# CHAPTER 2 TIME VALUE OF MONEY

(Difficulty Levels: Easy, Easy/Medium, Medium, Medium/Hard, and Hard)

# PART I - New and Revised Carryover Problems and Questions

#### **Multiple Choice: Problems**

#### FV of a lump sum

1. What would the future value of \$100 be after 5 years at 10% compound interest?

a. \$161.05
b. \$134.54
c. \$127.84
d. \$151.29
e. \$143.65

### FV of a lump sum

- 2. Suppose you have \$2,000 and plan to purchase a 3-year certificate of deposit (CD) that pays 4% interest, compounded annually. How much will you have when the CD matures?
  - a. \$2,324.89
    b. \$2,591.45
    c. \$2,249.73
    d. \$2,011.87
    e. \$2,854.13

#### FV of a lump sum

- 3. A company's 2005 sales were \$100 million. If sales grow at 8% per year, how large will they be 10 years later, in 2015, in millions?
  - a. \$190.49
    b. \$225.54
    c. \$188.32
    d. \$201.15
    e. \$215.89

#### FV of a lump sum

4. How much would \$1, growing at 5% per year, be worth after 100 years?

- a. \$141.05
  b. \$131.50
  c. \$164.52
  d. \$144.50
- e. \$155.94

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#### Answer: e EASY

Answer: b EASY

#### Answer: c EASY

# Answer: a EASY

#### PV of a lump sum

- 5. now. If the going interest rate on 3-year government bonds is 6%, how much is the bond worth today?
  - a. \$2,011.87 b. \$2,591.45 c. \$2,324.89 d. \$1,888.92

#### PV of a lump sum

- 6. How much would \$10,000 due in 100 years be worth today if the discount rate were 10%?
  - a. \$0.73 b. \$1.21 c. \$2.49 d. \$4.83 e. \$6.30

#### PV of a lump sum

- Suppose a U.S. government bond will pay \$1,000 three years from now. 7. If the going interest rate on 3-year government bonds is 4%, how much is the bond worth today?
  - a. \$943.46 b. \$991.43 c. \$889.00 d. \$907.91 e. \$968.40

#### Interest rate on a simple lump sum investment

- The U.S. Treasury offers to sell you a bond for \$613.81. No payments will 8. be made until the bond matures 10 years from now, at which time it will be redeemed for \$1,000. What interest rate would you earn if you bought this bond at the offer price?
  - a. 5.91% b. 6.71% c. 7.10% d. 5.59% e. 5.00%

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- Suppose a U.S. government bond promises to pay \$2,249.73 three years from
- e. \$2,854.13

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#### Answer: e EASY

#### Answer: a EASY

Answer: c EASY

Answer: d EASY

#### FV of an ordinary annuity

12. You want to buy a condo 5 years from now, and you plan to save \$3,000 per year, beginning one year from today. You will deposit the money in an account that pays 6% interest. How much will you have just after you make the 5th deposit, 5 years from now?

a. \$14,764.40 b. \$13,431.83 c. \$16,911.28 d. \$17,843.15 e. \$15,119.76

### Simple growth rate

- Sims Inc. earned \$1.00 per share in 2000. Five years later, in 2005, it 9. earned \$2.00. What was the growth rate in Sims' earnings per share (EPS) over the 5-year period?
  - a. 10.82% b. 14.87% c. 13.61%

  - e. 12.17%

#### Number of periods

10. How long would it take \$100 to double if it were invested in a bank that pays 5% per year?

a. 15.27 years b. 10.49 years c. 11.34 years d. 13.91 years e. 14.21 years

#### Number of periods

- 11. Addico Corp's 2005 earnings per share were \$2, and its growth rate during the prior 5 years was 11.0% per year. If that growth rate were maintained, how long would it take for Addico's EPS to double?
  - a. 6.64 years b. 6.81 years c. 6.99 years d. 7.13 years e. 7.28 years

- d. 14.28%

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### Answer: c EASY

Answer: b EASY

Answer: e EASY

Answer: a EASY

#### FV of an ordinary annuity

- 13. You want to go to grad school 3 years from now, and you can save \$5,000 per year, beginning one year from today. You plan to deposit the funds in a mutual fund which you expect to return 9% per year. Under these conditions, how much will you have just after you make the 3rd deposit, 3 years from now?
  - a. \$18,349.15
  - b. \$16,110.34
  - c. \$17,513.68
  - d. \$17,976.84
  - e. \$16,390.50

#### FV of an annuity due

- 14. You want to buy a condo 5 years from now, and you plan to save \$3,000 per year, <u>beginning immediately</u>. You will make 5 deposits in an account that pays 6% interest. Under these assumptions, how much will you have 5 years from today?
  - a. \$16,110.34
    b. \$17,925.96
    c. \$17,513.68
    d. \$15,976.84
    e. \$18,349.15

#### FV of an annuity due

- 15. You want to go to grad school 3 years from now, and you can save \$5,000 per year, <u>beginning immediately</u>. You plan to deposit the funds in a mutual fund which you expect to return 9% per year. Under these conditions, how much will you have just after you make the 3rd deposit, 3 years from now?
  - a. \$14,976.84
    b. \$16,110.34
    c. \$17,513.68
    d. \$17,865.65
    e. \$18,349.15

#### PV of an ordinary annuity

- 16. What is the PV of an ordinary annuity with 5 payments of \$3,000 if the appropriate interest rate is 5%?
  - a. \$12,988.43
    b. \$13,431.83
    c. \$14,764.40
    d. \$17,843.15
    e. \$15,119.76

#### Answer: d EASY

#### Answer: a EASY

# Answer: b EASY

Answer: e EASY

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#### PV of an ordinary annuity

- 17. You have a chance to buy an annuity that pays \$1,000 at the end of each year for 5 years. You could earn 6% on your money in other investments with equal risk. What is the most you should pay for the annuity?
  - a. \$3,324.89
    b. \$2,591.45
    c. \$4,212.36
    d. \$2,011.87
  - e. \$3,854.13

#### PV of an ordinary annuity

- 18. Your father is about to retire, and he wants to buy an annuity that will provide him with \$50,000 of income per year for 20 years, beginning a year from today. The going rate on such annuities is 6%. How much would it cost him to buy such an annuity today?
  - a. \$488,349.15
    b. \$416,110.34
    c. \$517,513.68
    d. \$615,976.84
    e. \$573,496.06

#### PV of an annuity due

- 19. What is the PV of an <u>annuity due</u> with 5 payments of \$3,000 at an interest rate of 5%?
  - a. \$11,110.34
    b. \$13,637.85
    c. \$12,513.68
    d. \$14,976.84
    e. \$15,349.15

#### PV of an annuity due

- 20. You have a chance to buy an annuity that pays \$1,000 at the <u>beginning</u> of each year for 5 years. You could earn 6% on your money in other investments with equal risk. What is the most you should pay for the annuity?
  - a. \$2,854.13
    b. \$2,591.45
    c. \$3,324.89
    d. \$4,465.11
    e. \$5,011.87

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#### Answer: e EASY

# Answer: b EASY

#### Answer: d EASY

#### PV of an annuity due

- 21. Your father is about to retire, and he wants to buy an annuity that will provide him with \$50,000 of income a year for 20 years, with the first payment coming <u>immediately</u>. The going rate on such annuities is 6%. How much would it cost him to buy the annuity today?
  - a. \$607,905.82
    b. \$416,110.34
    c. \$517,513.68
    d. \$615,976.84
  - e. \$488,349.15

#### Payments on an ordinary annuity

- 22. Suppose you inherited \$200,000 and invested it at 6% per year. How much could you withdraw at the end of each of the next 15 years?
  - a. \$24,764.40
    b. \$23,431.83
    c. \$20,592.55
    d. \$17,843.15
    e. \$15,119.76

#### Payments on an ordinary annuity

- 23. Your father has \$500,000 and wants to retire. He expects to live for another 20 years, and to be able to earn 8% on his invested funds. How much could he withdraw at the end of each of the next 20 years and end up with zero in the account?
  - a. \$55,119.76
    b. \$53,431.83
    c. \$54,764.40
    d. \$47,843.15
    e. \$50,926.10

#### Payments on an annuity due

- 24. Your father has \$500,000 and wants to retire. He expects to live for another 20 years, and he also expects to earn 8% on his invested funds. How much could he withdraw at the <u>beginning</u> of each of the next 20 years and end up with zero in the account?
  - a. \$53,431.83
    b. \$47,153.80
    c. \$54,764.40
    d. \$47,843.15
    e. \$45,119.76

Answer: a EASY

# Answer: c EASY

Answer: e EASY

### Answer: b EASY

### **Chapter 2: Time Value of Money**

#### Payments on an annuity due

- Suppose you inherited \$200,000 and invested it at 6% per year. How much 25. could you withdraw at the beginning of each of the next 15 years?
  - a. \$17,843.15 b. \$13,431.83 c. \$14,764.40 d. \$19,426.94 e. \$15,119.76

#### Years to deplete an ordinary annuity

- 26. Your father has \$500,000 invested at 8%, and he now wants to retire. He wants to withdraw \$50,000 at the end of each year, beginning at the end of this year. How many years will it take to exhaust his funds, i.e., run the account down to zero?
  - a. 20.91 years b. 18.49 years c. 11.34 years d. 13.91 years e. 15.27 years

#### Years to deplete an annuity due

- 27. Your father has \$500,000 invested at 8%, and he now wants to retire. He wants to withdraw \$50,000 at the beginning of each year, beginning immediately. How many years will it take to exhaust his funds, i.e., run the account down to zero?
  - a. 11.34 years b. 18.49 years c. 17.54 years d. 13.91 years e. 15.27 years

#### Interest rate implicit in an annuity

- 28. You just won the state lottery. The state gives you the choice of \$1,000,000 today or a 20-year annuity of \$75,000, with the first payment coming one year from today. What rate of return is built into the annuity?
  - a. 5.91% b. 6.71% c. 7.10% d. 5.59% e. 4.22%

#### Answer: e EASY

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Answer: c EASY

#### Answer: a EASY

### Chapter 2: Time Value of Money

### Interest rate implicit in an annuity

- Your girlfriend just won the Power Ball lottery. She has the choice of 29. \$10,000,000 today or a 30-year annuity of \$500,000, with the first payment coming today. What rate of return is built into the annuity?
  - a. 2.71%
  - b. 3.08%
  - c. 4.10%
  - d. 3.59%
  - e. 3.91%

#### Interest rate implicit in an annuity

- Assume that you own an annuity that will pay you \$10,000 per year for 10 30. years, with the first payment being made today. Your girlfriend's father offers to give you \$45,000 for the annuity. If you sell it, what rate of return would your girlfriend's father earn on his investment?
  - a. 25.59% b. 26.71% c. 17.10% d. 24.63% e. 22.91%

### PV of an annuity due

- 31. You own an oil well that will pay you \$25,000 per year for 8 years, with the first payment being made today. If you think a fair return on the well is 7%, how much should you ask if you decide to sell it?
  - a. \$159,732 b. \$116,110 c. \$217,513 d. \$315,976 e. \$288,349

#### PV of an ordinary annuity plus an ending payment

- 32. What's the present value of a 6-year ordinary annuity of \$1,000 per year plus an additional \$1,500 at the end of Year 6 if the interest rate is 6%?
  - a. \$5,324.89 b. \$5,591.45 c. \$5,974.77 d. \$6,011.87 e. \$4,854.13

### Answer: a EASY

Answer: c EASY

Answer: d EASY

#### PV of a perpetuity

- 33. What's the present value of a perpetuity that pays \$100 per year if the appropriate interest rate is 6%?
  - a. \$2,854.13
    b. \$2,591.45
    c. \$1,324.89
    d. \$1,011.87
    e. \$1,666.67

#### Rate of return on a perpetuity

- 34. What's the rate of return you would earn if you paid \$1,500 for a perpetuity that pays \$105 per year?
  - a. 6.71%
  - b. 7.00%
  - c. 7.30%
  - d. 5.59%
  - e. 5.91%

#### Dollar payments on a perpetuity

- 35. What annual payment would you have to receive in order to earn an 8% rate of return on a perpetuity that cost \$1,500?
  - a. \$127.84
    b. \$134.54
    c. \$151.29
    d. \$120.00
  - e. \$143.65

#### PV of an uneven cash flow stream

- 36. At a rate of 8%, what is the present value of the following cash flow stream? \$0 at Time 0; \$100 at the end of Year 1; \$300 at the end of Year 2; \$0 at the end of Year 3; and \$500 at the end of Year 4?
  - a. \$717.31
    b. \$625.54
    c. \$788.32
    d. \$701.15
  - e. \$690.49

#### PV of an uneven cash flow stream

- 37. An investment promises the following cash flow stream: \$1,000 at Time 0; \$2,000 at the end of Year 1 (or at T=1); \$3,000 at the end of Year 2; and \$5,000 at the end of Year 3. At a discount rate of 5%, what is the present value of the cash flow stream?
  - a. \$9,324.89
    b. \$9,591.45
    c. \$9,945.04
  - d. \$9,011.87

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#### Answer: c EASY/MEDIUM

# Answer: d EASY

### Answer: e EASY

# Answer: b EASY

# Answer: a EASY

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41. expected rate of return on this investment?

Interest rate built into an uneven cash flow stream

2; \$0 at the end of Year 3; and \$500 at the end of Year 4?

- b. \$991.43 c. \$943.46 d. \$975.89 e. \$968.40
- 40. At a rate of 8%, what is the future value of the following cash flow
- b. \$1,580.63 c. \$1,413.68 d. \$1,976.84 e. \$1,349.15

a. \$907.91

# FV of an uneven cash flow stream

stream? \$0 at Time 0; \$100 at the end of Year 1; \$300 at the end of Year

- a. \$1,110.34
- appropriate interest rate is 8%, compounded semiannually?
- e. \$2,530.64 What's the present value of \$2,000 discounted back 3 years if the

b. \$2,781.45 c. \$2,324.89

interest rate is 8%, compounded semiannually?

38.

39.

- a. \$2,854.13

e. \$9,854.13

FV of a lump sum, semiannually

- d. \$2,011.87

### PV of a lump sum, semiannually

- Answer: a MEDIUM
- An investment costs 1,000 (CF at T = 0) and is expected to produce cash flows of \$50 at the end of each of the next 5 years, then an additional lump sum payment of \$1,000 at the end of the 5th year. What is the
  - a. 5.0% b. 6.7% c. 7.1% d. 5.5%
  - e. 5.9%

Answer: d MEDIUM

Answer: e EASY/MEDIUM What's the future value of \$2,000 after 3 years if the appropriate

Answer: b EASY/MEDIUM

#### Interest rate built into an uneven cash flow stream

- 42. An investment costs \$500 and is expected to produce cash flows of \$50 at the end of Year 1, \$60 at the end of Year 2, \$70 at the end of Year 3, and \$516 at the end of Year 4. What rate of return would you earn if you bought this investment?
  - a. 11.1%
  - b. 12.7%
  - c. 10.0%
  - d. 9.5%
  - e. 10.9%

#### FV of a lump sum, monthly

- 43. What's the future value of \$2,000 after 3 years if the appropriate interest rate is 8%, compounded monthly?
  - a. \$2,854.13
    b. \$2,491.45
    c. \$2,324.89
    d. \$2,011.87
    e. \$2,540.47

#### PV of a lump sum, monthly

- 44. What's the present value of \$2,000 discounted back 3 years if the appropriate interest rate is 8%, compounded monthly?
  - a. \$1,491.45
    b. \$1,574.51
    c. \$1,324.89
    d. \$1,011.87
    e. \$1,854.13

#### APR vs. effective annual rate

- 45. Credit card issuers must by law print their Annual Percentage Rate (APR) on their monthly statements. If the APR is stated to be 15%, with interest paid monthly, what is the EFF% on the card?
  - a. 15.59%
    b. 16.71%
    c. 17.10%
    d. 16.08%
    e. 12.91%

#### Nominal vs. effective annual rate

- 46. If a bank pays a 6% nominal rate, with monthly compounding, on deposits, what effective annual rate does the bank pay?
  - a. 6.17% b. 6.71%
  - c. 5.10%
  - d. 6.59%

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#### Answer: d MEDIUM

### Answer: e MEDIUM

# Answer: b MEDIUM

### Answer: a MEDIUM

Answer: c MEDIUM

e. 5.91%

#### Interest charges, simple interest

- 47. Columbus Corp. borrowed \$10,000 at a rate of 8%, simple interest, with interest paid at the end of each month. The bank uses a 360-day year. How much interest would the firm have to pay in a 30-day month?
  - a. \$27.84
  - b. \$34.54
  - c. \$66.67
  - d. \$51.29
  - e. \$43.65

#### Fractional time periods

- Suppose you deposited \$5,000 in a bank account that pays 6% with daily 48. compounding and a 360-day year. How much could you withdraw after 7 months, assuming each month has 30 days?
  - a. \$5,854.13 b. \$5,591.45 c. \$5,324.89 d. \$5,011.87 e. \$5,178.08

#### Loan amortization: payment

- 49. Suppose you borrowed \$25,000 at a rate of 8% and must repay it in 4 equal installments at the end of each of the next 4 years. How large would your payments be?
  - a. \$7,691.45 b. \$7,548.02 c. \$7,324.89 d. \$7,011.87 e. \$7,854.13

#### Loan amortization: interest

- Suppose you borrowed \$25,000 at a rate of 8% and must repay it in 4 equal 50. installments at the end of each of the next 4 years. How much interest would you have to pay in the first year?
  - a. \$2,081.87 b. \$2,591.45 c. \$2,324.89 d. \$2,000.00 e. \$2,854.13

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#### Answer: d MEDIUM

#### Answer: e MEDIUM

# Answer: b MEDIUM

#### Answer: c MEDIUM

#### Comparing the effective cost of two bank loans

- Bank A offers to lend you \$10,000 at a nominal rate of 7%, compounded 51. monthly. The loan (principal plus interest) must be repaid at the end of the year. Bank B also offers to lend you the \$10,000, but it will charge 8%, with interest due at the end of the year. What is the difference in the effective annual rates charged by the two banks?
  - a. 0.77%
  - b. 1.71%
  - c. 1.10%
  - d. 1.59%
  - e. 0.91%

#### Mortgage payments

- You are buying your first house for \$220,000, and are paying \$30,000 as a 52. down payment. You have arranged to finance the remaining \$190,000 30-year mortgage with a 7% nominal interest rate and monthly payments. What are the equal monthly payments you must make?
  - a. \$1,513 b. \$1,110 c. \$1,264 d. \$1,976
  - e. \$1,349

#### Loan amortization: principal repayment

- 53. Suppose you borrowed \$25,000 at a rate of 8% and must repay it in 4 equal installments at the end of each of the next 4 years. By how much would you reduce the amount you owe in the first year?
  - a. \$5,349 b. \$6,110
  - c. \$6,513
  - d. \$4,976
  - e. \$5,548

#### Loan amortization: ending balance

- Suppose you borrowed \$25,000 at a rate of 8% and must repay it in 4 equal 54. installments at the end of each of the next 4 years. How much would you still owe at the end of the first year, after you have made the first payment?
  - a. \$21,110 b. \$19,452 c. \$18,513 d. \$18,976 e. \$19,049

Answer: e MEDIUM/HARD

Answer: b MEDIUM/HARD

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#### Answer: a MEDIUM

Answer: c MEDIUM

#### Retirement planning

#### Answer: d MEDIUM/HARD

- 55. Your sister turned 30 today, and she is planning to save \$3,000 per year for retirement, with the first deposit to be made one year from today. She will invest in a mutual fund, which she expects to provide a return of 10% per year. She plans to retire 35 years from today, when she turns 65, and she expects to live for 30 years after retirement, to age 95. Under these assumptions, how much can she spend in each year after she retires? Her first withdrawal will be made at the end of her first retirement year.
  - a. \$78,976
  - b. \$91,110
  - c. \$88,513
  - d. \$86,250
  - e. \$83,049

#### Non-annual compounding

#### Answer: a MEDIUM/HARD

- 56. You just deposited \$5,000 in a bank account that pays a 12% nominal interest rate, compounded monthly. If you also add another \$10,000 to the account one year (12 months) from now and another \$15,000 to the account two years from now, how much will be in the account three years (36 months) from now?
  - a. \$36,753.57
    b. \$33,431.83
    c. \$34,764.40
    d. \$37,843.15
    e. \$35,119.76

#### Lifetime subscription vs. annual payments

#### Answer: c MEDIUM/HARD

- 57. Your subscription to Making Money Monthly is about to run out. You plan to take the magazine for the rest of your life, and you can renew it by paying \$100 per year, beginning immediately, or you can get a lifetime subscription for \$1,000, payable immediately. Assuming you can earn 7% on your capital and the annual renewal rate will remain constant, how many years must you live to make the lifetime subscription the better buy? Round up if necessary to obtain a whole number of years. (Hint: Be sure to remember that you are solving for how many years you must live, not for how many payments must be made.)
  - a. 16 yearsb. 14 yearsc. 15 yearsd. 17 yearse. 13 years

#### **Chapter 2: Time Value of Money**

# Comparing the effective cost of two bank loans

- 58. Bank A offers to lend you \$10,000 at a nominal rate of 6%, simple interest, with interest paid monthly. Bank B offers to lend you the \$10,000, but it will charge 7%, simple interest, with interest paid at the end of the year. What is the difference in the effective annual rates charged by the two banks?
  - a. 1.17%
  - b. 1.12%
  - c. 0.91%
  - d. 1.28%
  - e. 0.83%

#### Retirement planning

#### Answer: b MEDIUM/HARD

59. It is now January 1, 2005. Tom and Jerry are cousins who were both born on January 1, 1975. Both turned 30 today. Their grandfather gave Tom \$4,000 on his 25th birthday, January 1, 2000, putting the funds into a trust that will be paid to Tom on his 70th birthday, January 1, 2045. Each year since 2000, the grandfather put an additional \$4,000 in the account on Tom's birthday, and the grandfather's own trustee will continue making the \$4,000 payments until January 1, 2045, when a 46th and final \$4,000 contribution will be made on Tom's 70th birthday. The grandfather wants Tom to work, not to be a "trust fund baby," but he also wants to insure that Tom is well provided for in his old age.

