HW #01

Roman Senkov

Question 1

0/1 pt 999 998

A LaGuardia Physics Professor is in a small boat somewhere in the middle of an ocean studying surface water waves. He can estimate the distance between two consecutive wave crests as 20 m. Also the boat goes up and down about 2 times every 5.2 seconds. What are the wavelength, period and frequency of the wave?

The wavelength of the wave, λ = _____ Units Select an answer .

The period of the wave, T = _____ Units Select an answer .

The frequency of the wave, f = _____ Units Select an answer .

What is the speed of the wave?

The speed of the wave, v = _____ Units Select an answer .

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Question 2

0/1 pt 999 998

The frequency of a radio station is 81.5 MHz. Find the period and wavelength of the radio waves emitted by this station in empty space. The speed of electromagnetic waves in vacuum is $c = 3 \cdot 10^8$ m/s.

The period, T = _____ Units Select an answer .

The wavelength, λ = _____ Units Select an answer .

When a radio wave of the same frequency propagates in water, it's wavelength is measured to be 2.77 m. What is the speed of that radio wave in water?

The speed of the wave in water, v = _____ Units Select an answer .

Find the ratio of the wave speed in vacuum to the speed in water: $n = \frac{c}{v}$ (it is called the *index of refraction* of the medium).

The index of refraction of water, n = _____ Units Select an answer .

The index of refraction is always greater or equal to 1, it means that the speed of electromagnetic waves in any medium is always Select an answer the speed of electromagnetic waves in empty space.

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Question 3 0/1 pt 999 998

We hear sounds best from 1000 Hz to 5000 Hz. Assuming the same air conditions for the sound waves at these frequencies which of the following statements are True?

The speed of 1000-Hz wave is greater than the speed of 5000-Hz wave: Select an answer .

The wavelength of 1000-Hz wave is shorter than the wavelength of 5000-Hz wave: Select an answer .

If the speed of sound is 342 m/s, what are the wavelengths of 1000-Hz and 5000-Hz waves?

The wavelength at 1000 Hz frequency, λ_1 = _____ Units Select an answer .

The wavelength at 5000 Hz frequency, λ_2 = _____ Units Select an answer .

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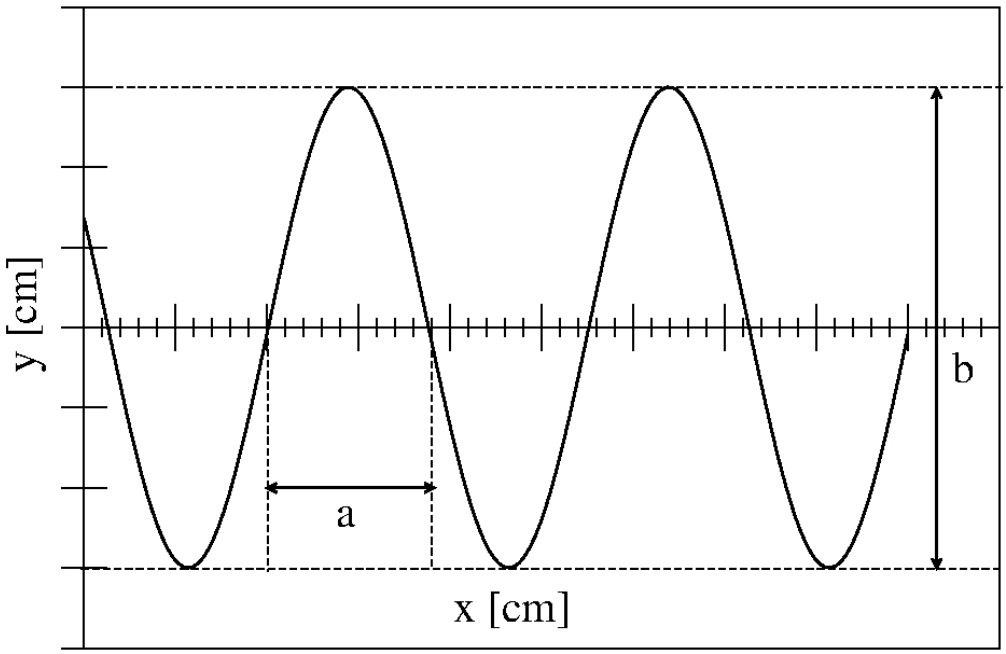
Question 4 0/1 pt 999 998

A snapshot of a simple wave moving in the positive x-direction is shown in the graph below. Find the following parameters of the wave if a = 12 cm, b = 50 cm, and the wave has a frequency of 35 Hz.



The amplitude of the wave, A = _____ Units Select an answer .

The wavelength of the wave, λ = _____ Units Select an answer .

The period of the wave, T = _____ Units Select an answer .

The speed of the wave, v = _____ Units Select an answer .

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Question 5 0/1 pt 999 998

A transverse wave propagating along a string is described by the following equation

$y = -0.2 \cdot \sin(-21.9 \cdot t - 135 \cdot x + 8.2 \cdot \pi)$,

where x is the coordinate along the string, y is the deviation from the equilibrium (both coordinates are in meters), t is the time in seconds, and the argument of the sin function is in radians. Find the parameters of the wave listed below.

The amplitude, A = _____ Units Select an answer .

The frequency, f = _____ Units Select an answer .

The wavelength, λ = _____ Units Select an answer .

The angular frequency, ω = _____ Units Select an answer .

The magnitude of the wave vector, k = _____ Units Select an answer .

The wave speed, v = _____ Units Select an answer .

The direction of the wave propagation, Select an answer

The maximum transverse speed, $V_{y,\,max}$ = _____ Units Select an answer .

Find the transverse velocity of the string point located at x = 0.25 m at t = 4.1 sec.

The transverse velocity, V_y = _____ Units Select an answer .

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Question 6 0/1 pt 999 998

A steel string has a length of L = 26 cm and a mass of m = 7.1 g. If the string is under a tension of 1.7 lb, what is the speed of waves on the string?

The speed of wave, v_1 = _____ Units Select an answer .

If we keep the same material and geometrical parameters of the string, but double the tension, what is the new speed of wave on the string?

The speed of wave, v_2 = _____ Units Select an answer .

If we keep the same tension, the same material and cross section area of the string, but double the length of the string, what is the new speed of wave on the string?

The speed of wave, v_3 = _____ Units Select an answer .

If we keep the same tension, the same material and length of the string, but double the radius of the cross section of the string, what is the new speed of wave on the string?

The speed of wave, v_4 = _____ Units Select an answer .

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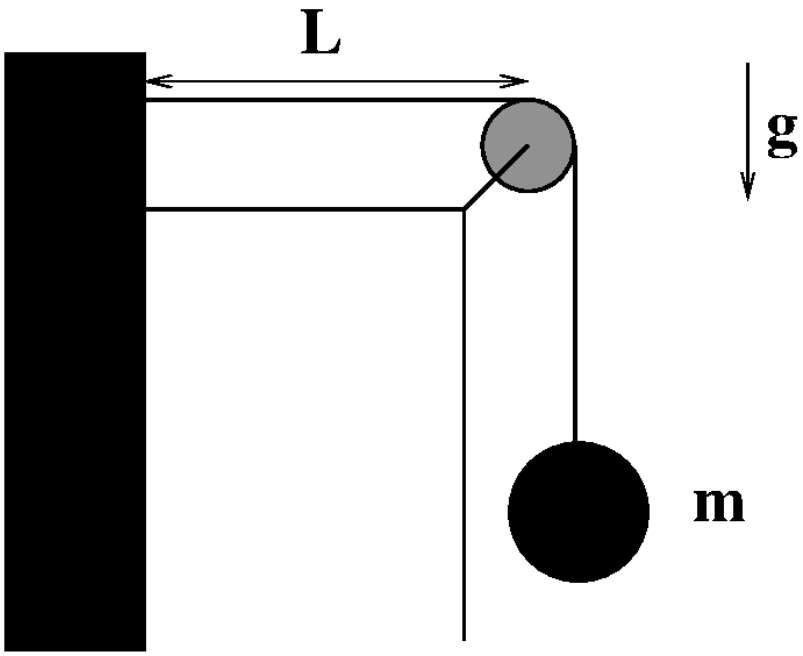
Question 7 0/1 pt 999 998

A 110-m telephone wire has a mass of 770 gram. A 1.5 m long segment of this wire is used to suspend a ball of m = 1.8 kg mass, see the picture below. What is the speed of wave on the horizontal section of the wire which has a length of L = 0.7 m?



The speed of wave, v_1 = _____ Units Select an answer .

What is the speed of wave on the vertical section of the wire?

The speed of wave, v_2 = _____ Units Select an answer .

What is the linear mass density of the wire?

The linear mass density, λ = _____ Units Select an answer .

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Question 8 0/1 pt 999 998

An uniform rope of length L = 0.55 m and mass m is attached to the ceiling, so it hangs down freely. A LaGuardia physics student briefly shakes the free end of the rope generating a pulse that travels up to the ceiling. How long does it take for the pulse to reach the ceiling? The free fall acceleration is g = 9.81 m/s^2.

The time of travel, t = _____ Units Select an answer .

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Question 9 0/1 pt 999 998

Under what tension should be a guitar string (with length 59 cm and linear mass density 0.11 g/cm), so that its first harmonic sounds at 190 Hz?

The tension in the string, τ = _____ Units Select an answer .

What are the frequencies and wavelengths of the 2^{nd} and 3^{rd} harmonics?

The frequency of 2^{nd} harmonic, f_2 = _____ Units Select an answer .

The wavelength of 2^{nd} harmonic, λ_2 = _____ Units Select an answer .

The frequency of 3^{rd} harmonic, f_3 = _____ Units Select an answer .

The wavelength of 3^{rd} harmonic, λ_3 = _____ Units Select an answer .

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Question 10

0/1 pt 999 998

Consider a string under tension with the both ends fixed. One possible resonance frequency of the string is 1200 Hz and the next higher resonance frequency of the same string is 1350 Hz. What is the lowest (fundamental) frequency of this string?

The fundamental frequency, f_1 = _____ Units Select an answer .

What is the next higher resonance frequency after 1350 Hz?

The next after 1350 Hz frequency, f = _____ Units Select an answer .

What are the harmonics of 1200-Hz and 1350-Hz waves?

The harmonic number of 1200-Hz wave is _____.

The harmonic number of 1350-Hz wave is _____.

What is the length of the string if the speed of wave is 120 m/s?

The length of the string, L = _____ Units Select an answer .

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Question 11

0/1 pt 999 998

An organ pipe with open ends produces sound of 290 Hz (fundamental frequency). What will be the fundamental frequency of the same pipe with the ends closed? What will be the fundamental frequency if one end is open and one is closed?

The frequency with the closed ends, f_{closed} = _____ Units Select an answer .

The frequency with the one open/one closed ends, $f_{closed\text{-}open}$ = _____ Units Select an answer .

If the speed of sound is 323 m/s, how long is the pipe?

The length of the pipe, L = _____ Units Select an answer .

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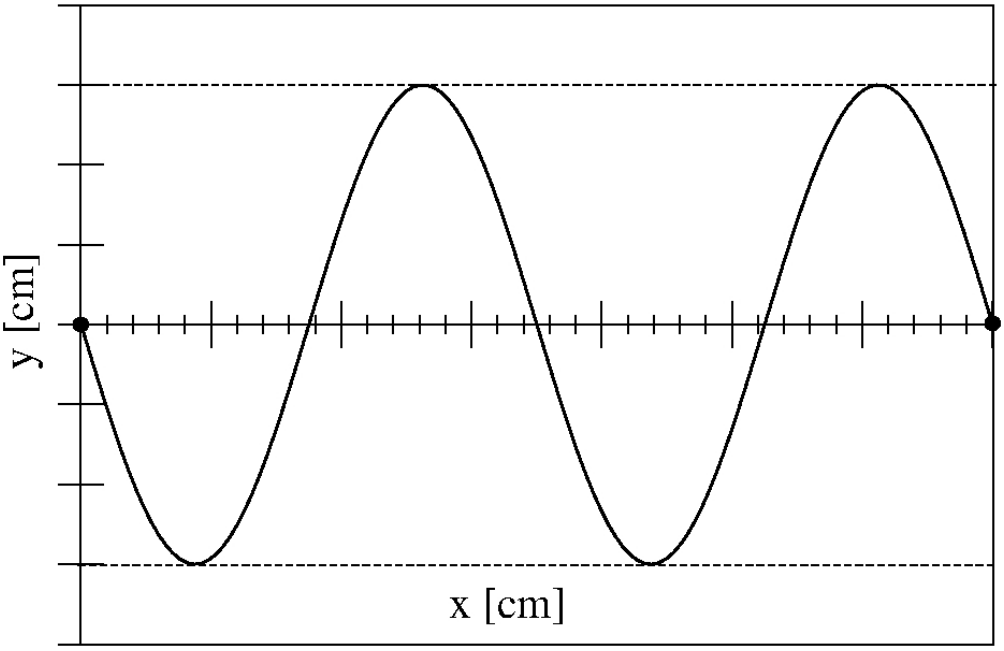
Question 12 0/1 pt 999 998

The graph shown below represents a standing wave on a string with fixed ends. The length of the string is L = 55 cm and it's mass is m = 27 g. If the string is under tension of 8.5 N, find the wavelength (in cm) and period (in msec) of the oscillations.



The wavelength, λ = _____ Units Select an answer .

The period, T = _____ Units Select an answer .

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Question 13 0/1 pt 999 998

Consider a pipe that is open at both ends. How long is the pipe, if the fundamental frequency in this pipe submerged in air is 248 Hz? Take the speed of sound in air 338 m/s?

The length of the pipe, L = _____ Units Select an answer .

What is the frequency of the forth harmonic in this pipe in air?

The frequency, f_4 = _____ Units Select an answer .

What is the fundamental frequency of the same pipe submerged in helium? Take the speed of sound in helium 970 m/s.

The frequency of the pipe in Helium, f_1(in He) = _____ Units Select an answer .

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Question 14

0/1 pt 999 998

Real Life Examples: Resonance Frequency and Standing Waves

1. Find the first and second lowest resonance frequencies of air oscillations in between two parallel buildings separated by 15 m distance. Take 337 m/s for the speed of sound in air.

The first frequency, f_1 = _____ Units Select an answer .

The second frequency, f_2 = _____ Units Select an answer .

2. How deep should be ocean to enhance physiologically harmful infrasonic waves of 6 Hz frequency? Take 1.46 km/s for the speed of sound in water and find the minimum and next to minimum depths of the ocean. Hint: in this case the quantization rule for standing waves is: $\frac{\lambda}{4} + (N-1) \cdot \frac{\lambda}{2} = L$, where N = 1,2,3,... - an integer number.

The minimum depth, h_1 = _____ Units Select an answer .

The next to minimum depth, h_2 = _____ Units Select an answer .

3. Why do you think the shape of stringed instruments such as violins, guitars and cellos is curved and reminds a “hourglass” figure? How does this shape effect the quality of sound? Please write a small paragraph below (up to 100 words).

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HW #02

Roman Senkov

Question 1

0/1 pt 999 998

A standing wave is formed as result of superposition of two plain waves that travel on the same string:

$y_1(x,t) = 19\ m \cdot \cos(290 \cdot t - 2.45 \cdot x)$,

$y_2(x,t) = -19\ m \cdot \cos(290 \cdot t + 2.45 \cdot x)$,

where x is in meters and t is in seconds. What is the distance between nodes?

The distance between the nodes, d = _____ Units Select an answer .

What is the position of the first anti-node (for $x > 0$)?

The first anti-node, $x_{1,\text{ anti-node}}$ = _____ Units Select an answer .

What is the amplitude of oscillations at x = 0.35 m?

The amplitude, A(x = 0.35 m) = _____ Units Select an answer .

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Question 2

0/1 pt 999 998

There are several ways to calculate the speed of sound c_s in a gas, for example

$$c_s = \sqrt{\frac{\gamma \cdot R \cdot T}{M}},$$

where γ is the adiabatic coefficient of the gas, R is the ideal gas constant, T is the temperature in Kelvin, and M is the molar mass. Find the speed of sound in air at $T = 0^\circ C$ and at $T = 20^\circ C$, use $\gamma = 1.4$, M = 28.97 g/mol, and 0°C = 273.15 K.

The speed of sound in air at 0°C, c_1 = _____ Units Select an answer .

The speed of sound in air at 20°C, c_2 = _____ Units Select an answer .

A convenient approximate way to find the speed of sound at low temperatures (note that the temperature must be small in Celsius, not in Kelvin: T(in °C) ≪ 273.15) is the following

$$c_s = c_0\sqrt{1 + \frac{T}{273.15}} \approx c_0 + \alpha \cdot T,$$

where T is the gas temperature in Celsius and c_0 and α are constants. Using the values you found above (c_1 and c_2) find the constants c_0 and α for the speed of sound in air.

The constant c_0 = _____ Units Select an answer .

The constant α = _____ Units Select an answer .

Use the second (approximate) equation to find the speed of sound in air at 14°C.

The speed of sound, c_3 = _____ Units Select an answer .

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Question 3

0/1 pt 999 998

Consider a pipe open at one end and closed at the other end. The length of the pipe is 0.22 m. If the temperature of air is 11.5°C, what is the fundamental frequency of the sound produced by the pipe? For the speed of sound in air use the following equation:

$c_{air} = (331.3 + 0.606 \cdot T)$ m/s, where T is the temperature in Celsius.

The frequency, f_1(at T = 11.5°C) = _____ Units Select an answer .

What is the frequency of the fundamental harmonic when the temperature of the air is increased by 20°C?

The frequency, f_1(at T = 31.5°C) = _____ Units Select an answer .

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Question 4 0/1 pt 999 998

A LaGuardia Physics Professor drops a stone into a well. How deep is the well if the Professor hears the sound from the stone hitting the bottom of the well 2.15 s later? Neglect the air resistance and take the free fall acceleration g = 9.81 m/s^2. The air temperature is T = 16°C.

The depth of the well, h = _____ Units Select an answer .

How long did it take for the sound to travel back?

The time, t_s = _____ Units Select an answer .

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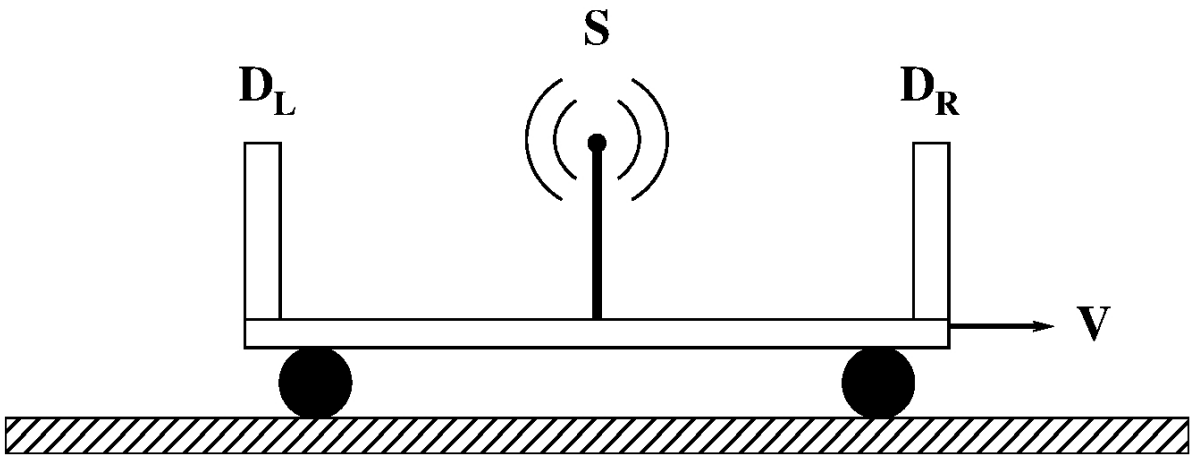
Question 5 0/1 pt 999 998

A car of length L = 18 m is moving through the stationary air with a constant velocity *V*, see the picture below. At the middle of the car there is a source of sound S, which emits signals in all directions, there are also two sound detectors D_L and D_R at the car's edges.

Which of the detectors will receive the signal earlier? Select an answer

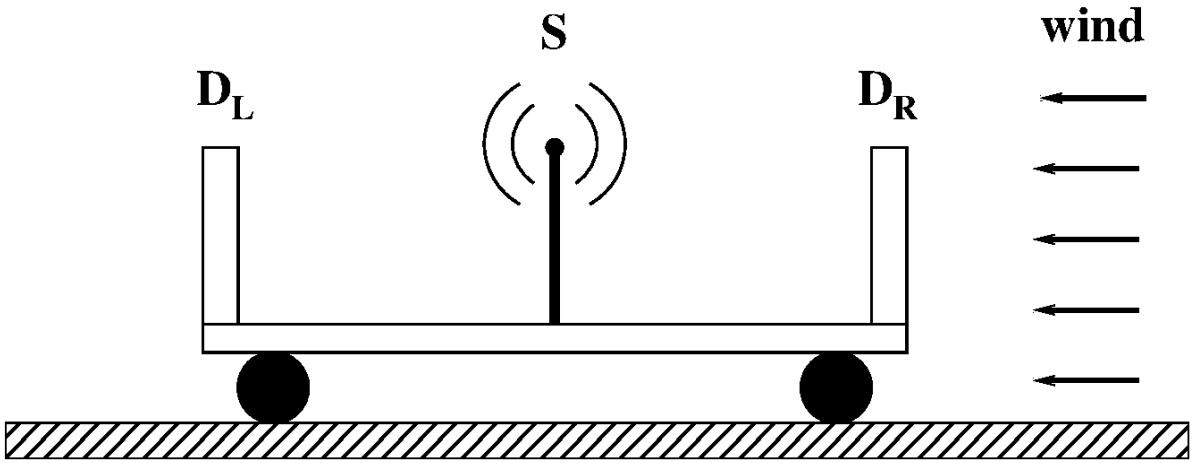


What is the speed of the car if one detector receives signals by 4.8 msec earlier than the other one? The air temperature is 14°C.

The speed of the car, V = _____ Units Select an answer .

Now the car is stationary but there is a 30.5-m/s wind blowing towards the car, as shown below.

Which of the detectors will receive the sound signal earlier? Select an answer



What is the time difference in the signal detection between the left and right detectors?

The time difference, Δt = _____ Units Select an answer .

By sending and detecting sound signals, is there any way to determine weather the car is moving through the air or it is the wind blowing and the car stays stationary? Select an answer

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Question 6 0/1 pt 999 998

Blitz problem solving: Sound Intensity and Intensity Level.

1. What is the intensity level in dB for a sound that has an intensity of $I_1 = 2 \times 10^{-6}$ W/m^2?

The intensity level, β_1 = _____ Units Select an answer .

2. What is the intensity of a 119-dB sound wave?

The intensity of sound, I_2 = _____ Units Select an answer .

3. The sound intensity level produced by 70 cars on Queens blvd is found to be 119 dB. If the cars contribute equally to the total intensity, what is the sound intensity level produced by one car?

The intensity level of one car, β_3 = _____ Units Select an answer .

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Question 7 0/1 pt 999 998

A point source emits sound isotropically. The sound intensity is 0.016 W/m^2 at a distance of 4.5 m from the source. What is the power of the source?

The power of the source, P = _____ Units Select an answer .

What is the sound intensity and sound level 20.3 m from the source?

The sound intensity, I = _____ Units Select an answer .

The sound level, β = _____ Units Select an answer .

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Question 8 0/1 pt 999 998

A LaGuardia Physics Professor is in the front row at a concert of *Grateful Dead* rock band, he is 4.9 meters away from the speaker. If the professor hears the sound at a level of β_1 = 130 dB, what is the intensity of the sound at this distance?

The intensity of the sound, I_1 = _____ Units Select an answer .

What will be the intensity of the sound if the professor walks 29.6 m away from the speaker? What will be the intensity level at this distance?

The intensity of the sound, I_2 = _____ Units Select an answer .

The corresponding intensity level, β_2 = _____ Units Select an answer .

How far from the speaker should the professor go to reduce the should level to 74 dB?

The distance, d = _____ Units Select an answer .

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Question 9 0/1 pt 999 998

The Sun radiates energy at about 3.85×10^{26} Joules per second. What is the sunlight intensity near planet Jupiter that is 780 million kilometers away from the Sun?

The intensity of the sunlight, I = _____ Units Select an answer .

What is the maximum power a 4.5-m by 1.5-m solar battery can produce if it is placed near Jupiter? Assume that the battery has an efficiency of 0.75.

The power produced by the battery, P = _____ Units Select an answer .

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Question 10 0/1 pt 999 998

There is a speaker on a platform which emits 1000-Hz sound waves as a stationary source and there is a LaGuardia Physics Professor who can detect these waves and determine their frequency. Both the Professor and the platform can move in any direction along the line joining them. If all the motions indicated below are relative to the ground (and to the air), which of the following statements are True/False?

