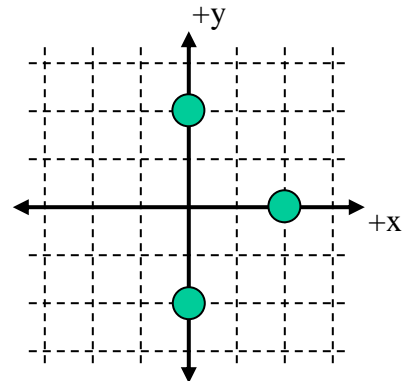


Three charges, all with a charge of $+8 \mu\text{C}$ ($+8 \times 10^{-6} \text{ C}$) are situated as shown (each grid line is separated by 1 meter).



- 1) What is the direction of the net electric field at the origin?
 - a) up
 - b) down
 - c) left
 - d) right
 - e) the electric field is zero

- 2) What is the magnitude of the net electric field at the origin?
 - a) 0 N/C
 - b) 9,000 N/C
 - c) 18,000 N/C
 - d) 27,000 N/C
 - e) 36,000 N/C

- 3) What is the net electric potential at the origin?
 - a) 0 V
 - b) 36,000 V
 - c) 72,000 V
 - d) 108,000 V
 - e) 144,000 V

- 4) What is the direction of the net force on the right charge at (2,0) due to the other two?
 - a) up
 - b) down
 - c) left
 - d) right
 - e) the electric force is zero

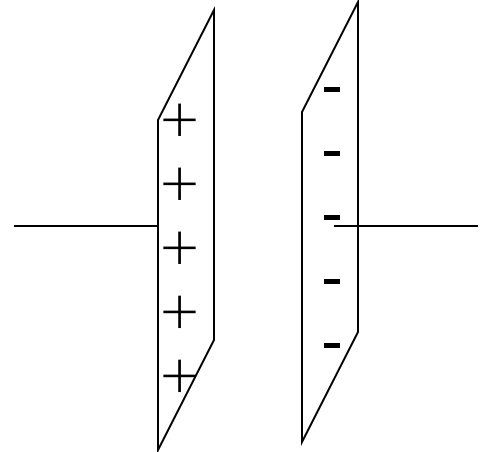
- 5) What is the magnitude of the net force on the right charge at (2,0) due to the other two?
 - a) 0 N
 - b) 0.102 N
 - c) 0.204 N
 - d) 0.306 N
 - e) 0.408 N

- 6) How much work would it take to move a 4th charge (of $+8 \mu\text{C}$) from very far a way (infinity) to the coordinate point (-2,0)?
 - a) 0.11 J
 - b) 0.22 J
 - c) 0.33 J
 - d) 0.44 J
 - e) 0.55 J

A capacitor is constructed from two metal sheets placed 2 mm apart. The total capacitance is 18 pF (18×10^{-12} F). A battery is used to charge the capacitor to 9 nC (9×10^{-9} C). The positive and negative plates are shown:

7) What direction do the electric field lines point inside the capacitor shown?

- a) up
- b) down
- c) left
- d) right
- e) the electric field is zero in the capacitor



8) What area of plates was needed to construct this capacitor?

- a) 0.0011 m²
- b) 0.0021 m²
- c) 0.0031 m²
- d) 0.0041 m²
- e) 0.0051 m²

9) What is the strength of the electric field between the plates?

- a) 150,000 V/m
- b) 250,000 V/m
- c) 350,000 V/m
- d) 450,000 V/m
- e) 550,000 V/m

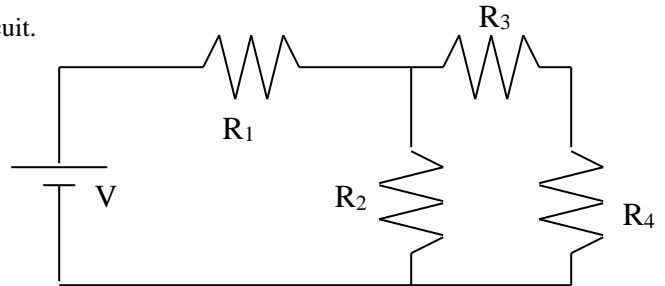
10) If 3 of these capacitors are connected in parallel and then this combination is connected in series with a fourth capacitor, what is the net capacitance of the combination?

