

FA Module 10: Long-term liabilities – practice problems

(The attached PDF file has better formatting.)

Exercise 10.1: Accrued interest

On March 1, 20X1, a firm issues a 6% semi-annual 100 par value ten year bond at par.

- A. What is the liability for long-term debt at December 31, 20X1?
- B. What is the accrued interest at December 31, 20X1?
- C. What are the operating cash flows and financing cash flows in 20X1?
- D. What is the interest expense in 20X1?

Part A: The liability for long-term debt is the carrying value of the bond. The bond is issued at par, so the carrying value = the sales price of 100.

Part B: The interest expense is 6% *per annum* or 0.5% a month. The firm pays a semi-annual coupon of 3 on August 1. At December 31, 20X1, it owes 4 months of interest, so accrued interest = $4 \times 0.5\% \times 100 = 2$.

Part C: Both GAAP and IFRS classify the issue of the bond as a financing cash flow. GAAP classifies the interest paid as an operating cash flow; IFRS classifies the interest paid as either an operating cash flow or a financing cash flow (at the option of the firm). For GAAP:

- operating cash flow = -3
- financing cash flow = +100

For IFRS, the cash flows are either the same as for GAAP or

- operating cash flow = 0
- financing cash flow = +97

Part D: The interest expense = interest paid + Δ (accrued interest) = $3 + (2 - 0) = 5$.

Equivalently, the interest expense = the yield on the bond $\times 10/12$ of the year $\times 100$.

Exercise 10.2: Corporate debt

- On January 1, 20X1, a firm issues a three year 100 par value annual coupon bond.
 - The bond pays 6 on January 1, 20X2, 20X3, and 20X4, and the principal of 100 on January 1, 20X4.
 - The yield to maturity at issue is 5%.
- A. What is the liability for long-term bonds on January 1, 20X1?
B. What is the accrued interest on December 31, 20X1?
C. What is the liability for long-term bonds on December 31, 20X1?
D. What is the interest expense in 20X1?
E. What is the amortization of premium in 20X1?

Part A: The liability for long-term bonds is

$$6 \times ((1.05)^{-1} + (1.05)^{-2} + (1.05)^{-3}) + 100 \times (1.05)^{-3} = 102.7232$$

Part B: The accrued interest on December 31, 20X1, is $6\% \times 100 = 6$. This interest will be paid on January 1, 20X2, but it has been accrued in 20X1.

Part C: The carrying value of the bond at December 31, 20X1, is

$$6 \times ((1.05)^{-1} + (1.05)^{-2}) + 100 \times (1.05)^{-2} = 101.8594$$

Equivalently, the carrying value on December 31, 20X1, is $102.7232 \times 1.05 - 6 = 101.8594$

Part D: The interest expense is the carrying value at the beginning of the year $\times$ the yield to maturity =

$$102.7232 \times 5\% = 5.1362$$

Part E: The amortization of premium = interest paid – interest expense = $6 - 5.1362 = 0.8638$.

We verify this as $102.7232 - 101.8594 = 0.8638$.

Exercise 10.3: Corporate debt

- On January 1, 20X1, a firm issues a three year 100 par value annual coupon bond.
 - The bond pays 6 on January 1, 20X2, 20X3, and 20X4, and the principal of 100 on January 1, 20X4.
 - The yield to maturity at issue is 7%.
- A. What is the liability for long-term bonds on January 1, 20X1?
B. What is the accrued interest on December 31, 20X1?
C. What is the liability for long-term bonds on December 31, 20X1?
D. What is the interest expense in 20X1?
E. What is the accrual of discount in 20X1?

Part A: The liability for long-term bonds is

$$6 \times ((1.07)^{-1} + (1.07)^{-2} + (1.07)^{-3}) + 100 \times (1.07)^{-3} = 97.3757$$

Part B: The accrued interest on December 31, 20X1, is $6\% \times 100 = 6$. This interest will be paid on January 1, 20X2, but it has been accrued in 20X1.