The grandfather has until now has been disappointed with Jerry, hence has not given him anything, but they recently reconciled, and the grandfather has decided to make an equivalent provision for Jerry. He will make the first payment to a trust for Jerry today, and he has instructed his trustee to make additional annual payments each year until January 1, 2045, when the 41st and final payment will be made. If both trusts earn an annual return of 10%, how much must the grandfather put into Jerry's trust annually to enable him to receive the same amount as Tom on January 1, 2045, when they reach age 70?

a. \$6,110
b. \$6,492
c. \$7,513
d. \$5,976
e. \$8,349

Answer: e MEDIUM/HARD

#### Saving to start a business

#### Answer: d HARD

- 60. After graduation, you plan to work for Mega Corporation for 10 years and then start your own business. You expect to save \$5,000 a year for the first 5 years and \$10,000 annually for the following 5 years, with the first deposit being made a year from today. The first \$10,000 will be deposited at the end of Year 5. In addition, your grandfather just gave you a \$20,000 graduation gift which you will deposit immediately. If the account earns 8% compounded annually, how much will you have when you start your business 10 years from now?
  - a. \$185,976
    b. \$116,110
    c. \$217,513
    d. \$144,944
    e. \$128,349

### Cash flow required to provide a given rate of return

Answer: a HARD

- 61. You have been offered a 7-year investment at a price of \$50,000. It will pay \$5,000 at the end of Year 1, \$10,000 at the end of Year 2, and \$15,000 at the end of Year 3, plus a fixed but currently unspecified cash flow, X, at the end of Years 4 through 7. The payer is essentially riskless, so you are sure the payments will be made, and you regard 9% as an appropriate rate of return on riskless 7-year investments. What cash flow must the investment provide at the end of each of the final 4 years, that is, what is X?
  - a. \$10,158.58
    b. \$13,431.83
    c. \$14,764.40
    d. \$17,843.15
    e. \$15,119.76

#### Saving for college

62. Nathan and Stephanie are saving for their daughter's college education. Their daughter, Paige, is now 8 years old and will be entering college 10 years from now (t = 10). College tuition and expenses at State U. are currently \$16,000 a year and are expected to increase at a rate of 4% a year. They expect Paige to graduate in 4 years (if Paige wants to go to graduate school, she's on her own). Tuition and other costs will be due at the beginning of each school year (at t = 10, 11, 12, and 13).

So far, Nathan and Stephanie have built up \$9,000 in the college savings account. Their long-run financial plan is to contribute \$3,000 a year at the beginning of each of the next five years (at t = 0, 1, 2, 3, and 4). Then they plan to make 6 equal annual contributions at the end of each of the following 6 years (t = 5, 6, 7, 8, 9, and 10). Their investment account is expected to earn 8%. How large must the annual payments be in the subsequent 6 years (t = 5, 6, 7, 8, 9, and 10) to meet their daughter's anticipated college costs?

a. \$2,513
b. \$3,110
c. \$5,758
d. \$2,976
e. \$4,349

#### Loan amortization: repayment of principal

- 63. Your company has just taken out a 1-year installment loan for \$100,000. Monthly payments on the loan will be \$8,978, due at the end of each month. What percentage of the 3rd monthly payment will go toward the repayment of principal?
  - a. 91.70%
    b. 94.81%
    c. 86.79%
    d. 88.54%
  - e. 89.06%

#### Loan amortization: interest paid

- 64. A homeowner just obtained a 30-year (360-month) mortgage for \$120,000. The mortgage has a fixed nominal annual rate of 8%, with monthly payments. What percentage of the total payments made during the first 3 months will go toward payment of interest?
  - a. 94.81% b. 90.79% c. 86.79% d. 88.54%
  - e. 91.70%

#### Answer: c HARD

#### Answer: e HARD

#### Answer: b HARD

### **Multiple Choice: Conceptual**

#### PV and discount rate

- 65. You are analyzing the value of an investment by calculating the present value of its expected cash flows. Which of the following would cause the investment to look better?
  - a. The discount rate decreases.
  - b. The cash flows are extended over a longer period of time, but the total amount of the cash flows remains the same.
  - c. The discount rate increases.
  - d. The riskiness of the project's cash flows increases.
  - e. The total amount of cash flows remains the same, but more of the cash flows are received in the later years and less are received in the earlier years.

#### Time value concepts

#### Answer: e EASY

Answer: c EASY

- 66. Which of the following statements is NOT CORRECT, assuming positive interest rates?
  - a. A 5-year \$100 annuity due will have a higher present value than similar ordinary annuity.
  - b. A 15-year, \$100,000 mortgage will have larger monthly payments than an otherwise similar 30-year mortgage.
  - c. If an investment pays 10% interest compounded annually, its effective rate will also be 10%.
  - d. Securities A and B offer the same nominal rate of interest, but A pays interest quarterly and B pays semiannually. Investment B will have the higher present value.
  - e. An investment's nominal interest rate will always be equal to or greater than its effective annual rate.

#### Time value concepts

- 67. A lump sum payment of \$1,000 is due at the end of 5 years. The nominal interest rate is 10%, semiannual compounding. Which of the following statements is CORRECT?
  - a. The present value of the \$1,000 would be greater if interest were compounded monthly rather than semiannually.
  - b. The periodic rate is greater than 5%.
  - c. The periodic interest rate is 5%.
  - d. The present value would be greater if the lump sum were discounted back for more periods.
  - e. The PV if the \$1,000 lump sum has a higher present value than the PV of a 5-year, \$200 ordinary annuity.

#### Answer: a EASY

#### Time value concepts

#### Answer: e EASY

- 68. Which of the following investments will have the highest future value at the end of 5 years? Assume that the effective annual rate for all investments is the same and greater than zero.
  - a. A pays \$50 at the end of every 6-month period for the next 5 years (a total of 10 payments).
  - b. B pays \$50 at the beginning of every 6-month period for the next 5 years (a total of 10 payments).
  - c. C pays \$500 at the end of 5 years (a total of one payment).
  - d. D pays \$100 at the end of every year for the next 5 years (a total of 5 payments).
  - e. E pays \$100 at the beginning of every year for the next 5 years (a total of 5 payments).

#### Effective annual rate

#### Answer: b EASY

- 69. Which of the following bank accounts has the highest effective annual return?
  - a. An account that pays 10% nominal interest with monthly compounding.
  - b. An account that pays 10% nominal interest with daily compounding.
  - c. An account that pays 10% nominal interest with annual compounding.
  - d. An account that pays 9% nominal interest with daily compounding.
  - e. An account that pays 9% nominal interest with monthly compounding.

#### Effective annual rate

#### Answer: d EASY

70. You are interested in investing your money in a bank account. Which of the following banks provides you with the highest effective rate of interest?

a. Bank 1; 8.0% with monthly compounding.

- b. Bank 2; 8.0% with annual compounding.
- c. Bank 3; 8.0% with quarterly compounding.
- d. Bank 4; 8.0% with daily (365-day) compounding.
- e. Bank 5; 8.2% with annual compounding.

#### Quarterly compounding

interest is 4%.

#### . .

b. The periodic rate of interest is 8% and the effective rate of interest is greater than 8%.

a. The periodic rate of interest is 2% and the effective rate of

- c. The periodic rate of interest is 4% and the effective rate of interest is 8%.
- d. The periodic rate of interest is 8% and the effective rate of interest is 8%.
- e. The periodic rate of interest is 2% and the effective rate of interest is greater than 8%.

#### Annuities

71.

#### Answer: c MEDIUM

- 72. Suppose someone offered you the choice of two equally risky annuities, each paying \$10,000 per year for five years. One is an ordinary (or deferred) annuity, while the other is an annuity due. Which of the following statements is CORRECT?
  - a. The present value of the ordinary annuity must exceed the present value of the annuity due, but the future value of an ordinary annuity may be less than the future value of the annuity due.
  - b. The present value of the annuity due exceeds the present value of the ordinary annuity, while the future value of the annuity due is less than the future value of the ordinary annuity.
  - c. The present value of the annuity due exceeds the present value of the ordinary annuity, and the future value of the annuity due also exceeds the future value of the ordinary annuity.
  - d. If interest rates increase, the difference between the present value of the ordinary annuity and the present value of the annuity due remains the same.
  - e. The present value of the ordinary annuity exceeds the present value of the annuity due, and the future value of an ordinary annuity also exceeds the future value of the annuity due.

Answer: e EASY

#### Amortization

#### Answer: e MEDIUM

- 73. A \$10,000 loan is to be amortized over 5 years, with annual end-of-year payments. Given these facts, which of these statements is CORRECT?
  - a. The annual payments would be larger if the interest rate were lower.
  - b. If the loan were amortized over 10 years rather than 5 years, and if the interest rate were the same in either case, the first payment would include more dollars of interest under the 5-year amortization plan.
  - c. The last payment would have a higher proportion of interest than the first payment.
  - d. The proportion of interest versus principal repayment would be the same for each of the 5 payments.
  - e. The proportion of each payment that represents interest as opposed to repayment of principal would be higher if the interest rate were higher.

#### Amortization

#### Answer: b MEDIUM

- 74. Which of the following statements regarding a 30-year (360-month) \$100,000 fixed-rate mortgage is CORRECT? (Ignore all taxes and transactions costs.)
  - a. The remaining balance after three years will be \$100,000 less the total amount of interest paid during the first 36 months.
  - b. The proportion of the monthly payment that goes towards repayment of principal will be higher 10 years from now than it will be this year.
  - c. The monthly payment on the mortgage will steadily decline over time.
  - d. The outstanding balance gets paid off at a faster rate early in a loan's life, rather than later.
  - e. Because it is a fixed rate mortgage, the amount paid in interest per payment is constant.

#### Amortization

#### Answer: a MEDIUM

- 75. Which of the following statements regarding a 30-year, \$100,000 mortgage with a nominal interest rate of 10%, compounded monthly, is NOT CORRECT?
  - a. The monthly payments will decline over time.
  - b. The proportion of the monthly payment that represents interest will be lower for the last payment than for the first payment on the loan.
  - c. The total dollar amount of principal being paid off each month gets larger as the loan approaches maturity.
  - d. The amount paid toward interest in the first payment would be lower if the nominal interest rate were 8%.
  - e. Over 90% of the first payment goes toward interest.

Answer: d MEDIUM

#### Time value concepts

- 76. Which of the following is NOT CORRECT?
  - a. The present value of a 5-year, \$100 annuity due will exceed the present value of a 5-year, \$100 ordinary annuity.
  - b. If a loan has a nominal rate of 10%, then the effective rate can never be less than 10%.
  - c. If there is annual compounding, then the effective, periodic, and nominal rates of interest are all the same.
  - d. An investment that compounds interest semiannually, and has a nominal rate of 10%, will have an effective rate less than 10%.
  - e. The proportion of the payment of a fully amortized loan that goes toward interest declines over time.

### PART II – Questions and Problems from Prior Test Bank not used in Part I

#### **Multiple Choice: Problems**

EASY (#77 through #86)

#### Growth rate

- 77. In 1958 the average tuition for one year at an Ivy League school was \$1,800. Thirty years later, in 1988, the average cost was \$13,700. What was the growth rate in tuition over the 30-year period?
  - a. 12%
  - b. 9%
  - c. 6%
  - d. 7%
  - e. 8%

#### Interest rate

- 78. South Penn Trucking is financing a new truck with a loan of \$10,000 to be repaid in 5 annual end-of-year installments of \$2,504.56. What annual interest rate is the company paying?
  - a. 7% b. 8% c. 9%
  - d. 10%
  - e. 11%

#### Answer: d

#### Answer: b

#### Effect of inflation

- 79. At an inflation rate of 9%, the purchasing power of \$1 would be cut in half in 8.04 years. How long to the nearest year would it take the purchasing power of \$1 to be cut in half if the inflation rate were only 4%?
  - a. 12 yearsb. 15 yearsc. 18 yearsd. 20 years
  - e. 23 years

#### Time for a sum to double

- 80. You are currently investing your money in a bank account that has a nominal annual rate of 7%, compounded monthly. How many years will it take for you to double your money?
  - a. 8.67
    b. 9.15
    c. 9.50
    d. 9.93
    e. 10.25

#### Time for lump sum to grow

81. Jill currently has \$300,000 in a brokerage account that pays 10% interest. Assuming Jill makes no additional contributions to the account, how many years will it take for her to have \$1,000,000 in the account?

a. 23.33 years
b. 3.03 years
c. 16.66 years
d. 33.33 years
e. 12.63 years

#### Monthly loan payments

82. You are considering buying a new, \$15,000 car, and you have \$2,000 to put toward a down payment. If you can negotiate a nominal annual interest rate of 10% and finance the car over 60 months, what are your monthly car payments?

a. \$216.67
b. \$252.34
c. \$276.21
d. \$285.78

e. \$318.71

### Answer: c

Answer: c

### Page 39

# Answer: e

### Answer: d

#### FV of an annuity

- 83. What is the future value of a 5-year ordinary annuity with annual payments of \$200, evaluated at 15%?
  - a. \$ 670.44
    b. \$ 842.91
    c. \$1,169.56
    d. \$1,522.64
    e. \$1,348.48

#### PV of an annuity

84. What is the present value of a 5-year, \$200 ordinary annuity, evaluated at 15%?

a. \$ 670.43
b. \$ 842.91
c. \$1,169.56
d. \$1,348.48
e. \$1,522.64

#### PV of a perpetuity

- 85. You can buy a perpetuity that pays \$1,000 annually, and your required rate of return on this investment is 15%. You should be indifferent to buying or not buying the investment if it were offered at a price of
  - a. \$5,000.00
    b. \$6,000.00
    c. \$6,666.67
    d. \$7,500.00
    e. \$8,728.50

### Required annuity payments

- 86. If a 5-year ordinary annuity has a present value of \$1,000, and if the interest rate is 10%, what is the amount of each annuity payment?
  - a. \$240.42
    b. \$263.80
    c. \$300.20
    d. \$315.38
    e. \$346.87

Answer: a

Answer: b

Answer: c

#### Answer: e

#### Quarterly compounding and FV

# Answer: a

87. If \$100 is placed in an account earning a nominal 4%, compounded quarterly, what will it be worth in 5 years?

a. \$122.02
b. \$105.10
c. \$135.41
d. \$120.90
e. \$117.48

#### PV of an uneven CF stream

#### Answer: b

88. A real estate investment has the following expected cash flows:

| Year | Cash Flows      |
|------|-----------------|
| 1    | \$10,000        |
| 2    | 25,000          |
| 3    | 50 <b>,</b> 000 |
| 4    | 35,000          |

If the discount rate is 8%, what is the investment's present value?

a. \$103,799
b. \$ 96,110
c. \$ 95,353
d. \$120,000
e. \$ 77,592

#### Effective annual rate

- 89. Bank A offers to lend a firm funds for an expansion, at a nominal rate of 8%, compounded monthly. Bank B will charge 9%, with interest due at the end of the year. What is the difference in the effective annual rates charged by the two banks?
  - a. 0.25% b. 0.50% c. 0.70% d. 1.00% e. 1.25%

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#### Answer: c

#### Effective annual rate

- 90. You recently received a no annual fee credit card offer that states that the annual percentage rate (APR) is 18% on outstanding balances. What is the effective annual interest rate? (Hint: Remember these companies bill you monthly.)
  - a. 18.81%
  - b. 19.56%
  - c. 19.25%
  - d. 20.00%
  - e. 18.00%

#### Effective annual rate

#### Answer: b

Answer: b

Answer: a

91. Which of the following investments has the highest effective annual rate (EAR)? (Assume that all CDs are of equal risk.)

a. A bank CD that pays 10% quarterly.b. A bank CD that pays 10% monthly.c. A bank CD that pays 10.2% annually.d. A bank CD that pays 10% semiannually.

e. A bank CD that pays 9.6% daily (on a 365-day basis).

#### Effective annual rate

- 92. Elizabeth has \$35,000 in an investment account, but she wants the account to grow to \$100,000 in 10 years without making any additional contributions to the account. What effective annual rate of interest does she need to earn on the account to meet her goal?
  - a. 9.03%
    b. 11.07%
    c. 10.23%
    d. 8.65%
    e. 12.32%

#### Effective annual rate

rate of return?

# Which one of the following investments provides the highest effective

- a. An investment that has a 9.9% nominal rate and quarterly annual compounding.
- b. An investment that has a 9.7% nominal rate and daily (365) compounding.
- c. An investment that has a 10.2% nominal rate and annual compounding.
- d. An investment that has a 10% nominal rate and semiannual compounding.
- e. An investment that has a 9.6% nominal rate and monthly compounding.

93.

