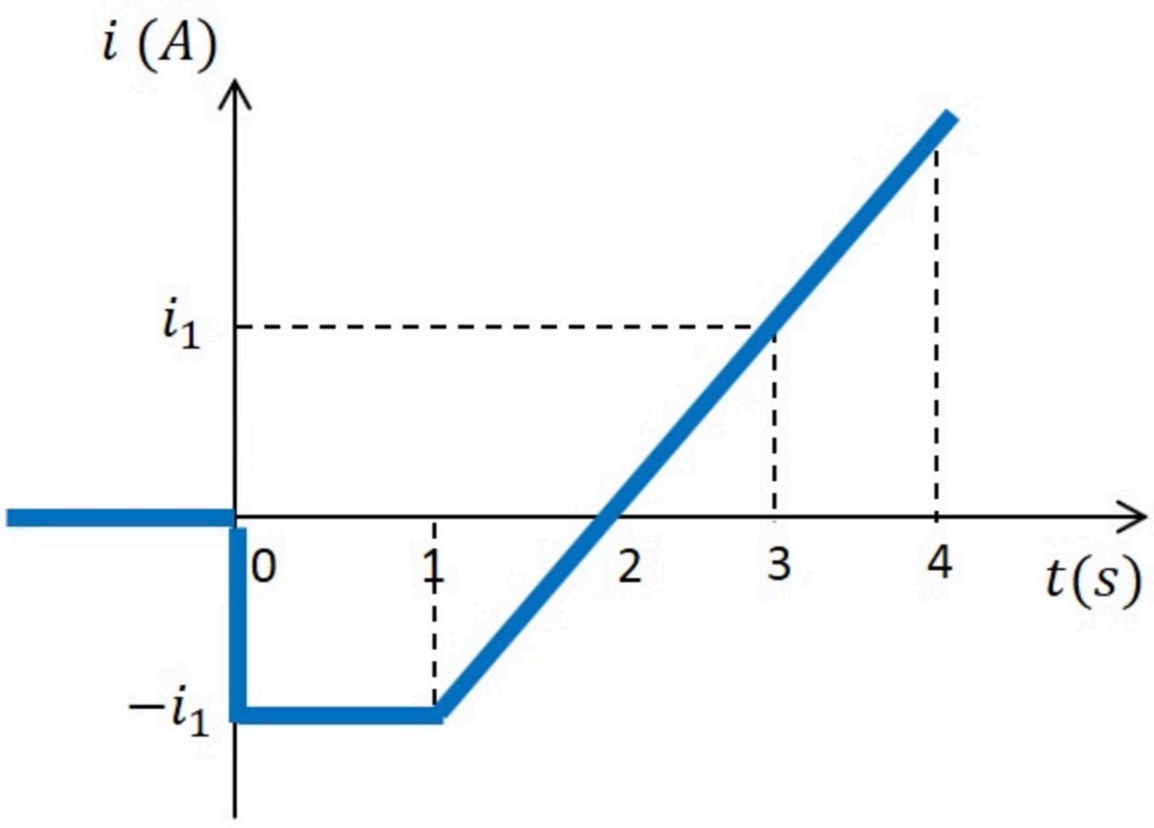
Basic concepts 001

Problem has been graded.

The curve shows the current flowing through a circuit element. Find the net charge q that has entered the element from t = 0 s to t = 4 s.



Given Variables:

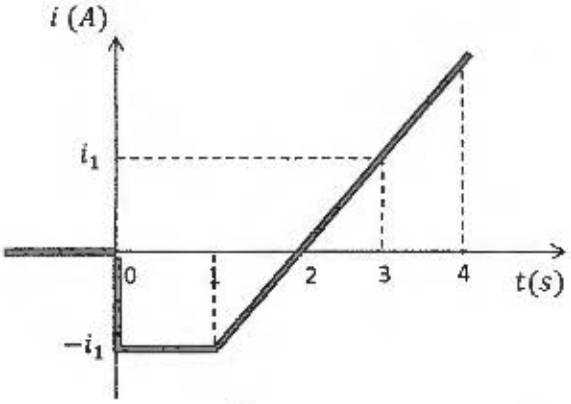
i_1 : 8 mA

Calculate the following:

q (C) :

Hint: Check the units.

