

Do not remove this answer page — you will turn in the entire exam. You have two hours to do this exam. No books or notes may be used. You may use a graphing calculator during the exam, but NO calculator with a Computer Algebra System (CAS) or a QWERTY keyboard is permitted. Absolutely no cell phone use during the exam is allowed.

The exam consists of 20 multiple choice questions worth 5 points each. Record your answers on this page by filling in the box corresponding to the correct answer. For example, if (b) is correct, you must write

a b c d e

Do not circle answers on this page, but please do circle the letter of each correct response in the body of the exam. It is your responsibility to make it CLEAR which response has been chosen. You will not get credit unless the correct answer has been marked on both this page and in the body of the exam.

GOOD LUCK!

1. a b c d e

11. a b c d e

2. a b c d e

12. a b c d e

3. a b c d e

13. a b c d e

4. a b c d e

14. a b c d e

5. a b c d e

15. a b c d e

6. a b c d e

16. a b c d e

7. a b c d e

17. a b c d e

8. a b c d e

18. a b c d e

9. a b c d e

19. a b c d e

10. a b c d e

20. a b c d e

For grading use:

Total	
	(out of 100 pts)

Please make sure to list the correct section number on the front page of your exam.
In case you forgot your section number, consult the following table:

Section #	Instructor	Lectures
002	W. Guo	MWF 9:00am-9:50am, BE 213
003	G. Butcher	MWF 10:00am-10:50am, CB 337
004	A. Bagchi Misra	MWF 10:00am-10:50am, FB 213
005	G. Butcher	MWF 11:00am-11:50am, CB 335
006	A. Corso	MWF 12:00pm-12:50pm, CB 114
008	W. Guo	MWF 1:00pm-1:50pm, CB 335
009	L. Roberson	MWF 2:00pm-2:50pm, CB 337
010	A. Bagchi Misra	MWF 3:00pm-3:50pm, CB 335
011	L. Roberson	MWF 3:00pm-3:50pm, CB 337
013	S. Nanwani	TR 8:00am-9:15am, CB 335
019	P. Zhang	TR 12:30pm-1:45pm, BS 108
020	S. Nanwani	TR 2:00pm-3:15pm, CB 333
021	Y. Li	TR 2:00pm-3:15pm, CB 347
022	Y. Li	TR 3:30pm-4:45pm, CB 335
023	P. Zhang	TR 3:30pm-4:45pm, CB 339
401	C. Norman	TR 6:00pm-7:15pm, CP 201
403	E. Stokes	TR 6:00pm-7:15pm, CB 337
404	E. Stokes	TR 7:30pm-8:45pm, CB 337

Formula Sheet:

Compound Interest: If a principal P is invested at an interest rate r for a period of t years, then the amount $A(t)$ of the investment is given by:

$$A(t) = P \left(1 + \frac{r}{n} \right)^{nt} \quad (\text{if compounded } n \text{ times per year})$$

$$A(t) = P e^{rt} \quad (\text{if compounded continuously}).$$

Exponential Growth Model If n_0 is the initial size of a population that experiences **exponential growth**, then the population $n(t)$ at time t increases according to the model:

$$n(t) = n_0 e^{rt}$$

where r is the relative rate of growth of the population (expressed as a proportion of the population).

Radioactive Decay Model: If m_0 is the initial mass of a radioactive substance with half-life h , then the mass $m(t)$ remaining at time t is modeled by the function:

$$m(t) = m_0 e^{-rt}$$

where $r = \frac{\ln 2}{h}$.

Newton's Law of Cooling: If D_0 is the initial temperature difference between an object and its surroundings, and if its surroundings have temperature T_S , then the temperature of the object at time t is modeled by the function:

$$T(t) = T_S + D_0 e^{-kt}$$

where k is a positive constant that depends on the object.

