

FIRST MIDTERM

Name (print) Zhuov Name (signed) _____

Discussion Instructor (circle): Brown Chakhbazian Condeffa Fortnoi Zhukov

Discussion Section # _____

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

Use the conversion constants and data given on the front page.

- (a) For the expression,

$$\frac{1}{(1-x)^{5/2}} = (1-x)^{-5/2} = 1 + \frac{5}{2}(-x) + \frac{5}{2} \cdot \frac{3}{2} \frac{(-x)^2}{2!} + \frac{5}{2} \cdot \frac{3}{2} \cdot \frac{1}{2} \frac{(-x)^3}{3!} + \dots$$

calculate the x^3 term in the binomial expansion.

$$= 1 - \frac{5}{2}x + \frac{15}{8}x^2 - \frac{15}{8}x^3$$

- (b) An electron is accelerated from rest in an electric field of 2.35×10^2 N/C. Calculate its speed after it has traveled 7.00 cm.

$$\frac{v_f^2}{2a} = s^2 \quad a = \frac{F}{m} = \frac{eE}{m}; \quad v = \sqrt{2eEs} = 2.40 \cdot 10^6 \text{ m/s}$$

- (c) If the radius of the earth were doubled and the mass of the earth increased by a factor of 10.0, what is the weight of a student who now weighs 1200 N?

$$R^1 = 2R \quad M^1 = 10M \quad W = G \frac{mM}{R^2} \quad W^1 = G \frac{mM^1}{R^{12}} = G \frac{m10M}{4R^2} = \frac{10}{4}W = 3000$$

- (d) Calculate the magnitude of the electric force between an electron and the nucleus of a hydrogen atom. The nuclear charge is equal to the charge of the electron. Take the distance between them as 1.00×10^{-10} m.

$$F = k \frac{e^2}{r^2} = 2.30 \cdot 10^{-8} \text{ N}$$

- (e) Calculate the speed (in m/s) of a satellite in a circular orbit 2000 km above the surface of the earth.

$$\frac{m \frac{v^2}{R}}{R} = \frac{GM}{R^2} \quad v = \sqrt{r \frac{M}{R}} = \sqrt{G \frac{M}{h+R_e}} = 6.90 \cdot 10^3 \text{ m/s}$$