

Michigan State University
Department of Mathematics

Name: _____ PID: _____ Section # _____

Signature: _____

Page	Maximum Points	Actual Points
2	15	
3	20	
4	20	
5	20	
6	15	
7	10	
8	20	
9	20	
10	25	
11	23	
12	12	
Total	200	

INSTRUCTIONS:

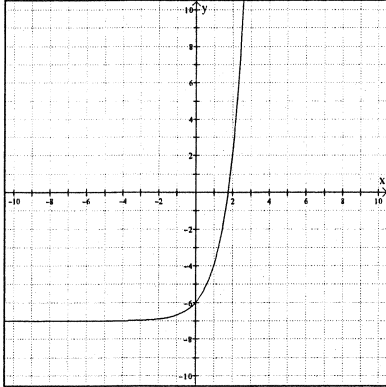
1. DO NOT OPEN THIS EXAM UNTIL YOU ARE INSTRUCTED TO DO SO.
2. *Without fully opening the exam*, check that you have pages 1 through 12 and that none is blank.
3. Fill in the information at the top of the page.
4. You will need a pen or pencil, one calculator and booklet for the exam.
Please clear everything else from your desk.
5. Calculators are not to be shared. Please do not ask your Instructor any questions about the use of your calculator.
6. **Please look to the board for possible corrections to this exam.**
7. Do not spend too much time on a particular problem. Work the easier problems first.
8. Show your work in the place provided. If you need additional space, use the backs of the exam pages. **You must show all your work!** Points may be withdrawn for answers given without substantiation. (There are problems, however, that will be graded on right-wrong base.)
9. If a graphing utility is used to answer questions, please include a sketch of the graph and give the definition of the function you are graphing.
10. Place your answers in the boxes, where provided. Answers can be in any form unless specified otherwise. Calculator solutions must be accurate within ± 0.0001 unless specified otherwise.
11. You will be given **exactly** 120 minutes for this exam.

Problems 1-18 are multiple-choice problems and worth 5 points each.

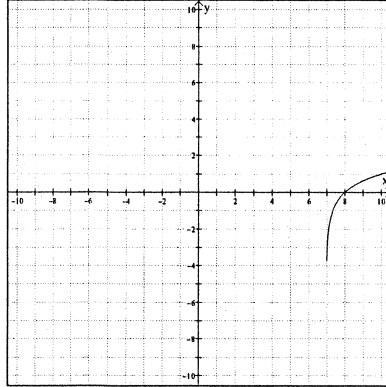
Circle one answer for each question.

1. Circle the graph of $f^{-1}(x)$ if $f(x) = \log_3(x+7)$.

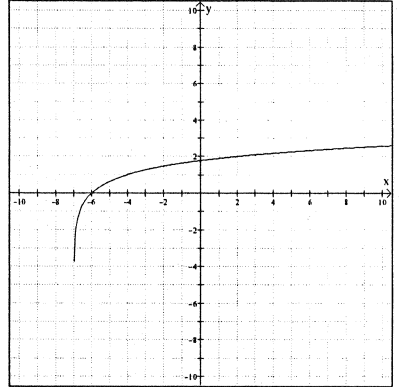
a)



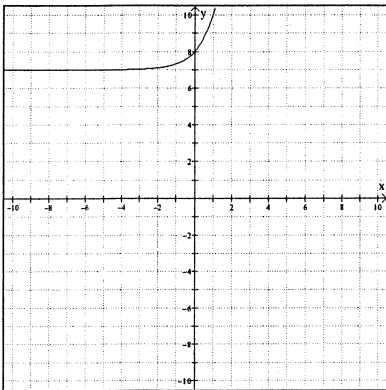
b)



c)