The pH Scale: Chemists measured the acidity of a solution by giving its hydrogen ion concentration until Sorensen, in 1909, defined a more convenient measure:

$$\text{pH} = -\log[H^+]$$

where $[H^+]$ is the concentration of hydrogen ions measured in moles per liter (M).

Solutions are defined in terms of the pH as follows:

those with $\text{pH} = 7$ (or $[H^+] = 10^{-7}M$) are *neutral*,

those with $\text{pH} < 7$ (or $[H^+] > 10^{-7}M$) are *acidic*,

those with $\text{pH} > 7$ (or $[H^+] < 10^{-7}M$) are *basic*.

Change of Base Formula: Let a and b be two positive numbers with $a, b \neq 1$. If $x > 0$, then:

$$\log_b x = \frac{\log_a x}{\log_a b}$$

Multiple Choice Questions (5 points each)

*Show all your work on the page where the question appears.
Clearly mark your answer both on the cover page on this exam
and in the corresponding questions that follow.*

1. If we simplify the expression

$$\frac{5x^5 - 10x^4}{x^3 - 4x^2} \cdot \frac{(x - 4)^2}{x^3(x^2 - 4)}$$

we obtain:

Possibilities:

- (a) $\frac{x - 4}{x(x + 2)}$
- (b) $\frac{5}{x(x + 2)}$
- (c) $\frac{5(x^2 + 4)}{x(x + 2)}$
- (d) $\frac{5(x - 4)}{x(x + 2)}$
- (e) $\frac{16}{x(x + 2)}$

2. If we simplify the expression

$$\frac{x - 1}{x} - \frac{4}{x + 4}$$

we obtain:

Possibilities:

- (a) $\frac{x^2 + x + 4}{x(x + 4)}$
 - (b) $\frac{x^2 - 2x - 4}{x(x + 4)}$
 - (c) $\frac{x^2 - x - 4}{x(x + 4)}$
 - (d) $\frac{x^2 - x + 4}{x(x + 4)}$
 - (e) $\frac{x - 5}{4}$
-

3. The solutions of the equation

$$x^2 + 8x + 4 = 0$$

are:

Possibilities:

- (a) $x = -4 \pm 2\sqrt{3}$
- (b) $x = -2 \pm 2\sqrt{3}$
- (c) $x = -4 \pm \sqrt{45}$
- (d) $x = -2 \pm 4\sqrt{5}$
- (e) $x = -4 \pm 4\sqrt{5}$

4. If we solve the inequality

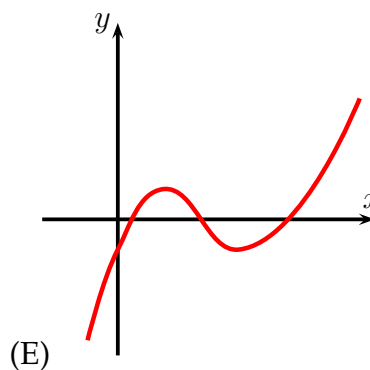
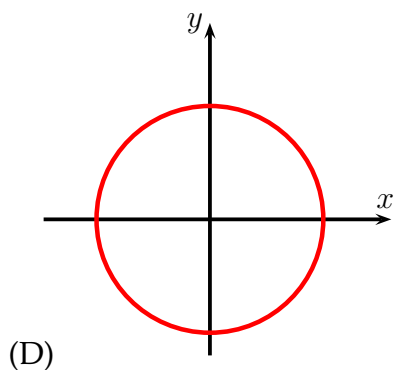
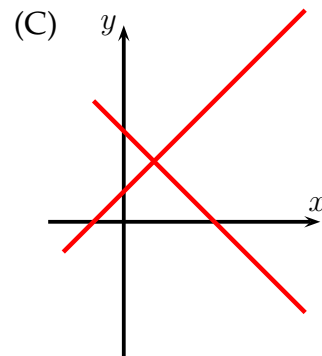
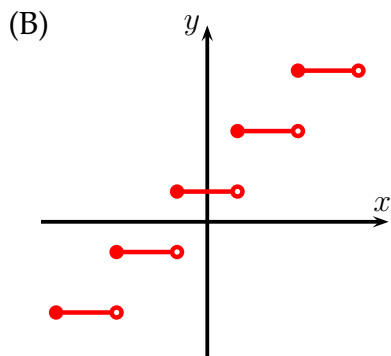
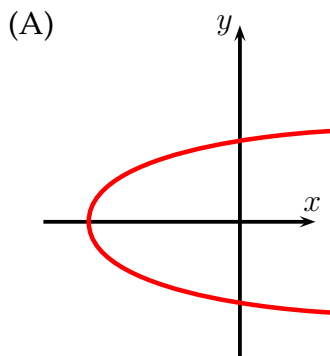
$$(x - 2)(x + 3)(x + 5) \geq 0$$

