

Instructions:

1. Do all of your work on this sheet.
2. **Show all of your steps** in problems for full credit.
3. **Be clear and neat** in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place your **answers in a box**.
5. If you need more space, you may use the back of the page and write **On back of page#** in the problem space.

1. **Multiple Guess** Find the answer which best fits the question and **write it in the space provided**.

- a. A wire that offers the least resistance is
 a) short and thin. b) long and thick. c) long and thin.
 d) short and thick. e) none of these _____
- b. A proton shot from a positively charged plate of a capacitor will
 a) slow down b) speed up c) move at a constant speed _____
- c. Of the visible colors the one with the shortest wavelength is
 a) red. b) green. c) blue. d) violet. e) none of these _____
- d. The impedance has units of
 a) farads. b) ohms. c) hertz. d) henries. e) none of these. _____
- e. In an RC circuit the voltage _____ the current.
 a) leads; b) is in phase with; c) lags. _____
- f. Two long parallel wires have current moving in opposite directions but perpendicular to your paper. The force on the left wire points
 a) to the left. b) to the right. c) downward. d) none of these. _____
- g. For a single diverging lens the image always appears
 a) real, inverted, smaller; b) virtual, inverted, larger;
 c) virtual, upright, smaller; d) real, upright, larger;
 e) none of these. _____
- h. What confirmed that photons have momentum?
 a) photoelectric effect. b) Compton effect. c) electron diffraction. d) blackbody radiation. e) None of these _____
- i. The images of two sources are said to be resolved when what is true of the diffraction patterns?
 a) The central maximum of one pattern falls on the first dark fringe of the other one. b) The central maxima fall on each other. c) The first bright fringes fall on each other. d) None of these. _____
- j. The internal resistance of an ideal ammeter should be
 a) zero b) 10 ohms c) infinite d) none of these. _____

	Page	Score
1	20 pts	
2	60 pts	
3	60 pts	
4	45 pts	
Total		185 pts

- k. The color of light, which is bent the most by a prism, is
 a) red b) green c) violet. d) white. e) none of these. _____
- l. A diffuse broad central band is produced by a
 a) double slit b) prism c) diffraction grating
 d) single slit e) none of these _____
- m. If the B-field points out of your paper and a negative charge moves from right to left in this field, then the force is directed
 a) towards the bottom of the paper; b) out of the paper;
 c) into the paper; d) towards the top of the paper. _____
- n. Farsighted vision can be corrected by using
 a) a converging lens. b) A diverging lens.
 c) More intense light. _____
- o. A car battery is rated at 80 A-h. An ampere-hour is a unit of
 a) power. b) charge. c) current. d) energy. e) force _____
- p. While underwater, a diver sees a bird flying above the surface. The image actually seen appears _____ the diver than the bird.
 a) closer to b) further from c) the same distance from _____
- q. Equipotential lines are lines of
 a) force; b) equal charge; c) constant electric potential;
 d) equal electric fields; e) none of these. _____
- r. Which is not a consequence of Einstein's postulates?
 a) Moving clocks tick slower than stationary ones.
 b) Simultaneous events in one inertial system may not be simultaneous in another system.
 c) Stationary lengths are larger than moving lengths.
 d) All of these. e) None of these. _____
- s. When a glass rod is rubbed with a piece of silk,
 a) electrons move onto the rod; b) protons move onto the rod;
 c) electrons move onto the silk; c) protons move onto the silk. _____
- t. Which of the following gives the relativistic kinetic energy of a mass?
 a) $KE = \frac{1}{2}mv^2$ b) $KE = mc^2$ c) $KE = \gamma mc^2$
 d) $KE = (\gamma - 1)mc^2$. _____

Constants

$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/(\text{Nm}^2)$, $\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$,
 $m_p = 1.67 \times 10^{-27} \text{ kg}$, $m_e = 9.11 \times 10^{-31} \text{ kg}$, $h = 6.63 \times 10^{-34} \text{ Js}$.

- a. A point charge ($+2.0 \times 10^{-8}$ C) is placed at the origin of the xy -plane. Let A be the point ($x = 0$ cm, $y = 10$ cm). Find the potential at a point A.