If the Professors detects 1020-Hz sound, then he and the platform can be moving away from each other.
Select an answer

If the Professors detects 980-Hz sound, then he and the platform can be moving in opposite directions.
Select an answer

If the Professors detects 1000-Hz sound, then he and the platform can be moving in the same direction.
Select an answer

If the Professors detects 1020-Hz sound, then the platform can be stationary.
Select an answer

If the Professors detects 980-Hz sound, then the platform must move towards the Professor.
Select an answer

If the Professors detects 1000-Hz sound, then he and the platform must be stationary.
Select an answer

Note: you MUST complete all sentences before submitting.

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Question 11 0/1 pt 999 998

While standing next to the main entrance of the E-building a LaGuardia student notices an ambulance car approaching her at a speed of 21.2 m/s. What are the frequency and wavelength of the sound wave that the student hears while the car is approaching? Take that the car has a siren producing a 1.6-kHz signals when it is stationary and 340 m/s for the speed of sound.

The frequency of the sound wave, f_1 = _____ Units Select an answer .

The wavelength of the sound wave, λ_1 = _____ Units Select an answer .

When the car has passed the building and is moving away from the student, what are frequency and wavelength of the sound wave she would hear in this case?

The frequency of the sound wave, f_2 = _____ Units Select an answer .

The wavelength of the sound wave, λ_2 = _____ Units Select an answer .

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Question 12

0/1 pt 999 998

H-alpha line is a red visible spectral line in hydrogen atom with a wavelength of 656.3 nm. Consider five distant stars labeled A, B, C, D, and E. The light from these starts was detected on Earth and, after performing spectral analysis, the following H-alpha wavelengths were measured:
λ_A = 663.1 nm, λ_B = 644.9 nm, λ_C = 654.2 nm, λ_D = 663.6 nm, and λ_E = 659.5 nm.

Which star has the slowest speed relative to Earth, in which direction and how fast does it move?

The slowest star is ? and it moves Select an answer Earth.

The speed of the slowest star (in km/s), $v_{slowest}$ = _____ Units Select an answer .

Which star has the fastest speed relative to Earth, in which direction and how fast does it move?

The fastest star is ? and it moves Select an answer Earth.

The speed of the fastest star (in km/s), $v_{fastest}$ = _____ Units Select an answer .

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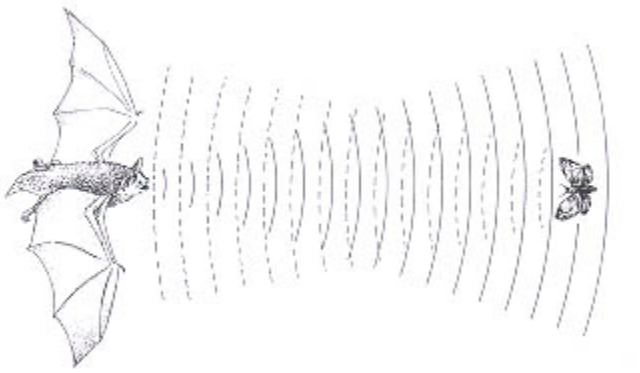
Question 13

0/1 pt 999 998

A bat sends an ultrasound signal of 40 kHz frequency towards a prey. Does the prey move away or towards the bat if the signal the bat receives back has 41.6 kHz frequency? What is the speed of the prey relative to the bat? Take 341 m/s for the speed of sound.



The prey moves Select an answer the bat.

The speed of the prey, V_{prey} = _____ Units Select an answer .

What frequency will the bat detect if the prey changes its direction of motion to the opposite but keeps the same speed?

The frequency detected by the bat, f = _____ Units Select an answer .

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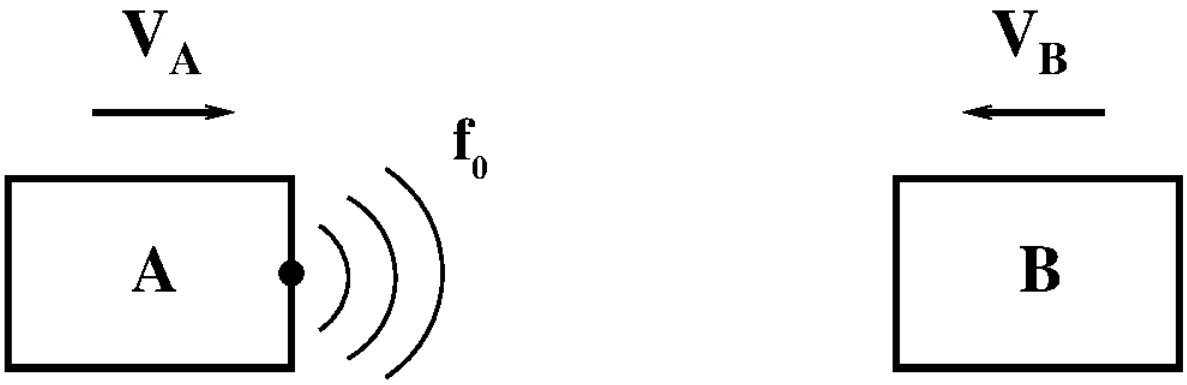
Question 14 0/1 pt 999 998

Two submarines A and B are approaching each other along a straight line as shown below. The speed of submarine A is V_A = 23 m/s, the speed of submarine B is unknown. Submarine A sends a 410-Hz acoustic signal towards submarine B and receives a reflected signal of a higher frequency of 437 Hz. What is the speed of submarine B if the speed of sound in water is 1500 m/s?



The speed of submarine B, V_B = _____ Units Select an answer .

What frequency does submarine B "hear"?

The frequency on submarine B, f_B = _____ Units Select an answer .

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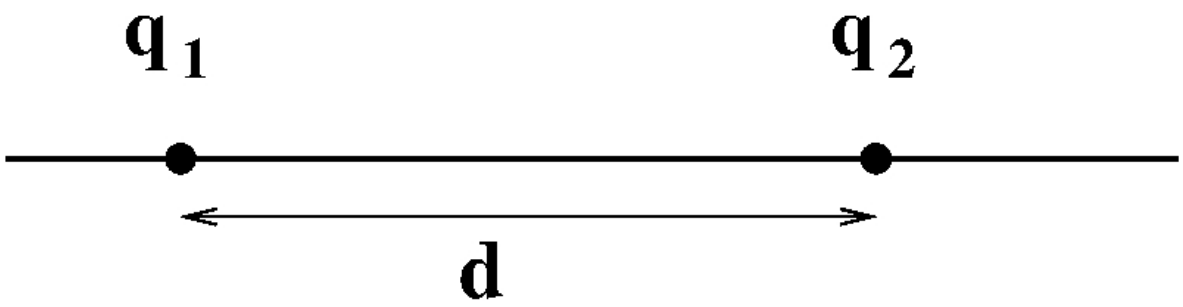
HW #03

Roman Senkov

Question 1

0/1 pt 999 998

Two charges q_1 = 30 μC and q_2 = 15 μC are separated by a distance 0.25 m. What is the magnitude of the electrostatic force acting on each charge?



The magnitude of the force, F = _____ Units Select an answer .

Is the force attractive or repulsive? Select an answer .

What is the direction of the force exerted on q_1? Select an answer .

What is the direction of the force exerted on q_2? Select an answer .

What should be the distance between these two charges so the electrostatic force is three times weaker?

The distance between the charges, d = _____ Units Select an answer .

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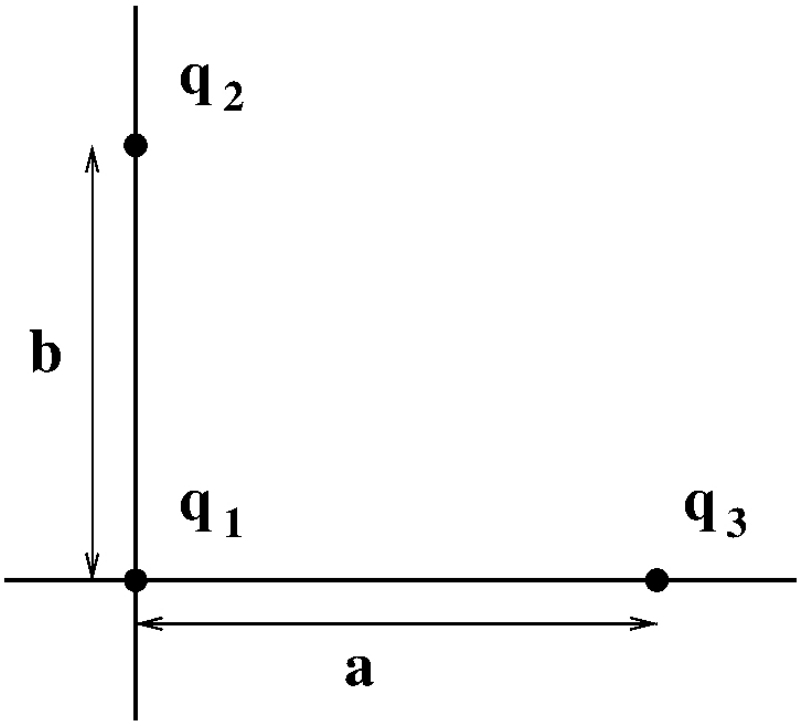
Question 2

0/1 pt 999 998

Three charges are arranged as shown below: q_1 = 38 μC is at the origin, q_2 = 16 μC is at a distance of b = 0.25 m along the vertical axis, and q_3 = 10 μC is at a distance of a = 0.5 m along the horizontal axis. Find the forces exerted on q_1 by q_2, by q_3 and by q_2 and q_3 together (the net force).



The magnitude of the force on q_1 due q_2, F_{12} = _____ Units Select an answer .

The direction of the force on q_1 due q_2 is Select an answer .

The magnitude of the force on q_1 due q_3, F_{13} = _____ Units Select an answer .

The direction of the force on q_1 due q_3 is Select an answer .

The magnitude of the net force on q_1, $F_{1,\ Net}$ = _____ Units Select an answer .

The direction of the net force on q_1 is Select an answer .

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Question 3 0/1 pt 999 998

A metallic plate holds a charge of Q = 8 nC.

Does the plate have excess or lack of electrons? Select an answer .

What total number of elementary charges does Q represent?

The number of elementary charges, N = _____ Units Select an answer .

After 47.5×10^{10} electrons were added to the plate, what is the new net charge on the plate?

The new charge of the plate, Q_{new} = _____ Units Select an answer .

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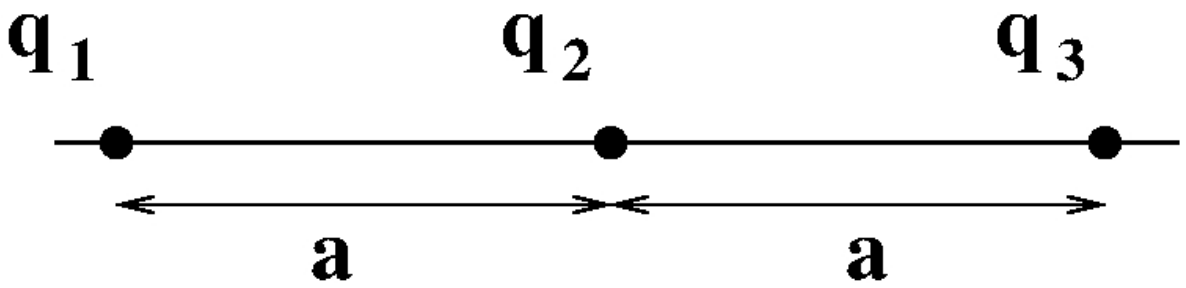
Question 4 0/1 pt 999 998

Three charges q_1, q_2, and q_3 are arranged as shown below. Which of the following statements are True/False?



If q1 is positive, q2 is positive, and q3 is positive, then q2 must experience the net force to the left. Select an answer .

If q1 is negative, q2 is positive, and q3 is positive, then q2 must experience the net force to the left. Select an answer .

If q1 is negative, q2 is negative, and q3 is negative, then q3 must experience the net force to the right. Select an answer .

If q1 is positive, q2 is negative, and q3 is positive, then q3 must experience the net force to the left. Select an answer .

If q1 is negative, q2 is positive, and q3 is negative, then q1 must experience the net force to the right. Select an answer .

If q1 is positive, q2 is negative, and q3 is negative, then q1 must experience the net force to the right. Select an answer .

Note: you MUST complete all sentences before submitting.

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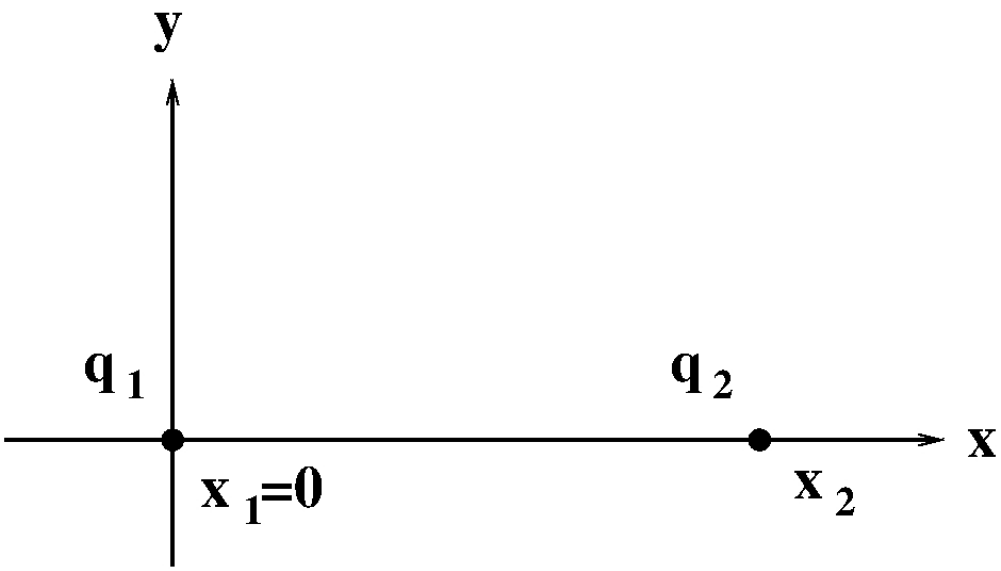
Question 5

0/1 pt 999 998

An electric charge q_1 = 48 mC is located at the origin of the (x,y) plane, while another charge q_2 = 15 mC is placed at the position x_2 = 2.2 m, see the picture below. At what position should a third charge q_3 be placed so it experiences no net force?



The position of the third charge, x_3 = _____ Units Select an answer .

Solve the same problem with all the same values, but with the opposite sign of the second charge: q_1 = 48 mC, q_2 = -15 mC, and x_2 = 2.2 m.

The new position of the third charge, $x_{3,\,new}$ = _____ Units Select an answer .

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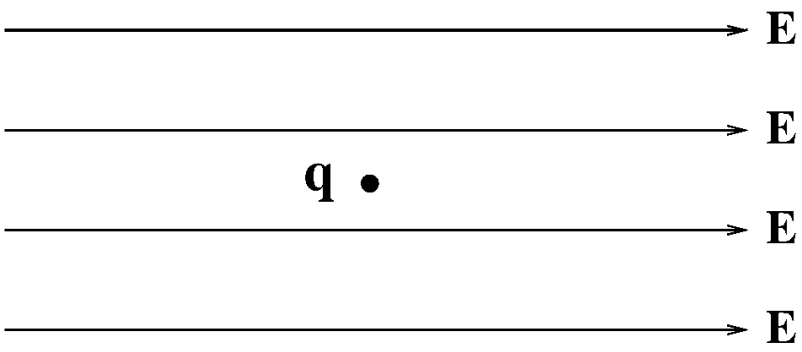
Question 6

0/1 pt 999 998

Blitz problem solving: Electric field.



1. A q = 22 μC charge is placed in an external electric field, it experiences a force of 50 mN magnitude. What are the strength and direction of the field?

The strength of E-field, E = _____ Units Select an answer .

The direction of E-field is Select an answer the direction of the force.

2. A q = -330 μC charge is placed in an external 1900-N/C electric field. What are the magnitude and direction of the force experienced by the charge?

The magnitude of the force, F = _____ Units Select an answer .

The direction of the force is Select an answer the direction of the electric field.

3. An unknown charge is placed in an external 380-N/C electric field. Find this charge if it experiences a force of 35 N in the direction opposite to the electric field.

The charge, q = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 7 0/1 pt 999 998

Which of the following statements about E-field are True/False?

E-field lines may cross.
Select an answer

E-field lines do not begin or end in a charge-free region except at infinity.
Select an answer

Negative charges prodice lines of E-field that point inward.
Select an answer

E-field lines make circles around positive charges.
Select an answer

A negative point charge released from rest will accelerate along an E-field line.
Select an answer

Positive charges prodices lines of E-field that point outward.
Select an answer

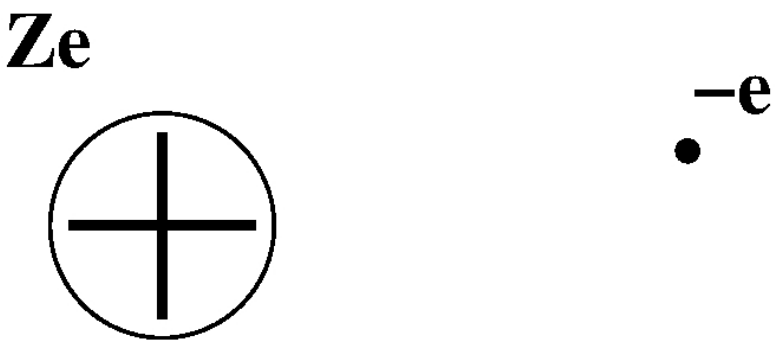
Where the lines of E-field are dense then the E-field must be weak.
Select an answer

Note: you MUST complete all sentences before submitting.

Question Help: Message instructor Post to forum

Question 8 0/1 pt 999 998

Describe the interaction between a nucleus of calcium (Z = 20) and an electron located at a distance of 0.55×10^{-10} m from the nucleus.



1. What is the electric field produced by the nucleus at the electron's position?

The magnitude of E-field produced by the nucleus, E = _____ Units Select an answer .

The electric field points Select an answer the nucleus.

2. What is the electrostatic force on the electron produced by the nucleus?

The magnitude of the force, F = _____ Units Select an answer .

The force on the electron points Select an answer the nucleus.

3. The electron produces it's own electric field at the position of the nucleus, find this electric field.

The magnitude of E-field produced by the electron, E = _____ Units Select an answer .

This electric field points Select an answer the electron.

4. What is the force on the nucleus produced by the electron?

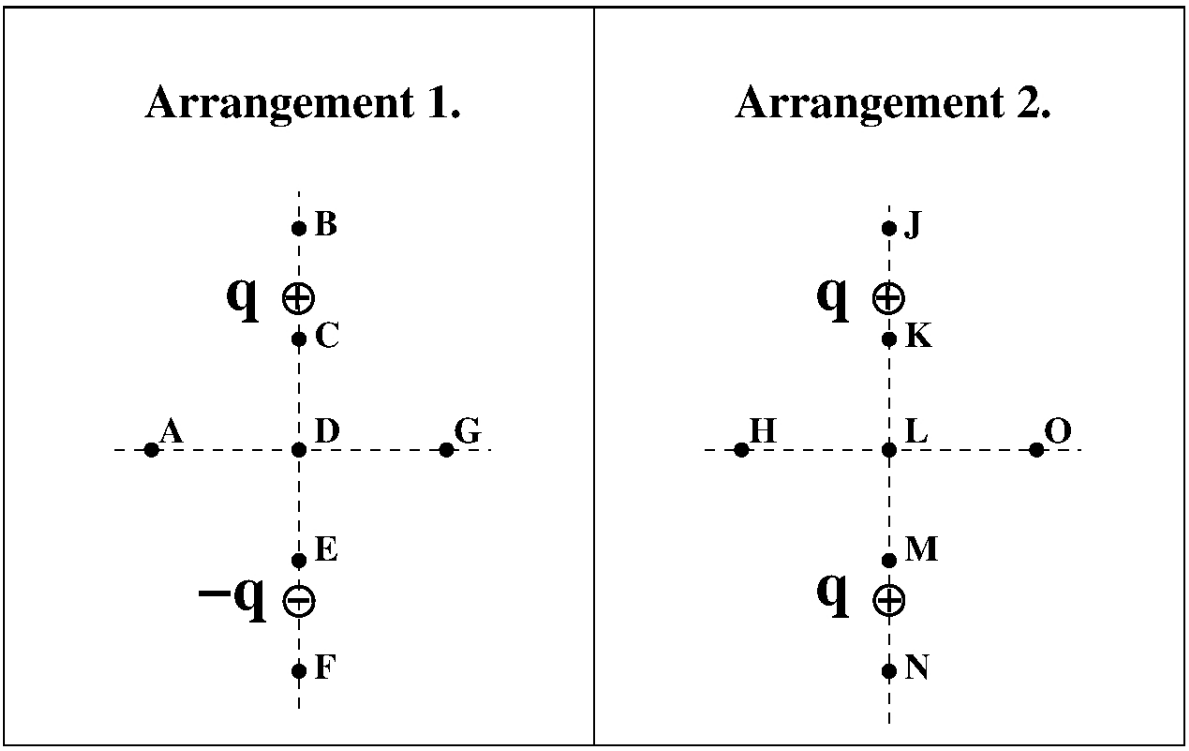
The magnitude of the force, F = _____ Units Select an answer .

The force on the nucleus points Select an answer the electron.

Question Help: Message instructor Post to forum

Question 9 0/1 pt 999 998

Find the direction of the net electric field for the charge arrangements shown below. In the first arrangement the field is created by two equal charges - one is positive and one is negative (q and -q), in the second arrangement the charges are equal and both are positive (q and q).



for Arrangement 1:

The net electric field at point A is directed Select an answer .

The net electric field at point B is directed Select an answer .

The net electric field at point C is directed Select an answer .

The net electric field at point D is directed Select an answer .

The net electric field at point E is directed Select an answer .

The net electric field at point F is directed Select an answer .

The net electric field at point G is directed Select an answer .

for Arrangement 2:

The net electric field at point H is directed Select an answer .

The net electric field at point J is directed Select an answer .

The net electric field at point K is directed Select an answer .

The net electric field at point L is directed Select an answer .

The net electric field at point M is directed Select an answer .

The net electric field at point N is directed Select an answer .

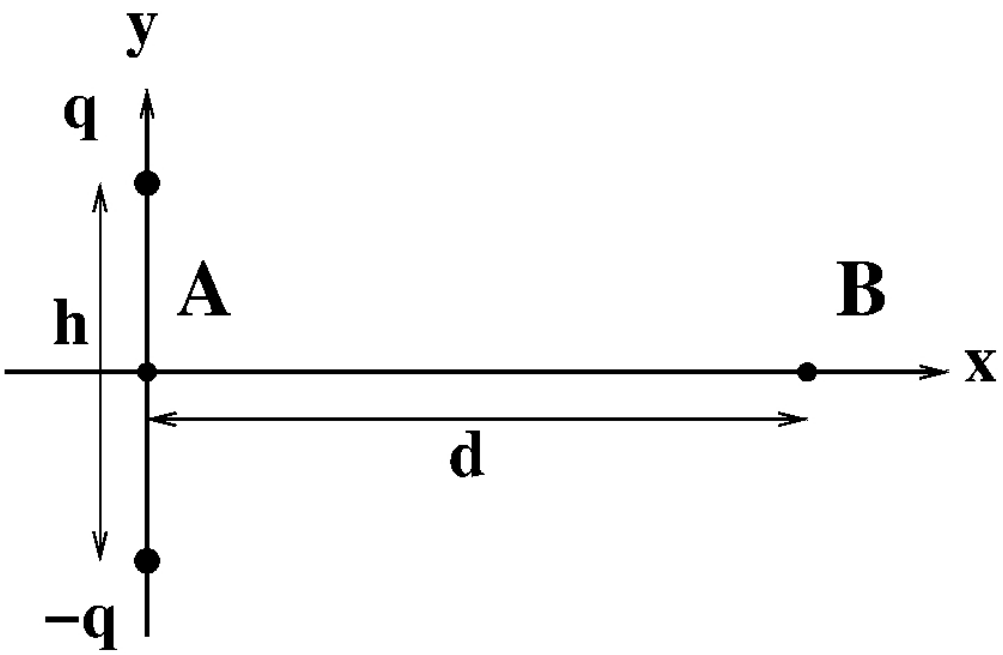
The net electric field at point O is directed Select an answer .

Note: you MUST complete all sentences before submitting.

Question Help: Message instructor Post to forum

Question 10 0/1 pt 999 998

Two charges q and -q are located at h/2 and -h/2 coordinates along the y-axis as shown below. Find the net electric field at point A (the origin and the midpoint between the charges), if q = 55 nC and h = 34 cm.



The magnitude of E-field at A, E_A = _____ Units Select an answer .

The filed at point A is directed Select an answer .

Find the net electric field at point B located at a distance d = 115 cm from the origin along the x-axis.

