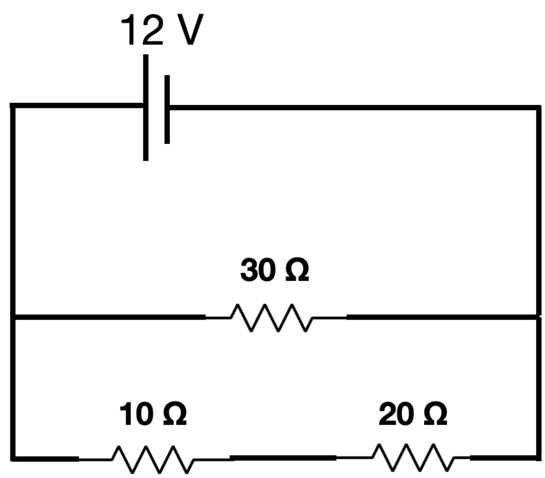
Phys 2B Summer 2022

Quiz 3 Practice

Question 1:

The diagram below shows an emf connected to a network of three resistors.



What is the current through the $10\,\Omega$ resistor?

(a) 0.13 A

(b) 0.16 A

(c) 0.32 A

(d) 0.40 A

(e) 0.80 A

Question 2:

A group of explorers has access to two identical incandescent light bulbs (that is, resistors) and one 12.0 V battery. The light bulbs have resistance 2.00 Ω. The explorers wish to maximize the total brightness of the bulbs combined, which means maximizing the total power dissipated by the resistors. What is the maximum amount of power that these two bulbs and one battery can emit in a single circuit?

(a) 18.0 W

(b) 36.0 W

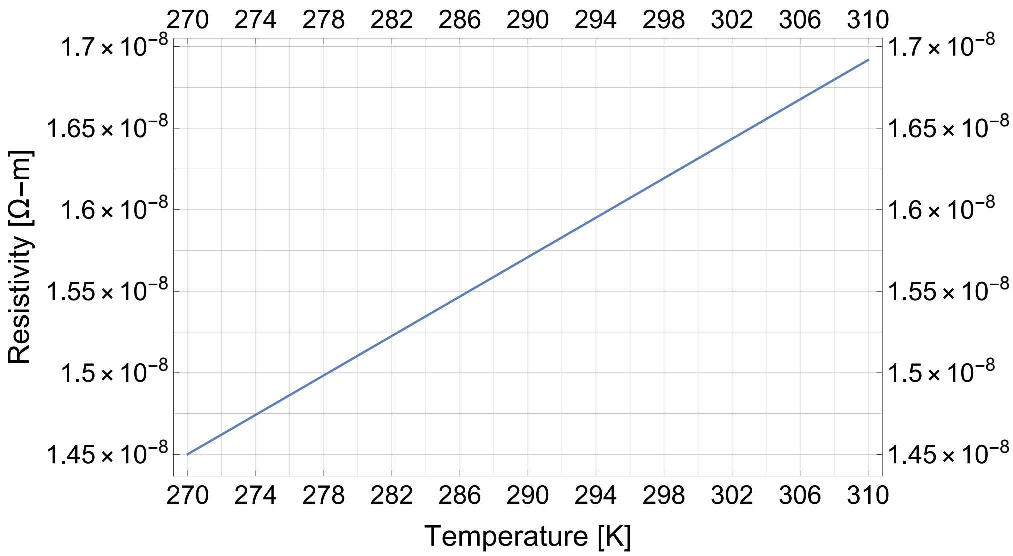
(c) 72.0 W

(d) 144 W

(e) 288 W

Question 3:

The plot below shows the resistivity of a certain conductor as a function of the temperature.



What is the best estimate of this material's temperature coefficient, α? It's impossible to be perfectly precise by eye, but it *is* possible to pick a clear best choice.

(a) 4.2×10^{-4}

(b) 3.8×10^{-3}

(c) 9.7×10^{-3}

(d) 1.5×10^{-2}

(e) 7.2×10^{-2}

Question 4:

Aluminum's resistivity is not exceptional, but it is often chosen for electrical grid wiring because it is relatively light and inexpensive by the standards of conducting metals, making very thick wires feasible. The resistivity of aluminum is about $2.65 \times 10^{-8}\,\Omega$-m. The resistivity of copper is about $1.72 \times 10^{-8}\,\Omega$-m. Thus, copper's resistivity is smaller, but since copper is heavier and more expensive than aluminum, it is not a strictly superior wiring material. What is the cross-sectional area of an aluminum wire that has the same resistance as a $1.0\,\text{cm}^2$ copper wire of the same length?

