Problem Assignments for Unit 1

Unless otherwise indicated, problems are from Wolfson. "**Supp**" refers to chapters in the supplementary reading and "A" refers to the additional problems that are available at the beginning of the Supplementary Reading booklet.

Assigned Problems for Wednesday, January 21

A2, A4, A109; **CH 20:** 1, 8, 15, 49, 57

Notes: The link for Problem A4 can be found on the Lecture 1 calendar page.

Assigned Problems for Friday, January 23

A5, A6, A7, A8, X1 (below); **CH 20:** 17, 23

Problem X1 A 65 μC point charge is at the origin. Find the electric field at the points (a) $x = 50\,\text{cm}$, $y = 0\,\text{cm}$, (b) $x = 50\,\text{cm}$, $y = 50\,\text{cm}$, (c) $x = 25\,\text{cm}$, $y = -75\,\text{cm}$.

Notes: The link for Problem A5 can be found on the Lecture 2 calendar page.

Answers: X1 (a) $2.3 \times 10^6 \hat{\imath}\,\text{N/C}$, (b) $(8.2 \times 10^5 \hat{\imath} + 8.2 \times 10^5 \hat{\jmath})\,\text{N/C}$, (c) $(3.0 \times 10^5 \hat{\imath} - 8.9 \times 10^5 \hat{\jmath})\,\text{N/C}$

Hand-In Set #1 Due Monday, January 26, 4:30 pm

A3, X2 (below); **CH 20:** 26, 32, 34, 46, 48, 52, 76

Problem X2 A thin rod lies on the x-axis with one end at $x = 0$ and the other end at $x = L$. The rod carries a total charge Q distributed uniformly over its length. Determine the electric field at a point on the x-axis at position $x = D$, where $D > L$.

Assigned Problems for Wednesday, January 28

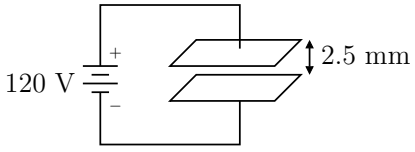
CH 21: 2, 3, 7, 8, 15, 19, 23ac, 27, 55

Notes: For **CH 21 #23ac, #27 and #55**, show all the steps needed to clarify how you get the electric field from Gauss's Law.

Assigned Problems for Friday, January 30

A9, A11, A12, X3 (below); **CH 22:** 2, 55; **CH 24:** 21, 23, 65

Problem X3 A 120 V battery is connected to two large, parallel conducting plates with a separation of 2.5 mm, as shown. (a) Determine the electric field magnitude and direction in the region between the plates. (b) Determine the charge density on the top and bottom plates.



Answers: X3 (a) $4.8 \times 10^4\,\text{N/C}$ downward, (b) $\pm 4.25 \times 10^{-7}\,\text{C/m}^2$, with + on the top and − on the bottom.

Hand-In Set #2 Due Monday, February 2, 4:30 pm

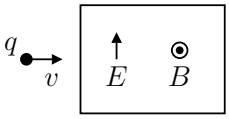
A13; **CH 21:** 14, 20, 24, 38; **CH 22:** 40, 44, 54; **CH 24:** 28, 66

Notes: For **CH 21 #24**, show all the steps needed to clarify how you get the electric field from Gauss's law. For **CH 22 #54** the distance from the center of the triangle to one of the charges is $a/\sqrt{3}$.

Assigned Problems for Wednesday, February 4

A18, X4 (below); **CH 26:** 1, 2, 13, 17, 21, 31, 55

Problem X4 A particle of positive charge q enters a region of uniform electric and magnetic fields with $E = 170\,\mathrm{N/C}$ pointing upward and $B = 0.042\,\mathrm{T}$ pointing out of the page, as shown in the figure.



(a) At what speed v will the particle experience no net force? (b) Would your answer change if the particle had charge $-q$? (c) For the positive charge, which way does it deflect if it is traveling slower than your answer to part (a)?

Notes: For **CH 26 #17** the answer in Wolfson is incorrect. It should be 311 ns.

Answers: X4 (a) 4050 m/s, (b) no, (c) upward

Assigned Problems for Friday, February 6

A15, A21, A22, A110, X6 (below); **CH 26:** 27, 61, 63, 65

Problem X6 A solenoid used in a plasma physics experiment is 10 cm in diameter, is 1.0 m long, and carries a 35 A current to produce a 100 mT magnetic field. (a) How many turns are in the solenoid? (b) If the solenoid resistance is $2.7\,\Omega$, how much power does it dissipate?

Notes: For **CH 26 #63** the answer in the back of Wolfson is incorrect. It should be $\mu_0 I/4a$. For **CH 26 #65** do not use Eq. 26.11.

Answers: X6 (a) 2300, (b) 3.3 kW

Hand-In Set #3 Due Monday, February 9, 4:30 pm

A17, X5 (below), X7 (below); **CH 26:** 18, 28, 32, 54, 68, 70, 80

Problem X5 A single-turn wire loop 10 cm in diameter carries a 12 A current. It experiences a $0.015\,\mathrm{N{\cdot}m}$ torque when the normal to the loop plane makes a 25° angle with a uniform magnetic field. Find the magnetic field strength.

Problem X7 Three parallel wires of length ℓ each carry current I in the same direction. They're positioned at the vertices of an equilateral triangle of side a, and oriented perpendicular to the triangle. Find an expression for the magnitude of the force on each wire. *Hint:* sketch the end-on view so 3 wires are shown as dots in an equilateral triangle, each carrying current out of the page. First find $\vec{B}$ at the top wire due to currents in the other two wires. You can treat the wires as infinitely long to find the field. Then find the force.

Notes: Hint for **Ch 26 #18**: The frequency is the reciprocal of the period of the electron's orbit.