The magnitude of E-field at B, E_B = _____ Units Select an answer .

The filed at point B is directed Select an answer .

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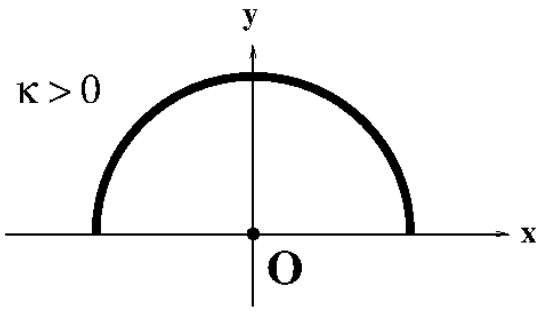
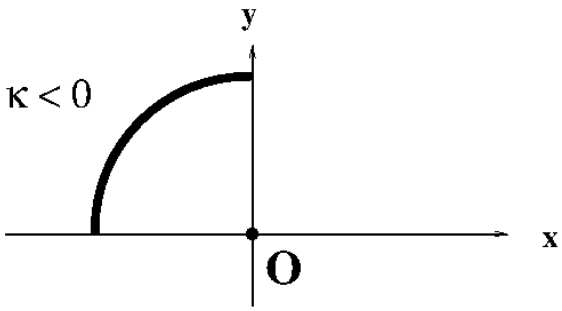
Question 11 0/1 pt 999 998

Find the electric field at the origin of the x,y-plane for charge distributions (a) and (b), see the figures shown below. The field is produced (a) by a thin half-circle with a radius of 25 cm and the linear charge density κ = 59 pC/cm and (b) by a thin quarter-circle with the same radius and the linear charge density κ = -59 pC/cm.



(a)



(b)

For the charge distribution (a):

The x-component of $\vec{E}_a$, $E_{a,x}$ = _____ Units Select an answer .

The y-component of $\vec{E}_a$, $E_{a,y}$ = _____ Units Select an answer .

For the charge distribution (b):

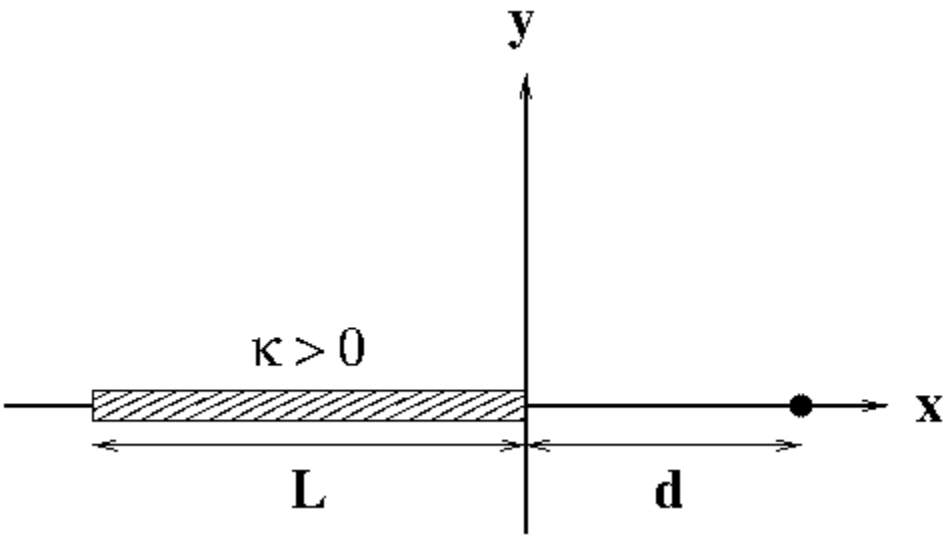
The x-component of $\vec{E}_b$, $E_{b,x}$ = _____ Units Select an answer .

The y-component of $\vec{E}_b$, $E_{b,y}$ = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 12 0/1 pt 999 998

Consider an uniformly charged thin rod of length L = 53 cm with a linear charge density of $\kappa = 30$ nC/cm. Find the electric field at a distance d = 24.5 cm from the closest rod's edge along the line of the rod as shown below.

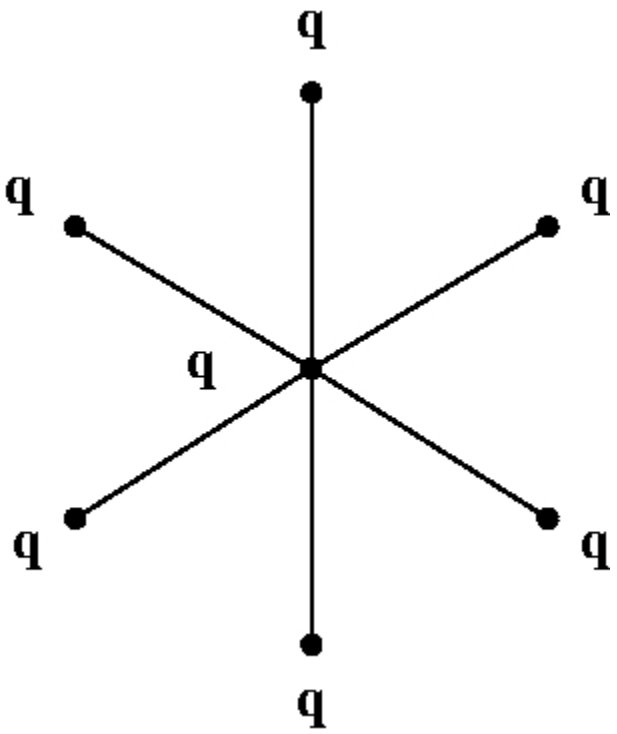


The electric field, E = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 13 0/1 pt 999 998

Seven identical charges q = 5 μC are connected with identical rigid strings as shown below. The distances between any two nearest charges equal l = 5.5 cm. Find the magnitude of the tension in each string.

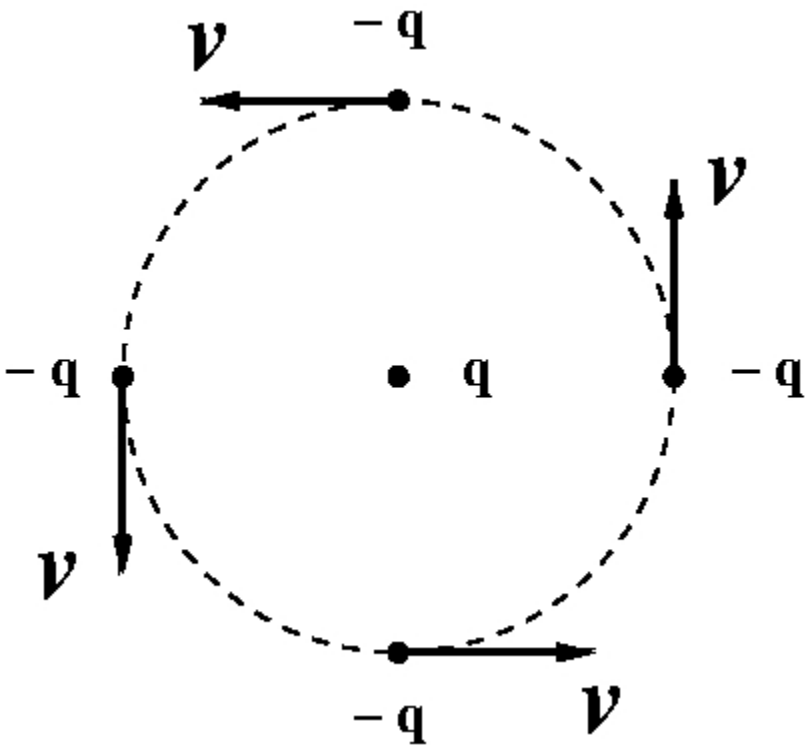


The tension, T = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 14 0/1 pt 999 998

Four electrons are orbiting a stationary proton along a perfect circle with a constant speed v as shown below. Find the orbital speed and frequency of this circular motion if the radius of the orbit is $0.8 \cdot 10^{-10} m$. The elementary charge $q = 1.6 \cdot 10^{-19} C$ and the electron mass $m_e = 9.11 \cdot 10^{-31} kg$.



The orbital speed, v = _____ Units Select an answer .

The frequency of orbital motion, f = _____ Units Select an answer .

Question Help: Message instructor Post to forum

HW #04

Roman Senkov

Question 1

0/1 pt 999 998

Blitz problem solving: Gauss' theorem

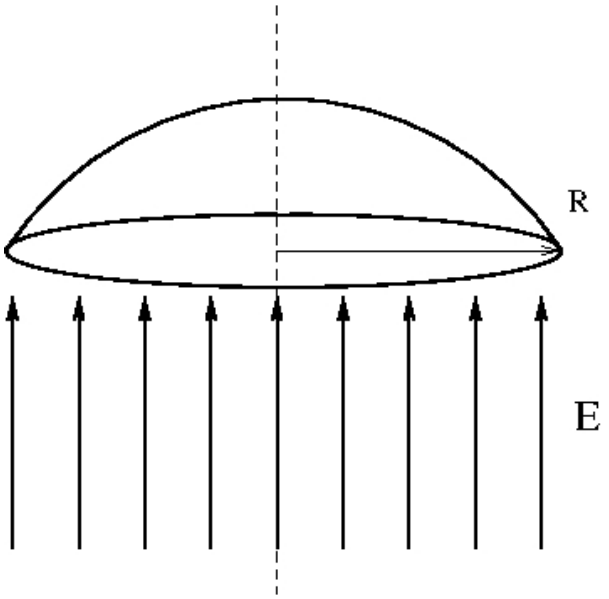
1. The flux of electric field through a closed surface is Φ_E = -340 V·m. Find the charge enclosed by this surface.

The charge enclosed, Q_1 = _____ Units Select an answer .

2. A point-like charge -90 nC is located at the center of an octahedron. Find the flux of electric field through one side of the octahedron.

The flux, Φ_2 = _____ Units Select an answer .

3. Find the magnitude of the flux of an uniform electric field $\vec{E}$ through a hemisphere of radius R, if the field is directed along the hemisphere axis as shown below. The magnitude of the field is E = 10 N/C and the radius of the hemisphere is R = 30 cm.



The flux, Φ_3 = _____ Units Select an answer .

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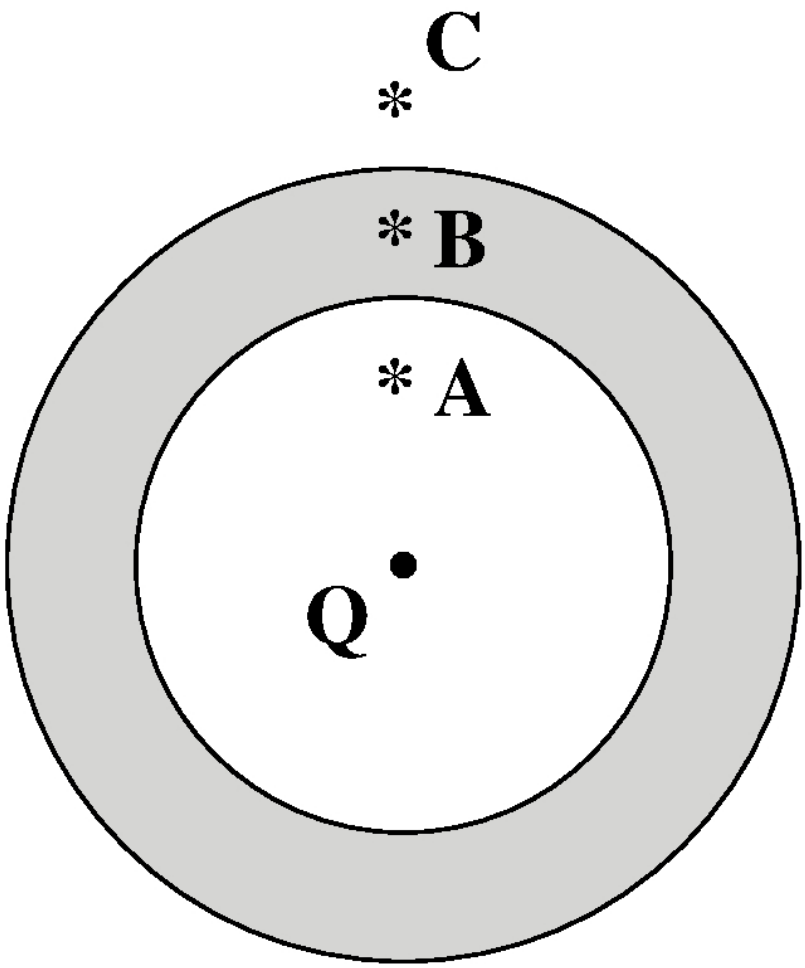
Question 2

0/1 pt 999 998

Consider a spherical conducting shell with the inner and outer surfaces, see the shaded area in the picture below. The shell has zero net charge and encloses a point-like central charge Q. Which of the following statements are True/False?



The inner surface of the shell has zero charge. Select an answer .

The outer surface of the shell has charge Q. Select an answer .

The electric field at point C is zero. Select an answer .

The outer surface of the shell has zero charge. Select an answer .

The inner surface of the shell has charge -Q. Select an answer .

The electric field at point A is zero. Select an answer .

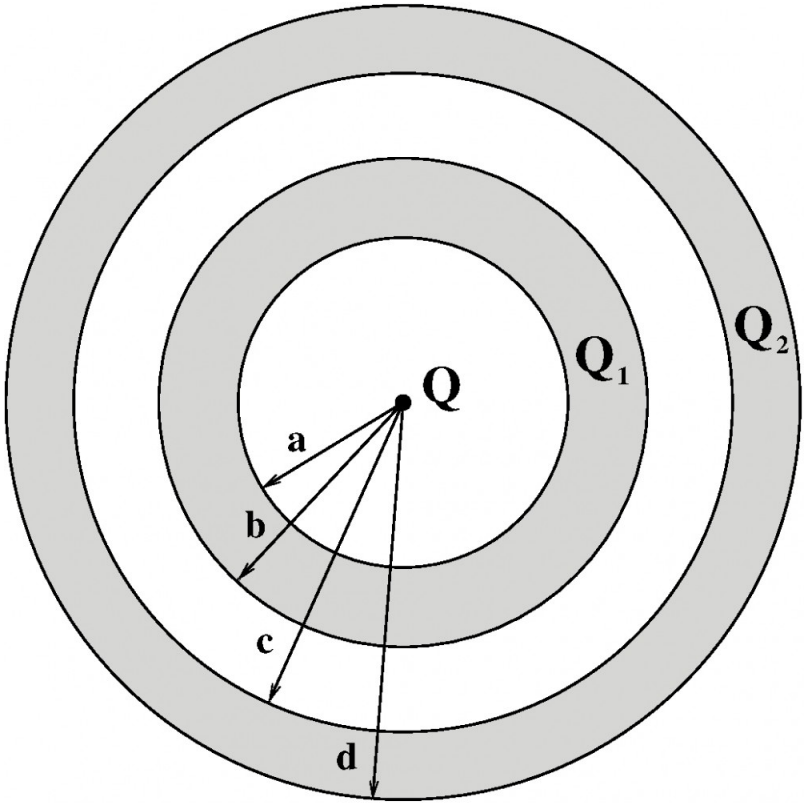
The electric field at point B is zero. Select an answer .

Note: you MUST complete all sentences before submitting.

Question Help: Message instructor Post to forum

Question 3 0/1 pt 999 998

Consider the system of two concentric conducting spherical shells shown below: the inner shell has the inner radius of a = 26 cm, the outer radius of b = 36 cm, and the net charge of Q_1 = -50 nC; the outer shell has the inner radius of c = 44 cm, the outer radius of d = 60 cm, and the net charge of Q_2 = 85 nC; there is also a point-like charge Q = -25 nC placed at the center of the system. Complete the following sentences using Gauss's theorem, see the hint below.



1. Find the charge on each surface of each shell.

The charge on the inner surface of the inner shell (r=a), $Q_{1,inner}$ = _____ Units Select an answer .

The charge on the outer surface of the inner shell (r=b), $Q_{1,outer}$ = _____ Units Select an answer .

The charge on the inner surface of the outer shell (r=c), $Q_{2,inner}$ = _____ Units Select an answer .

The charge on the outer surface of the outer shell (r=d), $Q_{2,outer}$ = _____ Units Select an answer .

2. Find the electric field produced by the shells and the central charge at different locations, submit positive value if the filed points outward (away from the center) and submit negative value if the field points inward (toward the center).

The radial component of E-field at r = 10 cm, E_1 = _____ Units Select an answer .

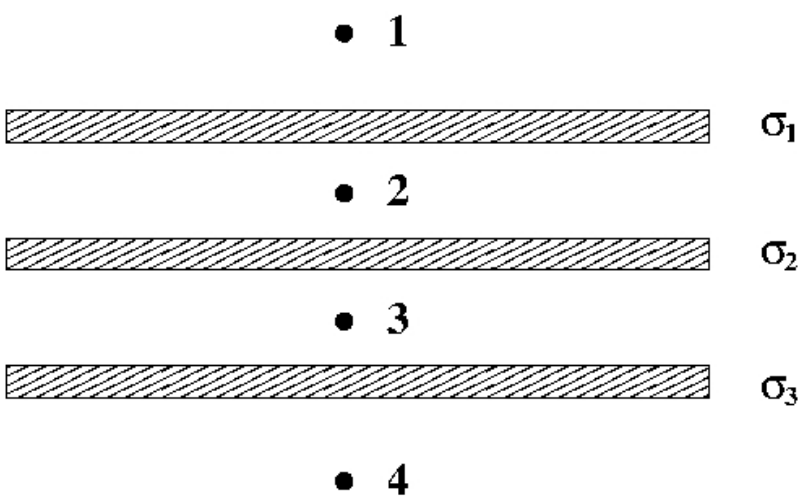
The radial component of E-field at r = 38 cm, E_2 = _____ Units Select an answer .

The radial component of E-field at r = 84 cm, E_3 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 4 0/1 pt 999 998

Three parallel large uniformly charged planes are arranged as shown in the picture below. Find the electric field at points 1, 2, 3, and 4 if the surface charge densities of the planes are σ_1 = 45 nC/m^2, σ_2 = -35 nC/m^2, and σ_3 = -25 nC/m^2 respectively. Assume the positive direction of the vertical axis upwards.



The E-field at point 1, E_1 = _____ Units Select an answer .

The E-field at point 2, E_2 = _____ Units Select an answer .

The E-field at point 3, E_3 = _____ Units Select an answer .

The E-field at point 4, E_4 = _____ Units Select an answer .

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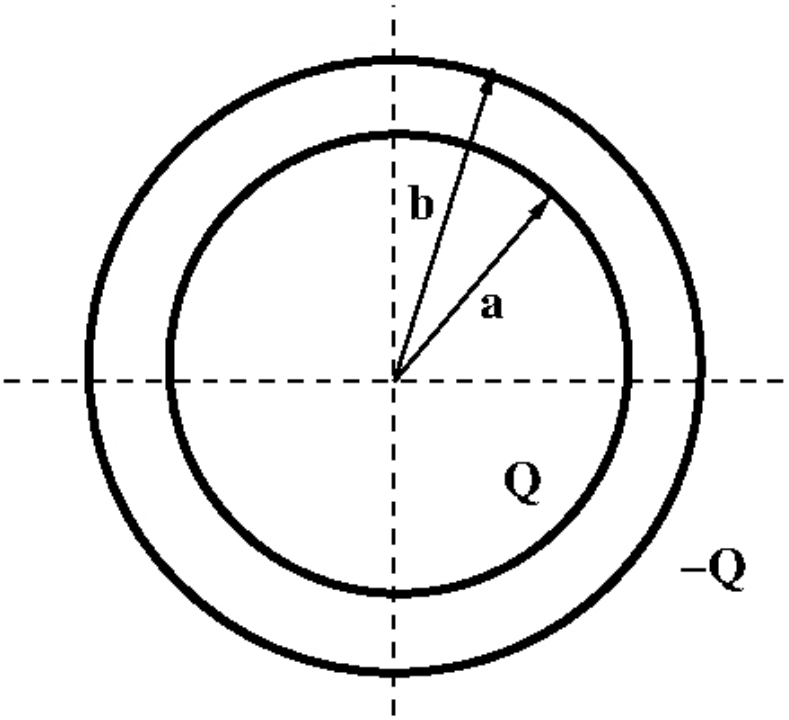
Question 5 0/1 pt 999 998

The two concentric spherical shells, of radii a = 15 cm and b = 31.5 cm, are uniformly charged with the same amounts of charge Q, but of opposite signs, see the picture below. Find the magnitude of the electric field at distances r_1 = 11.5 cm, r_2 = 24.5 cm, and r_3 = 41 cm, take Q = 16 μC.



The E-field at r_1, E_1 = _____ Units Select an answer .

The E-field at r_2, E_2 = _____ Units Select an answer .

The E-field at r_3, E_3 = _____ Units Select an answer .

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Question 6

0/1 pt 999 998

The volume charge density of a spherically charged cloud changes with the distance to the cloud center as

$$\rho(r) = \rho_0 \cdot \frac{r}{a},$$

where the parameters are $\rho_0 = 2.6$ nC/m^3 and $a = 23$ m. Find the magnitude of electric field at distance d = 26 m from the cloud center.

The electric field, E(r = 26 m) = _____ Units Select an answer .

Find the electric field (in N/C) as a function of r (in m). Do not submit the units.

The electric field, E(r) = _____ N/C.

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Question 7

0/1 pt 999 998

The hydrogen atom consists of a proton (at the center, charge $Q_p = +e$) and an electron distributed around the proton with the following volume charge density given as a function of the electron distance to the proton

$$\rho(r) = -\frac{e}{\pi a_0^3}\exp\left[-\frac{2\cdot r}{a_0}\right],$$

where $a_0 = 0.5\times 10^{-10} m$ is the Bohr radius and e is the elementary charge. Find the magnitude of the atomic electric field at distances $\frac{a_0}{4}$, a_0, and $4a_0$.

The E-field at $\frac{a_0}{4}$, E_1 = _____ Units Select an answer .

The E-field at a_0, E_2 = _____ Units Select an answer .

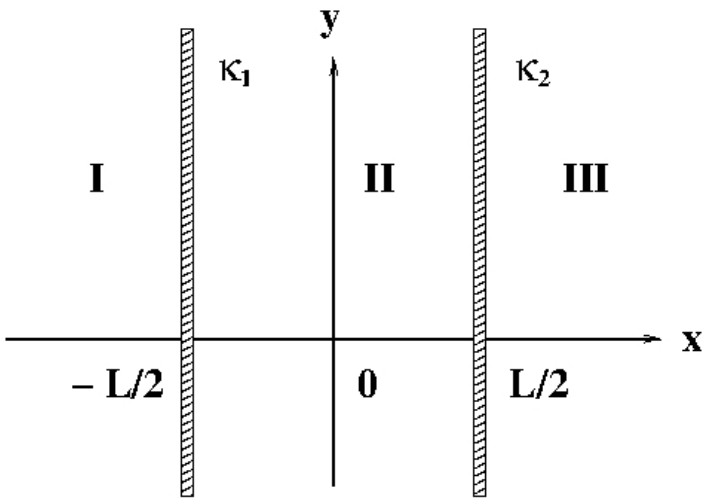
The E-field at $4a_0$, E_3 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 8

0/1 pt 999 998

The two long uniformly charged wires are parallel to the y-axis and located at $x = \pm\frac{L}{2}$ as shown in the figure below. At what x-coordinate is the net electric field zero? Take L = 65 cm, the linear charge densities κ_1=20 nC/cm and κ_2=10 nC/cm?



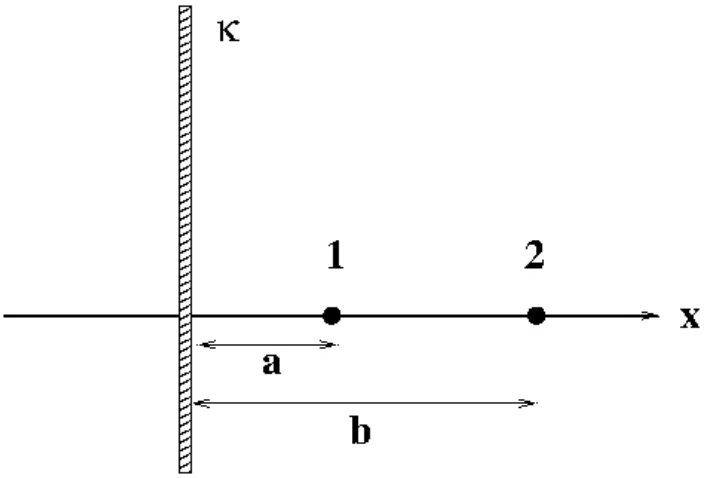
In which part of the graph do you expect the net field to be zero? Select an answer

The net field is zero at x = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 9 0/1 pt 999 998

How much work is required to move a negative charge, of q = -60 μC and m = 60 g, from point '1' to point '2' along the x-axis away from the long uniformly charged line that is parallel to the y-axis as shown in the figure below? The initial and final positions of the charge are a = 15 cm and b = 30 cm and the linear charge density of the line is κ = 20 nC/cm.