Part C: The carrying value of the bond at December 31, 20X1, is

$$6 \times ((1.07)^{-1} + (1.07)^{-2}) + 100 \times (1.07)^{-2} = 98.1920$$

Equivalently, the carrying value on December 31, 20X1, is $97.3757 \times 1.07 - 6 = 98.1920$

Part D: The interest expense is the carrying value at the beginning of the year $\times$ the yield to maturity =

$$97.3757 \times 7\% = 6.8163$$

Part E: The accrual of discount = interest paid – interest expense = $6.8163 - 6 = 0.8163$

We verify this as $98.1920 - 97.3757 = 0.8163$

Exercise 10.4: Zero-coupon debt

On December 31, 20X0, a firm issues 3 year zero-coupon debt that matures for 100 on December 31, 20X3. The yield to maturity at issue is 5% *per annum*.

- A. What is the liability for long-term debt on December 31, 20X0?
- B. What is the interest expense in 20X1?
- C. What is the liability for long-term debt on December 31, 20X1?
- D. What is the accrual of discount in 20X1?

Part A: The liability for long-term debt on December 31, 20X0, is $100 \times 1.05^{-3} = 86.3838$.

Part B: The interest expense in 20X1 is $86.3838 \times 5\% = 4.3192$.

Part C: The liability for long-term debt on December 31, 20X1, is $100 \times 1.05^{-2} = 90.7029$.

Part D: The accrual of discount in 20X1 is $90.7029 - 86.3838 = 4.3191$.

Equivalently, the accrual of discount in 20X1 is $86.3838 \times 5\% = 4.3192$.

Exercise 10.5: Bond valuation

A three year 240 par value bond with no issue fees is sold to bondholders for 226.185 on December 31, 20X0. It pays 20 on December 31, 20X1 and 20X2, and 240 on December 31, 20X3.

- A. What is the bond's carrying value on December 31, 20X0?
- B. What is the bond's yield to maturity?
- C. What is the bond's interest expense in 20X1?
- D. What is the cash flow in 20X1?
- E. What is the bond's carrying value on December 31, 20X1?

Part A: The carrying value of the bond at issue is the fair value of the bond, which is the price received for the bond if the bond has no issue costs (as assumed in this practice problem) = 226.185.

Part B: The accounting entries for interest expense, amortization, and carrying value in subsequent years depends on the yield to maturity of the bond at issue, called the effective interest rate in the textbook. This yield to maturity is not reported by the firm and the effective interest rate varies for each bond. In practice, we compute the yield to maturity by a spread-sheet or a hand calculator; final exam problems give the yield to maturity if it is needed to solve the problem. We solve the following equation for R:

$$20 \times (1+R)^{-1} + 20 \times (1+R)^{-2} + 240 \times (1+R)^{-3} = 226.18503$$

which gives a yield to maturity of 8% *per annum*. We verify:

$$20 \times 1.08^{-1} + 20 \times 1.08^{-2} + 240 \times 1.08^{-3} = 226.18503$$

Part C: Interest expense in 20X1 is $226.185 \times 8\% = 18.09480$

Part D: For GAAP, the operating cash flow is -20 (a cash outflow). Under IFRS, the firm classifies this cash outflow as either an operating cash flow or a financing cash flow.

Part E: The bond amortization in 20X1 is the interest paid minus the interest expense:

$$20 - 18.09480 = 1.90520$$

Part F: The carrying value of the bond on December 31, 20X1, is the carrying value on December 31, 20X0, minus the bond amortization:

$$226.18503 - 1.90520 = 224.27983$$

We can also compute the carrying value on December 31, 20X1, directly as

$$20 \times 1.08^{-1} + 20 \times 1.08^{-2} + 240 \times 1.08^{-3} = 224.27984$$

Exercise 10.6: Debt extinguishment

- A company issues a 5 year 500 par value 8% annual coupon bond on December 31, 20X1.
- The yield to maturity at issue of the bond is 8%.
- Legal costs of issue are zero.
- The company redeems the bond at a call price of 102 on December 31, 20X4.

- A. What is the carrying value of the bond at December 31, 20X4?
- B. What is the gain or loss on debt extinguishment?
- C. What is the operating cash flow in 20X4?
- D. What is the financing cash flow in 20X4?

Part A: The bond is issued at par with no issue costs, so the carrying value is the par value each year.

Part B: The bond is redeemed for $500 \times 1.02 = 510$. The gain or loss on debt extinguishment is $500 - 510 = -10$ (a loss of 10).

