Problems 25.32,56,62 (25.40) from MasteringPhysics (and text).

25.32

Consider the circuit shown in the figure. The terminal voltage of the 24.0 V battery is 21.2 V. The current in the circuit is 4.00 A.

Part A

What is the internal resistance r of the battery?

Part B

What is the resistance R of the circuit resistor?

25.56

A 2.0m length of wire is made by welding the end of a 120-cm-long silver wire to the end of an 80-cm-long copper wire. Each piece of wire is 0.60 mm in diameter. The wire is at room temperature. A potential difference of 5.0 V is maintained between the ends of the 2.0m composite wire.

Part A

What is the current in the copper section?

Part B

What is the current in the silver section?

Part C

What is the magnitude of $\vec{E}$ in the copper?

Part D

What is the magnitude of $\vec{E}$ in the silver?

Part E

What is the potential difference between the ends of the silver section of wire?

25.62

A rectangular block of metal of resistivity rho has dimensions $d \times 2d \times 3d$. A potential difference V is to be applied between two opposite faces of the block.

Part A

To which two faces of the block should the potential difference be applied to give the maximum current density?

Part B

What is this maximum current density?

Part C

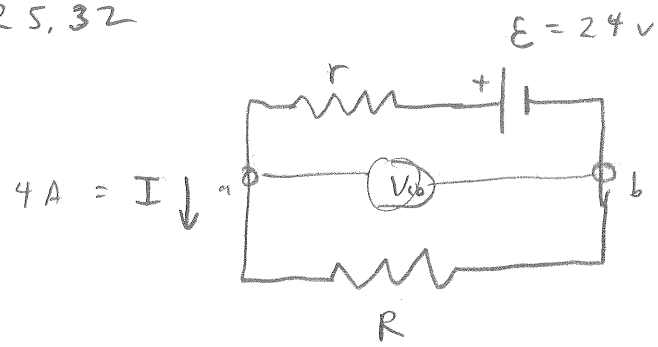
To which two faces of the block should the potential difference be applied to give the maximum current?

Part D

What is this maximum current?

25.40 - from Text Book

25.32

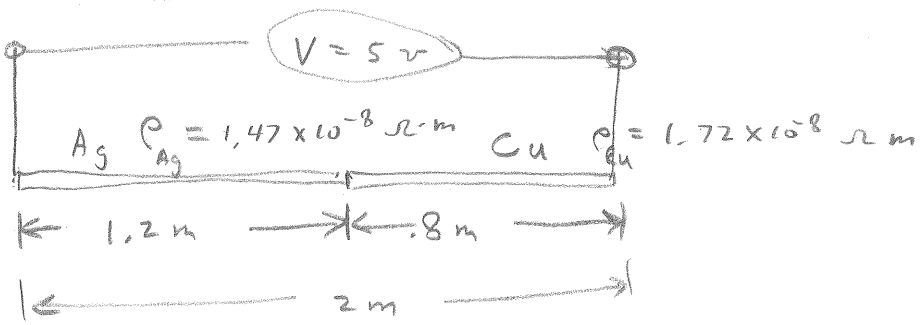


$V_{ab} = 21.2\,v$

a) $V_{ab} = \mathcal{E} - Ir \Rightarrow r = \dfrac{\mathcal{E} - V_{ab}}{I} = \dfrac{(24 - 21.2)\,v}{4\,A} = \boxed{0.7\,\Omega}$

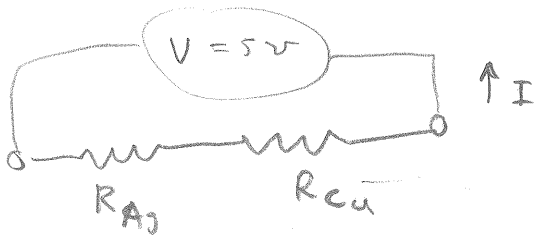
b) $V_{ab} = RI \Rightarrow R = \dfrac{V_{ab}}{I} = \dfrac{21.2\,V}{4\,A} = \boxed{5.3\,\Omega}$

25.56



a)

dia = 0.6 mm



$$V = IR_{Ag} + IR_{Cu} \Rightarrow I = \frac{V}{R_{Ag} + R_{Cu}} = \frac{V}{\dfrac{\rho_{Ag} L_{Ag}}{\frac{\pi d^2}{4}} + \dfrac{\rho_{Cu} L_{Cu}}{\frac{\pi d^2}{4}}}$$

$$\Rightarrow I = \frac{\pi d^2}{4} \frac{V}{\rho_{Ag} L_{Ag} + \rho_{Cu} L_{Cu}}$$

$$= \frac{\pi (0.6 \times 10^{-3}\,m)^2}{4} \frac{5\,v}{1.47 \times 10^{-8}\,\Omega m\,(1.2\,m) + 1.72 \times 10^{-8}\,\Omega m\,(.8\,m)}$$

$$\simeq \boxed{45.0\,A}$$

25.56 b) $$I_{Ag} = I_{Cu} = I = \boxed{45.0\ A}$$

c) $$E_{Cu} = \rho_{Cu} J = \rho_{Cu} \frac{I}{\left(\frac{\pi d^2}{4}\right)} = \frac{1.72 \times 10^{-8}\ \Omega m \quad 45\ A \quad (4)}{\pi \left(0.6 \times 10^{-3}\ m\right)^2}$$

$$= \boxed{2.74\ \frac{V}{m}}$$

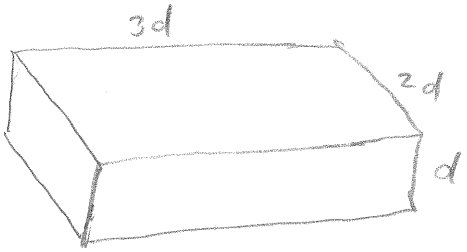
d) $$E_{Ag} = \rho_{Ag} J = \frac{\rho_{Ag}}{\rho_{Cu}} E_{Cu} = \left(\frac{1.47}{1.72}\right) 2.737465\ \frac{V}{m}$$

$$\simeq \boxed{2.34\ \frac{V}{m}}$$

e) $$V_{Ag} = E_{Ag} L_{Ag} = \left(2.34076\ \frac{V}{m}\right)(1.2\ m)$$

$$\simeq \boxed{2.81\ V}$$

25.62



a)

$$E = \rho J \Rightarrow \frac{V}{\ell} = \rho J \Rightarrow J = \frac{V}{\ell}\frac{1}{\rho}$$

$$\Rightarrow J_{max} = \frac{V}{\ell_{min}}\frac{1}{\rho} \Rightarrow \boxed{3d \times 2d \text{ face}} \quad \boxed{d \text{ apart}}$$

b) $$J_{max} = \boxed{\frac{V}{d}\frac{1}{\rho}}$$

c) $$E = \rho J \Rightarrow \frac{V}{\ell} = \rho\frac{I}{A} \Rightarrow I = \frac{V}{\ell}\frac{A}{\rho}$$

$$\Rightarrow I_{max} = \frac{V A_{max}}{\ell_{min}\rho} \Rightarrow \boxed{3d \times 2d \text{ face}} \quad \boxed{d \text{ apart}}$$

d) $$I_{max} = \frac{V(3d)(2d)}{d}\frac{}{\rho} = \boxed{\frac{6Vd}{\rho}}$$

25.40

Not Ohmic