**Answer on Question 61344, Physics, Electromagnetism**

**Question:**

15) A battery has emf $13.2\,V$ and internal resistance $24\,m\Omega$. If the load current is $20.0\,A$, find the terminal voltage of the battery:

a) $12.7\,V$

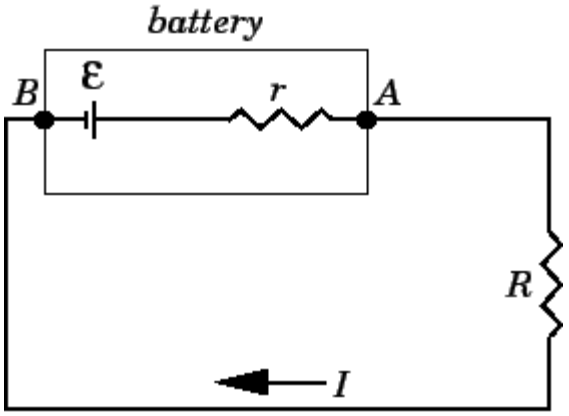
b) $14.5\,V$

c) $16.8\,V$

d) $17.7\,V$

**Solution:**

Let's consider a source of electromotive force (the battery) connected to a resistance $R$ through which a steady current $I$ flows as shown in the picture bellow:




here, $\mathcal{E}$ is the electromotive force of the battery; $A$ and $B$ is the positive and negative terminals of the battery, respectively; $R$ is the resistance connected to the battery; $r$ is the internal resistance of the battery.

Let's denote the potential difference across the resistance $R$ as $V$ and the potential drop across the battery as $V_r$. Then, we can write the formula for the electromotive force of the battery:

$$\mathcal{E} = V + V_r.$$

Or

$$V = \mathcal{E} - V_r.$$

We can find $V_r$ from the Ohm's law:

$$V_r = Ir.$$

Let's substitute $V_r$ into the previous formula:

$$V = \mathcal{E} - Ir,$$

here, $V$ is the terminal potential difference of the battery or the terminal voltage of the battery (because we measured it across the terminals $A$ and $B$).

Let's substitute the numbers:

$$V = \mathcal{E} - Ir = 13.2\,V - 20.0\,A \cdot 24 \cdot 10^{-3}\Omega = 12.7\text{ V}.$$

**Answer:**

$V = 12.7$ V.

16) Electrical energy is sold by PHCN in units of kilowatt-hour ($kWh$). The lighting of a house is done with five $60\,W$ bulbs which are swithed on for approximately three hours per day. What is the lighting bill for the household over a period of 30 days at the rate of $N1.20$ per kilowatt-hour?

a) $N1.50$

b) $N25.30$

c) $N32.40$

d) $N52.20$

**Solution:**

Let's first calculate the total energy used by 5 bulbs which are switched on for approximately three hours per day:

$$E = nPt,$$

here, $n$ is the number of bulbs, $P = 0.06\,kW$ is the power used by the one bulb, $t$ is the time.

Let's substitute the numbers:

$$E = nPt = 5 \cdot 0.06\ kW \cdot 3\ \frac{h}{day} = 0.9\ \frac{kWh}{day}.$$

Finally, we can calculate the lighting bill for the household over a period of 30 days at the rate of $N1.20$ per kilowatt-hour:

$$Lightning\ Bill = Rate \cdot Days \cdot E = N1.20\ \frac{\$}{kWh} \cdot 30\ days \cdot 0.9\ \frac{kWh}{day} = N32.40.$$

**Answer:**

c) $N32.40$