103 學年第二學期 普通物理 B 第一次段考試題

[Wolfson Ch. 20-24] 2015/03/31, ***8:20AM – 09:50AM***

B

(i)答案卷第一張正面為封面。第一張正、反兩面<u>不要寫任何答案</u>。

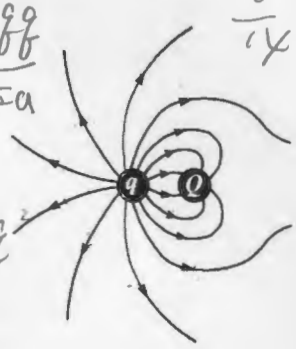
(ii)依空格號碼順序在第二張<u>正面</u>寫下所有填充題答案，不要寫計算過程。

(iii)依計算題之題號順序在第二張<u>反面</u>以後寫下演算過程與答案，<u>每題從新的一頁寫起</u>。

Note: $k = 9.0\times10^{9}\ \mathrm{N\cdot m^2\cdot C^{-2}}$, $\epsilon_0 = (4\pi k)^{-1} = 8.85\times10^{-12}\ \mathrm{C^2\cdot N^{-1}\cdot m^{-2}}$

Part I. Filling the blank (4 points per blank)

• The electric field of two point charges q and Q is represented by the right figure. The ratio $Q/q =$ 【1】 .



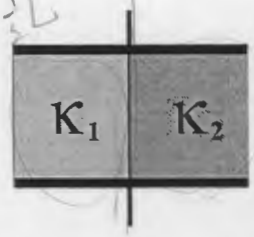
• The work to move a 50 μC charge against a 12 V potential difference is 【2】 μJ.

• Four point charges, each of charge q, are assembled to form a square of side a. The electrostatic energy of this charge distribution is 【3】 .

• A thin ring of radius R carries charge $5Q$ distributed uniformly over 3/4 of its circumference, and $-Q$ over the rest. The potential at the ring's center is 【4】 .

• A wire has a resistance of R_1. The resistance of another wire, made of the same material, that is half as long and has half the diameter, is R_2. The ratio R_2/R_1 is 【5】 .

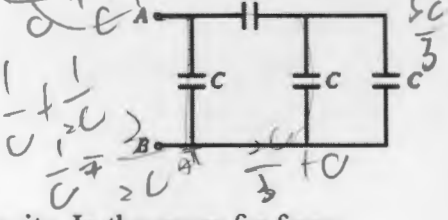
• The capacitance of a parallel-plate capacitor is C_0 when the space between the plates is empty. If the space is filled with two dielectrics (dielectric constants κ_1 and κ_2) of equal size, as shown in the figure, the capacitance is 【6】 C_0.



• A 35 Ω electric stove burner consumes 1.5 kW of power. At what voltage does it operate? 【7】 V.

• A capacitor consists of a conducting sphere of radius a surrounded by a concentric (同心) conducting shell of radius b. The capacitance is 【8】 .

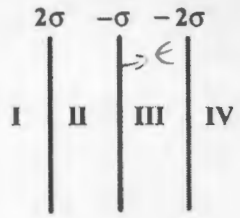
• The equivalent capacitance of the four identical capacitors in the figure, measured between A and B is 【9】 C.



• A conductor has a hollow cavity. There is a point charge $3q/2$ inside the cavity. In the space far from conductor the electric field is $\vec{E} = \frac{kQ}{r^2}\hat{r}$. The charge on the outer surface of the conductor is 【10】 .

• You have a typical resistance of 100 kΩ. How much current could a 12 V car battery pass through you? 【11】 mA.

• Three infinite sheets are charged with uniform surface charge density 2σ, $-\sigma$, and -2σ, shown in the right figure. The magnitude of electric field in region III is 【12】 .



• A uniformly charged wire of line charge density λ forms a rectangle of sides a and b. The electric field at the center of rectangle is 【13】 V/m.

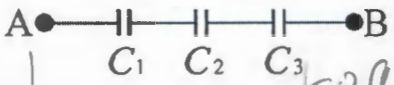
• A cube of side L has one corner at (0, 0) and its sides lie along the x, y, and z axes, respectively. There is an electric field given by $\vec{\mathbf{E}} = (a + by)\hat{\mathbf{j}}$. The net charge enclosed by the cube surface is 【14】 .

• Three positive point charges locate on the x-y plane: q at (a, 0), q at ($-a$, 0), and Q at an arbitrary point on the y-axis (0, y). (a) The electric force on Q is 【15】, and (b) the position where Q will experience the greatest force is 【16】 .

Part II Problems (10 points per problem)

1.

In the figure, three capacitors are connected in series where C_1 =10 μF, C_2 = 20 μF, and C_3 = 25 μF. If no capacitor can resist a potential difference of more than 100 V, what is the maximum safe potential difference between the terminals A and B?



2.

A sphere of radius R carries charge Q distributed uniformly over its surface. Calculate the electric energy stored in the electric field and express your result in terms of R, Q, and k.

3.

An infinitely long rod of radius R carrier a charge density $\rho(r) = Ar$, where r is the distance from the rod axis and A is a constant. Find the electric field strengths outside and inside the rod.

4.

A rod of length L has a charge Q uniformly distributed along its length. (a) Calculate the potential at a distance a from one end along the axis of the rod, as shown in the figure. (b) Find the electric $\vec{\mathbf{E}}$ field from (a).