The curve shows the current flowing through a circuit element. Find the net charge q that has entered the element from t = 0 s to t = 4 s.



i1 = 4 mA

$$q = \int_0^4 i(t)\,dt = \left(-i_1 \cdot 1\right) + \left(\frac{-i_1 \cdot 1}{2}\right) + \left(\frac{i_1 \cdot 1}{2}\right) + \left(i_1 \cdot 1 + \frac{i_1 \cdot 1}{2}\right)$$

$$= \frac{i_1}{2}$$

$$= \frac{4 \cdot 10^{-3}}{2}$$

$$\boxed{q = 0.002\ C}$$

Basic concepts 002

Problem has been graded.

Determine the values of B1, B2 and B3.

The current through a circuit element is

$$i(t) = A1 \cdot e^{\frac{t}{A2}} \quad \text{for } t \geq 0$$
$$= 0 \quad \text{for } t < 0$$

The total charge that has entered the circuit element can be represented as

$$q(t) = B1 + B2 \cdot e^{\frac{t}{B3}} \quad \text{for } t \geq 0$$
$$= 0 \quad \text{for } t < 0$$

Given Variables:

A1 : 4 A

A2 : -3 s

Calculate the following:

B1 (C) :

B2 (C) :

B3 (s) :

The current through a circuit element is

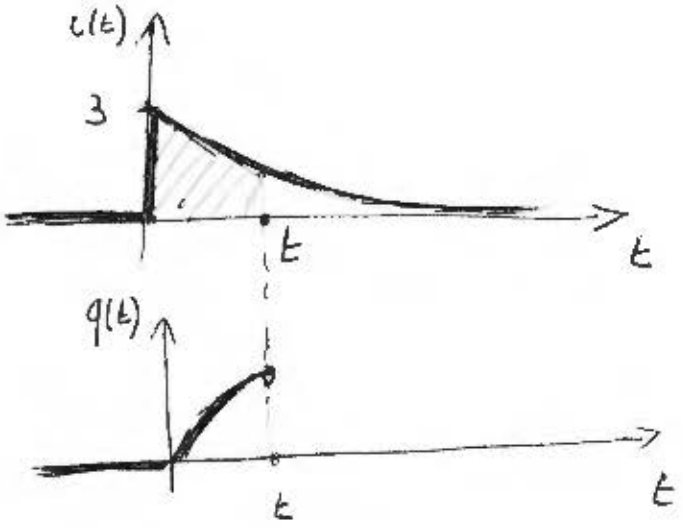
$$i(t) = A1 \cdot e^{\frac{t}{A2}} \quad \text{for } t \geq 0$$
$$= 0 \quad \text{for } t < 0$$

A1 = 3 A

A2 = -2 s

The total charge that has entered the circuit element can be represented as

$$q(t) = B1 + B2 \cdot e^{\frac{t}{B3}} \quad \text{for } t \geq 0$$
$$= 0 \quad \text{for } t < 0$$



at any time t: $q(t)$ is the integral of $i(t)$ up until time t

$$q(t) = \int_{-\infty}^{t} i(u)\,du = \int_{0}^{t} 3e^{-\frac{u}{2}}\,du$$

$$= 3(-2)\int_{0}^{t} e^{-\frac{u}{2}}\,d\left(-\frac{u}{2}\right) = -6\, e^{-\frac{u}{2}}\Big|_{0}^{t} = -6\left(e^{-\frac{t}{2}} - 1\right)$$

