

Please show **all** your work! Answers without supporting work will not be given credit.

Name: \_\_\_\_\_

### 1. Max and Mins

- Find the exact global maximal and minimal output of  $e^{-x^2} + x^2$  the interval  $[-2, 3]$ .
- Find all the local maximizers and minimizers (the  $x$ -coordinate) of  $x^4 - 8x^2 + 10$ .

### 2. Integration

- $\int_0^{\pi} x \sin(x) dx$
- $\int_2^4 xe^{x^2} dx$
- $\int \frac{3x + 2}{(x + 1)(1 - x)} dx$

### 3. Motion

- A rocket is launched from the ground with initial velocity of 10 feet per second. When does it achieve its maximal height? What is the maximal height?
- A penny is dropped from the MS (60 meters tall) building with 0 initial velocity. When does it hit the ground?
- You throw a ball upwards with a starting velocity of +5 meters per second from an initial height of 2 meters. When the ball returns to a height of 2 meters, what is the velocity?

### 4. Differential Equations and Applications

- Solve the differential equation  $\frac{dy}{dt} = e^{t-y}$  with initial conditions  $y(1) = 2$ .
- A Fish called Wanda lives in a lake. Normally, her body temperature is 15C. The lake's temperature is 10C. Ariel, who is on vacation in the lake, discovers Wanda is dead at 2PM with a temperature of 13C. If by the time Ariel gets Wanda to the underwater coroner it's 3PM and Wanda's temperature is 12C, when did Wanda die?