e) None of these



2. If $f(x) = 6x+1$ and $g(x) = \frac{x-1}{6}$, then $(f \circ g)(x)$ is equal to

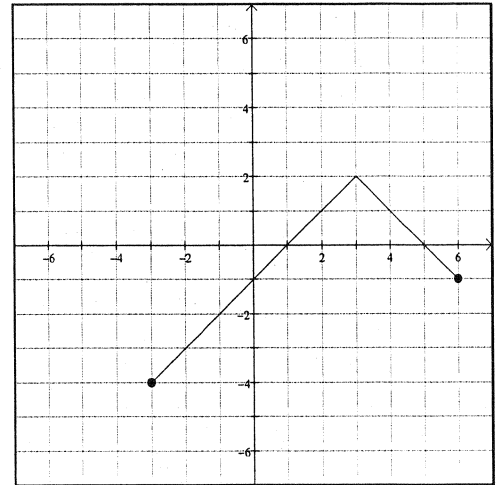
- a) x b) $\frac{x-1}{6x+1}$ c) 1 d) $\frac{6x+1}{x-1}$ e) None of these

3. If $x = 3 + 4i$ is a zero of a polynomial $f(x)$ with real coefficients, then another complex zero of this polynomial is

- a) $-3 - 4i$ b) $-3 + 4i$ c) $3 - 4i$ d) $4 - 3i$ e) None of these

4. Which one of the following statements is true based on the graph of $f(x)$ shown? (The grid lines are one unit by one unit.)

- a) The function has a minimum value of -5 that occurs at $x = -3$.
- b) The domain and range of f is $(-\infty, \infty)$.
- c) This piecewise function can be defined by three different equations, all in the form $y = mx + b$.
- d) f is increasing on the interval $(-3, 3)$.
- e) None of these



5. Use the calculator to evaluate $\log_{0.3} 22$.

Round your answer to 4 decimal places.

- a) -2.5675 b) -2.5674 c) 3.4563 d) -0.3895 e) None of these

6. Given

$$F(x) = \begin{cases} \log_3(x+5), & x > -5 \\ 4 - 2x, & x \leq -5 \end{cases}$$

$$F(-5) - F(4) =$$

- a) $F(9)$ b) -12 c) 12 d) $F(-9)$ e) None of these

7. The slope of the line perpendicular to the line $3 - 4x + 9y = 0$ is

- a) $-\frac{4}{9}$ b) $-\frac{9}{4}$ c) $\frac{4}{9}$ d) $\frac{9}{4}$ e) None of these

8. Solve the equation $3abc + 5ad - 4 = 2db$ for b .

a) $b = \frac{4 - 3ad}{5ac - 2d}$ b) $b = \frac{3ad - 4}{5ac - 2d}$ c) $b = \frac{4 + 5ad}{2d - 3ac}$ d) $b = \frac{4 - 5ad}{3ac + 2d}$

e) $b = \frac{5ad - 4}{2d - 3ac}$

9. Find the coordinates of the vertex for the parabola $f(x) = 2x^2 + 12x - 3$.

a) $(-3, 21)$ b) $(-3, -21)$ c) $(3, -21)$

d) $(-3, 3)$ e) None of these

10. The remainder after division

$f(x) = x^5 - 4x^4 + 3x^3 - 5x^2 - 7x + 6$ by $d(x) = x - 3$ is

a) $x^2 - 3$ b) $x - 3$ c) 6 d) -60 e) None of these

11. The equation of the line that passes through points $(-4, -3)$ and $(2, -3)$ is

a) $x = -3$ b) $y = -3$ c) $y = 2x - 3$ d) $y = -3x - 4$ e) None of these

12. The domain of $f(x) = \log_{0.8}(x-5) + 3$ is

- a) $[-5, \infty)$ b) $(-\infty, -5)$ c) $(5, \infty)$ d) $(8, \infty)$ e) None of these
-

13. The domain of $g(x) = \frac{1}{\sqrt{7-3x}}$ is:

- a) $\left[\frac{7}{3}, \infty\right)$ b) $\left(-\infty, \frac{7}{3}\right)$ c) $\left(\frac{7}{3}, \infty\right)$ d) $\left(-\infty, \frac{7}{3}\right]$ e) None of these
-

