

MA 16200
FINAL EXAM Form A
December 16, 2015

NAME _____ YOUR TA'S NAME _____

STUDENT ID # _____ RECITATION TIME _____

1. You must use a #2 pencil on the mark-sense sheet (answer sheet).
2. If the cover of your question booklet is GREEN, write 01 in the TEST/QUIZ NUMBER boxes and blacken in the appropriate spaces below. If the cover is ORANGE, write 02 in the TEST/QUIZ NUMBER boxes and darken the spaces below.
3. On the mark-sense sheet, fill in your TA's name and the course number.
4. Fill in your NAME and STUDENT IDENTIFICATION NUMBER and blacken in the appropriate spaces.
5. Fill in your four-digit SECTION NUMBER. If you do not know your section number, please ask your TA.
6. Sign the mark-sense sheet.
7. Fill in your name and your instructor's name on the question sheets above.
8. There are 25 questions, each worth 8 points. Blacken in your choice of the correct answer in the spaces provided for questions 1-25. Do all your work on the question sheets.
9. Turn in both the mark-sense sheets and the question sheets when you are finished.
10. If you finish the exam before 12:20, you may leave the room after turning in the scantron sheet and the exam booklet. If you don't finish before 12:20, you MUST REMAIN SEATED until your TA comes and collects your scantron sheet and your exam booklet.
11. NO CALCULATORS, PHONES, BOOKS, OR PAPERS ARE ALLOWED. Use the back of the test pages for scrap paper.

EXAM POLICIES

1. Students may not open the exam until instructed to do so.
2. Students must obey the orders and requests by all proctors, TAs, and lecturers.
3. No student may leave in the first 20 min or in the last 10 min of the exam.
4. Books, notes, calculators, or any electronic devices are not allowed on the exam, and they should not even be in sight in the exam room. Students may not look at anybody else's test, and may not communicate with anybody else except, if they have a question, with their TA or lecturer.
5. After time is called, the students have to put down all writing instruments and remain in their seats, while the TAs will collect the scantrons and the exams.
6. Any violation of these rules and any act of academic dishonesty may result in severe penalties. Additionally, all violators will be reported to the Office of the Dean of Students.

I have read and understand the exam rules stated above:

STUDENT NAME: _____

STUDENT SIGNATURE: _____

1. Find the vector projection of $\vec{b} = \langle -3, 1 \rangle$ onto $\vec{a} = \langle 2, 1 \rangle$

- A. $\langle 1, \frac{1}{2} \rangle$
- B. $\langle -2, -1 \rangle$
- C. $\langle \frac{2}{5}, \frac{1}{5} \rangle$
- D. $\langle \frac{-2}{5}, \frac{-1}{5} \rangle$
- E. $\langle \frac{-4}{5}, \frac{-2}{5} \rangle$

2. Find a unit vector that is perpendicular to both $\vec{a} = \langle 2, 1, 1 \rangle$ and $\vec{b} = \langle -1, -1, 1 \rangle$

- A. $\frac{1}{\sqrt{14}} \langle 2, -3, -1 \rangle$
- B. $\frac{1}{\sqrt{14}} \langle 2, 3, -1 \rangle$
- C. $\frac{1}{\sqrt{14}} \langle 1, 3, -2 \rangle$
- D. $\frac{1}{\sqrt{14}} \langle 2, 1, -3 \rangle$
- E. $\frac{1}{\sqrt{14}} \langle -2, 1, 3 \rangle$

3. Find the area of the triangle with vertices at $P(0, 1, 0)$, $Q(2, 2, 1)$, and $R(1, 2, 2)$

A. $\sqrt{11}$

B. $\sqrt{13}$

C. $\frac{\sqrt{11}}{2}$

D. $\frac{\sqrt{13}}{2}$

E. $\frac{3}{2}$

4. The base of a solid S is a triangular region with vertices at $(0, 0)$, $(0, 1)$, and $(2, 1)$. If the cross-sections perpendicular to the x -axis are squares, calculate the volume of S .

A. $\frac{3}{4}$

B. $\frac{2}{3}$

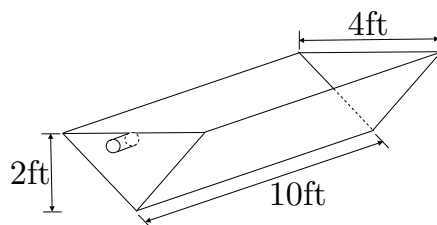
C. $\frac{5}{6}$

D. $\frac{5}{8}$

E. $\frac{1}{2}$

5. A triangular tank with height 2ft, width 4ft, and length 10ft is full of water. Find the work required to pump all of the water out from the spout at the top of the tank. Use the fact that water weighs 62.5 lb/ft^3 .

