Set 1 Questions

1. A bond with an issuer option is a(an):
   A. callable bond.
   B. putable bond.
   C. extendible bond.

2. A call option that can only be exercised on predetermined dates is *best* known as a(n):
   A. American-style callable bond.
   B. Bermudan-style call option.
   C. European-style call option.

3. An embedded option in which the holder can keep the bond for a number of years after maturity is *best* known as a(n):
   A. Bermudan call option.
   B. put option.
   C. extension option.

4. An acceleration provision and a delivery option are *most likely* unique to:
   A. sinking fund bonds.
   B. extendible bonds.
   C. hybrid bonds.

5. Compared to an otherwise similar straight bond, a callable bond *most likely* has:
   A. a higher value because of the call option.
   B. a lower value because of the call option.
   C. the same value.

6. If the value of a 10% coupon, annual-pay straight bond with five years remaining to maturity is $102.50, and the value of a callable bond of similar terms is $102.00, the value of the call option is *given* by:
   A. 0.
   B. $102.50 - $102.00.
   C. $102.00 - $102.50.

7. Relative to a straight bond, a putable bond *most likely* has:
   A. a higher value because of the put option.
   B. a lower value because of the put option.
   C. the same value.

8. A wealth manager has identified two four-year annual coupon government bonds, Bond X and Bond Y with similar terms. Bond X is callable at par three years from today and Bond Y is callable and putable at par three years from today. Compared to Bond Y, value of Bond X is:
   A. higher.
   B. lower.

C. the same.

9. Consider a bond callable at 100. The bond is *least likely* to be called if:
   A. value of the bond's future cash flows is higher than 100.
   B. value of the bond's future cash flows is lower than 100.
   C. value of the bond's future cash flows is close to 100.

Table 1: Equivalent Forms of a Yield Curve

Maturity (Years)	Par Rate (%)	Spot Rate (%)	One-Year Forward Rate (%)
1	1.00	1.00	1.00
2	2.00	2.01	3.03
3	3.00	3.04	5.13

10. Assume zero volatility and the term structure given in Table 1. The value of a three-year 4.50% default-free annual coupon bond callable at par one year and two years from now is *closest* to:
    A. $103.50
    B. $103.90
    C. $103.00

11. If the value of a three-year 4.5% straight bond is $104.30, and the value of a three-year 4.5% callable bond is $104.00, (both default-free bonds), the value of the call option is *closest* to:
    A. $0.20
    B. $0.00
    C. $0.30

12. For a three-year bond putable at par one year and two years from today, an investor will *most likely* exercise the put option when the:
    A. value of the bond's future cash flows is lower than 100.
    B. value of the bond's future cash flows is higher than 100.
    C. bond is trading at premium to par.

Table 1: Equivalent Forms of a Yield Curve

Maturity (Years)	One-Year Forward Rate (%)
1	1.00
2	3.03
3	5.13

13. Based on the one-year forward rates given in Table 1, the value of a three-year 4.5% annual-coupon default-free bond, putable at par one year and two years from today at zero volatility is *closest* to:
    A. $103.
    B. $104.
    C. $105.

14. Assume a flat yield curve. If interest rate volatility increases, the value of a callable bond:
    A. increases.

B. decreases.
C. stays the same.

15. Assume a flat yield curve. If interest rate volatility increases, the value of a putable bond:
    A. increases.
    B. decreases.
    C. stays the same.

16. All else equal, as the yield curve slopes upward, value of the call option in callable bonds *most likely*:
    A. decreases.
    B. increases.
    C. remains unaffected.

17. All else equal, a put option provides a hedge against:
    A. falling interest rates.
    B. rising interest rates.
    C. a change in shape of the yield curve.

The information below relates to questions 18-21.
Table 2: Binomial Interest Rate Tree at 10% Interest Rate Volatility
Based on the implied forward rates of Table 1

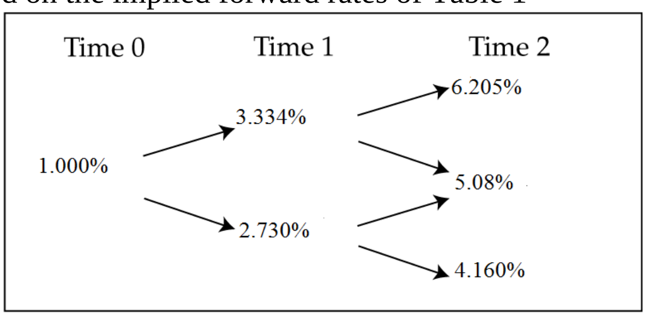


Table 3: Valuation of a Default-Free Three-Year 4.50% Annual Coupon Bond Callable at Par One Year and Two Years from Now at 10% Interest Rate Volatility

Year 0	Year 1	Year 2	Year 3
Value of the callable bond V_0 = $103.465 Value of a straight three-year 4.50% annual coupon bond = $104.306	C = 4.50 V = 100.085	C = 4.50 **Node 2-1** V = ?	104.50
	C = 4.50 V = 101.454	C = 4.50 V = 99.448	104.50
		C = 4.50 **Node 2-3** V = ?	104.50
			104.50

18. Given the one-year forward rates in Table 2, the value of the callable three-year 4.50% annual coupon bond at Node 2-3 is closest to:

A. $99.870; bond will not be callable at par.
B. $100.33; bond will be callable at par.
C. $98.670. bond will be callable at par.

19. Assuming no change in the initial setting except that volatility changes from 10% to 20% in Table 2, the new value of the same three-year 4.50% annual coupon callable bond from Table 3 is:
A. more than 103.465.
B. less than 103.465.
C. equal to 103.465.

20. Using Table 2, the value at Node 2-1 (Table 3) of the three-year 4.50% annual coupon bond putable at par in one year and two years from now is *closest* to:
A. $98.40 putable at par.
B. $99.40 not putable at par.
C. $100.33 putable at par.

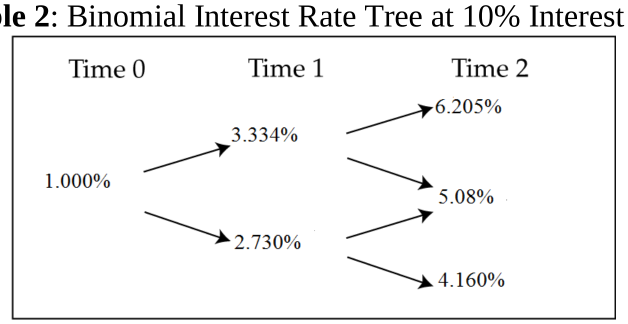
21. Assume nothing changes in the initial setting of the three-year 4.50% annual coupon putable bond valued at 104.96, except the bond is now putable at 96 instead of 100. A similar straight bond is valued at 104.31. The new value of the putable bond is *closest* to:
A. $100.00.
B. $104.96.
C. $104.31.

22. One of the approaches used to value risky bonds is to raise the one-year forward rates derived from the default-free benchmark yield curve by a fixed spread at zero volatility known as the:
A. swap spread.
B. Libor-OIS spread.
C. Z-spread.

23. For risky bonds with embedded options, the constant spread when added to one-year forward rates on the interest rate tree, makes the arbitrage-free value of the bond equal to its market price is *best* known as:
A. option-adjusted spread.
B. TED spread.
C. swap spread.

The information below relates to question 24

Table 2: Binomial Interest Rate Tree at 10% Interest Rate Volatility



24. Consider the interest rates given in Table 2. The price of a three-year 4.50% annual coupon risky callable bond (callable at par one year and two years) is 103.00 at 10% interest rate volatility. If the one-year forward rates in Table 2 are raised by an OAS of 30 bps, the price of the callable bond is 102.90. The correct OAS that justifies the given market price of 103 is:
    A. more than 30 bps.
    B. equal to 30 bps.
    C. less than 30 bps.