- a) 4.5 pF
- b) 13.5 pF
- c) 24 pF
- d) 36 pF
- e) 72 pF

You are given the following circuit with $V = 12\text{ V}$, $R_1 = 3\ \Omega$, $R_2 = 6\ \Omega$, $R_3 = 6\ \Omega$, and $R_4 = 3\ \Omega$:

11) Calculate the total equivalent resistance of the circuit.

- a) $2.18\ \Omega$
- b) $3\ \Omega$
- c) $6\ \Omega$
- d) $6.6\ \Omega$
- e) $18\ \Omega$



12) Compare the magnitude of the voltage drops across each resistor.

- a) $V_1 > V_2 > V_3 > V_4$
- b) $V_2 > V_3 > V_4 > V_1$
- c) $V_3 > V_4 > V_2 > V_1$
- d) $V_2 > V_1 > V_3 > V_4$
- e) $V_1 > V_2 > V_4 > V_3$

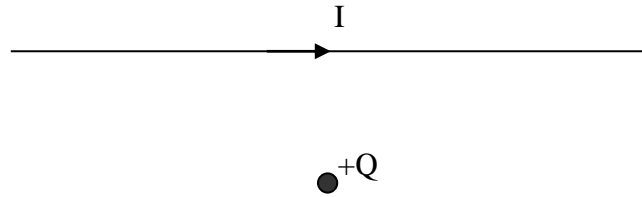
13) Compare the magnitudes of the currents through each resistor.

- a) $I_1 > I_2 > I_3 > I_4$
- b) $I_1 = I_2 > I_3 > I_4$
- c) $I_1 > I_2 = I_3 > I_4$
- d) $I_1 > I_2 > I_3 = I_4$
- e) $I_1 > I_2 = I_3 = I_4$

14) What is the power dissipated in R_4 ?

- a) 0.39 W
- b) 0.65 W
- c) 0.87 W
- d) 1.45 W
- e) 1.59 W

A single wire in the plane of the page has $I = 3 \text{ A}$ (directions shown by the arrow). A single charge $Q = +2 \mu\text{C}$ is moving below the wire at the location shown, 10 cm below the wire:

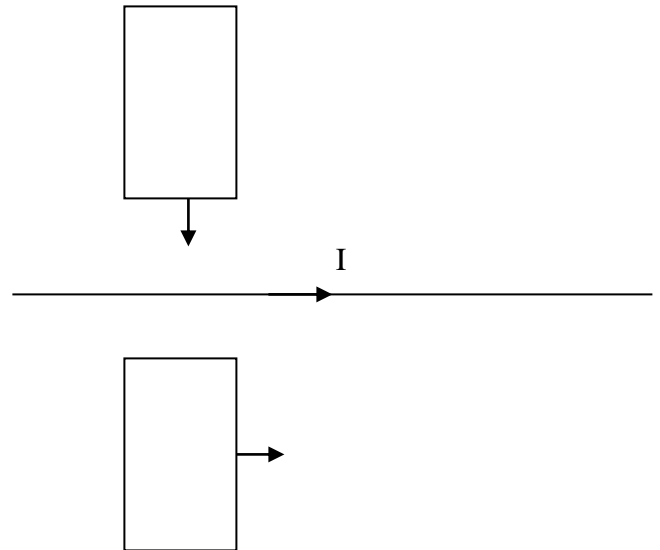


- 15) What is the direction of the magnetic field below the wire (due to just the wire)?
- a) up
 - b) down
 - c) into the page
 - d) out of the page
 - e) zero
- 16) What is the magnitude of the magnetic field 10 cm below the wire (due to just the wire)?
- a) $3 \times 10^{-6} \text{ T}$
 - b) $4 \times 10^{-6} \text{ T}$
 - c) $5 \times 10^{-6} \text{ T}$
 - d) $6 \times 10^{-6} \text{ T}$
 - e) $7 \times 10^{-6} \text{ T}$
- 17) If the charge was moving straight down, what is the direction of the force on the charge?
- a) left
 - b) right
 - c) into the page
 - d) out of the page
 - e) zero
- 18) If the charge was moving to the right, what is the direction of the force on the charge?
- a) up
 - b) down
 - c) into the page
 - d) out of the page
 - e) zero
- 19) When moving to the right at 18 m/s, what is the magnitude of the magnetic force on the charge?
- a) $1.16 \times 10^{-10} \text{ N}$
 - b) $2.16 \times 10^{-10} \text{ N}$
 - c) $3.16 \times 10^{-10} \text{ N}$
 - d) $4.16 \times 10^{-10} \text{ N}$
 - e) $5.16 \times 10^{-10} \text{ N}$

Given two loops moving near a fixed wire with current directed to the right. The loop above the wire moves directly down and the wire below the wire moves directly to the right:

20) What are the directions of the currents induced?

