In answering some of the following questions, you may need device characteristics. The operational amplifier is ideal. There is no offset. The output saturation voltage is 1.5 V below the power supply voltage. For JFET, $g_m = 4.0 \text{ mS}$. Parameters of BJT include $h_{FE} = \beta_{ac} = 250$, $r_\pi = h_{IE} = 1 \text{k}\Omega$, $V_{BE} = 0.68 \text{ V}$, and $r_x = 0$.

1. To measure a very low frequency, e.g., 10 Hz, waveform using an oscilloscope, one should use (a) DC coupling (b) AC coupling.
2. A voltage divider is made of 1 k$\Omega$ and 50 $\Omega$ resistors in series. If the input is one volt, what is the approximate output voltage? (a) 0.05 V (b) 0.5 V (c) 1 V (d) 5 V.
3. Two operational amplifier circuits were built; one with a gain of 20 and the other 200. Which circuit has a larger bandwidth? (a) gain of 20, (b) gain of 200.
4. The output impedance of the operational amplifier is of the order of (a) 30 $\Omega$ (b) 300 $\Omega$ (c) 3 k$\Omega$ (d) 300 k$\Omega$.
5. Under a reverse bias, the gate-source resistance of a JFET is of the order of (a) 1 k$\Omega$ (b) 10 k$\Omega$ (c) 1 M$\Omega$ (d) 10 M$\Omega$.
6. Consider the JFET amplifier built. Assuming everything else remains unchanged, which action may lead to an increase in the voltage gain? (a) decrease $R_D$ (b) increase $V_{GS}$, i.e., make it less negative (c) increase $R_S$.
7. With a power supply of 15 V, in order to realize the maximum voltage swing without distortion, the Q-point $V_{DS}$ of a JFET amplifier should be: (a) 7.5 V (b) 9 V (c) 12 V.
8. The input impedance of the common-emitter BJT amplifier is of the order of (a) 1 $\Omega$ (b) 10 $\Omega$ (c) 100 $\Omega$ (d) 1 k$\Omega$ (e) 10 k$\Omega$.
9. Based on the device characteristics given, calculate $R_1$ of the BJT amplifier circuit, if the power supply voltage is 15 V, $I_C=5 \text{ mA}$, $R_E=200 \text{ $\Omega$}$, and $R_2=47 \text{ k$\Omega$}$. $R_1$ should be approximately (a) 250 k$\Omega$ (b) 25 k$\Omega$ (c) 2.5 k$\Omega$.
10. Based on the device characteristics, calculate $R_S$ of the JFET amplifier circuit. Assume the power supply voltage is 15 V, $I_D=3 \text{ mA}$. $R_S$ should be approximately of the order of (a) 25 $\Omega$ (b) 250 $\Omega$ (c) 2.5 k$\Omega$.
11. With a power supply of 15 V, in order to realize the maximum voltage swing without distortion, the Q-point $V_{ce}$ of a BJT amplifier should be: (a) 7.5 V (b) 8 V (c) 9 V.
12. To increase the Q-point voltage at the collector of the BJT amplifier, one should (a) increase $R_1$ (b) increase $R_2$.
13. To obtain a voltage gain of 250, $R_C$ should be approximately (a) 100 $\Omega$ (b) 1 k$\Omega$ (c) 10 k$\Omega$ (d) 100 k$\Omega$. 
14. The main purpose of using a common-collector amplifier circuit is to provide (a) a low input impedance (b) **a low output impedance** (c) a high input impedance (d) a high output impedance.

15. The phase between the input and the output signal of the common-collector amplifier is (a) $0^\circ$, (b) $90^\circ$, (c) $180^\circ$, (d) $270^\circ$.

16. The phase between the two collector ports of the differential amplifier is (a) $0^\circ$, (b) $90^\circ$, (c) $180^\circ$, (d) $270^\circ$.

17. The output impedance of a constant voltage source is very low, therefore, the output impedance of a current source should be (a) very low (b) **very high**.

18. The low frequency -3 dB point of the differential amplifier is approximately (a) **non-existing**, i.e., it works even at DC (b) 20 Hz (c) 200 Hz (d) 2 kHz.

19. The frequency response of an R-C circuit is often determined by the RC time constant. Based on this, the high frequency -3 dB point would (a) increase (b) **decrease** if $R_C$ is increased in the differential amplifier circuit.

20. The differential amplifier built has easily a differential voltage gain in excess of 200. What is the common-mode voltage gain? (a) same as the differential gain (b) much larger than the differential gain (c) **much less than the differential gain**.