled over the time interval $[0, 3\pi]$ seconds.

- A) 0 meters B) 1 meter C) 3 meters D) 6 meters E) none of these

15. Which of the following graphs can be drawn without lifting your pencil or repeating a line?



- A) graphs I and III B) graph I C) graphs II and III D) all of them E) none of them

16. In the following partial fraction decomposition, solve for A , B , and C .

$$\frac{4x + 4}{x^2(x + 2)} = \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x + 2}$$

- A) $A = -1, B = 2, C = 1$ B) $A = 1, B = 2, C = -1$ C) $A = 1, B = -1, C = 2$ D) $A = 2, B = -1, C = 1$ E) none of these

TEAM 11-12 2017 Answer Key

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