PHYS 102:General PhysicsII **KOÇ UNIVERSITY** **Spring Semester 2012**

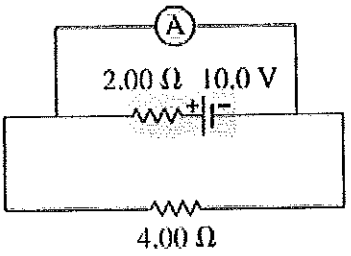
College of Sciences

Section 1 **Quiz 5** **15 March 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: **Student ID:** **Signature:**

An idealized ammeter is connected to a battery as shown in the figure. Find (a) the reading of the ammeter, and (b) the current through the $4\,\Omega$ resistor.



(a) and (b)

Since the ammeter is ideal it has no resistance, so the current will only circulate at the upper circuit. Therefore the current at $R = 4\,\Omega$ would be zero.

$$I_{ammeter} = \frac{V}{R_{total}} = \frac{10}{2+0} = \frac{10}{2} = 5\,A$$

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Section 2 Quiz 5 15 March 2012

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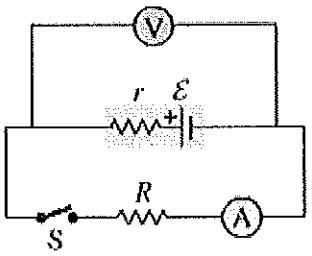
Quiz duration: 15 minutes

Name: Student ID: Signature:

When switch S is open, the voltmeter of the battery reads "x". When the switch is closed, the voltmeter reading drops to "y", and the ammeter reads "z". Find the emf, and the circuit resistance R in terms of x, y and z.



$\mathcal{E} = ?$

$R = ?$

S is open $\Rightarrow$ $V = \mathcal{E} - Ir$

since the circuit is open we have $I = 0$

$\Rightarrow$ $V = \mathcal{E}$

$\Rightarrow$ $\boxed{\mathcal{E} = x}$

S is closed : $V = \mathcal{E} - Ir$ and $\begin{cases} V = y \\ I = z \end{cases}$

$\Rightarrow$ $\boxed{y = \mathcal{E} - zr}$ (1)

also : $R = \frac{V}{I} = \frac{y}{z}$ $\Rightarrow$ $\boxed{R = \frac{y}{z}}$

And : $I = \frac{\mathcal{E}}{R+r}$ $\Rightarrow$ $z = \frac{x}{\frac{y}{z} + r}$ $\Rightarrow$ $x = z\left(\frac{y}{z} + r\right)$

$\Rightarrow$ $x = y + zr$ $\Rightarrow$ $\boxed{r = \frac{x-y}{z}}$ (2)

(1) & (2) $\Rightarrow$ $\mathcal{E} = y + zr = y + z\left(\frac{x-y}{z}\right) = y + x - y = x$ $\Rightarrow$ $\boxed{\mathcal{E} = x}$

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Section 3 **Quiz 5** **15 March 2012**

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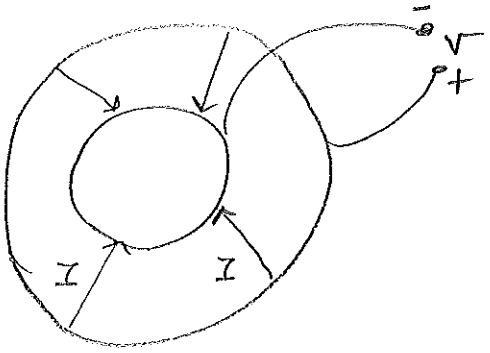
Quiz duration: 15 minutes

Name: **Student ID:** **Signature:**

The region between two concentric conducting spheres with radii "*a*" and "*b*" is filled with a conducting material with resistivity "*c*". Show that the resistance between the spheres is given by $R = c(b-a)/(4\,a\,b\,\pi)$.



According to the figure the current will flow radially inward.