#### Answer: b

#### Nominal and effective rates

- 94. An investment pays you 9% interest compounded semiannually. A second investment of equal risk, pays interest compounded quarterly. What nominal rate of interest would you have to receive on the second investment in order to make you indifferent between the two investments?
  - a. 8.71%
    b. 8.90%
    c. 9.00%
    d. 9.20%
    e. 9.31%

#### MEDIUM (#95 through #122)

#### FV of an annuity

- 95. Today is your 23<sup>rd</sup> birthday, and you just received a gift of \$1,000. You have used the money to open up a brokerage account. Your plan is to contribute an additional \$2,000 to the account each year on your birthday, up through and including your 65<sup>th</sup> birthday, starting next year. The account has an annual expected return of 12%. How much do you expect to have in the account right after you make the final \$2,000 contribution on your 65<sup>th</sup> birthday?
  - a. \$2,045,442
    b. \$1,811,996
    c. \$2,292,895
    d. \$1,824,502
    e. \$2,031,435

#### FV under monthly compounding

96. Bill plans to deposit \$200 into a bank account at the end of every month. The bank account has a nominal interest rate of 8% and interest is compounded monthly. How much will Bill have in the account at the end of 2<sup>1</sup>/<sub>2</sub> years (30 months)?

a. \$ 6,617.77
b. \$ 502.50
c. \$ 6,594.88
d. \$22,656.74
e. \$ 5,232.43

### Answer: a

### Answer: a

#### Answer: b

#### PV of an uneven CF stream

- 97. Assume that you will receive \$2,000 a year in Years 1 through 5, \$3,000 a year in Years 6 through 8, and \$4,000 in Year 9, with all cash flows to be received at the end of the year. If you require a 14% rate of return, what is the present value of these cash flows?
  - a. \$ 9,851
    b. \$13,250
    c. \$11,714
    d. \$15,129
    e. \$17,353

#### FV of a sum

#### Answer: b

- 98. You deposited \$1,000 in a savings account that pays 8% interest, compounded quarterly, planning to use it to finish your last year in college. Eighteen months later, you decide to go to the Rocky Mountains to become a ski instructor rather than continue school, so you close out your account. How much money will you receive?
  - a. \$1,171
    b. \$1,126
    c. \$1,082
    d. \$1,163
    e. \$1,008

#### FV of annuity due

#### Answer: d

- 99. Starting on her 23<sup>rd</sup> birthday, Janet plans to start saving for her retirement. She will contribute \$1,000 to a brokerage account each year on her birthday, starting today. Her 42<sup>nd</sup> and final contribution will take place on her 64<sup>th</sup> birthday. Janet's aunt gave her \$10,000 today to get the account started. If the account has an expected annual return of 10%, how much will Janet expect to have in her account on her 65<sup>th</sup> birthday?
  - a. \$ 985,704
    b. \$1,034,489
    c. \$1,085,274
    d. \$1,139,038
    e. \$1,254,041

#### Answer: c

#### Time value of money and retirement

### 100. Today, Bruce and Brenda each have \$150,000 in an investment account. No other contributions will be made to their investment accounts. Both have the same goal: They each want their account to reach \$1 million, at which time each will retire. Bruce has his money invested in riskfree securities with an expected annual return of 5%. Brenda has her money invested in a stock fund with an expected annual return of 10%. How many years after Brenda retires will Bruce retire?

a. 12.6
b. 19.0
c. 19.9
d. 29.4

e. 38.9

### FV of a sum

#### Answer: d

- 101. Suppose you put \$100 into a savings account today, the account pays a nominal annual interest rate of 6%, compounded semiannually, and you withdraw \$100 after 6 months. What would your ending balance be 20 years after the initial \$100 deposit was made?
  - a. \$226.20
    b. \$115.35
    c. \$ 62.91
    d. \$ 9.50
    e. \$ 3.00

#### FV of an annuity

#### Answer: e

- 102. Your bank account pays a nominal interest rate of 6%, compounded daily. Your plan is to deposit \$500 in the account today, and deposit \$1,000 in the account at the end of each of the next three years. How much will you have in the account at the end of three years, after making your final deposit?
  - a. \$2,591
    b. \$3,164
    c. \$3,500
    d. \$3,779
    e. \$3,788

#### Answer: b

#### FV of an annuity

#### Answer: c

103. Terry Austin is 30 years old and is saving for her retirement. She plans to make 36 contributions to her retirement account at the beginning of each of the next 36 years. The first contribution will be made today (t = 0) and the final contribution will be made 35 years from today (t = 35). The retirement account will earn a return of 10% a year. If each contribution she makes is \$3,000, how much will be in the retirement account 35 years from now (t = 35)?

a. \$894,380
b. \$813,073
c. \$897,380
d. \$987,118
e. \$978,688

#### FV of an annuity

#### Answer: d

- 104. Today is your 20<sup>th</sup> birthday, and your parents just gave you \$5,000 that you plan to use to open a stock brokerage account. You plan to add \$500 to the account each year on your birthday. Your first \$500 contribution will come one year from now on your 21<sup>st</sup> birthday. Your 45<sup>th</sup> and final \$500 contribution will occur on your 65<sup>th</sup> birthday. You plan to withdraw \$5,000 from the account five years from now on your 25<sup>th</sup> birthday to take a trip to Europe. You also anticipate that you will need to withdraw \$10,000 from the account 10 years from now on your 30<sup>th</sup> birthday to take a trip to Asia. You expect that the account will have an average annual return of 12%. How much money do you anticipate that you will have in the account on your 65<sup>th</sup> birthday, following your final contribution?
  - a. \$385,863
    b. \$413,028
    c. \$457,911
    d. \$505,803
    e. \$566,498

#### FV of annuity due

#### Answer: d

105. You are saving money so that you can purchase a house in five years. You plan to contribute six payments of 3,000 a year. The first payment will be made today (t = 0) and the final payment will be made five years from now (t = 5). If you earn 11% in your investment account, how much money will you have in the account five years from now (at t = 5)?

a. \$19,412
b. \$20,856
c. \$21,683
d. \$23,739
e. \$26,350

#### FV of annuity due

106. Today is your 21st birthday, and you are opening up an investment account. You plan to contribute \$2,000 per year on your birthday. The first contribution will be made today, and the 45<sup>th</sup>, and final, contribution will be made on your 65th birthday. If you earn 10% a year on your investments, how much money will you have in the account on your 65<sup>th</sup> birthday, immediately after making your final contribution?

a. \$1,581,590.64 b. \$1,739,749.71 c. \$1,579,590.64 d. \$1,387,809.67 e. \$1,437,809.67

#### FV under monthly compounding

- 107. You just put \$1,000 in a bank account that pays 6% nominal annual interest, compounded monthly. How much will you have in your account after 3 years?
  - a. \$1,006.00 b. \$1,056.45 c. \$1,180.32 d. \$1,191.00 e. \$1,196.68

#### FV under monthly compounding

- 108. Steven just deposited \$10,000 in a bank account that has a 12% nominal interest rate, compounded monthly. Steven also plans to contribute another \$10,000 to the account one year (12 months) from now and another \$20,000 to the account two years from now. How much will be in the account three years (36 months) from now?
  - a. \$57,231 b. \$48,993 c. \$50,971 d. \$49,542 e. \$49,130

#### FV under daily compounding

- 109. You have \$2,000 invested in a bank account that pays a 4% nominal interest rate with daily compounding. How much money will you have in the account in 132 days? (Assume there are 365 days in each year.)
  - a. \$2,029.14 b. \$2,028.93 c. \$2,040.00 d. \$2,023.44 e. \$2,023.99

### **Chapter 2: Time Value of Money**

#### Answer: d

#### Answer: e

#### Answer: e

### Answer: a

#### FV under non-annual compounding

110. Josh and John (2 brothers) are each trying to save enough money to buy their own cars. Josh is planning to save \$100 from every paycheck. (He is paid every 2 weeks.) John plans to put aside \$150 each month but has already saved \$1,500. Interest rates are currently quoted at 10%. Josh's bank compounds interest every two weeks while John's bank compounds interest monthly. At the end of 2 years they will each spend all their savings on a car. What is the price of the most expensive car purchased?

a. \$5,744.29
b. \$5,807.48
c. \$5,703.02
d. \$5,797.63
e. \$5,898.50

#### FV under quarterly compounding

#### Answer: c

- 111. An investment pays \$100 every six months (semiannually) over the next 2.5 years. Interest, however, is compounded quarterly, at a nominal rate of 8%. What is the future value of the investment after 2.5 years?
  - a. \$520.61
    b. \$541.63
    c. \$542.07
    d. \$543.98
    e. \$547.49

#### FV under quarterly compounding

#### Answer: d

112. Rachel wants to take a trip to England in 3 years, and saving to pay for the trip. Today (8/1/05) she made an initial deposit of \$1,000. Her plan is to add \$2,000 to the account one year from now (8/1/06) and another \$3,000 to the account two years from now (8/1/07). The account has a nominal interest rate of 7%, but the interest is compounded quarterly. How much will Rachel have in the account three years from today (8/1/08)?

a. \$6,724.84
b. \$6,701.54
c. \$6,895.32
d. \$6,744.78
e. \$6,791.02

#### Answer: d

#### FV of an uneven CF stream

113. You are saving money for your first house, and you plan to make regular deposits into a brokerage account earning 14%. Your first deposit of \$5,000 will be made today. You also plan to make four additional deposits at the beginning of each of the next four years. Your plan is to increase your deposits by 10% a year. (That is, you plan to deposit \$5,500 at t = 1, and \$6,050 at t = 2, etc.) How much money will be in your account after five years?

a. \$24,697.40
b. \$30,525.00
c. \$32,485.98
d. \$39,362.57
e. \$44,873.90

#### Present value

#### Answer: c

- 114. Which of the following securities has the largest present value? Assume in all cases that the annual interest rate is 8% and that there are no taxes.
  - a. A five-year ordinary annuity that pays you \$1,000 each year.
  - b. A five-year zero coupon bond that has a face value of \$7,000.
  - c. A preferred stock issue that pays an \$800 annual dividend in perpetuity. (Assume that the first dividend is received one year from today.)
  - d. A seven-year zero coupon bond that has a face value of \$8,500.
  - e. A security that pays you \$1,000 at the end of 1 year, \$2,000 at the end of 2 years, and \$3,000 at the end of 3 years.

#### PV under monthly compounding

- 115. You have just bought a 10-year security that pays \$500 every six months. Another equally risky security also has a maturity of 10 years, and pays 10%, compounded monthly (that is, the nominal rate is 10%). What price should you have paid for the security that you just purchased?
  - a. \$6,108.46
    b. \$6,175.82
    c. \$6,231.11
    d. \$6,566.21
    e. \$7,314.86

#### PV under non-annual compounding

- 116. An investment pays \$500 at the end of every 6 months for the next 3 years. The nominal interest rate is 12%; compounded quarterly. What is the present value of the investment?
  - a. \$2,458.66
    b. \$2,444.67
    c. \$2,451.73
    d. \$2,463.33

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Answer: c

### Answer: b

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### Answer: e

e. \$2,437.56

#### PV of an annuity

- 117. A magazine subscription is running out and you can renew it by sending \$10 a year (the regular rate) or get a lifetime subscription to the magazine for \$100. Your cost of capital is 7%. How many years would you have to live to make the lifetime subscription the better buy? Payments for the regular subscription are made at the beginning of each year. (Round up if necessary to obtain a whole number of years.)
  - a. 15 yearsb. 10 yearsc. 18 yearsd. 7 yearse. 8 years

#### Value of a perpetuity

### Answer: c

- 118. You are willing to pay \$15,625 to purchase a perpetuity that will pay you and your heirs \$1,250 each year, forever. If your required rate of return does not change, how much would you be willing to pay if this were a 20-year annual payment, ordinary annuity instead of a perpetuity?
  - a. \$10,342
    b. \$11,931
    c. \$12,273
    d. \$13,922
    e. \$17,157

#### FV of an uneven CF stream

#### Answer: d

- 119. After graduation, you plan to work for 10 years and then visit Australia. You expect to save \$1,000 a year for the first 5 years and \$2,000 annually for the next 5 years. These savings cash flows will start in one year. In addition, your family has just given you a \$5,000 graduation gift. If your gift and all future contributions are put into an account that pays 8% compounded annually, what will your financial "stake" be when you leave for Australia 10 years from now?
  - a. \$21,432
    b. \$28,393
    c. \$16,651
    d. \$31,148
    e. \$20,000

#### Answer: a

#### FV of an uneven CF stream

- 120. Erika just put \$10,000 into a new savings account, and she plans to contribute another \$20,000 one year from now, and \$50,000 two years from now. The savings account pays 6% annual interest. With no other deposits or withdrawals, how much will she have in the account 10 years from today?
  - a. \$ 8,246.00 b. \$116,937.04
  - c. \$131,390.46
  - d. \$164,592.62
  - e. \$190,297.04

#### PV of an uneven CF stream

121. What is the present value of the following cash flows, if the discount rate is 12%?



- b. \$4,804
  c. \$5,302
  d. \$4,289
- e. \$2,804

#### PV of uncertain cash flows

122. A 3-year project has the following probability distributions for possible end-of-year cash flows in each of the next three years:

| Year 1 |           | Year 2 |           | Year 3 |           |
|--------|-----------|--------|-----------|--------|-----------|
| Prob   | Cash Flow | Prob   | Cash Flow | Prob   | Cash Flow |
| 0.30   | \$300     | 0.15   | \$100     | 0.25   | \$200     |
| 0.40   | 500       | 0.35   | 200       | 0.75   | 800       |
| 0.30   | 700       | 0.35   | 600       |        |           |
|        |           | 0.15   | 900       |        |           |

If the interest rate is 8%, what is the *expected* present value of the project? (Hint: Find the expected cash flow in each year, then evaluate those cash flows.)

a. \$1,204.95
b. \$ 835.42
c. \$1,519.21
d. \$1,580.00
e. \$1,347.61

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#### Answer: c

Answer: a

#### Answer: e

#### MEDIUM/HARD (#123 through #155)

#### Value of missing payments

- 123. You recently purchased a 20-year investment that pays you \$100 at t = 1, \$500 at t = 2, \$750 at t = 3, and some fixed cash flow, X, at the end of each of the remaining 17 years. You purchased the investment for \$5,544.87. Alternative investments of equal risk have a required return of 9%. What is the annual cash flow received at the end of each of the final 17 years, that is, what is X?
  - a. \$600 b. \$625 c. \$650
  - d. \$675
  - e. \$700

#### Effective annual rate

#### Answer: b

Answer: d

- 124. If it were evaluated with an interest rate of 0%, a 10-year regular annuity would have a present value of \$3,755.50. If the future (compounded) value of this annuity, evaluated at Year 10, is \$5,440.22, what effective annual interest rate must the analyst be using to find the future value?
  - a. 7%
  - b. 8%
  - c. 9%
  - d. 10%
  - e. 11%

#### Effective annual rate

#### Answer: c

- 125. You want to borrow \$1,000 from a friend for one year, and you propose to pay her \$1,120 at the end of the year. She agrees to lend you the \$1,000, but she wants you to pay her \$10 of interest at the end of each of the first 11 months plus \$1,010 at the end of the 12<sup>th</sup> month. How much higher is the effective annual rate under your friend's proposal than under your proposal?
  - a. 0.00%
    b. 0.45%
    c. 0.68%
    d. 0.89%
    e. 1.00%
#### EAR and FV of an annuity

- 126. You plan to invest \$5,000 at the end of each of the next 10 years in an account that has a 9% nominal rate with interest compounded monthly. How much will be in your account at the end of the 10 years?
  - a. \$ 75,965
    b. \$967,571
    c. \$ 84,616
    d. \$ 77,359
    e. \$ 80,631

#### EAR and FV of an annuity

127. An investment pays \$5,000 at the end of each of the next five years. You plan to invest the money in an account paying 8% interest, compounded monthly. How much will you have in the account after receiving the final \$5,000 payment in 5 years (60 months)?

a. \$ 25,335.56
b. \$ 29,508.98
c. \$367,384.28
d. \$304,969.90
e. \$ 25,348.23

#### Remaining loan balance

128. A bank recently loaned you \$15,000 to buy a car. The loan is for five years (60 months) and is fully amortized. The nominal rate on the loan is 12%, and payments are made at the end of each month. What will be the remaining balance on the loan after you make the 30<sup>th</sup> payment?

a. \$ 8,611.17
b. \$ 8,363.62
c. \$14,515.50
d. \$ 8,637.38
e. \$ 7,599.03

#### Remaining mortgage balance

129. Jerry and Faith Hudson recently obtained a 30-year (360-month), \$250,000 mortgage with a 9% nominal interest rate. What will be the remaining balance on the mortgage after five years (60 months)?

a. \$239,024
b. \$249,307
c. \$239,700
d. \$237,056
e. \$212,386

#### Answer: d

## Answer: b

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#### Answer: c

## Answer: a

#### Remaining mortgage balance

- 130. You just bought a house and have a \$150,000 mortgage. The mortgage is for 30 years and has a nominal rate of 8% (compounded monthly). After 36 payments (3 years) what will be the remaining balance on your mortgage?
  - a. \$110,376.71
    b. \$124,565.82
    c. \$144,953.86
    d. \$145,920.12
    e. \$148,746.95

#### Amortization

- 131. The Howe family recently bought a house. The house has a 30-year, \$165,000 mortgage with monthly payments and a nominal interest rate of 8%. What is the total dollar amount of interest the family will pay during the first three years of their mortgage? (Assume that all payments are made at the end of the month.)
  - a. \$ 3,297.78
    b. \$38,589.11
    c. \$39,097.86
    d. \$43,758.03
    e. \$44,589.11

#### Required annuity payments

132. A baseball player is offered a 5-year contract that pays him the following amounts at the end of each year:

Year 1: \$1.2 million Year 2: 1.6 million Year 3: 2.0 million Year 4: 2.4 million Year 5: 2.8 million

Instead of accepting the contract, the baseball player asks his agent to negotiate a contract that has a present value of \$1 million more than the present value of that which has been offered. Moreover, the player wants to receive his payments in the form of a 5-year annuity due. All cash flows are discounted at 10%. If the team were to agree to the player's terms, what would be the player's annual salary (in millions of dollars)?

a. \$1.500
b. \$1.659
c. \$1.989
d. \$2.343
e. \$2.500

#### Answer: d

Answer: c

#### Answer: c

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133. Karen and her twin sister, Kathy, are celebrating their 30<sup>th</sup> birthday today. Karen has been saving for her retirement ever since their 25th birthday. On their 25<sup>th</sup> birthday, she made a \$5,000 contribution to her retirement account. Every year thereafter on their birthday, she has added another \$5,000 to the account. Her plan is to continue contributing \$5,000 every year on their birthday. Her 41st, and final, \$5,000 contribution will occur on their 65th birthday.

So far, Kathy has not saved anything for her retirement but she wants to begin today. Kathy plans to also contribute a fixed amount every year. Her first contribution will occur today, and her 36th, and final, contribution will occur on their 65<sup>th</sup> birthday. Assume that both investment accounts earn an annual return of 10%. How large does Kathy's annual contribution have to be for her to have the same amount in her account at age 65, as Karen will have in her account at age 65?

a. \$9,000.00 b. \$8,154.60 c. \$7,398.08 d. \$8,567.20 e. \$7,933.83

#### Required annuity payments

134. Jim and Nancy just got married today. They want to start saving so they can buy an average house five years from today. The average house in their town today sells for \$120,000. Housing prices are expected to increase 3% a year. When they buy their house five years from now, Jim and Nancy expect to get a 30-year (360-month) mortgage with a 7% nominal interest rate. They want the monthly payment on their mortgage to be \$500 a month.