then x lies in the intervals:

Possibilities:

- (a) $(-\infty, -5] \cup [-3, -2]$
 - (b) $[-5, -3] \cup [2, +\infty)$
 - (c) $(-\infty, -5] \cup [3, +\infty]$
 - (d) $(-\infty, -5] \cup [-3, 2]$
 - (e) no solution
-

5. Use the vertical line test to determine the complete list of graphs below that represent the graph of a function of x .



Possibilities:

- (a) (A) and (B)
- (b) (E)
- (c) (B) and (E)
- (d) (B)
- (e) (D) and (E)

6. Find the equation of the line that passes through the points $P(-3, 4)$ and $Q(1, -4)$

Possibilities:

- (a) $y + 4 = 2(x - 1)$
- (b) $y - 4 = -4/3(x + 3)$
- (c) $y - 3 = -2(x + 4)$
- (d) $y - 4 = 2(x + 3)$
- (e) $y + 4 = -2(x - 1)$

7. Let $f(x) = 5x + 6$. Which of the following expressions represents the inverse function $f^{-1}(x)$?

Possibilities:

- (a) $f^{-1}(x) = \frac{x - 6}{5}$
- (b) $f^{-1}(x) = \frac{x}{5} - 6$
- (c) $f^{-1}(x) = \frac{x + 6}{8}$
- (d) $f^{-1}(x) = \frac{1}{5x + 6}$
- (e) $f^{-1}(x) = \frac{x + 5}{6}$

8. The radius r of the circle defined by the equation

$$x^2 + y^2 - 12x + 18y = 0$$

is:

Possibilities:

- (a) $r = 30$
- (b) $r = \sqrt{12^2 + 18^2}$
- (c) $r = 6$
- (d) $r = 117$
- (e) $r = \sqrt{117}$

9. The solution of the system of linear equations

$$\begin{cases} 9x - 8y = 15 \\ 18x + 7y = -39 \end{cases}$$

is given by:

Possibilities:

- (a) $x = -1$ and $y = -3$
- (b) $x = -1$ and $y = 3$
- (c) $x = -3$ and $y = -1$
- (d) infinitely many solutions
- (e) no solutions

10. Let $f(x) = x^2 + 2x$ and let $h \neq 0$. Then the difference quotient

$$\frac{f(a+h) - f(a)}{h}$$

is equal to one of the following expressions:

Possibilities:

- (a) 1
- (b) $2x + 2$
- (c) $h + 2a + 2$
- (d) $h^2 + 2ah + 2h$
- (e) $h + 2$

11. Which of the following is a factor of

$$P(x) = x^4 - 7x^3 + 14x^2 - 3x - 9?$$

Possibilities:

- (a) $x + 1$
- (b) $x - 3$
- (c) $x + 3$
- (d) $x - 2$
- (e) $x + 2$

12. Let $f(x) = 4 - 2x^2$ and $g(x) = x + 1$.

Which of the following expressions represents the composite function $(f \circ g)(x) = f(g(x))$?