Part C: The operating cash outflow for GAAP is the interest payment of $8\% \times 500 = 40$, or an operating cash flow of -40 . For IFRS, the firm has the option of classifying interest payments as a financing cash outflow.

Part D: The financing cash outflow for GAAP is the redemption value of 510. For IFRS, if the firm classifies interest payments as a financing cash outflow, the financing cash outflow is 550.

Exercise 10.7: Debt amortization

A firm issues a five year 6% annual coupon 100,000 par value bond on December 31, 20X1. The interest expense on the bond in 20X6 is 6,400. The firm reports under IFRS.

- A. What is the interest paid in 20X6?
- B. What is the accrual of discount or amortization of premium in 20X6?
- C. What is the carrying value of the bond on December 31, 20X5?
- D. What is the yield to maturity on December 31, 20X1?
- E. What is the sale price of the bond on December 31, 20X1?

Part A: The interest paid in 20X6 is $6\% \times 100,000 = 6,000$.

Part B: The interest expense = interest paid – amortization of premium + accrual of discount.

The interest expense of 6,400 is more than the interest paid of 6,000, so the bond is sold at a discount and the accrual of discount in 20X6 = 400.

Part C: The carrying value of bond at December 31, 20X5, is the maturity value (the par value) – the discount accrued in 20X6 (or + the premium amortized in 20X6 if the bond had been sold at a premium):

$$100,000 - 400 = 99,600.$$

Part D: The yield to maturity is constant over the life of the bond.

The yield to maturity in 20X6 is $106,000 / 99,600 - 1 = 6.4257\%$

The yield to maturity is the same at December 31, 20X1.

Part E: The sale price of the bond on December 31, 20X1, =

$$6,000 \times (1/1.064257^1 + 1/1.064257^2 + 1/1.064257^3 + 1/1.064257^4 + 1/1.064257^5) + 100,000 / 1.064257^5 = 98,227.37$$

Question: Why does the problem say that the firm reports under IFRS?

Answer: IFRS requires constant yield amortization for bonds. The textbook says that GAAP permits straight line amortization for bonds (like for fixed assets), though firms generally use constant yield amortization. Final exam problems assume constant yield amortization for both IFRS and GAAP.

Exercise 10.8: Debt amortization

A firm issues a five year 6% annual coupon 100,000 par value bond on December 31, 20X1. The interest expense on the bond in 20X6 is 5,500. The firm reports under IFRS.

- A. What is the interest paid in 20X6?
- B. What is the accrual of discount or amortization of premium in 20X6?
- C. What is the carrying value of the bond on December 31, 20X5?
- D. What is the yield to maturity on December 31, 20X1?
- E. What is the sale price of the bond on December 31, 20X1?

Part A: The interest paid in 20X6 is $6\% \times 100,000 = 6,000$.

Part B: The interest expense = interest paid – amortization of premium + accrual of discount.

The interest expense of 5,500 is less than the interest paid of 6,000, so the bond is sold at a premium and the amortization of premium in 20X6 = 500.

Part C: The carrying value of bond at December 31, 20X5, is the maturity value (the par value) + the premium amortized in 20X6 – the discount accrued in 20X6.

Part D: The yield to maturity is constant over the life of the bond.

The yield to maturity in 20X6 is $106,000 / 100,500 - 1 = 5.4726\%$

The yield to maturity is the same at December 31, 20X1.

Part E: The sale price of the bond on December 31, 20X1, =

$$6,000 \times (1/1.054726^1 + 1/1.054726^2 + 1/1.054726^3 + 1/1.054726^4 + 1/1.054726^5) + 100,000 / 1.054726^5 = 102,253.84$$

Question: Why does the problem say that the firm reports under IFRS?

Answer: IFRS requires constant yield amortization for bonds. The textbook says that GAAP permits straight line amortization for bonds (like for fixed assets), though firms generally use constant yield amortization. Final exam problems assume constant yield amortization for both IFRS and GAAP.

Exercise 10.9: One year bond

A firm issues a one year 6% annual coupon 100,000 par value bond on December 31, 20X1, and receives cash of 99,600. Bond issue costs are zero.

- A. What is the carrying value of the bond on December 31, 20X1?
- B. What is the interest paid in 20X1?
- C. What is the yield to maturity of the bond?
- D. What is the amortization of premium / accrual of discount in 20X1?
- E. What is the interest expense in 20X1?

