P698 GB

ELEMENTARY CHARGE

The amount of charge is the product of the number of elementary charges (electrons or protons) and the magnitude of the elementary charge.

$$q = Ne$$

Quantity	Symbol	SI unit
amount of charge	q	C (coulomb)
number of elementary charges	N	integer (pure number, no unit)
elementary charge	e	C (coulomb)

Charge on one electron → 1.6×10^{-19} C

Nov 6-6:46 PM

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Charge and Electrons

A light bulb draws a current of 0.60 A. If the bulb is left on for 8.0 min, how many electrons (elementary charges) pass through the bulb?

$q = Ne$

$I = 0.60\text{A}$

$t = 8.0\text{min} = 480\text{sec}$

$N = ?$

$q = I\Delta t$

$q = (0.60\text{A})(480\text{sec})$

$q = 288\text{C}$

$q = Ne$

$288\text{C} = (N)(1.60 \times 10^{-19}\text{C})$

$N = 1.8 \times 10^{21}$ electrons

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12. Calculate the current if 2.85×10^{20} elementary charges pass a point in a circuit in 5.70 min.

13. A 16.0 V battery does 5.40×10^{4} J of work in 360.0 s.
    (a) Calculate the current through the battery.
    (b) Calculate the number of elementary charges that pass through the battery.

14. Calculate the number of elementary charges that pass a point in a circuit when a current of 3.50 A flows for 24.0 s.

15. In transferring 2.5×10^{20} elementary charges in 12 s, a battery does 68 J of work.
    (a) Calculate the current through the battery.
    (b) Calculate the potential difference of the battery.

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P700

12. Calculate the current if 2.85×10^{20} elementary charges pass a point in a circuit in 5.70 min.

$I = \frac{q}{\Delta t}$

$I = ?$

$N = 2.85 \times 10^{20}$

$t = 5.70 \text{ min} = 342 \text{ sec}$

$q = Ne$

$q = (2.85 \times 10^{20})(1.6 \times 10^{-19} \text{ C})$

$q = 45.6 \text{ C}$

$I = \frac{q}{\Delta t} = \frac{45.6 \text{ C}}{342 \text{ sec}} = 0.133 \text{ amps}$

Mar 23-9:04 AM

P700

13. A 16.0 V battery does 5.40×10^4 J of work in 360.0 s.
(a) Calculate the current through the battery.
(b) Calculate the number of elementary charges that pass through the battery.

$V = 16.0\,V$

$\Delta E_q = W = 5.40 \times 10^4\,J$

$t = 360.0\,sec$

$V = \frac{\Delta E_q}{Q}$

$q = \frac{\Delta E_q}{V}$

$q = \frac{5.40 \times 10^4\,J}{16.0\,V}$

$q = 3375\,C$

a) I $\quad I = \frac{q}{\Delta t} =$

$I = \frac{3375\,C}{360.0\,s} = 9.375\,amps$

b) $q = Ne$

$3375\,C = (N)(1.6 \times 10^{-19}\,C)$

$N = 2.1 \times 10^{22}$

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14. Calculate the number of elementary charges that pass a point in a circuit when a current of 3.50 A flows for 24.0 s.

$n = ?$

$I = 3.50\,A$

$T = 24.0\,sec$

$q = I\Delta t$

$q = (3.50\,A)(24.0\,sec)$

$q = 84.0\,C$

$q = Ne$

$84.0\,C = (N)(1.6 \times 10^{-19}\,C)$

$N = 5.25 \times 10^{20}$

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P700

12. Calculate the current if 2.85×10^{20} elementary charges pass a point in a circuit in 5.70 min.

$I = \frac{q}{\Delta t}$

$I = ?$

$N = 2.85 \times 10^{20}$

$t = 5.70 \text{ min} = 342 \text{ sec}$

$q = Ne$

$q = (2.85 \times 10^{20})(1.6 \times 10^{-19} \text{ C})$

$q = 45.6 \text{ C}$

$I = \frac{q}{\Delta t} = \frac{45.6 \text{ C}}{342 \text{ sec}} = 0.133 \text{ amps}$

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15. In transferring 2.5×10^{20} elementary charges in 12 s, a battery does 68 J of work.

(a) Calculate the current through the battery.

(b) Calculate the potential difference of the battery.

$N = 2.5 \times 10^{20}$

$t = 12 \text{ sec}$

$W = \Delta E_q = 68 \text{ J}$

$I = ?$

$q = Ne$

$q = (2.5 \times 10^{20})(1.6 \times 10^{-19} \text{ C})$

$q = 40 \text{ C}$

$I = \frac{q}{\Delta t}$

$I = \frac{40 \text{ C}}{12 \text{ sec}} = 3.33 \text{ A}$

$V = \frac{\Delta E_q}{Q}$

$V = \frac{68 \text{ J}}{40 \text{ C}} = 1.7 \text{ V}$

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