$$\boxed{q(t) = 6 - 6e^{-\frac{t}{2}}}$$

$B_1 = 6\ C$

$B_2 = -6\ C$

$B_3 = -2\ s$

Basic concepts 003

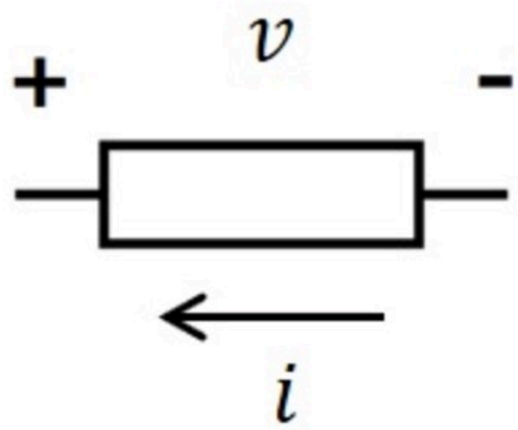
Problem has been graded.

Find the energy received by this element between time t = 0 and t = T1.

For this element

$$v(t) = 2\pi \cdot \cos(A1 \cdot \pi \cdot t) \qquad \text{V}$$

$$i(t) = A2 \cdot \sin(A1 \cdot \pi \cdot t)$$



(Note: *Hz* is the unit used for frequency. It is equal to s^{-1})

Given Variables:

A1 : 5 Hz

A2 : 3 A

T1 : 2.5 s

Calculate the following:

E (J) :

Hint: Are we using passive sign convention?

Find the energy received by this element between time t = 0 and t = T1.

For this element

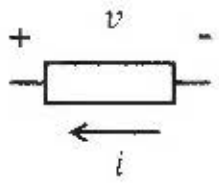
$$v(t) = 2\pi \cdot \cos(A1 \cdot \pi \cdot t) \quad V$$

$$i(t) = A2 \cdot \sin(A1 \cdot \pi \cdot t)$$

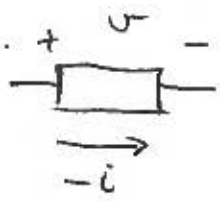
A1 = 1 Hz

A2 = 5 A

T1 = 1.5 s



(Note: Hz is the unit used for frequency. It is equal to s^{-1})



for passive sign convention ⇒ gives power received

$$p(t) = v(t) \cdot (-i(t)) = -2\pi \cos(\pi t) \cdot 5 \sin(\pi t)$$

$$= -10\pi \sin(\pi t)\cos(\pi t) = -5\pi \sin(2\pi t)$$

$$E = \int_0^{1.5} p(t)\,dt = -5\pi \int_0^{1.5} \sin(2\pi t)\,dt = \frac{-5\pi}{2\pi} \int_0^{1.5} \sin(2\pi t)\,d(2\pi t)$$