They are starting to save today for a down payment on the house. The down payment plus the mortgage will equal the expected price of the house. Their plan is to deposit \$2,000 in a brokerage account today and then deposit a fixed amount at the end of each of the next five years. Assuming that the brokerage account has an annual return of 10%, how much do Jim and Nancy need to deposit at the end of each year in order to accomplish their goal?

a. \$10,634 b. \$ 9,044 c. \$ 9,949 d. \$ 9,421 e. \$34,569

**Chapter 2: Time Value of Money** 

#### Answer: b

Answer: c

- 135. Today is your 25<sup>th</sup> birthday. Your goal is to have \$2 million by the time you retire at age 65. So far you have nothing saved, but you plan on making the first contribution to your retirement account today. You plan on making three other contributions to the account, one at age 30, age 35, and age 40. Since you expect that your income will increase rapidly over the next several years, the amount that you contribute at age 30 will be double what you contribute today, the amount at age 35 will be three times what you contribute today, and the amount at age 40 will be four times what you contribute today. Assume that your investments will produce an average annual return of 10%. Given your goal and plan, what is the minimum amount you need to contribute to your account today?
  - a. \$10,145 b. \$10,415 c. \$10,700 d. \$10,870 e. \$11,160

#### Monthly vs. quarterly compounding

- The First National Bank offers a 5% nominal interest rate, compounded 136. monthly on its savings accounts, while the Second National Bank offers the same effective annual return, but interest is compounded quarterly. What nominal rate does the Second National Bank offer on its savings accounts?
  - a. 5.12% b. 5.00% c. 5.02% d. 1.28%
  - e. 5.22%

#### Effective annual rate

- 137. Steaks Galore needs capital for its expansion program. One bank will lend the required \$1,000,000 if Steaks Galore agrees to pay interest each quarter and repay the principal at the end of the year. The quoted rate is 10%. A second lender offers 9%, daily compounding (365-day year), with interest and principal due at the end of the year. What is the difference in the effective annual rates (EFF%) charged by the two banks?
  - a. 0.31% b. 0.53% c. 0.75%
  - d. 0.96%
  - e. 1.25%

Answer: d

Answer: c

#### Answer: a

Amortization

e. \$ 6,667

#### Amortization: repayment of principal

139. You have just taken out an installment loan for \$100,000. Assume that the loan will be repaid in 12 equal monthly installments of \$9,456 and that the first payment will be due one month from today. How much of your third monthly payment will go toward the repayment of principal?

a. \$7,757.16 b. \$6,359.12 c. \$7,212.50 d. \$7,925.88 e. \$8,333.33

#### Amortization: interest paid

- 140. A homeowner just obtained a \$90,000 mortgage. The mortgage is for 30 years (360 months) and has a fixed nominal annual rate of 9%, with monthly payments. What percentage of the total payments made the first two years will go toward payment of interest?
  - a. 89.30% b. 91.70% c. 92.59% d. 93.65% e. 94.76%

#### Amortization: repayment of principal

141. You recently obtained a \$135,000, 30-year mortgage with a nominal interest rate of 7.25%. Assume that payments are made at the end of each month. What portion of the total payments made during the fourth year will go towards the repayment of principal?

a. 9.70% b. 15.86% c. 13.75% d. 12.85% e. 14.69%

**Chapter 2: Time Value of Money** 

- 138. You are buying a factory for \$250,000 by paying 20% as a down payment, while the rest of the balance will be paid off over 30 years at a 12% interest rate. What are the 30 equal annual payments?
  - a. \$20,593 b. \$31,036 c. \$24,829 d. \$50,212

## Answer: c

# Answer: c

Answer: a

#### Answer: e

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#### Amortization: remaining loan balance

- 142. The Bunker Family recently entered into a 30-year mortgage for \$300,000, with an 8% nominal interest rate. Interest is compounded monthly, and all payments are due at the end of the month. What will be the remaining balance on the mortgage after five years?
  - a. \$ 14,790.43 b. \$285,209.57
  - c. \$300,000.00
  - d. \$366,177.71
  - e. \$298,980.02

#### Amortization: remaining loan balance

- 143. Recently, Jamie and Jake each bought new cars. Both received a loan from a local bank with a nominal interest rate of 12% where payments are made at the end of each month, and they both pay the same monthly payment. Jamie's loan is for \$15,000; however, his loan matures at the end of 4 years (48 months), while Jake's loan matures in 5 years (60 months). After 48 months Jamie's loan will be paid off, but what will be the remaining balance on Jake's loan?
  - a. \$ 1,998.63
    b. \$ 2,757.58
    c. \$ 3,138.52
    d. \$ 4,445.84
    e. \$11,198.55

#### NPV and non-annual discounting

- 144. Your lease calls for payments of \$500 at the end of each month for the next 12 months. Now your landlord offers you a new 1-year lease that calls for zero rent for 3 months, then rental payments of \$700 at the end of each month for the next 9 months. You keep your money in a bank time deposit that pays a nominal annual rate of 5%. By what amount would your net worth change if you accept the new lease? (Hint: Your return per month is 5%/12 = 0.4166667%.)
  - a. -\$509.81
    b. -\$253.62
    c. +\$125.30
    d. +\$253.62
    e. +\$509.81

Answer: b

Answer: d

#### Answer: b

#### FV of an annuity

#### Answer: c

- 145. John and Julie Johnson are interested in saving for their retirement. John and Julie have the same birthday--both are 50 years old today. They started saving for their retirement on their 25<sup>th</sup> birthday, when they received a \$20,000 gift from Julie's aunt and deposited the money in an investment account. Every year thereafter, the couple added another \$5,000 to the account. (The first contribution was made on their 26<sup>th</sup> birthday and the 25<sup>th</sup> contribution was made today on their 50<sup>th</sup> birthday.) John and Julie estimate that they will need to withdraw \$150,000 from the account 3 years from now, to help meet college expenses for their 5 children. The couple plans to retire on their 58<sup>th</sup> birthday, 8 years from today. They will make a total of 8 more contributions, one on each of their next 8 birthdays with the last payment made on their 58<sup>th</sup> birthday. If the couple continues to contribute \$5,000 to the account on their birthday, how much money will be in the account when they retire? Assume that the investment account earns 12% a year.
  - a. \$1,891,521
    b. \$2,104,873
    c. \$2,289,627
    d. \$2,198,776
    e. \$2,345,546

#### FV of annuity due

#### Answer: a

146. To save money for a new house, you begin contributing money to a brokerage account. You plan to make ten \$1,500 contributions to the brokerage account at the beginning of each of the next 10 years, starting today (t = 0) and ending in nine years (t = 9). Assume that the brokerage account pays a 9% return with quarterly compounding. How much money do you expect to have in the brokerage account nine years from now (t = 9)?

a. \$23,127.49
b. \$25,140.65
c. \$25,280.27
d. \$21,627.49
e. \$19,785.76

#### Value of missing cash flow

147. Foster Industries has a project that has the following cash flows:

| Year | Cash Flow |
|------|-----------|
| 0    | -\$300.00 |
| 1    | 100.00    |
| 2    | 125.43    |
| 3    | 90.12     |
| 4    | ?         |

What cash flow will the project have to generate in the fourth year in order for the project to have a 15% rate of return?

a. \$ 15.55
b. \$ 58.95
c. \$100.25
d. \$103.10
e. \$150.75

#### EAR and FV of annuity

#### Answer: c

- 148. Today you opened up a local bank account. Your plan is to make five \$1,000 contributions to this account. The first \$1,000 contribution will occur today and then every six months you will contribute another \$1,000 to the account. (So your final \$1,000 contribution will be made two years from today). The bank account pays a 6% nominal annual interest, and interest is compounded monthly. After two years, you plan to leave the money in the account earning interest, but you will not make any further contributions to the account. How much will you have in the account 8 years from today?
  - a. \$7,092
    b. \$7,569
    c. \$7,609
    d. \$7,969
    e. \$8,070

#### FV of investment account

#### Answer: b

149. Kelly and Brian Johnson are a recently married couple whose parents advised them to start saving immediately in order to have enough money down the road to pay for their retirement and their children's college expenses. Today (t = 0) is their  $25^{th}$  birthday (the couple shares the same birthday).

The couple plan to have two children (Dick and Jane). Dick is expected to enter college 20 years from now (t = 20); Jane is expected to enter college 22 years from now (t = 22). So in years t = 22 and t = 23 there will be two children in college. Each child will take 4 years to complete college, and college costs are paid at the beginning of each year of college.

College costs per child will be as follows:

| Year | Cost per child  | Children in college |
|------|-----------------|---------------------|
| 20   | \$58,045        | Dick                |
| 21   | 62,108          | Dick                |
| 22   | 66 <b>,</b> 456 | Dick and Jane       |
| 23   | 71,108          | Dick and Jane       |
| 24   | 76,086          | Jane                |
| 25   | 81,411          | Jane                |

Kelly and Brian plan to retire 40 years from now at age 65 (at t = 40). They plan to contribute \$12,000 per year at the end of each year for the next 40 years into an investment account that earns 10% per year. This account will be used to pay for the college costs, and also to provide a nest egg for Kelly and Brian's retirement at age 65. How big will Kelly and Brian's nest egg (the balance of the investment account) be when they retire at age 65 (t = 40)?

a. \$1,854,642
b. \$2,393,273
c. \$2,658,531
d. \$3,564,751
e. \$4,758,333

#### PV of an uneven CF stream

#### Answer: c

- 150. Find the present value of an income stream that has a negative flow of \$100 per year for 3 years, a positive flow of \$200 in the 4<sup>th</sup> year, and a positive flow of \$300 per year in Years 5 through 8. The appropriate discount rate is 4% for each of the first 3 years and 5% for each of the later years. Thus, a cash flow accruing in Year 8 should be discounted at 5% for some years and 4% in other years. All payments occur at year-end.
  - a. \$ 528.21
    b. \$1,329.00
    c. \$ 792.49
    d. \$1,046.41
    e. \$ 875.18

#### Chapter 2: Time Value of Money

#### PV of an uneven CF stream

- 151. Hillary is trying to determine the cost of health care to college students and parents' ability to cover those costs. She assumes that the cost of one year of health care for a college student is \$1,000 today, that the average student is 18 when he or she enters college, that inflation in health care cost is rising at the rate of 10% per year, and that parents can save \$100 per year to help cover their children's costs. All payments occur at the end of the relevant period, and the \$100/year savings will stop the day the child enters college (hence 18 payments will be made). Savings can be invested at a nominal rate of 6%, annual compounding. Hillary wants a health care plan that covers the fully inflated cost of health care for a student for 4 years, during Years 19 through 22 (with payments made at the end of Years 19 through 22). How much would the government have to set aside now (when a child is born), to supplement the average parent's share of a child's college health care cost? The lump sum the government sets aside will also be invested at 6%, annual compounding.
  - a. \$1,082.76
    b. \$3,997.81
    c. \$5,674.23
    d. \$7,472.08
    e. \$8,554.84

#### Required annuity payments

152. You are saving for the college education of your two children. One child will enter college in 5 years, while the other child will enter college in 7 years. College costs are currently \$10,000 per year and are expected to grow at a rate of 5% per year. All college costs are paid at the beginning of the year. You assume that each child will be in college for four years.

You currently have \$50,000 in your educational fund. Your plan is to contribute a fixed amount to the fund over each of the next 5 years. Your first contribution will come at the end of this year, and your final contribution will come at the date when you make the first tuition payment for your oldest child. You expect to invest your contributions into various investments, which are expected to earn 8% per year. How much should you contribute each year in order to meet the expected cost of your children's education?

a. \$2,894
b. \$3,712
c. \$4,125
d. \$5,343
e. \$6,750

### Answer: d

### Answer: b

153. A young couple is planning for the education of their two children. They plan to invest the same amount of money at the end of each of the next 16 years. The first contribution will be made at the end of the year and the final contribution will be made at the end of the year the older child enters college.

The money will be invested in securities that are certain to earn a return of 8% each year. The older child will begin college in 16 years and the second child will begin college in 18 years. The parents anticipate college costs of \$25,000 a year (per child). These costs must be paid at the end of each year. If each child takes four years to complete their college degrees, then how much money must the couple save each year?

a. \$ 9,612.10
b. \$ 5,477.36
c. \$12,507.29
d. \$ 5,329.45
e. \$ 4,944.84

#### Required annuity payments

#### Answer: c

154. Your father, who is 60, plans to retire in 2 years, and he expects to live independently for 3 years. He wants a retirement income that has, in the first year, the same purchasing power as \$40,000 has today. However, his retirement income will be a fixed amount, so his real income will decline over time. His retirement income will start the day he retires, 2 years from today, and he will receive a total of 3 retirement payments.

Inflation is expected to be constant at 5%. Your father has \$100,000 in savings now, and he can earn 8% on savings now and in the future. How much must he save each year, starting today and ending next year, to meet his retirement goals?

a. \$1,863
b. \$2,034
c. \$2,716
d. \$5,350
e. \$6,102

Answer: b

155. You are considering an investment in a 40-year security. The security will pay \$25 a year at the end of each of the first three years. The security will then pay \$30 a year at the end of each of the next 20 years. The nominal interest rate is assumed to be 8%, and the current price (present value) of the security is \$360.39. Given this information, what is the equal annual payment to be received from Year 24 through Year 40 (for 17 years)?

a. \$35

b. \$38

c. \$40

d. \$45

e. \$50

#### HARD (#156 through #169)

#### Required annuity payments

#### Answer: a

156. John and Jessica are saving for their child's education. Their daughter is currently eight years old and will be entering college 10 years from now (t = 10). College costs are currently \$15,000 a year and are expected to increase at a rate of 5% a year. They expect their daughter to graduate in four years, and that all annual payments will be due at the beginning of each year (t = 10, 11, 12, and 13).

Right now, John and Jessica have \$5,000 in their college savings account. Starting today, they plan to contribute \$3,000 a year at the beginning of each of the next five years (t = 0, 1, 2, 3, and 4). Then their plan is to make six equal annual contributions at the end of each of the following six years (t = 5, 6, 7, 8, 9, and 10). Their investment account is expected to have an annual return of 12%. How large of an annual payment do they have to make in the subsequent six years (t = 5, 6, 7, 8, 9, and 10) in order to meet their child's anticipated college costs?

a. \$4,411
b. \$7,643
c. \$2,925
d. \$8,015
e. \$6,798

### Chapter 2: Time Value of Money

#### Answer: c

157. Today is Rachel's 30<sup>th</sup> birthday. Five years ago, Rachel opened a brokerage account when her grandmother gave her \$25,000 for her 25<sup>th</sup> birthday. Rachel added \$2,000 to this account on her 26<sup>th</sup> birthday, \$3,000 on her 27<sup>th</sup> birthday, \$4,000 on her 28<sup>th</sup> birthday, and \$5,000 on her 29<sup>th</sup> birthday. Rachel's goal is to have \$400,000 in the account by her 40<sup>th</sup> birthday.

Starting today, she plans to contribute a fixed amount to the account each year on her birthday. She will make 11 contributions, the first one will occur today, and the final contribution will occur on her 40<sup>th</sup> birthday. Complicating things somewhat is the fact that Rachel plans to withdraw \$20,000 from the account on her 35<sup>th</sup> birthday to finance the down payment on a home. How large does each of these 11 contributions have to be for Rachel to reach her goal? Assume that the account has earned (and will continue to earn) an effective return of 12% a year.

a. \$11,743.95 b. \$10,037.46 c. \$11,950.22 d. \$14,783.64 e. \$ 9,485.67

#### Required annuity payments

158. John is saving for his retirement. Today is his 40<sup>th</sup> birthday. John first started saving when he was 25 years old. On his 25<sup>th</sup> birthday, John made the first contribution to his retirement account; he deposited \$2,000 into an account that paid 9% interest, compounded monthly. Each year on his birthday, John contributes another \$2,000 to the account. The 15<sup>th</sup> (and last) contribution was made last year on his 39<sup>th</sup> birthday.

John wants to close the account today and move the money to a stock fund that is expected to earn an effective return of 12% a year. John's plan is to continue making contributions to this new account each year on his birthday. His next contribution will come today (age 40) and his final planned contribution will be on his 65<sup>th</sup> birthday. If John wants to accumulate \$3,000,000 in his account by age 65, how much must he contribute each year until age 65 (26 contributions in all) to achieve his goal?

a. \$11,892
b. \$13,214
c. \$12,471
d. \$10,388
e. \$15,572

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#### Answer: a

#### Answer: c

#### 159. Joe and June Green are planning for their children's college education. Joe would like his kids to attend his alma mater where tuition is currently \$25,000 per year. Tuition costs are expected to increase by 5% each year. Their children, David and Daniel, just turned 2 and 3 years old today, September 1, 2002. They are expected to begin college the year in which they turn 18 years old and each will complete his schooling in four years. College tuition must be paid at the beginning of each school year.

Grandma Green invested \$10,000 in a mutual fund the day each child was born. This was to begin the boys' college fund (a combined fund for both children). The investment has earned and is expected to continue to earn 12% per year. Joe and June will now begin adding to this fund every August  $31^{st}$  (beginning with August 31, 2003) to ensure that there is enough money to send the kids to college.

How much money must Joe and June put into the college fund each of the next 15 years if their goal is to have all of the money in the investment account by the time Daniel (the oldest son) begins college?

a. \$5,928.67
b. \$7,248.60
c. \$4,822.66
d. \$7,114.88
e. \$5,538.86

#### Required annuity payments

#### Answer: b

- 160. Bob is 20 years old today and is starting to save money, so that he can get his MBA. He is interested in a 1-year MBA program. Tuition and expenses are currently \$20,000 per year, and they are expected to increase by 5% per year. Bob plans to begin his MBA when he is 26 years old, and since all tuition and expenses are due at the beginning of the school year, Bob will make his one single payment six years from today. Right now, Bob has \$25,000 in a brokerage account, and he plans to contribute a fixed amount to the account at the end of each of the next six years (t = 1, 2, 3, 4, 5, and 6). The account is expected to earn an annual return of 10% each year. Bob plans to withdraw \$15,000 from the account two years from today (t = 2) to purchase a used car, but he plans to make no other withdrawals from the account until he starts the MBA program. How much does Bob need to put in the account at the end of each of the next six years to have enough money to pay for his MBA?
  - a. \$1,494
    b. \$ 580
    c. \$4,494
    d. \$2,266
    e. \$3,994

## Answer: a

#### Answer: e

- 161. Suppose you are deciding whether to buy or lease a car. If you buy the car, it will cost \$17,000 today (t = 0). You expect to sell the car four years (48 months) from now for \$6,000 (at t = 48). As an alternative to buying the car, you can lease the car for 48 months. All lease payments would be made at the end of the month. The first lease payment would occur next month (t = 1) and the final lease payment would do so with cash, so there is no need to consider financing. If you lease the car, there is no option to buy it at the end of the contract. Assume that there are no taxes, and that the operating costs are the same regardless of whether you buy or lease the car. Assume that all cash flows are discounted at a nominal annual rate of 12%, so the monthly periodic rate is 1%. What is the breakeven lease payment? (That is, at what monthly payment would you be indifferent between buying and leasing the car?)
  - a. \$333.00
    b. \$336.62
    c. \$339.22
    d. \$343.51
    e. \$349.67

#### Required annuity payments

- 162. Today is Craig's  $24^{\text{th}}$  birthday, and he wants to begin saving for retirement. To get started, his plan is to open a brokerage account, and to put \$1,000 into the account today. Craig intends to deposit \$X into the account each year on his subsequent birthdays until the age of 64. In other words, Craig plans to make 40 contributions of \$X. The first contribution will be made one year from now on his 25th birthday, and the 40<sup>th</sup> (and final) contribution will occur on his 64<sup>th</sup> birthday. Craig plans to retire at age 65 and he expects to live until age 85. Once he retires, Craig estimates that he will need to withdraw \$100,000 from the account each year on his birthday in order to meet his expenses. (That is, Craig plans to make 20 withdrawals of \$100,000 each--the first withdrawal will occur on his  $65^{\text{th}}$  birthday and the final one will occur on his  $84^{\rm th}$  birthday.) Craig expects to earn 9% a year in his brokerage account. Given his plans, how much does he need to deposit into the account for each of the next 40 years, in order to reach his goal? (That is, what is \$X?)
  - a. \$2,379.20
    b. \$2,555.92
    c. \$2,608.73
    d. \$2,657.18
    e. \$2,786.98

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### Answer: c

#### Annuity due vs. ordinary annuity

#### Answer: e

- 163. Bill and Bob are both 25 years old today. Each wants to begin saving for his retirement. Both plan on contributing a fixed amount each year into brokerage accounts that have annual returns of 12%. Both plan on retiring at age 65, 40 years from today, and both want to have \$3 million saved by age 65. The only difference is that Bill wants to begin saving today, whereas Bob wants to begin saving one year from today. In other words, Bill plans to make 41 total contributions (t = 0, 1, 2, ... 40), while Bob plans to make 40 total contributions (t = 1, 2, ... 40). How much more than Bill will Bob need to save each year in order to accumulate the same amount as Bill does by age 65?
  - a. \$796.77
    b. \$892.39
    c. \$473.85
    d. \$414.48
    e. \$423.09

#### Amortization

#### Answer: b

- 164. The Florida Boosters Association has decided to build new bleachers for the football field. Total costs are estimated to be \$1 million, and financing will be through a bond issue of the same amount. The bond will have a maturity of 20 years, a coupon rate of 8%, and has annual payments. In addition, the Association must set up a reserve to pay off the loan by making 20 equal annual payments into an account that pays 8%, annual compounding. The interest-accumulated amount in the reserve will be used to retire the entire issue at its maturity 20 years hence. The Association plans to meet the payment requirements by selling season tickets at a \$10 net profit per ticket. How many tickets must be sold each year to service the debt (to meet the interest and principal repayment requirements)?
  - a. 5,372
    b. 10,186
    c. 15,000
    d. 20,459
    e. 25,000

#### Effective annual rate

165. You have some money on deposit in a bank account that pays a nominal (or quoted) rate of 8.0944%, but with interest compounded daily (using a 365-day year). Your friend owns a security that calls for the payment of \$10,000 after 27 months. The security is just as safe as your bank deposit, and your friend offers to sell it to you for \$8,000. If you buy the security, by how much will the effective annual rate of return on your investment change?

a. 1.87% b. 1.53% c. 2.00%

- d. 0.96%
- e. 0.44%

#### PMT and quarterly compounding

- Answer: b
- 166. Your employer has agreed to make 80 quarterly payments of \$400 each into a trust account to fund your early retirement. The first payment will be made 3 months from now. At the end of 20 years (80 payments), you will be paid 10 equal annual payments, with the first payment to be made at the beginning of Year 21 (or the end of Year 20). The funds will be invested at a nominal rate of 8%, quarterly compounding, during both the accumulation and the distribution periods. How large will each of your 10 receipts be? (Hint: You must find the EAR and use it in one of your calculations.)
  - a. \$ 7,561
    b. \$10,789
    c. \$11,678
    d. \$12,342
    e. \$13,119

#### Value of unknown withdrawal

- 167. Steve and Robert were college roommates, and each is celebrating their 30<sup>th</sup> birthday today. When they graduated from college nine years ago (on their 21<sup>st</sup> birthday), they each received \$5,000 from family members for establishing investment accounts. Steve and Robert have added \$5,000 to their separate accounts on each of their following birthdays (22<sup>nd</sup> through 30<sup>th</sup> birthdays). Steve has withdrawn nothing from the account, but Robert made one withdrawal on his 27<sup>th</sup> birthday. Steve has invested the money in Treasury bills that have earned a 6% annual return, while Robert has invested his money in stocks that have earned a 12% annual return. Both Steve and Robert have the same amount in their accounts today. How much did Robert withdraw on his 27<sup>th</sup> birthday?
  - a. \$ 7,832.22
    b. \$ 8,879.52
    c. \$10,865.11
    d. \$15,545.07

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### Answer: d

#### Answer: c

e. \$13,879.52

#### Non-annual compounding

#### Answer: a

- 168. A financial planner has offered you three possible options for receiving cash flows. You must choose the option that has the highest present value.
  - (1) \$1,000 now and another \$1,000 at the beginning of each of the 11 subsequent months during the remainder of the year, to be deposited in an account paying a 12% nominal annual rate, but compounded monthly (to be left on deposit for the year).
  - (2) \$12,750 at the end of the year (assume a 12% nominal interest rate with semiannual compounding).
  - (3) A payment scheme of 8 quarterly payments made over the next two years. The first payment of \$800 is to be made at the end of the current quarter. Payments will increase by 20% each quarter. The money is to be deposited in an account paying a 12% nominal annual rate, but compounded quarterly (to be left on deposit for the entire 2-year period).