Part A: The carrying value of the bond at inception is the cash received (+ issue costs for IFRS) = 99,600.

The sales price is *less* than the par value, so the bond is sold at a discount.

Part B: The interest paid in 20X1 is $6\% \times 100,000 = 6,000$.

Part C: The yield to maturity is $106,000 / 99,600 - 1 = 6.4257\%$

Part D: The accrual of discount in 20X1 is $100,000 - 99,600 = 400$.

Part E: The interest expense can be derived two ways:

- Interest expense = interest paid + accrual of discount: $6,000 + 400 = 6,400$
- Interest expense = carrying value at beginning of year $\times$ yield to maturity = $99,600 \times 6.4257\% = 6,400.00$

Question: Do these formulas apply to semi-annual bonds?

Answer: The effective annual yield differs from a semi-annual bond yield. Exam problems asking for the yield to maturity use annual coupon bonds. Exam problems on other topics, such as accrued interest, may use semi-annual coupon bonds.

Exercise 10.10: One year bond

A firm issues a one year 6% annual coupon 100,000 par value bond on December 31, 20X1, and receives cash of 100,500. Bond issue costs are zero.

- A. What is the carrying value of the bond on December 31, 20X1?
- B. What is the interest paid in 20X1?
- C. What is the yield to maturity of the bond?
- D. What is the amortization of premium / accrual of discount in 20X1?
- E. What is the interest expense in 20X1?

Part A: The carrying value of the bond at inception is the cash received (+ issue costs for IFRS) = 100,500.

The sales price is *more* than the par value, so the bond is sold at a premium.

Part B: The interest paid in 20X1 is $6\% \times 100,000 = 6,000$.

Part C: The yield to maturity is $106,000 / 100,500 - 1 = 5.4726\%$

Part D: The amortization of premium in 20X1 is $100,500 - 100,000 = 500$.

Part E: The interest expense can be derived two ways:

- Interest expense = interest paid – amortization of premium: $6,000 - 500 = 5,500$
- Interest expense = carrying value at beginning of year $\times$ yield to maturity = $100,500 \times 5.4726\% = 5,500$

Question: Do these formulas apply to semi-annual bonds?

Answer: The effective annual yield differs from a semi-annual bond yield. Exam problems asking for the yield to maturity use annual coupon bonds. Exam problems on other topics, such as accrued interest, may use semi-annual coupon bonds.

The cash received yield to maturity on the bond is interest expense on the bond in 20X6 is $(6,500 / 5,500)$. The firm reports under IFRS.

Exercise 10.11: Current liabilities

A firm issues a 5 year 100 par value 6% annual coupon bond on July 1, 20X1. The yield to maturity is 6%.

- A. What are the current liabilities related to this debt at December 31, 20X4?
- B. What are the current liabilities related to this debt at December 31, 20X5?

Part A: The bond issued on July 1, 20X1, matures on June 30, 20X6, so it is a non-current liability of 100 on December 31, 20X4.

The accrued interest on the bond is payable on June 30, 20X5. On December 31, 20X5, it is a current liability of $6\% \times \frac{1}{2} \times 100 = 3$.

Part B: On December 31, 20X5, the bond principal of 100 is also a current liability, since it is due within one year. The total current liability is 103.

Question: The bond pays 106 on June 30, 20X6; why is the current liability only 103?

Answer: The interest expense of 3 for January through June 20X6 is not yet accrued on December 31, 20X5,.

Exercise 10.12: Current liabilities

A firm issues a 5 year 100 par value 6% annual coupon bond each July 1 from 20X1 through 20X5. All the bonds are issued with yields to maturity of 6%.

- A. What is the accrued interest related to this debt at December 31, 20X5?
- B. What are the current liabilities related to this debt at December 31, 20X5?
- C. What are the non-current liabilities related to this debt at December 31, 20X5?

Solution 10.12: the notes issued on July 1, 20X1, mature on June 30, 20X6. They are classified as current liabilities (100,000) on December 31, 20X5.

Part A: The accrued interest on all the bonds are payable on June 30, 20X6 = $5 \times 6\% \times \frac{1}{2} \times 100 = 15$.

