Suggested problems
Chapter 23

The quiz questions will be similar to the following text-book problems. Refer to the course website for the latest version of this document. You are encouraged to seek the help of your instructor during his office hours.

1. The square surface shown in Fig. 23-26 measures 3.2 mm on each side. It is immersed in a uniform electric field with magnitude \( E = 1800 \text{ N/C} \) and with field lines at an angle of \( \theta = 35^\circ \) with a normal to the surface, as shown. Take that normal to be directed “outward,” as though the surface were one face of a box. Calculate the electric flux through the surface.

Answer: 0.015 N.m\(^2\)/C

12. Figure 23-32 shows two nonconducting spherical shells fixed inplace. Shell 1 has uniform surface charge density \( +6.0 \mu\text{C/m}^2 \) on its outer surface and radius 3.0 cm; shell 2 has uniform surface chargedensity \( +4.0 \mu\text{C/m}^2 \) on its outer surface and radius 2.0 cm; the shell centers are separated by \( L = 10 \text{ cm} \). In unit-vector notation, what is thenet electric field at \( x = 2.0 \text{ cm} \)?

Answer: \(-2.8 \times 10^4 \hat{i} \text{ N/C}\)

21. An isolated conductor has net charge \(+10\mu\text{C}\) and a cavity with a point charge \( q = +3.0 \mu\text{C} \). What is the charge on (a) the cavity wall and (b) the outer surface?

Answer: (a) \(-3.0 \mu\text{C}\); (b) \(+13.0 \mu\text{C}\).

22. An electron is released 9.0 cm from a very long non-conducting rod with a uniform 6.0 \( \mu\text{C/m} \). What is the magnitude of the electron’s initial acceleration?

Answer: \(2.1 \times 10^{17} \text{ m/s}^2\)

33. In Fig. 23-40, two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have excess surface charge densities of opposite signs and magnitude \( 7.00 \times 10^{-22} \text{ C/m}^2 \). In unit-vector notation, what is the electric field at points (a) to the left of the plates, (b) to the right of them, and (c) between them?

Answer: (a) zero; (b) zero; (c) \(-7.91 \times 10^{-11} \hat{i} \text{ N/C}\)

57. A thin-walled metal spherical shell has radius 25.0 cm and charge \( 2.00 \times 10^{-7} \text{ C} \). Find \( E \) for a point (a) inside the shell, (b) just outside it, and (c) 3.00 m from the center.

Answer: (a) zero; (b) \(2.88 \times 10^4 \text{ N/C}\) away from the center; (c) 200 N/C away from the center

58. A uniform surface charge of density \( 8.0 \text{ nC/m}^2 \) is distributed over the entire \( xy \) plane. What is the electric flux through a spherical Gaussian surface centered on the origin and having a radius of 5.0 cm?

Answer: 7.1 N.m\(^2\)/C

65. Charge \( Q \) is uniformly distributed in a sphere of radius \( R \). (a) What fraction of the charge is contained within the radius \( r = R/2.00 \)? (b) What is the ratio of the electric field magnitude at \( r = R/2.00 \) to that on the surface of the sphere?

Answer: (a) \( q/Q = 1/8 = 0.125 \); (b) \( E_r/E_R = 1/2 = 0.5 \)