25. A portfolio manager is analyzing three 10-year 5.0% annual coupon callable bonds of equal risk. The bonds differ only in the OAS but are similar in characteristics and credit quality.

Bond A	OAS = 30 bps
Bond B	OAS = 25 bps
Bond C	OAS = 27 bps

Which bond is the *most* underpriced?
    A. Bond A.
    B. Bond B.
    C. Bond C.

26. If interest rate volatility increases from 10% to 20%, for a 20-year 5% annual coupon bond, callable in five years, the OAS for the bond:
    A. increases.
    B. decreases.
    C. is unaffected.

27. The *most appropriate* duration measure for bonds with embedded options is:
    A. effective duration.
    B. yield duration measure.
    C. modified duration.

28. Bond A has the following characteristics:

Time to maturity	5 years from now
Coupon	4.75% annual
Type of Bond	Callable at par one year from today
Current price (% of par)	101.25
Price (% of par) when shifting the benchmark yield curve down by 30 bps	102.00
Price (% of par) when shifting the benchmark yield curve up by 30 bps	100.74

The effective duration for Bond A is *closest* to:
    A. 0.60
    B. 2.10
    C. 5.20

29. At very high interest rates, the effective duration of a:

A. callable bond significantly exceeds that of an otherwise identical straight bond.
B. callable bond is similar to that of an otherwise identical straight bond.
C. callable bond is lower than an identical straight bond because the call option is deep in the money.

30. When interest rates fall, the effective duration of a putable bond is:
A. exceeds that of an otherwise identical option-free bond.
B. similar to that of an otherwise identical straight bond.
C. less than that of a straight bond.

31. To measure the interest rate sensitivity of a callable or putable bond when the embedded option is near the money:
A. one-sided durations are used.
B. two-sided effective duration is used.
C. average price response to up- and down-shifts of interest rates is applied.

32. A callable bond is more sensitive to interest rate rises than to interest rate declines, particularly when the call option is near the money. The one-sided duration for a 25 bps increase in interest rates is *most likely*:
A. higher than a one-sided duration for a 25 bps decrease in interest rates.
B. equal to a one-sided duration for a 25 bps decrease in interest rates.
C. lower than a one-sided duration for a 25 bps decrease in interest rates.

33. Which of the following statements is *least accurate*?
A. Key rate durations measure the sensitivity of a bond's price to changes in certain maturities on the benchmark yield curve.
B. Key rate durations help portfolio managers detect the "shaping risk" for bonds.
C. Key rate durations are calculated by assuming parallel shifts in the benchmark yield curve.

Table 4: Key Rate Durations of 30-Year Bonds Putable in 10 Years Valued at a 5% Flat Yield Curve with 15% Interest Rate Volatility

Coupon (%)	**Price (% of par)**	**Total**	**3-Year**	**5-Year**	**10-Year**	**30-Year**
2	76.85	7.80	–0.12	–0.32	7.56	0.68
5	106.87	14.97	–0.02	–0.06	5.45	9.60
10	205.30	12.79	0.06	0.18	2.05	10.50

34. Using the information presented in Table 4, the 10% coupon bond compared to the 2% coupon bond, is *most sensitive* to changes in the:
A. 10-year rate.
B. 3-year rate.
C. 30-year rate.

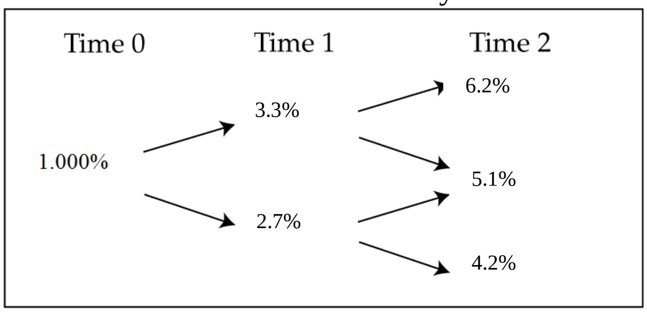
35. The effective convexity of a three-year 3.50% annual coupon bond callable at par one year from now:

A. is always positive.
B. turns negative when the call option is out of money.
C. turns negative when the call option is near the money.

36. Which of the following statements is *least* accurate?
  A. Putable bonds always exhibit positive convexity.
  B. Putable bonds have greater upside potential than otherwise similar callable bonds when interest rates fall.
  C. The upside for a putable bond is much larger than the downside when the put option is out of money.

The information below relates to question 37 - 38

Binomial Interest Rate Tree at 10% Interest Rate Volatility



3 Year Floating Rate Bonds issued by Cemex Corp.

Bond X	One-year Libor annually, set in arrears, capped at 5.00%
Bond Y	One-year Libor annually, set in arrears, floored at 3.25%

Both bonds have the same credit rating.

37. The value of Bond X is *closest* to:
  A. 98.874% of par.
  B. 99.684% of par.
  C. 10.324% of par.

38. The value of Bond Y is *closest* to:
  A. 100.000% of par.
  B. 101.490% of par.
  C. 102.493% of par.

Consider the following table for Questions 39-40.

Bond X: 4.25% Annual Coupon Callable Convertible Bond Maturing on 4 May 2020

Issue date	4 May 2015
Issue Price	At par denominated into bonds of $100,000 each, and multiples of $1,000 each thereafter

Conversion Period	4 June 2015 to 3 April 2020
Initial Conversion Price	$7.00 per share
Issuer Call Price	Two years, three years and four years from now at premium to par, where premium declines after the second year from 10% to 6% third year and to 3% in fourth year
Market Information	
Convertible Bond Price on 5 May 2016	$125,000
Share Price on Issue Date	$5.00
Share Price on 5 May 2016	$7.50

39. Using the initial conversion price of Bond X, the conversion ratio (in shares) is *closest* to:
    A. 14,286.
    B. 20,000.
    C. 17,900.

40. The minimum value of Bond A on 5 May 2016, assuming a yield of 5% on an identical non-convertible bond on that date, is given as:
    A. $82,285.
    B. $107,145.
    C. $100,000.

41. Value of a callable convertible bond is given by:
    A. Value of straight bond + Value of call option on the issuer's stock.
    B. Value of straight bond + Value of call option on the issuer's stock – Value of issuer call option.
    C. Value of straight bond + Value of call option on stock + Value of issuer call option.

42. On 1 June 2015 Company X issued a 5-year, 4% annual coupon convertible bond at $1,000 par with a conversion ratio of 25 ordinary shares, on 02 June 2016, given the market price of Company X stock as $54, the risk-return characteristics of the convertible *most likely* resemble that of:
    A. a busted convertible.
    B. a straight bond without the conversion option.
    C. Company X's common stock.

Set 1 Solutions

1. A is correct. A callable bond has an embedded call option which is an issuer option—that is, the right to exercise the option at the discretion of the bond's issuer. The call provision allows the issuer to redeem the bond before its intended maturity. A putable bond has an embedded put option which is an investor option. An extendible bond has an extension option which allows the bondholder the right to keep the bond for a number of years after maturity, with a different coupon. Sections 2.1.1, 2.1.2. LO.a.

2. B is correct. A Bermudan-style call option can be exercised only on a preset schedule dates after the end of the lockout period. These dates are given in the bond's indenture. The issuer of a European-style callable bond can only exercise the call option on a single date at the end of the lockout period. An American-style callable bond is continuously callable from the end of the lockout period until the maturity date. Section 2.1.1. LO.a.

3. C is correct. An embedded option in which at maturity, the bondholder (an extendible bond investor) has the right to keep the bond for a number of years after maturity, possibly with a different coupon is known as an extension option. Section 2.1.2. LO.a.

