Name: _____

Student ID number: _____

TA/classroom:_____

Guidelines for the test:

- Put your name or student ID number on every page.
- There are 11 problems
- The exam is closed book; calculators are not allowed.
- There is no partial credit for problem 1-3.
- For other problems, please show all work, unless instructed otherwise. Partial credit will be given only for work shown. Print as legibly as possible - correct answers may have points taken off, if they're illegible.
- **Mark the final answer**.

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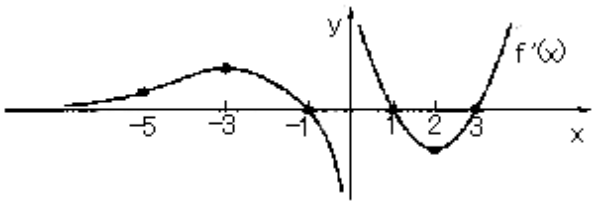
1. (2 pts each) $f(x)$ is a **continuous** function on $(-\infty, \infty)$ and the graph of its **derivative**, $f'(x)$, is shown in the figure below.

   (Note: $\lim_{x\to-\infty} f'(x) = 0$; $\lim_{x\to\infty} f'(x) = \infty$)



   Answer the following True/False questions (True $\Rightarrow \bigcirc$; False $\Rightarrow \times$).

   - _____ $(1, f(1))$ is an inflection point.
   - _____ f has a local maximum at $x = -1$
   - _____ f has a local minimum at $x = 1$
   - _____ $f(x)$ has 3 critical numbers.

2. (2 pts each) Suppose $f(x)$ is a continuous function, and $F(x)$ is an antiderivative function of $f(x)$, i.e., $F'(x) = f(x)$. Answer the following True/False questions (True $\Rightarrow \bigcirc$; False $\Rightarrow \times$).

   - _____ If $f(x)$ is an odd function, then $F(x)$ is an even function.
   - _____ If $f(x)$ is an even function, then $F(x)$ is an odd function.
   - _____ If $f(x)$ is a periodic function, then $F(x)$ is a periodic function.
   - _____ If $f(x)$ is monotonically increasing, then $F(x)$ is monotonically increasing.

   Note:

   - The graph of an even function is symmetric with respect to the y-axis.
   - The graph of an odd function is symmetric with respect to the origin.
   - A function f is called monotonic increasing, if for all x and y such that $x \leq y$ one has $f(x) \leq f(y)$.

3. (2 pts each) Answer the True/False questions (True $\Rightarrow \bigcirc$; False $\Rightarrow \times$).

   - _____ $2 - \cos x$ is an antiderivative function of $\sin x$.
   - _____ $2\sin^2 \dfrac{x}{2}$ is an antiderivative function of $\sin x$.

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4. Evaluate each of the following limits.

   (a) (5 pts) $\lim_{x\to 0^+} \sin x \, \ln x$

   (b) (5 pts) $\lim_{x\to 0^+} x^{\sin x}$

5. Find $\frac{dy}{dx}$ for each of the following.

   (a) (5 pts) $y = x^{\sin x}$, $x > 0$.

   (b) (5 pts) $y = e^{2x}\dfrac{\sqrt{x+1}}{x^2+2}(2x+1)^5, \quad x > 0.$

6. (10 pts) Given that $F(x) = \displaystyle\int_1^{x^2} e^{t^2}\, dt$, for $x \geq 0$,

   (a) Find $F'(x)$

   (b) Find $(F^{-1})'(0)$

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7. Evaluate the given integral

   (a) (5 pts) $\int e^{2x} \sin x \, dx.$

   (b) (5 pts) $\int \frac{\sqrt{\ln x}}{x} \, dx,$

   (c) (5 pts) $\int \frac{3x}{(x+1)(x-4)} \, dx,$

8. (10 pts) Evaluate the definite integrals $\int_1^4 e^{\sqrt{x}} \, dx$

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9. (a) (5 pts) Evaluate $\int \cos^2\theta\, d\theta$.

(b) (5 pts) Use the trigonometric substitution to evaluate $\int_0^1 \sqrt{1-x^2}\, dx$,

10. (5 pts) Use formulas for indefinite integrals to evaluate $\int \frac{1}{x^2-4x+5}\, dx$.

11. Evaluate the given integral

(a) (5 pts) $\int_{-1}^{1} x^{-2}\, dx$

(b) (5 pts) $\int_{-\infty}^{\infty} x\, dx$