PQ 3a Electricity

Questions and Answers

Q1

Determine the charge that has flowed through a torch battery producing a current of 300 mA if it has been left on for 20 minutes.

$I = q/t$ so, $q = It$ where $I = 300 \times 10^{-3} = 0.300$ A and $t = 20 \times 60 = 1200$ s.
Thus $q = 0.300 \times 1200 = 360$ C.

Q2

The alternator of a car being driven at night with the headlights on is producing a 50 A current at an EMF of 12 V.

a How many coulombs of charge flow from the alternator each second?

b How many joules of energy does each coulomb of charge obtain?

c How many joules of energy does the alternator produce each second?

d Where does this energy go?

a The 50 A current means that 50 C of charge flows each second ($q = It$).

b The 12 V EMF means that each 1 C of charge is given 12 J of energy.

c Each second, 50 C of charge each with 12 J of energy flows from the alternator, so the energy produced is $50 \times 12 = 600$ J.

d This energy will go to the headlights, the ignition system and any other electrical devices in operation. Some may also be used to recharge the battery.

Q3

The potential difference across a torch bulb is found to be 2.7 V. The current flowing through it is 0.2 A.

a How much charge flows through the torch in 1 minute?

b How much energy is lost by this charge?

a $q = It = 0.2\ \text{A} \times 60\ \text{s} = 12\ \text{C}$.

b Each coulomb lost 2.7 J of energy. $E = qV = 12 \times 2.7 = 32.4\ \text{J}$

Q4

- Current through a globe connected across the terminals of a 125-V outlet is 0.50 A. At what rate does the globe convert electric energy to light? (Assume 100 percent efficiency.)

$$P = IV = (0.50\ \text{A})(125\ \text{V}) = 63\ \text{J/s} = 63\ \text{W}$$

Q5

- A vehicle battery causes a current of 2.0 A through a lamp and produces 12 V across it. What is the power used by the lamp?

$$P = IV = (2.0\ \text{A})(12\ \text{V}) = 24\ \text{W}$$

Q6

- What is the current through a 75-W globe that is connected to a 125-V outlet?

$$P = IV$$

$$I = \frac{P}{V} = \frac{75\ \text{W}}{125\ \text{V}} = 0.60\ \text{A}$$

Q7

- The current through the starter motor of a vehicle is 210 A. If the battery maintains 12 V across the motor, how much electric energy is delivered to the starter in 10 seconds?

$$P = IV \text{ and } E = Pt$$

$$\text{Thus, } E = IVt = (210\ \text{A})(12\ \text{V})(10.0\ \text{s})$$

$$= 2.5 \times 10^4\ \text{J}$$

Q8

- A torch bulb is rated at 0.90 W. If the globe drops 3.0 V, how much current goes through it?

$$P = IV$$

$$I = \frac{P}{V} = \frac{0.90\ \text{W}}{3.0\ \text{V}} = 0.30\ \text{A}$$

Q9

- 100W bulb is 22 percent efficient. This means that 22 percent of the electric energy is converted to light energy.
- **a.** How many joules does the bulb convert into light each minute it is in operation?

$$E = Pt$$
$$= (0.22)(100.0\ \text{J/s})(1.0\ \text{min})(60\ \text{s/min})$$
$$= 1.3\times10^{3}\ \text{J}$$

- **b.** How many joules of thermal energy does the bulb produce each minute?

$$E = Pt$$
$$= (0.78)(100.0\ \text{J/s})(1.0\ \text{min})(60.0\ \text{s/min})$$
$$= 4.7\times10^{3}\ \text{J}$$

Q10

- An electric space heater draws 15.0 A from a 120-V source. It is operated, on the average, for 5 hours per day.
- How much power does the heater use?

$$P = IV = (15.0\ \text{A})(120\ \text{V})$$
$$= 1800\ \text{W} = 1.8\ \text{kW}$$