ECN 3321 Bond price calculation practice questions

Calculate the price of a bond with these characteristics. In each case, assume the coupon rate is 0.06, coupon payments are made every six months (twice per year), and the par value (maturity payment) of the bond is 1,000.

1. years to maturity = 5.0; market interest rate = 0.03.
2. years to maturity = 5.0; market interest rate = 0.05.
3. years to maturity = 5.0; market interest rate = 0.06.
4. years to maturity = 5.0; market interest rate = 0.08.
5. years to maturity = 5.0; market interest rate = 0.09.
6. years to maturity = 8.0; market interest rate = 0.03.
7. years to maturity = 8.0; market interest rate = 0.05.
8. years to maturity = 8.0; market interest rate = 0.06.
9. years to maturity = 8.0; market interest rate = 0.08.
10. years to maturity = 8.0; market interest rate = 0.09.
11. years to maturity = 12.0; market interest rate = 0.03.
12. years to maturity = 12.0; market interest rate = 0.05.
13. years to maturity = 12.0; market interest rate = 0.06.
14. years to maturity = 12.0; market interest rate = 0.08.
15. years to maturity = 12.0; market interest rate = 0.09.
16. years to maturity = 15.0; market interest rate = 0.03.
17. years to maturity = 15.0; market interest rate = 0.05.
18. years to maturity = 15.0; market interest rate = 0.06.
19. years to maturity = 15.0; market interest rate = 0.08.
20. years to maturity = 15.0; market interest rate = 0.09.

21. years to maturity = 20.0; market interest rate = 0.03.
22. years to maturity = 20.0; market interest rate = 0.05.
23. years to maturity = 20.0; market interest rate = 0.06.
24. years to maturity = 20.0; market interest rate = 0.08.
25. years to maturity = 20.0; market interest rate = 0.09.

Answers

1. $n = 2 \times 5.0 = 10$; $r = \frac{0.03}{2} = 0.01500$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.01500}\right)\left(\frac{(1+0.01500)^{10}-1}{(1+0.01500)^{10}}\right) + \frac{1{,}000}{(1+0.01500)^{10}}$$

$$P = (2{,}000)\left(\frac{1.16054-1}{1.16054}\right) + \frac{1{,}000}{1.16054}$$

$$P = 276.6655 + 861.6672$$

$$P = 1{,}138.33$$

2. $n = 2 \times 5.0 = 10$; $r = \frac{0.05}{2} = 0.02500$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.02500}\right)\left(\frac{(1+0.02500)^{10}-1}{(1+0.02500)^{10}}\right) + \frac{1{,}000}{(1+0.02500)^{10}}$$

$$P = (1{,}200)\left(\frac{1.28008-1}{1.28008}\right) + \frac{1{,}000}{1.28008}$$

$$P = 262.5619 + 781.1984$$

$$P = 1{,}043.76$$

3. $n = 2 \times 5.0 = 10$; $r = \frac{0.06}{2} = 0.03000$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.03000}\right)\left(\frac{(1+0.03000)^{10}-1}{(1+0.03000)^{10}}\right) + \frac{1{,}000}{(1+0.03000)^{10}}$$

$$P = (1{,}000)\left(\frac{1.34392-1}{1.34392}\right) + \frac{1{,}000}{1.34392}$$

$$P = 255.9061 + 744.0939$$

$$P = 1{,}000.00$$

4. $n = 2 \times 5.0 = 10$; $r = \frac{0.08}{2} = 0.04000$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.04000}\right)\left(\frac{(1+0.04000)^{10}-1}{(1+0.04000)^{10}}\right) + \frac{1{,}000}{(1+0.04000)^{10}}$$

$$P = (750)\left(\frac{1.48024-1}{1.48024}\right) + \frac{1{,}000}{1.48024}$$

$$P = 243.3269 + 675.5642$$

$$P = 918.89$$

5. $n = 2 \times 5.0 = 10$; $r = \frac{0.09}{2} = 0.04500$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.04500}\right)\left(\frac{(1+0.04500)^{10}-1}{(1+0.04500)^{10}}\right) + \frac{1{,}000}{(1+0.04500)^{10}}$$

$$P = (666.6667)\left(\frac{1.55297-1}{1.55297}\right) + \frac{1{,}000}{1.55297}$$

$$P = 237.3815 + 643.9277$$

$$P = 881.31$$

6. $n = 2 \times 8.0 = 16$; $r = \frac{0.03}{2} = 0.01500$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.01500}\right)\left(\frac{(1+0.01500)^{16}-1}{(1+0.01500)^{16}}\right) + \frac{1{,}000}{(1+0.01500)^{16}}$$

$$P = (2{,}000)\left(\frac{1.26899-1}{1.26899}\right) + \frac{1{,}000}{1.26899}$$

