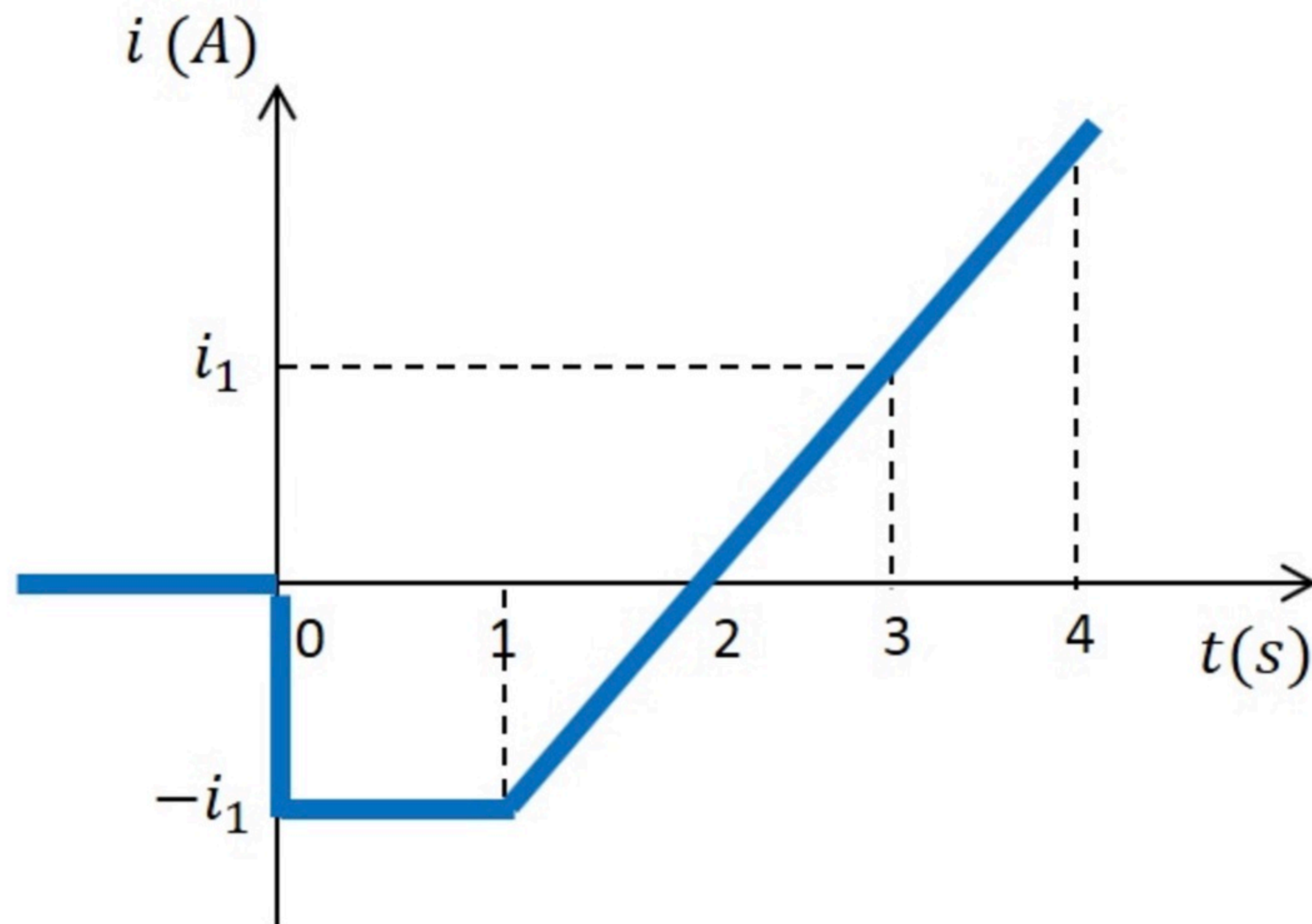


Basic concepts 001

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:

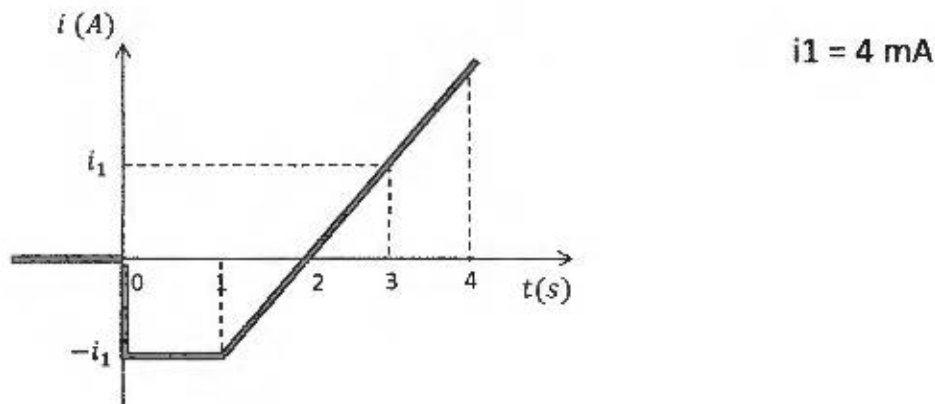
$i_1 : 8$ mA

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.



$$\begin{aligned}
 q &= \int_0^4 i(t) dt = \left(-i_1 \cdot 1 \right) + \left(\frac{-i_1 \cdot 1}{2} \right) \\
 &\quad + \left(\frac{i_1 \cdot 1}{2} \right) + \left(i_1 \cdot 1 + \frac{i_1 \cdot 1}{2} \right) \\
 &= \frac{-i_1}{2} \\
 &= \frac{4 \cdot 10^{-3}}{2}
 \end{aligned}$$

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

Basic concepts 002

Problem has been graded.

Determine the values of B1, B2 and B3.

