

$$1 \text{ A}\cdot\text{h of charge} = 3600 \text{ C}$$

Shannon

PSC-4011 Ampere-Hour Problems

1. The total charge of a car battery is 90 A·h. If the driver forgot to turn off his headlights (they were on for 5.5 hours, on a 15-ampere current), then will he be able to start his car again? Start-up requires a current of 400 amperes for 3 seconds.

$$Q_{\text{initial}} = 90 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (15 \text{ A})(5.5 \text{ h}) \\ &= 82.5 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{left}} &= 90 \text{ A}\cdot\text{h} - 82.5 \text{ A}\cdot\text{h} \\ &= 7.5 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{needed}} &= It \\ &= (400 \text{ A})\left(\frac{3}{3600} \text{ h}\right) \\ &= 0.33 \text{ A}\cdot\text{h} \end{aligned}$$

Yes, the car will start.

2. The total charge of a car battery is 95 A·h. If the driver forgot to turn off his headlights (they were on for 8 hours and 36 minutes, on an 11-ampere current), then will he be able to start his car again? Start-up requires a current of 370 amperes for 4 seconds.

$$Q_{\text{initial}} = 95 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (11 \text{ A})\left(8 \frac{36}{60} \text{ h}\right) \\ &= (11 \text{ A})(8.6 \text{ h}) \\ &= 94.6 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{left}} &= 95 \text{ A}\cdot\text{h} - 94.6 \text{ A}\cdot\text{h} \\ &= 0.4 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{needed}} &= It = (370 \text{ A})\left(\frac{4}{3600} \text{ h}\right) \\ &= 0.411 \end{aligned}$$

No, the car won't start.

3. The total charge of a car battery is 91 A·h. If the driver forgot to turn off his headlights (they were on for seven hours and 30 minutes, on a 12-ampere current), then will he be able to start his car again? Start-up requires a current of 500 amperes for 3.5 seconds.

$$Q_{\text{initial}} = 91 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (12 \text{ A})(7.5 \text{ h}) \\ &= 90 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{left}} &= 91 \text{ A}\cdot\text{h} - 90 \text{ A}\cdot\text{h} \\ &= 1 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{needed}} &= It = (500 \text{ A})\left(\frac{3.5}{3600} \text{ h}\right) \\ &= 0.486 \text{ A}\cdot\text{h} \end{aligned}$$

Yes, the car will start.

4. The total charge of a car battery is 95 A·h. If the driver forgot to turn off his headlights (they were on for seven hours and forty-five minutes, on a 12-ampere current), then will he be able to start his car again? Start-up requires a current of 380 amperes for 3.2 seconds.

$$Q_{\text{initial}} = 95 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (12 \text{ A})(7.75 \text{ h}) \\ &= 93 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{left}} &= 95 \text{ A}\cdot\text{h} - 93 \text{ A}\cdot\text{h} \\ &= 2 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{needed}} &= It \\ &= (380 \text{ A})\left(\frac{3.2}{3600} \text{ h}\right) \\ &= 0.338 \text{ A}\cdot\text{h} \end{aligned}$$

Yes, the car will start.

5. The total charge of a car battery is 85 A·h. If the driver forgot to turn off his headlights (they were on for six hours and forty minutes, on a 13-ampere current), then will he be able to start his car again? Start-up requires a current of 400 amperes for 3 seconds.

$$\rightarrow \frac{40}{60} = 0.67h$$

$$Q_{\text{initial}} = 85 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= (I)(t) \\ &= (13\text{A})(6.67\text{h}) \\ &= 86.71 \text{ A}\cdot\text{h} \end{aligned}$$

No, the car won't start. The battery is dead.

6. The total charge of a car battery is 90 A·h. If the driver forgot to turn off his headlights (they were on for 5.5 hours, on a 16-ampere current), then will he be able to start his car again? Start-up requires a current of 400 amperes for 3 seconds.

$$Q_{\text{initial}} = 90 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (16\text{A})(5.5\text{h}) \\ &= 88 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{left}} &= 90 \text{ A}\cdot\text{h} - 88 \text{ A}\cdot\text{h} \\ &= 2 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{needed}} &= It \\ &= (400\text{A})\left(\frac{3}{3600}\text{h}\right) \\ &= 0.33 \text{ A}\cdot\text{h} \end{aligned}$$

Yes the car will start.

