Basic Electronics Solutions

1. 4R
2. 102R
3. R/2
4. $\dfrac{(10R)(1R)}{10R+1R}=\dfrac{10}{11}R$
5. $\dfrac{2}{3}R$
6. $\dfrac{1}{{}^{1}\!/_{R}+{}^{1}\!/_{2R}+{}^{1}\!/_{2R}}=\dfrac{R}{2}$
7. $(12V)\dfrac{10k}{10k+10k}=6V$
8. Voltage divider
9. Short the voltage source, and calculate the Thevenin resistance. It turns out to simply be the parallel combination of two 10 k resistors, hence the output impedance is 5k.
10. Find the input impedance by first combining the two 30k resistors in series. The resulting 60k resistance is now in parallel with 10k from the lower leg of the pair of 10k resistors. The resulting 8.6k resistance is in series with the upper 10k resistor. Thus the input impedance is 18.6k.
11. Use superposition to solve this problem. First, imagine that the -5V node is instead connected to ground. Calculate the voltage, V_a. $V_a=(5V)\dfrac{2k+2k}{2k+2k+2k}=3.33V$. Now replace the -5V node, and imagine the +5V node is connected to ground. Calculate V_a, it is again a simple voltage divider. $V_a=(-5V)\dfrac{2k}{2k+2k+2k}=-1.67V$. The final solution is $V_a=3.33-1.67=1.67V$
12. Short the voltage sources to ground, and calculate the equivalent resistance from node a to ground. It turns out to be 2k in parallel with 4k, which is 1.5k. Thus, the Thevenin equivalent circuit is a 1.67V source in series with at 1.5k resistor.
13. Reduce the problem into a simple voltage divider by collapsing the upper loop. The uppermost resistors combine in series to 3k and then can be combined in parallel with the remaining 2k into an equivalent resistance of $\dfrac{6}{5}k$. This resistance now forms a simple voltage divider with the 10k resistor, hence, $V_a=(5V)\dfrac{(10k)}{\frac{6}{5}k+10k}=4.46V$.
14. The capacitance of capacitors in parallel add, so $C_{equiv}=11C$
15. 8C

16. $\text{Cequiv} = \dfrac{1}{\frac{1}{C} + \frac{1}{10C}} = \dfrac{10}{11}C$

17. Inductances of inductors in series add, so $L_{equiv}=11L$

18. The reciprocal inductances of inductors in parallel add, so $L_{equiv}=\dfrac{10}{11}L$

19. $(5V)\dfrac{(1M)}{800k + 1M} = 2.78V$