ELEMENTS OF ELECTRICAL ENGINEERING

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Numerical Examples on Superposition Theorem

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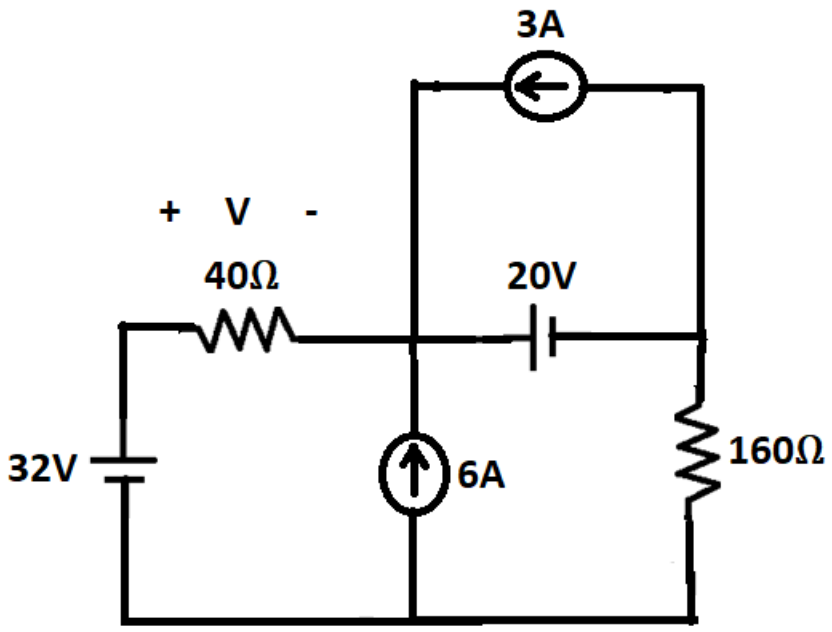
Numerical Example 1

Question:

Obtain voltage ‘V’ using Superposition Theorem.



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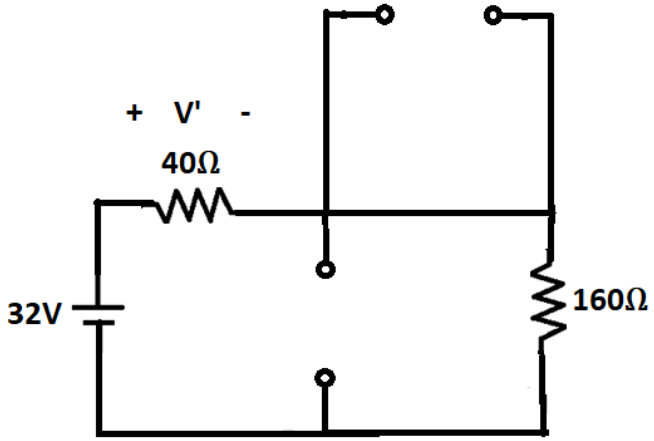
Numerical Example 1

Solution :

Considering 32V source alone,

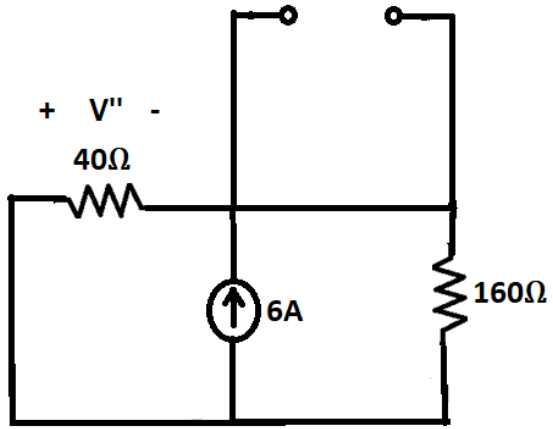


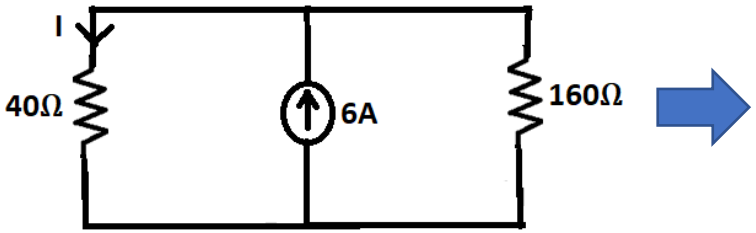
$$V' = 32V * \frac{40\Omega}{200\Omega} = 6.4V$$

Numerical Example 1

Solution (Continued..) :