(a) $0.421\ \text{cm}^2$

(b) $0.649\ \text{cm}^2$

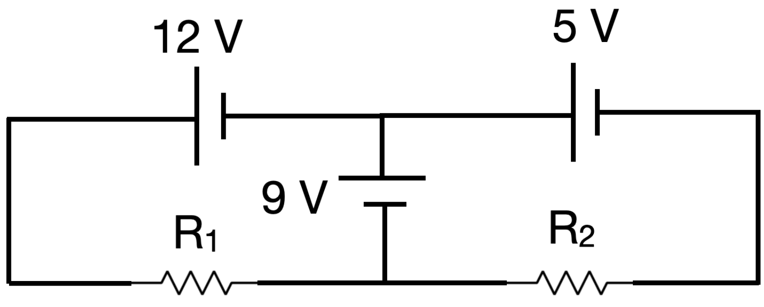
(c) $1.19\ \text{cm}^2$

(d) $1.54\ \text{cm}^2$

(e) $2.37\ \text{cm}^2$

Question 5:

The diagram below shows a circuit with three emfs and two resistors.



If $R_1 = 6\,\Omega$ and $R_2 = 4\,\Omega$, what is the current flowing on the central branch, which has the 9 Volt emf?

(a) 1.0 A

(b) 2.5 A

(c) 3.5 A

(d) 4.5 A

(e) 5.0 A

Question 6:

A capacitor, initially filled with air, is allowed to discharge in an RC circuit. It discharges to half of its initial charge after 2.0 seconds. Then, a dielectric with dielectric constant 3.5 is inserted in the capacitor, and the experiment is repeated. The capacitor is charged back to the original initial charge, and allowed to discharge in the same circuit again. What fraction of the charge is left after 2.0 seconds of discharging with the dielectric inserted?

(a) 0.82

(b) 0.74

(c) 0.63

(d) 0.39

(e) 0.15

Question 7:

Which of the following operations would increase the amount of time required for a capacitor to discharge to half of its initial charge in an RC circuit?

I. Filling the space between the capacitor's plates with a material that has a larger dielectric constant than whatever was originally between the plates.

II. Adding another resistor in series with the existing resistor(s).

III. Charging the capacitor to a larger initial charge.

(a) I only

(b) II only

(c) III only

(d) I and II, but not III

(e) All of I, II, and III

Question 8:

A very long wire carries a 10 A current in the positive y direction, along the y axis, ie $x = 0$. A second identical wire also carries a 10 A current in the positive y direction, but runs along the line $x = 1.0\,\mathrm{m}$. What is the net magnetic field at $x = 2.0\,\mathrm{m}$ due to the wires?

(a) $(-3.0\,\mu\mathrm{T})\hat{z}$

(b) $(-2.5\,\mu\mathrm{T})\hat{z}$

(c) $(+1.0\,\mu\mathrm{T})\hat{z}$

(d) $(+2.5\,\mu\mathrm{T})\hat{z}$

(e) $(+3.0\,\mu\mathrm{T})\hat{z}$

Question 9:

A $2.0\,\mathrm{m}$ wire carries a current $\vec{I} = (+2.0\,\mathrm{A})\hat{y}$. It is subject to an external magnetic field given by $\vec{B} = (2.5\,\mathrm{T})\hat{x} + (-1.2\,\mathrm{T})\hat{y}$. What is the approximate magnitude of the magnetic force on the wire?

(a) 2.4 N

(b) 4.8 N

(c) 5.0 N

(d) 10 N

(e) 11 N

Question 10:

Racecars feeling a stronger downward force have an advantage since the increased frictional forces between their wheels and the ground improve traction. The downward forces on racecars are therefore often restricted by regulatations.

An engineer notices that racing regulations say nothing about using the force of the Earth's magnetic field on a current-carrying wire to add additional downward force. The engineer sets up a sophisticated system that makes a 1000 A conventional current flow east-to-west at all times through an array of wires with total length 25 meters, regardless of the orientation of the car.

At a certain race track, the Earth's magnetic field points due north with strength 52 μT.

What is the downward magnetic force on the car produced by the Earth's magnetic field acting on the engineer's device?

(a) 0.95 N

(b) 1.3 N

(c) 52 N

(d) 92 N

(e) 180 N