The current through a circuit element is

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

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

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

Given Variables:

A1 : 4 A

A2 : -3 s

Calculate the following:

B1 (C) :

B2 (C) :

B3 (s) :

The current through a circuit element is

$$i(t) = A_1 \cdot e^{\frac{t}{A_2}} \\ = 0$$

$$\text{for } t \geq 0 \\ \text{for } t < 0$$

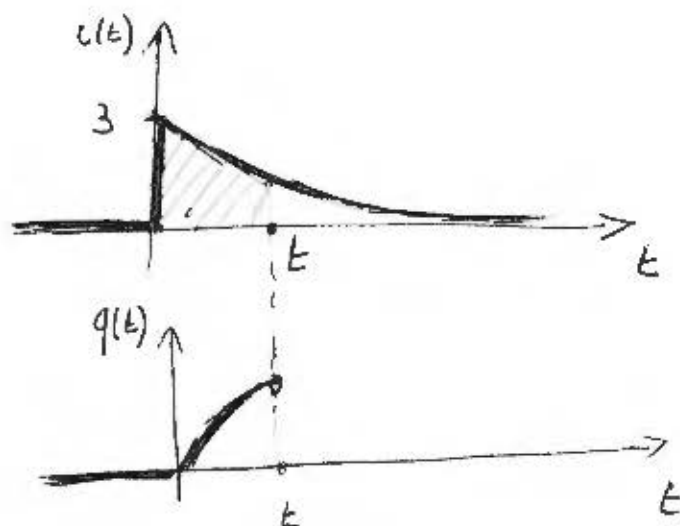
$$A_1 = 3 \text{ A}$$

$$A_2 = -2 \text{ s}$$

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

$$q(t) = B_1 + B_2 \cdot e^{\frac{t}{B_3}} \\ = 0$$

$$\text{for } t \geq 0 \\ \text{for } t < 0$$



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

$$q(t) = \int_{-\infty}^t i(u) du = \int_0^t 3 e^{-\frac{u}{2}} du \\ = 3(-2) \int_0^t e^{-\frac{u}{2}} d\left(-\frac{u}{2}\right) = -6 e^{-\frac{u}{2}} \Big|_0^t = -6 \left(e^{-\frac{t}{2}} - 1 \right)$$

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

$$B_1 = 6 \text{ C} \\ B_2 = -6 \text{ C} \\ B_3 = -2 \text{ s}$$

Basic concepts 003

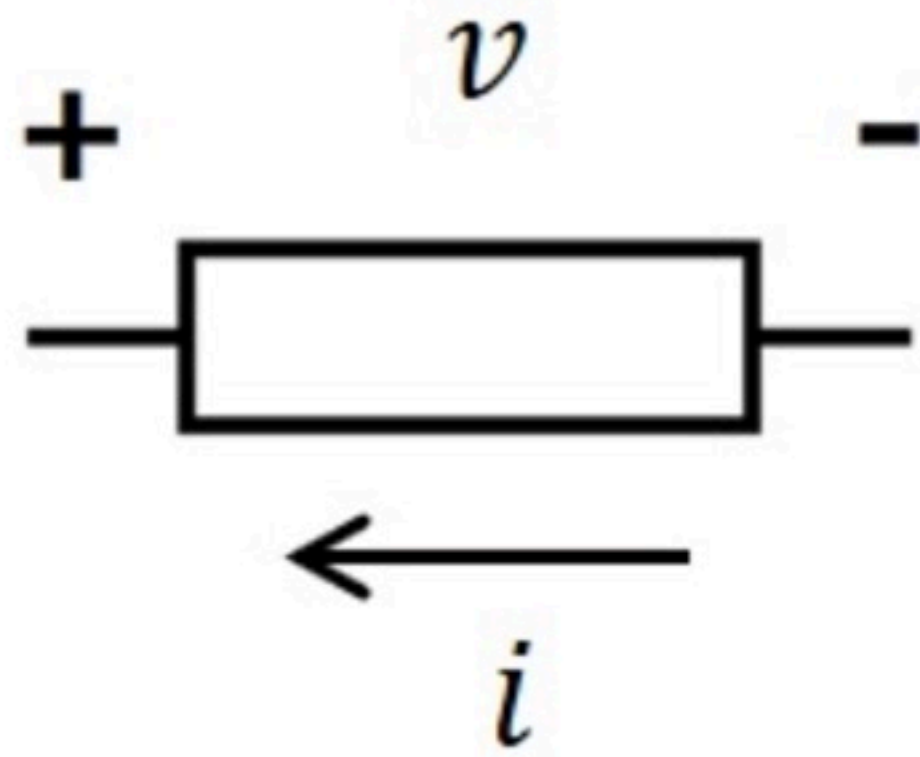
Problem has been graded.

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

For this element

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

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



(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 $t = T_1$.

For this element

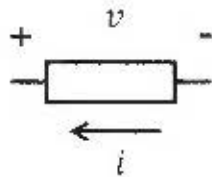
$$v(t) = 2\pi \cdot \cos(A_1 \cdot \pi \cdot t) \quad \text{V}$$