Which one would you choose?

- a. Choice 1
- b. Choice 2
- c. Choice 3
- d. Either one, since they all have the same present value.
- e. Neither one, since they all have negative present values.

#### Breakeven annuity payment

#### Answer: a

- 169. Linda needs a new car and is deciding whether to buy or lease the car. She estimates that if she buys the car, it will cost her \$17,000 today (t = 0) and that she would sell the car four years from now for \$7,000 (at t = 4). If she were to lease the car she would make a fixed lease payment at the end of each of the next 48 months (4 years). Assume that the operating costs are the same regardless of whether she buys or leases the car. Assume that if she leases, there are no up-front costs and that there is no option to buy the car after four years. Linda estimates that she should use a 6% nominal interest rate to discount the cash flows. What is the breakeven lease payment? (That is, at what monthly lease payment would she be indifferent between buying and leasing the car?)
  - a. \$269.85
    b. \$271.59
    c. \$275.60
    d. \$277.39
    e. \$279.83

#### Multiple Part:

(The following information applies to the next two problems.)

A 30-year, \$115,000 mortgage has a nominal annual rate of 7%. All payments are made at the end of each month.

#### Required mortgage payment

170. What is the monthly payment on the mortgage?

a. \$760.66
b. \$765.10
c. \$772.29
d. \$774.10
e. \$776.89

#### Remaining mortgage balance

171. What is the remaining balance on the mortgage after 5 years?

a. \$106,545.45
b. \$106,919.83
c. \$107,623.52
d. \$107,988.84
e. \$108,251.33

(The following information applies to the next two problems.)

Today is your  $21^{st}$  birthday and your parents gave you a gift of \$2,000. You just put this money in a brokerage account, and your plan is to add \$1,000 to the account each year on your birthday, starting on your  $22^{nd}$  birthday.

#### Time to accumulate a lump sum

- 172. If you earn 10% a year in the brokerage account, what is the minimum number of whole years it will take for you to have at least \$1,000,000 in the account?
  - a. 41
    b. 43
    c. 45
    d. 47
  - e. 48

#### Required annual rate of return

- 173. Assume that you want to have \$1,000,000 in the account by age 60 (39 years from today). What annual rate of return will you need to earn on your investments in order to reach this goal?
  - a. 12.15%
    b. 12.41%
    c. 12.57%
  - d. 12.66%

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## Answer: d

Answer: c

## Answer: b

#### Answer: e

e. 12.91%

(The following information applies to the next two problems.)

Your family recently bought a house. You have a \$100,000, 30-year mortgage with a 7.2% nominal annual interest rate. Interest is compounded monthly and all payments are made at the end of the month.

#### Monthly mortgage payments

174. What is the monthly payment on the mortgage?

a. \$639.08
b. \$674.74
c. \$678.79
d. \$685.10
e. \$691.32

#### Amortization

- 175. What percentage of the total payments during the first three years is going towards the principal?
  - a. 9.6%
    b. 10.3%
    c. 11.7%
    d. 12.9%
    e. 13.4%

(The following information applies to the next two problems.)

The Jordan family recently purchased their first home. The house has a 15year (180-month), \$165,000 mortgage. The mortgage has a nominal annual interest rate of 7.75%. All mortgage payments are made at the end of the month.

#### Monthly mortgage payments

176. What is the monthly payment on the mortgage?

a. \$1,065.63
b. \$1,283.61
c. \$1,322.78
d. \$1,553.10
e. \$1,581.97

#### Remaining mortgage balance

- 177. What will be the remaining balance on the mortgage after one year (right after the 12<sup>th</sup> payment has been made)?
  - a. \$152,879.31
    b. \$155,362.50
    c. \$158,937.91

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#### Answer: d

Answer: c

Answer: c

Answer: d

- d. \$160,245.39
- e. \$160,856.84

(The following information applies to the next two problems.)

Victoria and David have a 30-year, \$75,000 mortgage with an 8% nominal annual interest rate. All payments are due at the end of the month.

#### Amortization

#### Answer: d

- 178. What percentage of their monthly payments the first year will go towards interest payments?
  - a. 7.76% b. 9.49%
  - c. 82.17%
  - C. 82.1/3
  - d. 90.51%
  - e. 91.31%

#### Amortization

#### Answer: a

- 179. If Victoria and David were able to refinance their mortgage and replace it with a 7% nominal annual interest rate, how much (in dollars) would their monthly payment decline?
  - a. \$ 51.35
    b. \$ 59.78
    c. \$ 72.61
    d. \$ 88.37
    e. \$104.49

(The following information applies to the next two problems.)

Karen and Keith have a \$300,000, 30-year (360-month) mortgage. The mortgage has a 7.2% nominal annual interest rate. Mortgage payments are made at the end of each month.

#### Monthly mortgage payment

180. What is the monthly payment on the mortgage?

a. \$1,759.41
b. \$1,833.33
c. \$2,036.36
d. \$2,055.29
e. \$3,105.25

#### Amortization

181. What percentage of the total payments the first year (the first twelve months) will go towards repayment of principal?

a. 11.88% b. 12.00%

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Answer: c

## Answer: b

c. 13.21%
d. 13.55%
e. 14.16%

## Web Appendix 2A

#### **Multiple Choice: Problems**

#### PV continuous compounding

- 2A-1. In six years' time, you are scheduled to receive money from a trust established by your grandparents. When the trust matures there will be \$100,000 in the account. If the account earns 9% compounded continuously, how much is in the account today?
  - a. \$ 23,456 b. \$ 58,275 c. \$171,600 d. \$ 59,627 e. \$ 61,385

#### FV continuous compounding

- 2A-2. Assume one bank offers you a nominal annual interest rate of 6% compounded daily while another bank offers you continuous compounding at a 5.9% nominal annual rate. You decide to deposit \$1,000 with each bank. Exactly two years later you withdraw your funds from both banks. What is the difference in your withdrawal amounts between the two banks?

a. \$ 2.25 b. \$ 0.09 c. \$ 1.12 d. \$ 1.58 e. \$12.58

#### Continuous compounding

#### Answer: b MEDIUM

Answer: a MEDIUM

- 2A-3. You have \$5,438 in an account that pays 10% interest, compounded continuously. If you deposited some funds 10 years ago, how much was your original deposit?
  - a. \$1,000 b. \$2,000 c. \$3,000 d. \$4,000 e. \$5,000

**Chapter 2: Time Value of Money** 

#### Answer: b EASY/MEDIUM

#### Continuous compounded interest rate

In order to purchase your first home you need a down payment of 2A-4. \$19,000 four years from today. You currently have \$14,014 to invest. In order to achieve your goal, what nominal interest rate, compounded continuously, must you earn on this investment?

- a. 7.61%
- b. 7.26%
- c. 6.54%
- d. 30.56%
- e. 19.78%

#### Payment and continuous compounding

- You place \$1,000 in an account that pays 7% interest compounded 2A-5. continuously. You plan to hold the account exactly three years. Simultaneously, in another account you deposit money that earns 8% compounded semiannually. If the accounts are to have the same amount at the end of the three years, how much of an initial deposit do you need to make now in the account that pays 8% interest compounded semiannually?
  - a. \$1,006.42 b.\$ 986.73 c. \$ 994.50 d. \$ 975.01 e. \$ 962.68

#### Continuous compounding

#### Answer: d MEDIUM/HARD

- For a 10-year deposit, what annual rate payable semiannually will 2A-6. produce the same effective rate as 4% compounded continuously?
  - a. 2.02% b. 2.06% c. 3.95% d. 4.04% e. 4.12%

#### Continuous compounding

#### Answer: b MEDIUM/HARD

How much should you be willing to pay for an account today that will 2A-7. have a value of \$1,000 in 10 years under continuous compounding if the nominal rate is 10%?

a. \$354 b. \$368 c. \$385 d. \$376 e. \$370

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### Answer: a MEDIUM/HARD

Answer: d MEDIUM/HARD

#### Continuous compounding

#### Answer: b HARD

- 2A-8. If you receive \$15,000 today and can invest it at a 5% annual rate compounded continuously, what will be your ending value after 20 years?
  - a. \$35,821
  - b. \$40,774
  - c. \$75,000
  - d. \$81,342
  - e. \$86,750

## CHAPTER 2 ANSWERS AND SOLUTIONS

| 1. | FV of a lu | ump sum                 |  | Answer: a |
|----|------------|-------------------------|--|-----------|
|    | Ν          | 5                       |  |           |
|    | I/YR       | 10%                     |  |           |
|    | PV         | -\$100                  |  |           |
|    | PMT        | <b>\$0</b>              |  |           |
|    | FV         | <mark>\$161.05</mark>   |  |           |
| 2. | FV of a lu | ump sum                 |  | Answer: c |
|    | Ν          | 3                       |  |           |
|    | I/YR       | 4%                      |  |           |
|    | PV         | -\$2,000                |  |           |
|    | PMT        | <b>\$0</b>              |  |           |
|    | FV         | \$2,249.73              |  |           |
| З. | FV of a lu | ump sum                 |  | Answer: e |
|    | Ν          | 10                      |  |           |
|    | I/YR       | 8%                      |  |           |
|    | PV         | -\$100.00               |  |           |
|    | PMT        | \$0.00                  |  |           |
|    | FV         | \$215.89                |  |           |
| 4. | FV of a lu | ump sum                 |  | Answer: b |
|    | Ν          | 100                     |  |           |
|    | I/YR       | 5%                      |  |           |
|    | PV         | -\$1.00                 |  |           |
|    | PMT        | <u>\$0.00</u>           |  |           |
|    | FV         | <b>\$131.50</b>         |  |           |
| 5. | PV of a lu | ump sum                 |  | Answer: d |
|    | Ν          | 3                       |  |           |
|    | I/YR       | 6%                      |  |           |
|    | PV         | <mark>\$1,888.92</mark> |  |           |
|    | PMT        | \$0                     |  |           |
|    | FV         | -2,249.73               |  |           |

6. PV of a lump sum

#### Answer: a EASY

| Ν    | 100       |
|------|-----------|
| I/YR | 10%       |
| PV   | \$0.73    |
| PMT  | \$0       |
| FV   | -\$10,000 |

- 7. PV of a lump sum Answer: c EASY N 3 I/YR 4% PV \$889.00 PMT \$0 FV -\$1,000.00
- 8. Interest rate on a simple lump sum investment Answer: e EASY

| N    | 10           |
|------|--------------|
| I/YR | <b>5.00%</b> |
| PV   | -\$613.81    |
| PMT  | \$0          |
| FV   | \$1,000.00   |

9. Simple growth rate

| N    | 5             |
|------|---------------|
| I/YR | <b>14.87%</b> |
| PV   | -\$1.00       |
| PMT  | \$0           |
| FV   | \$2.00        |

10. Number of periods

| Ν    | 14.21     |
|------|-----------|
| I/YR | 5.00%     |
| PV   | -\$100.00 |
| PMT  | \$0       |
| FV   | \$200.00  |

11. Number of periods

| N    | 6.64    |
|------|---------|
| I/YR | 11.00%  |
| PV   | -\$2.00 |
| PMT  | \$0     |
| FV   | \$4.00  |

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Answer: b EASY

Answer: e EASY

Answer: a EASY

| 12. | FV of an ordinary annuity | Answer: c EAS |
|-----|---------------------------|---------------|
|     | N 5                       |               |
|     | I/YR <b>6.00%</b>         |               |
|     | PV <b>\$0.00</b>          |               |
|     | <u>PMT -\$3,000</u>       |               |
|     | FV \$16,911.28            |               |
| 13. | FV of an ordinary annuity | Answer: e EAS |
|     | N 3                       |               |
|     | I/YR 9.00%                |               |
|     | PV <b>\$0.00</b>          |               |
|     | PMT -\$5,000              |               |
|     | FV \$16,390.50            |               |
| 14. | FV of an annuity due      | Answer: b EAS |
|     | BGN mode                  |               |
|     | N 5                       |               |
|     | I/YR 6.00%                |               |
|     | PV <b>\$0.00</b>          |               |
|     | PMT -\$3,000              |               |
|     | FV \$17,925.96            |               |
| 15. | FV of an annuity due      | Answer: d EAS |
|     | BGN mode                  |               |
|     | N 3                       |               |
|     | I/YR 9.00%                |               |
|     | PV <b>\$0.00</b>          |               |
|     | PMT -\$5,000              |               |
|     | FV \$17,865.65            |               |
| 16. | PV of an ordinary annuity | Answer: a EAS |
|     | N 5                       |               |
|     | I/YR 5.00%                |               |
|     | PV \$12.988.43            |               |
|     | PMT -\$3.000              |               |
|     | FV \$0.00                 |               |
|     | - φύτου                   |               |
| 17. | PV of an ordinary annuity | Answer: c EAS |
|     |                           |               |

| I/YR       | 6.00%               |      |  |
|------------|---------------------|------|--|
| PV         | \$4,212.36          |      |  |
| PMT        | -\$1,000            |      |  |
| FV         | \$0.00              |      |  |
| •          |                     |      |  |
| PV of an o | ordinary annuity    |      |  |
| N          | 20                  |      |  |
| I/YR       | 6.00%               |      |  |
| PV         | \$573,496.06        |      |  |
| PMT        | -\$50,000           |      |  |
| FV         | \$0.00              |      |  |
| ?V of an a | annuity due         |      |  |
| BGN mode   |                     |      |  |
|            | 5                   |      |  |
| /YR        | 5.00%               |      |  |
| PV         | \$13,637.85         |      |  |
| PMT        | -\$3,000            |      |  |
| V          | \$0.00              |      |  |
| of an a    | annuity due         |      |  |
| N mode     |                     |      |  |
| 1          | 5                   |      |  |
| I/YR       | 6.00%               |      |  |
| V          | \$4.465.11          |      |  |
| MT         | -\$1,000            |      |  |
| ĨV         | \$0.00              |      |  |
| of an a    | annuity due         |      |  |
| N mode     |                     |      |  |
|            | 20                  |      |  |
| R          | 6.00%               |      |  |
|            | \$607.905.82        |      |  |
| MT         | -\$50,000           |      |  |
| FV         | \$0.00              |      |  |
| ayments o? | on an ordinary annu | iity |  |
| N          | 15                  |      |  |
| I/YR       | 6.00%               |      |  |
| PV         | -\$200,000          |      |  |
| PMT        | \$20,592.55         |      |  |
| FV         | \$0.00              |      |  |

Ν

5

| 23. | Payments o | on an ordinary a         | nnuity      | Answer: o | e EASY |
|-----|------------|--------------------------|-------------|-----------|--------|
|     | Ν          | 20                       |             |           |        |
|     | I/YR       | 8.00%                    |             |           |        |
|     | PV         | -\$500,000               |             |           |        |
|     | PMT        | \$50,926.10              |             |           |        |
|     | FV         | \$0.00                   |             |           |        |
| 24. | Payments o | on an annuity du         | le          | Answer: 1 | b EASY |
|     | BGN mode   |                          |             |           |        |
|     | Ν          | 20                       |             |           |        |
|     | I/YR       | 8.00%                    |             |           |        |
|     | PV         | -\$500,000               |             |           |        |
|     | PMT        | \$47,153.80              |             |           |        |
|     | FV         | \$0.00                   |             |           |        |
| 25. | Payments o | on an annuity du         | le          | Answer: o | d EASY |
|     | BGN mode   |                          |             |           |        |
|     | Ν          | 15                       |             |           |        |
|     | I/YR       | 6.00%                    |             |           |        |
|     | PV         | -\$200,000               |             |           |        |
|     | PMT        | <mark>\$19,426.94</mark> |             |           |        |
|     | FV         | \$0.00                   |             |           |        |
| 26. | Years to d | leplete an ordin         | ary annuity | Answer: a | a EASY |
|     | Ν          | 20.91                    |             |           |        |
|     | I/YR       | 8.00%                    |             |           |        |
|     | PV         | -\$500,000               |             |           |        |
|     | PMT        | \$50,000.00              |             |           |        |
|     | FV         | \$0.00                   |             |           |        |
| 27. | Years to d | leplete an annui         | ty due.     | Answer:   | C EASY |
|     | BGN mode   |                          |             |           |        |
|     | N          | 17.54                    |             |           |        |
|     | I/YR       | 8.00%                    |             |           |        |
|     | PV         | -\$500,000               |             |           |        |
|     | PMT        | \$50,000.00              |             |           |        |
|     | FV         | \$0.00                   |             |           |        |

| 28. | Interest | rate | implicit | in | an | annuity |
|-----|----------|------|----------|----|----|---------|
|-----|----------|------|----------|----|----|---------|

| N    | 20           |
|------|--------------|
| I/YR | 4.22%        |
| PV   | -\$1,000,000 |
| PMT  | \$75,000     |
| FV   | \$0.00       |

29. Interest rate implicit in an annuityAnswer: bEASY

| BGN mode |               |
|----------|---------------|
| Ν        | 30            |
| I/YR     | 3.08%         |
| PV       | -\$10,000,000 |
| PMT      | \$500,000     |
| FV       | \$0.00        |

30. Interest rate implicit in an annuity

BGN mode N 10 I/YR 24.63% PV -\$45,000 PMT \$10,000 FV \$0.00

31. PV of an annuity due

BGN mode N **8** I/YR **7.00% PV \$159,732** PMT **-\$25,000** FV **\$0.00** 

### 32. PV of an ordinary annuity plus an ending payment Answer: c EASY

|     | Ν         | 6                                  |                |
|-----|-----------|------------------------------------|----------------|
|     | I/YR      | 6.00%                              |                |
|     | PV        | \$5,974.77                         |                |
|     | PMT       | \$1,000                            |                |
|     | FV        | \$1,500                            |                |
| 33. | PV of a p | perpetuity                         | Answer: e EASY |
|     | I/YR      | 6.00%                              |                |
|     | PMT       | \$100                              |                |
|     | PV        | <b>\$1,666.67</b> Divide PMT by I. |                |
| 34. | Rate of 1 | return on a perpetuity             | Answer: b EASY |

Chapter 2: Time Value of Money

Answer: d EASY

Answer: a EASY

| Cost (PV) | \$1,500 |                     |
|-----------|---------|---------------------|
| PMT       | \$105   |                     |
| I/YR      | 7.00%   | Divide PMT by Cost. |

#### 35. Dollar payments on a perpetuity

Answer: d EASY

Answer: a EASY

| Cost (PV) | \$1,500                             |
|-----------|-------------------------------------|
| I/YR      | 8.00%                               |
| PMT       | <b>\$120.00</b> Multiply Cost by I. |

#### 36. PV of an uneven cash flow stream

| I/YR =     | 8%       |               |                 |             |                   |         |
|------------|----------|---------------|-----------------|-------------|-------------------|---------|
|            | 0        | 1             | 2               | 3           | 4                 |         |
| CFs:       | \$0      | \$100         | \$300           | \$0         | \$500             |         |
| PV of CFs: | \$0      | \$92.59       | \$257.20        | \$0         | \$367.51          |         |
| PV =       | \$717.31 | Find the indi | vidual PVs and  | l sum them  |                   |         |
| PV =       | \$717.31 | Automate the  | e process using | Excel or a  | calculator, by in | putting |
|            |          | the data into | the cash flow r | egister and | pressing the NP   | V key.  |

### 37. PV of an uneven cash flow stream

I/YR =5% 0 2 1 3 CFs: \$1,000 \$2,000 \$3,000 \$5,000 PV of CFs: \$1,000 \$1,904.76 \$2,721.09 \$4,319.19  $\mathbf{PV} =$ \$9,945.04 Found by summing individual PVs.  $\mathbf{PV} =$ \$9,945.04 Found with a calculator or Excel to automate the process. With a calculator, input the cash flows and I into the cash flow register, then press the NPV key.

