PHYS-2020: General Physics II
Problem Set 2, Spring 2025

There are two sections to this Problem Set, the first section of problems are located on the textbook publisher's *WebAssign* web site:

> **https://webassign.com**

These problems will be graded and must be completed by 6:00 p.m. on Friday, February 28, 2025. **Start working on these problems immediately once they are posted on *WebAssign*. Don't wait until the last day to start them. One never knows when the network will go down, and you will not be able to use this as an excuse for not doing your *WebAssign* problems.** As a matter of fact, there will be no allowed excuses for not doing your *WebAssign* homework.

Once you click on the *WebAssign* web site above, click on the "Enter Class Key" button on the upper right of this web page. The class key for this course is:

> etsu 9516 9316

A Quick Start Guide for using this web site can be found on the course web page. Should you need additional assistance with *WebAssign*, you can contact Technical Support information at:

> https://webassign.com/support/student-support/

via the web or

> 1-800-354-9706

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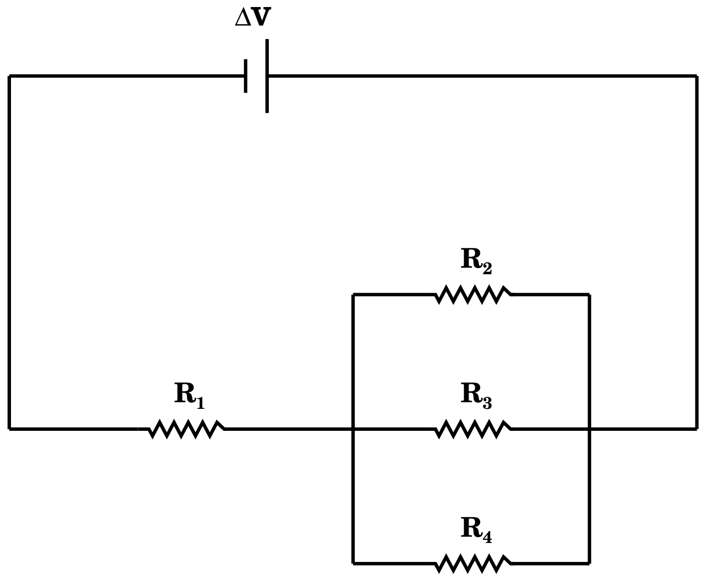
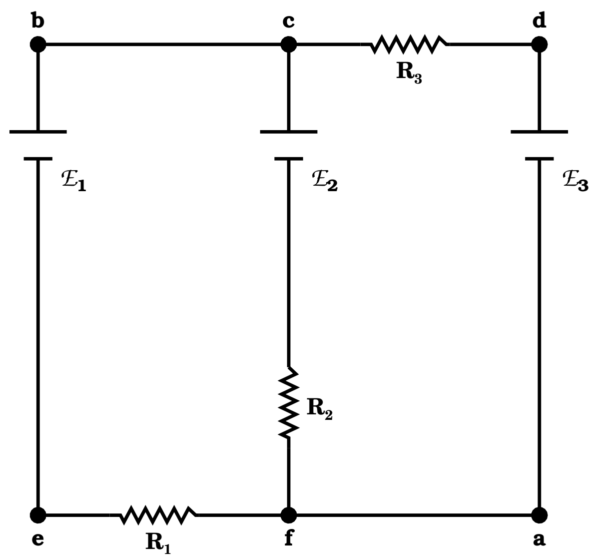
1. In the figure on the next page, $\Delta V = 30$ V, $R_1 = 12\ \Omega$, $R_2 = 18\ \Omega$, $R_3 = 9.0\ \Omega$, and $R_4 = 6.0\ \Omega$. Find the equivalent resistance of this circuit.



2. Using Kirchhoff's rules, (a) find the current in each resistor shown in the figure below and (b) find the potential difference between points c and f. In this figure, $\mathcal{E}_1 = 70.0$ V, $\mathcal{E}_2 = 60.0$ V, $\mathcal{E}_3 = 80.0$ V, $R_1 = 2.00$ kΩ, $R_2 = 3.00$ kΩ, and $R_3 = 4.00$ kΩ.



