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**General Physics I, Quiz 6**
PHYS10200, Class year 98
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SN:_____, Name:_____

*Chapter 22-24, Serway; ABSOLUTELY NO CHEATING!*
**Please write the answers on the blank space or on the back of this paper to save resources.**

**Example 23.7 The Electric Field of a Uniform Ring of Charge**

$$(1)\quad dE_x = k_e \frac{dq}{r^2}\cos\theta = k_e \frac{dq}{(a^2 + x^2)}\cos\theta$$

$$(2)\quad \cos\theta = \frac{x}{r} = \frac{x}{(a^2 + x^2)^{1/2}}$$

$$dE_x = k_e \frac{dq}{(a^2 + x^2)}\,\frac{x}{(a^2 + x^2)^{1/2}} = \frac{k_e x}{(a^2 + x^2)^{3/2}}\,dq$$

$$E_x = \int \frac{k_e x}{(a^2 + x^2)^{3/2}}\,dq = \frac{k_e x}{(a^2 + x^2)^{3/2}}\int dq$$

$$(3)\quad E = \frac{k_e x}{(a^2 + x^2)^{3/2}}\,Q$$

**Answer** In the expression for the field due to a ring of charge, let $x \ll a$, which results in

$$E_x = \frac{k_e Q}{a^3}\,x$$

Therefore, from Equation 23.8, the force on a charge $-q$ placed near the center of the ring is

$$F_x = -\frac{k_e q Q}{a^3}\,x$$

**P22.15** Isothermal expansion at $T_h = 523$ K

Isothermal compression at $T_c = 323$ K

Gas absorbs 1 200 J during expansion.

(a) $$|Q_c| = |Q_h|\left(\frac{T_c}{T_h}\right) = 1\,200\ \text{J}\left(\frac{323}{523}\right) = \boxed{741\ \text{J}}$$

(b) $$W_{\text{eng}} = |Q_h| - |Q_c| = (1\,200 - 741)\ \text{J} = \boxed{459\ \text{J}}$$