CFA Institute®
CFA Program

FIXED INCOME, DERIVATIVES, ALTERNATIVE INVESTMENTS, PORTFOLIO MANAGEMENT

CFA® Program Curriculum
2023 • LEVEL 1 • VOLUME 5

Fixed Income

SOLUTIONS

1. A is correct. A capital gain is least likely to contribute to the investor's total return. There is no capital gain (or loss) because the bond is held to maturity. The carrying value of the bond at maturity is par value, the same as the redemption amount. When a fixed-rate bond is held to its maturity, the investor receives the principal payment at maturity. This principal payment is a source of return for the investor. A fixed-rate bond pays periodic coupon payments, and the reinvestment of these coupon payments is a source of return for the investor. The investor's total return is the redemption of principal at maturity and the sum of the reinvested coupons.

2. C is correct. Because the fixed-rate bond is held to maturity (a "buy-and-hold" investor), interest rate risk arises entirely from changes in coupon reinvestment rates. Higher interest rates increase income from reinvestment of coupon payments, and lower rates decrease income from coupon reinvestment. There will not be a capital gain or loss because the bond is held until maturity. The carrying value at the maturity date is par value, the same as the redemption amount. The redemption of principal does not expose the investor to interest rate risk. The risk to a bond's principal is credit risk.

3. A is correct. Capital gains (losses) arise if a bond is sold at a price above (below) its constant-yield price trajectory. A point on the trajectory represents the carrying value of the bond at that time. That is, the capital gain/loss is measured from the bond's carrying value, the point on the constant-yield price trajectory, and not from the original purchase price. The carrying value is the original purchase price plus the amortized amount of the discount if the bond is purchased at a price below par value. If the bond is purchased at a price above par value, the carrying value is the original purchase price minus (not plus) the amortized amount of the premium. The amortized amount for each year is the change in the price between two points on the trajectory.

4. C is correct. The future value of reinvested cash flows at 8% after five years is closest to 41.07 per 100 of par value.

    $$[7 \times (1.08)^4] + [7 \times (1.08)^3] + [7 \times (1.08)^2] + [7 \times (1.08)^1] + 7 = 41.0662$$

    The 6.07 difference between the sum of the coupon payments over the five-year holding period (35) and the future value of the reinvested coupons (41.07) represents the "interest-on-interest" gain from compounding.

5. B is correct. The capital loss is closest to 3.31 per 100 of par value. After five years, the bond has four years remaining until maturity and the sale price of the bond is 96.69, calculated as

    $$\frac{7}{(1.08)^1} + \frac{7}{(1.08)^2} + \frac{7}{(1.08)^3} + \frac{107}{(1.08)^4} = 96.69$$

    The investor purchased the bond at a price equal to par value (100). Because the bond was purchased at a price equal to its par value, the carrying value is par value. Therefore, the investor experienced a capital loss of 96.69 − 100 = −3.31.

6. B is correct. The investor's five-year horizon yield is closest to 6.62%. After five years, the sale price of the bond is 96.69 (from problem 5) and the future value of reinvested cash flows at 8% is 41.0662 (from problem 4) per 100 of par value. The total return is 137.76 (= 41.07 + 96.69), resulting in a realized five-year horizon yield of 6.62%:

$$100.00 = \frac{137.76}{(1+r)^5}, \quad r = 0.0662$$

7. C is correct. The bond's Macaulay duration is closest to 2.83. Macaulay duration (MacDur) is a weighted average of the times to the receipt of cash flow. The weights are the shares of the full price corresponding to each coupon and principal payment.

Period	Cash Flow	Present Value	Weight	Period × Weight
1	6	5.555556	0.058575	0.058575
2	6	5.144033	0.054236	0.108472
3	106	84.146218	0.887190	2.661570
		94.845806	1.000000	2.828617

Thus, the bond's Macaulay duration (MacDur) is 2.83.

Alternatively, Macaulay duration can be calculated using the following closed-form formula:

$$MacDur = \left\{ \frac{1+r}{r} - \frac{1+r+[N \times (c-r)]}{c \times [(1+r)^N - 1] + r} \right\} - (t/T)$$

$$MacDur = \left\{ \frac{1.08}{0.08} - \frac{1.08 + [3 \times (0.06 - 0.08)]}{0.06 \times [(1.08)^3 - 1] + 0.08} \right\} - 0$$

MacDur = 13.50 − 10.67 = 2.83

8. A is correct. The bond's approximate modified duration is closest to 2.78. Approximate modified duration is calculated as

$$ApproxModDur = \frac{(PV_-) - (PV_+)}{2 \times (\Delta Yield) \times (PV_0)}$$

Lower yield-to-maturity by 5 bps to 2.95%:

$$PV_- = \frac{5}{(1 + 0.0295)^1} + \frac{5}{(1 + 0.0295)^2} + \frac{5 + 100}{(1 + 0.0295)^3} = 105.804232$$

Increase yield-to-maturity by 5 bps to 3.05%:

$$PV_+ = \frac{5}{(1 + 0.0305)^1} + \frac{5}{(1 + 0.0305)^2} + \frac{5 + 100}{(1 + 0.0305)^3} = 105.510494$$

$PV_0 = 105.657223$, ΔYield = 0.0005

$$ApproxModDur = \frac{105.804232 - 105.510494}{2 \times 0.0005 \times 105.657223} = 2.78$$

9. C is correct. A bond's modified duration cannot be larger than its Macaulay duration assuming a positive yield-to-maturity. The formula for modified duration is

$$ModDur = \frac{MacDur}{1+r}$$

where r is the bond's yield-to-maturity per period. Therefore, ModDur will typically be less than MacDur.

Effective duration is a measure of curve duration. Modified duration is a measure of yield duration.

10. A is correct. The interest rate risk of a fixed-rate bond with an embedded call option is best measured by effective duration. A callable bond's future cash flows are uncertain because they are contingent on future interest rates. The

issuer's decision to call the bond depends on future interest rates. Therefore, the yield-to-maturity on a callable bond is not well defined. Only effective duration, which takes into consideration the value of the call option, is the appropriate interest rate risk measure. Yield durations like Macaulay and modified durations are not relevant for a callable bond because they assume no changes in cash flows when interest rates change.

11. A is correct. Key rate duration is used to measure a bond's sensitivity to a shift at one or more maturity segments of the yield curve which result in a change to yield curve shape. Modified and effective duration measure a bond's sensitivity to parallel shifts in the entire curve.

12. B is correct. The effective duration of the pension fund's liabilities is closest to 14.99. The effective duration is calculated as follows:

$$\text{EffDur} = \frac{(PV_-) - (PV_+)}{2 \times (\varDelta \text{Curve}) \times (PV_0)}$$

$PV_0 = 455.4$, $PV_+ = 373.6$, $PV_- = 510.1$, and $\Delta \text{Curve} = 0.0100$.

$$\text{EffDur} = \frac{510.1 - 373.6}{2 \times 0.0100 \times 455.4} = 14.99$$

13. B is correct. A bond's yield-to-maturity is inversely related to its Macaulay duration: The higher the yield-to-maturity, the lower its Macaulay duration and the lower the interest rate risk. A higher yield-to-maturity decreases the weighted average of the times to the receipt of cash flow, and thus decreases the Macaulay duration.

    A bond's coupon rate is inversely related to its Macaulay duration: The lower the coupon, the greater the weight of the payment of principal at maturity. This results in a higher Macaulay duration. Zero-coupon bonds do not pay periodic coupon payments; therefore, the Macaulay duration of a zero-coupon bond is its time-to-maturity.

14. A is correct. The presence of an embedded put option reduces the effective duration of the bond, especially when rates are rising. If interest rates are low compared with the coupon rate, the value of the put option is low and the impact of the change in the benchmark yield on the bond's price is very similar to the impact on the price of a non-putable bond. But when benchmark interest rates rise, the put option becomes more valuable to the investor. The ability to sell the bond at par value limits the price depreciation as rates rise. The presence of an embedded put option reduces the sensitivity of the bond price to changes in the benchmark yield, assuming no change in credit risk.

15. A is correct. The portfolio's modified duration is closest to 7.62. Portfolio duration is commonly estimated as the market-value-weighted average of the yield durations of the individual bonds that compose the portfolio.

    The total market value of the bond portfolio is 170,000 + 120,000 + 100,000 = 390,000.

    The portfolio duration is 5.42 × (170,000/390,000) + 8.44 × (120,000/390,000) + 10.38 × (100,000/390,000) = 7.62.

16. A is correct. A limitation of calculating a bond portfolio's duration as the weighted average of the yield durations of the individual bonds is that this measure implicitly assumes a parallel shift to the yield curve (all rates change by the same amount in the same direction). In reality, interest rate changes frequently result in a steeper or flatter yield curve. This approximation of the "theoretically

correct" portfolio duration is *more* accurate when the yield curve is flatter (less steeply sloped). An advantage of this approach is that it can be used with portfolios that include bonds with embedded options. Bonds with embedded options can be included in the weighted average using the effective durations for these securities.

17. B is correct. Bond B has the greatest money duration per 100 of par value. Money duration (MoneyDur) is calculated as the annual modified duration (AnnModDur) times the full price (PV^{Full}) of the bond including accrued interest. Bond B has the highest money duration per 100 of par value.

    $MoneyDur = AnnModDur \times PV^{Full}$

    MoneyDur of Bond A = 5.42 × 85.00 = 460.70

    MoneyDur of Bond B = 8.44 × 80.00 = 675.20

    MoneyDur of Bond C = 7.54 × 85.78 = 646.78

18. B is correct. The PVBP is closest to 0.0648. The formula for the price value of a basis point is

    $$PVBP = \frac{(PV_-) - (PV_+)}{2}$$

    where

    PVBP = price value of a basis point

    PV_- = full price calculated by lowering the yield-to-maturity by 1 bp

    PV_+ = full price calculated by raising the yield-to-maturity by 1 bp

    Lowering the yield-to-maturity by 1 bp to 4.99% results in a bond price of 85.849134:

    $$PV_- = \frac{3}{(1 + 0.0499)^1} + \cdots + \frac{3 + 100}{(1 + 0.0499)^9} = 85.849134$$

    Increasing the yield-to-maturity by 1 bp to 5.01% results in a bond price of 85.719638:

    $$PV_+ = \frac{3}{(1 + 0.0501)^1} + \cdots + \frac{3 + 100}{(1 + 0.0501)^9} = 85.719638$$

    $$PVBP = \frac{85.849134 - 85.719638}{2} = 0.06475$$

    Alternatively, the PVBP can be derived using modified duration:

    $$ApproxModDur = \frac{(PV_-) - (PV_+)}{2 \times (\varDelta Yield) \times (PV_0)}$$

    $$ApproxModDur = \frac{85.849134 - 85.719638}{2 \times 0.0001 \times 85.784357} = 7.548$$

    PVBP = 7.548 × 85.784357 × 0.0001 = 0.06475

19. B is correct. Convexity measures the "second order" effect on a bond's percentage price change given a change in yield-to-maturity. Convexity adjusts the percentage price change estimate provided by modified duration to better approximate the true relationship between a bond's price and its yield-to-maturity which is a

curved line (convex).

