Problem 1

How much charge is represented by the given amount of electrons?

a. For 5.482×10^{17} electrons, the charge q = *-87.82 ± 3%* mC

b. For 3.24×10^{18} electrons, the charge q = *-519.05 ± 3%* mC

c. For 3.46×10^{19} electrons, the charge q = *-5.54 ± 3%* C

d. For 4.628×10^{20} electrons, the charge q = *-74.14 ± 3%* C

Explanation:

The coulomb representations of the given electrons are calculated as shown below:

a. $q = 5.482 \times 10^{17} \times [-1.602 \times 10^{-19}\ \text{C}] = -87.82\ \text{mC}$

b. $q = 3.24 \times 10^{18} \times [-1.602 \times 10^{-19}\ \text{C}] = -519.05\ \text{mC}$

c. $q = 3.46 \times 10^{19} \times [-1.602 \times 10^{-19}\ \text{C}] = -5.54\ \text{C}$

d. $q = 4.628 \times 10^{20} \times [-1.602 \times 10^{-19}\ \text{C}] = -74.14\ \text{C}$

Problem 2

A total charge of 400 C flows past a given cross-section of a conductor in 33 seconds. What is the value of the current?

The value of the current is *12.1 ± 3%* A.

Explanation:

The value of current is calculated as follows:

$$i=\frac{\Delta q}{\Delta t}=\frac{400\ \mathrm{C}}{33\ \mathrm{s}}=12.1\ \mathrm{A}$$

Problem 3

The charge entering the positive terminal of an element is $q = 6\sin(4\pi t)$ mC, while the voltage across the element (plus to minus) is $v = 5\cos(4\pi t)$ V.

Find the power delivered to the element at $t = 0.3$ s.

The power delivered to the element at $t = 0.3$ s is *246.74 ± 3%* mW.

Explanation:

The power delivered to the element at $t = 0.3$ s is calculated as follows:

$$i = \frac{dq}{dt} = \frac{d(6\sin(4\pi t))}{dt} = 24\pi\cos(4\pi t)\ \text{mA}$$

$p = vi = (5\cos(4\pi t)\ \text{V}) \times (24\pi\cos(4\pi t)\ \text{mA}) = 120\pi\cos^2(4\pi t)$ mW

At $t = 0.3$ s,

$p = vi = 120\pi\cos^2(4\pi \times 0.3)$ mW $= 246.74$ mW

Problem 4

The current entering the positive terminal of a device is $i(t) = 8\ e^{-2t}$ mA and the voltage across the device is $v(t) = 12\frac{di}{dt}$ V.

Determine the energy absorbed in 3 s.

The energy absorbed in 3 s is *-384 ± 2%* μJ.

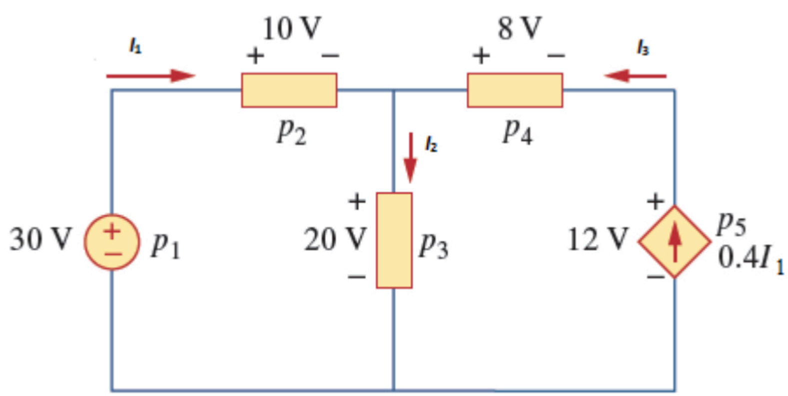
Explanation:

The energy absorbed in 3 s is calculated as follows:

$W = \int p\,dt$ = - 1.536$\int_0^3 e^{-4t}\,dt$ mJ = (- 1536.0/–4)$e^{-4t} 10^{-6}\Big|_0^3$ μJ = - 384 μJ

Problem 5

Find the power absorbed by each of the elements in the given figure, where I_1 = 12.00 A, and I_2 = 16.80 A.



The power absorbed by each of the elements is as follows:

p_1 = -360 ± 2% W

p_2 = 120 ± 2% W

p_3 = 336 ± 2% W

p_4 = -38.4 ± 2% W

p_5 = -57.6 ± 2% W

Explanation:

The power absorbed by each element is calculated as follows:

$p_1 = vi$ = 30 V × –12.00 A = -360.000 W

$p_2 = vi$ = 10 V × 12.00 A = 120.000 W

$p_3 = vi$ = 20 V × 16.80 A = 336.000 W

$p_4 = vi$ = 8 V × –4.80 A = -38.400 W

$p_5 = vi$ = 12 V × –4.80 A = -57.600 W

Problem 6

A utility company charges 8 cents/kWh. If a consumer operates a 60-W light bulb continuously for one day, how much is the consumer charged?