$$i(t) = A_2 \cdot \sin(A_1 \cdot \pi \cdot t)$$

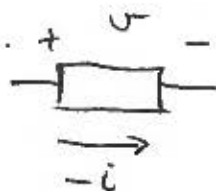
$$A_1 = 1 \text{ Hz}$$

$$A_2 = 5 \text{ A}$$

$$T_1 = 1.5 \text{ s}$$



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



for passive sign convention \leadsto gives power received

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

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

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

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

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

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

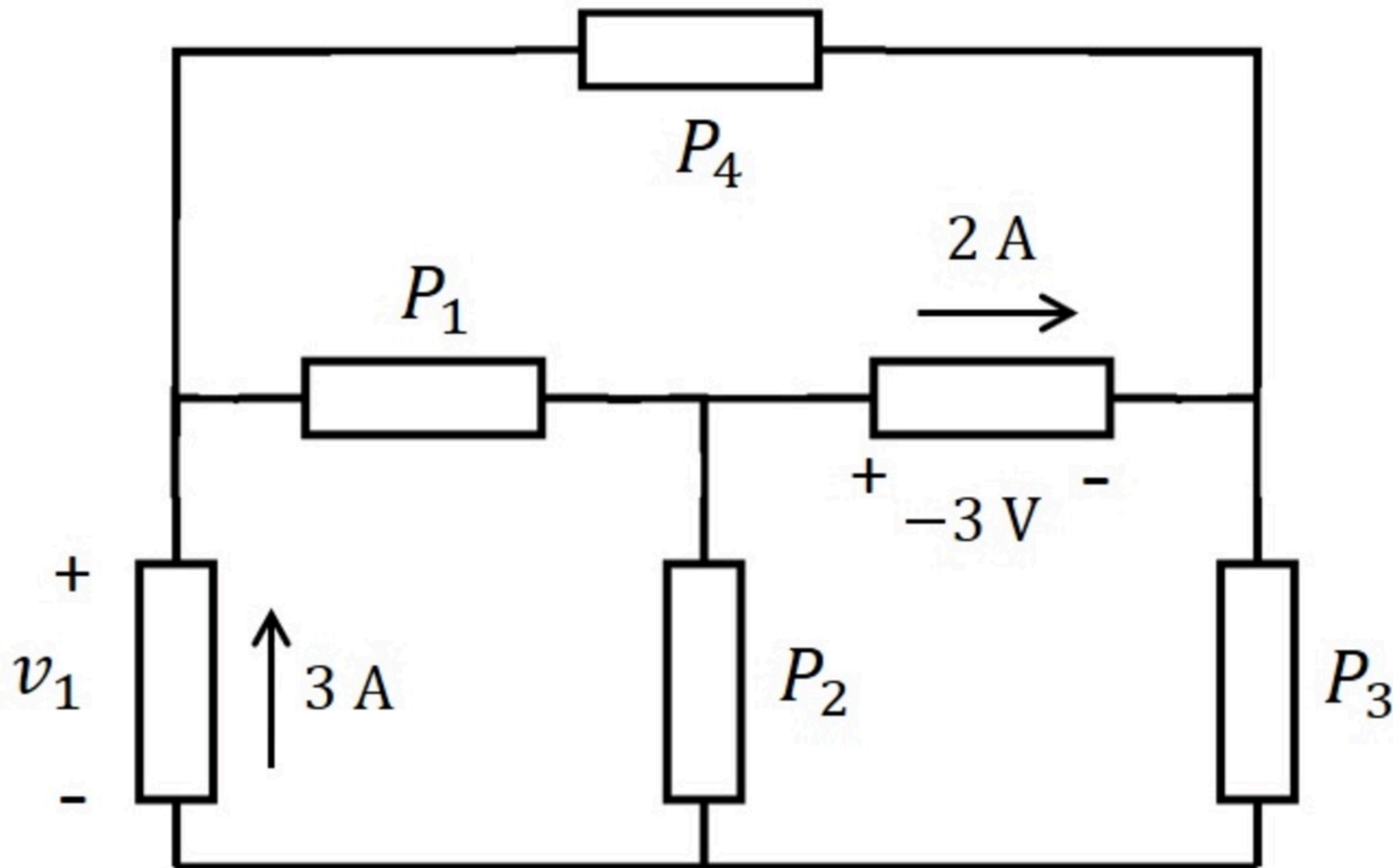
$$= -5$$

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

Basic concepts 004

Problem has been graded.

We are given the power received P_1 , P_2 , P_3 and the voltage v_1 . Find the power received P_4 .



Given Variables:

$v_1 : 2 \text{ V}$

$P_1 : 16 \text{ W}$

$P_2 : -4 \text{ W}$

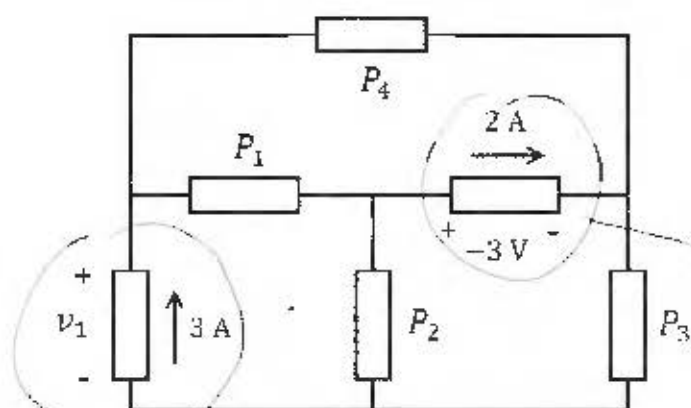
$P_3 : 1 \text{ W}$

Calculate the following:

$P_4 \text{ (W)} :$

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

We are given the power received P_1 , P_2 , P_3 and the voltage v_1 . Find the power received P_4 .



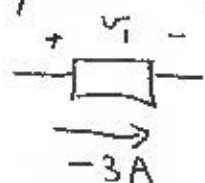
$$v_1 = 1\text{ V}$$

$$P_1 = 14\text{ W}$$

$$P_2 = -5\text{ W}$$

$$P_3 = -4\text{ W}$$

→ passive sign convention



$$P = 1 \cdot (-3) = -3\text{ W received}$$

→ $P = (-3) \cdot 2 = -6\text{ W received}$

$$\sum P_{\text{received}} = \sum P_{\text{supplied}} \Rightarrow -3 - 6 + P_1 + P_2 + P_3 + P_4 = 0$$