4. A is correct. A sinking fund bond (sinker), requires the issuer to make principal repayments where each payment is a certain percent of the original principal amount. The issuer sets aside funds over time to retire the bond issue, thereby lowering credit risk. Such a bond may include the following options: call option, an acceleration provision and a delivery option. Section 2.2. LO.a.

5. B is correct. For a callable bond, the investor is long the bond but short the call option. Compared to a straight bond, the value of the callable bond is lower because of the call option. Value of callable bond = Value of straight bond – Value of call option. Section 3.1. LO.b.

6. B is correct. Value of issuer call option = Value of straight bond – Value of callable bond = $102.50-$102.00 = $0.50. Section 3.1. LO.b.

7. A is correct. For a putable bond, an investor is long the bond and long the put option. Hence the value of the putable bond relative to the value of the straight bond **is higher** because of the put option. Value of putable bond = Value of straight bond + Value of investor put option. Section 3.1. LO.b.

8. B is correct. Relative to Bond Y, Bond X will have a lower value than Bond Y because it does not have a put option. Section 3.1. LO.b.

9. B is correct. Because the issuer borrows money, it will exercise the call option when the value of the bond's future cash flows is higher than the call price or if the price is very close to the call price. Section 3.3.1. LO.c.

10. A is correct. Value of a callable default-free three-year 4.50% annual coupon bond is given below. The bond is callable at par one year and two years from now at zero volatility. Using the one-year forward rates given in Table 1:

	Today	Year 1	Year 2	Year 3
Cash Flow		4.50	4.50	104.50
Discount Rate		1.00%	3.03%	5.13%
Value of Callable Bond	$\frac{100 + 4.50}{1.01}$ $= 103.4653$ $\cong \$103.50$	$\frac{99.40 + 4.50}{1.0303}$ $= 100.8444$ Called at 100	$\frac{104.50}{1.0513}$ $= 99.4007$ Not called	

Section 3.3.1. LO.c.

11. C is correct. The value of the call option in this callable bond is given by the difference between the value of the three-year 4.50% annual coupon straight bond $104.30 and the three-year 4.5% callable bond $104.00: 104.30 – 104.00 = $0.30. Section 3.3.1. LO.c.

12. A is correct. The decision to exercise the put option is made by the investor. He will exercise the put option when the value of the bond's future cash flows is lower than 100 (put price). Section 3.3.2. LO.c.

13. C is correct. Value of a bond with 4.5% annual coupon putable at par two years and one year from today at zero volatility is given as:

	Today	Year 1	Year2	Year 3
Cash Flow		4.50	4.50	104.50
Discount Rate		1.00%	3.03%	5.13%
Value of the Putable Bond	$\frac{101.43 + 4.50}{1.01}$ $= \$104.88$	$\frac{100 + 4.50}{1.0303}$ $= 101.4268$ $\cong 101.43$ Not put	$\frac{104.50}{1.0513}$ $= 99.4007$ Put at 100	

Section 3.3.2. LO.c.

14. B is correct. Value of a callable bond = Value of a straight bond – Value of the call option. All else equal an increase in volatility increases the chances of the call option being exercised by the issuer. As value of the call option **increases**, value of the callable bond **decreases**. Section 3.4.1. LO.d.

15. A is correct. Value of the putable bond = Value of the straight bond + Value of the put option. All else equal a higher volatility **increases** the value of the put and hence the value of the putable bond. Value of a **straight bond** is unaffected by interest rate volatility. Section 3.4.1. LO.d.

16. A is correct. When the yield curve is upward sloping, the one-year forward rates are higher and the opportunities for the callable bond issuer to call the bond are fewer. Hence the value

of the call option decreases. Value of call option in callable bonds increases as yield curve flattens or inverts. Section 3.4.2.1. LO.e.

17. B is correct. If interest rates start rising, bond investor would like their principal back so they can invest their money at a higher rate. Investing in a bond with an embedded put option makes this possible. All else being equal, the value of the put option decreases as the yield curve moves from being upward sloping, to flat, to downward sloping as opportunities to put the bond decline. Section 3.4.2.2. LO.e.

18. B is correct. At Node 2-3 V = $0.5 \times [(104.5/1.04160) + (104.50/1.04160)] = \$100.326$. The bond price exceeds par hence the bond is callable at par. The bond value is reset from $100.326 to $100.000. Section 3.5.1. LO.f.

19. B is correct. Value will be less than 103.465. A higher interest rate volatility increases the value of the call option. Value of the callable bond = value of the straight bond – value of call option. A higher call option value will consequently reduce the value of the callable bond since it is subtracted from the straight bond value. Section 3.5.1. LO.f.

20. A is correct. Given the one-year forward rates in Table 2, from Table 3 the three-year 4.50% annual coupon bond (putable at par one year and two years), is putable at Node 2-1. At Time 2, value at Node 2-1 = $0.5 \times [(104.5/1.06205) + (104.50/1.06205)] = \$98.395$. The bond is at a discount to par so it will be putable at par at Node (2, 1). Bond value will reset to 100. Section 3.5.2. LO.f.

21. C is correct. The put price of 96 is too low for the put option to be exercised in any scenario. Therefore, it will not be equal to its previous value of 104.96. The value of the put option is zero. Value of the putable bond is equal to the value of the straight bond which is $104.31. Section 3.5.2. LO.f.

22. C is correct. The Z-spread or zero-volatility spread is a fixed spread added to the one-year forward rates derived from the default-free benchmark yield curve to value risky bonds. A is incorrect, because swap spread is the spread paid by the fixed-rate payer of an interest rate swap over the rate of recently issued government security. B is incorrect because the Libor-OIS spread which is the difference between Libor and the OIS rate is used as an indicator of risk and liquidity of money market securities. Section 3.6.1. LO.g.

23. A is correct. Option-adjusted spread is that constant spread when added to the one-year forward rates of the binomial lattice makes the arbitrage-free price of a risky bond with embedded options equal to its market price. B & C are incorrect. The TED spread is an indicator of credit risk in the economy. Swap spread is explained above. Section 3.6.1. LO.g.

24. C is correct. The three-year 4.50% annual coupon callable risky bond at 10% interest rate volatility is given as 103.00. If the bond's price is given, the OAS is found by the trial and error method. At 30 bps which is added to the one-year forward rates in each state of the binomial interest rate tree, the price is lower at 102.90. Because of the inverse relationship

between a bond's price and its yield, this means that the discount rates are too high. Hence the OAS should be lower than 30 bps. Section 3.6.1. LO.g.

25. A is correct. Bond A has the highest OAS compared to Bond B and Bond C, so it is the most underpriced (cheap). Lower OAS for bonds with similar characteristics and credit quality (Bonds B & C) indicate that they are possibly overpriced. Section 3.6.1. LO.g.

26. B is correct. As interest rate volatility increases the OAS of the callable bonds decreases and vice versa. Section 3.6.2. LO.h.

27. A is correct. Effective duration works for bonds with embedded options and for straight bonds. Therefore, it is used by practitioners regardless of the type of bond being analyzed. Yield duration measures, such as modified duration, can be used *only* for option-free bonds because these measures assume that a bond's expected cash flows do not change when the yield changes. Section 4.1. LO.i.

28. B is correct. The effective duration for Bond A = $(102.00 - 100.74)/(2 \times 0.003 \times 101.25) = 2.074$. Section 4.1.1. LO.i.

