

1. A pn junction is forward biased when the n side is more positive than the p side.

☐ True      ☐ False

2. A half-wave rectifier's output never reverses direction.

☐ True      ☐ False

3. The BJT stays in the active region as long as

☐  $V_{CE} > 0$  V

☐  $V_{BE} > 0.7$  V

☐  $I_C > I_B$

☐  $V_{CE} > \text{about } 0.2$  V

4. An n-channel MOSFET with  $V_t = 1.5$  V and  $v_{GS} = 1.0$  V conducts a small drain current set by the square law.

☐ True      ☐ False

5. In the small-signal model, a DC supply rail becomes signal ground.

☐ True      ☐ False

6. An inverting stage has  $R_{in} = 10$  k $\Omega$  and  $R_f = 90$  k $\Omega$ . What is  $\beta_{fb}$ ?

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7. A 1  $\mu$ F coupling capacitor sees 10 k $\Omega$ . What is  $f_L$ , in Hz?

\_\_\_\_\_ Hz

8. Ten times the diode current costs how much extra voltage ( $n = 1$ )?

☐ 120 mV

☐ 0.7 V

☐ 26 mV

☐ about 60 mV

9. Each bridge diode must survive a peak inverse voltage of about

☐ the ripple

☐ 0.7 V

☐ one secondary peak (17 V here)

10. A bias divider has  $R_1 = 47$  k $\Omega$  to a 10 V supply and  $R_2 = 10$  k $\Omega$  to ground. What is  $V_B$ , in volts, ignoring base current?

\_\_\_\_\_ V

1. **False**

Forward bias puts the p side positive. With the n side positive the depletion region widens and the junction blocks.

2. **True**

The diode blocks the negative half-cycles, so the load current only ever flows one way. It is DC in direction, though far from steady.

3.  **$V_{CE} > \text{about } 0.2 \text{ V}$**

Saturation starts at about  $V_{CE} = 0.2 \text{ V}$ , with both junctions forward biased. Checking  $V_{CE} > 0$  lets a saturated transistor pass as an amplifier.

4. **False**

$v_{GS} < V_t$ , so no channel forms: the device is cut off. The square law applies only above threshold, in saturation.

5. **True**

A constant voltage has no wiggle, so for the signal it behaves as a short to ground. The same holds for large coupling and bypass capacitors at signal frequency.

6. **0.1**

$\beta_{fb} = \frac{10}{10 + 90} = 0.1$ . The ideal gain is  $-9$ ; with  $A_{OL} = 10^5$  the loop gain is  $10^4$ .

7. **15.9 Hz**

$\frac{1}{2\pi \times 10^4 \times 10^{-6}} = 15.9 \text{ Hz}$ .

8. **about 60 mV**

$\ln 10 \times V_T = 2.303 \times 26 = 59.9 \text{ mV}$ . This steepness is why the 0.7 V model works; with  $n = 2$  it would be 120 mV.

9. **one secondary peak (17 V here)**

The pair that is off sees one full secondary peak,  $12\sqrt{2} = 17 \text{ V}$ . Rate the diodes above that.

10. **1.75 V**

$10 \times \frac{10}{57} = 1.75 \text{ V}$ . Its Thévenin resistance is  $47 \text{ k} \parallel 10 \text{ k} = 8.25 \text{ k}\Omega$ .