

Assignment #2 – Revised

The wording of problems 14 and 15 has been improved.

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 3.5
14. Kleppner and Kolenkow 2.10 Your answer should include a result for the acceleration of the mass M_3 .
15. Modify the previous problem by introducing a coefficient of sliding friction μ between the masses M_1 and M_2 and the horizontal surface on which they slide. Assume that both masses are sliding.
 - (a) Draw force diagrams for each mass and show all relevant directions.
 - (b) How are the accelerations related?
 - (c) Find the tension T in the rope.

16. If $\vec{A}(t)$ and $\vec{B}(t)$ are time-dependent vectors prove that

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

17. Find the inverse of the 2×2 matrix

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

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 single page which can be submitted as the final sheet in your set of solutions.