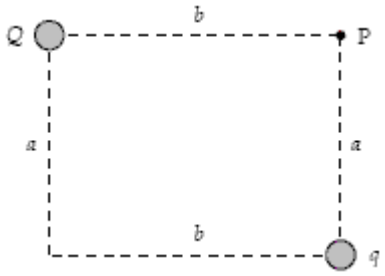
Question 1

1) Two-point charges are arranged as shown in the figure. If a = 60 cm, b = 80 cm, Q = −4.0 nC, and q = 1.5 nC,



a) Find the **magnitude** and **direction** of the electric field at point P.
b) The electric potential due to these two charges at point P.
c) The change in electric potential energy of the system of these two charges plus a third point charge of 5 nC as this third charge moves from infinity to point P.
d) The **magnitude** and **direction** of the resultant electric force on the third (10 nC) charge located at point P

2) A particle (mass = 5.0 g, charge = 40 mC) moves in a region of space where the electric field is uniform and is given by $E_x = 2.5$ N/C, $E_y = E_z = 0$. If the velocity of the particle at t = 0 is given by $v_y = 50$ m/s, $v_x = v_z = 0$, what is the speed of the particle at t = 2.0 s?

Question 2

a) A charge of 50 nC is uniformly distributed along the y axis from y = 3.0 m to y = 5.0 m. What is the magnitude of the electric field at the origin?

b) Charges q and Q are placed on the x axis at x = 0 and x = 2.0 m, respectively. If q = −40 pC and Q = +30 pC, determine the net flux through a spherical surface (radius = 1.0 m) centered on the origin.

c) The electric potential in a certain region is $V = ax^2 + bx + c$ where a=12V/m, $b = -10\ V/m$ and c=62V. Determine the magnitude of the electric field at x=+2.0 m.

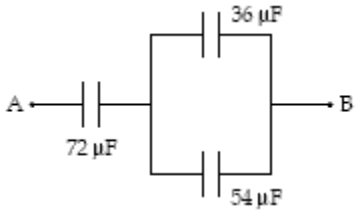
Question 3

a) A 200-volt battery is connected to a 0.50-microfarad parallel-plate, air-filled capacitor. Now the battery is disconnected, with care taken not to discharge the plates. Some Pyrex glass is then inserted between the plates, completely filling up the space.

I. Calculate is the capacitance.

II. What is the final potential difference between the plates? (The dielectric constant for Pyrex is $\kappa = 5.6$.)

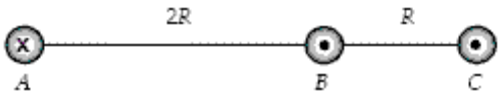
b) If $V_A - V_B = 50$ V, how much energy is stored in the 36-μF capacitor?



Question 4

a) What is the radius of curvature of the path of a 3.0-keV proton in a perpendicular magnetic field of magnitude 0.80 T?

b) The figure shows a cross section of three parallel wires each carrying a current of 24 A. The currents in wires B and C are out of the paper, while that in wire A is into the paper. If the distance R = 5.0 mm, what is the magnitude of the force on a 4.0-m length of wire A?



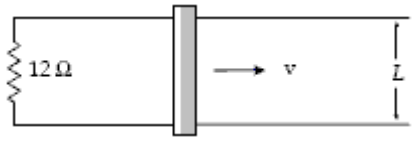
c) A long solenoid (n = 1200 turns/m, radius = 2.0 cm) has a current of a 0.30 A in its winding. A long wire carrying a current of 20 A is parallel to and 1.0 cm from the axis of the solenoid. What is the magnitude of the resulting magnetic field at a point on the axis of the solenoid?

Question 5

a) A proton moves with a velocity of v =2$\hat{\boldsymbol{\imath}}$ -4 $\hat{\boldsymbol{\jmath}}$+$\hat{\boldsymbol{k}}$ m/s in a region in which the magnetic field is B =($\hat{\boldsymbol{\imath}}$ +2 $\hat{\boldsymbol{\jmath}}-3\hat{\boldsymbol{k}}$) T. What is the magnitude of the magnetic force this charge experiences?

d) A flat coil of wire consisting of 20 turns, each with an area of 50 cm^2, is positioned perpendicularly to a uniform magnetic field that increases its magnitude at a constant rate from 2.0 T to 6.0 T in 2.0 s. If the coil has a total resistance of 0.40 Ω, what is the magnitude of the induced current?

c) A rod (length = 10 cm) moves on two horizontal frictionless conducting rails, as shown. The magnetic field in the region is directed perpendicularly to the plane of the rails and is uniform and constant. If a constant force of 0.60 N moves the bar at a constant velocity of 2.0 m/s, what is the current through the 12-Ω load resistor? (Assume the bar has zero resistance).



Question 6

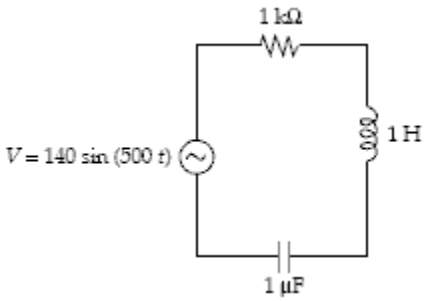
a) A current of 17.0 mA is maintained in a single circular loop of 2.00 m circumference. A magnetic field of 0.800 T is directed parallel to the plane of the loop.
(I) Calculate the magnetic moment of the loop.
(II) What is the magnitude of the torque exerted by the magnetic field on the loop?

b) If the magnetic susceptibilities χ of materials A and B are $2.3\text{x}10^{-5}$ and $-9.8\text{x}10^{-6}$, respectively. Indicate which of these materials is diamagnetic and which one is paramagnetic and explain your answer.

Question 7

a) An RLC series circuit has R = 100 ohms, C = 25 μF, and L = 0.16 H. For what angular frequency of an AC voltage is the current flow maximum?

a) An RLC circuit is connected as shown in the figure



Calculate:

I. The rms voltage for the circuit.
II. The inductive reactance, the capacitive reactance, and the impedance of the circuit.
II. The maximum current in the circuit .
III. The phase angle between the current and voltage .