MATH 152, Spring 2022

EXAM II - VERSION B

LAST NAME(print): ________________________________ FIRST NAME(print): ________________________________

UIN: ________________________________

INSTRUCTOR: ________________________________

SECTION NUMBER: ________________

DIRECTIONS:

1. No calculator, cell phones, or other electronic devices may be used, and they must all be put away out of sight.
2. TURN OFF cell phones and put them away. If a cell phone is seen during the exam, your exam will be collected and you will receive a zero.
3. In Part 1, mark the choice on your ScanTron using a No. 2 pencil. The scantrons will not be returned, therefore *for your own records, also record your choices on your exam!*
4. In Part 2, present your solutions in the space provided. *Show all your work* neatly and concisely and *clearly indicate your final answer*. You will be graded not merely on the final answer, but also on the quality and ness of the work leading up to it.
5. **Be sure to *fill in your name, UIN, section number and version letter of the exam* on the ScanTron *form.***

THE AGGIE CODE OF HONOR

"An Aggie does not lie, cheat or steal, or tolerate those who do."

Signature: ____

PART I: Multiple Choice. 4 points each.

1. Which of the following series diverges by the Test for Divergence?

   (a) $\sum_{n=1}^{\infty} \ln\left(\frac{n}{n+1}\right)$

   (b) $\sum_{n=1}^{\infty} \sin\left(\frac{1}{n}\right)$

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

   (d) $\sum_{n=1}^{\infty} e^{-n}$

   (e) The Test for Divergence fails for all of the above series.

2. Which of the following is a proper Partial Fraction Decomposition for $\frac{x+1}{(x^2-16)(x-3)^2(x^2+1)}$?

   (a) $\frac{x+1}{(x^2-16)(x-3)^2(x^2+1)} = \frac{A}{x-4} + \frac{B}{x+4} + \frac{C}{x-3} + \frac{D}{(x-3)^2} + \frac{Ex+F}{x^2+1}$

   (b) $\frac{x+1}{(x^2-16)(x-3)^2(x^2+1)} = \frac{Ax+B}{x^2-16} + \frac{C}{x-3} + \frac{D}{(x-3)^2} + \frac{Ex+F}{x^2+1}$

   (c) $\frac{x+1}{(x^2-16)(x-3)^2(x^2+1)} = \frac{Ax+B}{x^2-16} + \frac{Cx+D}{(x-3)^2} + \frac{Ex+F}{x^2+1}$

   (d) $\frac{x+1}{(x^2-16)(x-3)^2(x^2+1)} = \frac{A}{x-4} + \frac{B}{x+4} + \frac{C}{x-3} + \frac{D}{(x-3)^2} + \frac{E}{x^2+1}$

   (e) $\frac{x+1}{(x^2-16)(x-3)^2(x^2+1)} = \frac{A}{x-4} + \frac{B}{(x-4)^2} + \frac{C}{x-3} + \frac{D}{(x-3)^2} + \frac{Ex+F}{x^2+1}$

3. Which of the following statements is/are true for the sequences shown below?

   (I) $a_n = \cos\left(\frac{1}{n}\right)$ (II) $a_n = \frac{\cos(n)}{n}$

   (a) (I) converges to 0, and (II) converges to zero.

   (b) (I) converges to 1, and (II) converges to zero.

   (c) (I) diverges, and (II) converges to zero.

   (d) (I) converges to 1, and (II) diverges

   (e) Both diverge

4. Which of the following integrals are improper?

(I) $\displaystyle\int_0^1 \frac{1}{3x-1}\,dx$ (II) $\displaystyle\int_1^3 \ln(x-1)\,dx$ (III) $\displaystyle\int_{-\infty}^1 \frac{1}{x^4}\,dx$

(a) (III) only
(b) (I) and (III) only
(c) (II) and (III) only
(d) (I) and (II) only
(e) All of them are improper.

5. Consider the recursive sequence $a_1 = 2$, $a_{n+1} = 5 - \dfrac{4}{a_n}$. Given the sequence is increasing and bounded, find the limit.

(a) 1
(b) 4
(c) 2
(d) $\dfrac{5}{2}$
(e) 5

6. Which of the following statements is true regarding the improper integral $\displaystyle\int_1^\infty \frac{\cos^2 x + 5}{x^4}\,dx$?

(a) It converges since $\displaystyle\int_1^\infty \frac{\cos^2 x + 5}{x^4}\,dx \le \int_1^\infty \frac{5}{x^4}\,dx$, which converges.
(b) It converges since $\displaystyle\int_1^\infty \frac{\cos^2 x + 5}{x^4}\,dx \le \int_1^\infty \frac{1}{x^4}\,dx$, which converges.
(c) It diverges by oscillation.
(d) It converges to zero.
(e) It converges since $\displaystyle\int_1^\infty \frac{\cos^2 x + 5}{x^4}\,dx \le \int_1^\infty \frac{6}{x^4}\,dx$, which converges.

7. Find the limit of the sequence $a_n = \arcsin\left(\frac{n+1}{1-2n}\right)$.

(a) $-\frac{\pi}{3}$

(b) $\frac{4\pi}{3}$

(c) $-\frac{\pi}{6}$

(d) $\frac{7\pi}{6}$

(e) $\frac{\pi}{2}$

8. After an appropriate trigonometric substitution, $\int_{2\sqrt{2}}^{4} \frac{\sqrt{x^2-4}}{x}\,dx$ is equivalent to which of the following?