14. The y -intercept of the graph of $f(x) = (x+3)^3(x-2)^2(x+1)$ is

- a) $(108, 0)$ b) $(0, 108)$ c) $(0, 6)$ d) $(0, -108)$ e) None of these
-

15. The asymptote of the graph of $y = \log_2(x+3) - 7$ is

- a) $x = -3$ b) $y = -7$ c) $x = -7$ d) $y = 3$ e) None of these
-

16. The product $(5 - 7i)(5 + 7i)$ is equal to

- a) -12 b) 74 c) $25 - 35i$ d) $25 + 35i$ e) None of these
-

17. Expand this expression completely: $\log_3 \frac{27x^4}{y^5}$.

- a) $\log_3 27x^4 - \log_3 y^5$ b) $2\log_3 x - 5\log_3 y$ c) $\frac{\log_3 27x^4}{\log_3 y^5}$
d) $3 + 4\log_3 x - 5\log_3 y$ e) None of these
-

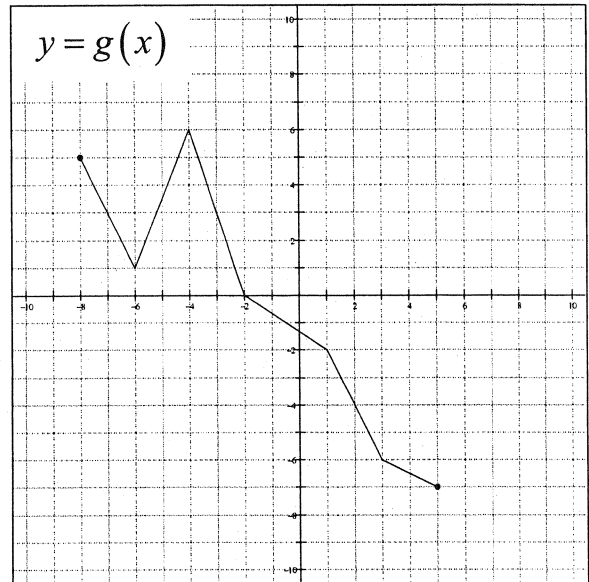
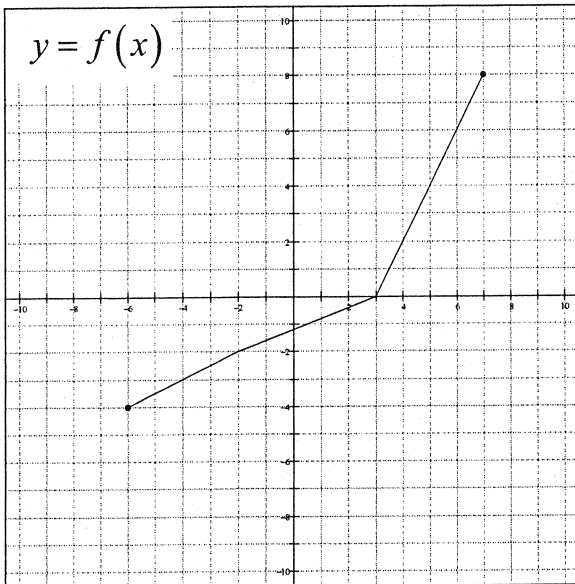
18. If a population growth is described by the equation

$$A(t) = 5,000e^{0.021t}, \quad t \text{ in years, then the population doubles in}$$

- a) 33 years, b) 40 years, c) 30 years, d) 140 years, e) None of these

Round your answer to the nearest integer.

19. (10 points.) The graphs of $f(x)$ and $g(x)$ are shown below.



Use these graphs to answer the following questions.

a) Find $f(-2) \cdot g(-2)$

b) Solve the equation $f(x) = 0$

c) Find $f^{-1}(-3)$

d) Find $(f \circ g)(-3)$

e) Find the domain of $\left(\frac{g}{f}\right)(x)$

20. (12 points.) A farmer collected data to see the relationship between crop yields, $Y(x)$, in bushels, and various amounts of fertilizer used, x , in pounds. The quadratic function that models this relationship is:

$$Y(x) = -7x^2 + 126x + 8.$$

- a) How much fertilizer must be applied to obtain the maximum crop yield?
- b) What is the maximum crop yield?

Present an algebraic solution for this optimization problem.