### 38. FV of a lump sum, semiannually

Answer: e EASY/MEDIUM

Answer: c EASY/MEDIUM

| Years  | 3                | N = Periods = years x periods/yr =                  | 6       |  |
|--|------------------|---|---------|--|
| Periods/Yr   | 2                |   |         |  |
| PMT  | \$0              |   |         |  |
| Nom. I/YR  | 8.00%            | I/Period = Nom. I/Periods per year =                | 4.00%   |  |
| PV   | \$2,000          |   |         |  |
| FV   | \$2,530.64 Could | be found using a calculator, the equation, or Excel | l. Note |  |
| that we must first convert to periods and rate per period. |                  |   |         |  |

39. PV of a lump sum, semiannually

Answer: b EASY/MEDIUM

| Years  | 3                       | N = Periods = years x periods/yr =             | 6     |
|--|-------------------------|--|-------|
| Periods/Yr   | 2                       |  |       |
| PMT  | \$0                     |  |       |
| Nom. I/YR  | 8.00%                   | I/Period = Nom. I/Periods per year =           | 4.00% |
| FV   | \$2,000                 |  |       |
| PV   | \$1,580.63 Could be for | und using a calculator, the equation, or Excel | Note  |
| that we must first convert to periods and rate per period. |                         |  |       |

#### 40. FV of an uneven cash flow stream

Answer: d MEDIUM

| I/YR =     | 8%              |                |                |               |               |         |
|------------|-----------------|----------------|----------------|---------------|---------------|---------|
|            | 0               | 1              | 2              | 3             | 4             |         |
| CFs:       | \$0             | \$100          | \$300          | <b>\$0</b>    | \$500         |         |
| FV of CFs: | \$0             | \$126          | \$350          | \$0           | \$500         |         |
| FV =       | \$975.89        | Found by sur   | nming individ  | ual PVs.      |               |         |
| FV =       | <b>\$975.89</b> | Found with the | ne NFV key in  | some calcu    | lators.       |         |
| FV =       | <b>\$975.89</b> | Found with a   | calculator by  | first finding | the PV of the | stream, |
| -          |                 | then finding t | the FV of that | PV.           |               |         |
|            |                 | PV of the stre | eam:           | \$717.31      |               |         |
|            |                 | FV of the PV   | /:             | \$975.89      | ]             |         |

| 1.  | Interest ra | ate built | into an une      | even cash        | flow str      | eam            | Answer: a     | MEDIUM |
|-----|-------------|-----------|------------------|------------------|---------------|----------------|---------------|--------|
|     |             | 0         | 1                | 2                | 3             | 4              | 5             |        |
|     | CFs:        | -\$1,000  | \$50             | \$50             | \$50          | \$50           | \$1,050       |        |
|     | I/YR        | 5.0%      | I is the discou  | nt rate that cau | ises the PV   | of the inflow  | s to equal    |        |
|     |             |           | the initial nega | ative CF, and i  | s found with  | n Excel's IRR  | t function or |        |
|     |             |           | by inputting the | ne CFs into a c  | alculator an  | d pressing th  | e IRR key.    |        |
| 40  | <b>T</b>    |           |                  |                  | <b>61</b>     |                | •             |        |
| 42. | interest ra | ate Duilt | into an une      | even cash        | ILOW STR      | eam            | Answer: c     | MEDIOM |
|     |             | 0         | 1                | 2                | 3             | 4              | _             |        |
|     | CFs:        | -\$500    | \$50             | \$60             | \$70          | \$516          |               |        |
|     | I/YR        | 10.0%     | I is the discou  | nt rate that cau | ises the PV   | of the positiv | e inflows to  |        |
|     |             |           | equal the initia | al negative CF   | . I can be fo | ound using E   | xcel's IRR    |        |
|     |             |           | function or by   | inputting the    | CFs into a c  | alculator and  | pressing      |        |
|     |             |           | •                | 1 0              |               | are aracor and | Pressing      |        |

| 43. | FV of a lum | p sum, monthly          | A  | nswer: e  | MEDIUM |
|-----|-------------|-------------------------|--|-----------|--------|
|     | Years       | 3                       | N = Periods = vears x periods/vr =             | 36        |        |
|     | Periods/Yr  | 12                      |  | 00        |        |
|     | PMT         | \$0                     |  |           |        |
|     | Nom. I/YR   | 8.00%                   | I/Period = Nom. I/Periods per year =           | 0.67%     |        |
|     | PV          | \$2,000                 |  |           |        |
|     | FV          | \$2,540.47 Could be for | ound using a calculator, the equation, or Ex   | cel. Note |        |
|     |             | that we mus             | st first convert to periods and rate per perio | od.       |        |

Chapter 2: Time Value of Money

| 44. | PV of a lump       | sum, monthly                       |                        |                         | Answer:    | b      | MEDIUM |
|-----|--------------------|------------------------------------|------------------------|-------------------------|------------|--------|--------|
|     | Years              | 3                                  | N = Periods = 2        | years x periods/yr =    |            | 36     | i      |
|     | Periods/ 11<br>DMT | 12                                 |                        |                         |            |        |        |
|     | Nom I/VP           | ምባ<br>8 በበ0/-                      | I/Period - Non         | 1/Periods per year -    |            | 670/   |        |
|     | EV                 | 0.0070<br>¢2.000                   | 1/r errou = Norr       | i. I/renous per year –  | U.         | 0770   |        |
|     | <b>DV</b>          | \$2,000<br>\$1 574 51 Could be for | ind using a calcula    | ator the equation or I  | Excel Note |        |        |
|     | 1 V                | that we mus                        | t first convert to pe  | eriods and rate per per | riod.      |        |        |
| 45. | APR vs. effe       | ctive annual rate                  |                        |                         | Answer:    | d      | MEDIUM |
|     |                    |                                    |                        |                         |            |        |        |
|     | APR                | 15%                                |                        |                         |            |        |        |
|     | Periods/yr         | 12                                 |                        |                         |            |        |        |
|     | EFF%               | 16.08%                             |                        |                         |            |        |        |
| 46. | Nominal vs.        | effective annual                   | rate                   |                         | Answer:    | a      | MEDIUM |
|     | Nominal I/YR       | 6                                  | %                      |                         |            |        |        |
|     | Periods/yr         |                                    | 12                     |                         |            |        |        |
|     | EFF%               | 6.17                               | <mark>%</mark>         |                         |            |        |        |
| 47. | Interest cha       | rges, simple inte                  | rest                   |                         | Answer:    | с      | MEDIUM |
|     | Nominal I/YR       | 8                                  | % D                    | ays in month            |            | 30     |        |
|     | Days/yr            | 3                                  | 60 Da                  | aily rate               | 0.02       | 22%    | ,      |
|     | Amount borrowe     | d <b>\$10,0</b>                    | 00 In                  | terest per day          | 5          | \$2.22 |        |
|     | Interest per mont  | h <b>\$66.</b>                     | <mark>67</mark>        |                         |            |        |        |
| 48. | Fractional t       | ime periods                        |                        |                         | Answer:    | e      | MEDIUM |
|     | Nominal I/YR       | 6                                  | % Ra                   | ate/day                 | 0.01       | .67%   | ,      |
|     | Number of month    | ns                                 | 7 Da                   | ays on deposit          |            | 210    | )      |
|     | Days in year       | 3                                  | 60                     |                         |            |        |        |
|     | Days in month      | í.                                 | 30                     |                         |            |        |        |
|     | Amount deposite    | d \$5,0                            | 00                     |                         |            |        |        |
|     | Ending amount      | \$5,178.                           | <mark>)8</mark>        |                         |            |        |        |
| 49. | Loan amortiz       | ation: payment                     |                        |                         | Answer:    | b      | MEDIUM |
|     | I/YR               | 8                                  | %                      |                         |            |        |        |
|     | Years              | 0                                  | 4                      |                         |            |        |        |
|     | Amount borrowe     | d \$25,0                           | 00                     |                         |            |        |        |
|     | Payments           | \$7,548.                           | <b>D2</b> Found with a | calculator, as the PM   | Г.         |        |        |
| 50. | Loan amortiz       | ation: interest                    |                        |                         | Answer:    | d      | MEDIUM |

| I/YR               | 8%         |
|--------------------|------------|
| Years              | 4          |
| Amount borrowed    | \$25,000   |
| Interest in Year 1 | \$2,000.00 |

Multiply the rate times the amt borrowed.

#### 51. Comparing the effective cost of two bank loans

This problem can be worked most easily using the interest conversion feature of a calculator. It could also be worked using the conversion formula. We applied the formula using Excel.

| 7%    |
|-------|
| 8%    |
| 12    |
| 1     |
| 7.23% |
| 8.00% |
| 0.77% |
|       |

#### 52. Mortgage payments

| Ν   | 360       |
|-----|-----------|
| Ι   | 0.5833%   |
| PV  | \$190,000 |
| PMT | -\$1,264  |
| FV  | \$0.00    |

#### 53. Loan amortization: principal repayment

| Interest rate                 | 8%              | /<br>0                               |         |
|-------------------------------|-----------------|--------------------------------------|---------|
| Years                         |                 | 4                                    |         |
| Amount borrowed               | \$25,00         | 0                                    |         |
| Step 1: Find the PMT          |                 |                                      | \$7,548 |
| Step 2: Find the 1st year's   | interest        |                                      | \$2,000 |
| Step 3: Subtract the interest | st from the pay | nent; this is repayment of principal | \$5,548 |

54. Loan amortization: ending balance

Answer: b MEDIUM/HARD

Answer: e MEDIUM/HARD

Answer: a MEDIUM

Answer: c MEDIUM

| Interest rate  | 8%       |
|--|----------|
| Years  | 4        |
| Amount borrowed  | \$25,000 |
| Step 1: Find the PMT   | \$7,548  |
| Step 2: Find the 1st year's interest   | \$2,000  |
| Step 3: Subtract the interest from the payment; this is repayment of principal | \$5,548  |
| Step 4: Subtract the repayment of principal from the beginning amount owed     | \$19,452 |

| 55. | Retirement planning  | Answer: | d  | MEDIUM/HARD |
|-----|--|---------|----|-------------|
|     | Interest rate  |         |    | 10%         |
|     | Years to retirement  |         |    | 35          |
|     | Years in retirement  |         |    | 30          |
|     | Amount saved per year  |         |    | \$3,000     |
|     | Step 1: Find the amount at age 65; use the FV function                   |         | \$ | 813,073     |
|     | Step 2: Find the PMT for a 30 year ordinary annuity using that FV as the | PV      |    | \$86,250    |

#### 56. Non-annual compounding

#### Answer: a MEDIUM/HARD

| Interest rate | 12%      |          |           |             |
|---------------|----------|----------|-----------|-------------|
| Periods/year  | 12       | Years on | Months on | Ending      |
| Monthly rate  | 1.00%    | deposit: | deposit:  | Amount      |
| 1st deposit   | \$5,000  | 3        | 36        | \$7,153.84  |
| 2nd deposit   | \$10,000 | 2        | 24        | \$12,697.35 |
| 3rd deposit   | \$15,000 | 1        | 12        | \$16,902.38 |
|               |          |          |           | \$36,753.57 |

#### 57. Lifetime subscription vs. annual payments Answer: c MEDIUM/HARD

Find N for an annuity due with the indicated terms to determine how long you must live to make the lifetime subscription worthwhile.

| Interest rate              | 7%               |    |
|----------------------------|------------------|----|
| Annual cost                | \$100            |    |
| Lifetime subscription cost | -\$1,000         |    |
| Number of payments made    | 15.70 rounded to | 16 |

Recall, we used BEGIN mode (because it is an annuity due), so it takes 16 payments before the lifetime subscription is better. Since the 1st payment occurs today, the 16th payment occurs at t = 15 (15 years from now). So, you must live for: 16 - 1 = 15 years.

#### 58. Comparing the effective cost of two bank loans Answer: e MEDIUM/HARD
Students must understand that "simple interest with interest paid monthly" means that the bank gets the interest at the end of each month, hence it can invest it, presumably at the same nominal rate. This results in the same effective rate as if it were stated as "6%, monthly compounding." The problem can be worked most easily using the interest conversion feature of a calculator. It could also be worked using the conversion formula. We applied the formula using Excel.

| Nominal rate, Bank A | 6%    |
|----------------------|-------|
| Nominal rate, Bank B | 7%    |
| Periods/yr, A        | 12    |
| Periods/yr, B        | 1     |
| EFF% A               | 6.17% |
| EFF% B               | 7.00% |
| Difference           | 0.83% |
|                      |       |

#### 59. Retirement planning

Answer: b MEDIUM/HARD

| Tom's retire | ement account |                                      | Jerry's re | tirement account |
|--------------|---------------|--------------------------------------|------------|------------------|
| Ν            | 46            |                                      | Ν          | 41               |
| I/YR         | 10%           |                                      | I/YR       | 10%              |
| PV           | \$0           |                                      | PV         | \$0              |
| PMT          | \$4,000       |                                      | PMT        | \$6,492          |
| FV           | \$3,167,181 = | on 70th b-day, accounts must equal = | FV         | \$3,167,181      |

#### 60. Saving to start a business

There are 3 cash flow streams: the gift and the two annuities. The gift will grow for 10 years. Then there is a 5-year annuity that will compound for an additional 5 years. Finally, there is a second 5-year annuity. The sum of the compounded values of those three sets of cash flows is the final amount.

| Nominal interest rate | 8%       | Year 5          | Year 10      |
|-----------------------|----------|-----------------|--------------|
| Gift                  | \$20,000 | NA              | \$43,178     |
| 1st annuity           | \$5,000  | \$29,333        | \$43,100     |
| 2nd annuity           | \$10,000 | NA              | \$58,666     |
| Total years           | 10       |                 |              |
| Annuity years         | 5        | <b>Final am</b> | t: \$144,944 |

61. Cash flow required to provide a given rate of return Answer: a HARD

#### Answer: d HARD

This is a very difficult problem. It would not generally be appropriate for a regular in-class exam. It would be better for a take-home exam. We must find a value of X such that the PV of the positive CFs, discounted at 9%, will equal the initial negative CF.

The problem is relatively easy with Excel but quite hard with a calculator because it's hard to conceptualize the required setup and steps.

Excel solution: Set the problem up as shown below. Put a guess--we initially guessed \$10,000--in the boxed cell under the first X. The IRR initially is less than 9%, so raise the guess, and keep iterating until IRR = 9%. This value of X is the required payment for the investment to provide the 9% rate of return. The problem can be worked faster if you know how to use Goal Seek; then you tell Excel to change the X cell to the value that causes IRR = 9%. It turns out to be exactly: I/YR = 9%

| 0         | 1       | 2        | 3        | 4        | 5        | 6        | 7        |
|-----------|---------|----------|----------|----------|----------|----------|----------|
| -\$50,000 | \$5,000 | \$10,000 | \$15,000 | X        | Х        | Х        | X        |
| -\$50,000 | \$5,000 | \$10,000 | \$15,000 | \$10,000 | \$10,000 | \$10,000 | \$10,000 |
| IRR =     | 8.78%   |          |          |          | -        |          |          |

Calculator solution:

Step 1: Use CF register to find the PV of the 4 known cash flows at the end of Year 3.-\$25,413.29Step 2: Now find the FV at the end of Period 3, i.e., compound PV for 3 years.-\$32,910.95Step 3: Now find the PMT for a 4-year annuity with the PV.\$10,158.58

62. Saving for college

Answer: c HARD

| Current college costs                 | \$16,000                     |          |                                      |
|---------------------------------------|------------------------------|----------|--------------------------------------|
| College cost inflation                | 4%                           |          |                                      |
| Account return                        | 8%                           |          |                                      |
| First 5 payments                      | \$3,000                      |          |                                      |
| Current account balance               | \$9,000                      |          |                                      |
| First, determine each year of colle   | ege's costs.                 |          |                                      |
| Year 1 of college $(t = 10)$          | =                            | \$23,684 |                                      |
| Year 2 of college $(t = 11)$          | =                            | \$24,631 |                                      |
| Year 3 of college $(t = 12)$          | =                            | \$25,617 |                                      |
| Year 4 of college $(t = 13)$          | =                            | \$26,641 |                                      |
| The PV (at $t = 10$ ) of all of these | college costs is:            | \$89,601 | This is what they need at $t = 10$ . |
| After the first 5 payments, the col   | lege account will have (at t | =4):     | \$29,844.20                          |

6 more contributions are left in order to get the required funds for college costs.

| Ν   | 6           |
|-----|-------------|
| Ι   | 8%          |
| PV  | -\$29,844   |
| PMT | -\$5,758    |
| FV  | \$89,601.29 |

## 63. Loan amortization: repayment of principal

Answer: e HARD

| N   | 12        |
|-----|-----------|
| Ι   | 1.17%     |
| PV  | \$100,000 |
| PMT | \$8,978   |
| FV  | \$0       |

% paid toward prin. = 89.06%

# Amortization schedule(first 4 years)

| Year | Beg. Balance | Payment | Interest   | Principal  | End.<br>Balance |
|------|--------------|---------|------------|------------|-----------------|
| 1    | \$100,000.00 | \$8,978 | \$1,165.41 | \$7,812.59 | \$92,187.41     |
| 2    | \$92,187.41  | \$8,978 | \$1,074.36 | \$7,903.64 | \$84,283.76     |
| 3    | \$84,283.76  | \$8,978 | \$982.25   | \$7,995.75 | \$76,288.01     |
| 4    | \$76,288.01  | \$8,978 | \$889.07   | \$8,088.93 | \$68,199.08     |

64. Loan amortization: interest paid

Answer: b HARD

|     | Ι     | 0.67%                     |            | Paid toward interest   |           | \$2,3   | 98     |      |
|-----|-------|---------------------------|------------|------------------------|-----------|---------|--------|------|
|     | PV    | \$120,000                 |            | Total payments         |           | \$2,64  | 42     |      |
|     | PMT   | \$881                     |            | % Paid toward interest |           | 90.79   | %      |      |
|     | FV    | \$0                       |            |                        |           | -       |        |      |
|     | Amort | tization schedule(first 3 | months)    |                        |           |         |        |      |
|     | Year  | Beg. Balance              | Payment    | Interest               | Principal | End.    | Balan  | ce   |
|     | 1     | \$120,000.00              | \$880.52   | \$800.00               | \$80.52   | \$119   | ,919.4 | 48   |
|     | 2     | \$119,919.48              | \$880.52   | \$799.46               | \$81.05   | \$119   | ,838.4 | 43   |
|     | 3     | \$119,838.43              | \$880.52   | \$798.92               | \$81.59   | \$119   | ,756.  | 84   |
|     |       | Total payments:           | \$2,641.55 | \$2,398.39             | \$243.17  |         |        |      |
| 65. | PV ar | nd discount rate          |            |                        |           | Answer: | a :    | EASY |
| 66. | Time  | value concepts            |            |                        |           | Answer: | e      | EASY |
| 67. | Time  | value concepts            |            |                        |           | Answer: | c      | EASY |

Statement a is false, because the more compoundings per year, the less the present value of a lump sum. Statement b is false and statement c is true, because the periodic rate is 5%. Statement d is false, because the more periods a lump sum is discounted, the less its present value is. Statement e is false, because the annuity has cash flows occurring sooner than the lump sum is due, so the sum of the PVs of its cash flows will be greater.

#### 68. Time value concepts

Ν

T

360

0 67%

Since the effective rates are all the same, the correct answer must be the investment that has the largest amount of money compounding for the longest time, which is statement e. This can be proven by assuming an effective annual rate and performing the calculations.