Duration estimates the change in the bond's price along the straight line that is tangent to this curved line ("first order" effect). Yield volatility measures the magnitude of changes in the yields along the yield curve.

20. B is correct. The bond's approximate convexity is closest to 70.906. Approximate convexity (ApproxCon) is calculated using the following formula:

$$\text{ApproxCon} = [PV_- + PV_+ - (2 \times PV_0)]/(\Delta\text{Yield}^2 \times PV_0)$$

where

PV_- = new price when the yield-to-maturity is decreased

PV_+ = new price when the yield-to-maturity is increased

PV_0 = original price

ΔYield = change in yield-to-maturity

$$\text{ApproxCon} = [98.782 + 98.669 - (2 \times 98.722)]/(0.001^2 \times 98.722) = 70.906$$

21. C is correct. The expected percentage price change is closest to 1.78%. The convexity-adjusted percentage price change for a bond given a change in the yield-to-maturity is estimated by

$$\%\Delta PV^{Full} \approx [-\text{AnnModDur} \times \Delta\text{Yield}] + [0.5 \times \text{AnnConvexity} \times (\Delta\text{Yield})^2]$$

$$\%\Delta PV^{Full} \approx [-7.020 \times (-0.0025)] + [0.5 \times 65.180 \times (-0.0025)^2] = 0.017754, \text{ or } 1.78\%$$

22. B is correct. The expected percentage price change is closest to −3.49%. The convexity-adjusted percentage price change for a bond given a change in the yield-to-maturity is estimated by

$$\%\Delta PV^{Full} \approx [-\text{AnnModDur} \times \Delta\text{Yield}] + [0.5 \times \text{AnnConvexity} \times (\Delta\text{Yield})^2]$$

$$\%\Delta PV^{Full} \approx [-7.140 \times 0.005] + [0.5 \times 66.200 \times (0.005)^2] = -0.034873, \text{ or } -3.49\%$$

23. B is correct. If the term structure of yield volatility is downward-sloping, then short-term bond yields-to-maturity have greater volatility than for long-term bonds. Therefore, long-term yields are more stable than short-term yields. Higher volatility in short-term rates does not necessarily mean that the level of short-term rates is higher than long-term rates. With a downward-sloping term structure of yield volatility, short-term bonds will not always experience greater price fluctuation than long-term bonds. The estimated percentage change in a bond price depends on the modified duration and convexity as well as on the yield-to-maturity change.

24. C is correct. When the holder of a bond experiences a one-time parallel shift in the yield curve, the Macaulay duration statistic identifies the number of years necessary to hold the bond so that the losses (or gains) from coupon reinvestment offset the gains (or losses) from market price changes. The duration gap is the difference between the Macaulay duration and the investment horizon. Modified duration approximates the percentage price change of a bond given a change in its yield-to-maturity.

25. C is correct. The duration gap is equal to the bond's Macaulay duration minus the investment horizon. In this case, the duration gap is positive, and price risk

dominates coupon reinvestment risk. The investor risk is to higher rates.

The investor is hedged against interest rate risk if the duration gap is zero; that is, the investor's investment horizon is equal to the bond's Macaulay duration. The investor is at risk of lower rates only if the duration gap is negative; that is, the investor's investment horizon is greater than the bond's Macaulay duration. In this case, coupon reinvestment risk dominates market price risk.

26. C is correct. The duration gap is closest to 4.158. The duration gap is a bond's Macaulay duration minus the investment horizon. The approximate Macaulay duration is the approximate modified duration times one plus the yield-to-maturity. It is 12.158 (= 11.470 × 1.06).

    Given an investment horizon of eight years, the duration gap for this bond at purchase is positive: 12.158 – 8 = 4.158. When the investment horizon is less than the Macaulay duration of the bond, the duration gap is positive, and price risk dominates coupon reinvestment risk.

27. A is correct. The price increase was most likely caused by a decrease in the bond's credit spread. The ratings upgrade most likely reflects a lower expected probability of default and/or a greater level of recovery of assets if default occurs. The decrease in credit risk results in a smaller credit spread. The increase in the bond price reflects a decrease in the yield-to-maturity due to a smaller credit spread. The change in the bond price was not due to a change in liquidity risk or an increase in the benchmark rate.

28. C is correct. Empirical duration is the best measure—better than analytical duration—of the impact of yield changes on portfolio value, especially under stressed market conditions, for a portfolio consisting of a variety of different bonds from different issuers, such as the portfolio described in Answer C. In this portfolio, credit spread changes on the high-yield bonds may partly or fully offset yield changes on the AAA rated sovereign bonds and spread changes on the AAA rated corporate bonds; this interaction is best captured using empirical duration. The portfolios described in Answers A and B consist of the same types of bonds from similar issuers—sovereign bonds from similar-rated sovereign issuers (A) and covered bonds from similar-rated corporate issuers (B)—so empirical and analytical durations should be roughly similar in each of these portfolios.

SOLUTIONS

1. A is correct. Credit migration risk or downgrade risk refers to the risk that a bond issuer's creditworthiness may deteriorate or migrate lower. The result is that investors view the risk of default to be higher, causing the spread on the issuer's bonds to widen.

2. C is correct. Market liquidity risk refers to the risk that the price at which investors transact may be different from the price indicated in the market. Market liquidity risk is increased by (1) less debt outstanding and/or (2) a lower issue credit rating. Because Stedsmart Ltd is comparable to Fignermo Ltd except for less publicly traded debt outstanding, it should have higher market liquidity risk.

3. C is correct. Credit risk is the risk of loss resulting from the borrower failing to make full and timely payments of interest and/or principal.

4. C is correct. Market liquidity risk is the risk that the price at which investors can actually transact—buying or selling—may differ from the price indicated in the market.

5. C is correct. Loss severity is the portion of a bond's value (including unpaid interest) an investor loses in the event of default.

6. B is correct. The two components of credit risk are default probability and loss severity. In the event of default, loss severity is the portion of a bond's value (including unpaid interest) an investor loses. A and C are incorrect because spread and market liquidity risk are credit-related risks, not components of credit risk.

7. A is correct. Credit risk has two components: default risk and loss severity. Because default risk is quite low for most high-quality debt issuers, bond investors tend to focus more on this likelihood and less on the potential loss severity.

8. B is correct. The expected loss for a given debt instrument is the default probability multiplied by the loss severity given default. The loss severity is often expressed as (1 – Recovery rate).

9. A is correct. First mortgage debt is senior secured debt and has the highest priority of claims. First mortgage debt also has the highest expected recovery rate. First mortgage debt refers to the pledge of specific property. Neither senior unsecured nor junior subordinate debt has any claims on specific assets.

10. B is correct. Whether or not secured assets are sufficient for the claims against them does not influence priority of claims. Any deficiency between pledged assets and the claims against them becomes senior unsecured debt and still adheres to the guidelines of priority of claims.

11. A is correct. Senior subordinated debt is ranked lower than senior unsecured debt and thus has a lower priority of payment.

12. C is correct. The highest-ranked unsecured debt is senior unsecured debt. Lower-ranked debt includes senior subordinated debt. A and B are incorrect because mortgage debt and second lien loans are secured and higher ranked.

13. C is correct. According to the absolute priority of claims, in the event of bankruptcy, creditors with a secured claim have the right to the value of that specific

property before any other claim.

14. A is correct. A second lien has a secured interest in the pledged assets. Second lien debt ranks higher in priority of payment than senior unsecured and senior subordinated debt and thus would most likely have a higher recovery rate.

15. A is correct. Second lien debt is secured debt, which is senior to unsecured debt and to subordinated debt.

16. C is correct. Both analysts and rating agencies have difficulty foreseeing future debt-financed acquisitions.

17. A is correct. Notching is the process for moving ratings up or down relative to the issuer rating when rating agencies consider secondary factors, such as priority of claims in the event of a default and the potential loss severity.

18. C is correct. Structural subordination can arise when a corporation with a holding company structure has debt at both its parent holding company and operating subsidiaries. Debt at the operating subsidiaries is serviced by the cash flow and assets of the subsidiaries before funds are passed to the parent holding company.

19. C is correct. The issuer credit rating usually applies to its senior unsecured debt.

20. C is correct. An issuer credit rating usually applies to its senior unsecured debt.

21. A is correct. Recognizing different payment priorities, and thus the potential for higher (or lower) loss severity in the event of default, the rating agencies have adopted a notching process whereby their credit ratings on issues can be moved up or down from the issuer rating (senior unsecured).

22. C is correct. As a general rule, the higher the senior unsecured rating, the smaller the notching adjustment. Thus, for corporate bonds rated Aa2/AA, the rating agencies will typically apply smaller rating adjustments, or notches, to the related issue.

23. A is correct. Credit migration is the risk that a bond issuer's creditworthiness deteriorates, or migrates lower. Over time, credit ratings can migrate significantly from what they were at the time a bond was issued. An investor should not assume that an issuer's credit rating will remain the same from the time of purchase through the entire holding period.

24. C is correct. Goodwill is viewed as a lower quality asset compared with tangible assets that can be sold and more easily converted into cash.

25. C is correct. The value of assets in relation to the level of debt is important to assess the collateral of the company—that is, the quality and value of the assets that support the debt levels of the company.

26. B is correct. The growth prospects of the industry provide the analyst insight regarding the capacity of the company.

27. A is correct. The construction company is both highly leveraged, which increases credit risk, and in a highly cyclical industry, which results in more volatile earnings.

28. B is correct. The interest expense is €166 million and EBITDA = Operating profit + Depreciation and amortization = €2,660 + 1,214 million = €3,874 million. EBITDA interest coverage = EBITDA/Interest expense = 3,874/166 = 23.34

times.

29. B is correct. Total debt is €4,364 million with Total capital = Total debt + Shareholders' equity = €4,364 + 7,058 = €11,422 million. The Debt/Capital = 4,364/11,422 = 38.21%.

30. A is correct. If the debt of the company remained unchanged but FFO increased, more cash was available to service debt compared to the previous year. Additionally, debt/capital improved, which implies that the ability of Pay Handle Ltd to service their debt also improved.

31. A is correct. Based on four of the five credit ratios, GZ Group's credit quality is superior to that of the industry.

32. A is correct. DCM Group has more financial leverage and less interest coverage than AB plc, which implies greater credit risk.

33. B is correct. An industry with a high number of suppliers reduces the suppliers' negotiating power, thus helping companies control expenses and aiding in the servicing of debt.

34. A is correct. Credit analysis starts with industry structure—for example, by looking at the major forces of competition, followed by an analysis of industry fundamentals—and then turns to examination of the specific issuer.