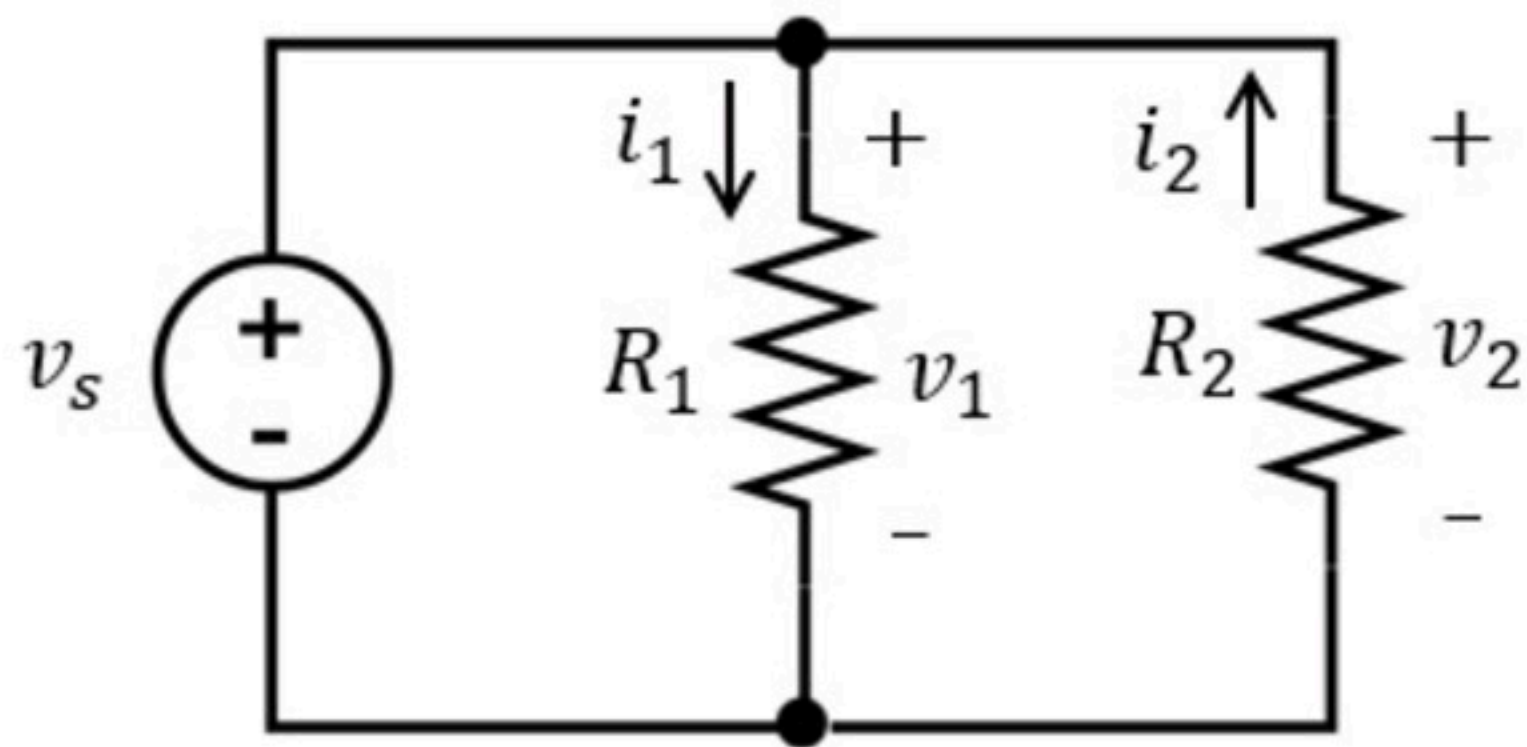
$$-3 - 6 + 14 - 5 - 4 + P_4 = 0$$

$$\boxed{P_4 = 4\text{ W}} \text{ received}$$

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) :

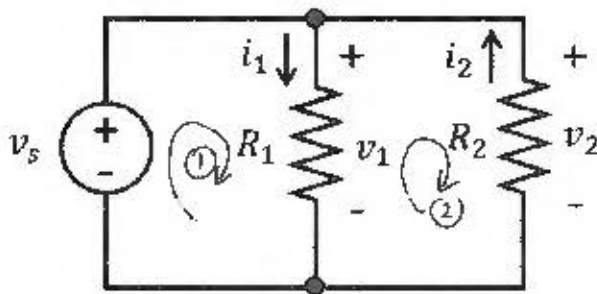
i_2 (A) :

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.



$$v_s = 20 \text{ V}$$

$$R_1 = 20 \Omega$$

$$R_2 = 10 \Omega$$

$$\text{KVL } \textcircled{1} : v_s = v_1 \Rightarrow v_1 = 20 \text{ V}$$

$$\text{KVL } \textcircled{2} : v_1 = v_2 \Rightarrow v_2 = 20 \text{ V}$$

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

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

$$P_1 = \frac{v_1^2}{R_1} = \frac{400}{20} \Rightarrow \boxed{P_1 = 20 \text{ W}}$$

received

or could have used

$$P = R \cdot i^2 \text{ or } P = i \cdot v$$

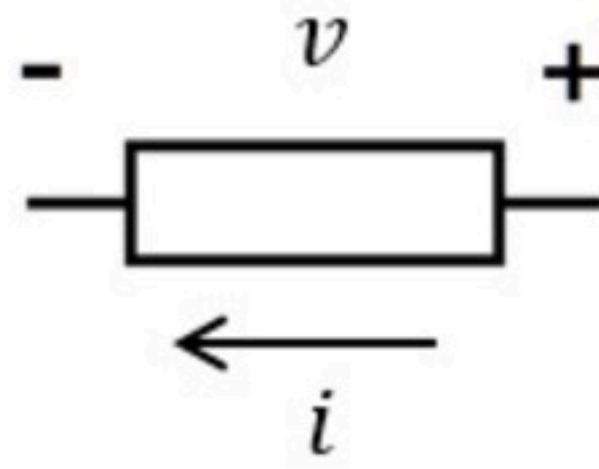
$$P_2 = \frac{v_2^2}{R_2} = \frac{400}{10} \Rightarrow \boxed{P_2 = 40 \text{ W}}$$