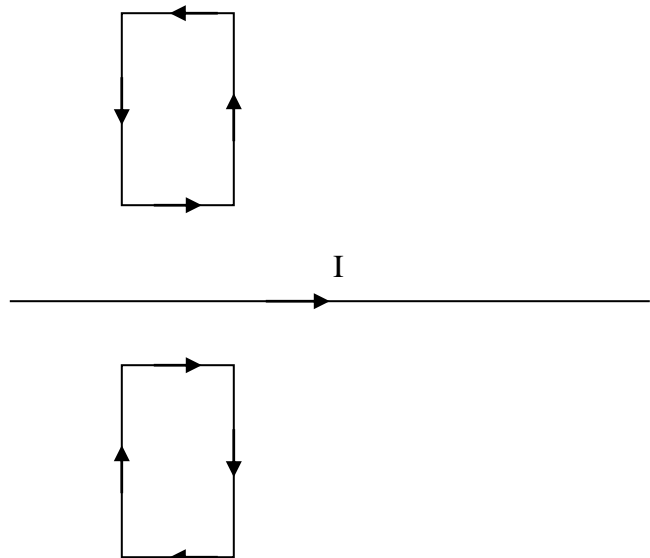
- a) the upper loop is CW, the lower loop is zero
- b) the upper loop is CCW, the lower loop is zero
- c) both are zero
- d) the upper loop is zero, the lower loop is CW
- e) the upper loop is zero, the lower loop is CCW



Given two loops (at rest) near a fixed wire with current directed to the right. The loop above the wire has a CCW current in it and the loop below the wire has a CW current in it:

21) What is true about the net force on each loop?

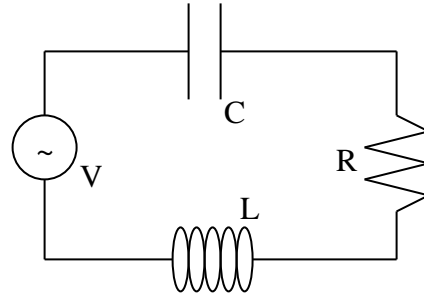
- a) the net force on both is down
- b) the net force on both is up
- c) the net force on both is zero
- d) the net force is up on the upper loop and down on the lower loop
- e) the net force is down on the upper loop and up on the lower loop



Shown below is an LRC circuit connected to an AC generator with $R = 22 \Omega$, $X_L = 58 \Omega$, and $X_C = 16 \Omega$. The generator voltage oscillates at a frequency of 60 Hz. The maximum current in the circuit is measured to be 0.8 A

22) The current through the capacitor _____ the voltage across the capacitor and the current through the resistor _____ the voltage across the resistor.

- a) leads, lags
- b) lags, leads
- c) leads, is in phase with
- d) lags, is in phase with
- e) is in phase with, is in phase with



23) What is the impedance of the circuit?

- a) 17Ω
- b) 27Ω
- c) 37Ω
- d) 47Ω
- e) 57Ω

24) What is the value of the capacitance C?

- a) $155 \mu\text{F}$
- b) $166 \mu\text{F}$
- c) $177 \mu\text{F}$
- d) $188 \mu\text{F}$
- e) $199 \mu\text{F}$

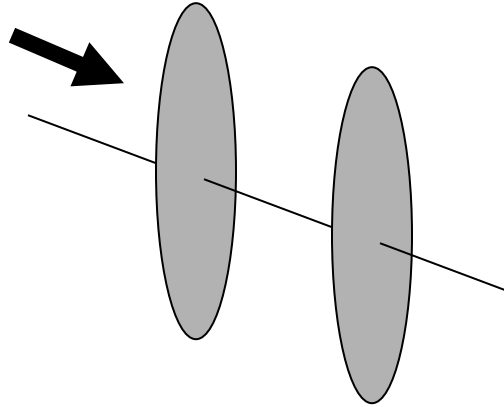
25) What is the current in the circuit the moment the generator voltage is at a maximum.