35. C is correct. Credit analysts can make judgments about management's character by evaluating the use of aggressive accounting policies, such as using a significant amount of off-balance-sheet financing. This activity is a potential warning flag for other behaviors such as using a significant amount of off-balance-sheet financing.

36. B is correct. Capacity refers to the ability of a borrower to service its debt. Capacity is determined through credit analysis of an issuer's industry and of the specific issuer.

37. A is correct. Credit analysts can make judgments about management's character in a number of ways, including by observing its use of aggressive accounting policies and/or tax strategies. An example of this aggressiveness is recognizing revenue prematurely.

38. C is correct. Debt/capital and debt/EBITDA are used to assess a company's leverage. Higher leverage ratios indicate more leverage and thus higher credit risk. Company C's debt/capital (46.3%) and debt/EBITDA (2.5×) are higher than those for Companies A and B.

39. B is correct. The EBITDA/interest expense and EBIT/interest expense are coverage ratios. Coverage ratios measure an issuer's ability to meet its interest payments. A higher ratio indicates better credit quality. Company B's EBITDA/interest expense (62.4×) and EBIT/interest expense (58.2×) are higher than those for Companies A and C.

40. C is correct because Company Y has a higher ratio of free cash flow after dividends to debt than Company X, not lower, as shown in the following table.

Free cash flow after dividends as a % of debt $= \frac{\text{FCF after dividends}}{\text{Debt}}$

	Company X	Company Y
Cash flow from operations	£3.3	£14.0

	Company X	Company Y
Less		
Net capital expenditures	−0.8	−1.1
Dividends	−0.3	−6.1
Free cash flow after dividends	£2.2	£6.8
Debt	£12.2	£29.8
Free cash flow after dividends as a % of debt	(2.2/12.2) × 100	(6.8/29.8) × 100
Free cash flow after dividends as a % of debt	18.0%	22.8%

A is incorrect. Company Y has a lower debt/capital than Company X, as shown in the following table.

$$\text{Debt divided by Capital (\%)} = \frac{\text{Debt}}{(\text{Debt} + \text{Equity})}$$

	Company X	Company Y
Debt	£12.2	£29.8
Capital		
Debt	12.2	29.8
+ Equity	1.3	64.0
Capital	£13.5	£93.8
Debt/Capital (%)	(12.2/13.5) × 100	(29.8/93.8) × 100
Debt/Capital (%)	90.4%	31.8%

B is incorrect because Company Y has a lower debt/EBITDA than Company Y, not higher, as shown in the following table.

	Company X	Company Y
Operating income	£1.1	£13.3
EBIT	£1.1	£13.3
plus		
Depreciation	1.0	3.8
Amortization	0.0	0.0
EBITDA	£2.1	£17.1
Debt	£12.2	£29.8
Debt/EBITDA	12.2/2.1	29.8/17.1
Debt/EBITDA	5.81	1.74

41. A is correct. Compared with Company Y, based on both their debt/capital and their ratios of free cash flow after dividends to debt, which are measures of leverage commonly used in credit analysis, Company X is more highly leveraged, as shown in the following table.

$$\text{Debt divided by Capital (\%)} = \frac{\text{Debt}}{(\text{Debt} + \text{Equity})}$$

	Company X	**Company Y**
Debt	£2.2	£29.8
Capital		
Debt	2.2	29.8
+ Equity	4.3	64.0
Capital	£6.5	£93.8
Debt/Capital (%)	(12.2/13.5) × 100	(29.8/93.8) × 100
Debt/Capital (%)	90.4%	31.8%

$$\text{Free cash flow after dividends as a \% of debt} = \frac{\text{FCF after dividends}}{\text{Debt}}$$

|	**Company X**	**Company Y**
Cash flow from operations	£3.3	£14.0
Less		
Net capital expenditures	−0.8	−1.1
Dividends	−0.3	−6.1
Free cash flow after dividends	£2.2	£6.8
Debt	£12.2	£29.8
Free cash flow after dividends as a % of debt	(2.2/12.2) × 100	(6.8/29.8) × 100
Free cash flow after dividends as a % of debt	18.0%	22.8%

42. A is correct. Low demand implies wider yield spreads, and heavy supply widens spreads even further.

43. B is correct. In weak financial markets, including weak markets for equities, credit spreads will widen.

44. B is correct. Weakening economic conditions will push investors to desire a greater risk premium and drive overall credit spreads wider.

45. C is correct. In periods of heavy new issue supply, credit spreads will widen if demand is insufficient.

46. C is correct. Non-sovereign governments typically must balance their operating budgets and lack the discretion to use monetary policy as many sovereigns can.

47. A is correct. Most investors in investment-grade debt focus on spread risk—that is, the effect of changes in spreads on prices and returns—while in high-yield analysis, the focus on default risk is relatively greater.

48. B is correct. Among the most important considerations in sovereign credit analysis is growth and age distribution of population. A relatively young and growing population contributes to growth in GDP and an expanding tax base and relies less on social services, pensions, and health care relative to an older population.

Derivatives

SOLUTIONS

1. B is correct. A 75-day timing difference exists between the commercial contract date and the delivery date when Montau AG is paid for the machine in KRW. A is true but does not explain why the use of a derivative is preferable to a spot market transaction. If as in C Montau were to sell the KRW it receives and buy EUR in a spot market transaction on the delivery date, it would be exposed to unfavorable changes in the KRW/EUR exchange rate over the 75-day period. A derivative contract in which the underlying KRW/EUR forward rate is agreed today and exchanged on the delivery date allows Montau to hedge or offset the EUR value of the future KRW payment. The derivative is therefore a more suitable contract to address the financial risk of the commercial transaction than a spot market sale of KRW.

2. A is correct. The derivative best suited to hedge Montau's financial risk is a firm commitment derivative in which a pre-determined amount is exchanged at settlement. The derivative underlying should be currencies, specifically the sale of KRW at a fixed EUR price in the future to offset or hedge the financial risk of the commercial contract. The machine price referenced under B is not considered an underlying, and C hedges the opposite of Montau's underlying exposure.

3. C is correct as per the following diagram:

Exhibit 1

Montau AG

KRW 650,000,000

Fixed EUR amount [KRW/EUR forward rate]

Financial intermediary
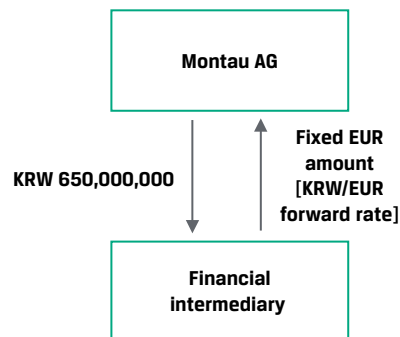
4. A is correct. The OTC market is most appropriate for Montau, as OTC contracts may be customized to match Montau's desired risk exposure profile. This is important to end users seeking to hedge a specific underlying exposure based upon non-standard terms. Montau would be unlikely to find an ETD contract under B that matches the exact size and maturity date of its desired hedge, which also makes C incorrect.

SOLUTIONS

1. C is correct. VFO may consider either a short futures position in (or a forward sale of) Biomian shares in six months to achieve its objective. This firm commitment allows VFO to offset its long position with a short position in six months at a pre-agreed price. The futures contract is an exchange-traded derivative with standardized terms set by the exchange and requires initial margin and daily settlement. Answers A and B are contingent claims that can both potentially increase, not decrease, VFO's exposure to Biomian stock in six months.

2. A is correct. VFO should purchase a six-month put option on Biomian shares to manage its exposure based on the market strategist's view. This contingent claim grants VFO the right but not the obligation to sell Biomian shares at a pre-agreed exercise price in exchange for a premium. A put option buyer exercises the option at maturity when the underlying price is below the exercise price. This allows VFO to continue to benefit from a rise in Biomian's share price over the next six months with a limited downside. Neither B nor C provides VFO with downside protection if Biomian stock declines in six months.

3. C is correct. Under a forward sale of Biomian shares, the profit is $[F_0(T) - S_T]$. If the shares rise significantly over the next six months—that is, $S_T > F_0(T)$—then VFO's loss on the derivative is the difference between the Biomian forward price, $F_0(T)$, and the spot price, S_T. Under the long put option on Biomian shares, VFO's profit is $\max(0, X - S_T) - p_0$. If Biomian shares rise significantly over the next six months (i.e., $S_T > X$), then the option expires worthless and VFO's loss is limited to the put premium paid, p_0. If $[F_0(T) - S_T] > -p_0$, then VFO's loss would be greater under the firm commitment than under the contingent claim.

4. A is correct. The profit is equal to $\Pi = \max(0, S_T - X) - c_0$, and the payoff is equal to $\max(0, S_T - X)$. The exercise price is INR16,000, and the spot price just prior to maturity is INR16,500, so $\Pi = -1{,}000$ [$= (16{,}500 - 16{,}000) - 1{,}500$], and the payoff is equal to INR500 [$= (16{,}500 - 16{,}000)$].

SOLUTIONS

1. B is correct. The Structured Note is linked to the performance of the S&P 500 Health Care Select Sector Index (SIXV). Note that the SIXV derivative is similar to that in the earlier SCSI CSI 300 example. The "Additional Amount" paid at maturity is equal to the greater of 100% of the returns on the S&P 500 Health Care Select Sector Index (SIXV) in excess of 5% above the current spot price of the SIXV or zero. This payoff profile [Max $(0, S_T - X)$] is identical to that of a purchased six-month SIXV call option with an exercise price (X) at 5% above today's SIXV spot price.

2. C is correct. The investor assumes the credit risk of Baywhite Financial LLC for the full value of the structured note as the structured note issuer. Under the purchased exchange-traded SIXV call option, the investor faces the risk of the exchange and its clearinghouse, which provides a guarantee of contract settlement backed by the exchange insurance fund.

3. C is correct. The Structured Note is likely to be far less liquid than the stand-alone SIXV call option, which is traded on a derivatives exchange. Recall from an earlier lesson that exchange-traded contracts are more formal and standardized, which facilitates a more liquid and transparent market. Note also that the Baywhite Financial LLC Structured Note is issued at 102% of face value, suggesting that an investor will likely forgo this premium if selling the note prior to maturity.

4. C is correct. The 20% Principal at Risk, or USD200 of Face Value for each USD1,000 (the minimum denomination), combined with the 2% (or USD20) issue premium, should be compared with the upfront premium for a six-month SIXV call option with an exercise price at 5% above the current SIXV spot price. The comparison should also consider the additional credit risk and liquidity risk of the Structured Note versus the exchange-traded option.

SOLUTIONS

1. Solution to 1:

    1. B is correct. The forward contract MTM value between inception and maturity, $V_t(T)$, is equal to the difference between the current spot price (adjusted by costs and benefits through maturity) and the present value of the forward price.