received

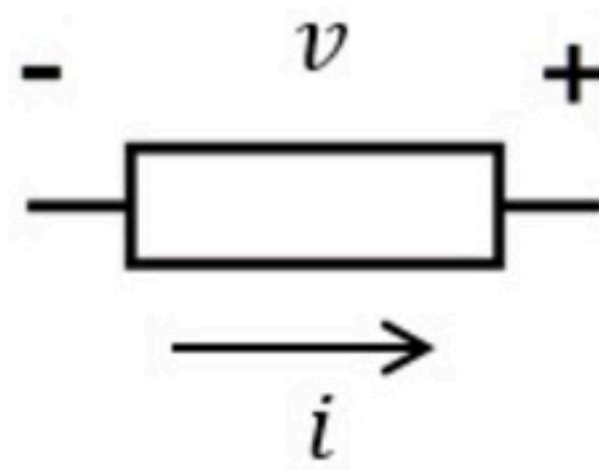
Basic Concepts 011

Problem has been graded.

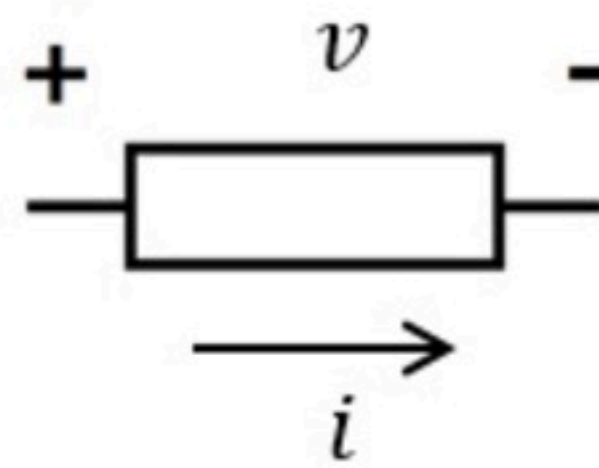
Find the power P_1 supplied by this element:



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:

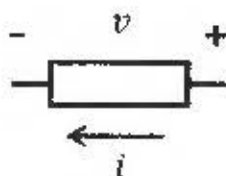
P_1 (W) :

P_2 (W) :

P_3 (W) :

Hint: Convert first to passive sign convention

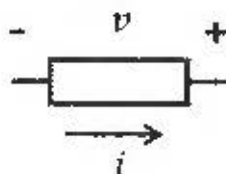
- (a) Find the power P_1 supplied by this element:



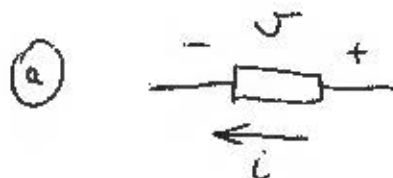
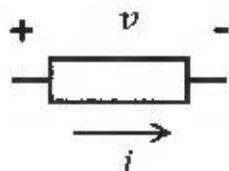
$$v = -2 \text{ V}$$

$$i = 3 \text{ A}$$

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



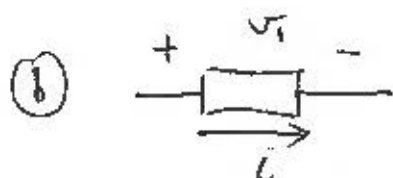
- (c) Find the power P_3 received by this element:



PASSIVE SIGN CONVENTION

$$P = v \cdot i = -6 \rightarrow \text{RECEIVED}$$

$$P_1 = 6 \text{ W SUPPLIED}$$

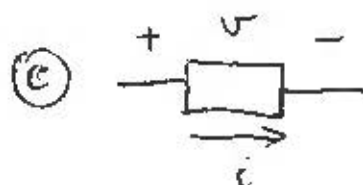


SWITCH TO PASSIVE SIGN CONVENTION

$$v_1 = -v = 2 \text{ V}$$

$$P = v_1 \cdot i = 6 \rightarrow \text{RECEIVED}$$

$$P_2 = -6 \text{ W SUPPLIED}$$



PASSIVE SIGN CONVENTION

$$P = v \cdot i = -6 \rightarrow \text{RECEIVED}$$

$$P_3 = -6 \text{ W RECEIVED}$$

PP - Basic concepts 001

Problem has been graded.

What is the current i flowing through the element at time $t = 0.25$ seconds, when the charge flow is $q(t)$?

$$q(t) = \frac{6}{\pi} \cdot \cos(10\pi t) \quad \mu\text{C}$$

Given Variables:

. : . .

Calculate the following:

i (mA) :

-0.06



Hint: Pay attention to the units

PP - Basic concepts 002

Problem has been graded.

A current of 5 mA is flowing through a conductor. What is the amount of charge q that has passed through any cross-section of this conductor in 10 seconds?

Given Variables:

...

Calculate the following:

q (C) :