29. B is correct. The effective duration of a callable bond cannot exceed that of a straight bond. At high interest rates, the call option is out of money, so the bond will unlikely be called. Therefore, the effect of an interest rate rise on a callable bond is very similar to an otherwise identical straight bond, and the two bonds in such an interest rate scenario will have similar effective durations. A & B are incorrect because, **when interest rates fall, the call option moves into money** limiting the price appreciation of the callable bond. Consequently, the call option reduces the effective duration of the callable bond relative to that of the straight bond. Section 4.1.1. LO.i.

30. B is correct. When interest rates fall, the put option is out of the money. The effective duration of a putable bond is similar to that of an otherwise identical option-free bond. Section 4.1.1. LO.j.

31. A is correct. One-sided durations—that is, the effective durations when interest rates go up or down—are better at capturing the interest rate sensitivity of a callable or putable bond than the the average price response to up- and down-shifts of interest rates - (two-sided) effective duration, particularly when the embedded option is near the money. When the embedded option is in the money, the price of the callable bond has limited upside potential or price of putable bond has limited downside potential. Section 4.1.2. LO.k.

32. A is correct. When the bond is immediately callable, a 25 bps increase in the interest rate has a greater effect on the value of the callable bond than a 25 bps decrease in the interest rate. When interest rates are high the call option will not be exercised. No matter how far interest rates decline, the price of the callable bond cannot exceed 100 because no investor will pay more than the price at which the bond can be immediately called. In contrast, there is no limit to the price decline if interest rates rise. Therefore, the one-sided up-duration is higher than the one-sided down-duration. Section 4.1.2. LO.k.

33. C is correct. Effective duration is calculated by assuming parallel shifts in the benchmark yield curve. In the calculation of key rate durations instead of shifting the entire benchmark yield curve, only key points are shifted, one at a time. The effective duration for each maturity point shift is then calculated separately. Key rate durations help to identify the "shaping risk" for bonds—that is, the bond's sensitivity to changes in the shape of the yield curve. Section 4.1.3. LO.k.

34. C is correct. Compared to the low coupon bond, the 10% putable bond (high coupon) is most sensitive to changes in the 30-year rate, because it is unlikely to be put and thus behaves like an otherwise identical option-free bond. Section 4.1.3. LO.k.

35. C is correct. The effective convexity of the callable bond turns negative when the call option is near the money, because the upside for a callable bond is much smaller than the downside. When interest rates decline, the price of the callable bond is capped by the price of the call option if it is near the exercise date. When interest rates are high the value of the call option is low, the callable and straight bond behave similarly from changes in interest rates – both have positive convexity. Section 4.2. LO.l.

36. C is correct. A & B hold true for putable bonds. When the option is near the money, the upside for a putable bond is much larger than the downside since putable bond price is floored by the price of the put option near the exercise date. Putable bonds have more upside potential than otherwise identical callable bonds when interest rates decline, because put option is worthless, and putable bond is similar to straight bond in terms of price change, whereas the call option is valuable which caps price appreciation in callable bonds. Section 4.2. LO.l.

37. B is correct. **Valuation of the Three-Year Libor Floater Capped at 5.00%.**

Today	**Year 1**	**Year2**	**Year 3**
		C = 3.3 R = 6.2 V = 98.870	C = ~~106.2~~ 105.0
	C =1.0 R = 3.3 V = 99.407		C = ~~106.2~~ 105.0
V = 99.684 R = 1.0		C = 3.3 R = 5.1 V = 99.905 C = 2.7	C = ~~105.1~~ 105.0
	C = 1.0 R = 2.7 V = 99.954		C = ~~105.1~~ 105.0
		C = 2.7 R = 4.2 V = 100	C = 104.2

			C = 104.2

C = Cash Flow (% of par)
R = One-Year Interest Rate (%)
V = Value of the Capped Floater (% of par)

For each scenario, we check whether the cap applies, and if it does, the cash flow is adjusted. For example, in state *uuu*, Libor is higher than the 5.00% cap. Thus, the coupon is capped at the 5.00 maximum amount, and the cash flow is adjusted downward from the uncapped amount (106.2) to the capped amount (105.0). The coupon is also capped for three other scenarios in Year 3.

For Year 2: $\left[\frac{(105)}{1.062}+\frac{(105)}{1.062}\right]\times 0.5 = 98.870.$

$\left[\frac{(105)}{1.051}+\frac{(105)}{1.051}\right]\times 0.5 = 99.905.$

$\left[\frac{(104.2)}{1.042}+\frac{(104.2)}{1.042}\right]\times 0.5 = 100.$

For Year 1: $\left[\frac{(98.870+3.3)}{1.033}+\frac{(99.905+3.3)}{1.033}\right]\times 0.5 = 99.407.$

$\left[\frac{(99.905+2.7)}{1.027}+\frac{(100+2.7)}{1.027}\right]\times 0.5 = 99.954.$

For Year 0: $\left[\frac{(99.407+1.0)}{1.01}+\frac{(99.954+1.0)}{1.01}\right]\times 0.5 = 99.684.$

Section 5.1. LO.m.

38. C is correct. **Valuation of the Three-Year Libor Floored Floater at 3.25%.**

Today	**Year 1**	**Year2**	**Year 3**
		C = 3.3 R = 6.2 V = 100	C = 106.2
	C =~~1.0~~ 3.25 R = 3.3 V = 100		C = 106.2
V = 102.493 R = 1.0		C = 3.3 R = 5.1 V = 100 C = ~~2.7~~ 3.25	C = 105.1
	C = ~~1.0~~ 3.25 R = 2.7 V = 100.536		C = 105.1
		C = ~~2.7~~ 3.25 R = 4.2	C = 104.2

		V = 100	
			C = 104.2

C = Cash Flow (% of par) R = One-Year Interest Rate (%) V = Value of the Capped Floater (% of par)

For Year 2: $\left[\frac{(106.2)}{1.062} + \frac{(106.2)}{1.062}\right] \times 0.5 = 100.$

$\left[\frac{(105.1)}{1.051} + \frac{(105.1)}{1.051}\right] \times 0.5 = 100.$

$\left[\frac{(104.2)}{1.042} + \frac{(104.2)}{1.042}\right] \times 0.5 = 100.$

For Year 1: $\left[\frac{(100+3.3)}{1.033} + \frac{(100+3.3)}{1.033}\right] \times 0.5 = 100.$

$\left[\frac{(100+3.25)}{1.027} + \frac{(100+3.25)}{1.027}\right] \times 0.5 = 100.536.$

For Year 0: $\left[\frac{(100+3.25)}{1.01} + \frac{(100.536+3.25)}{1.01}\right] \times 0.5 = 102.493.$

Section 5.2. LO.m.

39. A is correct. Conversion ratio = $(Bond\ A's\ par\ value)/(initial\ conversion\ price) = 100{,}000/7 = 14{,}285.71 \cong 14{,}286\ shares$. Section 6.1. LO.n.o.

40. B is correct. The minimum value of the convertible bond is given as:
Maximum (Conversion Value, Straight Bond Value)
The Conversion Value of Bond A on 5 May 2016 = Share Price x no. of shares
$7.50 x 14,286 = $107,145
The Straight Bond Value of Bond A, is given as:
Using the FC: N= 4, I/Y = 5, PMT = 4.25, FV = 100,000; CPT PV = 82,285.32
Max ($107,145, $82,285) = $107,145. Section 6.2. LO.o.

41. B is correct. Value of callable convertible bond = Value of straight bond + Value of call option on the issuer's stock -Value of issuer call option. Section 6.3. LO.p.

42. C is correct. The conversion price = par value/conversion ratio = $1000/25 = $40 per share. On 02 June 2016, the stock price of Company X = $54. The share price of $54 is well above the conversion price of $40. The risk-return characteristics of the convertible bond are similar to those of the underlying stock of Company X. When the underlying share price is well **below** the conversion price, the convertible bond is described as "busted convertible" and exhibits mostly bond risk–return characteristics, hence A & B are incorrect. Section 6.4. LO.q.

