

Assignment #2

Reading:

Sept 20 Kleppner & Kolenkow 2.6, 2.10, 3.3-3.6, 4.1-4.5*Sept 22* Kleppner & Kolenkow 4.6-4.10, 5.1-5.6

Problems:

9. Kleppner and Kolenkow 1.2
10. Kleppner and Kolenkow 1.4
11. Kleppner and Kolenkow 1.8
12. Kleppner and Kolenkow 2.6
13. Kleppner and Kolenkow 2.10 Your answer should include a result for the acceleration of the mass M_3 .
14. Kleppner and Kolenkow 3.5
15. If $\vec{A}(t)$ and $\vec{B}(t)$ are time-dependent vectors prove that

$$\frac{d}{dt}(\vec{A}(t) \cdot \vec{B}(t)) = \frac{d\vec{A}(t)}{dt} \cdot \vec{B}(t) + \vec{A}(t) \cdot \frac{d\vec{B}(t)}{dt}$$

16. Find the inverse of the 2×2 matrix

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}.$$

17. Find the 3×3 matrix M corresponding to a change of coordinate system from the basis $\hat{e}_1, \hat{e}_2, \hat{e}_3$ to a new basis $\hat{e}'_1, \hat{e}'_2, \hat{e}'_3$ by a rotation through θ about the \hat{e}_2 axis (clockwise as viewed along the direction of \hat{e}_2). What are the coordinates in the prime system of the vector $\vec{r} = 3\hat{e}_1 + 7\hat{e}_2 - 6\hat{e}_3$?
18. Use a Python Jupyter notebook to find the numerical values for the following quantities showing at least 8 decimal digits of accuracy:
 - (a) The quantity $\sin\{1 + 3^n\}$ for the five even values of the integer n between 2 and 10.
 - (b) The quantity

$$\sum_{i=1}^{12} \frac{1}{i^3}.$$

Finally use the same Python Jupyter notebook to construct two arrays of $N + 1$ points

$$\begin{aligned} x(n) &= \cos(2\pi * n/N) \\ y(n) &= \sin(2\pi * n/N) \end{aligned}$$

where the integer n takes all values between 0 and N . Plot the N -sided polygon joining these points for each value of N between 4 and 12. Show all 9 polygons on the same plot. You can submit your solution to this problem by simply printing your complete Jupyter notebook as a pdf file which can be appended to the file containing your solutions to previous eight problems. [See suggestions for installing Python on your laptop at http://www.columbia.edu/~nhc1/UN2801/Python/Python_index.html]