Considering 6A source alone,





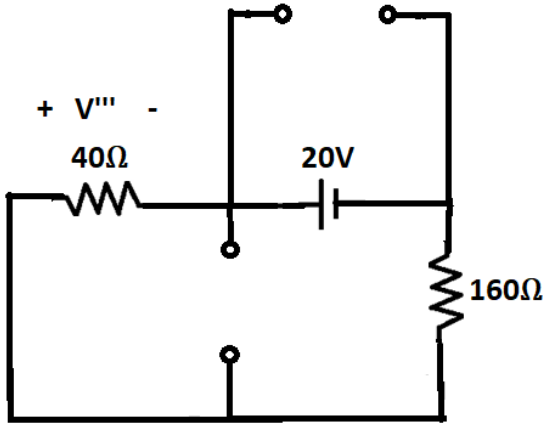
$$I = 6A * \frac{160\Omega}{200\Omega} = 4.8A$$

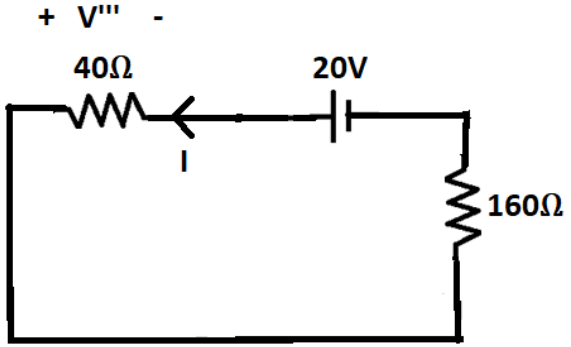
$$V'' = -4.8A * 40\Omega = -192V$$

Numerical Example 1

Solution (Continued..) :

Considering 20V source alone,





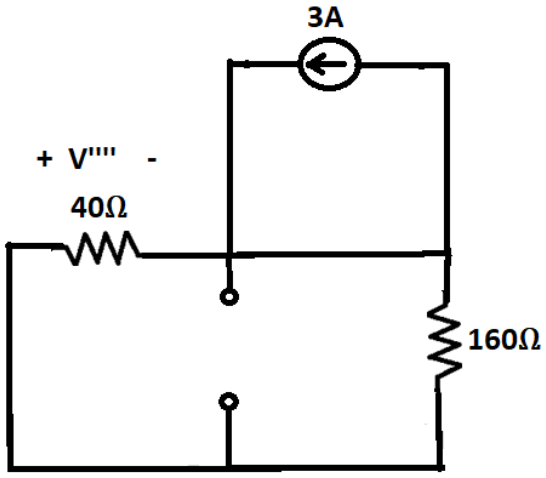
$$I = \frac{20V}{200\Omega} = 0.1A$$

$$V''' = -0.1A * 40\Omega = -4V$$

Numerical Example 1

Solution (Continued..) :

Considering 3A source alone,



$V'''' = 0$

By Superposition Theorem,

$V = V' + V'' + V''' + V'''' = -189.6V$

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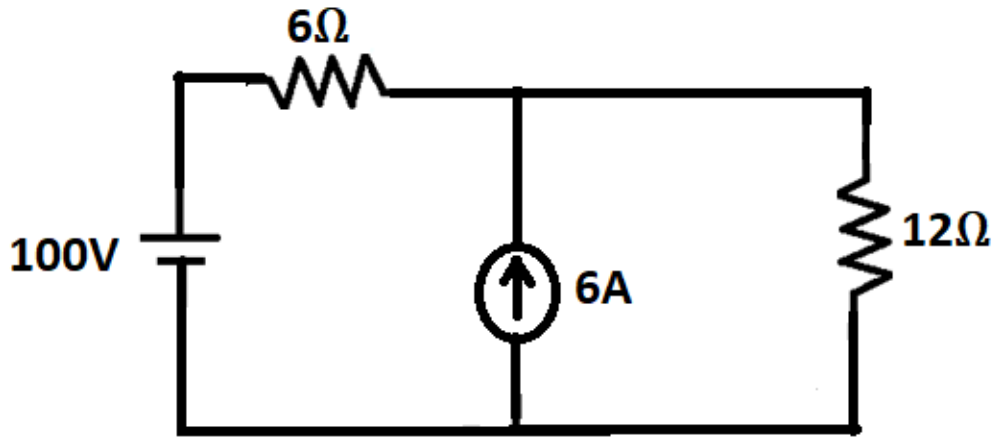
Numerical Example 2

Question:

Find the power absorbed by 12Ω resistor using Superposition Theorem.