3. An uncharged capacitor and a resistor are connected in series to a source of emf. If $\mathcal{E} = 9.00$ V, $C = 20.0\mu$F, and $R = 100\ \Omega$, find (a) the time constant of the circuit, (b) the maximum charge on the capacitor, and (c) the charge on the capacitor after one time constant.

4. (a) Find the direction of the force on a proton ($q = +e$) moving through the magnetic fields in the figures drawn in the solutions. (b) Repeat part (a), assuming the moving particle is an electron ($q = -e$).

5. A proton travels with a speed of 3.0×10^6 m/s at an angle of 37° with the direction of the 0.30 T magnetic field in the $+y$ direction. What are (a) the magnitude of the magnetic force on the proton and (b) the proton's acceleration?

6. A wire carries a current of 10.0 A in a direction that makes an angle of 30.0° with the direction of a magnetic field of strength 0.300 T. Find the magnetic force on a 5.00-m length of wire.

7. An eight-turn coil encloses an elliptical area having a major axis of 40.0 cm and a minor axis of 30.0 cm. The coil lies in the plane of the page and carries a clockwise current of 6.00 A. If the coil is in a uniform magnetic field of 2.00×10^{-4} T directed towards the left of the page, what is the magnitude of the torque on the coil? *Hint:* The area of an ellipse is $A = \pi ab$, where a and b are, respectively, the semimajor and semiminor axes of the ellipse.

8. Consider the mass-spectrometer shown in the figure drawn in the solutions. The electric field between the plates of the velocity selector is 950 V/m, and the magnetic field in both the velocity selector and the deflection chamber have magnitudes of 0.930 T. Calculate the radius of the of the path in the system for a single charged ion with mass $m = 2.18 \times 10^{-26}$ kg.

9. Two wires are separated by $d = 10.0$ cm and carry currents of $I = 5.00$ A in opposite directions. Find the magnitude and direction of the net magnetic field (a) at a point midway between the wires; (b) at a point P_1, 10.0 cm to the right of the wire on the right; and (c) at a point P_2, $2d = 20.0$ cm to the left of the wire on the left.

10. What current is required in the windings of a long solenoid that has 1000 turns uniformly distributed over a length of 0.400 m in order to produce a magnetic field of magnitude 1.00×10^{-4} T at the center of the solenoid?

11. Consider a place where Earth's magnetic field has strength of 0.520×10^{-4} T and makes an angle of 62.0° with the horizontal. At this location a magnetic compass points towards true north. What is the magnetic flux in a rectangular loop of wire that is 15.0 by 25.0 cm and is lying on a table? What is the magnetic flux in this loop if it is mounted vertically on a north wall? On an east wall?

12. A strong electromagnet produces a uniform field of 1.60 T over a cross-sectional area of 0.200 m^2. We place a coil having 200 turns and a total resistance of 20.0 Ω around the electromagnet. We then smoothly decrease the current in the electromagnet until it reaches zero in 20.0 ms. What is the current induced in the coil?

13. A jet with a wingspan of 60.0 m is flying horizontally at a speed of $30\underline{0}$ m/s at an altitude of 1.98 km. At the location of the jet, the Earth's magnetic field is 50.0 μT pointing 58.0° below the horizontal. What voltage is generated between the wingtips as a result of these conditions?

14. A flat coil enclosing an area of 0.10 m^2 is rotating at 60 rev/s, with its axis of rotation perpendicular to a 0.20 T magnetic field. (a) If there are 1000 turns on the coil, what

is the maximum voltage induced in the coil? (b) When the maximum induced voltage occurs, what is the orientation of the coil with respect to the magnetic field?

15. A 2.00 H inductor carries a steady current of 0.500 A. When the switch in the circuit is thrown open, the current is effectively zero after 10.0 ms. What is the average induced emf in the inductor during this time?

16. A 6.0-V battery is connected in series with a resistor and an inductor. The series circuit has a time constant of 600 μs, and the maximum current is 300 mA. What is the value of the inductance?

17. An air-core solenoid with 68 turns is 8.00 cm long and has a diameter of 1.20 cm. How much energy is stored in its magnetic field when it carries a current of 0.770 A?