0.05

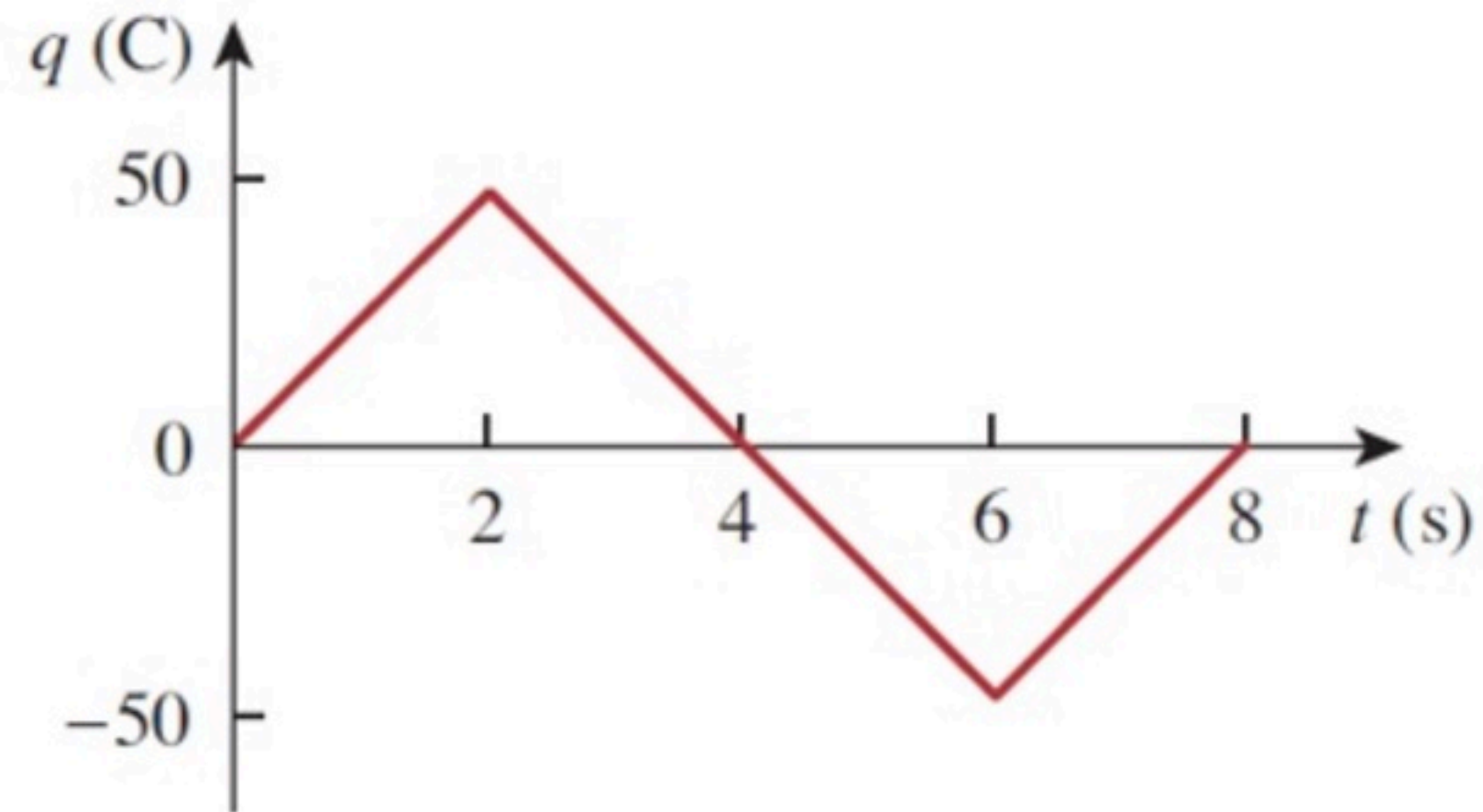


 Hint: Pay attention to the units

PP - Basic concepts 003

Problem has been graded.

What is the current i flowing through the element at time $t = 7$ seconds, when the charge flow is as shown in the figure?



Given Variables:

...

Calculate the following:

i (A) :