The consumer charge is *11.52 ± 2%* cents.

Explanation:

The consumer charge is calculated as follows:
$W = pt = 60 \times 24 \text{ Wh} = 1.44 \text{ kWh}$
$C = 8 \text{ cents/kWh} \times 1.44 \text{ kWh} = 11.52 \text{ cents}$

Problem 7

An electric stove with four burners and an oven is used in preparing a meal as follows.

Burner 1: 20 minutes
Burner 2: 40 minutes
Burner 3: 15 minutes
Burner 4: 45 minutes
Oven: 30 minutes

If each burner is rated at 1.3 kW and the oven at 1.6 kW, and electricity costs 12 cents per kWh, calculate the cost of electricity used in preparing the meal.

The cost of electricity used in preparing the meal is *40.8 ± 3%* cents.

Explanation:

The cost of electricity used in preparing the meal is calculated as follows:

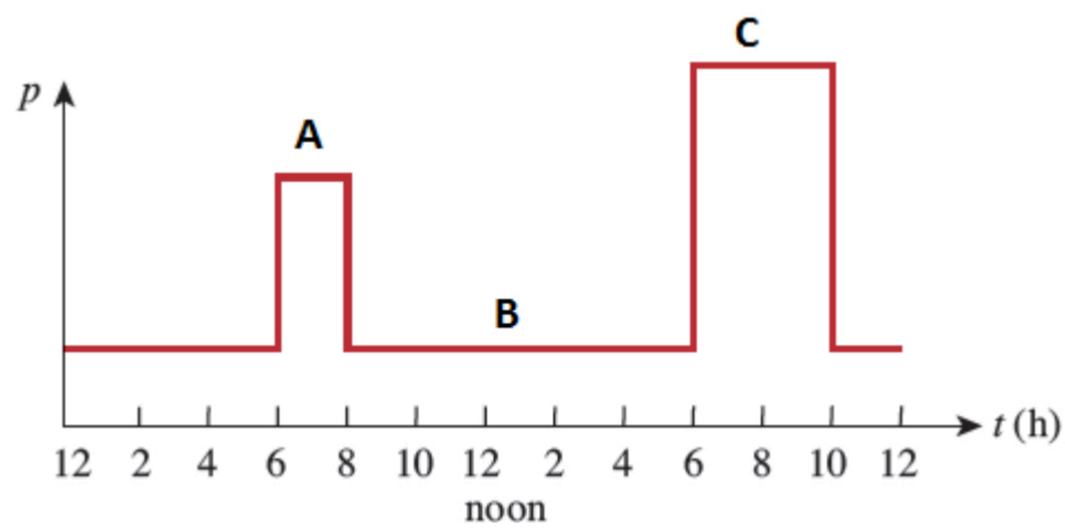
$$w = pt = 1.3\,\text{kW}\frac{(20+40+15+45)}{60}\text{h} + 1.6\,\text{kW}\left(\frac{30}{60}\right)\text{h}$$

w = 2.6 kWh + 0.80 kWh = 3.40 kWh

Cost = 12 cents/kWh × 3.40 kWh = 40.8 cents

Problem 8

The figure given below shows the power consumption of a certain household in one day, where A = 760 W, B = 280 W, and C = 1020 W.



Calculate the total energy consumed.

The total energy consumed is *10.64 ± 2%* kWh.

Explanation:

The total energy consumed is calculated as follows:
Energy = $\sum pt$ = (280 W × 6 h) + (760 W × 2 h) + (280 W × 10 h) + (1020 W × 4 h) + (280 W × 2 h) = 10.64 kWh

Problem 9

A total of 6 MJ are delivered to an automobile battery (assume 12 volts) giving it an additional charge. How much is that additional charge?

The additional charge is *138.9 ± 3%* ampere-hours.

Explanation:

The additional charge is calculated as follows:

$6 \times 10^6 = w = pt = vit = 12it = 12(\text{Charge})$

or

Charge = $6 \times 10^6 / 12 = 5.0000 \times 10^5$ coulomb = 5.0000×10^5 coulomb × 1 hour/3,600 seconds = 138.9 ampere-hours

Charge = 138.9 ampere-hours

Problem 10

How much energy does a 8-hp motor deliver in 34 minutes? Assume that 1 horsepower = 746 W.

The energy delivered by the 8-hp motor in 34 minutes is *12.17 ± 2%* × 10^6 J.

Explanation:

The energy delivered by the 8-hp motor in 34 minutes is calculated as follows:

p = 8 hp = 8 × 746 W = 5968 W

$W = pt$ = 5968 W × (34 × 60) seconds = 12.17 × 10^6 J