

Homework 1, due 1/28

1. Take the first and second derivatives with respect to x , namely df/dx and d^2f/dx^2 :
 - a. $f(x) = ax^3$
 - b. $f(x) = ax^{10} - bx^5 + c$
 - c. $f(x) = e^{-ax^2}$
 - d. $f(x) = a \sin kx + b \cos kx$
 - e. $f(x) = \ln ax$
 - f. $f(x) = \frac{1}{1 + ae^{-\beta x}}$
2. Perform the following integrations:
 - a. $\int x^3 dx$
 - b. $\int (ax^7 - bx^2 + c) dx$
 - c. $\int (\sin kx) dx$
 - d. $\int \frac{1}{x} dx$
 - e. $\int e^{-ax} dx$
3. Plot the functions below and find the minima and maxima as well as the roots for the following functions:
 - a. $8x^3 - 12x$
 - b. $3\cos^2 \theta - 1$
 - c. $\frac{1}{9}\rho^2 - 2\rho + 6$
4. Calculate the following determinants:
 - a. $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$
 - b. $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$

5. Calculate the following matrix calculations:

a.
$$\begin{pmatrix} 1 & 3 & 0 \\ 7 & 0 & 4 \\ 2 & 1 & 2 \end{pmatrix} \begin{pmatrix} 5 \\ 2 \\ 4 \end{pmatrix}$$

b.
$$\begin{pmatrix} 1 & 3 & 0 \\ 7 & 0 & 4 \\ 2 & 1 & 2 \end{pmatrix} \begin{pmatrix} 3 & 6 & 2 \\ 6 & 0 & 9 \\ 1 & 3 & 1 \end{pmatrix}$$

c.
$$(6 \ 1 \ 3) \begin{pmatrix} 1 & 3 & 0 \\ 7 & 0 & 4 \\ 2 & 1 & 2 \end{pmatrix}$$

6. Write a short (1-2 page) essay on how quantum mechanics was born out of the ashes of classical physics. Do not copy from book or web, write it using your own language.