#### 69. Effective annual rate

The bank account that pays the highest nominal rate with the most frequent rate of compounding will have the highest EAR. Consequently, statement b is the correct choice.

#### 70. Effective annual rate

The investment with the highest nominal rate and most frequent compoundings will have the highest effective rate. For this reason, Bank 4 (statement d) dominates Banks 1-3 (statements a, b, and c). Therefore, Bank 4's effective rate (8.328%) must be calculated and compared to Bank 5's effective rate (8.2%). Therefore, statement d is the correct choice.

Answer: e EASY

\$2 398

#### Answer: b EASY

Answer: d EASY

## **Chapter 2: Time Value of Money**

#### 71. Quarterly compounding

If the nominal rate is 8% and there is quarterly compounding, the periodic rate must be 8%/4 = 2%. The effective rate will be greater than the nominal rate; it will be 8.24%. So the correct answer is statement e.

#### 72. Annuities

Statement a is false, because the present value of an annuity due (all else equal) is greater than the present value of an ordinary annuity, since cash flows are received sooner and reinvested longer. Statements b and e are false, because the present and future values of an annuity due (all else equal) are also greater, since the cash flows are reinvested longer. Statement c is true for the same reasons. Statement d is false, because the difference in PVs of the two annuities will change as interest rates change.

#### 73. Amortization

Statement a is false, because the interest rate and annual payments are positively correlated (higher rates = higher payments, and vice versa). Statement b is false, because interest during Year 1 would be the interest rate times the beginning balance, which are identical in both cases. Statement c is false, because early payments in a loan's life have a lot of interest, but later payments include very little interest since the balance is low at this point. Statement d is false, because this composition changes with each payment, as more principal and less interest is paid with each payment. Statement e is true, because if the interest rate is higher, then a greater proportion of total payments (and hence, each individual payment) goes toward interest.

#### 74. Amortization

Statement a is false, because the remaining balance will be the loan amount less the amount paid toward principal. Statement b is true, because the percentage paid toward principal increases throughout the loan's life. Statement c is false, because the payment will be same each month. Statement d is false, because the balance gets paid off quicker at the end of a bond's life when the balance is lower and more of the payment goes toward principal. Statement e is false, because fixed-rate means that the interest rate applied to the outstanding balance (which does change) will be fixed.

#### 75. Amortization

Statement a is false, because monthly payments will not decline over time, they will stay the same. Statement b is true, because the percentage paid toward interest declines over time. Statement c is true, because interest due for every payment gets progressively smaller, which means that the portion toward principal gets larger. Statement d is true, because if the interest rate is lower, less is paid toward interest. Statement e is

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# Answer: e EASY

Answer: c MEDIUM

# Answer: e MEDIUM

Answer: b MEDIUM

Answer: a MEDIUM

true. Therefore, answer choice a is the correct answer.

#### 76. Time value concepts

#### 77. Growth rate

Financial calculator solution: Inputs: N = 30; PV = -1800; PMT = 0; FV = 13700. Output: I/YR = 7.0%.

#### 78. Interest rate

Time Line: 0 i = ? 1 2 3 4 5 Years 10,000 -2,504.56 -2,504.56 -2,504.56 -2,504.56 -2,504.56

Financial calculator solution: Inputs: N = 5; PV = 10000; PMT = -2504.56; FV = 0. Output: I/YR = 8%.

## 79. Effect of inflation

Time Line: 0 4% 1 n = ? Years -1.00 0.50

Financial calculator solution: Inputs: I/YR = 4; PV = -1; PMT = 0; FV = 0.50. Output:  $N = -17.67 \approx 18$  years.

#### 80. Time for a sum to double

I/YR = 7/12; PV = -1; PMT = 0; FV = 2; and solve for N = 119.17 months = 9.93 years.

#### 81. Time for lump sum to grow

Financial calculator solution: Inputs: I/YR = 10; PV = -300000; PMT = 0; FV = 1000000. Outputs: N = 12.63 years.

#### 82. Monthly loan payments

First, find the monthly interest rate = 0.10/12 = 0.8333%/month. Now, enter in your calculator N = 60; I/YR = 0.8333; PV = -13000; FV = 0; and solve for PMT = \$276.21.

## Page 94

# Answer: d

Answer: e

Answer: c

# Answer: c

# Answer: b

#### Answer: d MEDIUM

Answer: d

# 83. FV of an annuity

| Tim | e Line:       |      |      |      |         |
|-----|---------------|------|------|------|---------|
| 0   | 15 <u>8</u> 1 | 2    | 3    | 4    | 5 Years |
| ⊢   | 13.0          |      |      |      |         |
|     | -200          | -200 | -200 | -200 | -200    |
|     |               |      |      |      | FV = ?  |

Financial calculator solution: Inputs: N = 5; I/YR = 15; PV = 0; PMT = -200. Output: FV = \$1,348.48.

#### 84. PV of an annuity

Time Line: 2 3 4 5 Years 0 15% 1 + \_\_\_\_ PV = ? -200-200 -200 -200 -200

Financial calculator solution: Inputs: N = 5; I/YR = 15; PMT = -200; FV = 0. Output: PV = \$670.43.

#### 85. PV of a perpetuity

V = PMT/i = \$1,000/0.15 = \$6,666.67.

#### 86. Required annuity payments

| Time | line: |       |      |       |       |        |       |
|------|-------|-------|------|-------|-------|--------|-------|
| 0    | 10%   | 1     | 2    | 3     | 3 4   | 1 5    | Years |
| ⊢    | 100   |       |      |       |       |        |       |
| PV = | 1,000 | PMT = | ? PN | IT PM | IT PM | AT PMT |       |

Financial calculator solution: Inputs: N = 5; I/YR = 10; PV = -1000; FV = 0. Output: PMT = \$263.80.

#### 87. Quarterly compounding and FV

Time line: 0<sub>12</sub>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 Qtrs ⊢\_\_+ -100 FV = ?

Financial calculator solution: Inputs: N = 20; I/YR = 1; PV = -100; PMT = 0. Output: FV = \$122.02.

88. PV of an uneven CF stream

**Chapter 2: Time Value of Money** 

Answer: e

# Answer: c

Answer: a

## Answer: b

#### Answer: a

Answer: b

NPV =  $\$10,000/1.08 + \$25,000/(1.08)^2 + \$50,000/(1.08)^3 + \$35,000/(1.08)^4$ = \$9,259.26 + \$21,433.47 + \$39,691.61 + \$25,726.04=  $\$96,110.38 \approx \$96,110.$ 

Financial calculator solution (using the cash flow register): Inputs:  $CF_0= 0$ ;  $CF_1 = 10000$ ;  $CF_2 = 25000$ ;  $CF_3 = 50000$ ;  $CF_4 = 35000$ ; I/YR = 8.

Output: NPV = 
$$$96,110.39 \approx $96,110$$

### 89. Effective annual rate

Bank A: 8%, monthly.

 $EAR_{A} = \left(1 + \frac{r_{Nom}}{m}\right)^{m} - 1$  $= \left(1 + \frac{0.08}{12}\right)^{12} - 1 = 8.30\%.$ 

Bank B: 9%, interest due at end of year  $\label{eq:Bank} \text{EAR}_\text{B} = 9\%.$ 

9.00% - 8.30% = 0.70%.

#### 90. Effective annual rate

Use the formula for calculating effective rates from nominal rates as follows: EAR =  $(1 + 0.18/12)^{12} - 1 = 0.1956$  or 19.56%.

#### 91. Effective annual rate

Convert each of the alternatives to an effective annual rate (EAR) for comparison. This problem can be solved with either the EAR formula or a financial calculator.

a. EAR = 10.38%.
b. EAR = 10.47%.
c. EAR = 10.20%.
d. EAR = 10.25%.
e. EAR = 10.07%.

Therefore, the highest effective return is choice b.

#### 92. Effective annual rate

Financial calculator solution: Inputs: N = 10; PV = -35000; PMT = 0; FV = 100000. Outputs: I/YR = 11.07%.

#### 93. Effective annual rate

Convert each of the alternatives to an effective annual rate (EAR) for comparison. This problem can be solved with either the EAR formula or

#### Chapter 2: Time Value of Money

#### Answer: b

#### Answer: b

Answer: a

# Answer: b

Answer: c

a. EAR = 10.2736%. b. EAR = 10.1846%. c. EAR = 10.2000%. d. EAR = 10.2500%. e. EAR = 10.0339%. Therefore, the highest effective return is choice a. Nominal and effective rates Answer: b 1<sup>st</sup> investment: Enter the following: NOM% = 9; P/YR = 2; and solve for EFF% = 9.2025%. 2<sup>nd</sup> investment: Enter the following: EFF% = 9.2025; P/YR = 4; and solve for NOM% = 8.90%.

#### 95. FV of an annuity

94.

The payments start next year, so the calculator should be in END mode. Enter the following data in your calculator: N = 42; I/YR = 12; PV = -1000; PMT = -2000. Output: FV = \$2,045,442.

#### 96. FV under monthly compounding

a financial calculator.

- Step 1: The interest rate must match the payment period, and since the payments are monthly, you need the monthly periodic rate. Periodic rate = 8%/12 = 0.667%.
- Step 2: Enter the numbers given into your financial calculator: N = 30; I/YR = 8/12 = 0.667; PV = 0; PMT = -200. Output: FV = \$6,617.77.

#### 97. PV of an uneven CF stream

Time Line:

2 3 4 5 6 7 8 9 Years 0 <sub>14%</sub> 1 \_ \_\_\_\_\_ \_\_\_\_ PV = ? 2,000 2,000 2,000 2,000 2,000 3,000 3,000 3,000 4,000

Financial calculator solution (using the cash flow register): Inputs:  $CF_0 = 0$ ;  $CF_1 = 2000$ ;  $N_j = 5$ ;  $CF_2 = 3000$ ;  $N_j = 3$ ;  $CF_3 = 4000$ ; I/YR = 14. Output: NPV = \$11,714.

98. FV of a sum



Answer: c

Answer: b

Answer: a

Answer: a

Financial calculator solution: Inputs: N = 6; I/YR = 2; PV = -1000; PMT = 0. Output: FV = \$1,126.

#### 99. FV of annuity due

Since payments begin today and occur every year on Janet's birthday, the calculator must be set to BEGIN mode. Now, find the future value of these payments with your financial calculator: BEG N = 42; I/YR = 10; PV = 10000; PMT = 1000. Output: FV = \$1,139,038.

#### 100. Time value of money and retirement

- Step 1: Find the number of years it will take for each \$150,000
  investment to grow to \$1,000,000.
  BRUCE: I/YR = 5; PV = -150000; PMT = 0; FV = 1000000; and
  solve for N = 38.88.
  BRENDA: I/YR = 10; PV = -150000; PMT = 0; FV = 1000000; and
  solve for N = 19.90.
- Step 2: Calculate the difference in the length of time for the
   accounts to reach \$1 million:
   Bruce will be able to retire in 38.88 years, or 38.88 19.90
   = 19.0 years after Brenda does.

#### 101. FV of a sum

Step 1: Solve for amount on deposit at the end of 6 months:  $\$100\left(1 + \frac{0.06}{2}\right) - \$100 = \$3.00.$ 

Step 1: Determine the effective annual rate:

Step 2: Calculate the ending balance 20 years after the initial deposit of \$100 was made: Inputs: N = 39; I/YR = 3; PV = -3.00; PMT = 0. Output: FV = \$9.50.

#### 102. FV of an annuity

- The nominal rate is 6%, but we need the effective annual rate. Using the calculator, input the following data: NOM% = 6; P/YR = 365; and solve for EFF% = 6.1831%.
- Step 2: Determine the future value of the annuity: N = 3; I/YR = 6.1831; PV = -500; PMT = -1000; and solve for FV = \$3,787.92  $\approx$  \$3,788.

#### Answer: b

#### Answer: d

Answer: e

#### Answer: d

#### 103. FV of an annuity

To calculate the solution to this problem, change your calculator to BEGIN mode. Then enter N = 35; I/YR = 10; PV = 0; PMT = 3000; and solve for FV = \$894,380.4160. Add the last payment of \$3,000, and the value at t = 35 is  $\$897,380.4160 \approx \$897,380$ .

#### 104. FV of an annuity

First, find the present values today of the two withdrawals to occur on the  $25^{th}$  and  $30^{th}$  birthdays (in the  $5^{th}$  and  $10^{th}$  year of the problem, respectively).

PV today of \$5,000 withdrawal five years from now: N = 5; I/YR = 12; PMT = 0; FV = 5000; and solve for PV = -\$2,837.13.

PV today of \$10,000 withdrawal 10 years from now: N = 10; I/YR = 12; PMT = 0; FV = 10000; and solve for PV = -\$3,219.73.

Now, we subtract the PV of these withdrawals from our initial investment: \$5,000.00 - \$2,837.13 - \$3,219.73 = \$-1,056.86.

Finally, we have our simple TVM setup with N, I/YR, PV, and PMT, solving for FV: N = 45; I/YR = 12; PV = -1056.86; PMT = 500; and solve for FV =  $$505,803.08 \approx $505,803.$ 

#### 105. FV of annuity due

### Answer: d

There are a few ways to do this. One way is shown below. To get the value at t = 5 of the first 5 payments: BEGIN mode, N = 5; I/YR = 11; PV = 0; PMT = -3000; and solve for FV = \$20,738.58.

Now add on to this the last payment that occurs at t = 5.  $$20,738.58 + $3,000 = $23,738.58 \approx $23,739$ .

#### 106. FV of annuity due

#### Answer: e

- Step 1: Calculate the value at t = 45 of the first 44 annuity
  contributions:
   Enter the following inputs in the calculator:
   BEGIN mode, N = 44; I/YR = 10; PV = 0; PMT = -2000; and solve
   for FV = \$1,435,809.67.

#### Answer: c

Answer: d

#### 107. FV under monthly compounding

Financial calculator solution: N = 3  $\times$  12 = 36; I/YR = 6/12 = 0.5; PV = -1000; PMT = 0; and solve for FV = \$1,196.68.

#### 108. FV under monthly compounding

#### Answer: d

Answer: e

- Step 1: Calculate the FV at t = 36 of the first deposit. Enter N = 36; I/YR = 12/12 = 1; PV = -10000; PMT = 0; and solve for FV = \$14,308.
- Step 2: Calculate the FV at t = 36 of the second deposit. Enter N = 24; I/YR = 12/12 = 1; PV = -10000; PMT = 0; and solve for FV = \$12,697.
- Step 3: Calculate the FV at t = 36 of the third deposit. Enter N = 12; I/YR = 12/12 = 1; PV = -20000; PMT = 0; and solve for FV = \$22,537.

Step 4: The sum of the future values gives you the answer, \$49,542.

#### 109. FV under daily compounding

Solve for FV as N = 132; I/YR = 4/365 = 0.0110; PV = -2000; PMT = 0; and solve for FV = \$2,029.14.

#### 110. FV under non-annual compounding

First, find the FV of Josh's savings as:  $N = 2 \times 26 = 52$ ; I/YR = 10/26 = 0.3846; PV = 0; PMT = -100; and FV = \$5,744.29.

John's savings will have two components, a lump sum contribution of \$1,500 and his monthly contributions. The FV of his regular savings is: N = 2 × 12 = 24; I/YR = 10/12 = 0.8333; PV = 0; PMT = -150; and FV = \$3,967.04. The FV of his previous savings is: N = 24; I/YR = 0.8333; PV = -1500; PMT = 0; and FV = \$1,830.59.

Summing the components of John's savings yields \$5,797.63, which is greater than Josh's total savings. Thus, the most expensive car purchased costs \$5,797.63.

#### 111. FV under quarterly compounding

The effective rate is given by: NOM% = 8; P/YR = 4; and solve for EFF% = 8.2432%.

#### Answer: a

#### Answer: d

Answer: c

The nominal rate on a semiannual basis is given by: EFF% = 8.2432; P/YR = 2; and solve for NOM% = 8.08%. The future value is given by: N =  $2.5 \times 2 = 5$ ; I/YR = 8.08/2 = 4.04; PV = 0; PMT = -100; and solve for FV = \$542.07.

#### 112. FV under quarterly compounding

Answer: d

There are several ways of solving this. One way is: First, find the periodic (quarterly) rate of 7%/4 = 1.75%.

Next, find the future value of each amount put in the account: N = 12; I/YR = 1.75; PV = -1000; PMT = 0; and solve for FV = \$1,231.4393. N = 8; I/YR = 1.75; PV = -2000; PMT = 0; and solve for FV = \$2,297.7636. N = 4; I/YR = 1.75; PV = -3000; PMT = 0; and solve for FV = \$3,215.5771.

Add up the future values for the answer: \$6,744.78.

#### 113. FV of an uneven CF stream

First, calculate the payment amounts:  $PMT_0 = \$5000$ ,  $PMT_1 = \$5500$ ,  $PMT_2 = \$6050$ ,  $PMT_3 = \$6655$ ,  $PMT_4 = \$7320.50$ . Then, find the future value of each payment at t = 5: For  $PMT_0$ , N = 5; I/YR = 14; PV = -5000; PMT = 0; thus, FV = \$9,627.0729. Similarly, for  $PMT_1$ , FV = \$9,289.2809, for  $PMT_2$ , FV = \$8,963.3412, for  $PMT_3$ , FV = \$8,648.8380, and for  $PMT_4$ , FV = \$8,345.3700. Finally, summing the future values of the respective payments will give the balance in the account at t = 5 or \$44,873.90.

#### 114. Present value

Answer: c

Use your financial calculator to determine each security's present value, and then choose the one with the largest present value.

- a. Enter the following inputs in your calculator: N = 5; I/YR = 8; PMT = 1000; FV = 0; and solve for PV = \$3,992.71.
- b. Enter the following inputs in your calculator: N = 5; I/YR = 8; PMT = 0; FV = 7000; and solve for PV = \$4,764.08.
- c. P = PMT/I = \$800/0.08 = \$10,000.
- d. Enter the following inputs in your calculator: N = 7; I/YR = 8; PMT = 0; FV = 8500; and solve for PV = \$4,959.67.

#### Answer: e

e. Enter the following inputs in your calculator:  $CF_0 = 0$ ;  $CF_1 = 1000$ ;  $CF_2 = 2000$ ;  $CF_3 = 3000$ ; I/YR = 8; and solve for NPV = \$5,022.10.

The preferred stock issue, statement c, has the largest present value among these choices.

#### 115. PV under monthly compounding

Start by calculating the effective rate on the second security: P/YR = 12; NOM% = 10; and solve for EFF% = 10.4713%. Then, convert this effective rate to a semiannual rate: EFF% = 10.4713; P/YR = 2; NOM% = 10.2107%. Now, calculate the value of the first security as follows:  $N = 10 \times 2 = 20$ ; I/YR = 10.2107/2 = 5.1054; PMT = 500; FV = 0; and solve for PV = -\$6, 175.82.

#### 116. PV under non-annual compounding

First, find the effective annual rate for a nominal rate of 12% with quarterly compounding: P/YR = 4; NOM% = 12; and EFF% = 12.55%. In order to discount the cash flows properly, it is necessary to find the nominal rate with semiannual compounding that corresponds to the effective rate calculated above. Convert the effective rate to a semiannual nominal rate as P/YR = 2; EFF% = 12.55; and NOM% = 12.18%. Finally, find the PV as  $N = 2 \times 3 = 6$ ; I/YR = 12.18/2 = 6.09; PMT = 500; FV = 0; and solve for PV = -\$2,451.73.

#### 117. PV of an annuity

Time Line: 0 78 3 1 2 n = ? Years I---+ + -\_  $PV_{Lifetime} = 100$ \_ \_ 10 10 10 10 10  $PV_{Annual} = 100$ 

Financial calculator solution: Inputs: I/YR = 7; PV = -90; PMT = 10; FV = 0. Output: N = 14.695 ≈ 15 years.

#### 118. Value of a perpetuity

Time Line:

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Answer: c

## Answer: a

Answer: c

Answer: b

0 r = ? = 8% 1 2 PMT = 1,250 1,250 1,250 1,250 1,250 1,250 Solve for required return, r. We know  $V_p = \frac{PMT}{r}$  , thus,  $r = \frac{PMT}{V_{p}} = \frac{\$1,250}{\$15,625} = 8\%.$ 

Financial calculator solution: Inputs: N = 20; I/YR = 8; PMT = -1250; FV = 0. Output: PV = \$12,272.68 ≈ \$12,273.