Part B: The bond issued in 20X1 matures in 20X6, so it is a current liability of 100 on December 31, 20X5.

The total current liabilities on December 31, 20X5, = $15 + 100 = 115$.

Part C: The bonds issued in 20X2-20X5 mature after 20X6, so the non-current liability is $4 \times 100 = 400$

Exercise 10.13: Bond covenants

Which of the following might be included as a bond covenant?

- A. Minimum vs maximum current ratio
- B. Minimum vs maximum interest coverage ratio
- C. Minimum vs maximum shareholder dividends
- D. Restrictions on future borrowings
- E. Restrictions on future stock issues

Part A: A higher current ratio means the firm has more current assets covering its debt. The bond covenant might require a minimum current ratio.

Part B: A higher interest coverage ratio means the firm has more income to pay its debt. The bond covenant might require a minimum interest coverage ratio.

Part C: Shareholder dividends take money out of the firm that might otherwise be used to pay its debt. The bond covenant might restrict shareholder dividends below a maximum.

Part D: Future borrowings increase the firm's debt obligations. If new bondholders require collateral, the assets which might cover the existing debt are restricted for the new debt. The bond covenant might restrict future borrowings.

Part E: Stock issues add money to the firm, and the debt has precedence over shareholders' rights. The bond covenant would not restrict stock issues.

Exercise 10.14: Zero coupon bond and debt-to-equity ratio

- A firm has shareholders equity of 100 and no debt on December 31, 20X1.
 - The firm receives 100 by issuing a five year zero coupon bond on December 31, 20X1, with a yield to maturity of 6% *per annum*.
 - The firm's net income in 20X2 is 10,000, and it pays no shareholder dividends.
- A. What is the firm's shareholders' equity on December 31, 20X2?
B. What is the firm's debt on December 31, 20X2?
C. What is the debt to equity ratio on December 31, 20X2?

Part A: Shareholders' equity on December 31, 20X2, is $100 + \text{net income in 20X2} - \text{shareholder dividends} = 100 + 10 = 110$.

Part B: Long-term debt on December 31, 20X2, is $100 \times 1.06 = 106$.

Part C: The debt-to-equity ratio is $106 / 110 = 0.9636$.

Exercise 10.15: Bond amortization and interest income

A firm buys an 8% annual coupon bond in the secondary market on 12/31/20X1. The carrying value of the bond is

- 103.3872 on 12/31/20X2
- 102.6243 on 12/31/20X3

The cash flow statement shows interest received on this bond of 8 in 20X3. The accrued interest on the bond is the same at December 31, 20X3, as at December 31, 20X2.

- A. What is the interest income on the bond in 20X3?
- B. What is the yield to maturity on the bond?
- C. What is the interest income on the bond in 20X4?
- D. What is the carrying value of the bond at December 31, 20X4?

Part A: The interest income = the interest received + the bond amortization =

$$8 + (102.6243 - 103.3872) = 7.2371$$

The firm bought the bonds some time ago in the secondary market. The yield to maturity of the bond when the firm bought it was less than the coupon rate on the bond, so the bond sold at a premium. The amortization each year reduces the premium, so the interest income is less than the interest received.

Part B: The effective interest rate (the yield to maturity) on the bond is the interest income / the carrying value at the beginning of the year = $7.2371 / 103.3872 = 7.00\%$.

Part C: The interest income = the carrying value at the beginning of the year $\times$ the yield to maturity.

The interest income on the bond in 20X4 = $102.6243 \times 7\% = 7.1837$.

Part C: The firm received 8 in cash, so the change in the carrying value of the bond is $7.1837 - 8 = -0.8163$.

The carrying value of the bond at 12/31/20X4 is $102.6243 - 0.8163 = 101.8080$.

Exercise 10.16: Solvency ratios

On December 30, 20X1, a firm has non-debt liabilities of 100, a debt-to-equity ratio of 50%, and a debt to assets ratio of 25%. On December 31, 20X1, the firm issues additional debt of 50 and uses the proceeds to repurchase outstanding shares.

- A. What is the firm's debt on December 30, 20X1?
- B. What is the firm's debt to capital ratio on December 31, 20X1?

Part A: Let Z = the firm's debt on December 30, 20X1.