25



Hint: Current is the derivative of charge at a certain time

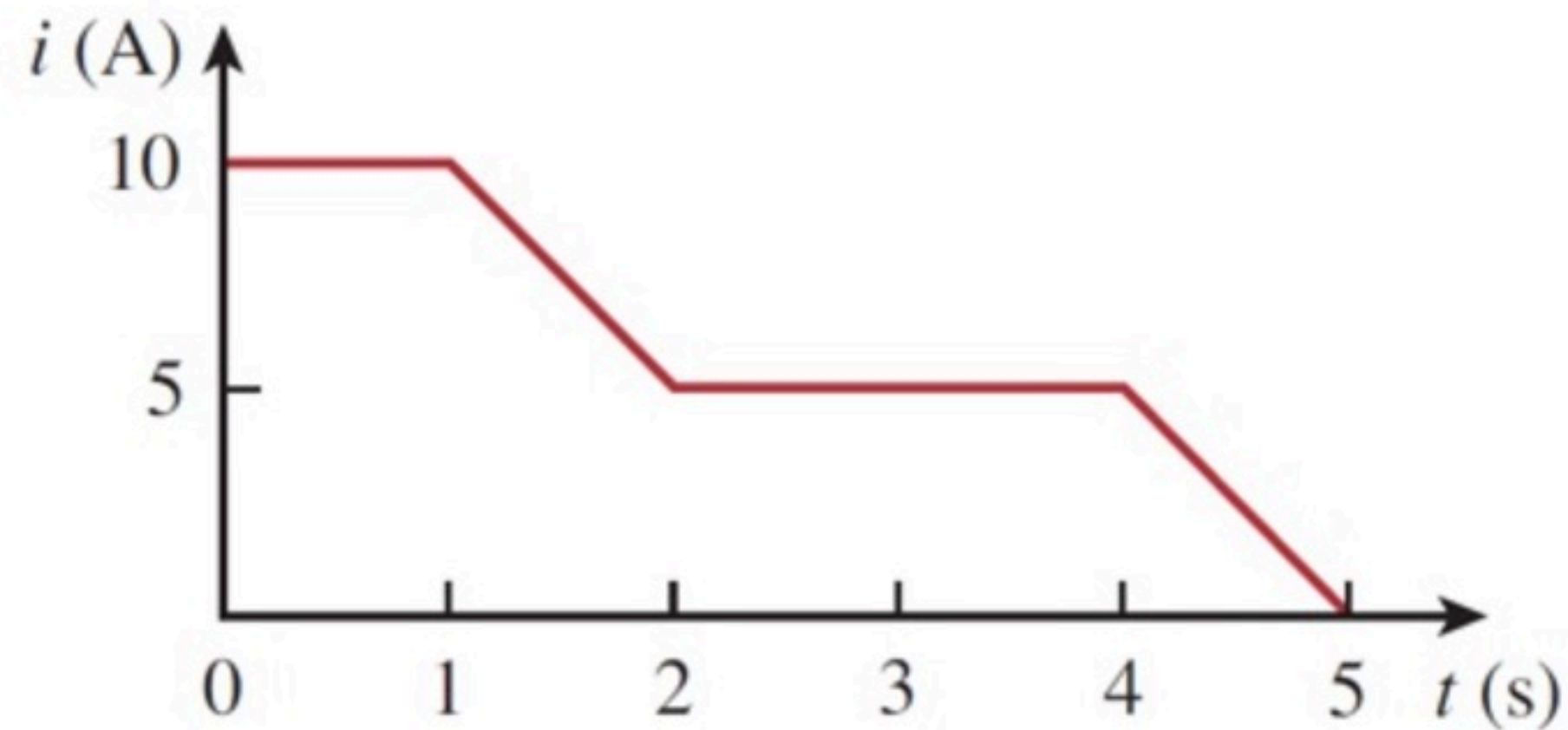
PP - Basic concepts 004

Problem has been graded.

The current flowing through an element is shown in the figure. At time $t = 0$, the charge that has passed through the element already is 2 C.

What is the total amount of charge q_1 that has passed through the element at time $t_1 = 3$ seconds?

What is the total amount of charge q_2 that has passed through the element at time $t_2 = 5$ seconds?



Given Variables:

...

Calculate the following:

q_1 (C) :

24.5



q_2 (C) :

32

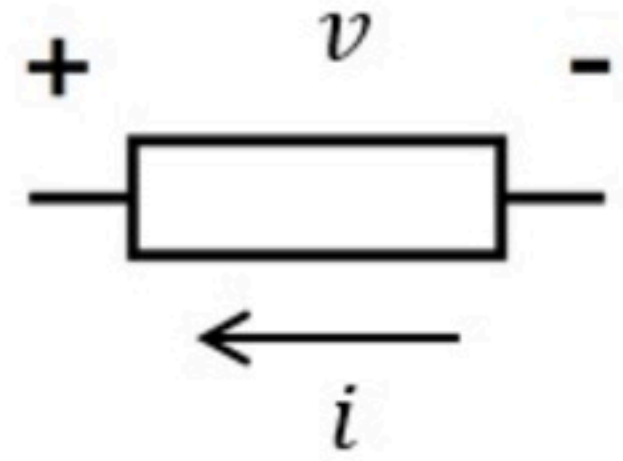


Hint: Don't forget the initial charge

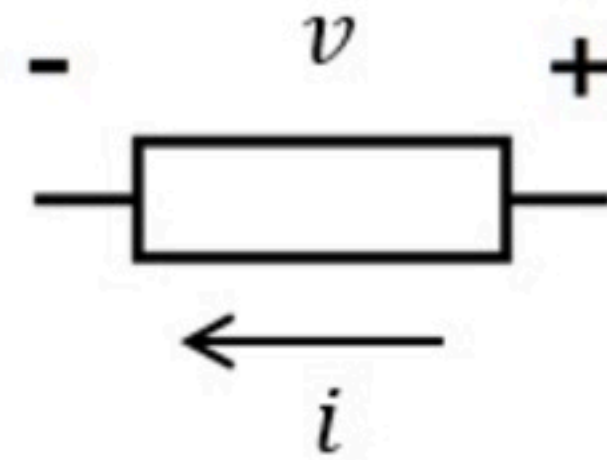
PP - Basic concepts 005

Problem has been graded.

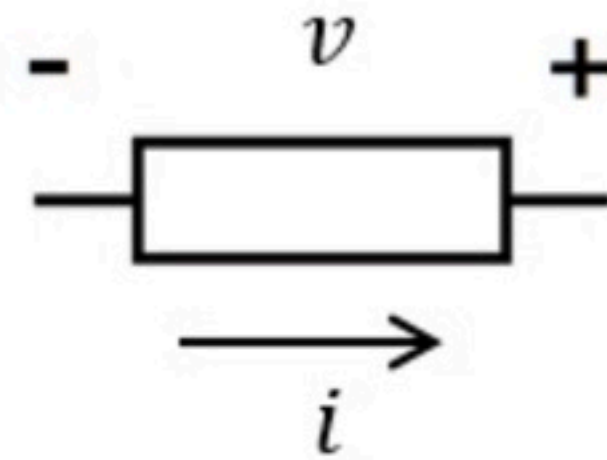
Find the power P_1 received by this element:



Find the power P_2 received by this element:



Find the power P_3 supplied by this element:



Given Variables:

$v : 2 \text{ V}$

$i : -3 \text{ A}$

Calculate the following:

