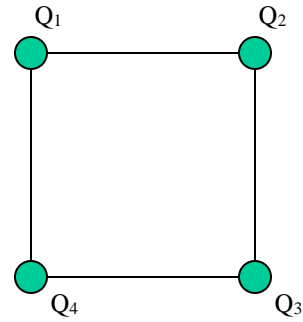Four charges are on the four corners of a square. $Q_1 = +5\mu C$, $Q_2 = -10\mu C$, $Q_3 = +5\mu C$, $Q_4 = -10\mu C$. The side length of each side of the square is 3 m.

1) What is the direction of the force on Q_1 due to ONLY Q_4?

(a) up
(b) down
(c) left
(d) right
(e) zero

2) What is the x-component (horizontal component) of the NET force on Q_1 due to the other three charges? (positive is to the right)

(a) 0.05 N
(b) 0.041 N
(c) 0 N
(d) -0.041 N
(e) -0.05 N

3) What is the y-component (vertical component) of the NET force on Q_1 due to the other three charges? (positive is up)
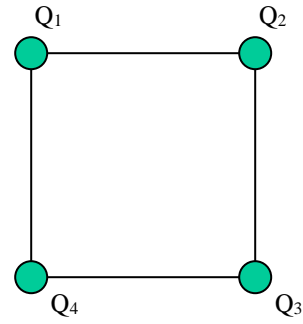
(a) 0.05 N
(b) 0.041 N
(c) 0 N
(d) -0.041 N
(e) -0.05 N

4) What is the magnitude of the net electric field at the center of the square?

(a) 40,000 N/C
(b) 30,000 N/C
(c) 20,000 N/C
(d) 10,000 N/C
(e) 0 N

(The same situation of the previous page is continued here.)

Four charges are on the four corners of a square. $Q_1 = +5\mu C$, $Q_2 = -10\mu C$, $Q_3 = +5\mu C$, $Q_4 = -10\mu C$. The side length of each side of the square is 3 m.

5) What is the electric potential at the center of the square?

(a) 42,400 V
(b) 21,200 V
(c) 0 V
(d) -21,200 V
(e) -42,400 V

6) What is the total electric potential energy of this system?

(a) 0.66 J
(b) 0.33 J
(c) 0 J
(d) -0.33 J
(e) -0.66 J

A capacitor is connected to a battery and charged up. It remains connected to the battery so that the voltage across the capacitor stays fixed. Then the distance between the plates of the capacitor is increased.

7) What happens to the capacitance of the capacitor?

(a) increases
(b) decreases
(c) remains the same

8) What happens to the charge on the capacitor?

(a) increases
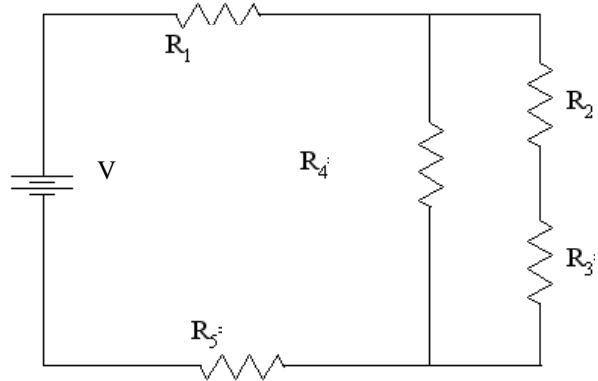(b) decreases
(c) remains the same

9) What happens to the energy stored in the capacitor?

(a) increases
(b) decreases
(c) remains the same

10) What happens to the magnitude of the electric field between the plates of the capacitor?

(a) increases
(b) decreases
(c) remains the same

The following circuit has the values: V = 9 V,
$R_1 = 1\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 3\ \Omega$, $R_4 = 4\ \Omega$, $R_5 = 5\ \Omega$.

11) Compare the current through R_1, R_4, and R_5.

(a) $I_1 > I_5 > I_4$
(b) $I_1 > I_5 = I_4$
(c) $I_1 = I_5 > I_4$
(d) $I_1 = I_4 = I_5$
(e) $I_1 > I_4 > I_5$

12) Compare the voltage drop across R_2, R_3, and R_4.