$$P = 423.9379 + 788.0310$$

$$P = 1{,}211.97$$

7. $n = 2 \times 8.0 = 16$; $r = \frac{0.05}{2} = 0.02500$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.02500}\right)\left(\frac{(1+0.02500)^{16}-1}{(1+0.02500)^{16}}\right) + \frac{1{,}000}{(1+0.02500)^{16}}$$

$$P = (1{,}200)\left(\frac{1.48451-1}{1.48451}\right) + \frac{1{,}000}{1.48451}$$

$$P = 391.6501 + 673.6249$$

$$P = 1{,}065.28$$

8. $n = 2 \times 8.0 = 16$; $r = \frac{0.06}{2} = 0.03000$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.03000}\right)\left(\frac{(1+0.03000)^{16}-1}{(1+0.03000)^{16}}\right) + \frac{1{,}000}{(1+0.03000)^{16}}$$

$$P = (1{,}000)\left(\frac{1.60471-1}{1.60471}\right) + \frac{1{,}000}{1.60471}$$

$$P = 376.8331 + 623.1669$$

$$P = 1{,}000.00$$

9. $n = 2 \times 8.0 = 16$; $r = \frac{0.08}{2} = 0.04000$;
   $C = \frac{0.06 \times 1{,}000}{2} = 30$
   $P =$ price of bond:

$$P = \left(\frac{30}{0.04000}\right)\left(\frac{(1+0.04000)^{16}-1}{(1+0.04000)^{16}}\right) + \frac{1{,}000}{(1+0.04000)^{16}}$$

$$P = (750)\left(\frac{1.87298-1}{1.87298}\right) + \frac{1{,}000}{1.87298}$$

$$P = 349.5689 + 533.9082$$

$$P = 883.48$$

10. $n = 2 \times 8.0 = 16$; $r = \frac{0.09}{2} = 0.04500$;
    $C = \frac{0.06 \times 1{,}000}{2} = 30$
    $P =$ price of bond:

$$P = \left(\frac{30}{0.04500}\right)\left(\frac{(1+0.04500)^{16}-1}{(1+0.04500)^{16}}\right) + \frac{1{,}000}{(1+0.04500)^{16}}$$

$$P = (666.6667)\left(\frac{2.02237-1}{2.02237}\right) + \frac{1{,}000}{2.02237}$$

$$P = 337.0205 + 494.4693$$

$$P = 831.49$$

11. $n = 2 \times 12.0 = 24$; $r = \frac{0.03}{2} = 0.01500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.01500}\right)\left(\frac{(1+0.01500)^{24}-1}{(1+0.01500)^{24}}\right) + \frac{1{,}000}{(1+0.01500)^{24}}$$

$$P = (2{,}000)\left(\frac{1.42950-1}{1.42950}\right) + \frac{1{,}000}{1.42950}$$

$$P = 600.9122 + 699.5439$$

$$P = 1{,}300.46$$

12. $n = 2 \times 12.0 = 24$; $r = \frac{0.05}{2} = 0.02500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.02500}\right)\left(\frac{(1+0.02500)^{24}-1}{(1+0.02500)^{24}}\right) + \frac{1{,}000}{(1+0.02500)^{24}}$$

$$P = (1{,}200)\left(\frac{1.80873-1}{1.80873}\right) + \frac{1{,}000}{1.80873}$$

$$P = 536.5496 + 552.8754$$

$$P = 1{,}089.42$$

13. $n = 2 \times 12.0 = 24$; $r = \frac{0.06}{2} = 0.03000$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.03000}\right)\left(\frac{(1+0.03000)^{24}-1}{(1+0.03000)^{24}}\right) + \frac{1{,}000}{(1+0.03000)^{24}}$$

$$P = (1{,}000)\left(\frac{2.03279-1}{2.03279}\right) + \frac{1{,}000}{2.03279}$$

$$P = 508.0663 + 491.9337$$

$$P = 1{,}000.00$$

14. $n = 2 \times 12.0 = 24$; $r = \frac{0.08}{2} = 0.04000$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.04000}\right)\left(\frac{(1+0.04000)^{24}-1}{(1+0.04000)^{24}}\right) + \frac{1{,}000}{(1+0.04000)^{24}}$$

$$P = (750)\left(\frac{2.56330-1}{2.56330}\right) + \frac{1{,}000}{2.56330}$$

$$P = 457.4089 + 390.1215$$

$$P = 847.53$$

15. $n = 2 \times 12.0 = 24$; $r = \frac{0.09}{2} = 0.04500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.04500}\right)\left(\frac{(1+0.04500)^{24}-1}{(1+0.04500)^{24}}\right) + \frac{1{,}000}{(1+0.04500)^{24}}$$

$$P = (666.6667)\left(\frac{2.87601-1}{2.87601}\right) + \frac{1{,}000}{2.87601}$$

$$P = 434.8644 + 347.7035$$

$$P = 782.57$$

16. $n = 2 \times 15.0 = 30$; $r = \frac{0.03}{2} = 0.01500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.01500}\right)\left(\frac{(1+0.01500)^{30}-1}{(1+0.01500)^{30}}\right) + \frac{1{,}000}{(1+0.01500)^{30}}$$