$P_1 \text{ (W)} :$

6



$P_2 \text{ (W)} :$

-6



$P_3 \text{ (W)} :$

-6



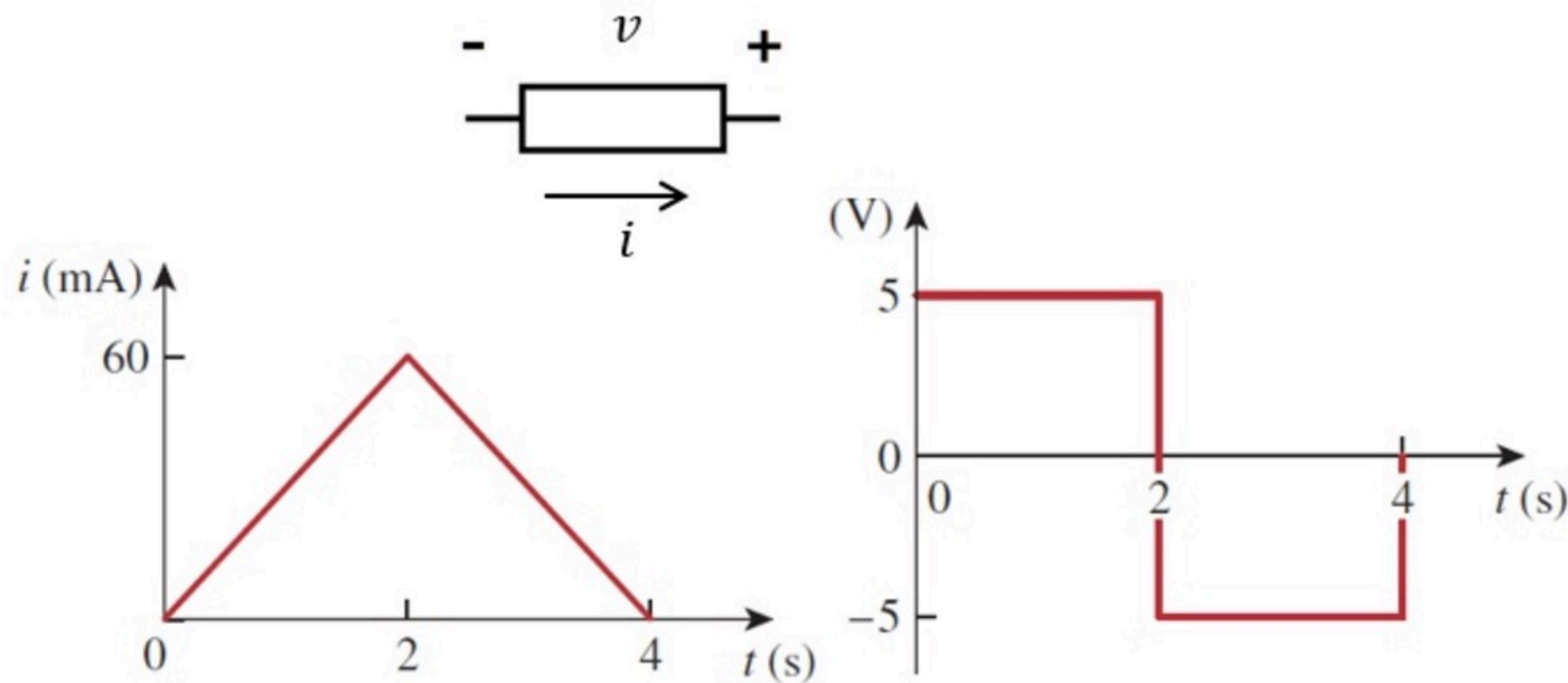
Hint: Convert first to passive sign convention

PP - Basic concepts 007

Problem has been graded.

The current flowing through an element and the voltage across this element are shown in the figures.

Find the total energy E received by the element for the period time $0 < t < 3$ s.



Given Variables:

...

Calculate the following:

E (J) :

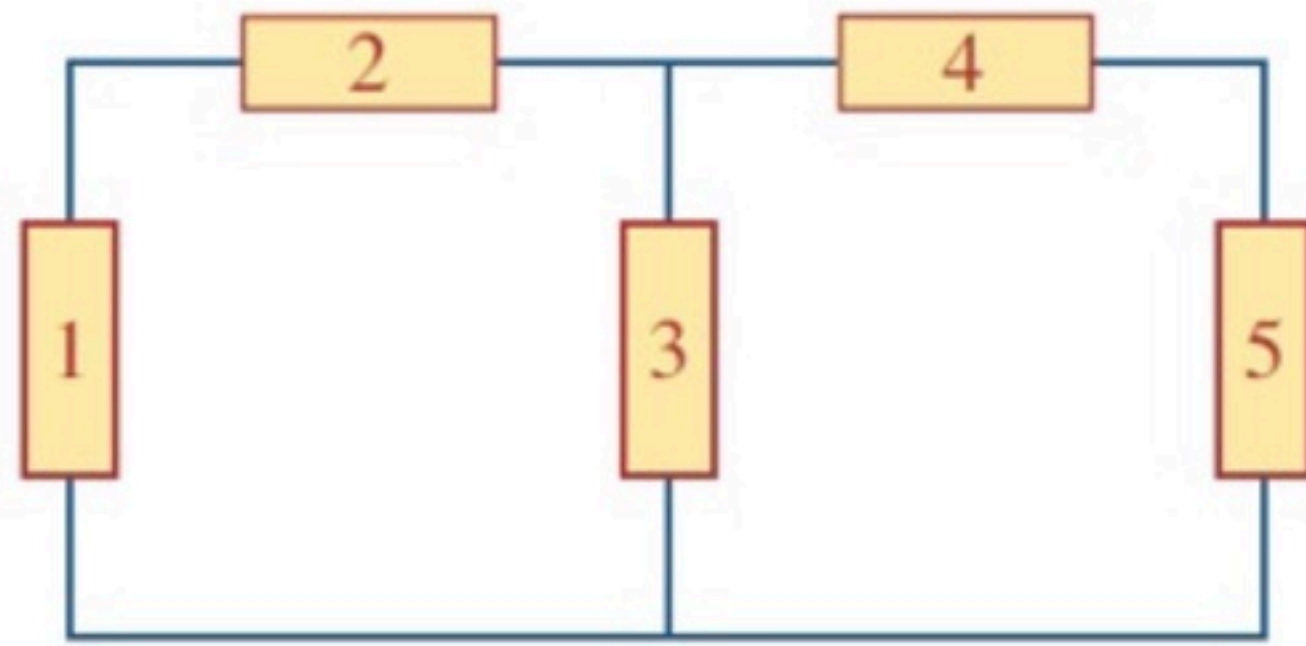
-0.075



PP - Basic concepts 008

Problem has been graded.

The figure shows a circuit with 5 circuit elements.



Element 1 supplies 3 W
Element 2 supplies -5 W
Element 3 receives 8 W
Element 4 receives -1 W

How much power P does element 5 supply?

Given Variables:

$\therefore \dots$

Calculate the following:

P (W) :

9