Set 2 Questions

The following information relates to questions 1-4.

Sienna Miller, CIO of a hedge fund, is interviewing Kumar for the post of a fixed income analyst, and asks him to evaluate two bonds. Information on the bonds is given in Table 1:

Table 1: Bond Information

Bond	**Maturity**	**Coupon**	**Type of Bond**
C&N Corp. Bond (1)	Three years	4.5% annual	Callable at par in one year & two years from now
PBX Co. Bond (2)	Three years	4.5% annual	Putable at par in one year & two years from now

Miller questions Kumar on how to determine the value of these bonds. Kumar responds by stating, "For both bonds 1 & 2, the value of the bond is calculated by subtracting the value of the embedded option from the value of the straight bond."
Miller next states, “"Interest rate volatility and the shape of the yield curve may also affect the values of Bonds 1 & 2. Assume the following situations:

I: Interest rate volatility increases and the yield curve remains flat.
II: Interest rate volatility remains at the current 10% level and the yield curve flattens further with rates rising in the 0 – 1 year maturity and declining in the 2-year maturity and above."

Miller inquires, about the impact on both bonds under each volatility and interest rate scenario.

1. The embedded option in both bonds (listed in Table 1), is *most likely* known as:
   A. Bermudan-style.
   B. European-style.
   C. American-style.

2. Is Kumar *correct* about the valuation of bonds with embedded option?
   A. Yes.
   B. No, he is incorrect about the valuation of Bond 1.
   C. No, he is incorrect about the valuation of Bond 2.

3. If Situation I occurs, it is *most likely* that the value of Bond 1:
   A. and value of Bond 2 will fall.
   B. will fall and value of Bond 2 will rise.
   C. will rise and value of Bond 2 will fall.

4. If Situation II occurs, it is *most likely* that the value of Bond 1:
   A. will rise more rapidly than the straight bond value and Bond 2 value will rise less rapidly than the straight bond value.
   B. and Bond 2 will rise less rapidly than the straight bond value.
   C. will fall and value of Bond 2 will rise more rapidly than the straight bond value.

5. Li Min, fixed-income strategist, asks her intern to evaluate a three-year 5.25% annual coupon bond callable at par ($100) in one year and two years from now using the binomial interest rate tree depicted in Table 2.

Table 2. Binomial Interest Rate Tree at 10% Interest Rate Volatility

Year 0	Year 1	Year 2
2.50%	3.87%	5.52%
	3.17%	4.52%
		3.70%

Using the above information, the value of the bond is *closest* to:
A. $102.68.
B. $101.85.
C. $100.16.

6. Trudie Wilder, CFO, asks Bret Ruttie, recently hired quantitative analyst, about valuation approaches of callable bonds. Ruttie responds by making the following statements:
   - **Statement I:** "One approach is to use a binomial interest rate tree and then use a process of backward induction to determine the value of a default-free bond.
   - **Statement II:** To value risky bonds, option-adjusted spread (OAS) is used; OAS is a constant spread that, when added to all the one-period forward rates on the interest rate tree, makes the value of the bond equal to its market price.
   - **Statement III:** OAS may be used as a relative value measure. An OAS greater than the OAS of bonds with similar characteristics and credit quality shows that it is most likely underpriced. However, if interest rate volatility increases, then the OAS and thus relative cheapness of a callable bond will increase."

Which of Ruttie's statements is *least likely* correct?
A. Statement I.
B. Statement II.
C. Statement III.

The following information relates to questions 7 – 9.

Peter Han is a portfolio manager for a fixed-income fund that invests in corporate bonds, including convertible bonds. One of the convertible bonds in the fund was issued on 3 March 2016 by Shou Heavy Industries. Each bond has a par value of CNY1,000,000. The initial conversion price was CNY1,500. At the convertible bond issuance date, Shou's common stock was trading at CNY1,080. The bonds have a threshold dividend of CNY100 and a change of control conversion price of CNY500.

On 4 March 2017, the market conversion price for Shou bonds was CNY1,600 and its common shares closed at CNY995. The next day, Shou, paid a dividend (never previously paid) to common shareholders of CNY150 per share.

7. The conversion ratio of the Shou bonds on the date of issuance was *closest* to:
   A. 925.93.
   B. 666.67.
   C. 2,000.

8. On 4 March 2017, the risk-return characteristics of Shou's bonds *most likely* resemble those of:
   A. shares of common stock.
   B. busted convertibles.
   C. putable bond.

9. The dividend paid to Shou's common stock holders will *least likely* affect the bond's:
   A. conversion ratio.
   B. conversion price.
   C. change of control conversion price.

10. Ann Georgiou, portfolio manager asks Libby Kareblo, junior fixed income analyst, about the advantages of holding convertible bonds in a portfolio to investors. Kareblo explains, "The first advantage is a higher coupon rate for investors than similarly rated option-free bond. The second advantage is that the convertibles will generally increase in value if the underlying common stock price increases." Is Kareblo *most likely* correct regarding the two advantages of investing in convertibles?
   A. Yes.
   B. No, she is incorrect regarding the increase in value.
   C. No, she is incorrect regarding the higher coupon rate.

11. Greet Wilder, head of research, discusses convertible bonds that were issued by Haldrone Corporation with a call option and a conversion price of ₤6.00 with his team members. Haldrone's common stock is currently trading at ₤5.625 and has been rising steadily for two months. Wilder asks one of the analysts, "Will you convert the bonds if the common stock price rises above the conversion price or wait and continue to receive the coupon payments?" The analyst responds, "I'll wait because the share price may trend further upwards." Wilder interjects, "No, bondholders will likely not be able to wait, since there's a mechanism in Haldrone bonds to protect existing shareholders." The mechanism that Wilder refers to is *most likely* a(n):
   A. call option.
   B. conversion period.
   C. adjusted conversion price.

12. Shams Lakhani, fund manager DLB Asset Management Company, during a presentation to portfolio managers, makes the following comments comparing the valuation of convertible bonds with callable bonds:
   Comment 1: "Value of a convertible bond is equal to the value of an otherwise identical straight bond minus the value of a call option on the issuer's stock. Hence, it is similar to the value of a callable bond.

Comment 2: The valuation procedure of a convertible is similar to the valuation of a bond with embedded options. Its value is determined using an interest rate tree based on the given yield curve and interest rate volatility assumptions. Backward induction process is applied to calculate the bond's present value after determining whether the embedded options will be exercised at each node.
Comment 3: Convertible bonds are more complex than callable bonds because the analyst must consider factors that may affect the issuer's common stock, including dividend payments and the issuer's actions, plus market conditions and exogenous reasons that affect the value of the issuer's common stock and the bond."

Which of Lakhani's comments is *least likely* correct?
A. 1.
B. 2.
C. 3.

The following information relates to questions 13-15.

Tom Bailey, a quantitative analyst, is asked to evaluate bonds with embedded options that are currently perceived to be mispriced. He gathers data on a group of comparable bonds that have the same market liquidity.

Table 3: Bond Features and Prices

	Bond I	Bond II	Bond III
Remaining maturity	3 years	3 years	3 years
Credit rating	AA	AA	AA
Coupon rate	5.00%	5.00%	5.00%
Optionality	Callable	option-free	Putable
Price	102.282	102.114	102.397

Bailey's supervisor tells him that the research desk has just circulated an interest rate forecast according to which the interest rate volatility is expected to decrease and the yield curve, which is currently flat, is expected to become upward sloping. He asks Bailey to consider the impact of these expected changes on the values of the bonds given in Table 3.

13. Assuming Bond II is correctly priced, given the information in Table 3, is Bond I mispriced?
A. No.
B. Yes.
C. Lack of sufficient information to determine mispricing.