- b. A mosquito is embedded in a piece of amber ($n = 1.50$). It appears to be 5.00 cm from the surface of a piece of the amber. What is the actual depth?

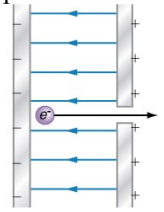
- c. A magnifying glass has a focal length of 12.0 cm and is placed 3.00 cm from text letters that are 3.00 mm high. What is the location and size of the image of the text?

- d. An automobile battery produces a potential difference of 12.0 volts between its terminals. A headlight bulb is to be connected directly across the terminals of the battery and dissipates 60 watts of joule heat. What current will it draw and what must its resistance be?

- e. A magnetic field perpendicular to the plane of a wire loop with and area of 0.400 m^2 decreases by 0.200 T in 10^{-3} s. What is the magnitude of the average value of the emf induced in the loop?

- f. The current from a dc power supply is carried in opposite directions to an instrument by two long parallel wires, 12.0 cm apart. What is the magnetic field midway between the two wires when the current carried is 10.0 A?

- g. A parallel plate capacitor has a 1000 N/C electric field and the plates are 0.25 cm apart. Find the speed that an electron would attain if it were released from rest at the negative plate.



- h. Determine the new resistance of a 75.0Ω resistor if the temperature increased by 50°C ? [Use a temperature coefficient of resistivity of $0.0060 \text{ } (^\circ\text{C})^{-1}$.]

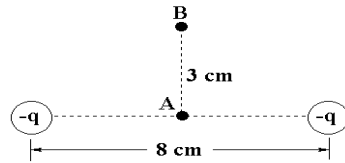
- i. A capacitor is found to offer 50.0 ohms of capacitive reactance when connected in a 800Hz circuit. What is its capacitance?

- j. A child looks into a spherical reflecting ball, which is 5.00 cm in diameter. The child sees her face at a quarter its actual size. How far is her face from the ball?

- k. How fast does light travel in glass of refractive index 2.50?

- l. The Millennium Falcon approaches Tatooine from the west moving at a speed of $0.600c$ relative to Tatooine. The length of the Millennium Falcon is 34.4 m. What length would an observer on Tatooine measure?

a. Consider the charges below for $q = 5.00 \mu\text{C}$. What is the magnitude and direction of the force between the two charges?



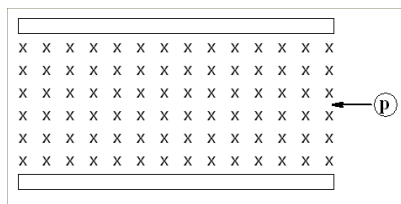
b. A $5.0 \mu\text{F}$ capacitor is connected in series with an inductor, causing them to resonate at a frequency of 1200 Hz. What is the magnitude of the inductor?

c. A 0.50 g charged ball is suspended in equilibrium in a 1000 N/C electric field between two horizontal, parallel plates. What is the magnitude of the charge?

d. A beam of protons enters a 0.500 T magnetic field with a speed of $4.50 \times 10^6 \text{ m/s}$. What is the radius of the resulting path?

e. Unpolarized light with intensity 3.00 W/m^2 strikes a piece of polarizing material. It passes through and comes into contact with another polarizing material, which is at 50° with respect to the first. What is light intensity that is transmitted through these polarizing materials?

f. A proton passes through a velocity selector with a 8.00 kV/m electric field and a 40.0 mT magnetic field. If it is not deflected, what is the speed of the proton?



g. Luke Skywalker can travel from his home on the planet Tatooine to the capital in 35.0 minutes as measured from his X-wing star fighter traveling at a speed of $0.850c$. What time would be measured on Tatooine?

h. The focal length of a concave mirror is 5.00 cm . A 4.00 cm high object is placed 20.0 cm in front of the mirror. Find the image location and height.

i. With two slits spaced 0.200 mm apart, and a screen at a distance of $L = 2.00 \text{ m}$, the second bright fringe is found to be displaced 5.00 mm from the central fringe. Find the wavelength of the light used.

