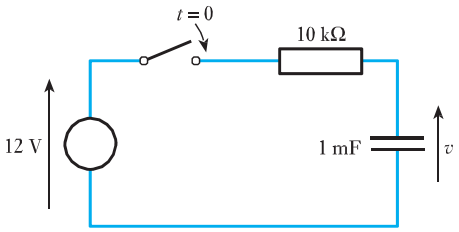
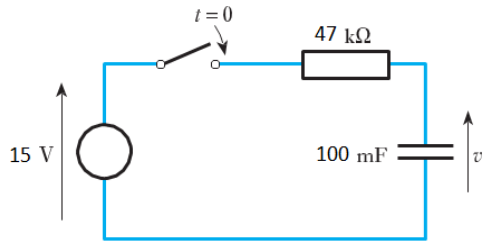
9.1 Explain the meanings of the terms 'steady-state response' and 'transient response'.

9.2 When a voltage is suddenly applied across a series combination of a resistor and an uncharged capacitor, what is the initial current in the circuit? What is the final, or steady-state, current in the circuit?

9.3 The switch in the following circuit is closed at $t = 0$ s. Derive an expression for the current in the circuit after this time and hence calculate the current in the circuit at $t = 4$ s.



9.4 The switch in the following circuit is closed at t = 0 s. Derive an expression for the voltage v and hence calculate the voltage across the capacitor at t = 5 s.

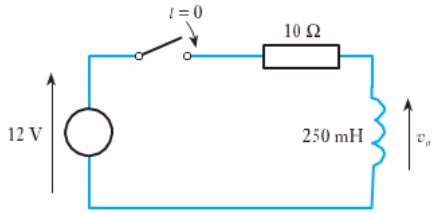


9.5 In the circuit of Exercise 9.4 what is the final or steady-state voltage across the capacitor?

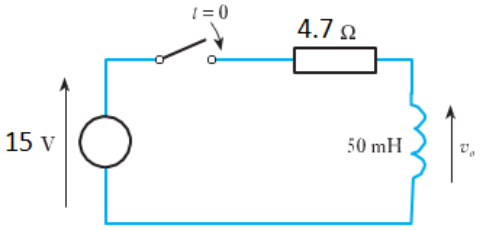
9.6 In the circuit of Exercise 9.4 what is the final or steady-state voltage across the resistor?

9.7 When a voltage is suddenly applied across a series combination of a resistor and an inductor, what is the initial current in the circuit? What is the final, or steady-state, current in the circuit?

9.8 The switch in the following circuit is closed at $t = 0$. Deduce an expression for the output voltage of the circuit and hence calculate the time at which the output voltage will be equal to 8 V.



9.9 The switch in the following circuit is closed at t = 0. Derive an expression for the current in the circuit and hence calculate the current in the inductor at t = 20 ms.



9.10 In the circuit of Exercise 9.9, what is the final or steady-state voltage across the inductor?

9.11 In the circuit of Exercise 9.9, what is the final or steady-state voltage across the resistor?

9.12 A capacitor of 25 μF is initially charged to a voltage of 50 V. At time $t = 0$, a resistance of 1 kΩ is connected directly across its terminals. Derive an expression for the voltage across the capacitor as it is discharged and hence determine the time taken for its voltage to drop to 10 V.

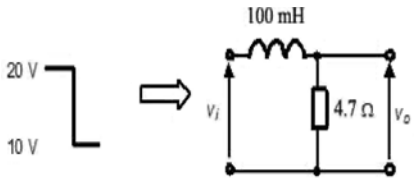
9.13 An inductor of 25 mH is passing a current of 1 A. At $t = 0$, the circuit supplying the current is instantly replaced by a resistor of 100 Ω connected directly across the inductor. Derive an expression for the current in the inductor as a function of time and hence determine the time taken for the current to drop to 100 mA.

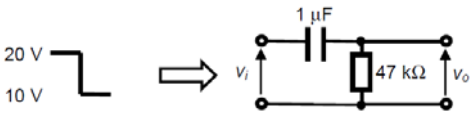
9.14 What is meant by a first order system and what kind of circuits fall within this category?

9.15 Explain how the equation for an increasing or decreasing exponential waveform may be found using the initial and final values of the waveform

9.16 The input voltage to the following RC network undergoes a step change from 20 V to 10 V at time t = 0. Derive an expression for the resulting

9.17 The input voltage to the following RL network undergoes a step change from 20 V to 10 V at time t = 0. Derive an expression for the resulting output voltage.





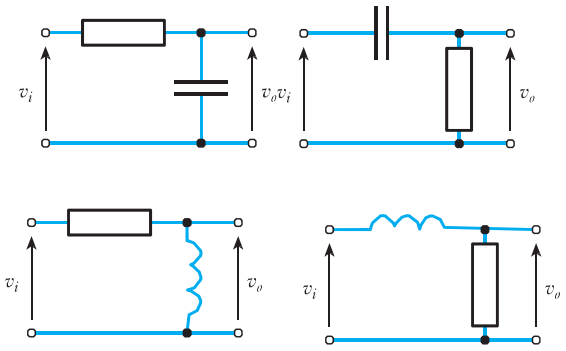
9.18 What is meant by a saturating exponential waveform?

9.19 What is meant by a decaying exponential waveform?

9.20 Sketch the exponential waveform $v = 5e^{-t/10}$.

9.21 For each of the following circuit arrangements, sketch the form of the output voltage when the period of the square-wave input voltage is:

- much greater than the time constant of the circuit;
- equal to the time constant of the circuit;
- much less than the time constant of the circuit.



9.22 Under what circumstances does the behaviour of a first-order high-pass filter resemble that of a differentiator?

9.23 Under what circumstances does the behaviour of a first-order low-pass filter resemble that of an integrator?

9.24 What is meant by a 'second-order system', and what kind of circuits fall within this category?

9.25 Derive an expression for the *current* in the circuit of Figure 9.8.

9.26 Explain what is meant by the terms 'undamped natural frequency' and 'damping factor' as they apply to second-order systems.

9.27 What is meant by 'critical damping' and what value of the damping factor corresponds to this situation?