7. The total charge of a car battery is 99 A·h. If the driver forgot to turn off his headlights (they were on for 5½ hours, on an 18.5-ampere current), then will he be able to start his car again? Start-up requires a current of 600 amperes for 2.5 seconds.

$$Q_{\text{initial}} = 99 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (18.5\text{A})(5.33\text{h}) \\ &= 98.605 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{left}} &= 99 \text{ A}\cdot\text{h} - 98.605 \text{ A}\cdot\text{h} \\ &= 0.395 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{needed}} &= It = (600\text{A})\left(\frac{2.5}{3600}\text{h}\right) \\ &= 0.417 \text{ A}\cdot\text{h} \end{aligned}$$

No, the car won't start.

8. The total charge of a car battery is 100 A·h. If the driver forgot to turn off his headlights (they were on for six hours and ten minutes, on a 16-ampere current), then will he be able to start his car again? Start-up requires a current of 710 amperes for 2.9 seconds.

$$\rightarrow \frac{10}{60} = 0.167h$$

$$Q_{\text{initial}} = 100 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (16\text{A})(6.167\text{h}) \\ &= 98.672 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{needed}} &= It \\ &= (710\text{A})\left(\frac{2.9}{3600}\text{h}\right) \\ &= 0.572 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{left}} &= 100 \text{ A}\cdot\text{h} - 98.672 \text{ A}\cdot\text{h} \\ &= 1.328 \text{ A}\cdot\text{h} \end{aligned}$$

Yes, the car will start.

9. The total charge of a car battery is 90 A·h. If the driver forgot to turn off his headlights (they were on for eight hours, on a 14-ampere current), then will he be able to start his car again? Start-up requires a current of 400 amperes for 3 seconds.

$$Q_{\text{initial}} = 90 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (14 \text{ A})(8 \text{ h}) \\ &= 112 \text{ A}\cdot\text{h} \end{aligned}$$

No, the car won't start.
The battery is dead.

10. The total charge of a car battery is 90 A·h. If the driver forgot to turn off his headlights (they were on for 4 and a half hours, on a 20-ampere current), then will he be able to start his car again? Start-up requires a current of 450 amperes for 3 seconds.

$$Q_{\text{initial}} = 90 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (20 \text{ A})(4.5 \text{ h}) \\ &= 90 \text{ A}\cdot\text{h} \end{aligned}$$

No, the car won't start.
The battery is dead.

11. The total charge of a car battery is 98 A·h. If the driver forgot to turn off his headlights (they were on for six and a half hours, on a 15-ampere current), then will he be able to start his car again? Start-up requires a current of 420 amperes for 3.8 seconds.

$$Q_{\text{initial}} = 98 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (15 \text{ A})(6.5 \text{ h}) \\ &= 97.5 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{left}} &= 98 \text{ A}\cdot\text{h} - 97.5 \text{ A}\cdot\text{h} \\ &= 0.5 \text{ A}\cdot\text{h} \end{aligned}$$

Yes, the car will start.

$$\begin{aligned} Q_{\text{needed}} &= It = (420 \text{ A})\left(\frac{3.8}{3600} \text{ h}\right) \\ &= 0.443 \text{ A}\cdot\text{h} \end{aligned}$$

12. The total charge of a car battery is 86 A·h. If the driver forgot to turn off his headlights (they were on for four hours and forty-five minutes, on an 18-ampere current), then will he be able to start his car again? Start-up requires a current of 550 amperes for 2.7 seconds.

$$Q_{\text{initial}} = 86 \text{ A}\cdot\text{h}$$

$$\begin{aligned} Q_{\text{used}} &= It \\ &= (18 \text{ A})(4.75 \text{ h}) \\ &= 85.5 \text{ A}\cdot\text{h} \end{aligned}$$

$$\begin{aligned} Q_{\text{needed}} &= It \\ &= (550 \text{ A})\left(\frac{2.7}{3600} \text{ h}\right) \\ &= 0.4125 \text{ A}\cdot\text{h} \end{aligned}$$

$$Q_{\text{left}} = 86 \text{ A}\cdot\text{h} - 85.5 \text{ A}\cdot\text{h} = 0.5 \text{ A}\cdot\text{h}$$

Yes, the car will start.

$$\rightarrow \frac{45 \text{ min}}{60} = 0.75 \text{ h}$$