- a) 0 A
- b) 0.17 A
- c) 0.27 A
- d) 0.37 A
- e) 0.47 A

26) The frequency is changed to now be at the resonant frequency of the circuit (but the voltage of the generator stays the same). What is the maximum current in the circuit?

- a) 1.52 A
- b) 1.62 A
- c) 1.72 A
- d) 1.82 A
- e) 1.92 A

Unpolarized light with initial intensity of I_0 goes through two linear polarizers. The first polarizer has a transmission axis at an angle of $+75^\circ$ with respect to the vertical and the second polarizer has a transmission axis at an angle of $+45^\circ$ with respect to the vertical.



27) What is the final intensity of light?

- a) $0.5 I_0$
- b) $0.375 I_0$
- c) $0.25 I_0$
- d) $0.125 I_0$
- e) 0

28) If a third polarizer is placed in-between the two shown, at which angle to the vertical (of the choices listed below) will the intensity of transmitted light be maximized?

- a) at 0°
- b) at 0° or 90°
- c) at 45°
- d) at 75°
- e) at 45° or 75°

29) If a third polarizer is placed in-between the two shown, at which angle to the vertical (of the choices listed below) will the intensity of transmitted light be minimized?

- a) at 0°
- b) at 0° or 90°
- c) at 45°
- d) at 75°
- e) at 45° or 75°

30) Which statement about E-M radiation is FALSE?

- a) The intensity of the radiation depends on the strength of the electric and magnetic fields.
- b) The electric and magnetic fields are changing in time.
- c) The electric and magnetic fields are always perpendicular to each other.
- d) The speed of the radiation in vacuum depends on the frequency.
- e) There is energy carried by E-M radiation.

Online Physics 122 Formulas

$$F = ma$$

$$F = \frac{kq_1q_2}{r^2}$$

$$E = \frac{F}{q_o}$$

$$E = \frac{kq}{r^2}$$

$$U = \frac{kq_1q_2}{r}$$

$$V = \frac{U}{q_o}$$

$$V = \frac{kq}{r}$$

$$E = \frac{V}{d}$$

$$C = \epsilon_o \frac{A}{d}$$

$$C = \frac{Q}{V}$$

$$U = \frac{1}{2} QV$$

$$I = \frac{Q}{t}$$

$$C_p = C_1 + C_2$$

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$R_s = R_1 + R_2$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = \rho \frac{L}{A}$$

$$V = IR$$

$$P = IV$$

$$Q = Q_o e^{-\frac{t}{RC}}$$

$$Q = Q_o \left(1 - e^{-\frac{t}{RC}} \right)$$

$$F = qvB \sin \theta$$

$$F = ILB \sin \theta$$

$$B = \frac{\mu_o I}{2\pi r}$$

$$B = \mu_o nI$$

$$r = \frac{mv}{qB}$$

$$\Phi_B = BA \cos \phi$$

$$emf = vBL$$

$$emf = -N \frac{\Delta \Phi_B}{\Delta t}$$

$$U = \frac{1}{2} LI^2$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$V_{rms} = I_{rms} Z$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$X_c = \frac{1}{2\pi fC}$$

$$X_L = 2\pi fL$$

$$\bar{P} = V_{rms} I_{rms} \cos \phi$$

$$\tan \phi = \frac{X_L - X_C}{R}$$

$$f_o = \frac{1}{2\pi \sqrt{LC}}$$

$$c = \lambda f$$

$$c = \frac{1}{\sqrt{\epsilon_o \mu_o}}$$

$$U = \frac{1}{2} \epsilon_o E^2 + \frac{1}{2\mu_o} B^2$$

$$E = cB$$

$$I = I_o \cos^2 \theta$$

$$k = 8.99 \times 10^9 \text{ Nm}^2 / \text{C}^2$$

$$\epsilon_o = 8.85 \times 10^{-12} \text{ C}^2 / \text{m}^2 \text{ N}$$

$$q_e = 1.60 \times 10^{-19} \text{ C}$$

$$\mu_o = 4\pi \times 10^{-7} \text{ Tm} / \text{A}$$

$$c = 3 \times 10^8 \text{ m} / \text{s}$$