Possibilities:

- (a) $f(g(x)) = x^2 + 2x - 2$
- (b) $f(g(x)) = 2x^2 - 4x + 2$
- (c) $f(g(x)) = 2x^2 + 4x - 2$
- (d) $f(g(x)) = -2x^2 - 4x + 2$
- (e) $f(g(x)) = -2x^2 + 4x + 2$

13. The horizontal and vertical asymptotes (if any) of the rational function

$$r(x) = \frac{4x + 2}{x - 3}$$

are:

Possibilities:

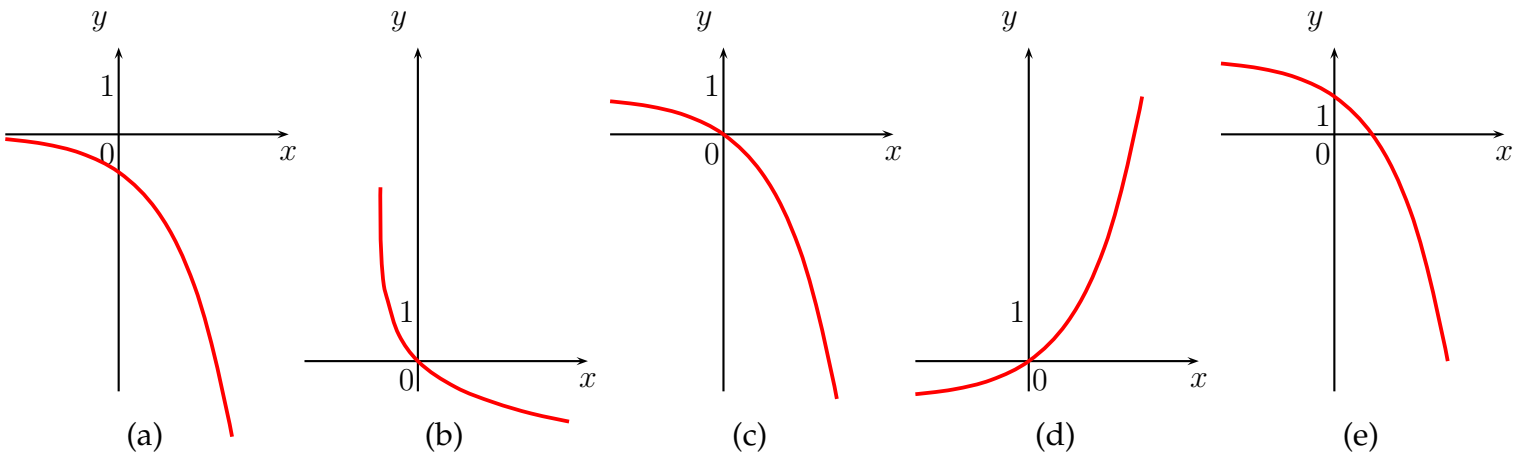
- (a) **Horizontal asymptote:** none ; **Vertical asymptotes:** $x = 3$
- (b) **Horizontal asymptote:** $y = 4$; **Vertical asymptotes:** $x = -3$
- (c) **Horizontal asymptote:** $y = -\frac{2}{3}$; **Vertical asymptotes:** $x = 3$
- (d) **Horizontal asymptote:** $y = 0$; **Vertical asymptotes:** $x = -3$
- (e) **Horizontal asymptote:** $y = 4$; **Vertical asymptotes:** $x = 3$

14. The graph of the function

$$y = -\ln(x + 1)$$

is

Possibilities:



15. Write

$$\frac{1}{216} = 6^{-3}$$

in logarithmic form.

