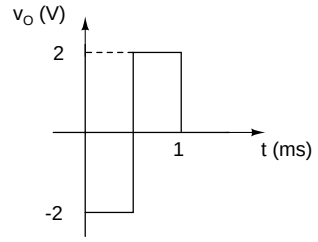
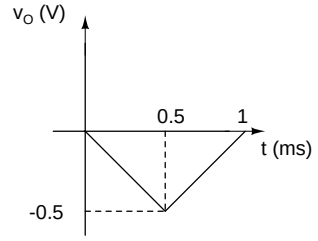
Operational Amplifiers
Answers to Extra Practice Problems

1. Using the basic current source configuration, $R_{ref} = 7.15k\Omega$ and $r_o = 50k\Omega$. Other configurations can be used, so this is not the only correct answer.
2. $I_{REF} = 13.6\mu A$; select $R = 1.7M\Omega$
3. $\frac{v_O}{v_{in}} \approx 20$
4. (a) $R_1 = 10k\Omega$, $R_2 = 1M\Omega$ (b) $bw = \frac{w_\tau R_1}{R_2 + R_1} = 9.9kHz$
5. (a) $R_1 = 100\Omega$, $R_2 = 9900\Omega$ (b) $bw = \frac{w_\tau R_1}{R_2 + R_1} = 10kHz$ (c) $A_v = \frac{a}{1+a\beta} = \frac{a}{1+\frac{aR_1}{R_1+R_2}} = 99$
6. See graph below.




7. See graph below.




8. (a) $v_o = v_i + RC\frac{dv_i}{dt}$ (b) $v_o = (1 + sCR)v_i$
9. $Z_{in} = \frac{sCR_1+1}{sCR_2+1}R_2$
10. $v_O = 5v_{IN} - 5$
11. $\frac{v_{O1}}{v_{IN}} = -10/3$, $\frac{v_{O2}}{v_{IN}} = -20/3$
12. $$-v_O = \frac{R_2}{R_1}v_i(t) + \left(R_2C + \frac{L}{R_1}\right)\frac{dv_{in}}{dt} + LC\frac{d^2v_{in}}{dt^2}$$