

NORTHERN ILLINOIS UNIVERSITY

PHYSICS DEPARTMENT

Physics 283 – Modern Physics

Spring 2025

Problem Set #1

Problem Set Due: Thurs., Jan. 23, 2025

Read Krane Chapter 2

1. OpenStax University Physics Vol. 2: Section 16.2: Problem 43
2. OpenStax University Physics Vol. 2: Section 16.2: Problem 45
3. OpenStax University Physics Vol. 3: Section 3.2: Problem 28

4. Krane: Problem 3 page 66 (draw picture)

Also for this problem: prove that, to third order for x near 0, the Taylor series expansion of $1 / (1 + x^2)$ is:

$$\frac{1}{1 + x^2} \approx 1 - x^2 + x^4 + \dots$$

Use the relation that the Taylor series expansion of $f(x)$ for x near a is

$$f(x) = f(a) + f'(a)(x - a) + \frac{1}{2!}f''(a)(x - a)^2 + \frac{1}{3!}f'''(a)(x - a)^3 + \dots$$

(see Winkepedia: Google Taylor Series expansion)

5. Krane: Problem 4 page 66 (draw picture & show reference frames)

Also for this problem: prove that, to third order for x near 0, the Taylor series expansion of $\sqrt{1 + x^2}$ is:

$$\sqrt{1 + x^2} \approx 1 + \frac{x^2}{2} - \frac{x^4}{8} + \dots$$

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| 6. Krane Problem 6 | page 66 (draw picture & show reference frames) |
| 7. Krane Problem 32 | page 68 (just show derivation) |
| 8. Krane Problem 44 | page 68 (draw picture & show reference frames) |