$$= -\frac{5}{2}\left(-\cos(2\pi t)\right)_0^{1.5}$$

$$= -2.5\left(-\cos(3\pi t) + 1\right)$$

$$= -2.5\left(-(-1) + 1\right)$$

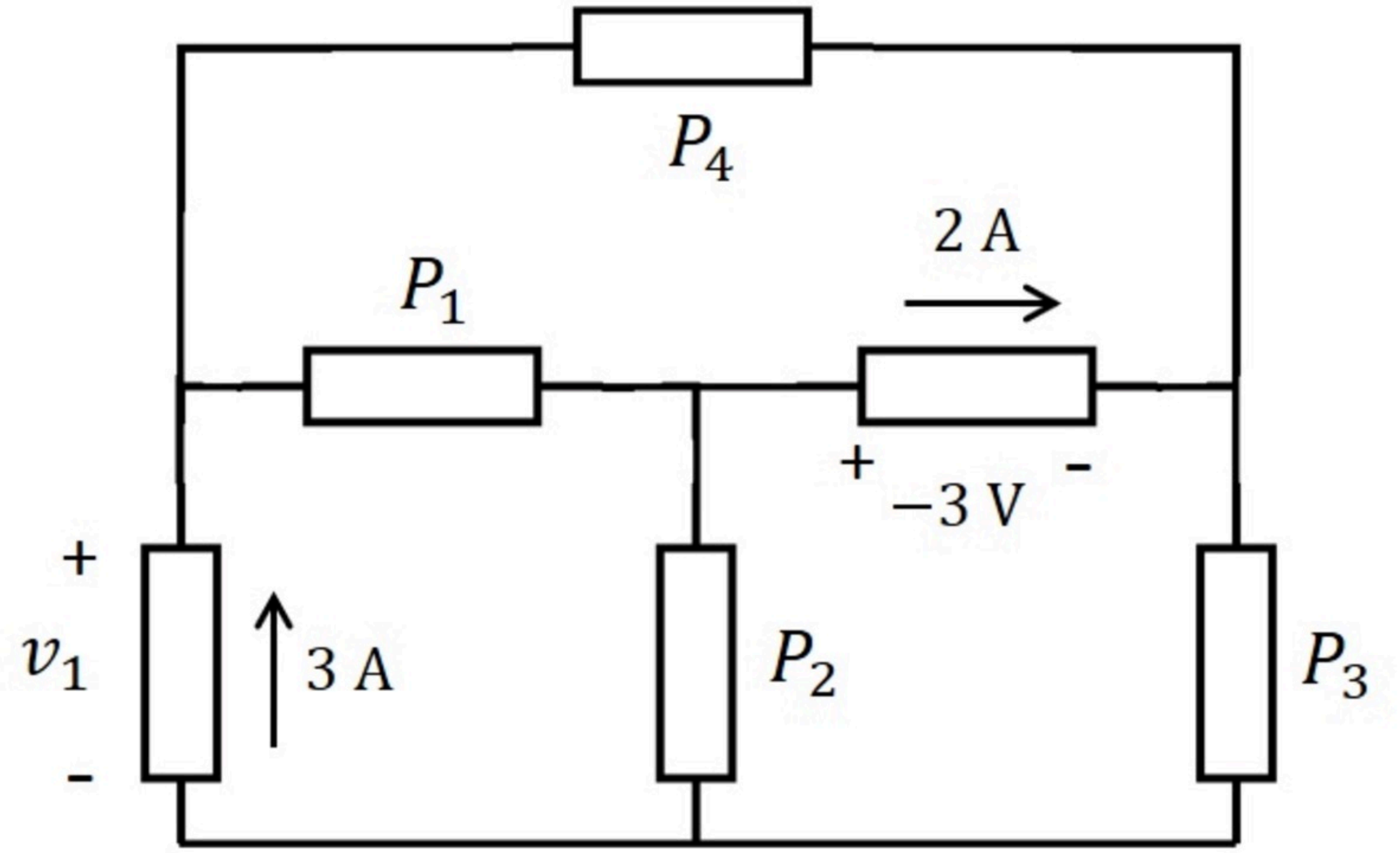
$$= -5$$

$$\boxed{E = -5\ \text{J}}$$ received

Basic concepts 004

Problem has been graded.

We are given the power received P1, P2, P3 and the voltage v1. Find the power received P4.



Given Variables:

v1 : 2 V

P1 : 16 W

P2 : -4 W

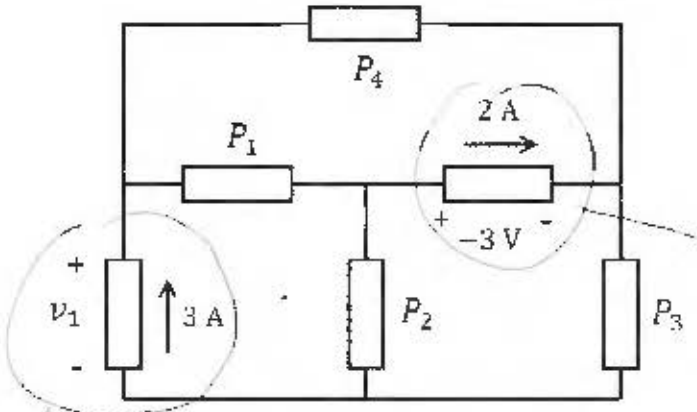
P3 : 1 W

Calculate the following:

P4 (W) :

Hint: Sum of power received is equal to sum of power supplied.