The work required, W = _____ Units Select an answer .

If the same charge is released from rest from point '2', what will be the speed of this charge as it passes point '1'?

The speed at '1', v = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 10 0/1 pt 999 998

The three identical charges, of q = 15 μC and m = 50 g, are held in the vertices of an equilateral triangle. What is the potential energy of the system if the size of the triangle is d = 70 cm?

The potential energy, PE = _____ Units Select an answer .

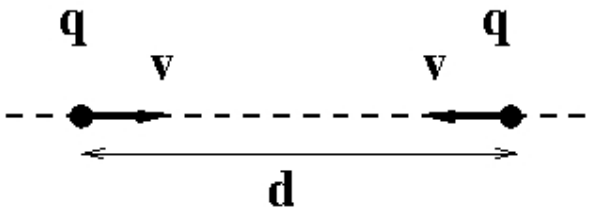
If the charges are released and start moving away from each other, what is the speed of each charge at infinity? Assume that the energy of interaction splits equally between the charges.

The speed at infinity, v = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 11 0/1 pt 999 998

The two identical charges, of q = 45 μC and m = 40 g, are moving towards each other along the x-axis as shown below. What are the initial potential and kinetic energies of the system if the initial separation distance between the charges d = 50 cm and the initial speed of each charge v = 37 m/s.



The potential energy, PE = _____ Units Select an answer .

The kinetic energy, KE = _____ Units Select an answer .

To what minimum distance can the charges approach each other?

The minimum distance, d_{min} = _____ Units Select an answer .

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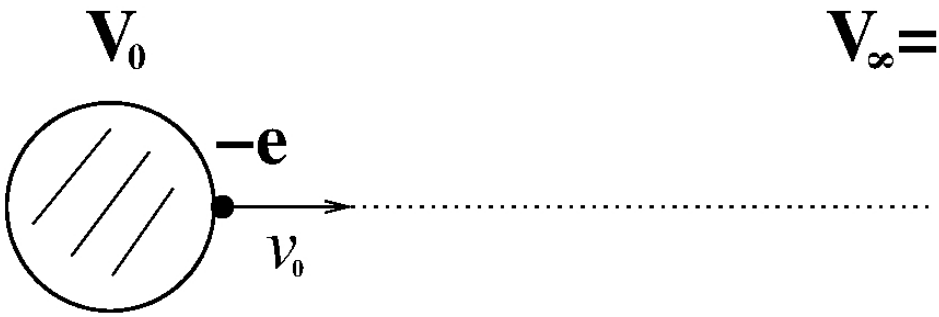
Question 12 0/1 pt 999 998

An electron is located at the surface of a heavy metallic sphere that is charged to a potential of V_0 = 270 V. Find the potential energy of the electron in Joules and in electron-Volts. Use $1eV = 1.6 \times 10^{-19}$ J, $m_e = 9.11 \times 10^{-31}$ kg, and $Q_e = -e = -1.6 \times 10^{-19}$ C.



The potential energy of the electron in J, PE = _____ Units Select an answer .

The potential energy of the electron in eV, PE = _____ Units Select an answer .

The electron is attracted to the sphere but if it has enough initial kinetic energy it can escape to a very large distance, see the picture above. Find the minimum speed at which electron can completely escape from the sphere. Take that the electric potential at large distances is zero, $V_\infty = 0$ V.

The escape velocity of the electron, v_0 = _____ Units Select an answer .

While the electron moves away from the sphere its potential energy Select an answer and its kinetic energy Select an answer .

Question Help: Message instructor Post to forum

Question 13 0/1 pt 999 998

A proton ($Q_p = 1.6 \times 10^{-19}$ C and $m_p = 1.67 \times 10^{-27}$ kg) is approaching a metallic sphere from a large distance, as shown below. The sphere is charged to an electric potential of V_0 = 150 V. When the proton is far from the sphere it has a potential energy of PE_p = 0 eV and a kinetic energy of KE_p = 170 eV. What is the speed of the proton at large distances from the sphere?

The speed of the proton at infinity, v_∞ = _____ Units Select an answer .

While the proton is approaching the sphere its kinetic energy Select an answer and its potential energy Select an answer .

Find the potential and kinetic energies of the proton when it reaches the surface of the sphere.

The proton potential energy at the surface of the sphere, PE = _____ Units Select an answer .

The proton kinetic energy at the surface of the sphere, KE = _____ Units Select an answer .

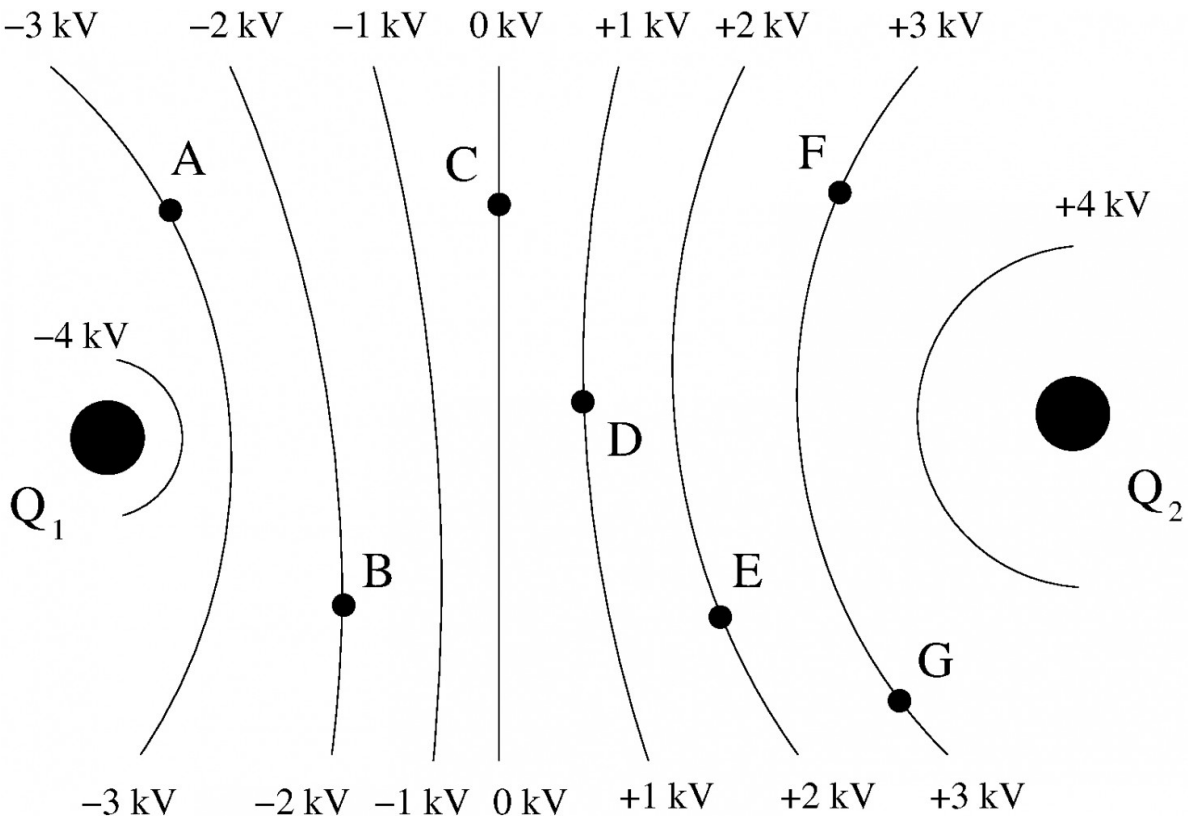
What is the speed of the proton at the surface of the sphere?

The speed of the proton at the surface, v_0 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 14 0/1 pt 999 998

Two charged systems Q_1 and Q_2 produce the electrostatic field presented below with the help of equipotential lines. The step between the lines is 1 kV.



1. What are the signs of Q_1 and Q_2 and which charge has the greater magnitude?

The left charge Q_1 is Select an answer and the right charge Q_2 is Select an answer .

Charge ? has the greater magnitude than charge ? .

2. Calculate the work required to move a q_1 = -25 μC charge from one point to another:

The work required to move q_1 from G to F, W_1 = _____ Units Select an answer .

The work required to move q_1 from B to A, W_2 = _____ Units Select an answer .

3. Calculate the work required to move a q_2 = 30 μC charge from one point to another:

The work required to move q_2 from G to C, W_3 = _____ Units Select an answer .

The work required to move q_2 from B to E, W_4 = _____ Units Select an answer .

4. A charged particle of q_3 = 25 μC and m_3 = 30 mg is released from rest at point E and starts to move in the direction of Q_1. What is the speed of the particles when it passes the -3 kV equipotential line?

The speed of the particle, v = _____ Units Select an answer .

HW #05

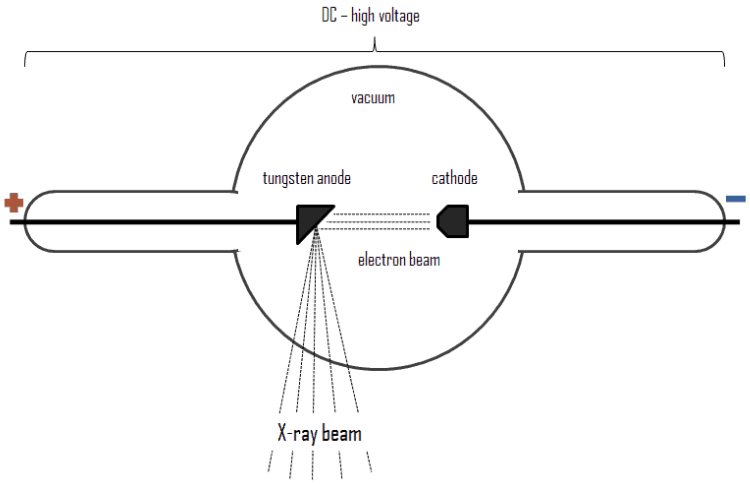
Roman Senkov

Question 1

0/1 pt 999 998

In an x-ray machine, electrons are accelerated from cathode (plate at negative potential) to anode (plate at positive potential) by a high potential difference between the plates, as shown in the figure below. If the potential difference between the plates is 40-kV, find the kinetic energy gained by each electron and its speed as they arrive to the anode. Take electron charge 1.6×10^{-19} C and electron mass 9.11×10^{-31} kg.

Note: the electron's speed that you will get may be faster than/closer to the speed of light and it is not realistic because at high speed relativistic kinetic energy should be calculated differently. Relativistic kinetic energy reaches infinity when speed reaches the speed of light and hence speed can't be faster than the speed of light. This problem is for illustration purposes only. Relativistic effect need to be taken into account for realistic answer.



(a) Kinetic energy of each electron, KE = _____ Units Select an answer

(b) Speed of each electron, v = _____ Units Select an answer .

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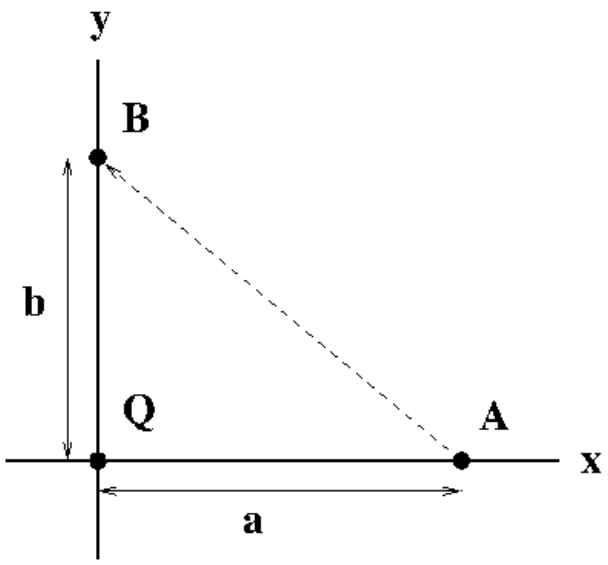
Question 2

0/1 pt 999 998

A charge Q = 105 nC is placed at the origin of the (x,y)-plane shown below. Find the electric potential at points A and B if the distances are a = 30.5 cm and b = 44.3 cm.



The potential at A, V_A = _____ Units Select an answer .

The potential at B, V_B = _____ Units Select an answer .

How much work is required to move an electron from point A to point B?

The work, $W_{A \to B}$ = _____ Units Select an answer .

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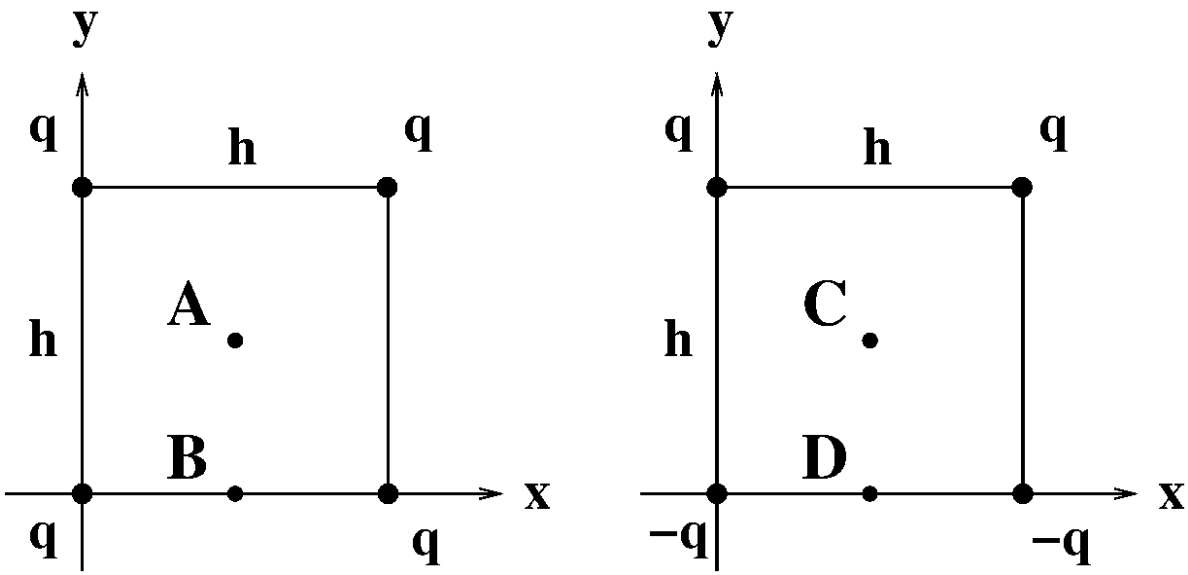
Question 3 0/1 pt 999 998

Consider two separate systems with four charges of the same magnitude q = 22 μC arranged in the vertexes of a square of length h = 55 cm, see the picture below. Calculate the electric potential at the center of the square (points A and C) and at the middle of the bottom side of the square (points B and D).



The potential at point A, V_A = _____ Units Select an answer .

The potential at point B, V_B = _____ Units Select an answer .

The potential at point C, V_C = _____ Units Select an answer .

The potential at point D, V_D = _____ Units Select an answer .

How much work is required to move a -12 μC charge from point A to point B?

The work required, $W_{A\to B}$ = _____ Units Select an answer .

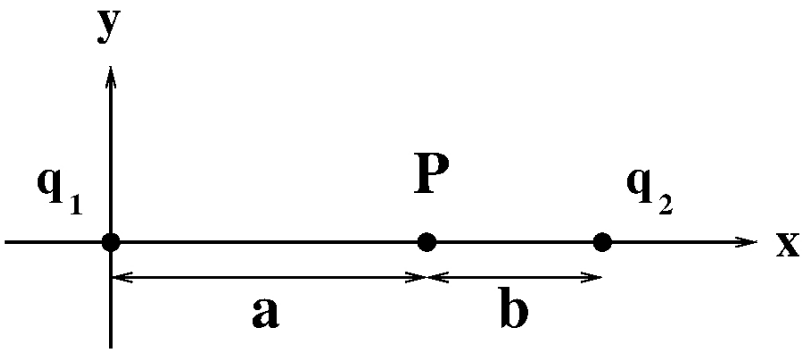
How much work is required to move a -12 μC charge from point C to point D?

The work required, $W_{C\to D}$ = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 4 0/1 pt 999 998

Two charges q_1 = 40 nC and q_2 (the charge is unknown) are located on the x-axis at the distances a = 5.5 cm and b = 3 cm from a point P respectively, see the picture below. Find q_2 if the electric potential at point P is 500 Volts.



The second charge, q_2 = _____ Units Select an answer .

There are two points on the x-axis where the electric potential is zero. Find the x-coordinate of the left and right point with zero potential.

The position of the left point, x_1 = _____ Units Select an answer .

The position of the right point, x_2 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 5 0/1 pt 999 998

The electric potential of a charged conducting sphere (as well as a spherical shell) can be calculated as

$$V = k\frac{Q}{R},$$

where Q is the charge and R is the radius of the sphere. Calculate the electric potential of a solid conducting sphere of a radius of R = 3.5 cm if the sphere loses 0.1% from the total number of its free electrons. The sphere is made of aluminum and has the density 2.7 g/cm^3, molar mass 27 g/mol and one free electron per atom. Follow the steps listed below.

1. Find the number of free electrons per cm^3 in aluminum.

The number of free electrons per cm^3, n_e = _____ Units Select an answer .

2. Calculate the volume of the sphere and use it to find the total number of free electron inside the sphere.

The number of free electrons, N_e = _____ Units Select an answer .

3. Calculate the charge of the sphere after it loses 0.1% of its electrons and use it to find the potential of the sphere.

The electric potential of the sphere, V = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 6

0/1 pt 999 998

Three concentric conducting spherical shells of radii r, 2r, and 3r are charged with net electric charges q, 2q and −3q respectively. Find the electric potential of each shell. Assume

$$V_0 = \frac{kq}{r} = 120\text{V}.$$

The potential at r, V_1 = _____ Units Select an answer .

The potential at $2r$, V_2 = _____ Units Select an answer .

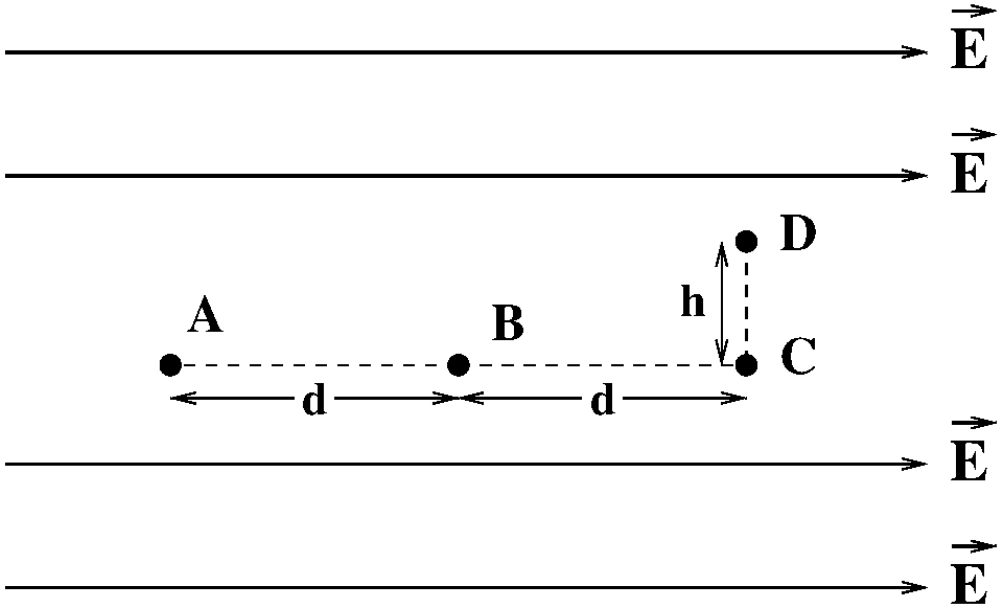
The potential at $3r$, V_3 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 7

0/1 pt 999 998

Consider four points A, B, C and D located in an external constant electric field $\vec{E}$. The field is directed to the right, the magnitude of the field is E = 1000 N/C; the points are separated by a distance of d = 36 cm in the horizontal direction and by h = 12 cm in the vertical direction, see the picture below. What information about the electric potential at these points can be obtained in this situation?



At which point(s) the potential is the highest? Select an answer .

At which point(s) the potential is the lowest? Select an answer .

Which points (if any) have the same potential? Select an answer .

Find the difference in the electric potential between the following points:

$\Delta V_{A\to B}$ = V(at point B) - V(at point A) = _____ Units Select an answer .

$\Delta V_{A\to C}$ = V(at point C) - V(at point A) = _____ Units Select an answer .

$\Delta V_{C\to D}$ = V(at point D) - V(at point C) = _____ Units Select an answer .

$\Delta V_{B\to D}$ = V(at point D) - V(at point B) = _____ Units Select an answer .

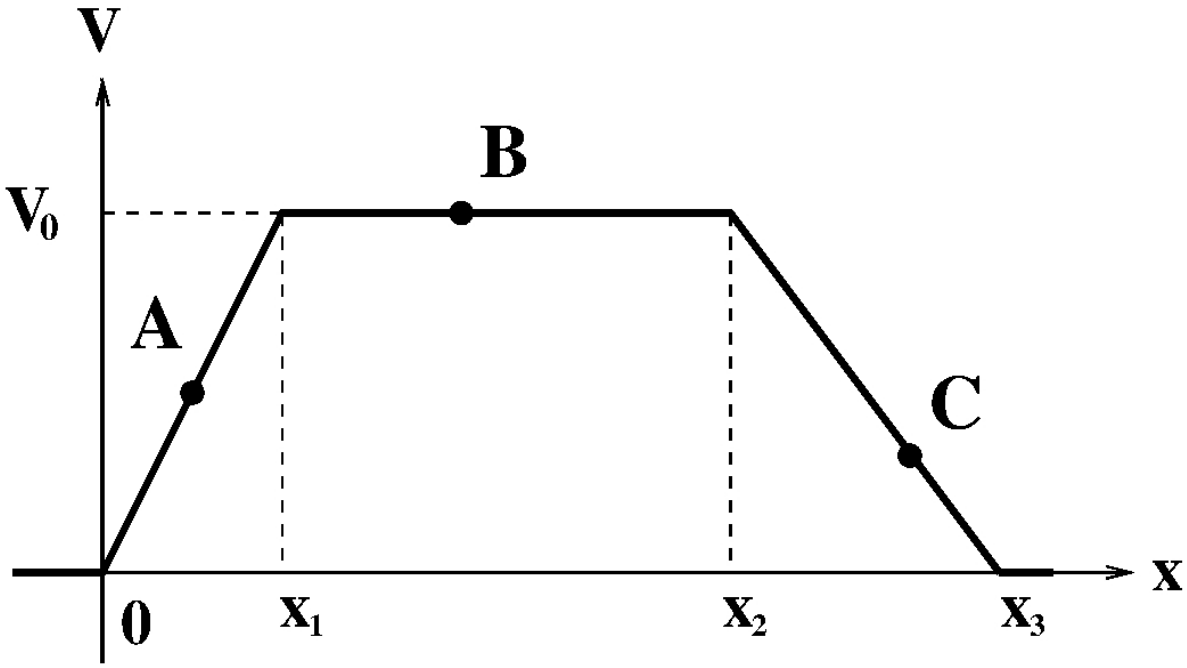
$\Delta V_{D\to A}$ = V(at point A) - V(at point D) = _____ Units Select an answer .

$\Delta V_{C\to B}$ = V(at point B) - V(at point C) = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 8 0/1 pt 999 998

The electric potential of a system is presented by the figure shown below. Find the x-component of the electric field at points A, B, and C if V_0 = 9 V and x_1 = 25 cm, x_2 = 100 cm, x_3 = 150 cm.



The x-component of E-field at point A, E_A = _____ Units Select an answer .

The x-component of E-field at point B, E_B = _____ Units Select an answer .

The x-component of E-field at point C, E_C = _____ Units Select an answer .

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Question 9

0/1 pt 999 998

A particle of mass 9.4 g and charge 8.5 μC is moving in an electric potential field

$$V(x, y) = c_1 \cdot x - c_2 \cdot y^2 + c_3 \cdot y \cdot x^2,$$

where c_1= 15 V/m, c_2= 35 V/m^2, and c_3= 75 V/m^3. Find the electric field acting on the particle as a function of its position. Use V/m and meters for the units, but do not put them explicitly in $\vec{E}(x, y)$.

The x-compoment of the E-field, $E_x(x,y)$ = _____ Units Select an answer .

The y-compoment of the E-field, $E_y(x,y)$ = _____ Units Select an answer .

What is the magnitide of the particle's acceleration at x = 2 m and y = -1.5 m?