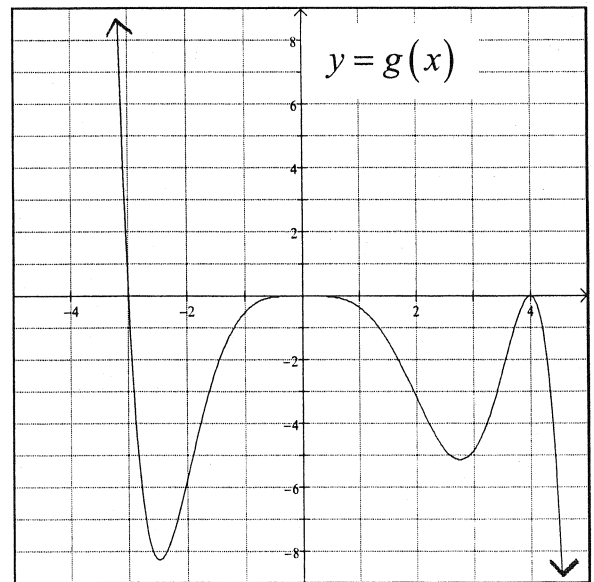
a)

b)

12	<input style="width: 100%; height: 100%;" type="text"/>
----	---

21. (8 points.) The graph of a polynomial function $g(x)$ is shown to the right.

- a) The degree of $g(x)$ is:
 even odd (circle one)
- b) The leading coefficient of $g(x)$ is:
 positive negative (circle one)
- c) State the "End behavior" of $g(x)$:



$g(x)$: _____	to the right
$g(x)$: _____	to the left

8	<input style="width: 100%; height: 100%;" type="text"/>
---	---

20	<input style="width: 100%; height: 100%;" type="text"/>
----	---

22. (10 points.) Solve the following inequality **algebraically**.
State your answer in **interval notation**.

$$|10 - 2x| \geq 8$$

--

10	
----	--

-
23. (10 points.) Solve the following inequality **algebraically**. Show your work. State your answer in interval notation, using exact values.

$$2x^2 - 7x + 4 \leq 0$$

--

10	
----	--

20	
----	--

24. (15+10+15=40 points.) Use algebraic methods to find **exact solutions** of the following equations (i.e., solve the equations **without using a graphing utility.**)

a)
$$\frac{-4x}{x-1} + \frac{4}{x+1} = \frac{-8}{x^2-1}$$

--

15	
----	--

b) $2 + \sqrt{2x-1} = x$

--

10	
----	--

25	
----	--

c) $\log x + \log(x-3) = 1$

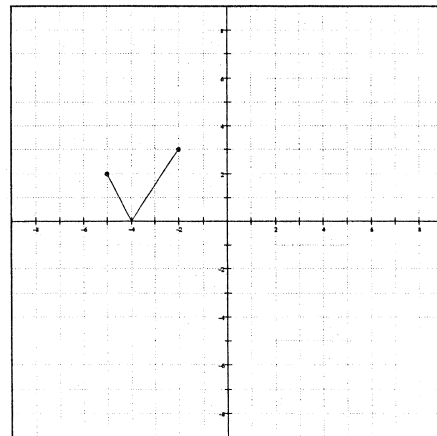
--

15	
----	--

Problems 25-29 are “short answer” problems worth 4 points each.

25. Given the graph of a function $f(x)$.

Sketch the graph of $g(x) = f(-x) + 3$.



4	
---	--

26. The zeros of the polynomial function $f(x) = -27x^3(x+18)^2$ are

$x = \underline{\hspace{2cm}}$ of multiplicity $k = \underline{\hspace{2cm}}$;

$x = \underline{\hspace{2cm}}$ of multiplicity $k = \underline{\hspace{2cm}}$;

4	
---	--

23	
----	--

27. Find an equation for $f^{-1}(x)$ where $f(x) = \sqrt[3]{x+5}$.

$f^{-1}(x) =$

4	
---	--

28. Without using a calculator, evaluate the following expression: $\log_2 \frac{1}{16}$

--

4	
---	--

29. Simplify the following expression. *Your answer should not contain logarithms.*

$$e^{\ln 30x^5 - \ln 6x^4}$$

--

4	
---	--

12	
----	--