    2. C is correct. The forward price, $F_0(T)$, is the future value of the underlying asset spot price (S_0) compounded at the risk-free rate incorporating the present value of the costs and benefits of asset ownership.

    3. A is correct. Under no-arbitrage conditions for a given underlying spot price, S_0, adjusted by the costs and benefits, risk-free rate (r), and forward price, $F_0(T)$, the forward contract MTM value at inception, $V_0(T)$, should be equal to zero (ignoring transaction costs).

2. B is correct. The original VIVU spot price (S_0) at $t = 0$ must equal the present value of the forward price discounted at the risk-free rate, so an immediate fall in the spot price to $S_0^- < S_0$ results in an MTM gain for the forward contract seller. A is not correct, since a higher risk-free rate will reduce the contract MTM from the client's perspective by reducing the PV of $F_0(T)$, while C will also reduce the forward contract MTM from the seller's perspective.

3. C is correct. A decline in the interest rate differential between MXN and USD will cause the client to realize an MTM loss on the MXN/USD forward contract, while B states that this decline will result in an MTM gain. A is incorrect as the forward price, $F_0(T)$, is not adjusted during the contract life.

    Specifically, the original MXN/USD forward exchange rate at inception is equal to 20.20 (= $19.8248e^{(.0425 - 0.005) \times 0.5}$). If the MXN rate were to decline by 50 bps immediately after the contract is agreed, a new MXN/USD forward contract would be at a forward exchange rate of 20.15 (= $19.8248e^{(.0375 - 0.005) \times 0.5}$). The MXN would weaken or depreciate against the USD. Since the MXN seller has locked in a forward sale at the original 20.20 versus the new 20.15 rate, the seller's MTM loss is equal to 0.05, or MXN50,000 per MXN1,000,000 (= 0.05 × 1,000,000) notional amount.

4. C is correct. The one-year annual rate equals the one-year zero rate, as it involves a single cash flow at maturity ($z_1 = r_1$). Since the breakeven reinvestment rate involves a single cash flow at maturity, substitute the one-year rate (r_1) into the two-year bond price equation to solve for z_2, then set $(1 + r_1) \times (1 + \text{breakeven reinvestment rate}) = (1 + z_2)^2$ and solve for the breakeven reinvestment rate ($IFR_{1,1}$).

5. A is correct. As Baywhite faces exposure to a rise in one-month MRR over the next 30 days, it should enter into the FRA as a fixed-rate payer in order to benefit from a rise in one-month MRR above the FRA rate and offset its higher borrowing cost. Both B and C are incorrect, as the fixed-rate *receiver* in an FRA does not benefit but rather must make a higher payment upon settlement if MRR rises.

SOLUTIONS

1. A is correct. The CTA will face a margin call if the copper contract price falls by more than \$4,000, or \$0.16 (= \$4,000/25,000) per pound. We may solve for the price at which the CTA receives a margin call by first solving for the initial futures contract price, $f_0(T)$, at contract inception as follows:

   $f_0(T) = [S_0 + PV_0(C)] (1 + r)^T$.

   Solve for $PV_0(C)$ per pound as follows:

   $PV_0(C) = \$9.98 \, (= \$10[1.01875^{-(1/12)}])$.

   Substitute $PV_0(C) = \$9.98$ into Equation 4 to solve for $f_0(T)$:

   $f_0(T) = [(\$4.25 \times 25{,}000) + \$9.98](1.01875^{\,-(1/12)})$

   $f_0(T) = \$106{,}425$ per contract ($\approx \$4.257$ per pound).

   So, \$106,425 – \$4,000 = \$102,425 per contract, and \$4.257 – \$0.16 = \$4.10 per pound.

   B is incorrect as it assumes there is no maintenance margin, and while C may be true under some circumstances, the change in A is immediate (occurs at trade inception).

2. B is correct. The long investor client forward position with Ace benefits from an MTM gain on its forward contract with Ace, but no cash is exchanged until maturity. Ace receives a deposit in its futures margin account equal to the daily MTM futures contract gain, which if spot and futures prices change by approximately the same amount will be equal to €1,500 (€15 × 100).

3. 1. C is correct. The futures contract price changes daily based upon a (yield – 100) quoting convention, so its price will increase as yields fall and vice versa. The fixed rate on an FRA does not change for the life of the contract.

   2. A is correct. An FRA fixed-rate payer (floating-rate receiver) will realize a gain on the contract upon settlement (equal to the present value of the difference between the fixed rate and MRR multiplied by the contract notional over the specified interest period) if MRR settles above the initial fixed rate on the contract.

   3. B is correct. If the MRR settles above the initial forward commitment rate at maturity, the FRA fixed-rate payer has an MTM loss on the contract.

4. C is correct. Mandatory central clearing requirements impose margin requirements on financial intermediaries similar to those of standardized exchange-traded futures markets, who often pass these costs and/or requirements on to their clients. Answers A and B are incorrect, as the MTM gains on the forward contracts are not realized until maturity.

SOLUTIONS

1. The correct answer is B. The loss on the forward sale will be greater than the loss on the purchased put at maturity if Biomian's share price exceeds the forward price by more than the initial put premium. VFO's downside return is limited to the put premium paid, while the forward sale has unlimited downside as Biomian shares appreciate. A is incorrect as it does not take the put premium paid into account, while C is incorrect as the time value of an option is equal to zero at maturity.

2. The correct answer is C. The put exercise price, X (equal to $F_0(T)$ in this case), represents the *upper* bound on the put value, while the *lower* bound is the greater of the present value of the exercise price minus the spot price and zero:

$$\text{Max}\left(0,\ X(1+r)^{-(T-t)} - S_t\right)\ <\ p_t \leq X$$

   A is incorrect, as the *lower* bound of the put price is the greater of zero and the present value of the exercise price minus the spot price, not the present value of the spot price minus the exercise price. B is incorrect, as the *lower*, not the upper, bound of the put price equals the present value of the exercise price minus the spot price.

3. The correct answer is B. The option price is equal to the sum of the exercise value and the time value. A call option's exercise value is equal to the greater of zero and the spot price minus the present value of the exercise price:

$$Max\left(0,\ S_t - X(1+r)^{-(T-t)}\right)$$

   $= \text{Max}(0, \text{INR}325 - \text{INR}300.84(1.04)^{-0.25})$

   $= \text{INR}27.10$

   The time value is equal to the call price minus the exercise value, or INR 19.31 (= INR46.41 − INR27.10). A is incorrect as it takes the spot price minus the exercise price as the exercise value, while C calculates the exercise value as the present value of the spot price minus the exercise price.

4. The correct answer is C. An increase in the volatility of the underlying share price will increase both the upfront premium received on the sold call option and the premium paid on the purchased put option. Therefore, since the purchased put strategy involves an increased upfront payment made by VFO and the sold call strategy involves an increased premium received, the volatility increase will increase the attractiveness of the call strategy versus the put strategy.

5. The correct answer is B. Changes in the time to expiration tend to have a similar directional effect on the put and call strategies (the only exception being deep-in-the-money put options in some cases), while changes in the exercise price and the risk-free rate tend to have the opposite effect.

SOLUTIONS

1. The correct answer is C. A 12% increase in the stock price gives:

   $S_1^u = R^u S_0 = 1.12 \times €105.25 = €117.88$.

   The put option will expire unexercised:

   $p_1^u = \text{Max}(0, X - S_1^u) = \text{Max}(0, €100 - €117.88) = €0$.

   Alternatively, a 10% price decrease gives:

   $S_1^d = R^d S_0 = 0.9 \times €105.25 = €94.73$.

   The put option will pay off:

   $p_1^d = \text{Max}(1, X - S_1^d) = \text{Max}(0, €100 - €94.73) = €5.27$.

   To price this option, the risk-neutral pricing formula gives the risk-neutral probability π as:

   $\pi = (1 + 0.0037 - 0.9)/(1.12 - 0.9) = 0.47$.

   The no-arbitrage price is:

   $$p_0 = \frac{\left(\pi \times p_1^u + (1 - \pi)p_1^d\right)}{(1 + r)}$$

   $p_0 = (0.47 \times €0 + 0.53 \times €5.27)/(1 + 0.0037) = €2.79/1.0037 = €2.78$.

2. The correct answer is A. If the put option can be purchased for less than the no-arbitrage price, then a potential arbitrage opportunity is available. In this case, Kleinert's clients should purchase the underpriced put option and buy h^* units of SparCoin's stock. The hedge ratio, h^*, is calculated as:

   $$h^* = \frac{\left(p_1^u - p_1^d\right)}{\left(S_1^u - S_1^d\right)} = \frac{€0 - €5.27}{€117.88 - €94.73} = \frac{-€5.27}{€23.15} = -0.2276.$$

   Note that the negative hedge ratio implies that both the put option and underlying are purchased or sold to create a hedge. This initial purchase of the put option and stock will cost:

   $€2.50 + 0.2276 \times €105.25 = €26.45$.

   Should the stock price decrease, the value of this portfolio will be:

   $V_1 = V_1^d = h^* S_1^d + p_1^d = 0.2276 \times €94.73 + €5.27 = €26.83$.

   The strategy generates a risk-free return of $(€26.83 - €26.45)/€26.45 = 1.44\%$, which is greater than the 0.37% return on other available risk-free investments.

3. The correct answer is C. Rising interest rates reduce the value of a put option. Increasing the risk-free rate will increase the risk-neutral probability of a price increase π and decrease the present value of the expected option payoff. Since the value of a put option is inversely related to the price of the underlying asset, an increased probability of an upward price move will reduce the expected payoff from the put. Consequently, both of these effects will reduce the put option value as the return on risk-free investments increases.

4. The correct answer is B. A 24% (previously 12%) increase in the stock price gives:

$S_1^u = R^u S_0 = 1.24 \times €105.25 = €130.51.$

The put option will expire unexercised:

$p_1^u = \text{Max}(0, X - S_1^u) = \text{Max}(0, €100.00 - €130.51) = €0.$

Alternatively, a 20% (previously 10%) decrease gives:

$S_1^d = R^d S_0 = 0.8 \times €105.25 = €84.20.$

The put option will pay off:

$p_1^d = \text{Max}(0, X - S_1^d) = \text{Max}(0, €100 - €84.20) = €15.80.$

To price this option, the risk-neutral pricing formula gives the risk-neutral probability as:

$\pi = (1 + 0.0037 - 0.8)/(1.24 - 0.8) = 0.46.$

The no-arbitrage price is:

$$p_0 = \frac{\left(\pi \times p_1^u + (1 - \pi)p_1^d\right)}{(1 + r)} = \frac{(0.46 \times €0 + 0.54 \times €15.80)}{(1 + 0.0037)} = \frac{€8.53}{1.0037} = €8.50.$$

Alternative Investments

SOLUTIONS

1. C is correct. Long-only equity funds are typically considered traditional investments, and real estate and commodities are typically classified as alternative investments.