Possibilities:

(a) $\log_3 \frac{1}{6} = 216$

(b) $\log_6 \frac{1}{216} = 3$

(c) $\log_{216} \frac{1}{6} = -3$

(d) $\log_6 \frac{1}{216} = -3$

(e) $\log_3 216 = 6$

16. If we use common logarithms to find the exact solution of the equation

$$3^{2x-4} = 5,$$

we obtain:

Possibilities:

(a) $x = \frac{\log 5 + 4 \log 3}{2 \log 3}$

(b) $x = \frac{\log 5 + 4 \log 3}{2}$

(c) $x = \frac{\log 5 - 4 \log 3}{2 \log 3}$

(d) $x = \frac{1}{2} \left(\frac{5}{3} + 4 \right)$

(e) $x = \frac{\log 5 - \log 3}{\log(3^2)}$

17. If we use the Laws of Logarithms to combine the expressions

$$\log 5 + 2 \log x - 3 \log(x^2 + 1)$$

we obtain:

Possibilities:

(a) $\log(5x^2(x^2 + 1)^3)$

(b) $\log(30x(x^2 + 1))$

(c) $\log\left(\frac{5x^2}{(x^2 + 1)^3}\right)$

(d) $\log\left(5 + x^2 - (x^2 + 1)^3\right)$

(e) $\log\left(\frac{5x}{x^2 + 1}\right)$

18. How long will it take for an investment of \$10,000 to triple in value if the investment is compounded continuously at an interest rate of 8%?

Possibilities:

(a) $t = \frac{\ln 2}{8}$ years

(b) $t = \frac{\ln 30,000}{0.08}$ years

(c) $t \approx 8.78$ years

(d) $t = 3$ years

(e) $t = \frac{\ln 3}{0.08}$ years

19. The domain of the function

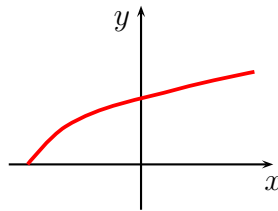
$$h(x) = e^{x-2}$$

is:

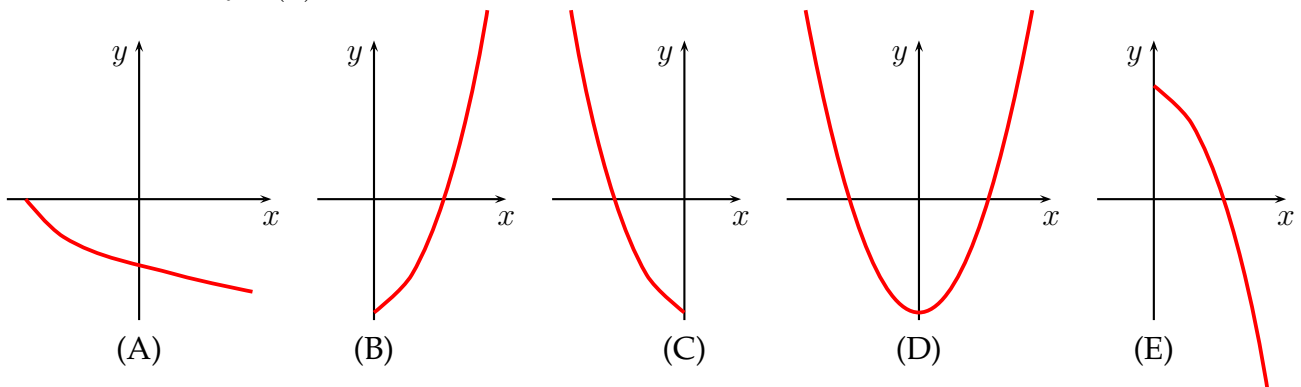
Possibilities:

- (a) $x \geq 2$
- (b) $x \leq 2$
- (c) $x > 0$
- (d) all real numbers x
- (e) $-2 \leq x \leq 2$

20. The graph provided below



is the graph of the one-to-one function $f(x) = \sqrt{x+4}$. Which of the following is the graph of the inverse function $f^{-1}(x)$?



Possibilities:

- (a) (A)
- (b) (B)
- (c) (C)
- (d) (D)
- (e) (E)