Take the resistance element dR as an spherical shell of thickness dr and surface A.

$$dR = \rho \frac{\ell}{A}$$

$$\begin{cases} \rho = c \\ \ell = dr \\ A = 4\pi r^2 \end{cases} \Rightarrow dR = \rho \frac{\ell}{A} = c \frac{dr}{4\pi r^2}$$

$$\Rightarrow R = \int_a^b dR = \frac{c}{4\pi} \int_a^b \frac{dr}{r^2} = \frac{-c}{4\pi} \left[\frac{1}{r}\right]_a^b$$

$$\Rightarrow R = \frac{-c}{4\pi} \left(\frac{1}{b} - \frac{1}{a}\right) = \frac{c}{4\pi} \left(\frac{1}{a} - \frac{1}{b}\right)$$

$$\Rightarrow R = \frac{c}{4\pi} \frac{b-a}{ab}$$

$$\Rightarrow \boxed{R = \frac{c(b-a)}{4ab\pi}}$$

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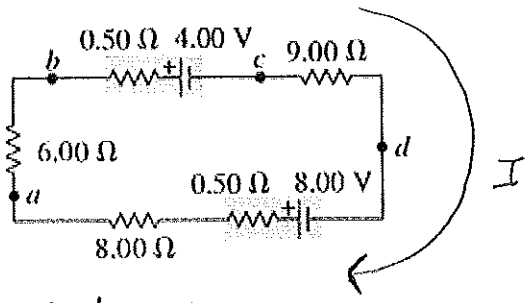
Section 4 **Quiz 5** **15 March 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: **Student ID:** **Signature:**

What is the potential difference *V(a)-V(d)?*



First we need to calculate the current. Specify an arbitrary direction for current such as the one shown above.

Start from any point say "a" and circulate in the direction of current:

$$V(a) - 6I - 0.5I - 4 - 9I + 8 - 0.5I - 8I = V(a)$$

$$\Rightarrow \quad -24I + 4 = 0$$

$$\Rightarrow \quad \boxed{I = \frac{4}{24} = \frac{1}{6}\ A > 0}$$

$\Rightarrow$ The direction we have chosen is correct.

$$V(a) + 8I + 0.5I - 8 = V(d)$$

$$I = \frac{1}{6}\ A \Rightarrow V(a) - V(d) = 8 - 8.5 \times \frac{1}{6} = 6.5\ V$$

$$\Rightarrow \boxed{V(a) - V(d) = 6.5\ V}$$

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Section 5 **Quiz 5** **15 March 2012**

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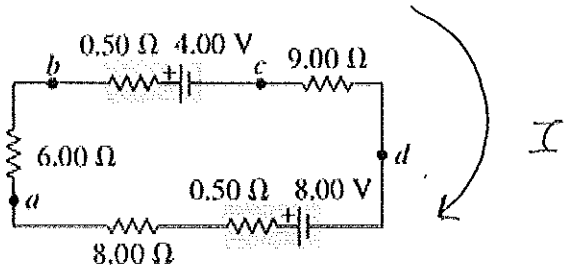
Quiz duration: 15 minutes

Name: **Student ID:** **Signature:**

What is the potential difference *V(b)-V(d)*?



. First calculat current. Choose an arbitrary direction for I. Start from a certain point say "a" and circulat along the direction of current.

$V(a) - 6I - 0.5I - 4 - 9I + 8 - 0.5I - 8I = V(a)$

$-24I + 4 = 0 \Rightarrow \boxed{I = \frac{1}{6}\ A > 0} \Rightarrow$ The direction of I is correct.

$V(b) - 0.5I - 4 - 9I = V(d)$

$I = \frac{1}{6}$

$\Rightarrow V(b) - V(d) = 9.5I + 4 = 9.5 \times \frac{1}{6} + 4$

$\Rightarrow \boxed{V(b) - V(d) = 5.58\ V}$