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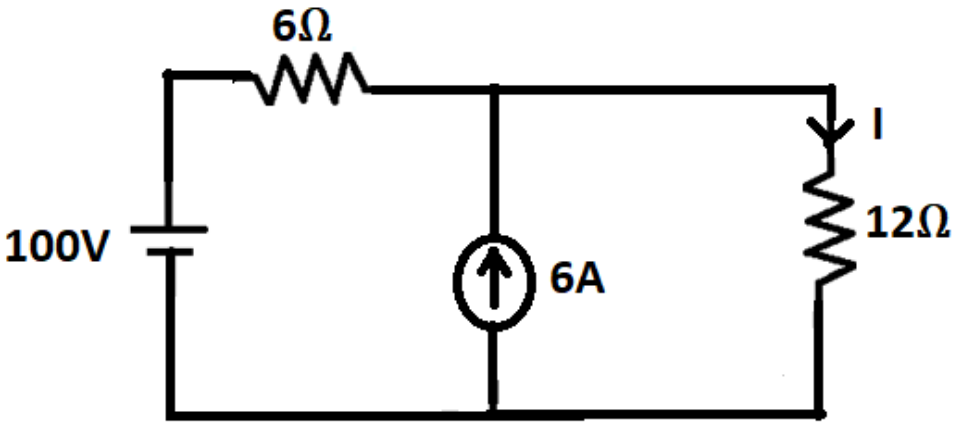
Numerical Example 2

Solution :



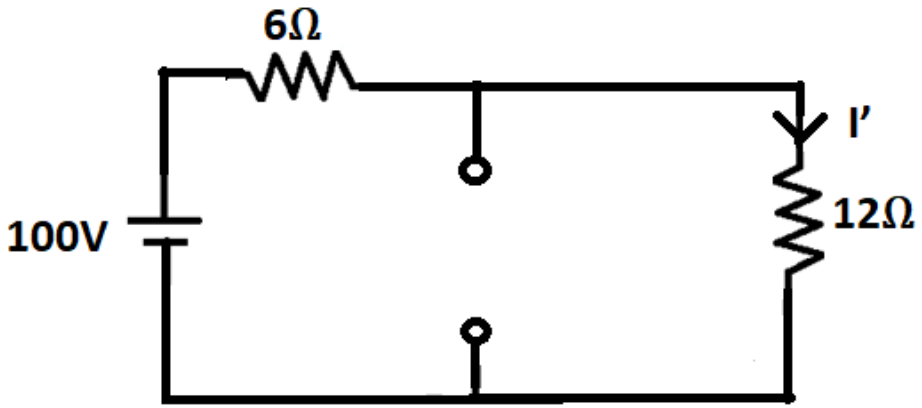
Let us consider individual current & Power responses due to 100V source acting alone as I′ & P’

Let us consider individual current & Power responses due to 6A source acting alone as I″ & P’’

Numerical Example 2

Solution (Continued..) :

Considering 100V source alone,

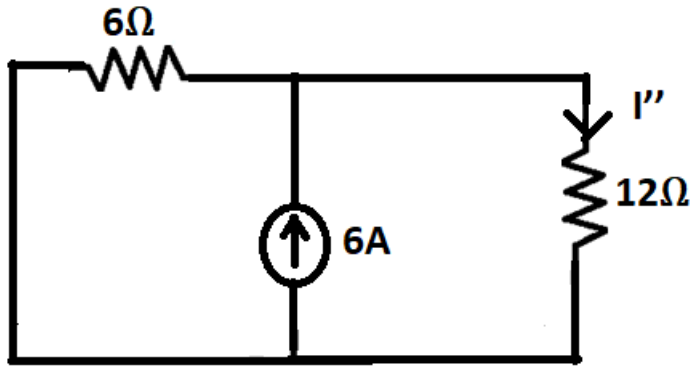


$$I' = \frac{100V}{18\Omega} = 5.56A \quad \& \quad P' = (I')^2 * 12 = 370.96W$$

Numerical Example 2

Solution (Continued..) :

Considering 6A source alone,



$I'' = 6A * \frac{6\Omega}{18\Omega} = 2A$ & $P'' = (I'')^2 * 12 = 48W$

Numerical Example 2

Solution (Continued..) :

By Superposition, current in 12Ω resistor = I = I’ + I’’ = 7.56A

Hence, Power absorbed by 12Ω resistor = I^2*12 = 685.84W

Adding the individual Power responses, P’ + P’’ = 418.96W, which is not equal to the actual power absorbed.

Hence, individual power responses cannot be superposed to get total power because power is a quadratic term.

Thus, to get total power response, apply superposition principle to get total current or total voltage & using that find the power.

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Text Book & References

Text Book:

"Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 11th Edition, Pearson Education, 2012.

Reference Books:

1. "Basic Electrical Engineering", K Uma Rao, Pearson Education, 2011.
2. "Basic Electrical Engineering - Revised Edition", D. C. Kulshreshta, Tata- McGraw-Hill, 2012.
3. "Engineering Circuit Analysis", William Hayt Jr., Jack E. Kemmerly & Steven M. Durbin, 8th Edition, McGraw-Hill, 2012.

THANK YOU

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