411.

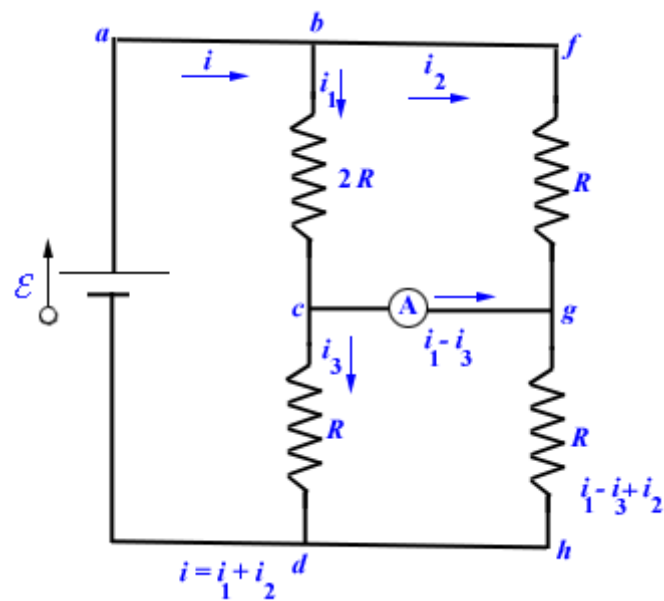## Problem 33.33 (RHK)

In the circuit shown in the figure, we have to find the current flowing through the ammeter A, assuming that A has zero resistance.

Solution:

It is a multi-loop circuit. We have indicated currents in different branches of the circuit by taking care of conservation of charge. We have three unknown currents, i, i_1 and i_3, as $i_2 = i - i_1$.

Considering the circuit *abcde* and applying Kirchoff's law, we get

$$-2Ri_1 - i_3R + \mathrm{E} = 0,$$

or

$$2Ri_1 + i_3R = \mathrm{E}.$$

Applying Kirchoff's law to loops *bfgc* and *cghd*, we get

$$-(i - i_1)R + 2Ri_1 = 0, \text{ or } i_1 = \frac{i}{3},$$

and

$$-(i - i_3)R + i_3R = 0, \text{ or } i_3 = \frac{i}{2}.$$

We now have three linear equations connecting i_1, i_3 and i. We solve them and find

$$i = \frac{6}{7}\frac{\mathrm{E}}{R}, \ i_1 = \frac{2}{7}\frac{\mathrm{E}}{R}, \text{ and } i_3 = \frac{3}{7}\frac{\mathrm{E}}{R}.$$

Therefore, the current in the ammeter, $|i_1 - i_3|$, will be

$$\frac{3}{7}\frac{\mathrm{E}}{R} - \frac{2}{7}\frac{\mathrm{E}}{R} = \frac{\mathrm{E}}{7R}.$$