2. B is correct. Hedge funds may take long and short positions, use a variety of strategies, and generally have a low correlation with traditional investments.

3. A is correct. Alternative investments are characterized as typically having low levels of transparency.

4. A is correct. There are many approaches to managing alternative investment funds, but typically these funds are actively managed.

5. A is correct. Investing in alternative investments is often pursued through such special vehicles as hedge funds and private equity funds, which have flexibility to use leverage. Alternative investments include investments in such assets as real estate, which is an illiquid asset, and investments in such special vehicles as private equity and hedge funds, which may make investments in illiquid assets and take short positions. Obtaining information on strategies used and identifying reliable measures of risk and return are challenges of investing in alternatives.

6. B is correct. Adding alternative investments to a portfolio may provide diversification benefits because of these investments' less-than-perfect correlation with other assets in the portfolio. As a result, allocating a portion of one's funds to alternatives could potentially result in an improved risk–return relationship. Challenges to allocating a portion of a portfolio to alternative investments include obtaining reliable measures of risk and return and selecting portfolio managers for the alternative investments.

7. C is correct. From the perspective of the investor, direct investing is the most active approach to investing because of the absence of fund managers and the services and expertise they generally provide.

   A is incorrect because co-investing includes fund investing, which requires less due diligence compared with direct investing.

   B is incorrect because fund investing in alternative assets demands less participation from the investor compared with the direct and co-investing approaches. An investor depends on the fund manager to identify, select, and manage the fund's investments.

8. B is correct. Co-investing may be subject to adverse selection bias. For example, the fund manager may make less attractive investment opportunities available to the co-investor while allocating its own capital to more appealing deals.

   A is incorrect because co-investing is likely not more expensive than fund investing since co-investors can co-invest an additional amount alongside the fund directly in a fund investment without paying management fees on the capital that has been directly invested.

   C is incorrect because direct investing, not co-investing, provides the greatest amount of flexibility for the investor.

9. B is correct. Direct investing due diligence may be more independent than that of co-investing because the direct investing team is typically introduced to opportu-

nities by third parties rather than fund managers, as is customary in co-investing.

A is incorrect because the direct investing team has more control over the due diligence process compared with co-investing.

C is incorrect because due diligence for direct investing requires the investor to conduct a thorough investigation into the important aspects of a target asset or business, whereas in co-investing, fund managers typically provide investors with access to a data room so they can view the due diligence completed by the fund managers.

10. C is correct. Due diligence in direct investing will typically be more thorough and more rigid from an investor's perspective because of the absence of a fund manager that would otherwise conduct a large portion of the necessary due diligence.

11. C is correct. An alternative investment fund's hurdle rate is a minimum rate of return the GP must exceed in order to earn a performance fee.

A is incorrect because if a catch-up clause is included in the partnership agreement, the catch-up clause permits distributions in relation to the hurdle rate.

B is incorrect because it is a high-water mark (not a hurdle rate) that protects clients from paying twice for the same performance.

12. B is correct. A clawback provision requires the general partner in a private equity fund to return any funds distributed (to the general partner) as incentive fees until the limited partners have received their initial investments *and* the contracted portion of the total profits. A high hurdle rate will result in distributions occurring only after the fund achieves a specified return. A high hurdle rate decreases the likelihood of, but does not prevent, excess distributions. Management fees, not incentive fees, are based on committed capital.

13. B is correct. Until the committed capital is fully drawn down and invested, the management fee for a private equity fund is based on committed capital, not invested capital.

14. A is correct. Although profits are typically split 80/20 between LPs and the GP, the distribution method of profits is not called an "80/20 split." "Fair division" is not a real term that exists in the industry.

15. C is correct. American waterfalls, also known as deal-by-deal waterfalls, pay performance fees after every deal is completed and are more advantageous to the GP because they get paid sooner (compared with European, or whole-of-fund, waterfalls).

SOLUTIONS

1. B is correct. The Sharpe ratio assumes normally distributed returns. However, alternative assets tend to have non-normal return distributions with significant skewness (fat tails in one direction or the other) and kurtosis (sharper peak than a normal distribution has, with fatter tails). Therefore, the Sharpe ratio may not be a good risk-adjusted performance measure to rely on for alternative investments.

   A is incorrect because the Sharpe ratio does not use a semi-deviation measure of volatility; it uses standard deviation. The Sortino ratio uses a semi-deviation measure of volatility. Further, the use of semi-deviation instead of standard deviation actually makes the Sortino ratio a more attractive measure of alternative asset performance than the Sharpe ratio.

   C is incorrect because correlation does not enter into the calculation of the Sharpe ratio. However, it is true that alternative assets can have low correlations with other asset classes.

2. B is correct. The determination of an IRR involves certain assumptions about a financing rate to use for outgoing cash flows (typically a weighted average cost of capital) and a reinvestment rate assumption to make on incoming cash flows (which must be assumed and may or may not actually be earned).

   A is incorrect because the money multiple calculation completely ignores the timing of cash flows.

   C is incorrect because it is somewhat of a reversal of cause and effect: Private equity (PE) funds can appear to have low volatility because of the lag in their mark-to-market process. It's not that PE investments don't actually rise and fall behind the scenes with economic influences, but accounting conventions may simply leave longer-lived investments marked at their initial cost for some time or with only modest adjustments to such carrying value until known impairments or realization events begin to transpire. Also, because PE funds are not easily marked to market, their returns can appear somewhat smoothed, making them appear more resilient and less correlated with other assets than they really are. The slowness to re-mark them can unfortunately be confused by investors as an overall lack of volatility.

3. C is correct. It is not true that a calibrated model will produce a reliable liquidation value in a mark-to-model valuation. The need to use a model for valuation arises when an asset is so illiquid that there are not reliable market values available. A model may reflect only an imperfect theoretical valuation, not a true liquidation value, should liquidation become necessary. The illiquid nature of alternative assets means that estimates, rather than observable transaction prices, may have been used for valuation purposes.

4. C is correct. Downside risk measures focus on the left side of the return distribution curve, where losses occur. The standard deviation of returns assumes that returns are normally distributed. Many alternative investments do not exhibit close-to-normal distributions of returns, which is a crucial assumption for the validity of a standard deviation as a comprehensive risk measure. Assuming normal probability distributions when calculating these measures will lead to an underestimation of downside risk for a negatively skewed distribution. Both the Sortino ratio and the VaR measure are measures of downside risk.

5. B is correct. The Calmar ratio is typically calculated using the prior three years of performance and is a comparison of the average annual compounded return to

its maximum drawdown risk. For this particular investment, the Calmar ratio is calculated as follows:

6.2% (average compounded return over the past three years)/10.2% (maximum drawdown) = 0.60784 ≈ 0.61.

6. B is correct. The net investor return is 12.54%, calculated as follows:

> End-of-year capital = USD250 million × 1.16 = USD290 million.
>
> Management fee = USD290 million × 2% = USD5.8 million.
>
> Hurdle amount = 8% of USD250 million = USD20 million.
>
> Incentive fee = (USD290 – USD250 – USD20 – USD5.8) million × 20% = USD2.84 million.
>
> Total fees to United Capital = (USD5.8 + USD2.84) million = USD8.64 million.
>
> Investor net return: (USD290 – USD250 – USD8.64)/USD250 = 12.54%.

7. A is correct because the net investor return is 7.9%, calculated as follows:
First, note that "1 and 10" refers to a 1% management fee and a 10% incentive fee.

> End-of-year capital = GBP140 million + GBP80 million = GBP220 million.
>
> Management fee = GBP220 million × 1% = GBP2.2 million.
>
> Incentive fee = (GBP220 – GBP200) million × 10% = GBP2 million.
>
> Total fees to Capricorn = (GBP2.2 + GBP2) million = GBP4.2 million.
>
> Investor net return: (GBP220 – GBP200 – GBP4.2)/GBP200 = 7.9%.

8. A is correct. Although the gross return of Rotunda results in a USD360 million gross NAV, the deduction of the USD7.2 million incentive fee brings NAV to USD352.8 million, which is below the prior high-water mark. Rotunda earns a management fee of USD7.20 million but does not earn an incentive fee because the year-end fund value net of management fee does not exceed the prior high-water mark of USD357 million. Since Rotunda is still also below the prior-year high-water mark, the hurdle rate of return is also basically irrelevant in this fee calculation.
The specifics of this calculation are as follows:

> End-of-year AUM = Prior year-end AUM × (1 + Fund return) = USD288 million × 1.25 = USD360 million.
>
> USD360 million × 2% = USD7.20 million management fee.
>
> USD360 million – USD7.2 million = USD352.8 million AUM net of management fee.

The year-end AUM net of fees do not exceed the USD357 million high-water mark. Therefore, no incentive fee is earned.

9. C is correct. The management fee for the year is

> USD642 × 0.02 = USD12.84 million.

Because the ending gross value of the fund of USD642 million exceeds the high-water mark of USD610 million, the hedge fund can collect an incentive fee on gains above this high-water mark but net of the hurdle rate of return. The incentive fee calculation becomes

{USD642 − [USD610 × (1 + 0.04)]} × 0.20 = USD1.52 million.

The net return to the investor for the year is

[(USD642 − USD12.84 − USD1.52)/USD583.1] − 1 ≈ 0.07638 ≈ 7.64%.

SOLUTIONS

1. C is correct. A CLO manager will extend several loans to corporations (usually to firms involved in LBOs, corporate acquisitions, or other similar types of transactions), pool these loans, and then divide that pool into various tranches of debt and equity that range in seniority and security. The CLO manager will then sell each tranche to different investors according to their risk profiles; the most senior portion of the CLO will be the least risky, and the most junior portion of the CLO (i.e., equity) will be the riskiest.

   A is incorrect because with the different CLO tranches having distinct risks varying with their seniority and security, they will be priced over a range of interest rates. In contrast, unitranche debt combines different tranches of secured and unsecured debt into a single loan with a single, blended interest rate.

   B is incorrect because debt extended to niche borrowers in specific situations is more commonly offered through specialty loans. For example, in litigation finance, a specialist funding company provides debt to a client to finance the borrower's legal fees and expenses in exchange for a portion of any case winnings.

2. B is correct. Investments in private capital funds can add diversity to a portfolio composed of publicly traded stocks and bonds because they have less-than-perfect correlation with those investments. There is also the potential to offer further diversification within the private capital asset class. For example, private equity investments may also offer vintage diversification since capital is not deployed at a single point in time but is invested over several years. Private debt provides investors with the opportunity to diversify the fixed-income portion of their portfolios since private debt investments offer more choices than bonds and other public forms of traditional fixed income.

   A is incorrect because although private equity is considered by many to be the largest component of private capital, using "private equity" as a generic term could be less accurate and possibly misleading since other private forms of alternative finance have grown considerably in size and popularity.