The acceleration, a = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 10 0/1 pt 999 998

A point-like charge Q = 17.5 μC is embedded into a dielectric material with constant κ = 30. Find the magnitude of E-field and energy density at distance d = 0.3 m from the charge.

The magnitude of E-field, E = _____ Units Select an answer .

The energy density, u_E = _____ Units Select an answer .

Find the force on a test charge q = 59 μC placed at the same distance 0.3 m from Q.

The force on the test charge, F_q = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 11 0/1 pt 999 998

An air-filled parallel-plate capacitor with a plate separation of 1 mm has a capacitance of 100 pF. What is the area of one of the capacitor's plates? Be careful about units.

The plate area, A = _____ Units Select an answer .

What is the magnitude of electric field in the capacitor if it is charged to Q = 3.3 nC?

The electric field, E = _____ Units Select an answer .

What is the energy density that corresponds to this electric field?

The energy density, u_E = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 12 0/1 pt 999 998

Consider an isolated parallel-plate capacitor filled with air. Which of the following statements are True/False? Below Q and U are the charge and the energy stored on the capacitor, C is the capacitance, d is the distance between the plates and E is the electric field in the capacitor.

When a dielectric material is inserted then the energy U decreases.
Select an answer

When the distance d increases then the capacitance C increases as well.
Select an answer

The capacitance C increases when a dielectric material is inserted.
Select an answer

The charge Q increases when a dielectric material is inserted.
Select an answer

When the distance d decreases then the charge Q stays the same.
Select an answer

When the distance d increases then the energy U increases as well.
Select an answer

When the distance d increases then the electric field E increases as well.
Select an answer

Note: you MUST complete all sentences before submitting.

Question Help: Message instructor Post to forum

Question 13

0/1 pt 999 998

Consider a parallel-plate capacitor with plate's area A = 37.9 cm^2 and separation between the plates d = 5.3 mm. What are the charge and energy stored on the capacitor if it is connected to a 55-Volt battery? The capacitor is filled with air.

The charge, Q_1 = _____ Units Select an answer .

The energy, U_1 = _____ Units Select an answer .

If a dielectric material with κ= 2.45 is inserted so that it fills the space between the plates (with the capacitor still connected to the same battery), what are the new changre and energy on the capacitor?

The new charge, Q_2 = _____ Units Select an answer .

The new energy, U_2 = _____ Units Select an answer .

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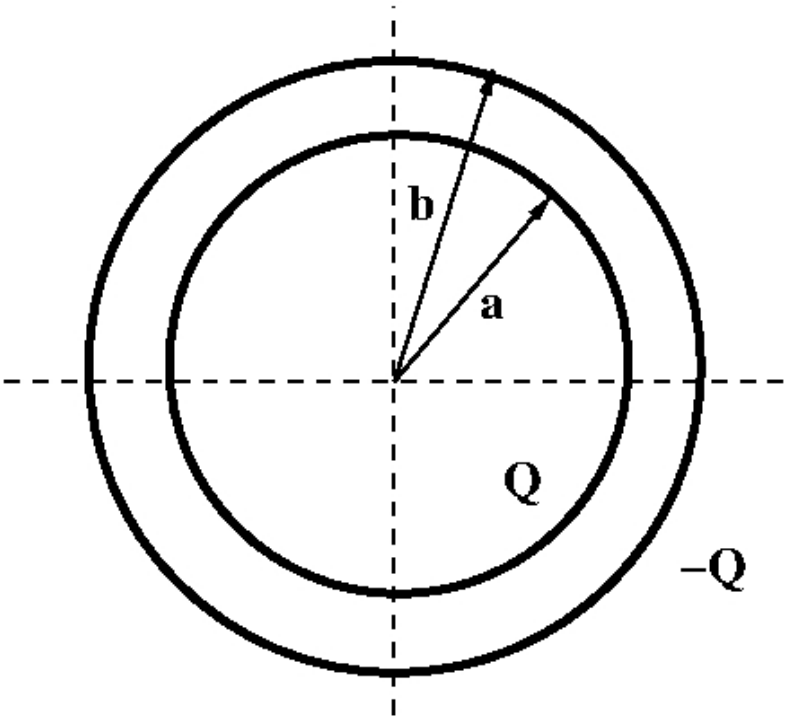
Question 14 0/1 pt 999 998

Two concentric spherical conducting shells are separated by vacuum. The inner shell has total charge +Q and radius a, and outer shell has charge -Q and radius b. Using the integration of electric field energy density find the electric energy stored in the system. Take Q = 10.5 μC, a = 15 cm and b = 90 cm.



The energy, U_0 = _____ Units Select an answer .

Using the obtained energy and formula for the energy stored in a capacitor, $U = \frac{Q^2}{2C}$, find the capacitance of the system.

The capacitance, C_0 = _____ Units Select an answer .

Repeat the calculations for the same system with a dielectric material of κ = 6 inserted in between the shells.

The energy, U_1 = _____ Units Select an answer .

The capacitance, C_1 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

HW #06

Roman Senkov

Question 1

0/1 pt 999 998

1.9×10^{21} electrons are flowing past any point in a wire per minute (electron charge = -1.6×10^{-19} C).

(a) How much electric current is flowing through the wire?

The current, I = _____ Units Select an answer .

(b) How many protons are flowing through the wire? _____.

(c) If the applied potential difference at two ends of the wire is 10 V, find the resistance of the wire.

The resistance, R = _____ Units Select an answer .

(d) If the radius of the wire is 0.14 mm and resistivity of the material is 1.8×10^{-8} Ω·m, find the length of the wire.

The length of the wire, l = _____ Units Select an answer .

(e) Find the power dissipation due to resistance of the wire.

The power, P = _____ Units Select an answer .

(f) How much energy is lost in one hour?

The energy lost, E = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 2

0/1 pt 999 998

A 0.5 m long wire is stretched to 1.6 m long. What is the percentage change in its resistance?

The change, $\frac{\delta R}{R}\cdot 100\,\%$ = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 3

0/1 pt 999 998

Relativistic Electron Ion Collider (eRHIC) at Brookhaven National Laboratory (BNL) may accelerate two beams of 2.5-A electrons (charge -e) at very nearly speed of light (c = 3×10^{8} m/s) in opposite direction in circular rings of circumference 3834 m. How many electrons are in each beam? (Here e = 1.6×10^{-19} C)

The number of ions, N = _____ .

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Question 4

0/1 pt 999 998

A small light-bulb draws 0.17-A current from a 5.5-V battery. In 4 min:

(a) How much charge flows from the battery?

The charge, Q = _____ Units Select an answer .

(b) How much energy does the battery supply?

The energy, E = _____ Units Select an answer .

(c) How many electrons passes through a point in the circut every second?

The number of electrons, N = _____ Units Select an answer

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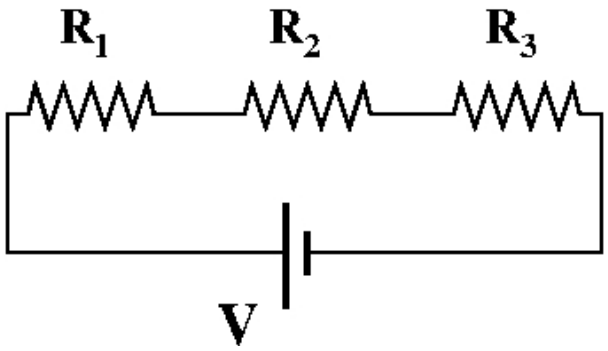
Question 5

0/1 pt 999 998

The resistors R_1 = 6.5 Ω, R_2 = 66.5 Ω and R_3 = 17.5 Ω are connected in series with a 18-V battery. What is the equivalent resistance of the circuit? What is the current through the battery?



The equivalent resistance, R_{eq} = _____ Units Select an answer .

The current, I = _____ Units Select an answer .

What is the drop of electric potential across each resistor?

The voltage across R_1, ΔV_1 = _____ Units Select an answer .

The voltage across R_2, ΔV_2 = _____ Units Select an answer .

The voltage across R_3, ΔV_3 = _____ Units Select an answer .

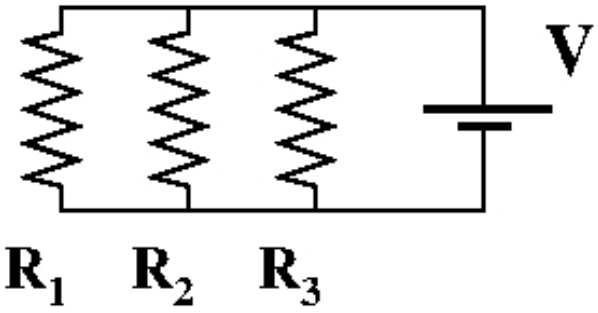
What is the power released in the circuit?

The power, P = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 6 0/1 pt 999 998

The resistors R_1 = 76.5 Ω, R_2 = 74 Ω and R_3 = 17.5 Ω are connected in parallel with a 6-V battery. What is the equivalent resistance of the circuit? What is the current through the battery?



The equivalent resistance, R_{eq} = _____ Units Select an answer .

The current, I = _____ Units Select an answer .

What is the current in each resistor?

The current in R_1, I_1 = _____ Units Select an answer .

The current in R_2, I_2 = _____ Units Select an answer .

The current in R_3, I_3 = _____ Units Select an answer .

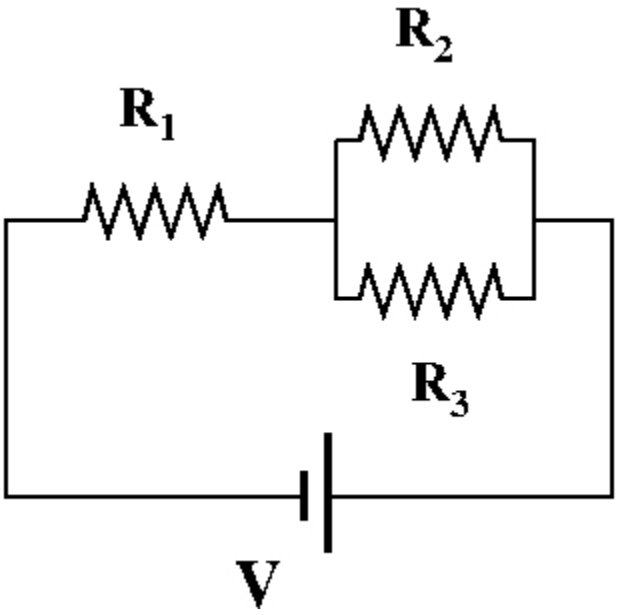
What is the power released in the circuit?

The power, P = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 7 0/1 pt 999 998

The resistors R_1 = 23.5 Ω, R_2 = 36 Ω and R_3 = 34 Ω are connected to a 12-V battery as shown in the figure below. What is the equivalent resistance of the circuit? What is the current through the battery?



The equivalent resistance, R_{eq} = _____ Units Select an answer .

The current, I = _____ Units Select an answer .

What is the current in resistors R_2 and R_3?

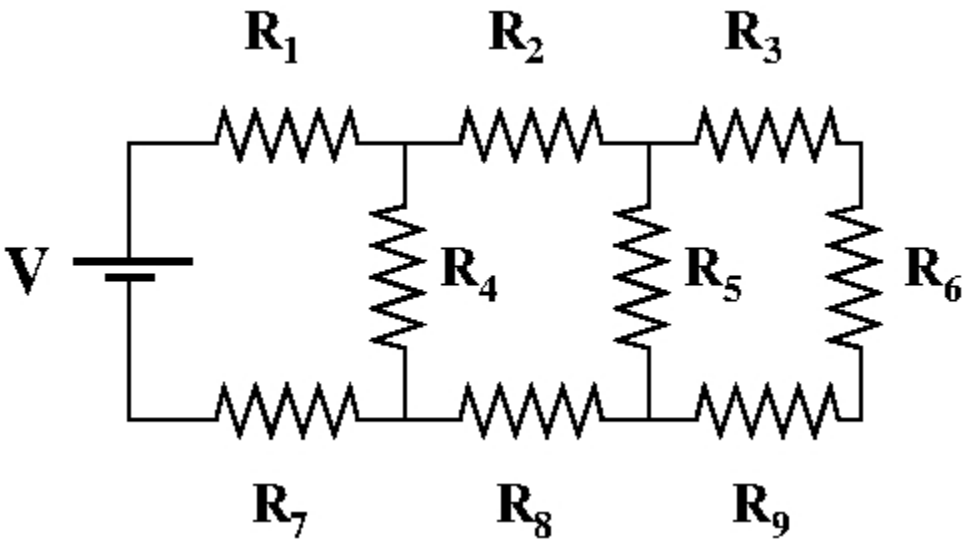
The current in R_2, I_2 = _____ Units Select an answer .

The current in R_3, I_3 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 8 0/1 pt 999 998

Consider the circuit shown below. What is the equivalent resistance of the circuit? What is the current through the battery? Assume R_1 = 5 Ω, R_2 = 15 Ω, R_3 = 25 Ω, R_4 = 5 Ω, R_5 = 20 Ω, R_6 = 10 Ω, R_7 = 25 Ω, R_8 = 5 Ω, R_9 = 15 Ω, and V = 40 V.



The equivalent resistance, R_{eq} = _____ Units Select an answer .

The current, I = _____ Units Select an answer .

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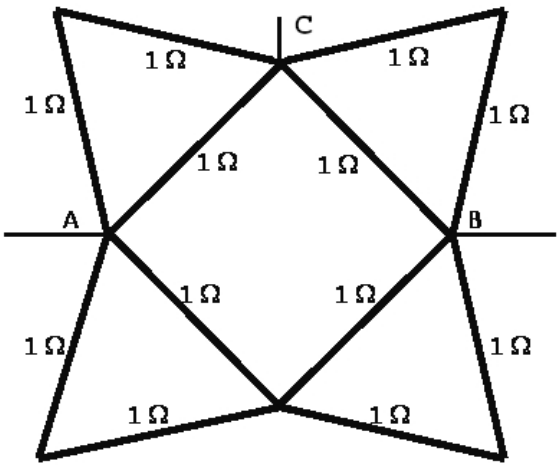
Question 9 0/1 pt 999 998

What is the equivalent resistance between points A and B and between points A and C in the circuit shown below? Each segment is 1 Ω.



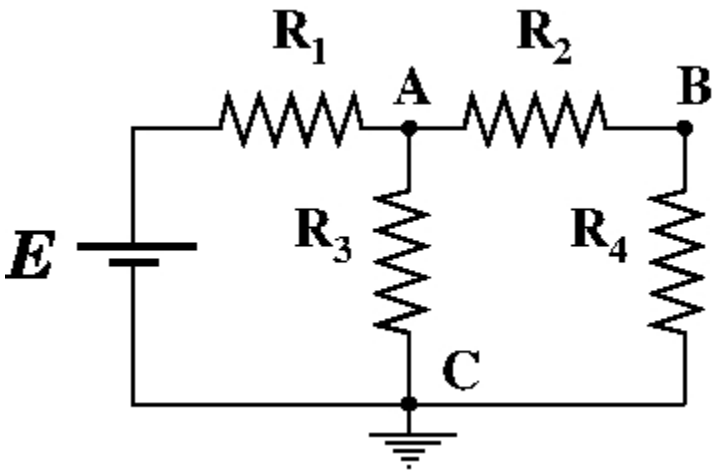
The equivalent resistance, R_{AB} = _____ Units Select an answer .

The equivalent resistance, R_{AC} = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 10 0/1 pt 999 998

Find the electric potential at points A and B for the circuit shown below. A E = 36 V battery is connected to R_1 = 20 Ω, R_2 = 15 Ω, R_3 = 10 Ω, and R_4 = 10 Ω. Note that point C is grounded ($V_C = 0$).



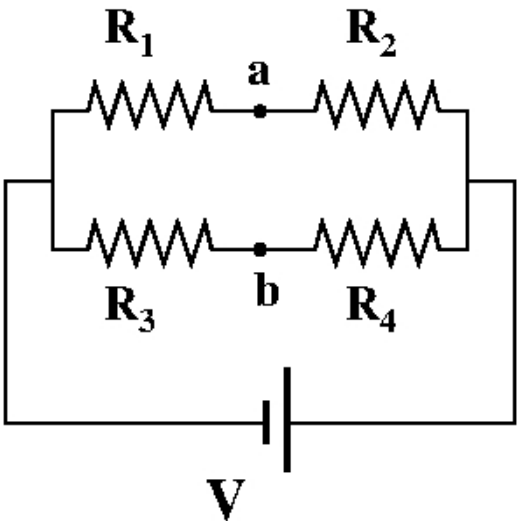
The potential at point A, V_A = _____ Units Select an answer .

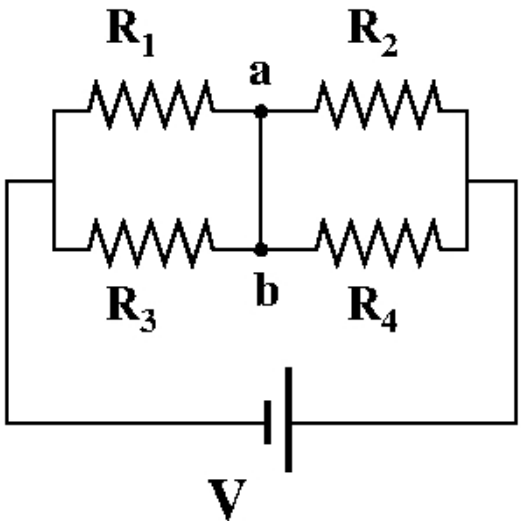
The potential at point B, V_B = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 11 0/1 pt 999 998

Consider the circuits shown below: a V = 30 V battery is connected to R_1 = 40 Ω, R_2 = 45 Ω, R_3 = 15 Ω, and R_4 = 35 Ω. For the left-side circuit, what is the potential difference between points a and b?





The potential difference, V_{ab} = _____ Units Select an answer .

For the right-side circuit, what is the current between points a and b?

The current, I_{ab} = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 12 0/1 pt 999 998

A solar cell generates an EMF of 24 V. The terminal potential difference of 18 V is measured when a 6 Ω resistor is connected across the battery. What is the internal resistance of the solar cell?

The internal resistance, r = _____ Units Select an answer .

How much power is released in the cell and in the load?

The power in the cell, $P_{internal}$ = _____ Units Select an answer .

The power in the load, P_{useful} = _____ Units Select an answer .

What maximum useful power can be generated by the cell?

The max. power, P_{max} = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 13 0/1 pt 999 998

First, a real battery is connected to a load R_1 = 1.9 Ω, then the same battery is connected to another load R_2 = 0.9 Ω. What is the internal resistance of the battery if in both cases the power released in the loads is the same.

The internal resistance, r = _____ Units Select an answer .

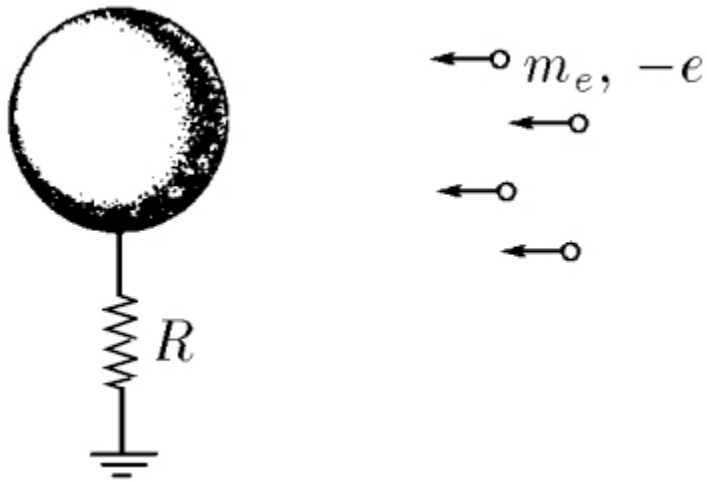
What is the emf of the battery if the useful power in both cases was 9 W?

The emf of the battery, E = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 14 0/1 pt 999 998

A conducting sphere of radius a = 25 cm is grounded with a resistor R = 75 Ω as shown below. The sphere is exposed to a beam of electrons moving towards the sphere with the constant velocity v = 17 m/s and the concentration of electrons in the beam is $n_e = 3.2\times10^{18}$ m^{-3}. How much charge per second is received by the sphere (find the current)? Assume that the electrons move fast enough.



The current, I = _____ Units Select an answer .

Find the maximum charge on the sphere.

The maximum charge, Q = _____ Units Select an answer .

Question Help: Message instructor Post to forum

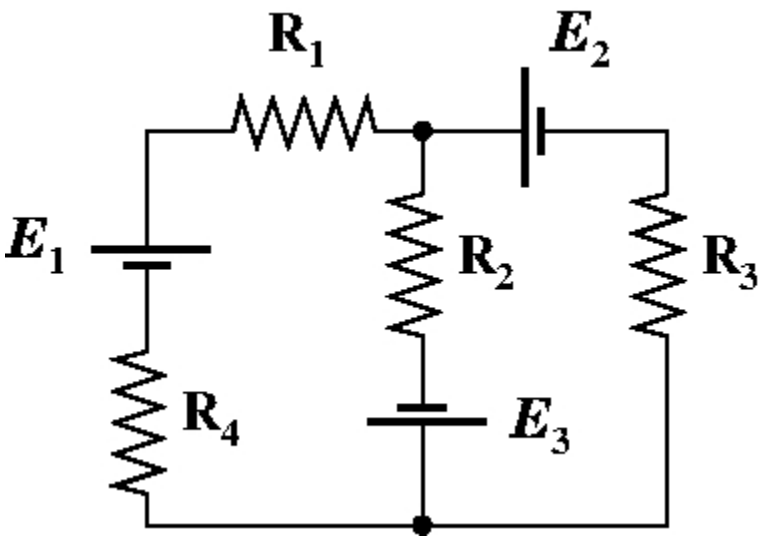
HW #07

Roman Senkov

Question 1

0/1 pt 999 998

Consider the circuit shown below. What is the current in each resistance? Assume R_1 = 10 Ω, R_2 = 25 Ω, R_3 = 20 Ω, R_4 = 20 Ω and E_1 = 52 V, E_2 = 16 V, E_3 = 32 V.



The magnitude of current in R_1, I_1 = _____ Units Select an answer ,

I_1 is directed Select an answer .

The magnitude of current in R_2, I_2 = _____ Units Select an answer ,

I_2 is directed Select an answer .

The magnitude of current in R_3, I_3 = _____ Units Select an answer ,

I_3 is directed Select an answer .

The magnitude of current in R_4, I_4 = _____ Units Select an answer ,

I_4 is directed Select an answer .

What is the total power consumed by the circuit?

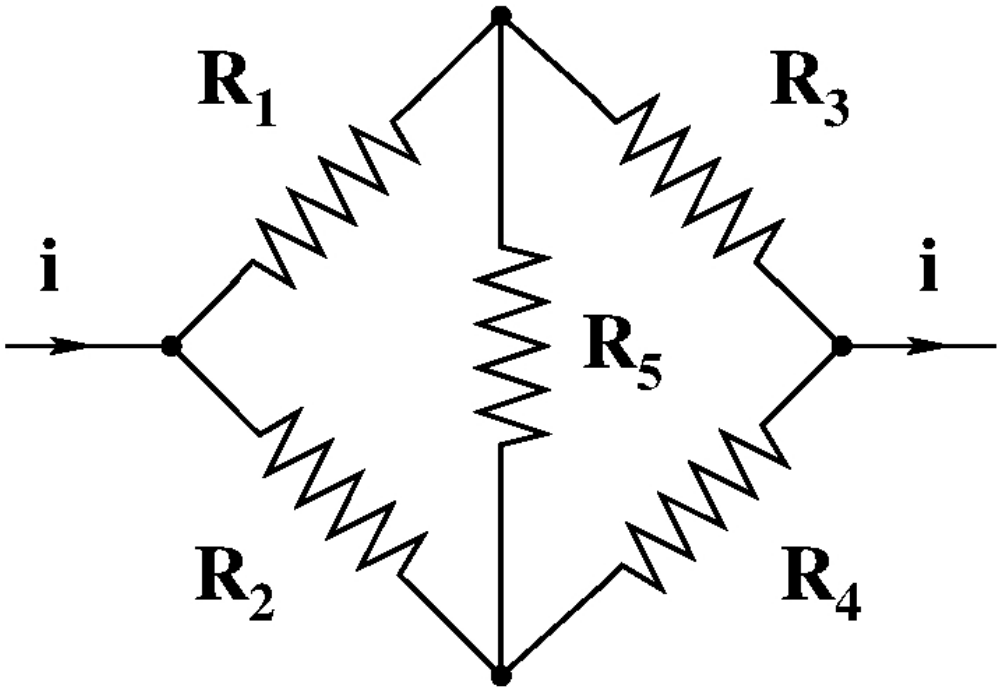
The power, P = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 2

0/1 pt 999 998

The current i = 36 mA is passing through a system of five resistors connected as shown in the circuit below. Find the magnitude of the current in each resistor if R_1 = 12 Ω, R_2 = 14 Ω, R_3 = 9 Ω, R_4 = 29 Ω, and R_5 = 7 Ω. Use Kirchhoff's rules to solve for the currents.



