

Functions

PSU Math Relays 2017

- There are 32 problems
 - For each problem, place your answer in the appropriate blank of the answer sheet provided.
 - All functions on the test are real-valued functions.
 - Simplify each answer as much as possible. Rationalize fractions. Give numerical answers in fractional form, if applicable. Do not use decimal approximations.
 - Use interval notation and use $+\infty$ and $-\infty$ for positive and negative infinity.
 - No calculators are allowed on the exam.
-

For problems 1-11 decide if the following sets, graphs, or relations are functions or not. Place a **yes** on the answer sheet if it is a function and a **no** if it is not a function.

1. $\{(0, 0), (1, 1), (2, 3), (4, 6), (-2, 5)\}$
2. $\{(-4, 3), (2, 3), (3, 6), (1, 0)\}$
3. $\{(1, 5), (2, 9), (3, 7), (1, 6)\}$
4. $\{(x, y) \mid y = -2x\}$
5. $\{(x, y) \mid x = -1\}$
6. $\{(x, y) \mid y = -x^2\}$
7. $\{(x, y) \mid x = y^2\}$
8. $\{(x, y) \mid y = x \text{ or } y = -x\}$
9. $3x^3 - 9x^2 = 14 + 3y$
10. $x^2 + y^2 = 4$
11. $y = \begin{cases} 1 & x \text{ is rational} \\ -1 & x \text{ is irrational} \end{cases}$

Recall that $a^x = y$ exactly when $\log_a(y) = x$.

12. Find $\log_3(9)$.
13. Find $\log_2(0.125)$.
14. Find $\log_3(81) \log_2(0.5)$.
15. Find $3^{\log_9(81)}$.

For problems 16-23 below, use the functions

- $f(x) = \frac{1}{2x+1}$
- $g(x) = \sqrt{3-x}$
- $h(x) = x^2$
- $k(x) = 3^x$

Evaluate and simplify your answers. If the answer does not exist, write “DNE”.

16. $f(2) =$
17. $h(-1) =$
18. $k(0) =$
19. $g(5) =$
20. $(h/k)(-1) =$
21. $(f \circ g)(-2) =$
22. $(gk)(3) =$
23. $(f \circ k)(1) - (h \circ g)(-1) =$

For problems 24-28 state whether the following functions are odd, even, both, or neither.

24. $y = \sin x$
25. $y = 0$
26. $y = 3x^3 - 17x^2 + x + 5$
27. $y = 42x^4 + 17x^2 + 18$
28. $y = 15x^3 + 9x - 5$

For problems 29-32, use the parabolic function $h(x) = -x^2 + 8x - 12$.

29. Find the vertex of $h(x)$.
30. Find the axis of symmetry for $h(x)$.
31. Find the range of $h(x)$.
32. What is the average rate of change for $h(x)$ on $[-2, 3]$.