- A. $\frac{250}{3}$ ft-lb
 B. $\frac{2500}{3}$ ft-lb
 C. $\frac{5000}{3}$ ft-lb
 D. 2500 ft-lb
 E. 5000 ft-lb



6. Evaluate the integral.

$$\int_{-1}^0 \frac{9x}{e^{3x}} dx$$

- A. $-2e^3 - 1$
 B. $-\frac{3}{2}e^3 + 2$
 C. $3e^3 - 3$
 D. $9e^3$
 E. $\frac{3}{2}e^3$

7. Evaluate the integral.

$$\int_0^{\pi/2} \sin^2(x) \sin(2x) dx$$

Hint: $\cos^2 \theta = \frac{1 + \cos 2\theta}{2}$ and $\sin^2 \theta = \frac{1 - \cos 2\theta}{2}$

- A. 0
- B. $\frac{7}{12}$
- C. $\frac{8}{15}$
- D. $\frac{1}{2}$
- E. $\frac{1}{3}$

8. What does the integral $\int \frac{x^2}{\sqrt{x^2 + 25}} dx$ become after a trigonometric substitution?

- A. $25 \int (\tan^2 \theta)(\sec \theta) d\theta$
- B. $5 \int (\tan^2 \theta)(\sec \theta) d\theta$
- C. $25 \int \frac{\tan^2 \theta}{\sec \theta} d\theta$
- D. $5 \int \frac{\tan^2 \theta}{\sec \theta} d\theta$
- E. $25 \int \sin^2 \theta d\theta$

9. Compute $\int_0^4 \sqrt{16 - x^2} dx$. Hint: $\cos^2 \theta = \frac{1 + \cos 2\theta}{2}$ and $\sin^2 \theta = \frac{1 - \cos 2\theta}{2}$

- A. 2
- B. 4
- C. 0
- D. 2π
- E. 4π

10. Compute $\int \frac{1}{x^2 - x} dx =$

- A. $-\frac{1}{2} \tan^{-1} \left(x + \frac{1}{2} \right) + C$
- B. $\ln |x^2 - x| + C$
- C. $\ln \left| \frac{x}{x-1} \right| + C$
- D. $\ln \left| \frac{x-1}{x} \right| + C$
- E. $-\frac{1}{2} \tan^{-1}(x) + C$

11. Compute $\int \frac{dx}{3x^2\sqrt{4x^2+9}}$ by using the following formula:

$$\int \frac{du}{u^2\sqrt{u^2+a^2}} = \frac{-\sqrt{a^2+u^2}}{a^2u} + C$$

- A. $\frac{-2\sqrt{9+4x^2}}{27x} + C$
- B. $\frac{-\sqrt{9+4x^2}}{27x} + C$
- C. $\frac{-\sqrt{9+4x^2}}{9x} + C$
- D. $\frac{-\sqrt{9+4x^2}}{6x} + C$
- E. $\frac{-\sqrt{9+4x^2}}{3x} + C$

12. Find all values of p for which the integral $\int_{-\infty}^0 e^{(p-1)x} dx$ converges.

- A. $p < 1$
- B. $p < 0$
- C. $p > 1$
- D. $p > 0$
- E. The integral diverges for all p

13. The derivative of a function g is $g'(x) = \sqrt{\sec^2 x \tan^2 x - 1}$. What is the length of the curve $y = g(x)$ on the interval $0 \leq x \leq \frac{\pi}{4}$?

A. $\sqrt{2} - 1$

B. $\frac{\sqrt{2}}{2} - 1$

C. $\frac{\sqrt{2}}{2}$

D. $\sqrt{2}$

E. 1

14. The region bounded by the curves $y = x^2$, $y = 0$, and $x = 2$ has area $\frac{8}{3}$. If its centroid is at (\bar{x}, \bar{y}) , then $\bar{x} =$

A. $3/2$

B. $6/5$

C. $3/5$

D. $3/4$

E. 2

15. Which of the following sequences converge?

I. $a_n = \frac{\sqrt{n^2 + 2n}}{2n^2 + 1}$

II. $a_n = \frac{\ln n}{n + 2}$

III. $a_n = \frac{(-1)^n n}{n^2 + 1}$

A. II and III

B. I and II

C. I and III

D. I only

E. I, II, and III

16. Compute

$$\sum_{n=1}^{\infty} \frac{2^{n-1} + (-1)^n}{4^n}$$

A. $\frac{1}{5}$

B. $\frac{2}{5}$

C. $\frac{-3}{5}$

D. $\frac{3}{10}$

E. $\frac{-3}{10}$

17. Which of following statement(s) is/are correct?

I. If the Ratio Test is inconclusive, then the series is either divergent or conditionally convergent.

II. $\sum_{n=1}^{\infty} \frac{\ln n}{n}$ diverges by direct comparison to $\sum_{n=1}^{\infty} \frac{1}{n}$

III. $\sum_{n=1}^{\infty} \frac{1}{n(\ln n)^2}$ converges by the Integral Test.

- A. II only
- B. III only
- C. I and II only
- D. II and III only
- E. I, II, and III