The current through R_1, i_1 = _____ Units Select an answer .

The current through R_2, i_2 = _____ Units Select an answer .

The current through R_3, i_3 = _____ Units Select an answer .

The current through R_4, i_4 = _____ Units Select an answer .

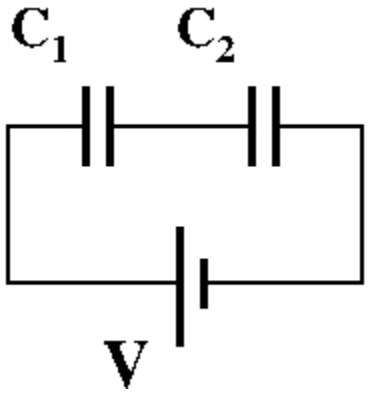
The current through R_5, i_5 = _____ Units Select an answer .

The direction of the current through R_5 is Select an answer .

Question Help: Message instructor Post to forum

Question 3 0/1 pt 999 998

The capacitors C_1 = 10.5 μF and C_2 = 31.5 μF are connected to a 3-V battery as shown in the figure below. What is the equivalent capacitance of the circuit?



The equivalent capacitance, C_{eq} = _____ Units Select an answer .

What is the charge in each capacitor?

The charge in C_1, Q_1 = _____ Units Select an answer .

The charge in C_2, Q_2 = _____ Units Select an answer .

What is the drop of potential across each capacitor?

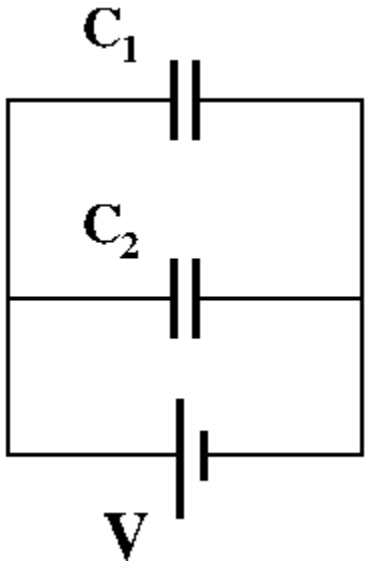
The potential difference across C_1, ΔV_1 = _____ Units Select an answer .

The potential difference across C_2, ΔV_2 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 4 0/1 pt 999 998

The capacitors C_1 = 78 μF and C_2 = 234 μF are connected to a 15-V battery as shown in the figure below. What is the equivalent capacitance of the circuit?



The equivalent capacitance, C_{eq} = _____ Units Select an answer .

What is the charge in each capacitor?

The charge in C_1, Q_1 = _____ Units Select an answer .

The charge in C_2, Q_2 = _____ Units Select an answer .

What is the energy stored in each capacitor?

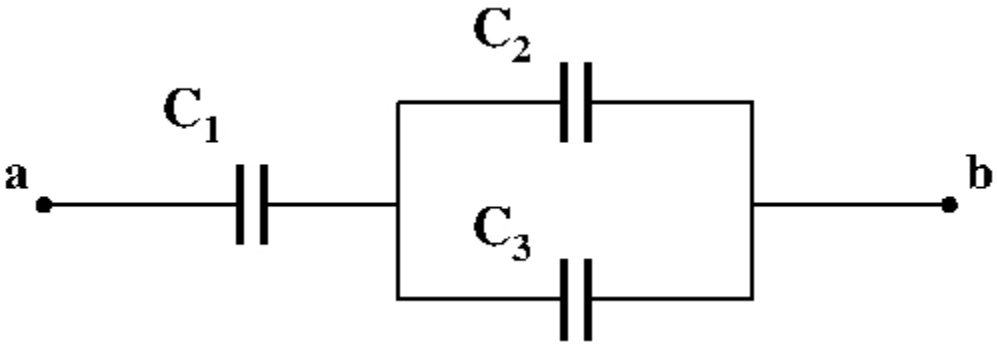
The energy in C_1, U_1 = _____ Units Select an answer .

The energy in C_2, U_2 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 5 0/1 pt 999 998

The capacitors C_1 = 15.5 μF, C_2 = 31 μF and C_3 = 51.5 μF are connected as shown below. What is the equivalent capacitance between points a and b?



The equivalent capacitance, C_{eq} = _____ Units Select an answer .

If a 6-V battery is connected across points a and b, what is the charge in each capacitor?

The charge in C_1, Q_1 = _____ Units Select an answer .

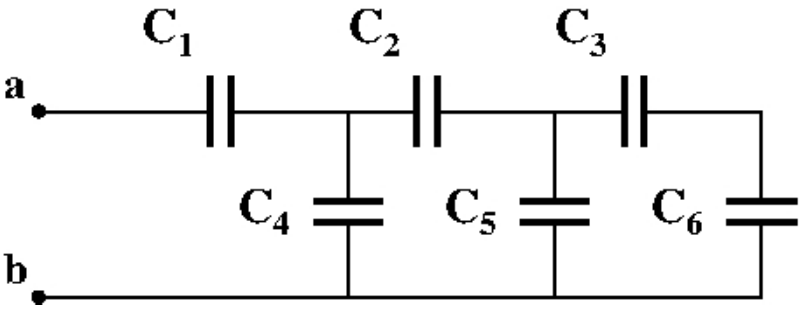
The charge in C_2, Q_2 = _____ Units Select an answer .

The charge in C_3, Q_3 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 6 0/1 pt 999 998

The capacitors C_1 = 42.5 μF, C_2 = 42.5 μF, C_3 = 56.5 μF, C_4 = 48.5 μF, C_5 = 41.5 μF, and C_6 = 73.5 μF are connected as shown below. What is the capacitance of the circuit between points a and b?



The equivalent capacitance, C_{eq} = _____ Units Select an answer .

What is the total charge and energy stored in the system if a 12-V battery is connected to points a and b?

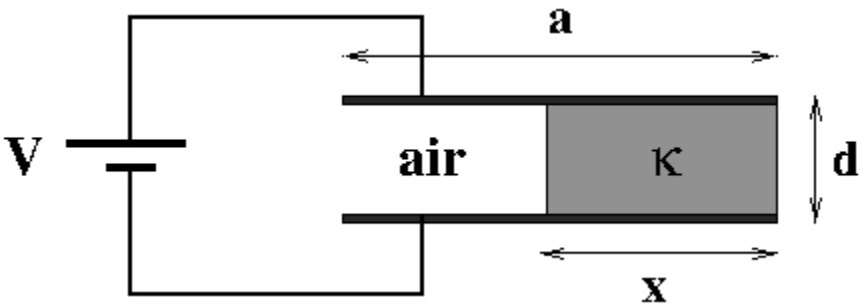
The charge in the system, Q = _____ Units Select an answer .

The energy in the system, U = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 7 0/1 pt 999 998

Consider a parallel plate capacitor with the plate surface area a×b and distance between the plates d. A nonconducting slab of a similar size x×b×d with dielectric constant κ is completely inserted into the capacitor as shown below. Find the capacitance, charge and energy stored in the system if a battery of 36-V is attached accros the capacitor. Take κ = 7.5, a = 21 cm, b = 23 cm, d = 0.2 cm, and x = 11 cm.



The capacitance, C = _____ Units Select an answer .

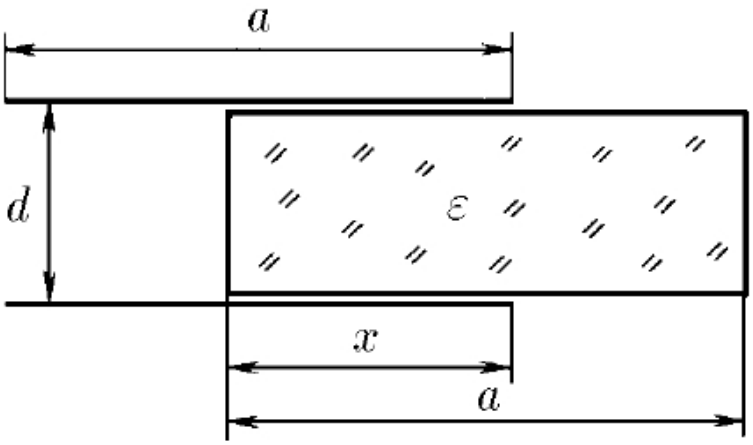
The echarge, Q = _____ Units Select an answer .

The energy, U = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 8 0/1 pt 999 998

Consider an isolated charged parallel plate capacitor with charge stored Q, plate surface area a×b, and distance between the plates d. A nonconducting slab of a similar size a×b×d with dielectric constant ε is inserted a distance x into the capacitor as shown below. Find the capacitance and energy of the system as a function of x. Assume Q= 22.5 μC, ε= 3.5 , a= 19 cm, b= 6 cm, and d = 0.2 cm. Use pF, Joules and meters for the units, but do not put them explicitly.



The capacitance, C(x) = [ ] Units Select an answer .

The energy, U(x) = [ ] Units Select an answer .

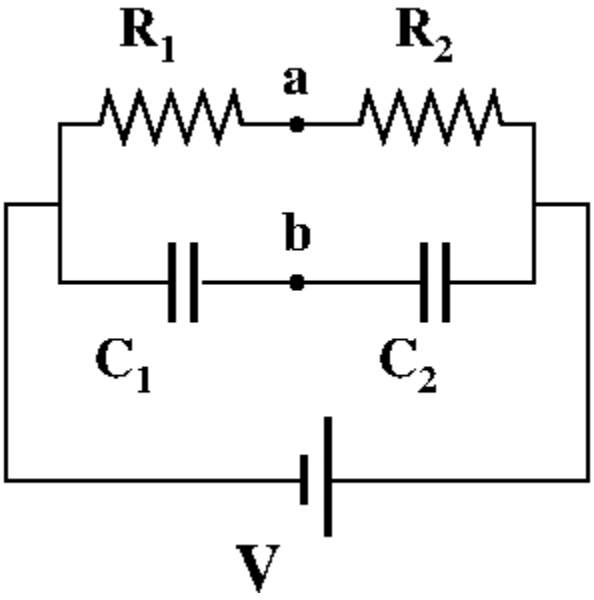
With what force is the slab pulled into the capacitor?

The force, F(x) = [ ] Units Select an answer .

Question Help: Message instructor Post to forum

Question 9 0/1 pt 999 998

Two capacitors C_1 = 50 μF and C_2 = 55 μF and two resistors R_1 = 25 Ω and R_2 = 60 Ω are connected to a 6-V battery as shown in the figure below. What is the potential difference between points a and b?

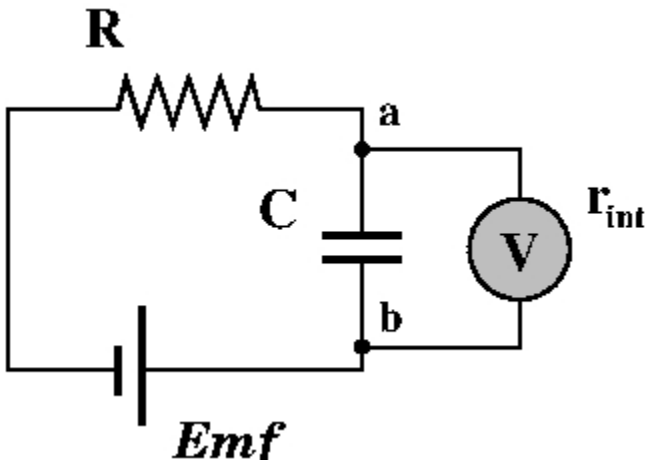


The potential difference, V_a-V_b = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 10 0/1 pt 999 998

A capacitor C = 50 μF, resistor R = 170 Ω and a voltmeter are connected to a battery of Emf = 12 V as shown in the figure below. If the voltmeter is disconnected, what is the potential difference across the capacitor?



The potential difference, V_1 = _____ Units Select an answer .

Then the voltmeter is connected to points a and b and used to measure the potential difference across the capacitor. What does the voltmeter read if its internal resistance is r_{int} = 2 kΩ?

The voltmeter readings, V_2 = _____ Units Select an answer .

How can the accuracy of voltmeter be increased? What internal resistance would provide more accurate measurements? Please write your answer in the box below.

Question Help: Message instructor Post to forum

Question 11 0/1 pt 999 998

An uncharged capacitor and a resistor are connected in series to a source of EMF. If Emf = 6 V, C = 70 μF, and R = 30 Ω, calculate the time constant of the circuit.

The time constant, τ = _____ Units Select an answer .

Calculate the maximum charge on the capacitor.

The maximum charge, Q_{max} = _____ Units Select an answer .

Calculate the charge on the capacitor after one time constant.

The charge, Q = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 12 0/1 pt 999 998

A leaky capacitor loses 15% of its charge in 6 min. What is the effective time constant of the system?

The time constant, τ = _____ Units Select an answer .

What fraction of charge (in %) will be on the capacitor after 24 min?

The charge, $\frac{Q}{Q_0} \times 100\,\%$ = _____ Units Select an answer .

After what time there will be 5% of the initial charge left on the capacitor?

The time, t = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 13 0/1 pt 999 998

A 40 μF capacitor with an initial energy of 1.1 J is discharged through a 9 MΩ resistor. What is the initial charge on the capacitor?

The charge, Q_0 = _____ Units Select an answer .

What is the current through the resistor when the discharge starts?

The current, I_0 = _____ Units Select an answer .

Determine the potential difference across the capacitor and the rate at which the thermal energy is dissipating in the resistance 6.6 min after the discharge starts.

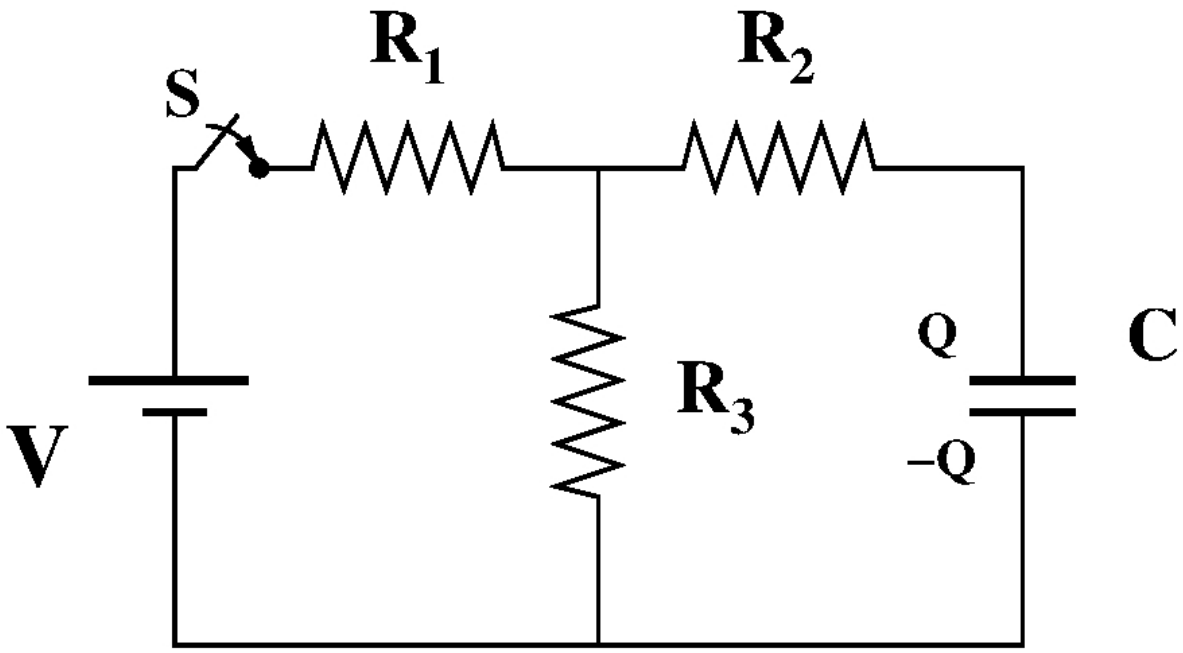
The potential difference across C, V_C = _____ Units Select an answer .

The power dissipated in R, P = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 14 0/1 pt 999 998

Three resistors, a battery and a capacitor are connected as shown below. Initially the switch 'S' is open for a long time, then at time $t = 0$ the switch is closed. Assuming R_1 = 3 Ω, R_2 = 4 Ω, R_3 = 18 Ω, C = 3 μF, and V = 6 V, answer the following questions about the charging process in the circuit.



What is the maximum charge on the capacitor (at $t \to \infty$)?

The maximum charge, Q_{max} = _____ Units Select an answer .

What is the time constant of this RC circuit?

The time constant, τ = _____ Units Select an answer .

What is the charge on the capacitor at t = 18 μs?

The charge, Q = _____ Units Select an answer .

Question Help: Message instructor Post to forum

HW #08

Roman Senkov

Question 1

0/1 pt 999 998

The deuterons, the nuclei of heavy hydrogen, are accelerated and injected into a region with constant magnetic field (a cyclotron). Determine the cyclotron frequency of the particles, if the strength of the magnetic field in the cyclotron is 2.8 T and the mass of deuteron is $3.3 \times 10^{-27} kg$.

The cyclotron frequency, f = _____ Units Select an answer .

Determine the cyclotron radius for the particles, which enters the cyclotron with a kinetic energy of 20 MeV.

The radius, R = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 2

0/1 pt 999 998

An electron moves in an uniform magnetic field (with the orbital plane perpendicular to the field). If the cylotron radius of the electron is 5 cm and it's kinetic energy is 2.4 keV, find the electron's speed, the magnitude of the magnetic field, the cyclotron frequency, and the period of the motion. Use $m_e = 9.11 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C, and 1 T = 10^4 G.

The speed, v = _____ Units Select an answer .

The magnetic field, B = _____ Units Select an answer .

The cyclotron frequency, f = _____ Units Select an answer .

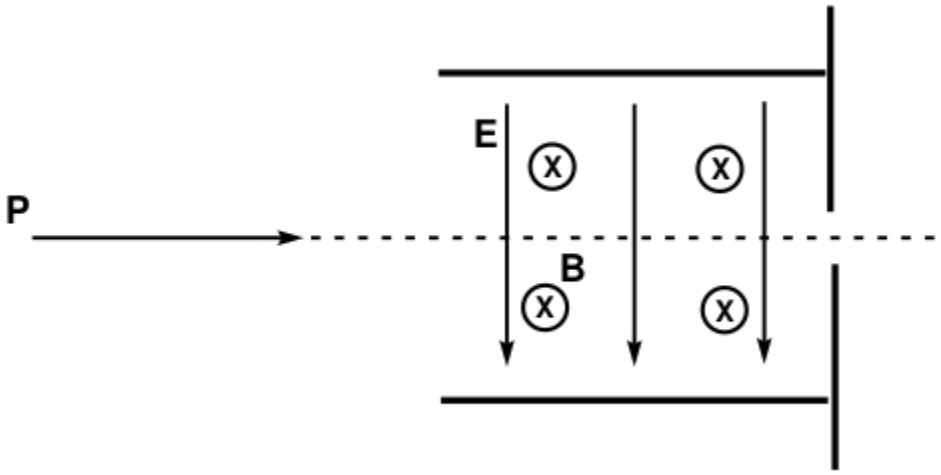
The period, T = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 3

0/1 pt 999 998

A proton, that is accelerated from rest through a potential of 15 kV enters the velocity filter, consisting of a parallel-plate capacitor and a magnetic field, shown below. What is the proton's speed? Take $m_p = 1.67 \times 10^{-27}$ kg and $e = 1.6 \times 10^{-19}$ C.



The speed, v = _____ Units Select an answer .

The E-field between the plates is 2.8×10^5 N/C. What B-field is required so that the protons are not deflected?

The magnetic field, B = _____ Units Select an answer .

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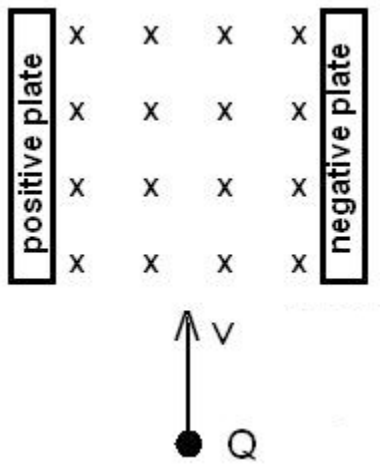
Question 4 0/1 pt 999 998

The velocity selector shown below allows a 7 μC charged particle to pass through without being deflected as long as its velocity is v = 5,500 m/sec. Which of the following statements are True/False?



If E is increased, all positive charges with v = 5,500 m/sec deflect right. Select an answer

If v = 4,500 m/sec, a negative charge deflects left. Select an answer

If B is increased, all negative charges with v = 5,500 m/sec deflect left. Select an answer

If v = 6,500 m/sec, a positive charge deflects right. Select an answer

Any charged particle traveling at 5,500 m/sec passes through undeflected. Select an answer

Note: you MUST complete all sentences before submitting.

Question Help: Message instructor Post to forum

Question 5 0/1 pt 999 998

In a mass spectrometer, a singly charged ion having a particular velocity is selected by using a magnetic filed of 150 mT perpendicular to an electric field of 6.2 kV/m. The same magnetic field is used to deflect the ion in a circular path with a radius of 103 mm. What is the mass of the ion?

The mass, m = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 6 0/1 pt 999 998

A wire carries a current of i = 6 A in a direction that makes an angle of 35° with the direction of a magnetic field of 0.9 T. Calculate the magnetic force on a 21 cm length of the wire.

The force, F_1 = _____ Units Select an answer .

What is the force if the angle is 0°?

The force, F_2 = _____ Units Select an answer .

What is the force if the angle is 90°?

The force, F_3 = _____ Units Select an answer .

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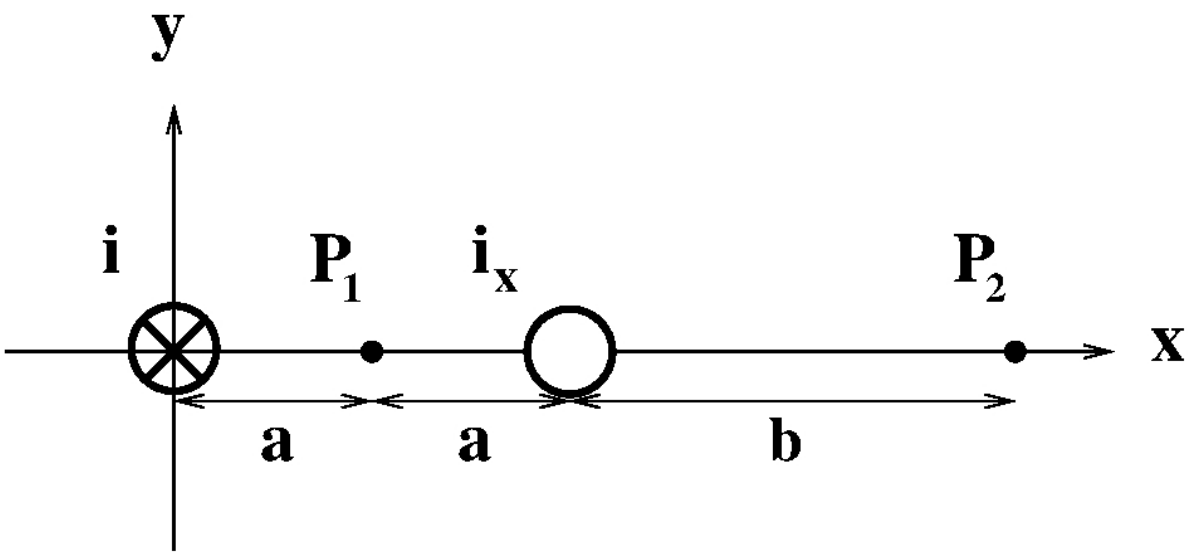
Question 7

0/1 pt 999 998

Two very long parallel conductors are located at a distance of $2 \cdot a$ from each other, perpendicular to the plane of the figure below. The left-side conductor is carrying a current of i = 15 A directed into the page. What current i_x (magnitude and direction) must flow through right-side conductor to produce a zero magnetic field at point P_2? Use out of the page as the positive direction and a = 2 cm and b = 12 cm.



The current, i_x = _____ Units Select an answer .

What is the magnitude and direction of the magnetic field at point P_1?

