Physics 212 **Classical and Modern Physics** **Spring 2025**

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 22

A2, A4, A5, A6, X1 (below); **CH 20:** 17, 23, 49

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 links for Problems A4 and A5 can be found on the Lecture 1 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) $(3.0 \times 10^5 \hat{\imath} - 8.9 \times 10^5 \hat{\jmath})\,\text{N/C}$

Assigned Problems for Friday, January 24

A7, A8; **CH 20:** 34; **CH 21:** 1, 2, 3, 15, 19

Answers: CH 20 #34 (a) 1.35 cm; (b) proton momentarily comes to rest, reverses direction, then accelerates and exits the field region with speed 3.8×10^5 m/s

Hand-In Set #1 Due Monday, January 27, 4:30 pm

A3, A109, X2 (below); **CH 20:** 26, 32, 48, 76; **CH 21:** 14, 20

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 29

A9, A11; **CH 21:** 7, 8, 27, 55; **CH 22:** 2, 39, 55

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

Assigned Problems for Friday, January 31

A12, A18; **CH 24:** 21, 23, 65; **CH 26:** 1, 13, 17, 21

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

Hand-In Set #2 Due Monday, February 3, 4:30 pm

A13, A17; **CH 21:** 24; **CH 22:** 40, 44, 56; **CH 24:** 28, 66; **CH 26:** 54

Notes: For **CH 21 #24**, show all the steps needed to clarify how you get the field from Gauss's law.

Assigned Problems for Wednesday, February 5

A14, A15, A110; **CH 26:** 27, 31, 55, 61, 63, 65

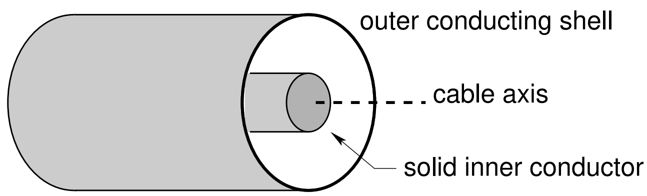
Notes: Do not use Eq. 26.11 for either **CH 26 #29** or **#65**. For **CH 26 #63** the answer in the back of Wolfson is incorrect. It should be $\mu_0 I/4a$.

Assigned Problems for Friday, February 7

A21, A22, A111, X3 (below), X4 (below); **CH 26:** 8, 33, 67

Problem X3 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?

Problem X4 A coaxial cable (see figure) consists of a 1.0 mm diameter inner conductor and a hollow outer conductor with diameter 1.0 cm. A 100 mA current flows down the inner conductor and back along the outer conductor. Find the magnetic field strength (a) 0.10 mm, (b) 4.0 mm, and (c) 2.0 cm from the cable axis.



Answers: **X3** (a) 2300, (b) 3.3 kW; **X4** (a) 8.0×10^{-6} T, (b) 5.0×10^{-6} T, (c) 0; **CH 26 #8** same direction

Hand-In Set #3 Due Monday, February 10, 4:30 pm

X5 (below), X6 (below), X7 (below); **CH 26:** 28, 32, 34, 68, 70, 80

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

Problem X6 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.

Problem X7 The coaxial cable shown in Problem X4 consists of a solid inner conductor of radius a and a hollow outer conductor of radius b. The two carry equal but opposite currents I, uniformly distributed. Find expressions for the magnetic field as a function of radial position r (a) within the inner conductor, (b) between the inner and outer conductors, and (c) beyond the outer conductor.