   C is incorrect because although many private investment firms have private equity and private debt arms, these teams typically will not invest in the same assets or businesses to avoid overexposure to a single investment.

3. A is correct. The seed stage supports market research and product development and is generally the first stage at which venture capital funds invest. The seed stage follows the angel investing stage. In the angel investing stage, funds are typically provided by individuals (often friends or family), rather than a venture capital fund, to assess an idea's potential and to transform the idea into a plan. Mezzanine-stage financing is provided by venture capital funds to prepare the portfolio company for its IPO.

4. B is correct. Private equity funds can realize an immediate cash exit in a trade sale. Using this strategy, the portfolio company is typically sold to a strategic buyer.

5. B is correct. Formative-stage financing occurs when the company is still in the process of being formed and encompasses several financing steps. Angel investing capital is typically raised in this early stage of financing.

6. B is correct. The majority of private equity activity involves leveraged buyouts. Merger arbitrage and market neutral are strategies used by hedge funds.

7. B is correct. The majority of real estate property may be classified as either com-

mercial or residential.

8. A is correct. When owning real estate directly, there is a benefit related to taxes. The owner can use property non-cash depreciation expenses to reduce taxable income and lower the current income tax bill. In fact, accelerated depreciation and interest expense can reduce taxable income below zero in the early years of asset ownership, and losses can be carried forward to offset future income. Thus, a property investment can be cash-flow positive while generating accounting losses and deferring tax payments. If the tax losses do not reverse during the life of the asset, depreciation-recapture taxes can be triggered when the property is sold.

   B is incorrect because the large capital requirement is a major disadvantage of investing directly in real estate.

   C is incorrect because a disadvantage for smaller investors who own real estate directly is that they bear the risk of portfolio concentration.

9. C is correct. When interest rates decline, borrowers are likely to refinance their loans at a faster pace than before, resulting in faster amortization of each MBS tranche, including the senior tranche, which is the lowest-risk tranche.

   A is incorrect because risk-averse investors, primarily insurance companies, prefer the lowest-risk tranches, which are the first to receive interest and principal. The junior-most tranche is referred to as the first-loss tranche. It is the highest-risk tranche and is the last to receive interest and principal distributions.

   B is incorrect because when interest rates rise, prepayments will likely slow down, lengthening the duration of most MBS tranches. Prepayments will likely increase when interest rates decline, because borrowers are likely to refinance their loans at a faster pace.

10. B is correct. Real estate investments, including REITs, provide important portfolio benefits due to moderate correlation with other asset classes. However, there are periods when equity REIT correlations with other securities are high, and their correlations are highest during steep market downturns.

    A is incorrect because equity REITs, like other public companies, must report earnings per share based on net income as defined by GAAP or IFRS.

    C is incorrect because REITs can avoid this double taxation. A REIT can avoid corporate income taxation by distributing dividends equal to 90%–100% of its taxable net rental income. This ability to avoid double taxation is the main appeal of the REIT structure.

11. A is correct. A repeat sales index uses the changes in price of repeat sales properties to construct the index. Sample selection bias is a significant drawback because the properties that sell in each period vary and may not be representative of the overall market the index is meant to cover. The properties that transact are not a random sample and may be biased toward properties that changed in value. Understated volatility and reliance on subjective appraisals by experts are drawbacks of an appraisal index.

12. C is correct. The higher the loan-to-value ratio, the higher leverage is for a real estate investment, which increases the risk to both debt and equity investors.

13. B is correct. Publicly traded infrastructure securities, which include shares of companies, exchange-traded funds, and listed funds that invest in infrastructure, provide the benefits of transparent governance, liquidity, reasonable fees, market prices, and the ability to diversify among underlying assets. Direct investment in infrastructure involves a large capital investment in any single project, resulting in high concentration risks. Direct investment in infrastructure provides control

over the assets and the opportunity to capture the assets' full value.

14. C is correct. Publicly traded infrastructure securities, such as exchange-traded MLPs, provide the benefit of liquidity.

15. B is correct. A brownfield investment is an investment in an existing infrastructure asset, which is more likely to have a history of steady cash flows compared with that of a greenfield investment. Growth opportunities and returns are expected to be lower for brownfield investments, which are less risky than greenfield investments.

16. B is correct. Investing in an existing infrastructure asset with the intent to privatize, lease, or sell and lease back the asset is referred to as a brownfield investment. An economic infrastructure asset supports economic activity and includes such assets as transportation and utility assets. Hospitals are social infrastructure assets, which are focused on human activities.

17. A is correct. Infrastructure projects involving construction have more risk than investments in existing assets with a demonstrated cash flow or investments in assets that are expected to generate regular cash flows.

18. B is correct. A primary risk of timber is the international competitive landscape. Timber is a globally sold and consumed commodity subject to world trade interruptions. So the international context can be considered one of its major risk factors.

    A is incorrect because timberland offers an income stream based on the sale of trees, wood, and other timber products that has not been highly correlated with other asset classes.

    C is incorrect because investors are interested in timber due to its global nature (everyone requires shelter), the current income generated from the sale of the product, inflation protection from holding the land, and its safe haven characteristics (it offers some insulation from financial market volatility).

19. B is correct. Unlike timberland products, farm products must be harvested when ripe, so there is little flexibility in the timing of harvest. In contrast, timber (trees) can be grown and easily "stored" by simply not harvesting. This feature offers the flexibility of harvesting more trees when timber prices are up and delaying harvests when prices are down.

    A is incorrect because just as a primary return driver for timberland is change in either the spot or futures price of the commodity (lumber from cut wood), farmland's returns are driven by agricultural commodity prices, with commodity futures contracts potentially combined with farmland holdings to generate an overall hedged return.

    C is incorrect because both farmland and timberland are owned or leased for the benefit of the bounty each generates in the form of crops and timber. And since these resources consume carbon as part of the plant life cycle, the considered value comes not just from the harvest but also from the offset to other human activities.

20. C is correct. In order to be transparent, investable, and replicable, commodity indexes typically use the price of futures contracts on the commodities included in the index rather than the prices of the physical commodities themselves.

    A is incorrect because trading in physical commodities is primarily limited to a smaller group of entities that are part of the physical supply chain. Thus, most commodity investors do not trade actual physical commodities but, rather, trade commodity derivatives.

B is incorrect because although supply chain participants use futures to hedge their forward purchases and sales of the physical commodities, those commodity producers and consumers nonetheless both hedge and speculate on commodity prices.

21. A is correct. Timberland offers an income stream based on the sale of timber products as a component of total return and has historically generated returns not highly correlated with other asset classes.

22. B is correct. Contango is a condition in the futures markets in which the spot price is lower than the futures price, the forward curve is upward sloping, and there is little or no convenience yield. Backwardation is the opposite condition in the futures markets, where the spot price exceeds the futures price, the forward curve is downward sloping, and the convenience yield is high. Equilibrium is an economic term where supply is equal to demand.

23. B is correct. Most equity hedge strategies use a bottom-up strategy.

    A is incorrect because most equity hedge strategies use a bottom-up (not top-down) strategy.

    C is incorrect because most equity hedge strategies use a bottom-up (not market-timing) strategy.

24. C is correct. Hedge funds of funds have multi-layered fee structures, whereas the fee structure for a single hedge fund is less complex. Funds of funds presumably have some expertise in conducting due diligence on hedge funds and may be able to negotiate more favorable redemption terms than an individual investor in a single hedge fund could.

25. A is correct. Private equity funds and hedge funds are typically structured as partnerships where investors are limited partners and the fund is the general partner. The management fee for private equity funds is based on committed capital, whereas for hedge funds, the management fees are based on assets under management. For most private equity funds, the general partner does not earn an incentive fee until the limited partners have received their initial investment back.

26. A is correct. Long–short positions are used by both types of hedge funds to potentially profit from anticipated market or security moves. Event-driven strategies use a bottom-up approach and seek to profit from a catalyst event typically involving a corporate action, such as an acquisition or a restructuring. Macro strategies seek to profit from expected movements in evolving economic variables.

27. A is correct. Margin calls can magnify losses. To meet the margin call, the hedge fund manager may be forced to liquidate a losing position in a security, which, depending on the position size, could exert further price pressure on the security, resulting in further losses. Restrictions on redemptions, such as lockup and notice periods, may allow the manager to close positions in a more orderly manner and minimize forced-sale liquidations of losing positions.

28. C is correct. Fundamental growth strategies take long positions in companies identified, using fundamental analysis, to have high growth and capital appreciation. Fundamental value strategies use fundamental analysis to identify undervalued companies. Market-neutral strategies use quantitative and fundamental analysis to identify under- and overvalued companies.

Portfolio Management

SOLUTIONS

1. A is correct. Combining assets into a portfolio should reduce the portfolio's volatility. Specifically, "individuals and institutions should hold portfolios to reduce risk." As illustrated in the reading, however, risk reduction may not be as great during a period of dramatic economic change.

2. A is correct. Combining assets into a portfolio should reduce the portfolio's volatility. The portfolio approach does not necessarily provide downside protection or guarantee that the portfolio always will avoid losses.

3. B is correct. As illustrated in the reading, portfolios reduce risk more than they increase returns.

4. C is correct. The client's objectives and constraints are established in the investment policy statement and are used to determine the client's target asset allocation, which occurs in the execution step of the portfolio management process.

5. A is correct. Securities are analyzed in the execution step. In the planning step, a client's objectives and constraints are used to develop the investment policy statement.

6. B is correct. Portfolio monitoring and rebalancing occurs in the feedback step of the portfolio management process.

7. C is correct. Portfolio 3 has the same equity exposure as Portfolio 1 and has a higher exposure to alternative assets, which have greater volatility (as discussed in the section of the reading comparing the endowments from Yale University and the University of Virginia).

8. A is correct. The excess reserves invested by banks need to be relatively liquid. Although investment companies and non-life insurance companies have high liquidity needs, the liquidity need for banks is on average the greatest.

9. B is correct. Most foundations and endowments are established with the intent of having perpetual lives. Although defined benefit plans and life insurance companies have portfolios with a long time horizon, they are not perpetual.

10. A is correct. Income is necessary to meet the cash flow obligation to retirees. Although defined benefit plans have a need for income, the need for liquidity typically is quite low. A retiree may need life insurance; however, a defined benefit plan does not need insurance.

11. B is correct. Investment companies manage investments in mutual funds. Although endowments and insurance companies may own mutual funds, they do not issue or redeem shares of mutual funds.

12. B is correct. Open-end funds trade at their net asset value per share, whereas closed-end funds and exchange traded funds can trade at a premium or a discount.

13. A is correct. Exchange traded funds do not have capital gain distributions. If an investor sells shares of an ETF (or open-end mutual fund or closed-end mutual fund), the investor may have a capital gain or loss on the shares sold; however, the

gain (or loss) from the sale is not a distribution.