14. If the interest rate volatility changes in the way forecasted, which bond in Table 3 will *most likely* experience the largest decrease in price?
A. Bond I.
B. Bond II.
C. Bond III.

15. If the shape of the yield curve changes as forecasted, and price of Bond II does not change, the price of Bond III will *most likely*:
    A. decrease.
    B. increase.
    C. not change.

16. Akash Bhavin analyzes Bond T, a three year 4.75% annual-pay coupon bond putable at 98 one year and two years from now. He assumes 15% interest rate volatility and, using yields on par bonds, constructs the binomial interest rate tree given in Table 4.

Table 4: Binomial Interest Rate Tree

Year 0	Year 1	Year 2
4.20%	5.51%	7.14%
	4.08%	5.29%
		3.92%

Using the interest rate tree given in Table 4, the value of the putable bond is *closest* to:
A. 97.965.
B. 99.986.
C. 101.236.

17. Shermeen Ojas, portfolio manager, is evaluating a 5-year putable bond recently purchased by a client. She calculates the current and the expected values of the bond if market interest rates were to rise or fall by 30 basis points (bps). Ojas then uses the estimated values of the bond given in Table 5 to determine the effective duration.

Table 5: Value of 5-year Putable Bond

Change in interest rates	**+30 bps**	**No change**	**-30 bps**
Value of bond	96.890	98.875	100.699

The effective duration calculated by Ojas is *closest* to:
A. 6.4.
B. 7.0.
C. 3.1.

18. Pal Lakshay, senior fixed income portfolio manager, while discussing the effective duration and convexity of bonds with his colleagues makes the following comments:
Comment I: "The effective duration of a callable or a putable bond cannot be greater than that of an otherwise identical option-free bond.
Comment II: The effective convexity of a callable bond is always positive whereas the effective convexity of a putable bond turns negative when the put is near the money.
Comment III: The option-free bonds have low positive convexity."

Which of Lakshay's three comments is *least likely* correct?
A. Comment I.
B. Comment II.
C. Comment III.

The following information relates to questions 19 – 22.

Andy Sloan, chief investment officer at Puth Investments, a firm specializing in fixed- income portfolio management, would like to add bonds with embedded options to the firm's bond portfolio. He asks Su Crane, one of the firm's senior analysts, to analyse and select bonds for the firm's bond portfolio.

Crane first chooses two corporate bonds that are callable at par and uses the option adjusted spread (OAS) approach to analyse the bonds, assuming an interest rate volatility of 15%. The following Table 6 presents the results of her approach.

Table 6: Crane's Analysis Using OAS Approach

Bond*	OAS
Bond S	28.5 bps
Bond T	33.6 bps

**Both bonds have the same maturity credit ratings and call dates.*

Crane then selects the following four bonds issued by Dragnet Industries listed in Table 7.

Table 7: Dragnet Industries' Bonds

Bond	**Coupon**	**Maturity**	**Special Provision**
Bond P	5.00% annual	3 years	option- free bond
Bond Q	5.00% annual	3 years	Callable at par in one year & two years
Bond R	5.00% annual	3 years	Putable at par in one year & two years
Bond V	One- year Libor annually, set in arrears	3 years	

Note: These bonds have the same credit quality.

To value the Dragnet Industries' bonds, Crane uses constructs the binomial interest rate tree presented in Table 8 with an interest rate volatility of 10%.

Table 8

Year 0	**Year 1**	**Year 2**
2.00%	3.90%	5.50%
	3.20%	4.50%
		3.70%

Finally, Sloan wants Crane to determine the sensitivity of Bond Q's price to a 30 bps parallel shift of the benchmark yield curve. Crane calculates Bond Q's price as 103.245% of par for a 30 bps parallel shift down in interest rates, and 102.639% of par for a 30 bps shift up in interest rates.

19. Based on Table 6, compared to Bond S, Bond T is *most likely*:
    A. underpriced.
    B. overpriced.
    C. fairly priced.

20. The effective duration of Bond V is closest to:
    A. higher than 3.
    B. higher than or equal to 2.
    C. lower than or equal to 1.

21. Using Table 7, if interest rates increase, the bond whose effective duration will lengthen is *most likely*:
    A. Bond P.
    B. Bond Q.
    C. Bond R.

22. Using Table 8, if the current full price of the bond (with no shift) is 102.941% of par, the effective duration of Bond Q is *closest* to:
    A. 1.70.
    B. 0.98.
    C. 0.93.

The following information relates to questions 23 – 24.

Bella Hadim, a fixed-income analyst has been assigned to value two floating-rate bonds issued by Dymax Inc. given in Table 9. Both bonds have a maturity of three years and the same credit quality.

Table 9

Bond I	One-year Libor annually, set in arrears, capped at 4.00%
Bond II	One-year Libor annually, set in arrears, floored at 3.00%

Using the binomial interest rate tree given below, Hadim calculates the value of the Dymax bonds.

Year 0	**Year 1**	**Year 2**
2.50%	4.63%	5.33%
	3.43%	3.95%
		2.93%

Hadim's analysis for the 4.5% capped floater is shown below:

Table 10: Valuation of Bond I.

Today	Year 1	Year2	Year 3
		C = ~~4.63~~ 4.00 R = 5.33 V = 98.737	C = ~~105.33~~ 104.00
	C =2.5 R = 4.63 V = 98.794		C = ~~105.33~~ 104.00
R = 2.50		C = ~~4.63~~ 4.00 R = 3.95 V = 100 C = 3.43	C = 103.95
	C = 2.5 R = 3.43 V = 100		C = 103.95
C = Cash Flow (% of par) R = One-Year Interest Rate (%) V = Value of the Capped Floater (% of par)		C = 3.43 R = 2.93 V = 100	C = 102.93
			C = 102.93

23. Using Table 10, the value of Bond I is *closest* to:
    A. 100.00% of par.
    B. 99.41% of par.
    C. 97.83% of par.

24. Using Table 9, the value of Bond II is *closest* to:
    A. 100.5% of par.
    B. 101.4% of par.
    C. 99.97% of par.

The following information relates to questions 25 – 29.

Tom Holland, chief investment officer Zavier Investment Advisors during his meeting with the analysts discusses the impact of weakening economic activity. The equity market values are predicted to decline in the coming year and the negative GDP growth rate of the previous quarters is not expected to improve. Holland wants the investors to consider adding more fixed-income securities to their portfolios and limiting their equity exposure.

Holland observes, "Because of low government yields we should consider investment- grade corporate bonds over government securities. According to the consensus forecast among economists, the central bank is expected to lower interest rates in their upcoming meeting."

After the meeting, Zandya Coleman, a fixed-income analyst selects the following four fixed- rate investment- grade bonds issued by Bliss Paper Company for investment (Exhibit 1).

Exhibit 1: Bliss Paper Company's Fixed-Rate Bonds

Bond	Annual Coupon	Type
*Bond X	2.0%	Straight bond
Bond Y	2.0%	Callable at par without a lockout period
Bond Z	2.0%	Putable at par one and two years from now
Bond S	2.0%	Convertible bond: currently out of money

**Note: All bonds have a remaining maturity of three years.*

Coleman finds that demand for consumer credit is relatively strong, despite other poor macroeconomic indicators. As a result, she believes that volatility in interest rates will increase. Coleman also reads a report from Thomson Crew, a reliable financial and economic information provider, forecasting that the yield curve may invert in the coming months.

25. Based on Exhibit 1, if the forecast for interest rates and equity returns are proven accurate, which bond's option is *most likely* to be exercised?
    A. Bond Y.
    B. Bond Z.
    C. Bond S.