We are given the power received P1, P2, P3 and the voltage v1. Find the power received P4.



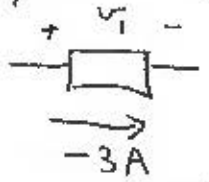
v1 = 1 V

P1 = 14 W

P2 = -5 W

P3 = -4 W

→ passive sign convention



$p = 1 \cdot (-3) = -3$ W received

→ $p = (-3) \cdot 2 = -6$ W received

$$\sum_{\text{received}} p = \sum_{\text{supplied}} p \Rightarrow -3 - 6 + p_1 + p_2 + p_3 + p_4 = 0$$

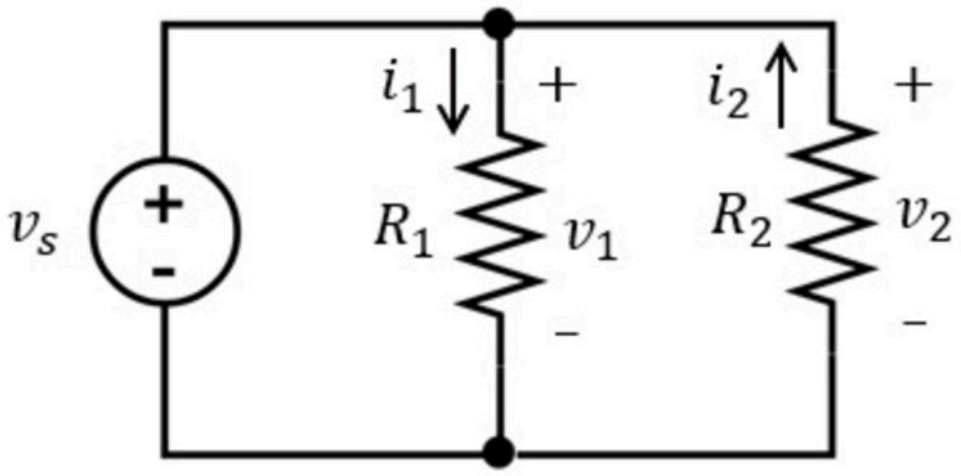
$$-3 - 6 + 14 - 5 - 4 + p_4 = 0$$

$$\boxed{p_4 = 4\text{W}} \text{ received}$$

Basic concepts 005

Problem has been graded.

For each of the resistors, calculate the current through them and power received by them.



Given Variables:

v_s : 10 V

R_1 : 10 ohm

R_2 : 4 ohm

Calculate the following:

i_1 (A) :

---

i_2 (A) :

P_1 (W) :

P_2 (W) :

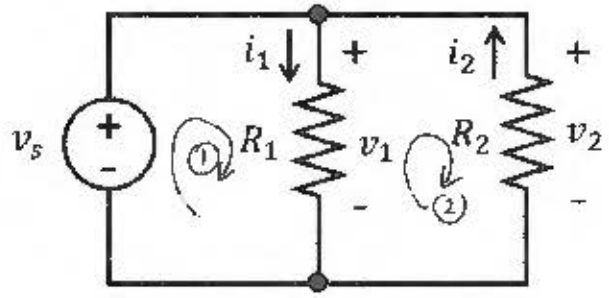
> Hint: Find the voltage across the resistors first

For each of the resistors, calculate the current through them and power received by them.