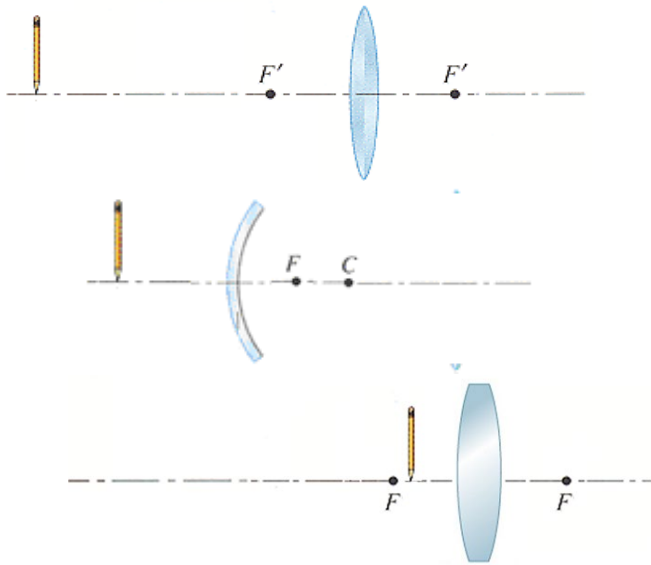
j. A charge of magnitude $-3.0 \mu\text{C}$ moves through a potential difference of 80.0 V . Calculate the work done on the charge.

k. A farsighted person cannot see objects that are closer than 50.0 cm from the eye. Determine the focal length of the contact lenses that would enable the person to read a book at the normal near point.

l. A soap bubble appears green (540 nm) when viewed head on. What is the minimum thickness for the soap film if its index of refraction is 1.40 ?

a. On the same bar of iron are wound two coils, one with 45 loops and the other with 15 loops. If a 100.0 V alternating voltage is connected to the 45 loop coil, what will be the voltage in the 15 loop coil?

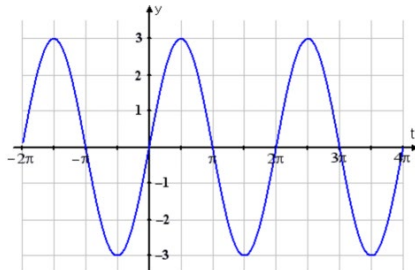
b. Draw ray diagrams for the systems below and draw the final images. Are they real or virtual?



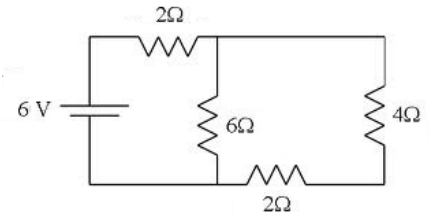
c. A certain radio wave has a wavelength of 5.00 m. What is the frequency of this electromagnetic radiation?

d. A coil of 40 ohms inductive reactance in series with a resistance of 30 ohms is connected to an ac line of $V_0 = 130$ volts. What is the measured current in the circuit?

e. For the voltage graph below, give (with units) the
 i. Amplitude _____ ii. Period _____ iii. Frequency _____



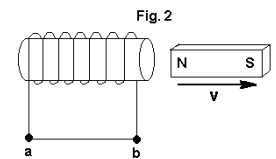
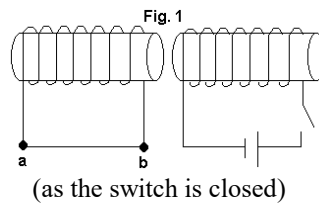
f. Given the circuit below find the equivalent resistance of the network of resistors.



g. For the above circuit find the current flowing through each resistor.

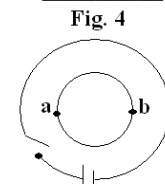
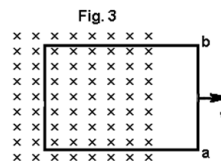
h. What are the energy and momentum of a photon with a wavelength of 550.0 nm?

i. In the following closed loops, indicate the direction of the induced current as clockwise (cw) or counterclockwise (ccw).



1. _____

2. _____



3. _____

(as the switch is closed)
 4. _____