科目： 普通物理　　　　　　　　系所組：光電組（物理學系）

1. (20 pts) Two concentric spheres are shown in the figure. The inner sphere is a solid nonconductor and carries a charge of +5.00 μC uniformly distributed over its outer surface. The outer sphere is a conducting shell that carries a net charge of -8.00 μC. No other charges are present. The radii shown in the figure have the values $R_1 = 10.0$ cm, $R_2 = 20.0$ cm, and $R_3 = 30.0$ cm.
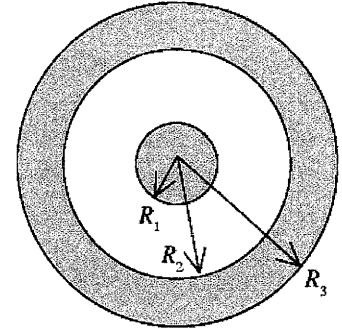
$(k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9 \, \text{N} \cdot \text{m}^2/\text{C}^2)$

(a) Find the total excess charge on the inner and outer surfaces of the conducting sphere.

(b) Find the magnitude and direction of the electric field at the following distances r from the center of the inner sphere: (i) $r = 9.5$ cm, (ii) $r = 15.0$ cm, (iii) $r = 27.0$ cm, (iv) $r = 35.0$ cm.

2. (20 pts) At one eighth of a cycle after the capacitor in an *LC* circuit is fully charged, what are the following quantities as fractions of their peak values: (a) capacitor charge, (b) energy in the capacitor (c) inductor current, (d) energy in the inductor?
[Hint: $q(t) = q_{0,\text{fully charged}} \cdot \cos\omega t$]

3. (20 pts)
   (a) Mark the torque directions produced by F and W in the given figure.
   (b) If the friction force is considered ($\mu_s \sim 0.65$) and the weight of the person is 70 kg, discuss how the standing person's balance can be kept.
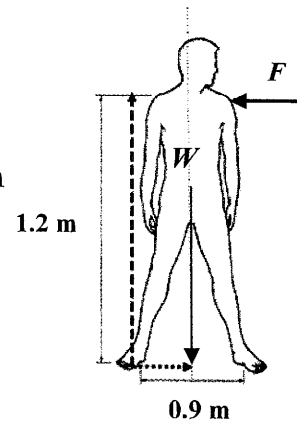
4. (20 pts) The potential energy as a function of position for a particle is given by:

$$U(x) = U_0\left(\frac{x^3}{x_0^3} + 5\frac{x^2}{x_0^2} + 4\frac{x}{x_0}\right)$$, where x_0 and U_0 are constants.

Find the possible equilibrium positions of this particle.

5. (20 pts) Write down the major contributions to our knowledge of nature from the following physicists.

   (a) Gustav R. Kirchhoff; (b) Jean Augustin Fresnel; (c) Pierre Curie; (d) Lord Kevin (William Thomson).

※ 注意：1.考生須在「彌封答案卷」上作答。
　　　　2.本試題紙空白部份可當稿紙使用。
　　　　3.考生於作答時，請勿使用計算機。