14. A is correct. Hedge funds are currently exempt from the reporting requirements of a typical public investment company.

15. B is correct. Buyout funds or private equity firms make only a few large investments in private companies with the intent of selling the restructured companies in three to five years. Venture capital funds also have a short time horizon; however, these funds consist of many small investments in companies with the expectation that only a few will have a large payoff (and that most will fail).

SOLUTIONS

1. C is correct. –10.1% is the holding period return, which is calculated as: (3,050 – 3,450 + 51.55)/3,450, which is comprised of a dividend yield of 1.49% = 51.55/ (3,450) and a capital loss yield of –11.59% = –400/(3,450).

2. B is correct. $[(1 + 0.14)(1 – 0.10)(1 – 0.02)] – 1 = 0.0055 = 0.55\%$.

3. A is correct. $[(1 + 0.22)(1 – 0.25)(1 + 0.11)]^{(1/3)} – 1 = 1.0157^{(1/3)} – 1 = 0.0052 = 0.52\%$

4. A is correct. The geometric mean return compounds the returns instead of the amount invested.

5. B is correct. Computation of the money-weighted return, r, requires finding the discount rate that sums the present value of cash flows to zero.

    The first step is to group net cash flows by time. For this example, we have –$1,000 for the $t = 0$ net cash flow, –$3,140 = –$3,165 + $25 for the $t = 1$ net cash flow, and $4,500 = $4,400 + $100 for the $t = 2$ net cash flow

    Solving for r,

    $$CF_0 = -1,000$$
    $$CF_1 = -3,140$$
    $$CF_2 = +4,500$$

    $$\frac{CF_0}{(1 + IRR)^0} + \frac{CF_1}{(1 + IRR)^1} + \frac{CF_2}{(1 + IRR)^2}$$
    $$= \frac{-1,000}{1} + \frac{-3,140}{(1 + IRR)^1} + \frac{4,500}{(1 + IRR)^2} = 0$$

    results in a value of r = 6.91%

6. C is correct. The money-weighted rate of return considers both the timing and amounts of investments into the fund. To calculate the money-weighted rate of return, tabulate the annual returns and investment amounts to determine the cash flows

Year	1	2	3
Balance from previous year	0	$1,150	$4,560
New investment	$1,000	$2,850	$40,440
Net balance at the beginning of year	$1,000	$4,000	$45,000
Investment return for the year	15%	14%	–4%
Investment gain (loss)	$150	$560	–$1,800
Balance at the end of year	$1,150	$4,560	$43,200

CF_0 = –$1,000, CF_1 = –$2,850, CF_2 = –$40,440, CF_3 = +$43,200

Each cash inflow or outflow occurs at the end of each year. Thus, CF_0 refers to the cash flow at the end of Year 0 or beginning of Year 1, and CF_3 refers to the cash flow at end of Year 3 or beginning of Year 4. Because cash flows are being discounted to the present—that is, end of Year 0 or beginning of Year 1—the period of discounting CF_0 is zero whereas the period of discounting for CF_3 is 3 years. Solving for r,

$$CF_0 = -1,000$$
$$CF_1 = -2,850$$
$$CF_2 = -40,440$$
$$CF_3 = +43,200$$

$$\frac{CF_0}{(1+IRR)^0} + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3}$$
$$= \frac{-1,000}{1} + \frac{-2,850}{(1+IRR)^1} + \frac{-40,440}{(1+IRR)^2} + \frac{43,200}{(1+IRR)^3} = 0$$

results in a value of $r = -2.22\%$.

Note that B is incorrect because the time-weighted rate of return (TWR) of the fund is the same as the geometric mean return of the fund and is thus positive:

$$TWR = \sqrt[3]{(1.15)(1.14)(0.96)} - 1 = 7.97\%$$

7. A is correct. Computation of the money-weighted return, *r*, requires finding the discount rate that sums the present value of cash flows to zero. Because most of the investment came during Year 2, the measure will be biased toward the performance of Year 2. The cash flows are as follows:

    $$CF_0 = -10$$

    $$CF_1 = -100$$

    $$CF_2 = +120.31$$

    The terminal value is determined by summing the investment returns for each period [(10 × 1.14 × 1.08) + (100 × 1.08)]

    $$\frac{CF_0}{(1+IRR)^0} + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2}$$
    $$= \frac{-10}{1} + \frac{-100}{(1+IRR)^1} + \frac{120.31}{(1+IRR)^2}$$

    results in a value of $r = 8.53\%$.

    The time-weighted return of the fund is $= \sqrt[2]{(1.14)(1.08)} - 1 = 10.96\%$.

8. B is correct. The annualized rate of return for ETF 2 is 12.05% = $(1.0110^{52/5}) - 1$, which is greater than the annualized rate of ETF 1, 11.93% = $(1.0461^{365/146}) - 1$, and ETF 3, 11.32% = $(1.1435^{12/15}) - 1$. Despite having the lowest value for the periodic rate, ETF 2 has the highest annualized rate of return because of the reinvestment rate assumption and the compounding of the periodic rate.

9. B is correct. (1 + 0.080)/(1 + 0.0210) − 1 = 5.8%

10. A is correct. (1 + 0.065)/(1 + 0.0210) − 1 = 4.3%

11. A is correct. (1 + 0.080)/(1 + 0.0250) − 1 = 5.4%

12. B is correct. (1 + 0.0650)/(1 + 0.0250) − 1 = 3.9%

13. C is correct. Brokerage commissions are negotiated with the brokerage firm. A security's liquidity impacts the operational efficiency of trading costs. Specifically, liquidity impacts the bid–ask spread and can impact the stock price (if the ability to sell the stock is impaired by the uncertainty associated with being able to sell the stock).

14. C is correct. Historical data over long periods of time indicate that there exists a positive risk–return relationship, which is a reflection of an investor's risk aver-

sion.

15. A is correct. A risk-free asset has a variance of zero and is not dependent on whether the investor is risk neutral, risk seeking or risk averse. That is, given that the utility function of an investment is expressed as $U = E(r) - \frac{1}{2}A\sigma^2$, where A is the measure of risk aversion, then the sign of A is irrelevant if the variance is zero (like that of a risk-free asset).

16. C is correct. The most risk-averse investor has the indifference curve with the greatest slope.

17. A is correct. A negative value in the given utility function indicates that the investor is a risk seeker.

18. C is correct. Investment 3 has the highest rate of return. Risk is irrelevant to a risk-neutral investor, who would have a measure of risk aversion equal to 0. Given the utility function, the risk-neutral investor would obtain the greatest amount of utility from Investment 3.

Investment	Expected Return (%)	Expected Standard Deviation (%)	Utility $A = 0$
1	18	2	0.1800
2	19	8	0.1900
3	20	15	0.2000
4	18	30	0.1800

19. C is correct. Investment 4 provides the highest utility value (0.2700) for a risk-seeking investor, who has a measure of risk aversion equal to −2.

Investment	Expected Return (%)	Expected Standard Deviation (%)	Utility $A = -2$
1	18	2	0.1804
2	19	8	0.1964
3	20	15	0.2225
4	18	30	0.2700

20. B is correct. Investment 2 provides the highest utility value (0.1836) for a risk-averse investor who has a measure of risk aversion equal to 2.

Investment	Expected Return (%)	Expected Standard Deviation (%)	Utility $A = 2$
1	18	2	0.1796
2	19	8	0.1836
3	20	15	0.1775
4	18	30	0.0900

21. A is correct. Investment 1 provides the highest utility value (0.1792) for a risk-averse investor who has a measure of risk aversion equal to 4.

Investment	Expected Return (%)	Expected Standard Deviation (%)	Utility A = 4
1	18	2	0.1792
2	19	8	0.1772
3	20	15	0.1550
4	18	30	0.0000

22. A is correct. The CAL is the combination of the risk-free asset with zero risk and the portfolio of all risky assets that provides for the set of feasible investments. Allowing for borrowing at the risk-free rate and investing in the portfolio of all risky assets provides for attainable portfolios that dominate risky assets below the CAL.

23. B is correct. The CAL represents the set of all feasible investments. Each investor's indifference curve determines the optimal combination of the risk-free asset and the portfolio of all risky assets, which must lie on the CAL.

24. A is correct. The asset's returns are not used to calculate the portfolio's variance [only the assets' weights, standard deviations (or variances), and covariances (or correlations) are used].

25. C is correct.

$$\sigma_{port} = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2}$$
$$= \sqrt{(0.3)^2 (20\%)^2 + (0.7)^2 (12\%)^2 + 2(0.3)(0.7)(0.40)(20\%)(12\%)}$$
$$= (0.3600\% + 0.7056\% + 0.4032\%)^{0.5} = (1.4688\%)^{0.5} = 12.11\%$$

26. A is correct.

$$\sigma_{port} = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 Cov(R_1 R_2)}$$
$$= \sqrt{(0.3)^2 (20\%)^2 + (0.7)^2 (12\%)^2 + 2(0.3)(0.7)(-0.0240)}$$
$$= (0.3600\% + 0.7056\% - 1.008\%)^{0.5} = (0.0576\%)^{0.5} = 2.40\%$$

27. C is correct. A portfolio standard deviation of 14.40% is the weighted average, which is possible only if the correlation between the securities is equal to 1.0.

28. B is correct. A portfolio standard deviation of 14.40% is the weighted average, which is possible only if the correlation between the securities is equal to 1.0. If the correlation coefficient is equal to 1.0, then the covariance must equal 0.0240, calculated as: $Cov(R_1, R_2) = \rho_{12}\sigma_1\sigma_2 = (1.0)(20\%)(12\%) = 2.40\% = 0.0240$.

29. C is correct.

$$R_p = w_1 \times R_1 + (1 - w_1) \times R_2$$
$$R_p = w_1 \times 16\% + (1 - w_1) \times 12\%$$
$$15\% = 0.75(16\%) + 0.25(12\%)$$

30. A is correct.

$$\sigma_{port} = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2}$$
$$= \sqrt{(0.5)^2 (20\%)^2 + (0.5)^2 (20\%)^2 + 2(0.5)(0.5)(-0.15)(20\%)(20\%)}$$
$$= (1.0000\% + 1.0000\% - 0.3000\%)^{0.5} = (1.7000\%)^{0.5} = 13.04\%$$

31. B is correct.

$$\sigma_{port} = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2}$$
$$= \sqrt{(0.5)^2 (20\%)^2 + (0.5)^2 (20\%)^2 + 2(0.5)(0.5)(0.00)(20\%)(20\%)}$$
$$= (1.0000\% + 1.0000\% - 0.0000\%)^{0.5} = (2.0000\%)^{0.5} = 14.14\%$$

32. C is correct. An equally weighted portfolio of Asset 2 and Asset 3 will have the lowest portfolio standard deviation, because for each outcome, the portfolio has the same expected return (they are perfectly negatively correlated).

