Homework Week 5

113-2 General Physics II

Due before 4:10 PM on March 24, 2025

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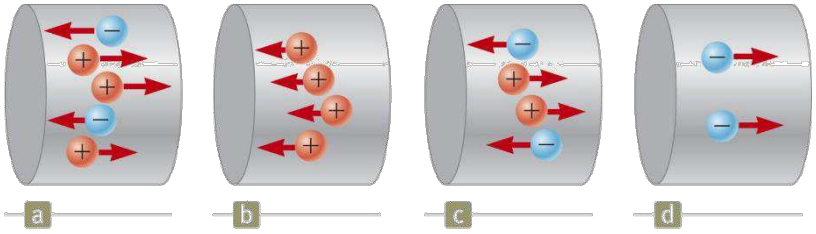
1. [15 points] **Example 26.1 Drift Speed in a Copper Wire**

   The 12-gauge copper wire in a typical residential building. What is the drift speed (v_d) of the electrons in the wire?

   - Cross-sectional area of 3.31×10^{-6} m^2.
   - A constant current of 10.0 A.
   - Each copper atom contributes one free electron to the current.
   - The density of copper is 8.92 g/cm^3.
   - The molecular mass of copper is 63.5 g/mol. \

2. [20 points] **Quick Quiz 26.1**

   Consider positive and negative charges of equal magnitude moving horizontally through the four regions. Rank the current in these four regions from highest to lowest.



3. [20 points] **Example 26.3 The Radial Resistance of a Coaxial Cable**

   Coaxial cables are used extensively for cable television and other electronic applications. (a) Calculate the radial resistance of the plastic between the two conductors. [10 points] (b) Calculate the resistance to that of the inner copper conductor of the cable along the 15.0-cm length. [10 points]

   - Two concentric cylindrical conductors
   - The region between conductors is completely filled with polyethylene plastic
   - Unwanted current leakage through the plastic, in the *radial* direction
   - a = 0.500 cm, b = 1.75 cm, L = 15.0 cm. The resistivity of the plastic is 1.0×10^{13} Ω • m.

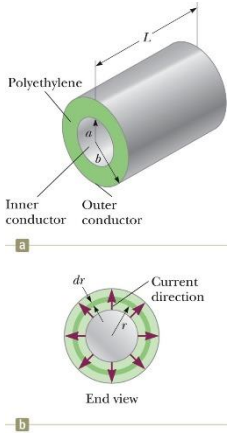


Table 27.2 Resistivities and Temperature Coefficients of Resistivity for Various Materials

Material	Resistivity[a] ($\Omega \cdot m$)	Temperature Coefficient[b] α $[(°C)^{-1}]$
Silver	1.59×10^{-8}	3.8×10^{-3}
Copper	1.7×10^{-8}	3.9×10^{-3}

4. [20 points] **Example 26.4 Power in an Electric Heater**

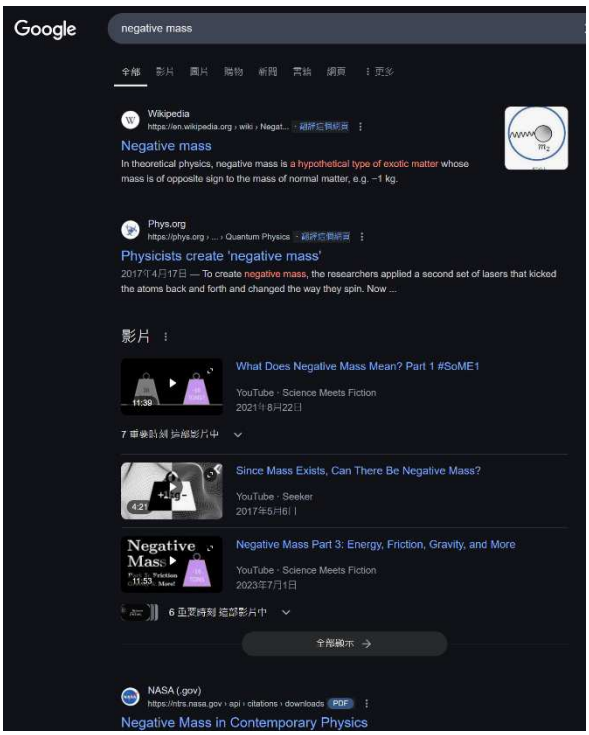
   An electric heater is constructed by applying a potential difference of 120 V across a Nichrome wire that has a total resistance of 8.00 Ω. Find (a) the current carried by the wire [10 points] and (b) the power rating of the heater. [10 points]

