

**PHYSICS 507**  
**3<sup>rd</sup> HOMEWORK**  
**Dr. V. Lempesis**

**Hand in: Sunday 29<sup>th</sup> of March 2015, time: 23:59**

**Student Name :** \_\_\_\_\_

**Student ID:** \_\_\_\_\_

*Each question gets 20 marks for full answer*

1. A spherical drop of water carrying a charge of  $3 \times 10^{-11} \text{ C}$  has a potential of  $500 \text{ V}$  at its surface. (a) What is the radius of the drop? (b) If two such drops of the same charge and radius combine to form a single spherical drop, what is the potential at the surface of the new drop so formed?
2. Three point charges  $q_1 = q$ ,  $q_2 = -q$ ,  $q_3 = 2q$  are placed at the points  $A(a, 0, 0)$ ,  $B(0, -a, 0)$ ,  $C(0, 0, 2a)$  respectively. What is the potential energy of the system?
3. The relation  $W = (\epsilon_0 / 2) \int_{\text{all space}} E^2 d\tau$  clearly implies that the energy of a stationary charge distribution is always positive. On the other hand for two opposite charges  $+q$  and  $-q$  at a distance  $r$  the energy is negative ( $W = -(q^2 / 4\pi\epsilon_0 r)$ ). Why? What happens? Explain this.
4. Find the electric field at a height  $z$  above the center of a square charged sheet of side  $a$  and surface charge density  $\sigma$ . Check your answer for the limiting cases  $a \rightarrow \infty$  and  $\sigma \rightarrow \infty$ .
5. Find the potential in the region between the two semi-infinite charged planes which have a potential  $V=0$ . The planes are as shown in figure. The position of the charge is at  $(a, b)$ .

