Physics 21 Problem Set 3

Harry Nelson

due Monday, January 29, In Class

Course Info: The reading this week will be: 1)Review pp. 11-19, 2)pp. 39-45 on Taylor Series, 3)p. 52-75. The material from Chapter 2 has a lot of 'enrichment' material on the discussion of Newton's Laws and units. I won't focus much on the general discussion of the Laws and units, and will proceed to working problems fairly quickly.

Prof. Nelson's office hours: Friday 2-2:50pm 5103 Broida, 4:10-5:30pm in Phelps 1508. Richard Eager's office hours are Monday 2:00-3:00pm, Tuesday 11:00-12:00noon, and Thursday 11:00-12:00noon in Broida 1019 (The Physics Study Room).

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1. Consider the function $f(x)$:

$$f(x) = \frac{1}{\cos(bx)}$$

   (a) Symbolically expand $f(x)$ to third order about the point $x = a$; that is, symbolically find the coefficients labeled 'c' in the equation:

$$f(x) \approx c_0 + c_1(x-a) + c_2(x-a)^2 + c_3(x-a)^3$$

   (b) Numerically evaluate the c coefficients for the case $b = 1/6$ and $a = \pi$.

   (c) Plot both the exact value of $f(x)$ and the third-order approximation for $0 < x < \pi$, using the coefficients of the last part.

2. K&K Problem 1.15.

3. K&K Problem 1.19. Denote the radius of the tire R, and put your answers in terms of V, R, t, and of course $\hat{\boldsymbol{\imath}}$ and $\hat{\boldsymbol{\jmath}}$. I suggest pursuing the velocity of the pebble first, using the results of the last problem. Then, the position will be equal to the integral of the velocity, plus a constant vector $c_x\hat{\boldsymbol{\imath}} + c_y\hat{\boldsymbol{\jmath}}$. Choose c_x and c_y so that the pebble is at the origin when $t = 0$.

4. K&K Problem 2.1.

5. K&K Problem 2.3.

6. K&K Problem 2.4.

7. K&K Problem 2.7.

8. K&K Problem 2.8.

9. K&K Problem 2.16. Please do this problem initially for arbitrary incline angle, θ. There are two ways to go about this problem... you can work in an accelerated frame (see p. 62, where the equation $\mathbf{F}_{\text{apparent}} = \mathbf{F}_{\text{true}} - M\ddot{\mathbf{R}}$ is a direct generalization of the answer from Problem 1.15(a)). Or, you can implement the constraint equation discussed on the top half of p. 74.