5. [25 points] (A) 重複 HW Week 2 最後一題的問題。[5 points] (B) Google 搜尋關鍵字 or 查閱維基有無文章 (注意維基不見得正確)。[20 points]

   螢幕截圖或照相，線上繳交。如前面手寫，可分開繳交。

答案範例:

1. 庫侖力的形式與牛頓重力相似，電荷有正負之分，質量有正負之分嗎，有的話會發生什麼事?
2. (中英皆可)



1. $I_{avg} = n q A v_d$

$$\Rightarrow v_d = \frac{I_{avg}}{n q A}$$

$$= \frac{I_{avg}}{\frac{N_A \rho}{M} q A}$$

$$= \frac{I_{avg} M}{q A N_A \rho}$$

$$= \frac{(10\ A)(0.0635\ kg/mol)}{(1.6 \times 10^{-19}\ C)(3.31 \times 10^{-6}\ m^2)(6.02 \times 10^{23}\ 1/mol)(8920\ kg/m^3)}$$

$$= 2.23 \times 10^{-4}\ (m/s)$$

#

2. $I = \frac{dQ}{dt} \propto dQ$

(a) > (b) = (c) > (d)

3. (1) $dR = \frac{\rho\, dr}{A} = \frac{\rho}{2\pi r L}\, dr$

$\int \frac{dx}{x} = \ln|x| + C$

$\Rightarrow R = \int dr = \frac{\rho}{2\pi L} \ln\left(\frac{b}{a}\right)$

$= \frac{1\times10^{13}\ (\Omega\cdot m)}{2\pi\,(0.15\ m)} \ln\left(\frac{1.95\ cm}{0.5\ cm}\right)$

$= 1.33 \times 10^{13}\ (\Omega)$ #

(2) $R_{Cu} = \rho \frac{l}{A}$

$= (1.7\times10^{-8}\ \Omega\cdot m)\left[\frac{0.15\ m}{\pi(5\times10^{-3}\ m)^2}\right]$

$= 3.2 \times 10^{-5}\ (\Omega)$ #

4. (1) $I = \frac{V}{R} = \frac{120}{8} = 15\ (A)$ #

(2) $P = IV = 15 \times 120 = 1800\ (W)$ #

5. What happened to the "room temperature superconductor", LK-99?

LK-99

Article Talk

From Wikipedia, the free encyclopedia

LK-99 (from the **Lee-Kim 1999** research),[2] also called **PCPOSOS**,[3] is a gray–black, polycrystalline compound, identified as a copper-doped lead-oxyapatite. A team from Korea University led by Lee Sukbae (이석배) and Kim Ji-Hoon (김지훈) began studying this material as a potential superconductor starting in 1999.[4]:1 In July 2023, they published preprints claiming that it acts as a room-temperature superconductor[4]:8 at temperatures of up to 400 K (127 °C; 260 °F) at ambient pressure.[2][5][4]:1

Many different researchers have attempted to replicate the work, and were able to reach initial results within weeks, as the process of producing the material is relatively straightforward.[6] By mid-August 2023, the consensus[1] was that LK-99 is not a superconductor at room temperature, and is an insulator in pure form.[7][8][9]

As of 12 February 2024, no replications had gone through the peer review process of a journal, but some had been reviewed by a materials science lab. A number of replication attempts identified non-superconducting ferromagnetic and diamagnetic causes for observations that suggested superconductivity. A prominent cause was a copper sulfide impurity[10] occurring during the proposed synthesis, which can produce resistance drops, lambda transition in heat capacity, and magnetic response in small samples.[11][12][10][13][14][15][16]

After the initial preprints were published, Lee claimed they were incomplete,[17] and coauthor Kim Hyun-Tak (김현탁) said one of the papers contained flaws.[18]