(a) $V_4 > V_2 > V_3$
(b) $V_4 > V_2 = V_3$
(c) $V_4 > V_3 > V_2$
(d) $V_4 = V_3 = V_2$
(e) $V_4 = V_3 > V_2$

13) Calculate the current through R_1.

(a) 1.09 A
(b) 1.75 A
(c) 2.23 A
(d) 2.74 A
(e) 3.28 A

14) Calculate the voltage drop across R_2.

(a) 0.18 V
(b) 0.59 V
(c) 0.80 V
(d) 0.97 V
(e) 1.57 V

15) Calculate the power dissipated in R_4.

(a) 0.94 W
(b) 1.09 W
(c) 1.22 W
(d) 1.35 W
(e) 1.48 W

A square loop with side lengths of 0.4 m is moving toward a long
straight vertical wire with a current of 3.9 A. In the position
shown, the front edge of the loop is 0.3 m from the straight
wire and the induced current is 1.6 A in a CCW direction.
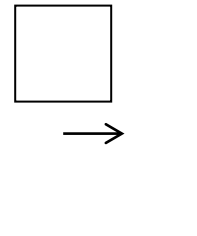
16) What is the direction of the magnetic field near the loop
due to the long straight wire?

(a) up
(b) down
(c) out of the page
(d) into the page
(e) right

17) What is the direction of the current in the long straight vertical wire?

(a) up
(b) down
(c) zero

18) What is the direction of the force on the loop due to the long straight vertical wire, as the loop moves
toward the long straight vertical wire?

(a) up
(b) down
(c) left
(d) right
(e) zero

19) What is the magnitude of the force on the loop due to the long straight vertical wire, at the instant
described above?

(a) 4.3 x 10^{-7} N
(b) 5.7 x 10^{-7} N
(c) 7.2 x 10^{-7} N
(d) 8.1 x 10^{-7} N
(e) 9.5 x 10^{-7} N

20) If the loop were on the other side of the vertical wire but moving in the same direction (to the right)
what would be the direction of the induced current?

(a) clockwise
(b) counterclockwise
(c) there would be no induced current – the change in magnetic flux would be zero!

A simple RLC series circuit is connected to a generator with frequency 60 Hz. The maximum voltage across each element (the resistor, inductor, and capacitor) is measured along with the maximum current in the circuit. It is found that: $V_{Rmax} = 18$ V, $V_{Lmax} = 25$ V, $V_{Cmax} = 37$ V and $I_{max} = 0.8$ A.

21) In which circuit element does the current lag the voltage?

(a) capacitor
(b) inductor
(c) resistor

22) What is the maximum voltage across the generator?

(a) 13.4 V
(b) 21.6 V
(c) 38.1 V
(d) 49.2 V
(e) 60.7 V

23) What is the capacitance of the capacitor?

(a) 16 µF
(b) 25 µF
(c) 32 µF
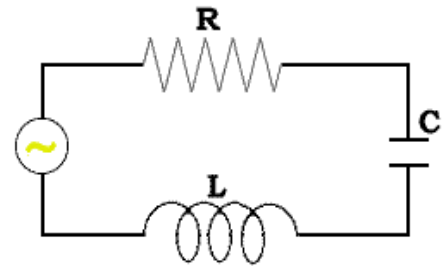(d) 57 µF
(e) 65 µF

24) What is the inductance of the inductor?

(a) 83 mH
(b) 115 mH
(c) 172 mH
(d) 221 mH
(e) 265 mH

25) What is the average power dissipated in the circuit?

(a) 4.3 W
(b) 7.2 W
(c) 10.2 W
(d) 16.5 W
(e) 20.1 W
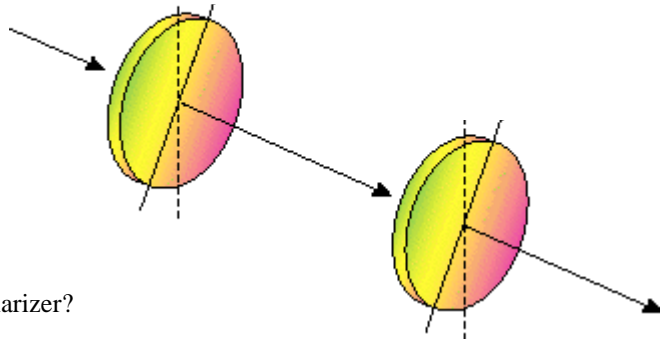
26) What is the resonance frequency of this RLC circuit?