The debt-to-equity ratio is 50%, so shareholders' equity = $2Z$. The debt to assets ratio is 25%, so

$$Z / (100 + Z + 2Z) = 25\% \Rightarrow Z = 25 + 75\% \times Z \Rightarrow Z = 100.$$

Part B: On December 31, 20X1, debt increases by 50 and shareholders' equity decreases by 50. The new values for debt and equity are

- Debt: $100 + 50 = 150$
- Equity: $2 \times 100 - 50 = 150$

The debt to capital ratio is $150 / (150 + 150) = 50\%$.

Exercise 10.17: Coverage ratios

In 20X1, a firm has

- Net revenue = 900
- Net income = 100
- Effective tax rate = 20%
- Interest expense = 15
- Lease expense = 30

- A. What is the firm's interest coverage ratio for 20X1?
B. What is the firm's fixed charge coverage ratio for 20X1?

Part A: Earnings before tax is net income / (1 – effective tax rate) = $100 / (1 - 20\%) = 125$

Earnings before interest and taxes is $125 + 15 = 140$.

The interest coverage ratio is $140 / 15 = 9.3333$.

Part B: Earnings before interest, taxes, and other fixed charges (leases) is $125 + 15 + 30 = 170$.

The fixed charge coverage ratio is $170 / (15 + 30) = 3.7778$

Exercise 10.18: Coverage ratios

In 20X1, a firm has

- Net revenue = 1,000
 - Net profit margin = 10%
 - Effective tax rate = 20%
 - Interest expense = 15
 - Lease expense = 30
 - Capitalized interest = 10
 - Depreciation expense for capitalized interest of past years = 3
 - Operating cash flow = 120
 - Financing cash flow = -40
- A. What is net income in 20X1?
- B. What is earnings before tax in 20X1?
- C. What is earnings before interest and taxes in 20X1?
- D. What is the interest coverage ratio for 20X1?
- E. What is earnings before interest, taxes, and other fixed charges in 20X1?
- F. What is the fixed charge coverage ratio for 20X1?
- G. What is earnings before interest, taxes, and capitalized interest in 20X1?
- H. What is the interest coverage ratio (including capitalized interest) for 20X1?
- I. What is earnings before interest, taxes, capitalized interest, and other fixed charges in 20X1?
- J. What is the fixed charge coverage ratio (including capitalized interest) for 20X1?
- K. What is the operating cash flow adjusted for capitalized interest in 20X1?
- L. What is the investing cash flow adjusted for capitalized interest in 20X1?

Part A: Net income in 20X1 is net revenue $\times$ net profit margin = $1,000 \times 10\% = 100$.

Part B: Earnings before tax is net income / (1 – effective tax rate) = $100 / (1 - 20\%) = 125$

Part C: Earnings before interest and taxes is $125 + 15 = 140$.

Part D: The interest coverage ratio is $140 / 15 = 9.3333$.

Part E: Earnings before interest, taxes, and other fixed charges (leases) is $125 + 15 + 30 = 170$.

Part F: The fixed charge coverage ratio is $170 / (15 + 30) = 3.7778$

Part G: Earnings before interest, taxes, and capitalized interest is $125 + 15 + 3 = 143$.

Question: Why don't we add the capitalized interest to earnings before interest and taxes? Why do we add only the depreciation of capitalized interest?

Answer: Capitalized interest is not deducted from earnings before tax.

- The full interest expense is deducted on the income statement in the year it accrues.
- The capitalized interest is deducted as depreciation expense over several years.

Part H: The interest coverage ratio (including capitalized interest) is $143 / (15 + 10) = 5.7200$

Part I: Earnings before interest, taxes, capitalized interest, and other fixed charges is

$125 + 15 + 30 + 3 = 173$.

Part J: The fixed charge coverage ratio (including capitalized interest) is $173 / (15 + 30 + 10) = 3.1455$.

Part K: The operating cash flow adjusted for capitalized interest is $120 - 10 = 110$.

Part L: The investing cash flow adjusted for capitalized interest is $-40 + 10 = -30$.

Capitalized interest is part of investing cash outflows, whereas expensed interest reduces operating cash flow. If the capitalized interest had been expensed, the 10 of capitalized interest would have been an operating cash outflow instead of an investing cash outflow.