$Math \underbrace{2300, Exam}_{\text{June 17, 2019}} 1$

PRINT INSTRUCTOR'S NAME:

- No calculators or cell phones or other electronic devices allowed at any time.
- Show all your reasoning and work for full credit, except where otherwise indicated. Use full mathematical or English sentences.
- You have 1 hour 30 minutes and the exam is 100 points.
- You do not need to simplify numerical expressions like 100/7 or expressions like $\ln(3)/2$ as is. You do need to simplify numerical expressions like $\ln(1)$ and $\sin\left(\frac{\pi}{4}\right)$.
- When done, give your exam to the proctor, who will mark your name off on a photo roster.

Section 400	Patrick Newberry	9:15 - 10:35	Section 402	Harrison Stalvey	11:00 - 12:20
Section 401	Kevin Manley	11:00 - 12:20	Section 403	Al Bronstein	12:45 - 2:05

Mark your section/instructor:

Question	Points	Score
1	5	
2	5	
3	5	
4	5	
5	5	
6	15	
7	15	
8	15	
9	15	
10	15	
Total:	100	

1. (5 points) Evaluate $\int_{1}^{e} 3x^{2} \ln x \, dx$.

(A.)
$$-3e + 3$$

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

2. (5 points) Evaluate
$$\int \arctan(2x) dx$$
.

(A.)
$$x \arctan(2x) - \frac{1}{4}\ln(1+4x^2) + C$$

(B.) $x \arctan(2x) - \frac{1}{2}\ln(1+4x^2) + C$
(C.) $\frac{2}{1+4x^2} + C$
(D.) $x \arctan(2x) - \frac{1}{8}\ln(1+4x^2) + C$
(E.) $x \arctan(2x) - \frac{1}{2}x^2 + C$

3. (5 points) Does the following integral converge or diverge? Choose the correct answer with the best justification.

$$\int_{1}^{\infty} \frac{x^2}{3x^4 + 5x} dx$$
(A.) Diverges by comparison with $\int_{1}^{\infty} \frac{1}{3x^2} dx$
(B.) Converges by comparison with $\int_{1}^{\infty} \frac{1}{3x^2} dx$
(C.) Converges by comparison with $\int_{1}^{\infty} \frac{1}{x} dx$
(D.) Diverges by comparison with $\int_{1}^{\infty} \frac{1}{3} dx$
(E.) Converges by comparison with $\int_{1}^{\infty} \frac{1}{3} dx$

4. (5 points) Given
$$\int_{0}^{1} f(x) dx = 8$$
 and $\int_{5}^{6} f(x) dx = 5$,
evaluate $\int_{0}^{1} x f(x^{2} + 5) dx$.

- (A.) 10
- (B.) 16
- (C.) 4
- (D.) 5
- (E.) $\frac{5}{2}$

5. (5 points) Which one of the following graphs would give an overestimate when using left-hand endpoints and an underestimate when using midpoints for approximating the area under the curve.



6. (15 points) Evaluate
$$\int \frac{3x^2 + 15x}{(x-1)^2(x+2)} dx.$$

7. (15 points) Evaluate $\int e^x \sin(2x) dx$.

8. (15 points) Evaluate: $\int \sin^2 x \cos^3 x \, dx$.

9. (15 points) Evaluate:
$$\int \frac{1}{\sqrt{x^2+1}} dx$$

10. (15 points)

(a) Explain why
$$\int_{-1}^{1} \frac{1}{x^3} dx$$
 is an improper integral.

(b) Determine if
$$\int_{-1}^{1} \frac{1}{x^3} dx$$
 converges or diverges.