(a) 22 Hz
(b) 38 Hz
(c) 60 Hz
(d) 73 Hz
(e) 92 Hz

Unpolarized light with a wavelength of 600 nm and an intensity of 3.8 W/m^2 is incident on two linear polarizers.

27) What is the frequency of this radiation?

(a) 3 x 10^{14} Hz
(b) 5 x 10^{14} Hz
(c) 7 x 10^{14} Hz
(d) 9 x 10^{14} Hz
(e) 11 x 10^{14} Hz

28) What is the intensity of the light after the first polarizer?

(a) 0 W/m^2
(b) 1.0 W/m^2
(c) 1.9 W/m^2
(d) 3.0 W/m^2
(e) 3.8 W/m^2

29) If the intensity after the second polarizer is 0.8 W/m^2, what is the angle between the transmission axes of the two polarizers?

(a) 30°
(b) 40°
(c) 50°
(d) 60°
(e) 70°

30) Increasing the wavelength of the light would do what to the speed of this radiation?

(a) increase the speed
(b) decrease the speed
(c) do nothing to the speed

31) The electric and magnetic fields are always parallel to each other in E-M waves.

(a) True
(b) False

32) Radio waves, microwaves, infrared waves, light, ultraviolet waves, x-rays, and gamma rays are all types of E-M radiation.

(a) True
(b) False

Online Physics 122 Formulas

$$F = ma \qquad F = \frac{kq_1q_2}{r^2} \qquad E = \frac{F}{q_o} \qquad E = \frac{kq}{r^2}$$

$$U = \frac{kq_1q_2}{r} \qquad V = \frac{U}{q_o} \qquad V = \frac{kq}{r} \qquad E = \frac{V}{d}$$

$$C = \varepsilon_o \frac{A}{d} \qquad C = \frac{Q}{V} \qquad U = \frac{1}{2}QV \qquad I = \frac{Q}{t}$$

$$C_p = C_1 + C_2 \qquad \frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} \qquad R_s = R_1 + R_2 \qquad \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = \rho \frac{L}{A} \qquad V = IR \qquad P = IV \qquad Q = Q_o e^{\frac{-t}{RC}}$$

$$Q = Q_o \left(1 - e^{\frac{-t}{RC}}\right) \qquad F = qvB\sin\theta \qquad F = ILB\sin\theta \qquad B = \frac{\mu_o I}{2\pi r}$$

$$B = \mu_o nI \qquad r = \frac{mv}{qB} \qquad \Phi_B = BA\cos\phi \qquad emf = vBL$$

$$emf = -N\frac{\Delta\Phi_B}{\Delta t} \qquad U = \frac{1}{2}LI^2 \qquad \frac{V_s}{V_p} = \frac{N_s}{N_p} \qquad V_{rms} = I_{rms}Z$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \qquad X_c = \frac{1}{2\pi fC} \qquad X_L = 2\pi fL$$

$$\overline{P} = V_{rms}I_{rms}\cos\phi \qquad \tan\phi = \frac{X_L - X_C}{R} \qquad f_o = \frac{1}{2\pi\sqrt{LC}} \qquad c = \lambda f$$

$$c = \frac{1}{\sqrt{\varepsilon_o \mu_o}} \qquad U = \frac{1}{2}\varepsilon_o E^2 + \frac{1}{2\mu_o}B^2 \qquad E = cB$$

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

$$k = 8.99\times10^9 \, Nm^2/C^2$$
$$\varepsilon_o = 8.85\times10^{-12} \, C^2/m^2N$$
$$q_e = 1.60\times10^{-19} \, C$$
$$\mu_o = 4\pi\times10^{-7} \, Tm/A$$
$$c = 3\times10^8 \, m/s$$