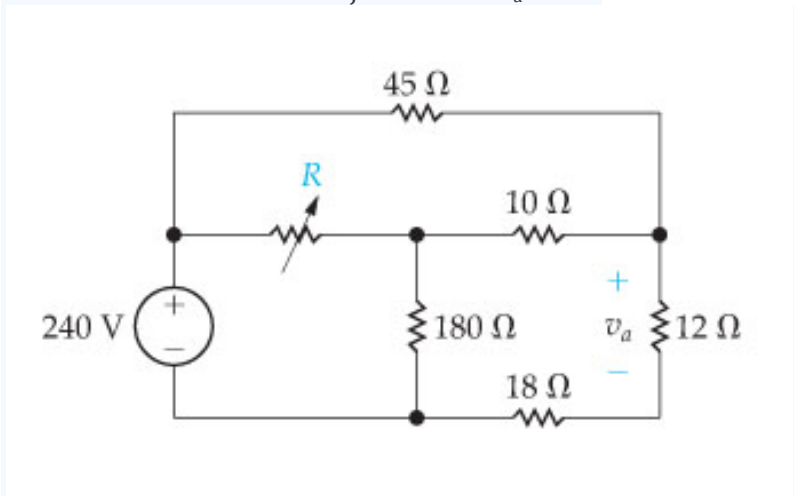
Problem 2.24

The variable resistor R is adjusted until $v_a = 60V$



Find the value of R

Express your answer to two significant figures and include the appropriate units.

Solution:

The current through the 12 Ohm resistor is 60V/12 Ohm = 5A

The voltage across the 18 ohm resistor is therefore: 18 Ohm * 5A = 90V

KVL around the large loop gives:

240 V – 45 * I (45 ohm) -60 – 90 = 0

I (45 ohm) = 2 A

KCL at the node above the 12 ohm resistor now gives:

I (10 ohm) + I (45 ohm) = I (12 ohm)

I (10 ohm) = 5 A – 2 A = 3A

The voltage drop going from left to right across the 10 ohm resistor is then:

V = IR = 3A*10Ohm = 30V

KVL around the rightmost loop gives the voltage across the 180 ohm resistor:

V (180 Ohm) – V (10ohm) – 60 -90 = 0

V (180 Ohm) = 180 V

KCL gives the current through the variable resistor R:

I (variable resistor) = I (10 ohm) + I (180 ohm) = 3 A + 180/180 = 4A

Ohm's law gives the value of the variable resistor R:

(240V – 180V) = 4A * R

R = 15 Ohm