1. Explain and give an example

(a) Newton's first law of motion. (6%)

(b) Newton's second law of motion. (6%)

(c) Newton's third law of motion. (6%)

2. In Fig. 1(a) and Fig. 1(b), two springs of spring constant k_1 and k_2 are attached to a block of mass m. What is the frequency of simple harmonic oscillation on the frictionless floor for Fig. 1(a) and Fig. 1(b), respectively. (12%)

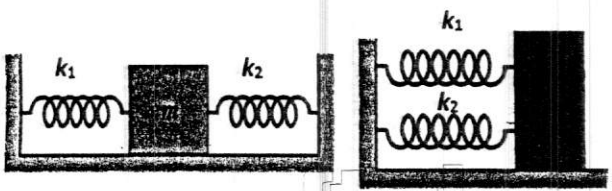

Fig. 1(a)　Fig. 1(b)

3. Fig. 2, an electron is constrained to the central axis of the ring of charge of radius R, where $z << R$. Find :

(a) the electrostatic force on the electron (10%)

(b) the period of the electron oscillate through ring center with simple harmonic motion. (10%)

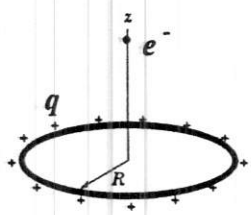

Fig. 2

(If q is the ring's charge, m is the electron mass, and e is the electron charge.)

4. In the circuit of Fig. 3, $\varepsilon = 1.2$ kV, $C = 8.5$ μF, $R_1 = R_2 = R_3 = 0.55$ MΩ. With C completely uncharged, switch S is suddenly closed (at $t = 0$). Find:

(a) At $t = 0$, current I_1 in resistor 1? (4%)

(b) At $t = 0$, current I_2 in resistor 2? (4%)

(c) At $t = 0$, current I_3 in resistor 3? (4%)

(d) At $t = \infty$ (that is, after many time constants), current I_1 in resistor 1?

(e) At $t = \infty$, current I_2 in resistor 2? (4%)

(f) At $t = \infty$, current I_3 in resistor 3? (4%)

(g) What is the potential difference V_3 across resistor 3 at $t = 0$? (5%)

(h) What is the potential difference V_3 across resistor 3 at $t = \infty$? (5%)

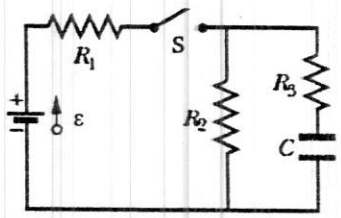

Fig. 3

5. A circular loop of wire having a radius of 8.0 cm carries a current of 0.20 A. A vector of unit length and parallel to the dipole moment $\vec{\mu}$ of the loop is given by $0.60\hat{i} - 0.80\hat{j}$. (This unit vector gives the orientation of the magnetic dipole moment vector.) If the loop is located in a uniform magnetic field given by $\vec{B} = (0.25T)\hat{i} + (0.30T)\hat{k}$, find:

(a) the torque on the loop (in unit-vector notation) (10%)

(b) the orientation energy of the loop. (10%)