vs = 20 V

R1 = 20 Ω

R2 = 10 Ω



KVL ①: $v_s = v_1 \Rightarrow v_1 = 20V$

KVL ②: $v_1 = v_2 \Rightarrow v_2 = 20V$

$i_1 = \frac{v_1}{R_1} = \frac{20}{20} \Rightarrow \boxed{i_1 = 1A}$

$i_2 = \frac{-v_2}{R_2} = \frac{-20}{10} \Rightarrow \boxed{i_2 = -2A}$

$p_1 = \frac{v_1^2}{R_1} = \frac{400}{20} \Rightarrow \boxed{p_1 = 20W}$ received

$p_2 = \frac{v_2^2}{R_2} = \frac{400}{10} \Rightarrow \boxed{p_2 = 40W}$ received

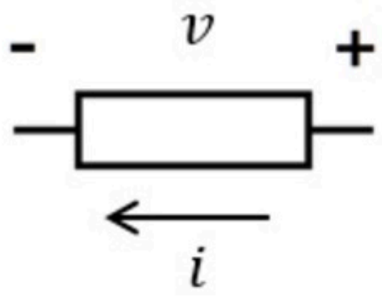
or could have used

$p = R \cdot i^2$ or $p = i \cdot v$

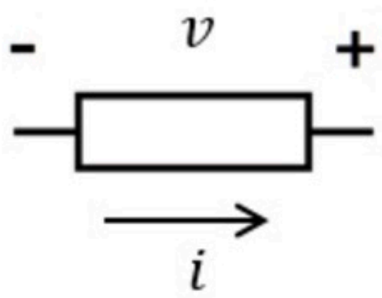
Basic Concepts 011

Problem has been graded.

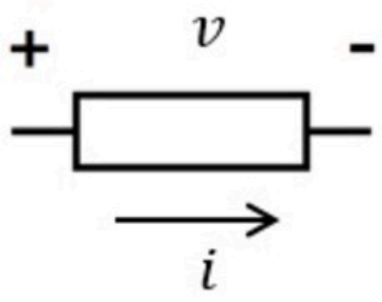
Find the power P_1 supplied by this element:



Find the power P_2 supplied by this element:



Find the power P_3 received by this element:



Given Variables:

v : -5 V

i : 4 A

Calculate the following:

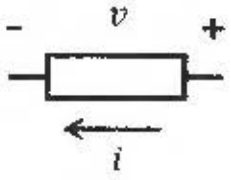
P1 (W) :

P2 (W) :

P3 (W) :

> Hint: Convert first to passive sign convention

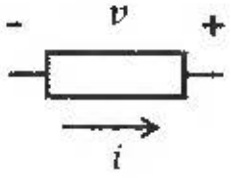
(a) Find the power P_1 supplied by this element:



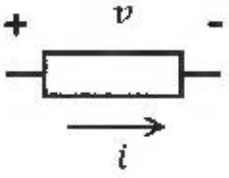
v = -2 V

i = 3 A

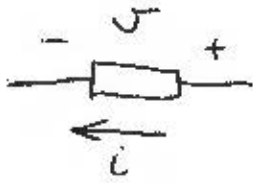
(b) Find the power P_2 supplied by this element:



(c) Find the power P_3 received by this element:



(a)

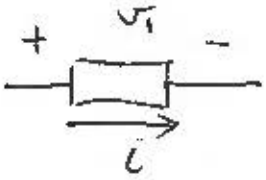


PASSIVE SIGN CONVENTION

$P = v \cdot i = -6$ → RECEIVED

$P_1 = 6$ W SUPPLIED

(b)



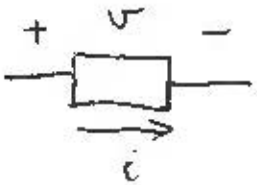
SWITCH TO PASSIVE SIGN CONVENTION

$v_1 = -v = 2V$

$P = v_1 i = 6$ → RECEIVED

$P_2 = -6$ W SUPPLIED

(c)



PASSIVE SIGN CONVENTION

$P = v \cdot i = -6$ → RECEIVED

$P_3 = -6$ W RECEIVED