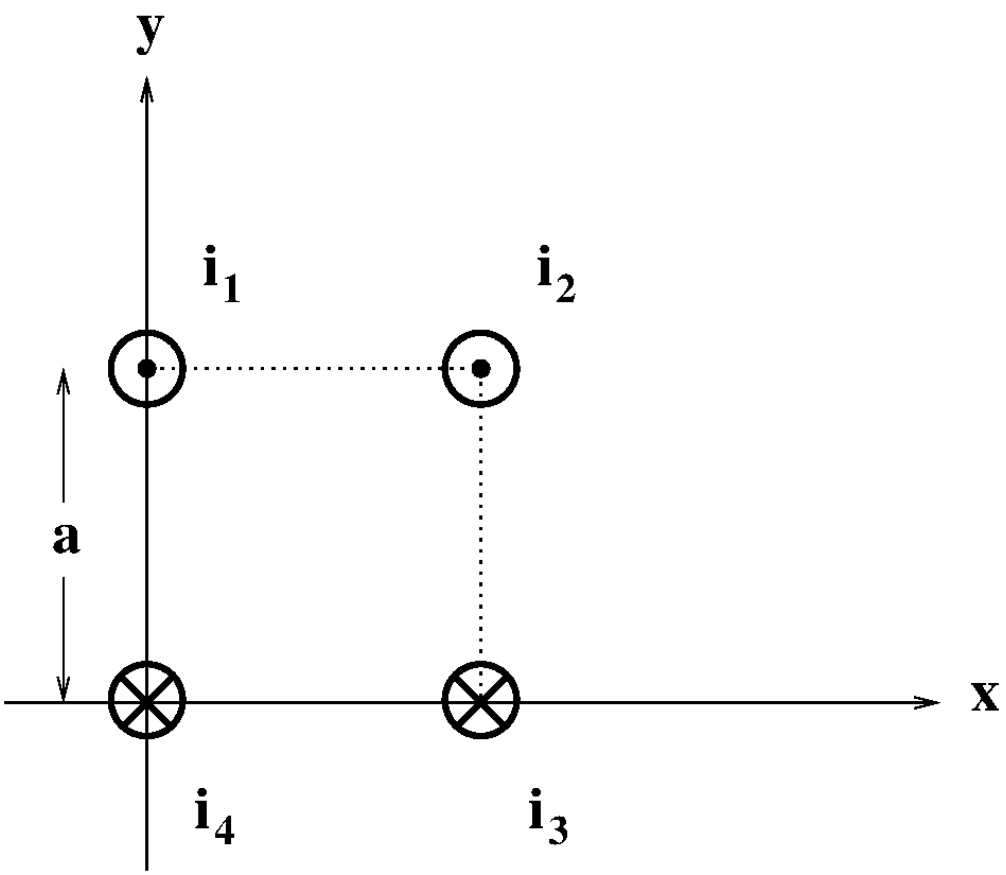
The magnitude of the B-field, B_1 = _____ Units Select an answer .

The field is directed Select an answer .

Question Help: Message instructor Post to forum

Question 8 0/1 pt 999 998

The figure below shows an arrangement in which four long parallel wires carry equal currents directly into or out of the page at the corners of a square. Find the net force *per unit of length* on current i_1 if all currents are 5 A and a = 65 cm.



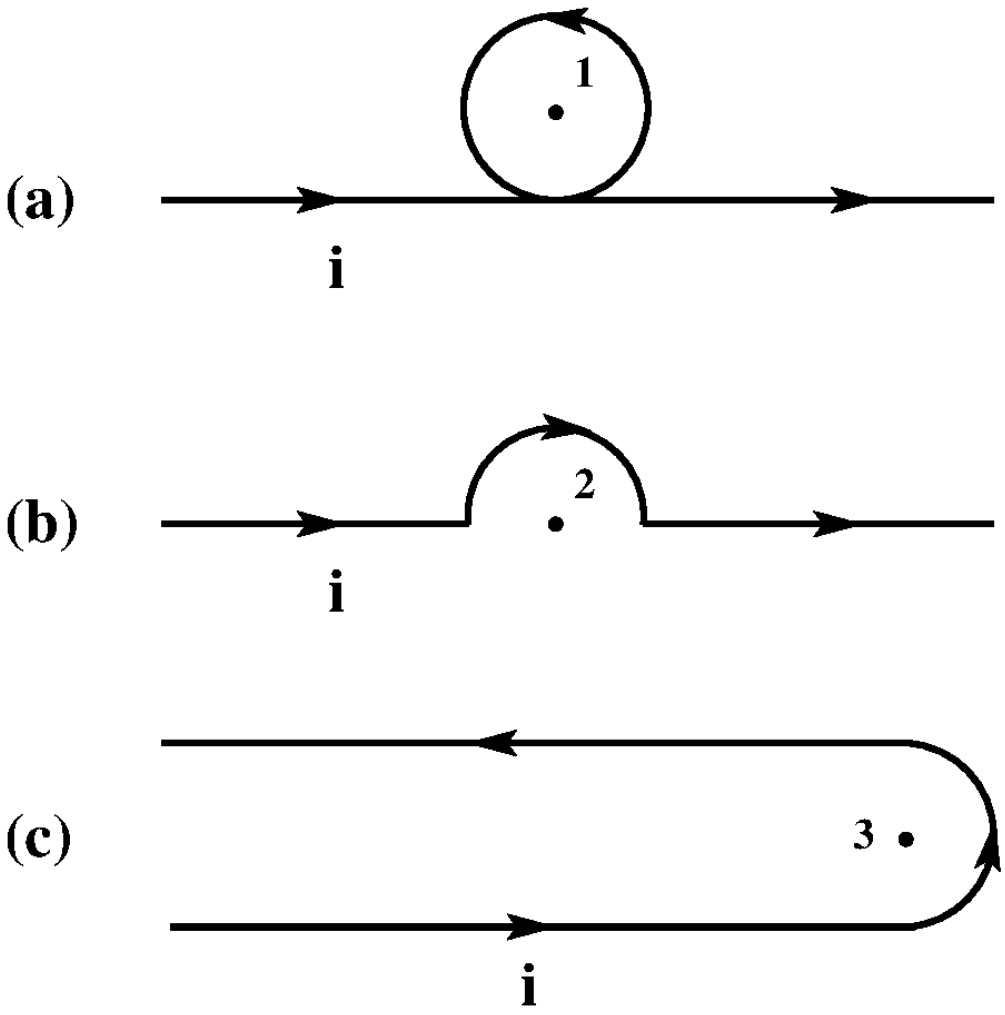
The x component, F_x/L = _____ Units Select an answer .

The y component, F_y/L = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 9 0/1 pt 999 998

In the three separate arrangements (a), (b), and (c) shown below a current i = 12.5 A is set up in a long conductor formed by bending a wire into a semicircle/circle of radius R = 55 cm. Find the magnetic field at points 1, 2, and 3? Use out of the page as the positive direction.



The magnetic field at '1', B_1 = _____ Units Select an answer .

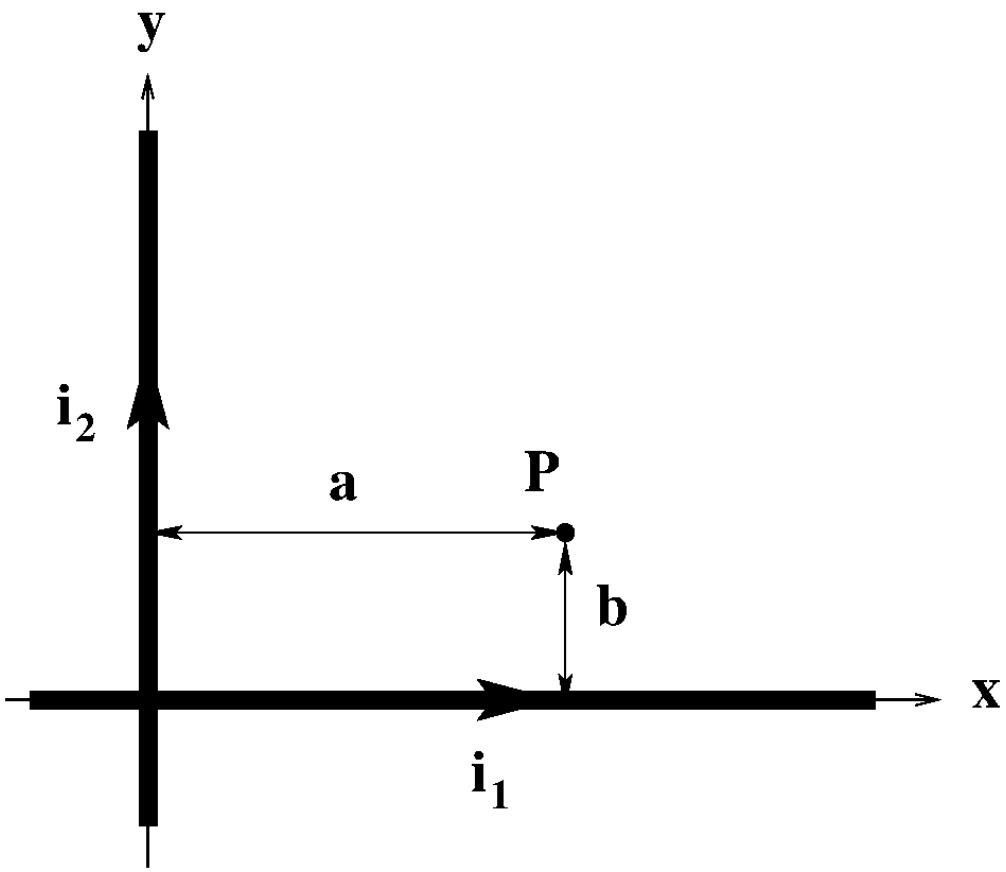
The magnetic field at '2', B_2 = _____ Units Select an answer .

The magnetic field at '3', B_3 = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 10 0/1 pt 999 998

A very long wire carries an i_1 = 6 A current along the x axis and another long wire carries an i_2 = 13 A current along the y axis. What is the magnetic field at point P located at a = 6.8 m and b = 2.5 m? Use out of the page as the positive direction.



The magnetic field at P, B = _____ Units Select an answer .

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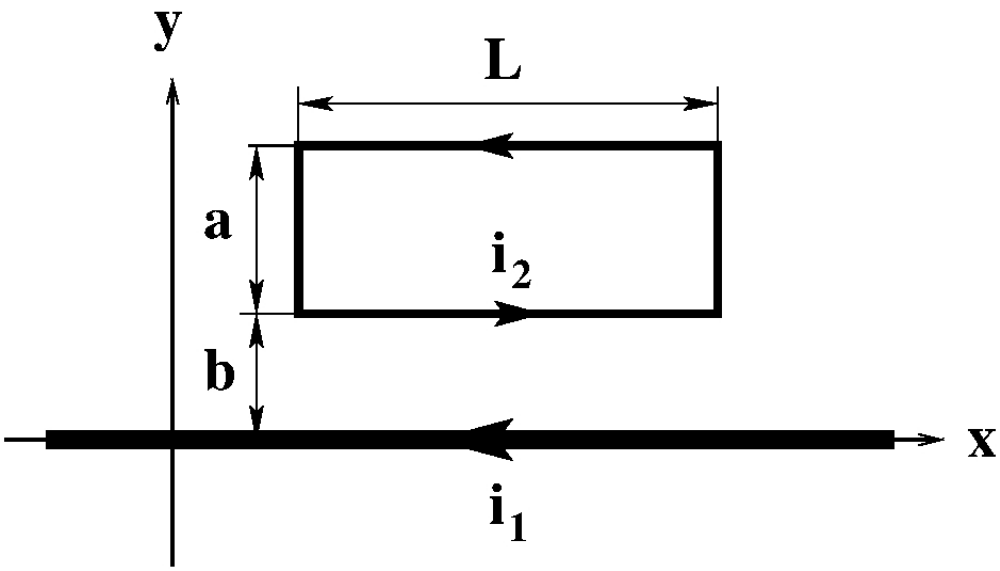
Question 11 0/1 pt 999 998

In the figure shown below, the current in the long, straight wire is i_1 = 9.5 A, and the wire lies in the plane of the rectangular loop, which carries i_2 = 6.5 A. The dimensions are a = 13.5 cm, b = 5.5 cm, and L = 14.5 cm. Find the magnitude and direction of the force exerted by the magnetic field due to the straight wire on the top and bottom segments of the loop.



The force on the top segment:

the magnitude, F_{top} = _____ Units Select an answer ,
the force is directed Select an answer .

The force on the bottom segment:

the magnitude, F_{bottom} = _____ Units Select an answer ,
the force is directed Select an answer .

Find the net force on the loop.

The magnitude of the net force, F_{net} = _____ Units Select an answer ,
the force is directed Select an answer .

Question Help: Message instructor Post to forum

Question 12 0/1 pt 999 998

A long solenoid with n = 25 turns per centimeter and a radius of R = 14 cm carries a current of i = 50 mA. Find the magnetic field in the solenoid.

The magnetci field, B_0 = _____ Units Select an answer .

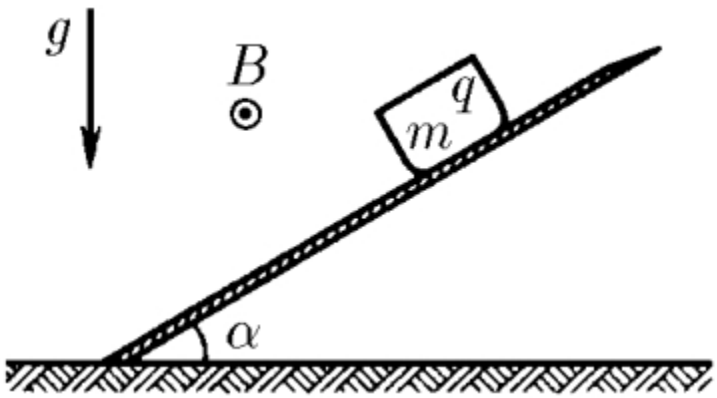
If a straight conductor is positioned along the axis of the solenoid and carries a current of 44 A, what is the magnitude of the net magnetic field at the distance R/2 from the axis of the solenoid?

The net magnetic field, B_{Net} = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 13 0/1 pt 999 998

Find the maximum speed a charged body can acquire while sliding down an inclined plane in an external magnetic field B = 3.5 T, see the figure below. The body has the charge q = -0.5 C and the mass m = 2.6 kg. The magnetic field is parallel to the plane and perpendicular to the gravitational field g. The inclination angle is $\alpha = 35^\circ$ and the friction coefficient is $\mu = 0.2$. Neglect the air resistance and take the free fall acceleration g = 9.81 m/s^2.



The maximum speed, v = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 14 0/1 pt 999 998

Consider an electron orbiting around a proton with an orbital radius of `R=8.48*10^(-10)` m. What is the orbital frequency of the electron motion? Use `m_e = 9.11 times 10^(-31)` kg, `e = 1.6 times 10^(-19)` C, and `k = 9 times 10^(9)` Nm^2/C^2.

The frequency, f_0 = _____ Units Select an answer .

By how much would this frequency increase (assume the same orbital radius) if an external magnetic field of B = 0.5 T is applied to the system along the the electron axis of rotation?

The increase in the frequency , Δf = _____ Units Select an answer .

Question Help: Message instructor Post to forum

HW #09

Roman Senkov

Question 1

0/1 pt 999 998

A 35-cm side length square coil has 110 turns. An initial uniform magnetic field of strength 13 mT is applied perpendicularly to the plane of the coil. Calculate the magnetic flux through the coil.

The flux, Φ = _____ Units Select an answer .

If the field increases in strength from the initial value to 38 mT in 0.35 s, what average emf is induced in the coil?

The induced emf, emf = _____ Units Select an answer .

What is the average current in the coil if it's resistance is 205 Ω?

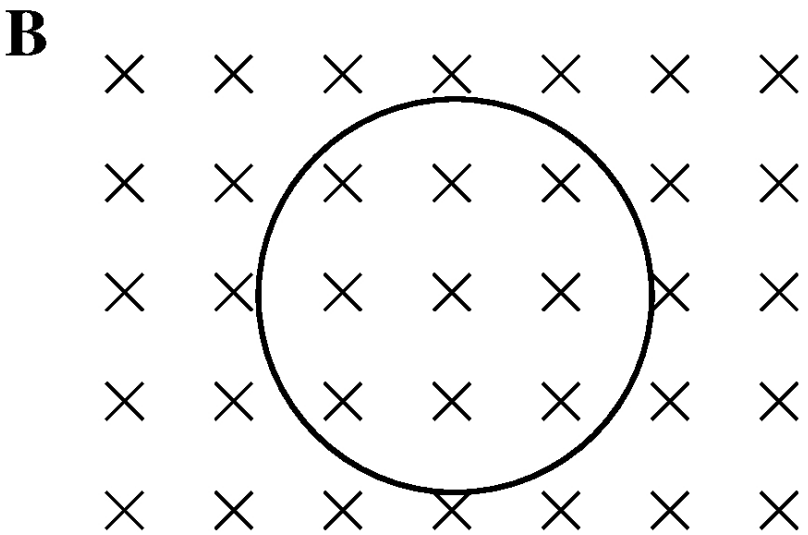
The current, I = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 2

0/1 pt 999 998

A single-turn circular loop has a radius of 10 cm, it is placed in a magnetic field of B = 1.8 T which is perpendicular to the plane of the loop, see the figure below. The loop is reshaped into a perfect square without stretching the length of the loop. It takes 0.71 s to reshape the loop. What is the magnetic flux through the loop before and after it is reshaped?



The initial flux, Φ_i = _____ Units Select an answer .

The final flux, Φ_f = _____ Units Select an answer .

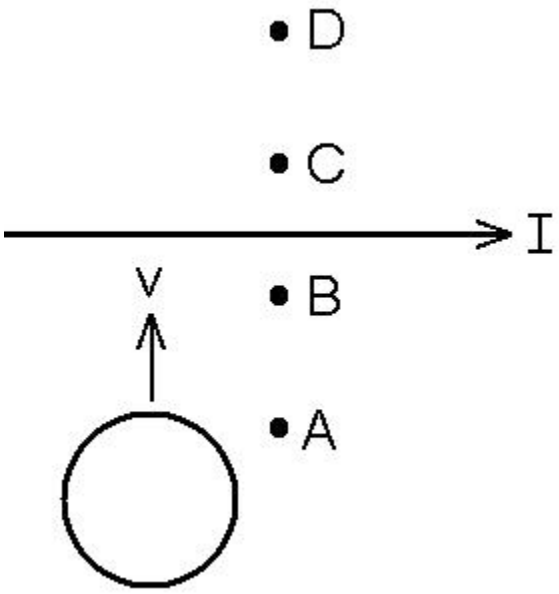
What is the magnitude of the average induced emf in the loop during the reshaping process?

The induced emf, Emf = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 3 0/1 pt 999 998

A wire carries a constant current I to the right. A wire loop moves either upward or downward with a constant velocity V in the plane of the paper. Which of the following statements are True/False?



1. Current flows counterclockwise as the loop moves from A to B and clockwise as the loop moves from C to D. Select an answer .

2. Current flows counterclockwise as the loop moves from A to B and clockwise as the loop moves from D to C. Select an answer .

3. Current flows counterclockwise as the loop moves from A to B and counterclockwise as the loop moves from C to D. Select an answer .

4. Current flows clockwise as the loop moves from B to A and clockwise as the loop moves from D to C. Select an answer .

5. Current flows clockwise as the loop moves from A to B and counterclockwise as the loop moves from C to D. Select an answer .

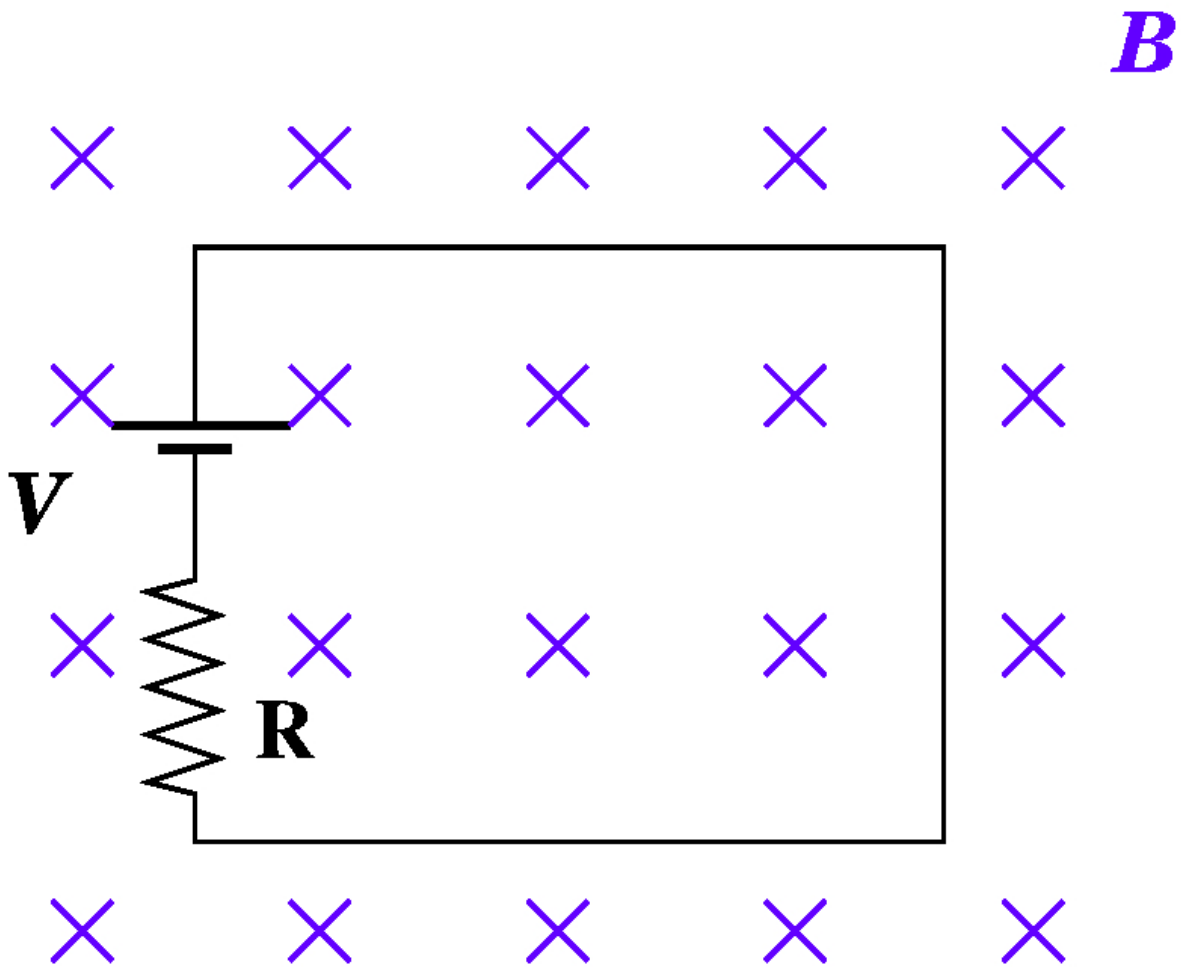
6. Current flows clockwise as the loop moves from A to B and clockwise as the loop moves from C to D. Select an answer .

Note: you MUST complete all sentences before submitting.

Question Help: Message instructor Post to forum

Question 4 0/1 pt 999 998

A V = 18 mV battery is connected to a single turn loop of dimensions a = 9 cm by b = 6 cm has a resistance of R = 24 Ω. The loop is placed in a uniform magnetic field which is perpendicular to the plane of the loop. If the magnetic field is increasing at a rate of 1.2 T/sec, what is the magnitude and direction of the current in the circuit?



The magnitude, I = _____ Units Select an answer .

The direction: Select an answer .

Note: you MUST provide all answers before submitting.

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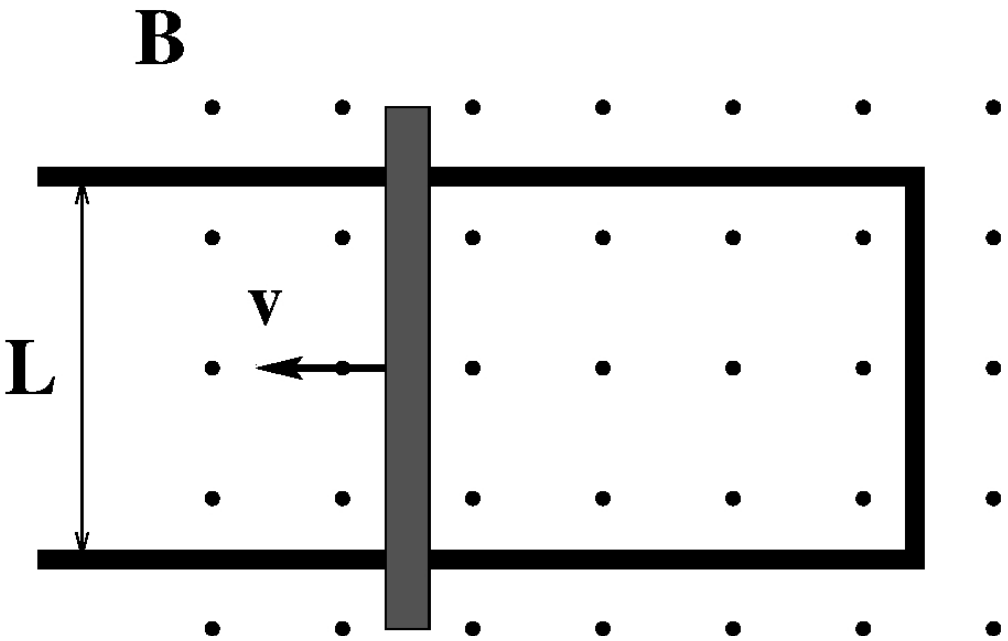
Question 5 0/1 pt 999 998

A conducting rod is pulled horizontally with constant force along a set of rails separated by L = 25 cm. A uniform magnetic field B = 0.2 T is directed out of the page. There is no friction between the rod and the rails, and the rod moves with constant velocity v = 6 m/s. If the resistance of the system is 0.15 Ω calculate the induced emf and current in the loop. Assign clockwise to be the positive direction for Emf.