$$P = (2{,}000)\left(\frac{1.56308-1}{1.56308}\right) + \frac{1{,}000}{1.56308}$$

$$P = 720.4751 + 639.7624$$

$$P = 1{,}360.24$$

17. $n = 2 \times 15.0 = 30$; $r = \frac{0.05}{2} = 0.02500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.02500}\right)\left(\frac{(1+0.02500)^{30}-1}{(1+0.02500)^{30}}\right) + \frac{1{,}000}{(1+0.02500)^{30}}$$

$$P = (1{,}200)\left(\frac{2.09757-1}{2.09757}\right) + \frac{1{,}000}{2.09757}$$

$$P = 627.9088 + 476.7427$$

$$P = 1{,}104.65$$

18. $n = 2 \times 15.0 = 30$; $r = \frac{0.06}{2} = 0.03000$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.03000}\right)\left(\frac{(1+0.03000)^{30}-1}{(1+0.03000)^{30}}\right) + \frac{1{,}000}{(1+0.03000)^{30}}$$

$$P = (1{,}000)\left(\frac{2.42726-1}{2.42726}\right) + \frac{1{,}000}{2.42726}$$

$$P = 588.0132 + 411.9868$$

$$P = 1{,}000.00$$

19. $n = 2 \times 15.0 = 30$; $r = \frac{0.08}{2} = 0.04000$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.04000}\right)\left(\frac{(1+0.04000)^{30}-1}{(1+0.04000)^{30}}\right) + \frac{1{,}000}{(1+0.04000)^{30}}$$

$$P = (750)\left(\frac{3.24340-1}{3.24340}\right) + \frac{1{,}000}{3.24340}$$

$$P = 518.7610 + 308.3187$$

$$P = 827.08$$

20. $n = 2 \times 15.0 = 30$; $r = \frac{0.09}{2} = 0.04500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.04500}\right)\left(\frac{(1+0.04500)^{30}-1}{(1+0.04500)^{30}}\right) + \frac{1{,}000}{(1+0.04500)^{30}}$$

$$P = (666.6667)\left(\frac{3.74532-1}{3.74532}\right) + \frac{1{,}000}{3.74532}$$

$$P = 488.6667 + 267.0000$$

$$P = 755.67$$

21. $n = 2 \times 20.0 = 40$; $r = \frac{0.03}{2} = 0.01500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.01500}\right)\left(\frac{(1+0.01500)^{40}-1}{(1+0.01500)^{40}}\right) + \frac{1{,}000}{(1+0.01500)^{40}}$$

$$P = (2{,}000)\left(\frac{1.81402-1}{1.81402}\right) + \frac{1{,}000}{1.81402}$$

$$P = 897.4754 + 551.2623$$

$$P = 1{,}448.74$$

22. $n = 2 \times 20.0 = 40$; $r = \frac{0.05}{2} = 0.02500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.02500}\right)\left(\frac{(1+0.02500)^{40}-1}{(1+0.02500)^{40}}\right) + \frac{1{,}000}{(1+0.02500)^{40}}$$

$$P = (1{,}200)\left(\frac{2.68506-1}{2.68506}\right) + \frac{1{,}000}{2.68506}$$

$$P = 753.0833 + 372.4306$$

$$P = 1{,}125.51$$

23. $n = 2 \times 20.0 = 40$; $r = \frac{0.06}{2} = 0.03000$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.03000}\right)\left(\frac{(1+0.03000)^{40}-1}{(1+0.03000)^{40}}\right) + \frac{1{,}000}{(1+0.03000)^{40}}$$

$$P = (1{,}000)\left(\frac{3.26204-1}{3.26204}\right) + \frac{1{,}000}{3.26204}$$

$$P = 693.4432 + 306.5568$$

$$P = 1{,}000.00$$

24. $n = 2 \times 20.0 = 40$; $r = \frac{0.08}{2} = 0.04000$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.04000}\right)\left(\frac{(1+0.04000)^{40}-1}{(1+0.04000)^{40}}\right) + \frac{1{,}000}{(1+0.04000)^{40}}$$

$$P = (750)\left(\frac{4.80102-1}{4.80102}\right) + \frac{1{,}000}{4.80102}$$

$$P = 593.7832 + 208.2890$$

$$P = 802.07$$

25. $n = 2 \times 20.0 = 40$; $r = \frac{0.09}{2} = 0.04500$;
$C = \frac{0.06 \times 1{,}000}{2} = 30$
$P =$ price of bond:

$$P = \left(\frac{30}{0.04500}\right)\left(\frac{(1+0.04500)^{40}-1}{(1+0.04500)^{40}}\right) + \frac{1{,}000}{(1+0.04500)^{40}}$$

$$P = (666.6667)\left(\frac{5.81636-1}{5.81636}\right) + \frac{1{,}000}{5.81636}$$

$$P = 552.0475 + 171.9287$$

$$P = 723.98$$