# Polytechnic Tutoring Center
Final Review – PH 2023 Spring 2021

Disclaimer: This mock exam is only for practice. It was made by tutors in the Polytechnic Tutoring Center and is not representative of the actual exam given by the Academic Department.

1. When a 10 nF and a 21 nF capacitor are connected in series to a 12 V battery, what is the voltage across the 10 nF capacitor?

2. Four +2 μC charged particles are put together in a regular tetrahedron shape, meaning the distance between each pair of particles is 1cm. How much energy does it take to remove one particle from this system?

3. A horizontal water hose of a 5.0 cm radius ends with a 1.2 cm radius nozzle, which is open to atmosphere. What must the pressure in the hose be for the flow rate to be 0.006 m^3/s?

4. A 0.25 H inductor is connected in series with a 8 Ω resistor, 6 V battery and a switch. What is the voltage across the resistor 3 ms after the switch was closed?

5. What is the RC time constant of the circuit shown in the diagram on the right if each capacitor is 3F and each resistor is 2Ω? Hint: treat it as one capacitor and one resistor. The time constant is the product RC.
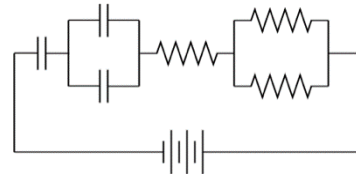
6. Two long straight parallel wires each carry a current of 30A in opposite directions. If the wires are 1m apart, what is the magnitude of the magnetic field at ¾ the distance between them?

7. The loop $x^2 + y^2 = 1$, z=0 is carrying a 5mA charge. What is the integral of magnetic field over the path $(x-1)^2 + z^2 = 1$, y=0?

8. What is the magnitude of magnetic field at the center of a pair of concentric wires with a 5A current running counterclockwise around a 1m radius circular path and 7A current running clockwise around the 2m radius circular path as shown in the diagram?
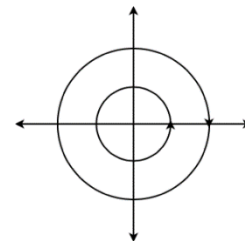
9. A circular coil of wire of radius 5 cm with N = 1000 turns has a resistance of 2 Ω and rotates at an angular speed of 200 rad/s about an axis perpendicular to an external magnetic field of 0.2 T. If at t = 0 s, the plane of the coil is perpendicular to the field, what is the current through the coil at time t=5.236 $\times 10^{-3}$ s?

10. A large sheet of uniformly charged plane is located at the xy plane with surface charge density 10 nC/m^2. What is the potential differential between points (3,2,7) and (4,9,5)?

11. A deuteron (m = 3.34×10^{-27} kg, q = 1.60×10^{-19} C) is accelerated from rest through a 10 kV potential difference and then moves perpendicularly to a uniform magnetic field of strength of 1.6 T. What is the radius of the resulting circular path of the deuteron?

12. A wire of length 13 m is used to form an N-turn circular coil of radius 23 cm. In order for the magnetic field at the center to exactly cancel the earth's magnetic field of 35 μT, what must the current in the wire be?

13. Two charged particles are spinning around each other in space due electric force between them. There is 1 m between them, and each charge is +3mC. If their mass is 2g and neglect gravity, what is the magnetic field in the center of their path?

14. By how large fast does the current need to increase in a 100 turn, 5cm-radius circular coil in order to induce an emf of 10 V?

15. What is the potential energy of a magnet placed 30 with the the magnetic field if the polarity of the magnet is 10 J/T and the strength of the magnetic field is 20 T.