The induced emf, Emf = _____ Units Select an answer .

The induced current, i = _____ Units Select an answer .

At what rate does thermal energy releases in the rod?

The power, P_R = _____ Units Select an answer .

What force is required to maintain the constant velocity of the rod? At what rate does this force do work?

The force, F = _____ Units Select an answer .

The power, P_F = _____ Units Select an answer .

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Question 6 0/1 pt 999 998

Calculate the average induced voltage between the tips of the wings of a Boeing 747 flying at 800 km/hr above Queens, NY. The downward component of the earth's magnetic field at this place is 1.1 G. Assume that the wingspan is 57 meters. Note: $1G = 10^{-4}T$.

The induced emf, Emf = _____ Units Select an answer .

If you try to use this voltage (for example, to charge a smartphone), would it make harder for the plane to fly? Explain your reasoning in the box below.

If your phone consumes 3.5 W of power while charging from the motional emf generated by the wingspan, what additional force does it exert on the plane?

The force, F = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 7 0/1 pt 999 998

A generator is constructed by rotating a coil of N turns in a magnetic field B at a frequency f. The internal resistance of the coil is R and the cross sectional area of the coil is A. Which of the following statements are True/False?

The maximum induced EMF doubles if the resistance R is doubled.
Select an answer

The maximum induced EMF occurs when the rotated coil is perpendicular to the magnetic field.
Select an answer

The maximum induced EMF doubles if the magnetic field B is doubled.
Select an answer

The maximum induced EMF doubles if the frequency f is doubled.
Select an answer

The maximum induced EMF doubles if the area A is doubled.
Select an answer

What is the maximum induced EMF if N = 5, B = 1.7 T, f = 20 Hz, R = 5 Ω, and A = 19 cm^2?

The maxumum emf, EMF = _____ Units Select an answer .

Note: you MUST answer all questions before submitting.

Question Help: Message instructor Post to forum

Question 8 0/1 pt 999 998

When the coil of a motor is rotating at maximum speed, the current in the windings is 3.85 A. When the motor is first turned on, the current in the windings is 8.99 A. If the motor is operated at 120 V, calculate the resistance of the windings.

The resistance, R_{coil} = _____ Units Select an answer .

Calculate the back emf in the coil at maximum speed.

The back emf, E_{back} = _____ Units Select an answer .

What is the current in the windings if the speed of the motors is half of its maximum value?

The current, I = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 9 0/1 pt 999 998

An ideal step-down transformer has a primary coil of 570 turns and a secondary coil of 100 turns. Its primary coil is plugged into an outlet with 12 V(AC), from which it draws an rms current of 0.28 A. What is the voltage and rms current in the secondary coil?

The voltage, V_S = _____ Units Select an answer .

The current, I_S = _____ Units Select an answer .

Assuming that the transformer secondary is driving a resistive load, calculate the resistance of the load and the average power dissipated in the resistor.

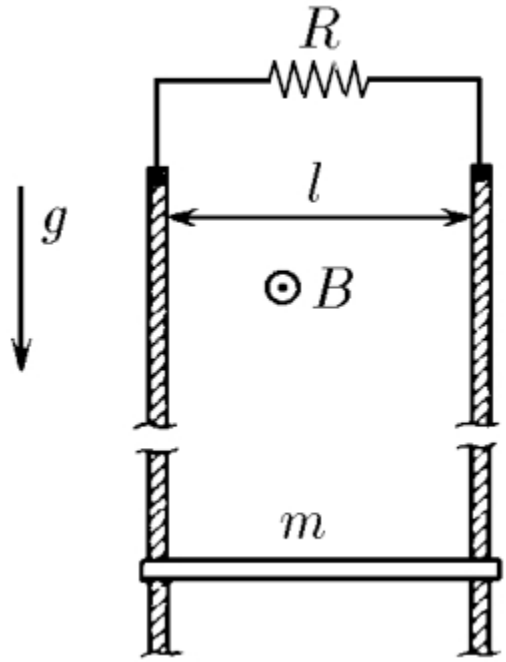
The resistance, R = _____ Units Select an answer .

The power consumed, P = _____ Units Select an answer .

Question Help: Message instructor Post to forum

Question 10 0/1 pt 999 998

A conducting rod of mass m = 55 g can freely slide down along the two vertical rail tracks as show below. The tracks are parallel to each other, separated by the distance l = 55 cm, and connected with a resistance R = 5.6 Ω (the entire system form a circuit). Find the terminal velocity of the rode if the there is an external uniform magnetic field B = 3.4 T perpendicular to the tracks. Take g = 9.81 m/s^2.



The terminal velocity, v = _____ Units Select an answer .

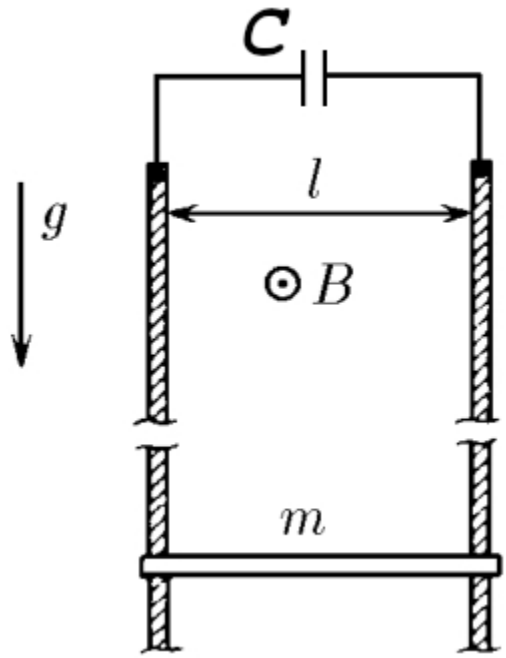
Find the speed of the rod (in m/s) as a function of time t (in s), assume that the rod starts to slide down from rest, $v(0) = 0$. Do not submit the units. Hint: use analogy with the RC circuits.

The speed, v(t) = _____ m/s.

Question Help: Message instructor Post to forum

Question 11 0/1 pt 999 998

A conducting rod of mass m = 15 g can freely slide down along the two vertical rail tracks as show below. The tracks are parallel to each other, separated by the distance l = 50 cm, and connected with a capacitance C = 2 mF (the entire system form a circuit). Find the acceleration of the rode if the there is an external uniform magnetic field B = 2.6 T perpendicular to the tracks. Take g = 9.81 m/s^2.



The acceleration, a = _____ Units Select an answer .

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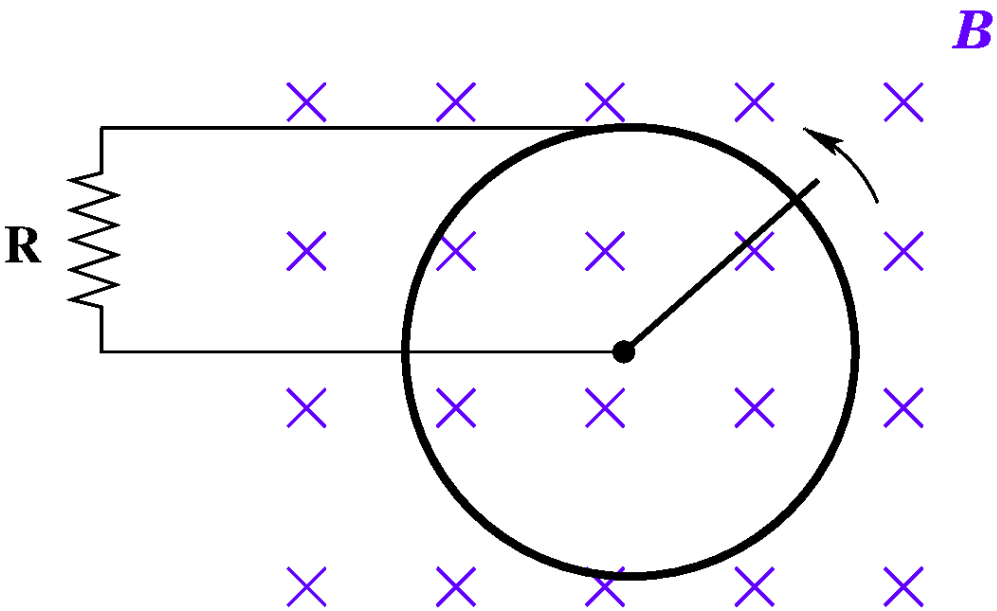
Question 12 0/1 pt 999 998

A simple DC generator consists of a rotating rod and a conducting circular track (all placed in an external magnetic field that is perpendicular to the plane of the track, see the picture below). Find the current in a R = 20 Ω load connected to the generator if the rod rotates at 120 rad/s, the radius of the track is 34 cm, and the strength of the magnetic field is B = 0.7 T.



The current, I = _____ Units Select an answer .

What torque must be applied to the rod to make it spin at the given angular velocity? Neglect the friction force on the rod.

The torque, τ = _____ Units Select an answer .

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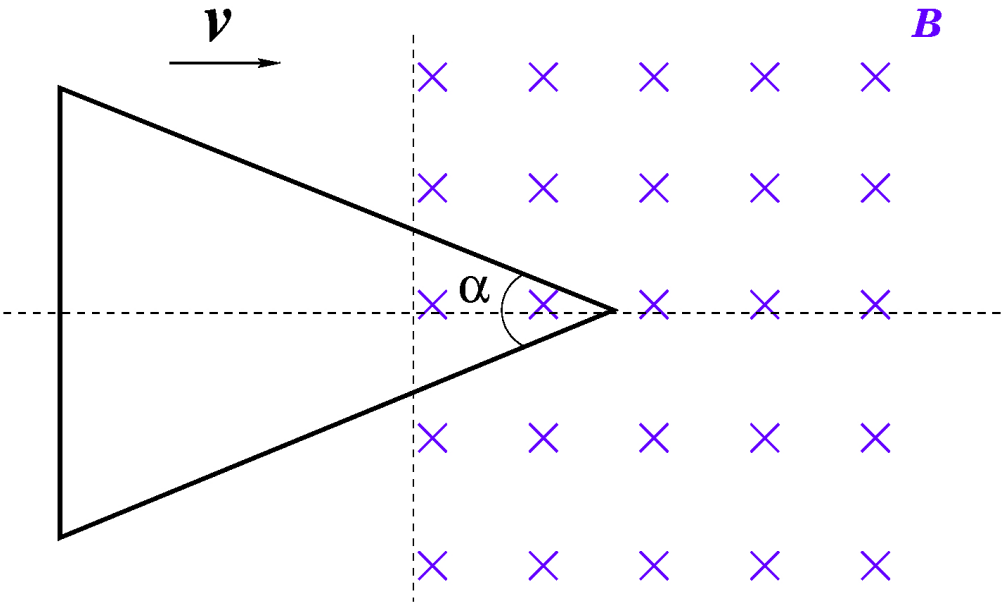
Question 13 0/1 pt 999 998

A triangle loop moves into the area with a constant magnetic field shown in the picture below. The field has a strength of B = 0.5 T and is perpendicular to the plane of the loop. Find the emf induced in the loop as a function of time (in sec) if the angle α = 15°, the loops moves with a constant speed of v = 2.5 m/s and at $t = 0$ the loop was just entering the field area (the tip of the triangle was touching the B-field). Do not submit the units.



The induced emf, Emf = [ ] Units Select an answer .

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Question 14 0/1 pt 999 998

A small solenoid with a radius of 5 cm and 85 turns is placed inside a long solenoid (n = 550 turns/cm). The solenoids are concentric. Find the induced emf generated in the small solenoid if the current through the long solenoid increases at 20 mA per second.

The induced emf, Emf = [ ] Units Select an answer .

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HW #10

Roman Senkov

Question 1

0/1 pt 15

Inductance of a closely wound coil is such that when the current changes by 4.1 A per second, it induces electromotive force of 7 mV. Furthermore, we know that a steady current of 8 A generates in each turn of the coil a magnetic flux of 55.1 μWb. Calculate the inductance of the coil and determine the number of turns of the coil.

The inductance, L = _____ Units Select an answer .

The number of turns, N = _____ Units Select an answer .

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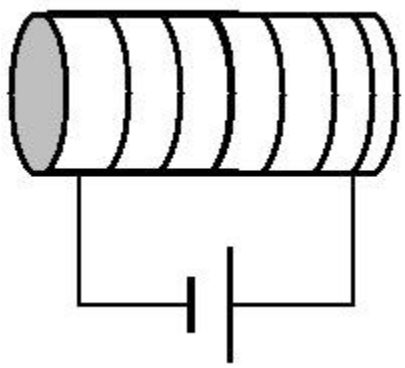
Question 2

0/1 pt 15

A solenoid of radius 5 cm has 390 turns and a length of 30 cm. Calculate its inductance.



The inductance, L = _____ Units Select an answer .

Calculate the rate at which current must change through the solenoid to produce an emf of 12 mV.

The rate of change, $\frac{dI}{dt}$ = _____ Units Select an answer .

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Question 3

0/1 pt 15

To measure the muon magnetic moment a 2.6-T uniform magnetic field is used. How much energy is stored in the field if the experimental chamber where the field is created has dimensions of 20 cm×25 cm×70 cm?

The energy, U_B = _____ Units Select an answer .

How long will it take to "switch on" the field if the experiment uses a 3.5-kW power supply?

The time, t = _____ Units Select an answer .

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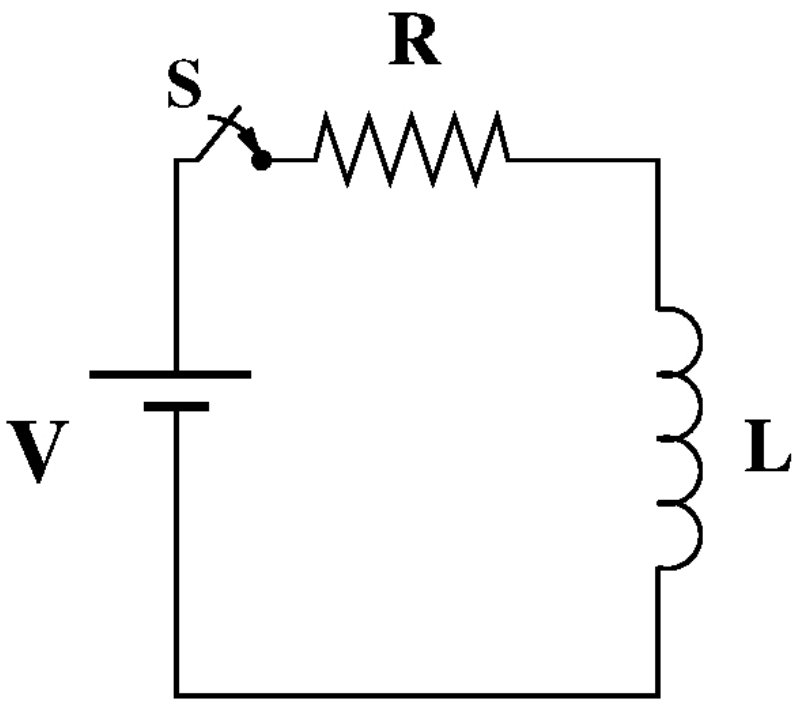
Question 4 0/1 pt 15

Consider the RL circuit shown below. What is the time constant of the circuit if V = 30 V, R = 330 Ω and L = 0.15 H?



The time constant, τ = _____ Units Select an answer .

What is the voltage across the inductor in the instant just after the switch is closed?

The voltage across L, V_0 = _____ Units Select an answer .

What is the voltage across the inductor 1 msec after the switch is closed?

The voltage across L, V_1 = _____ Units Select an answer .

After the switch is closed for a long time, what is the energy stored in the inductor?

The energy, U = _____ Units Select an answer .

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Question 5 0/1 pt 15

A capacitor of capacitance 110 μF and an inductor form an LC circuit that oscillates at 15 kHz, with a current amplitude of 5 mA. What are the inductance, the total energy in the circuit, and the maximum charge on the capacitor?

The inductance, L = _____ Units Select an answer .

The total energy, U = _____ Units Select an answer .

The maximum charge, Q_{max} = _____ Units Select an answer .

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Question 6 0/1 pt 15

A 90-V/30-Hz source is connected to an inductance L = 0.9 H and a capacitance C = 15 μF, the elements are connected in series. Find the rms current in the circuit.

The current, I = _____ Units Select an answer .

Find the rms current through the each element in the circuit if the elements are connected in parallel.

The current through L, I_L = _____ Units Select an answer .

The current through C, I_C = _____ Units Select an answer .

The current through the power source, I_V = _____ Units Select an answer .

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Question 7 0/1 pt 15

An RLC series circuit is connect to a 116-V/330-Hz source. Given that L = 90 mH, C = 95 μF and R = 84 Ω, find the rms current in the circuit and rms voltage drop across the inductor, the capacitor and the resistor.

The current, I_{rms} = _____ Unit Select an answer .

The voltage drop across L, $(V_L)_{rms}$ = _____ Unit Select an answer .

The voltage drop across C, $(V_C)_{rms}$ = _____ Unit Select an answer .

The voltage drop across R, $(V_R)_{rms}$ = _____ Unit Select an answer .

Find the phase shift, resonant frequency, and the power dissipated in the circuit.

The phase shift, ϕ = _____ Unit Select an answer .

The resonant frequency, f_R = _____ Unit Select an answer .

The power dissipation, P = _____ Unit Select an answer .

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Question 8

0/1 pt 15

Resonant circuit in a radio has a 82-μH inductor. You want to tune the radio to catch your favorite station which is broadcasting at frequency 120-MHz. What should be the value of the capacitor in the resonant circuit to catch this frequency?

The capacitance, C = _____ Unit Select an answer .

What frequency will it tune to if you increase the value of the capacitor by a factor of 2?

The frequency, f = _____ Unit Select an answer .

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Question 9

0/1 pt 15

Which of the following statements are True/False?

1. Microwaves, radio waves and infrared travel at the same speed. Select an answer .

2. Microwaves travels through the space faster than radio waves. Select an answer .

3. The higher-frequency waves have shorter wavelengths than the lower-frequency waves. Select an answer .

4. The higher-frequency waves travel slower than the lower-frequency waves. Select an answer .

5. The energy density of an electromagnetic wave in free space is equally divided between the magnetic and the electric fields. Select an answer .

6. Electric and magnetic fields are parallel to each other and also parallel to the direction of wave propagation. Select an answer .

7. Electric and magnetic fields are perpendicular to each other and also perpendicular to the direction of wave propagation. Select an answer .

8. Electric and magnetic fields are parallel to each other and but perpendicular to the direction of wave propagation. Select an answer .

9. Microwaves travels through the space faster than ultraviolet. Select an answer .

Note: you MUST complete all sentences before submitting.

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Question 10

0/1 pt 15

What are the wavelengths of electromagnetic wave and sound wave of same frequency 1.1-kHz? Speed of electromagnetic wave is 3×10^8 m/s, speed of sound wave is 337 m/s.

Wavelength of electromagnetic wave, λ_1 = _____ Unit Select an answer .

Wavelength of sound wave, λ_2 = _____ Unit Select an answer .

What is the speed of electromagnetic wave in a medium of dielectric constant 4.9 and magnetic permeability 1.4×10^{-3} H/m?

The speed of wave, v = _____ Unit Select an answer .

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Question 11

0/1 pt 15

An electromagnetic wave of frequency 5.9×10^{15} Hz falls on a medium of refractive index 2.6. The speed of E-M waves in vacuum is 3×10^{8} m/s.

The wavelength of the E-M wave in vacuum, λ_0 = _____ Unit Select an answer .

The speed of the E-M wave in the medium, v = _____ Unit Select an answer .

The wavelength of the E-M wave in the medium, λ = _____ Unit Select an answer .

If the incident wave falls from air and the angle of incidence is 38°, what is the angle of refraction?

The angle of refraction, θ_r = _____ Unit Select an answer .

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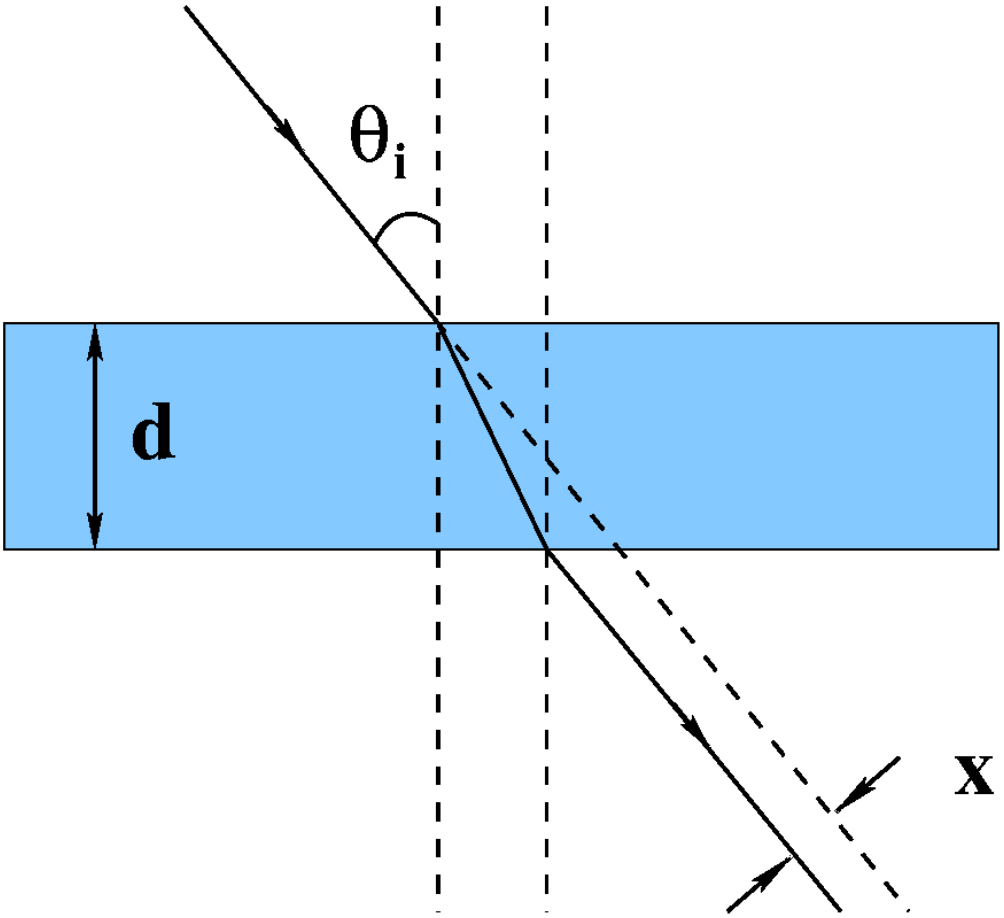
Question 12 0/1 pt 15

A ray of light strikes a flat, 3.3-cm-thick block of glass (n = 2) at an angle of 45° with the normal, see the figure below. Trace the light beam through the glass and find the angles of incidence and refraction at each surface.



Angle of incidence at top of glass, θ_1 = _____ Units Select an answer .

Angle of refraction at top of glass, θ_2 = _____ Units Select an answer .

Angle of incidence at bottom of glass, θ_3 = _____ Units Select an answer .

Angle of refraction at bottom of glass, θ_4 = _____ Units Select an answer .

By what distance is the light displaced after passing through the block of glass?

The displacement, x = _____ Units Select an answer .

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Question 13 0/1 pt 15

Superposition of waves shows interference pattern. Monochromatic light (light wave of a particular frequency) falls on double-slit 0.031-mm apart produces the 5^{th}-order bright fringe at an 15^{o} angle. Find the wavelength of the light used.

The wavelength, λ = _____ Unit Select an answer .

If the distance of the viewing screen is 4.5 m away from the slit, how far this fringe will form on the screen from its center?

The distance to the fringe, y_5 = _____ Unit Select an answer .

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Question 14 0/1 pt 15

640-nm light is shined on two narrow slits separated by 0.027-mm. What is the distance between two adjacent bright fringes on a screen at a distance 8-m from the slits?

The distance, d = _____ Unit Select an answer

At what angle from the centerline does the 6^{th}-order dark fringe occur?

The angle, θ_6 = _____ Unit Select an answer .

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