

NOTES:

1. Make sure your NAME is on the front of the green book.
2. Problems can be written in the green book IN ANY ORDER, but please START each problem on a NEW PAGE (EITHER side) and label it properly.
3. PLEASE *label* (or underline or box in) all ANSWERS clearly.
4. There are 100 points possible on this test. The point value of each problem is listed in parentheses after the number.
5. Show your WORK — partial credit is possible only when all work needed to obtain an answer is presented legibly.
6. **NO CALCULATORS!**

1. (18) Let $f(x) = 6 - 3x^2 - x^3$.

- (a) Using Calculus methods, find all possible values of x where $f(x)$ attains a relative maximum or minimum and indicate which x -value corresponds to which type of extremal point.
- (b) At which x value does $f(x)$ have a “point of inflection” (i.e., where the concavity changes)?

2. (18) Evaluate the following limits:

(a) $\lim_{x \rightarrow 0} \frac{\cos(x^2) - 1}{x^3}$ (b) $\lim_{x \rightarrow 0^+} \frac{1}{x} - \frac{1}{\sqrt{x}}$

3. (14) Solve the following differential equation, given that the curve goes through the point (1,3):

$$\frac{dy}{dx} = 5x^2 - 2$$

In problems 4–7, integrate the indicated expression.

4. (10) $\int \cos^2 2x dx$

5. (10) $\int \sec^2 4x dx$

6. (10) $\int \frac{1}{\sqrt{1-4x^2}} dx$

7. (10) $\int \frac{x}{\sqrt{1-4x^2}} dx$

8. (10) Let $f(x) = 15x - 3x^2$. Given the interval $(a, b) = (1, 3)$, find the point c in the interval that satisfies the Mean Value Theorem (i.e., that the tangent line at c is parallel to the chord from $(a, f(a))$ to $(b, f(b))$).