26. Based on Exhibit 1, Bond X is *most likely* trading at a current price higher than the price of:
    A. Bond Y.
    B. Bond Z.
    C. Bond S.

27. Assuming the interest rates forecast is proven accurate, the bond with the smallest price increase is *most likely*:
    A. Bond X.
    B. Bond Y.
    C. Bond Z.

28. If the forecast of the interest rate volatility proves accurate, the bond with the greatest price increase is *most likely*:
    A. Bond Y.
    B. Bond Z.
    C. Bond S.

29. If Thomson Crew's forecast comes true, the value of the embedded option will *most likely* increase in:
    A. Bond Y.

B. Bond Z.
C. Both Bond Y and Z.

The following information relates to questions 30 – 33.

Julianne Maurice, a fixed-income analyst for Chariot Investments, Inc. collects data on three corporate bonds, given below.

Bond	Annual Coupon	Type	Price
Bond S	4.5%	Callable at par one year & two years from now	101.300
Bond T	4.5%	Option-free	102.400
Bond U	4.5%	Putable at par one year & two years from now	103.200

Note: Each bond has a maturity of three years remaining and a credit rating of BBB^{+}.

30. If benchmark yields fall, which bond would *most likely* exhibit a decline in effective duration?
A. Bond S.
B. Bond T.
C. Bond U.

31. For Bond S, one-sided:
A. up-duration will be lesser than one-sided down-duration.
B. up-duration will be greater than one-sided down-duration.
C. up-duration and one-sided down duration will be equal.

32. The key rate duration which is the largest for Bond T is:
A. one-year key rate duration.
B. two-year key rate duration.
C. three-year key rate duration.

33. The bond which has *most likely* the lowest effective convexity is:
A. Bond S.
B. Bond T.
C. Bond U.

Set 2 Solutions

1. A is correct. In a European-style callable/putable bond, the call/put option can only be exercised on a single date at the end of the lockout period. An American-style callable bond is continuously callable from the end of the lockout period until the maturity date. A Bermudan-style embedded option can be exercised only on a predetermined schedule of dates after the end of the lockout period, as described for Bond 1 and Bond 2. Sections 2.1.1.-2.1.2. LO.a.

2. C is correct. Value of a callable bond (Bond 1 in this case) = Value of straight bond – Value of call option. Value of a putable bond (Bond 2 in this case) = Value of straight bond + Value of put option. Kumar is incorrect about the valuation of Bond 2. Section 3.1. LO.b.

3. B is correct. All else being equal, the call option increases in value with interest rate volatility. As interest rate volatility increases in a flat yield curve environment, the value of the callable bond decreases. All else being equal, the put option increases in value with interest rate volatility, therefore with a flat yield curve as interest rate volatility increases, the value of the putable bond increases. Section 3.4.1. LO.d.

4. B is correct. All else being equal, as the yield curve flattens, the value of call option in Bond 1 increases. Although Bond 1 increases in value, but the increase in the call option results in a lower value than a straight bond. As the yield curve flattens, the value of the put option in Bond 2 declines, therefore the value of the putable bond will not rise as much as a straight bond. Section 3.4.2.1-3.4.2.2. LO.e.

5. A is correct. Valuation of the 3-year 5.25% annual coupon bond, callable at par in one year and two years from today using the backward induction process is as follows:

Year 0	**Year 1**	**Year 2**	**Year 3**
R = 2.50 V = 102.683	C = 5.25 R = 3.87 V = ~~101.205~~ Called at 100	C = 5.25 R = 5.52 V = 99.744	105.25
	C = 5.25 R = 3.17 V = ~~102.016~~ Called at 100	C = 5.25 R = 4.52 V = ~~100.698~~ Called at 100	105.25
		C = 5.25 R = 3.70 V = ~~101.495~~ Called at 100	105.25
C = Annual coupon R = One-year interest rate V = Value of the callable bond			105.25

For example: Take the Year 2 V = $99.744, calculated as follows:

$$0.5 \times \left[\frac{105.25}{1.0552} + \frac{105.25}{1.0552}\right] = 99.744.$$

Similarly, V = 100.698 in Year 2 (Middle box). Since this value is greater than $100, the bond will be called at $100. Replacing $100.698 with $100 and continuing with the backward induction process until Year 0. Section 3.3.1. LO.f.

6. C is correct. "OAS is often used as a measure of value relative to the benchmark. An OAS lower than that for a bond with similar characteristics and credit quality indicates that the bond is likely overpriced (rich) and should be avoided. A larger OAS than that of a bond with similar characteristics and credit quality means that the bond is likely underpriced (cheap)." If interest rate volatility increases, then the OAS and the relative cheapness of a callable bond will decrease. A & B are correct statements. Section 3.6.1.- 3.6.2. LO. g, h.

7. B is correct. The conversion ratio on issuance date = face value of each bond/ initial conversion price = CNY1,000,000/CNY1,500 = 666.67 shares. Each CNY1,000,000 converts into 666.67 common shares. Section 6.1. LO. n, o.

8. B is correct. On 4 March 2017, the market conversion price of the bonds was CNY1,600. Therefore, the market conversion premium ratio = (CNY1,600/CNY995) – 1 = 60.80%. The underlying common stock is below the market conversion price, and the embedded call option is far out of money. Hence Shou bonds will resemble option-free bonds, also known as busted convertibles. Section 6.2.3., 6.4 LO.q.

9. C is correct. The conversion price is adjusted downwards increasing the conversion ratio if the annual dividend payments are above the threshold dividend to compensate convertible bondholders. Section 6.1. LO.n.

10. C is correct. Convertible bondholders participate in the upside potential because of the conversion option when the underlying common stock rises above the conversion price. Therefore, they accept a lower coupon rate than on similarly rated option-free bonds. Section 6.1. LO.n.

11. A is correct. Haldrone's convertible bonds are callable, therefore it has an incentive to call the bond when the underlying share price increases above the conversion price in order to avoid paying further coupons. This is called forced conversion because it forces bondholders to convert their bonds into shares. Section 6.1. LO. n.

12. A is correct. Value of convertible bond = Value of straight bond + Value of call option on the issuer's stock. Comments 2 & 3 are correct. Section 6.3. LO.o.

13. B is correct. The three bonds have the same credit rating, coupon rate and the same remaining maturity, but they are trading above par. Therefore, the coupon rate of a par bond with the same credit rating and maturity must be lower than 5.00%. Bond II is a straight

bond, while Bond I is a callable bond. All else equal the price of Bond I will be capped relative to the price appreciation of Bond II because of the call option at lower interest rates. Hence its price should likely be lower than the price of Bond II. Sections 3.2-3.3. LO.b.

14. C is correct. The value of a straight bond is unaffected by interest rate volatility. The value of the call option and put option decrease with a decrease in interest rate volatility. Hence the value of the callable Bond I will increase whereas the value of the putable Bond III will decrease. Section 3.4.1. LO.d.

15. B is correct. As the yield curve moves from flat to upward sloping, the value of the put option increases. Since the value of the putable Bond III is equal to the value of an otherwise identical straight bond plus the put option value, it will increase too. Section 3.4.2.2. LO.e.

16. B is correct. The value of the three year 4.75% annual coupon bond, putable at 98 one year and two years from now is calculated using the interest rate tree given in Table 4 and the backward induction process.

Year 0	Year 1	Year 2	Year 3
R = 4.20 V = 99.986	C = 4.75 R = 5.51 V = 98.089	C = 4.75 R = 7.14 V =~~97.769~~ Put at 98*	104.75
	C = 4.75 R = 4.08 V = 100.781	C = 4.75 R = 5.29 V =99.487	104.75
		C = 4.75 R = 3.92 V = 100.799	104.75
C = annual coupon R = one-year interest rate V = value of the putable bond.			104.75

*The bond will be put in year 2 because the present value of the bond's future cash flows is lower than the put price of 98. Section 3.5.2. LO.f.