18. Find the interval of convergence of

$$\sum_{n=0}^{\infty} (-1)^n \frac{(x-3)^n}{2n+1}$$

- A. $[3, 4]$
- B. $(2, 4)$
- C. $[2, 4)$
- D. $(2, 4]$
- E. $[2, 4]$

19. The first 3 terms of the Maclaurin series of $f(x) = \frac{x}{1+x^3}$ are

- A. $x + x^4 + x^7$
- B. $x - x^4 + x^7$
- C. $1 - x^3 + x^6$
- D. $1 + x^3 + x^6$
- E. $-x - x^4 - x^7$

20. The binomial series is

$$(1+x)^k = \sum_{n=0}^{\infty} \binom{k}{n} x^n = 1 + kx + \frac{k(k-1)}{2!}x^2 + \frac{k(k-1)(k-2)}{3!}x^3 + \dots$$

If $(1+3x)^{-1/3} = 1 + c_1x + c_2x^2 + c_3x^3 + \dots + c_nx^n + \dots$, then c_3 is equal to

- A. $45/4$
- B. $1/4$
- C. $1/3$
- D. $-15/2$
- E. $-14/3$

21. Find the first four terms of the Taylor series of $f(x) = x^3 - 4x + 1$ centered at $a = 3$.

- A. $16 + 23(x - 3) + 18(x - 3)^2 + 6(x - 3)^3$
- B. $16 - 23(x - 3) + 18(x - 3)^2 - 6(x - 3)^3$
- C. $16 + 23(x - 3) + 9(x - 3)^2 + (x - 3)^3$
- D. $16 + 23(x - 3) + 9(x - 3)^2 - (x - 3)^3$
- E. $16 + 23(x - 3) + 3(x - 3)^2 + 6(x - 3)^3$

22. The binomial series is

$$(1 + x)^k = \sum_{n=0}^{\infty} \binom{k}{n} x^n = 1 + kx + \frac{k(k-1)}{2!} x^2 + \frac{k(k-1)(k-2)}{3!} x^3 + \dots$$

What is the power series representation of

$$f(x) = \frac{1}{\sqrt[4]{1+x}}?$$

- A. $\sum_{n=0}^{\infty} \frac{(-1)^n [1 \cdot 5 \cdot 9 \cdot \dots \cdot (2n-1)]}{4^n n!} x^n$
- B. $\sum_{n=0}^{\infty} \frac{(-1)^n [1 \cdot 3 \cdot 5 \cdot \dots \cdot (2n+1)]}{4^{n+1} n!} x^n$
- C. $\sum_{n=0}^{\infty} \frac{(-1)^n [1 \cdot 3 \cdot 5 \cdot \dots \cdot (2n-1)]}{4^n n!} x^n$
- D. $\sum_{n=0}^{\infty} \frac{(-1)^n (2n+1)}{4^n n!} x^n$
- E. $\sum_{n=0}^{\infty} \frac{(-1)^n [1 \cdot 5 \cdot 9 \cdot \dots \cdot (4n-3)]}{4^n n!} x^n$

23. Given the parametric equations $x = 4 + t^7$ and $y = t + t^3$ what is $\frac{d^2y}{dx^2}$?

A. $\frac{-15t^2 - 6}{t^7}$

B. $\frac{9t^4 + 6t^2 + 1}{49t^{12}}$

C. $\frac{1}{7t^4}$

D. $\frac{1 + 3t^2}{7t^6}$

E. $\frac{-12t^2 - 6}{49t^{13}}$

24. Which of these lines is an asymptote of the hyperbola $x^2 - 4y^2 - 2x - 3 = 0$?

A. $y = \frac{1}{2}x + \frac{3}{2}$

B. $y = \frac{1}{2}x - \frac{1}{2}$

C. $y = -\frac{1}{2}x - \frac{1}{2}$

D. $y = \frac{1}{2}x - \frac{3}{2}$

E. $y = -\frac{1}{2}x - \frac{3}{2}$

25. Write $-5i$ in polar form with the argument between 0 and 2π .

A. $25(\cos(\frac{3\pi}{2}) - i \sin(\frac{3\pi}{2}))$

B. $5(\cos(\frac{3\pi}{2}) - i \sin(\frac{3\pi}{2}))$

C. $5(\cos(\frac{\pi}{2}) + i \sin(\frac{\pi}{2}))$

D. $25(\cos(\frac{\pi}{2}) + i \sin(\frac{\pi}{2}))$

E. $5(\cos(\frac{3\pi}{2}) + i \sin(\frac{3\pi}{2}))$