(a) $\int_{\pi/4}^{\pi/6} \sin(\theta)\,d\theta$

(b) $\int_{\pi/4}^{\pi/3} \sin(\theta)\,d\theta$

(c) $2\int_{\pi/4}^{\pi/6} \tan^2\theta\,d\theta$

(d) $2\int_{\pi/4}^{\pi/3} \tan^2\theta\,d\theta$

(e) None of the above

9. $\int \frac{x^3+x}{x-1}\,dx =$

(a) $\frac{x^3}{3}+\frac{x^2}{2}+2x+2\ln|x-1|+C$

(b) $\frac{x^3}{3}-\frac{x^2}{2}+2x+2\ln|x-1|+C$

(c) $\frac{x^3}{3}+\frac{x^2}{2}+2x-2\ln|x-1|+C$

(d) $\frac{x^3}{3}+\frac{x^2}{2}-2x+2\ln|x-1|+C$

(e) $\frac{x^3}{3}-\frac{x^2}{2}+2x-2\ln|x-1|+C$

10. Suppose $s_n = \dfrac{3n+4}{2n+2}$ is the sequence of partial sums for the series $\sum_{n=1}^{\infty} a_n$. Find $\sum_{n=1}^{\infty} a_n$ and a_4.

(a) $\sum_{n=1}^{\infty} a_n = \dfrac{3}{2}$ and $a_4 = -\dfrac{1}{60}$

(b) $\sum_{n=1}^{\infty} a_n = \dfrac{3}{2}$ and $a_4 = -\dfrac{1}{40}$

(c) $\sum_{n=1}^{\infty} a_n = 2$ and $a_4 = -\dfrac{1}{40}$

(d) $\sum_{n=1}^{\infty} a_n = \dfrac{3}{2}$ and $a_4 = -\dfrac{129}{40}$

(e) $\sum_{n=1}^{\infty} a_n = 2$ and $a_4 = -\dfrac{1}{60}$

11. After an appropriate trigonometric substitution, $\displaystyle\int \frac{dx}{\sqrt{x^2+8x+41}}$ is equivalent to which of the following?

(a) $\dfrac{1}{5}\displaystyle\int \cos(\theta)\, d\theta$

(b) $\dfrac{1}{5}\displaystyle\int \sin(\theta)\, d\theta$

(c) $\displaystyle\int \sec^2(\theta)\, d\theta$

(d) $\displaystyle\int \tan(\theta)\, d\theta$

(e) $\displaystyle\int \sec(\theta)\, d\theta$

12. Evaluate $\displaystyle\int_1^{\infty} \frac{e^{2/x}}{x^2}\, dx$.

(a) $-2\left(1-e^2\right)$

(b) $2\left(1-e^2\right)$

(c) $-\dfrac{1}{2}\left(1-e^2\right)$

(d) $\dfrac{1}{2}\left(1-e^2\right)$

(e) $\dfrac{1}{2}e^2$

13. $\displaystyle\sum_{n=1}^{\infty} \frac{(-3)^{n+1}}{4^n} =$

(a) 9

(b) $\frac{2}{3}$

(c) $\frac{9}{7}$

(d) $-\frac{12}{7}$

(e) -12

14. The sequence $a_n = \frac{1}{3}\ln(4+2n) - \frac{1}{3}\ln(4n+1)$

(a) Converges to $\frac{1}{3}\ln(2)$

(b) Diverges

(c) Converges to 0

(d) Converges to $\frac{1}{3}\ln(4)$

(e) Converges to $\frac{1}{3}\ln\left(\frac{1}{2}\right)$

True or False. On your scantron, bubble 'a' if true and bubble 'b' if false. One point each.

15. Given $f(x)$ and $g(x)$ are continuous, positive functions on the interval $[a,\infty)$ and $f(x) \geq g(x)$ on the interval $[a,\infty)$. If $\int_a^{\infty} g(x)\,dx$ diverges, so does $\int_a^{\infty} f(x)\,dx$.

16. If $\lim_{n\to\infty} a_n = 0$, then $\displaystyle\sum_{n=1}^{\infty} a_n$ converges.

17. If $\lim_{n\to\infty} s_n = 1$, then $\displaystyle\sum_{n=1}^{\infty} a_n$ diverges.

18. The geometric series $\displaystyle\sum_{n=2}^{\infty} ar^{n-1}$ converges if $|r| < 1$.

PART II: Free Response: Show all work and box your final answer!

19. (10 pts) $\displaystyle\int \frac{2x^2 + 2x + 1}{x^2(x^2+1)}\,dx$

20. (10 pts) Find $\int \frac{x^2}{\sqrt{9-x^2}}\,dx$

21. Consider the series $\displaystyle\sum_{n=1}^{\infty} \frac{1}{(n+5)[\ln(n+5)]^2}$

(a) (6 pts) Prove the series converges.

(b) (4 pts) Using the Remainder Estimate for the Integral Test, find an upper bound on the remainder, R_6, if we used s_6, the 6^{th} partial sum, to approximate the sum of the series.

22. Consider the series $\sum_{n=1}^{\infty} \frac{6}{n(n+2)}$

(a) (6 pts) Find a formula for s_n, the n^{th} partial sum.

(b) (4 pts) Find the sum of the series.

DO NOT WRITE IN THIS TABLE.

Question	Points Awarded	Points
1-18		60
19		10
20		10
21		10
22		10
		100