

Seminars - 1st week

1. The total charge entering a terminal is given by $q = 5t \sin(4\pi t)$ mC. Calculate the current at $t = 0.5$ s.¹
2. An energy source forces a constant current of 2 A for 10 s to flow through a lightbulb. If 2.3 kJ is given off in the form of light and heat energy, calculate the voltage drop across the bulb.
3. To move charge q from point a to point b requires -30 joule. Find the voltage drop v_{ab} if $q = 2$ C.
4. Find the power delivered to an element at $t = 3$ ms if the current entering its positive terminal is $i = 5 \cos(50\pi t)$ A and the voltage is (a) $v = 3i$, (b) $v = 3 \frac{di}{dt}$.
5. In a very simplified approach, we will consider the gate of the MOSFET transistor as a capacitor C_G (actually, there are three capacitances, C_{GS} , C_{GD} and C_m). Consider that the transistor acts as a PWM switch, so it is periodically switched on and off and the gate is periodically charged at the voltage V_G and discharged to zero. Consider that $C_G = 18.3$ nF, $V_G = 10$ V and $f_{PWM} = 100$ kHz. Find average source and sink current to the gate. Find the peak current, if total charge time is $t_{on} = 196$ ns (assuming linear charging).
6. A lightning bolt with 8 kA strikes an object for 15 μ s. How much charge is deposited on the object?
7. A rechargeable flashlight battery is capable of delivering 85 mA for about 12 h. How much charge can it release at that rate? If the terminal voltage is 1.2 V, how much energy can the battery deliver? What power rating has a lightbulb?
8. The rated power of the resistor with resistance $R = 1$ k Ω is $P = 1$ W. Calculate maximum current, which may flow through the resistor, and maximum allowed voltage.
9. The rated capacity of the car battery is 25 kWh and rated voltage is $V = 400$ V. Calculate rated capacity of battery in Ah.

¹Alexander Ch. K., Sadiku M., N. O.: Fundamentals of Electric Circuits, 3rd ed., Mc Graw Hill, ISBN: 978-0-07-297718-9