17. A is correct. The effective duration of the bond is given by the following Equation (3)
$Effective\ duration = \frac{PV_{-} - PV_{+}}{2 \times (\Delta\ Curve) \times PV_0} = \frac{100.699 - 96.890}{2 \times 0.0030 \times 98.875} = 6.42$. Section 4.1.1. LO.i.

18. B is correct. Putable bonds always exhibit positive convexity. Conversely, the effective convexity of a callable bonds turns negative when the call option is near the money. Section 4.2. LO.l.

19. A is correct. If two bonds have the same characteristics and credit quality, they should have the same OAS. If this is not the case, the bond with the largest OAS (i.e., Bond Y) is likely to

be underpriced (cheap) compared to the bond with the smallest OAS (Bond X). Section 3.6.1. LO.g.

20. C is correct. Because the effective duration of a floater is close to the time to next reset and the reset for Bond V is annual, the effective duration of Bond V, a floating-rate bond is lower than or equal to 1. Section 4.1.1. LO.j.

21. B is correct. The effective duration of Bond P, an option-free bond changes very little in response to interest rate movements. For a callable bond (Bond Q here), as interest rates rise, a call option moves out of the money, which increases the bond value and lengthens its effective duration. For a putable, as interest rates rise, a put option moves into the money, limiting the price depreciation of the putable bond and shortening its effective duration. Thus Bond Q's effective duration will lengthen if interest rates rise. Section 4.1.1. LO.j.

22. B is correct. Effective Duration = $\frac{PV_{-} - PV_{+}}{2 \times (\Delta curve) \times (PV_0)}$. For a 30 bps shift, and PV_0 = 102.941,
Effective Duration = $\frac{(103.245 - 102.639)}{(2 \times 0.0030 \times 102.941)} = 0.9811.$ Section 4.1.1. LO.i.

23. B is correct. From Table 10:
For Year 0: $\left[\frac{(98.794+2.5)}{1.025} + \frac{(102.5)}{1.025}\right] \times 0.5 = 99.412\%\ of\ par.$ Section 5.1. LO.m.

24. A is correct. **Valuation of Bond II floored at 3.00%.**

Today	**Year 1**	**Year2**	**Year 3**
		C = 4.63 R = 5.33 V = 100	C = 105.33
	C =~~2.5~~ 3.00 R = 4.63 V = 100		C = 105.33
V = 100.504 R = 2.50		C = 4.63 R = 3.95 V = 100 C = 3.43	C = 103.95
	C = ~~2.5~~ 3.00 R = 3.43 V = 100.033		C = 103.95
C = Cash Flow (% of par) R = One-Year Interest Rate (%) V = Value of the Capped Floater (% of par)		C = 3.43 R = 2.93 V = 100.068	C = ~~102.93~~ 103.00
			C = ~~102.93~~

			103.00

For each scenario, we check whether the floor applies, and if it does, the cash flow is adjusted. For example, in year 3, Libor is lower than the 3.00% floor. Thus, the coupon is floored at the 3.00 amount, and the cash flow is adjusted upward from 102.93 to 103.00. Similarly, the other states are also checked and where necessary the floor is applied to the coupon.

For Year 2: $\left[\frac{(105.33)}{1.0533} + \frac{(105.33)}{1.0533}\right] \times 0.5 = 100.$

$\left[\frac{(103.95)}{1.0395} + \frac{(103.95)}{1.0395}\right] \times 0.5 = 100.$

$\left[\frac{(103.0)}{1.0293} + \frac{(103.0)}{1.0293}\right] \times 0.5 = 100.068.$

For Year 1: $\left[\frac{(100+4.63)}{1.0463} + \frac{(100+4.63)}{1.0463}\right] \times 0.5 = 100.$

$\left[\frac{(100+3.43)}{1.0343} + \frac{(100.068+3.43)}{1.0343}\right] \times 0.5 = 100.033.$

For Year 0: $\left[\frac{(100+3.00)}{1.025} + \frac{(100.033+3.00)}{1.025}\right] \times 0.5 = 100.504.$

Section 5.2. LO.m.

25. A is correct. If interest rates are lowered, the yields on Bliss's bonds are likely to decrease and Bond Y (callable) may be called. B is incorrect because if the equity market declines, Bliss's stock price will likely decrease and Bond S's (convertible) conversion option would likely not be exercised. Because Bond S is currently trading out of the money, it will likely trade further out of the money once the stock price decreases. C is incorrect because Bond Z (putable) is not likely to be exercised in a decreasing interest rate environment. Section 2.1, 4.1, 6.1. LO.a.

26. A is correct. Bond Y (callable) most likely has a current price that is less than Bond X (straight or option free) because investors are short the call option and must be compensated for bearing call risk. Bond S (convertible) most likely has a current price that is greater than Bond X because investors are paying for the embedded conversion option which has time value associated with it. Similarly, Bond Z, most likely trades at a premium relative to Bond X because of the put option. Section 3.3., 3.5., 3.6, 6.1. LO.b.

27. A is correct. According to the consensus economic forecast interest rates will decrease. With interest rates decreasing, all bond prices should rise ignoring any price impact resulting from any embedded options. When interest rates fall, the call option in Bond 4 (callable) becomes valuable, causing an opposing effect on price. The put option of putable bonds, by contrast, increases in value when interest rates rise rather than decline. Section 4.1. LO.j.

28. B is correct. An increase in interest rate volatility will cause the values of the put and call options in Bond Z and Bond Y to increase. Bond Z (putable) would likely experience a price increase due to the increased value of the put option whereas Bond Y (callable) would experience a price decrease because of the increased value of the call option.

The price of Bond S, an out-of- the-money convertible, should be minimally affected by changes in interest rate volatility. Section 3.5. LO.d.

29. A is correct. All else being equal, the value of a put option decreases as the yield curve moves from being upward sloping to flat to downward sloping (inverted). Alternatively, a call option's value increases as the yield curve flattens and increases further if the yield curve inverts. Hence if the yield curve became inverted, the value of the embedded option in Bond Y (Callable) would increase. Section 3.4.2. LO.e.

30. A is correct. Bond S is a callable bond and the effective duration of a callable bond decreases when interest rates fall. This is because an interest rates decline may result in the call option moving into the money, which limits the price appreciation of the callable bond. The price of Bond S is 101.300 and it is callable at par in one year and two years. Thus, the call option is already in the money and would likely be exercised in response to increases in the bond's price. Section 4.1.1. LO.j.

31. B is correct. For Bond S (callable), an (say 30 bps) increase in the interest rate has a greater effect on the value of the callable bond than a (30 bps) decrease in the interest rate. This is because the callable bond is more sensitive to interest rate rises than to interest rate declines For the option-free bond one-sided up-duration and one-sided down-duration will be about equal. For putable bonds, one-sided down duration is greater than one-sided up duration. Section 4.1.2. LO.k.

32. C is correct. For Bond T (an option-free bond) an option-free bond the longest key rate duration will be in the year of its maturity because the largest cash flow (payment of both coupon and principal) occurs in that year. Section 4.1.3. LO.k.

33. A is correct. All else being equal, a callable bond will have lower effective convexity than an option-free bond when the call option is in the money. Similarly, when the call option is in the money, a callable bond will also have lower effective convexity than a putable bond if the put option is out of the money. Bond S (callable) is currently priced higher than its call price of par value, which means the embedded call option is in the money. The put option embedded in Bond U is not in the money; the bond is currently priced above par value. Thus, the effective convexity of Bond S will likely be lower than the option-free and the putable bond. Section 4.2. LO.l.