33. A is correct. An equally weighted portfolio of Asset 1 and Asset 2 has the highest level of volatility of the three pairs. All three pairs have the same expected return; however, the portfolio of Asset 1 and Asset 2 provides the least amount of risk reduction.

34. B is correct. The contribution of each individual asset's variance (or standard deviation) to the portfolio's volatility decreases as the number of assets in the equally weighted portfolio increases. The contribution of the co-movement measures between the assets increases (i.e., covariance and correlation) as the number of assets in the equally weighted portfolio increases. The following equation for the variance of an equally weighted portfolio illustrates these points: $\sigma_p^2 = \frac{\bar{\sigma}^2}{N} + \frac{N-1}{N}\overline{COV} = \frac{\bar{\sigma}^2}{N} + \frac{N-1}{N}\bar{\rho}\ \bar{\sigma}^2$.

35. C is correct. The co-movement measures between the assets increases (i.e., covariance and correlation) as the number of assets in the equally weighted portfolio increases. The contribution of each individual asset's variance (or standard deviation) to the portfolio's volatility decreases as the number of assets in the equally weighted portfolio increases. The following equation for the variance of an equally weighted portfolio illustrates these points:

$$\sigma_p^2 = \frac{\bar{\sigma}^2}{N} + \frac{N-1}{N}\overline{COV} = \frac{\bar{\sigma}^2}{N} + \frac{N-1}{N}\bar{\rho}\ \bar{\sigma}^2.$$

36. A is correct. Higher correlations will produce less diversification benefits provided that the other components of the portfolio standard deviation do not change (i.e., the weights and standard deviations of the individual assets).

37. C is correct. The efficient frontier does not account for the risk-free rate. The efficient frontier is the set of all attainable risky assets with the highest expected return for a given level of risk or the lowest amount of risk for a given level of return.

38. C is correct. The global minimum-variance portfolio is the portfolio on the minimum-variance frontier with the lowest standard deviation. Although the portfolio is attainable, when the risk-free asset is considered, the global minimum-variance portfolio is not the optimal risky portfolio.

39. B is correct. The Markowitz efficient frontier has higher rates of return for a given level of risk. With respect to the minimum-variance portfolio, the Markowitz efficient frontier is the set of portfolios above the global minimum-variance port-

folio that dominates the portfolios below the global minimum-variance portfolio.

40. A is correct. The use of leverage and the combination of a risk-free asset and the optimal risky asset will dominate the efficient frontier of risky assets (the Markowitz efficient frontier).

41. B is correct. The CAL dominates the efficient frontier at all points except for the optimal risky portfolio. The ability of the investor to purchase additional amounts of the optimal risky portfolio by borrowing (i.e., buying on margin) at the risk-free rate makes higher rates of return for levels of risk greater than the optimal risky asset possible.

42. C is correct. Each individual investor's optimal mix of the risk-free asset and the optimal risky asset is determined by the investor's risk preference.

SOLUTIONS

1. B is correct. A capital allocation line (CAL) plots the expected return and total risk of combinations of the risk-free asset and a risky asset (or a portfolio of risky assets).

2. B is correct. A portfolio of the risk-free asset and a risky asset or a portfolio of risky assets can result in a better risk-return tradeoff than an investment in only one type of an asset, because the risk-free asset has zero correlation with the risky asset.

3. B is correct. Investors will have different optimal portfolios depending on their indifference curves. The optimal portfolio for each investor is the one with highest utility; that is, where the CAL is tangent to the individual investor's highest possible indifference curve.

4. B is correct. Although the optimal risky portfolio is the market portfolio, highly risk-averse investors choose to invest most of their wealth in the risk-free asset.

5. B is correct. Although the capital allocation line includes all possible combinations of the risk-free asset and any risky portfolio, the capital market line is a special case of the capital allocation line, which uses the market portfolio as the optimal risky portfolio.

6. A is correct. The market includes all risky assets, or anything that has value; however, not all assets are tradable, and not all tradable assets are investable.

7. A is correct. The optimal risky portfolio is the market portfolio. Capital market theory assumes that investors have homogeneous expectations, which means that all investors analyze securities in the same way and are rational. That is, investors use the same probability distributions, use the same inputs for future cash flows, and arrive at the same valuations. Because their valuations of all assets are identical, all investors will invest in the same optimal risky portfolio (i.e., the market portfolio).

8. C is correct. Theoretically, any point above the CML is not achievable and any point below the CML is dominated by and inferior to any point on the CML.

9. B is correct. As one moves further to the right of point M on the capital market line, an increasing amount of borrowed money is being invested in the market portfolio. This means that there is negative investment in the risk-free asset, which is referred to as a leveraged position in the risky portfolio.

10. A is correct. The combinations of the risk-free asset and the market portfolio on the CML where returns are less than the returns on the market portfolio are termed 'lending' portfolios.

11. C is correct. Investors are capable of avoiding nonsystematic risk by forming a portfolio of assets that are not highly correlated with one another, thereby reducing total risk and being exposed only to systematic risk.

12. B is correct. Nonsystematic risk is specific to a firm, whereas systematic risk affects the entire economy.

13. B is correct. Only systematic risk is priced. Investors do not receive any return for

accepting nonsystematic or diversifiable risk.

14. C is correct. The sum of systematic variance and nonsystematic variance equals the total variance of the asset. References to total risk as the sum of systematic risk and nonsystematic risk refer to variance, not to risk.

15. A is correct. Security 1 has the highest total risk = 0.25 compared to Security 2 and Security 3 with a total risk of 0.20.

16. C is correct. Security 3 has the highest beta value; $1.07 = \frac{\rho_{3,m}\sigma_3}{\sigma_m} = \frac{(0.80)\ (20\%)}{15\%}$ compared to Security 1 and Security 2 with beta values of 1.00 and 0.93, respectively.

17. B is correct. Security 2 has the lowest beta value; $0.93 = \frac{\rho_{2,m}\sigma_2}{\sigma_m} = \frac{(0.70)\ (20\%)}{15\%}$ compared to Security 1 and 3 with beta values of 1.00 and 1.07, respectively.

18. B is correct. In the market model, $R_i = \alpha_i + \beta_i R_m + e_i$, the intercept, α_i, and slope coefficient, β_i, are estimated using historical security and market returns.

19. B is correct. In the market model, $R_i = \alpha_i + \beta_i R_m + e_i$, the slope coefficient, β_i, is an estimate of the asset's systematic or market risk.

20. A is correct. In the market model, $R_i = \alpha_i + \beta_i R_m + e_i$, the intercept, α_i, and slope coefficient, β_i, are estimated using historical security and market returns. These parameter estimates then are used to predict firm-specific returns that a security may earn in a future period.

21. B is correct. The average beta of all assets in the market, by definition, is equal to 1.0.

22. A is correct. The CAPM shows that the primary determinant of expected return for an individual asset is its beta, or how well the asset correlates with the market.

23. A is correct. If an asset's beta is negative, the required return will be less than the risk-free rate in the CAPM. When combined with a positive market return, the asset reduces the risk of the overall portfolio, which makes the asset very valuable. Insurance is an example of a negative beta asset.

24. B is correct. In the CAPM, the market risk premium is the difference between the return on the market and the risk-free rate, which is the same as the return in excess of the market return.

25. B is correct. The security market line (SML) is a graphical representation of the capital asset pricing model, with beta risk on the x-axis and expected return on the y-axis.

26. B is correct. The security market line applies to any security, efficient or not. The CAL and the CML use the total risk of the asset (or portfolio of assets) rather than its systematic risk, which is the only risk that is priced.

27. B is correct. The expected return of Security 1, using the CAPM, is 12.0% = 3% + 1.5(6%); $E(R_i) = R_f + \beta_i[E(R_m) - R_f]$.

28. B is correct. The expected risk premium for Security 2 is 8.4%, (11.4% − 3%), indicates that the expected market risk premium is 6%; therefore, since the risk-free rate is 3% the expected rate of return for the market is 9%. That is, using the CAPM, $E(R_i) = R_f + \beta_i[E(R_m) - R_f]$, 11.4% = 3% + 1.4(X%), where X% = (11.4% −

3%)/1.4 = 6.0% = market risk premium.

29. C is correct. Security 3 has the highest beta; thus, regardless of the value for the risk-free rate, Security 3 will have the highest expected return:

$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$

30. C is correct. Security 3 has the highest beta; thus, regardless of the risk-free rate the expected return of Security 3 will be most sensitive to a change in the expected market return.

31. A is correct. The homogeneity assumption refers to all investors having the same economic expectation of future cash flows. If all investors have the same expectations, then all investors should invest in the same optimal risky portfolio, therefore implying the existence of only one optimal portfolio (i.e., the market portfolio).

32. B is correct. The homogeneous expectations assumption means that all investors analyze securities in the same way and are rational. That is, they use the same probability distributions, use the same inputs for future cash flows, and arrive at the same valuations. Because their valuation of all assets is identical, they will generate the same optimal risky portfolio, which is the market portfolio.

33. C is correct. The Sharpe ratio $\left(\widehat{SR}\right)$ is the mean excess portfolio return per unit of risk, where a higher Sharpe ratio indicates better performance:

$$\widehat{SR}_1 = \frac{\overline{R}_p - \overline{R}_f}{\hat{\sigma}_p} = \frac{14.38 - 2.60}{10.53} = 1.12$$

$$\widehat{SR}_2 = \frac{\overline{R}_p - \overline{R}_f}{\hat{\sigma}_p} = \frac{9.25 - 2.60}{6.35} = 1.05$$

$$\widehat{SR}_3 = \frac{\overline{R}_p - \overline{R}_f}{\hat{\sigma}_p} = \frac{13.10 - 2.60}{8.23} = 1.28$$

34. C is correct. Jensen's alpha adjusts for systematic risk, and M^2 and the Sharpe Ratio adjust for total risk.

35. C is correct. The sign of Jensen's alpha indicates whether or not the portfolio has outperformed the market. If alpha is positive, the portfolio has outperformed the market; if alpha is negative, the portfolio has underperformed the market.

36. A is the correct. M^2 adjusts for risk using standard deviation (i.e., total risk).

37. A is correct. The security characteristic line is a plot of the excess return of the security on the excess return of the market. In such a graph, Jensen's alpha is the intercept and the beta is the slope.

38. B is correct. If the estimated return of an asset is above the SML (the expected return), the asset has a lower level of risk relative to the amount of expected return and would be a good choice for investment (i.e., undervalued).

39. C is correct. This is because of the plot of the excess return of the security on the excess return of the market. In such a graph, Jensen's alpha is the intercept and the beta is the slope.

40. C is correct. Since managers are concerned with maximizing risk-adjusted returns, securities with a higher value of Jensen's alpha, α_i, should have a higher

weight.

41. C is correct. Since managers are concerned with maximizing risk-adjusted returns, securities with greater nonsystematic risk should be given less weight in the portfolio.