#### 119. FV of an uneven CF stream

# Time Line: 0 8% 1 5 6 10 Years 5,000 1,000 1,000 2,000 2,000 2,000 FV = ?

Financial calculator solution: Calculate PV of the cash flows, then bring them forward to FV using the interest rate. Inputs:  $CF_0 = 5000$ ;  $CF_1 = 1000$ ;  $N_j = 5$ ;  $CF_2 = 2000$ ;  $N_j = 5$ ; I/YR = 8. Output: NPV = \$14, 427.45. Inputs: N = 10; I/YR = 8; PV = -14427.45; PMT = 0. Output:  $FV = $31, 147.79 \approx $31, 148$ .

## 120. FV of an uneven CF stream

#### The easiest way to find the solution to this problem is to find the PV of all her contributions today, and then find the FV of that PV 10 years from now.

- Step 1: Calculate the PV of all the deposits today:  $CF_0 = 10000$ ;  $CF_1 = 20000$ ;  $CF_2 = 50000$ ; I/YR = 6; and solve for NPV = \$73, 367.74653.
- Step 2: Calculate the FV 10 years from now of the PV of the deposits: N = 10; I/YR = 6; PV = -73367.74653; PMT = 0; and solve for FV= \$131,390.46.

#### 121. PV of an uneven CF stream

Time Line:

#### Answer: c

Answer: a

Answer: d

#### 122. PV of uncertain cash flows

Answer: e

| Time | Line: |           |           |           |
|------|-------|-----------|-----------|-----------|
| 0    | 8%    | 1         | 2         | 3 Years   |
|      | 0.0   |           |           |           |
| 0    |       | $E(CF_1)$ | $E(CF_2)$ | $E(CF_3)$ |

Calculate expected cash flows  $E(CF_1) = (0.30)(\$300) + (0.40)(\$500) + (0.30)(\$700) = \$500.$   $E(CF_2) = (0.15)(\$100) + (0.35)(\$200) + (0.35)(\$600) + (0.15)(\$900) = \$430.$  $E(CF_3) = (0.25)(\$200) + (0.75)(\$800) = \$650.$ 

Financial calculator solution: Using cash flows Inputs:  $CF_0 = 0$ ;  $CF_1 = 500$ ;  $CF_2 = 430$ ;  $CF_3 = 650$ ; I/YR = 8. Output: NPV = \$1,347.61.

#### 123. Value of missing payments

Answer: d

Find the FV of the price and the first three cash flows at t = 3. To do this first find the present value of them.  $CF_0 = -5544.87$ ;  $CF_1 = 100$ ;  $CF_2 = 500$ ;  $CF_3 = 750$ ; I/YR = 9; and solve for NPV = -\$4,453.15.

Find the FV of this present value. N = 3; I/YR = 9; PV = -4453.15; PMT = 0; FV = \$5,766.96.

Now solve for X. N = 17; I/YR = 9; PV = -5766.96; FV = 0; and solve for PMT = \$675.

#### 124. Effective annual rate

Time Line:

 $O_{B} = ?$ 1 4 2 10 Years 3 i<sub>A</sub> = 0% + + ••• H -\_\_\_\_ \_\_\_\_ PMT  $PV_{A} = 3,755.50 PMT$ PMT PMT PMT  $PMT_{B} = PMT_{A} = 375.55$  $FV_{B} = 5,440.22$ 

Financial calculator solution: Calculate the PMT of the annuity Inputs: N = 10; I/YR = 0; PV = -3755.50; FV = 0. Output: PMT = \$375.55. Calculate the effective annual interest rate Inputs: N = 10; PV = 0; PMT = -375.55; FV = 5440.22. Output: I/YR =  $7.999 \approx 8.0$ %.

#### 125. Effective annual rate

```
Your proposal:
EAR<sub>1</sub> = $120/$1,000
EAR<sub>1</sub> = 12%.
```

Your friend's proposal: Interest is being paid each month (10/1,000 = 1% per month), so it compounds, and the EAR is higher than  $r_{Nom} = 12$ %: EAR<sub>2</sub> =  $\left(1 + \frac{0.12}{12}\right)^{12} - 1 = 12.68$ %.

Difference = 12.68% - 12.00% = 0.68%.

You could also visualize your friend's proposal in a time line format: 0 i = ? 1 2 11 12 11 12 -10 -10 -10 -10 -10 -10

Insert those cash flows in the cash flow register of a calculator and solve for IRR. The answer is 1%, but this is a monthly rate. The nominal rate is 12(1%) = 12%, which converts to an EAR of 12.68% as follows: Input into a financial calculator the following:

P/YR = 12; NOM% = 12; and solve for EFF% = 12.68%.

### 126. EAR and FV of an annuity

Step 1: Find the effective annual rate: Enter the following input data in the calculator:

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Answer: d

Answer: c

NOM% = 9; P/YR = 12; and solve for EFF% = 9.3807%.

Step 2: Calculate the FV of the \$5,000 annuity at the end of 10 years: Now, put the calculator in End mode, switch back to 1 P/YR, and enter the following input data in the calculator: N = 10; I/YR = 9.3807; PV = 0; PMT = -5000; and solve for FV =  $$77,358.80 \approx $77,359$ .

#### 127. EAR and FV of an annuity

#### Answer: b

| 0        | 12    | 24    | 36    | 48    | 60 Mos. |
|----------|-------|-------|-------|-------|---------|
| $\vdash$ | 8.30% |       |       |       |         |
| 0        | 5,000 | 5,000 | 5,000 | 5,000 | 5,000   |
|          |       |       |       |       | FV = ?  |

- Step 1: Because the interest is compounded monthly, but payments are made annually, you need to find the interest rate for the payment period (the effective rate for one year). Enter the following input data in your calculator: NOM% = 8; P/YR = 12; EFF% = 8.30%. Now use this rate as the interest rate. Remember to switch back P/YR = 1.
- Step 2: Find the FV of the annuity: N = 5; I/YR = 8.30; PV = 0; PMT = -5000; and solve for FV = \$29,508.98.

#### 128. Remaining loan balance

#### Answer: a

- Step 1: Solve for the monthly payment: Enter the following input data in the calculator: N = 60; I/YR = 12/12 = 1; PV = -15000; FV = 0; and solve for PMT = \$333.6667.
- Step 2: Determine the loan balance remaining after the 30th payment: 1 INPUT 30  $\blacksquare$  AMORT

= displays Int: \$3,621.1746
= displays Prin: \$6,388.8264
= displays Bal: \$8,611.1736.
Therefore, the balance will be \$8,611.17.

#### 129. Remaining mortgage balance

First, find the payment: Enter N = 360; I/YR = 9/12 = 0.75; PV = -250000; FV = 0; and solve for PMT = \$2,011.56. Use the calculator's amortization feature to find the remaining mortgage balance: 5 years =  $5 \times 12 = 60$  payments. 1 INPUT  $60 \blacksquare$  AMORT = displays Int: \$110,393.67= displays Prin: \$10,299.93= displays Bal: \$239,700.07.

#### 130. Remaining mortgage balance

Solve for the monthly payment as follows:  $N = 30 \times 12 = 360$ ; I/YR = 8/12 = 0.667; PV = -150000; FV = 0; and solve for PMT = \$1,100.65/month.

Use the calculator's amortization feature to find the remaining
principal balance:
3 × 12 = 36 payments
1 INPUT 36 ■ AMORT
= displays Int: \$35,543.52
= displays Prin: \$4,079.88
= displays Bal: \$145,920.12.

#### 131. Amortization

```
Step 1: Determine the monthly payment of the mortgage:
Enter the following inputs in the calculator:
N = 360; I/YR = 8/12 = 0.6667; PV = -165000; FV = 0; and solve
for PMT = $1,210.7115.
```

Step 2: Determine the amount of interest during the first 3 years of the mortgage by using the calculator's amortization feature: 1 INPUT 36 ■ AMORT = displays Int: \$39,097.8616.

### 132. Required annuity payments

Answer: c

#### Answer: d

Answer: c

Answer: c

Enter CFs:  $CF_0 = 0$ ;  $CF_1 = 1.2$ ;  $CF_2 = 1.6$ ;  $CF_3 = 2.0$ ;  $CF_4 = 2.4$ ;  $CF_5 = 2.8$ . I/YR = 10; NPV = \$7.2937 million. \$1 + \$7.2937 = \$8.2937 million. Now, calculate the annual payments: BEGIN mode, N = 5; I/YR = 10; PV = -8.2937; FV = 0; and solve for PMT = \$1.989 million.

#### 133. Required annuity payments

#### Answer: b

Step 1: Work out how much Karen will have saved by age 65: Enter the following inputs in the calculator: N = 41; I/YR = 10; PV = 0; PMT = 5000; and solve for FV = \$2,439,259.

Step 2: Figure the payments Kathy will need to make to have the same
amount saved as Karen:
Enter the following inputs in the calculator:
N = 36; I/YR = 10; PV = 0; FV = 2439259; and solve for PMT =
\$8,154.60.

#### 134. Required annuity payments

#### Answer: c

Step 1: Figure out how much their house will cost when they buy it in
5 years:

Enter the following input data in the calculator:

N = 5; I/YR = 3; PV = -120000; PMT = 0; and solve for FV = \$139,112.89.

This is how much the house will cost.

Step 2: Determine the maximum mortgage they can get, given that the nominal interest rate will be 7%, it is a 360-month mortgage, and the payments will be \$500:

N = 360; I/YR = 7/12 = 0.5833; PMT = -500; FV = 0; and solve for PV = \$75,153.78.

This is the PV of the mortgage (that is, the total amount they can borrow).

Step 3: Determine the down payment needed: House prices are \$139,112.89, and they can borrow only \$75,153.78. This means the down payment will have to be: Down payment = \$139,112.89 - \$75,153.78 = \$63,959.11. This is the amount they will have to save to buy their house. Step 4: Determine how much they need to deposit each year to reach this goal: N = 5; I/YR = 10; PV = -2000; FV = 63959.11; and solve for PMT = \$9,948.75  $\approx$  \$9,949.

#### 135. Required annuity payments

Answer: a

Here's a time line depicting the problem:

25 30 35 40 65 ↓ 10% ↓ ↓ ↓ • • • ↓ PMT 2PMT 3PMT 4PMT FV = 2,000,000

\$2,000,000 = PMT(1.10)<sup>40</sup> + 2PMT(1.10)<sup>35</sup> + 3PMT(1.10)<sup>30</sup> + 4PMT(1.10)<sup>25</sup> \$2,000,000 = 45.259256PMT + 56.204874PMT + 52.348207PMT + 43.338824PMT \$2,000,000 = 197.15116PMT \$10,144.50 = PMT PMT ≈ \$10,145.

#### 136. Monthly vs. quarterly compounding

There are several ways to do this, but the easiest is with the calculator:

- Step 1: Find the effective rate on the account with monthly compounding: NOM% = 5; P/YR = 12; and solve for EFF% = 5.1162%.
- Step 2: Translate the effective rate to a nominal rate based on quarterly compounding: EFF% = 5.1162; P/YR = 4; and solve for NOM% = 5.0209%  $\approx$  5.02%.

#### 137. Effective annual rate

$$EAR_{Qtr} = \left(1 + \frac{0.10}{4}\right) - 1 = 10.38\%.$$
$$EAR_{Dly} = \left(1 + \frac{0.09}{365}\right)^{365} - 1 = 9.42\%.$$

 $(0, 1, 0)^4$ 

Difference = 10.38% - 9.42% = 0.96%.

138. Amortization

Time Line:

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#### Answer: d

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Answer: c

Answer: c



Financial calculator solution: Inputs: N = 30; I/YR = 12; PV = -200000; FV = 0. Output: PMT =  $$24,828.73 \approx $24,829$ .

#### 139. Amortization: repayment of principal

```
Answer: a
```

Given: Loan value = \$100,000; Repayment period = 12 months; Monthly payment = \$9,456.

N = 12; PV = -100000; PMT = 9456; FV = 0; and solve for I/YR = 2.00%  $\times$  12 = 24.00%.

To find the amount of principal paid in the third month (or period), use the calculator's amortization feature. 3 INPUT 3 ■ AMORT = displays Int: \$1,698.84 = displays Prin: \$7,757.16 = displays Bal: \$77,181.86.

#### 140. Amortization: interest paid

#### Answer: c

Enter the following inputs in the calculator: N = 30  $\times$  12 = 360; I/YR = 9/12 = 0.75; PV = -90000; FV = 0; PMT = \$724.16.

Total payments in the first 2 years are  $724.16 \times 24 = 17,379.85$ .

Use the calculator's amortization feature: 12 × 2 = 24 payments 1 INPUT 24 ■ AMORT = displays Int: \$16,092.44.

Percentage of first two years that is interest is: \$16,092.44/\$17,379.85 = 0.9259 = 92.59%.

#### 141. Amortization: repayment of principal

Answer: e

Step 1: Calculate the monthly mortgage payment: Enter the following inputs in the calculator: N = 360; I/YR = 7.25/12 = 0.604167; PV = -135000; FV = 0; and solve for PMT = \$920.9380.

- Step 2: Obtain the amortization schedule for the fourth year (months
  37-48) by using the calculator's amortization feature:
  37 INPUT 48 AMORT
  = displays Int: \$9,428.2512
  = displays Prin: \$1,623.0048.
- Step 3: Calculate the percentage of payments in the fourth year that
  will go towards the repayment of principal:
  \$1,623.0048/(\$920.938 × 12) = 0.1469 = 14.69%.

#### 142. Amortization: remaining mortgage balance

#### Answer: b

- Step 1: Find the monthly mortgage payment by entering the following
  inputs in your calculator:
  N = 360; I/YR = 8/12 = 0.667; PV = -300000; FV = 0; and solve
  for PMT = \$2,201.29.
- Step 2: Calculate the remaining principal balance after 5 years by
  using your financial calculator's amortization feature.
  60 INPUT AMORT
  = displays Int: \$1,903.38
  = displays Prin: \$297.91
  = displays Bal: \$285,209.57.

#### 143. Amortization: remaining loan balance

#### Answer: d

- Step 1: Calculate the common monthly payment using the information you
  know about Jamie's loan:
  N = 48; I/YR = 12/12 = 1; PV = -15000; FV = 0; and solve for
  PMT = \$395.0075.
- Step 2: Calculate how much Jake's car cost using the information you
  know about his loan and the monthly payment solved in Step 1:
  N = 60; I/YR = 12/12 = 1; PMT = -395.0075; FV = 0; and solve
  for PV = \$17,757.5787.
- Step 3: Calculate the balance on Jake's loan at the end of 48 months
   by using the calculator's amortization feature:
   1 INPUT 48 AMORT
   = displays Int: \$5,648.62
   = displays Prin: \$13,311.74
   = displays Bal: \$4,445.84.

#### 144. NPV and non-annual discounting





 $CF_0$  = 0;  $CF_{1\text{-}3}$  = 0;  $CF_{4\text{-}12}$  = -700; I/YR = 0.4167; and solve for NPV = -\$6,094.23.

Therefore, the PV of payments under the proposed lease would be greater than the PV of payments under the old lease by 6,094.23 - 5,840.61 = 253.62. Thus, your net worth would decrease by 253.62.

#### 145. FV of an annuity

Answer: c

- Step 1: The value of what they have saved so far is: Enter the following input data in the calculator: N = 25; I/YR = 12; PV = -20000; PMT = -5000; and solve for FV = \$1,006,670.638.
- Step 2: Deduct the amount to be paid out in 3 years: Enter the following input data in the calculator: N = 3; I/YR = 12; PMT = 0; FV = 150000; and solve for PV = \$106,767.037. The value remaining is \$1,006,670.638 - \$106,767.037 = \$899,903.601.
- Step 3: Determine how much will be in the account on their  $58^{th}$  birthday, after 8 more annual contributions: Enter the following input data in the calculator: N = 8; I/YR = 12; PV = -899903.601; PMT = -5000; and solve for FV = \$2,289,626.64  $\approx$  \$2,289,627.

#### 146. FV of annuity due

First, convert the 9% return with quarterly compounding to an effective rate of 9.308332%. With a financial calculator, NOM% = 9; P/YR = 4; EFF% = 9.308332%. (Don't forget to change P/YR = 4 back to P/YR = 1.) Then calculate the FV of all but the final payment. BEGIN MODE (1 P/YR) N = 9; I/YR = 9.308332; PV = 0; PMT = 1500; and solve for FV = \$21,627.49. You must then add the \$1,500 at t = 9 to find the answer, \$23,127.49.

### 147. Value of missing cash flow

#### Answer: d

Financial calculator solution: Enter the first 4 cash flows, enter I/YR = 15, and solve for NPV = -\$58.945. The future value of \$58.945 will be the required cash flow. N = 4; I/YR = 15; PV = -58.945; PMT = 0; and solve for FV = \$103.10.

#### 148. EAR and FV of annuity

#### Answer: c

First, we must find the appropriate effective rate of interest. Using your calculator enter the following data as inputs as follows: NOM% = 6; P/YR = 12; and solve for EFF% = 6.167781%.

Since the contributions are being made every 6 months, we need to determine the nominal annual rate based on semiannual compounding. Enter the following data in your calculator as follows: EFF% = 6.167781%; P/YR = 2; and solve for NOM% = 6.0755%.

Now, use the periodic rate 6.0755%/2 = 3.037751% to calculate the FV of the annuities due. Now, we must solve for the value of all contributions as of the end of Year 2. Enter the following data inputs in your calculator: N = 4; I/YR = 3.037751; PV = 1000; PMT = 1000; and solve for FV = \$5,313.14.

#### Chapter 2: Time Value of Money

#### Answer: a

So, these contributions will be worth \$5,313.14 as of the end of Year 2. Now, we must find the value of this investment after the eighth year. For this calculation, we can use annual periods and the effective annual rate calculated earlier. Enter the following data as inputs to your calculator: N = 6; I/YR = 6.167781; PV = -5313.14; PMT = 0; and solve for FV =  $$7,608.65 \approx $7,609$ .

#### 149. FV of investment account

#### Answer: b

We need to figure out how much money they would have saved if they didn't pay for the college costs. N = 40; I/YR = 10; PV = 0; PMT = -12000; and solve for FV = \$5,311,110.67.

Now figure out how much they would use for college costs. First get the college costs at one point in time, t = 20, using the cash flow register.  $CF_0 = 58045$ ;  $CF_1 = 62108$ ;  $CF_2 = 66,456 \times 2 = 132912$  (two kids in school);  $CF_3 = 71,108 \times 2 = 142216$ ;  $CF_4 = 76086$ ;  $CF_5 = 81411$ ; I/YR = 10; NPV = \$433,718.02.

The value of the college costs at year t = 20 is \$433,718.02. What we want is to know how much this is at t = 40. N = 20; I/YR = 10; PV = -433718.02; PMT = 0; and solve for FV = \$2,917,837.96.

The amount in the nest egg at t = 40 is the amount saved less the amount spent on college.  $$5,311,110.67 - $2,917,837.96 = $2,393,272.71 \approx $2,393,273.$ 

#### 150. PV of an uneven CF stream

#### Answer: c



Calculate the PV of CFs 4-8 as of time = 3 at i = 5% Inputs:  $CF_0 = 0$ ;  $CF_1 = 200$ ;  $CF_2 = 300$ ;  $N_j = 4$ ; I/YR = 5. Output:  $NPV_3 = \$1,203.60$ .

Calculate PV of the FV of the positive CFs at time = 3 Inputs: N = 3; I/YR = 4; PMT = 0; FV = -1203.60. Output: PV = \$1,070.

Total PV = \$1,070 - \$277.51 = \$792.49.

#### 151. PV of an uneven CF stream

#### Answer: d

Time Line: 0 1 2 i = 6%+100 +100 +100 +100 -6,115.91 -6,727.50 -7,400.25 -8,140.27

-\$8,554.84 PV of health care costs <u>1,082.76</u> PV of parents' savings <u>-\$7,472.08</u> Lump sum government must set aside

Find the present value of parent's savings: N = 18; I/YR = 6; PMT = -100; FV = 0; and solve for PV = \$1,082.76.

Health care costs, Years 19-22:  $-\$1,000(1.1)^{19} = -\$6,115.91; -\$1,000(1.1)^{20} = -\$6,727.50; -\$1,000(1.1)^{21} = -\$7,400.25; -\$1,000(1.1)^{22} = -\$8,140.27.$ 

Find the present value of health care costs:  $CF_0 = 0$ ;  $CF_{1-18} = 0$ ;  $CF_{19} = -6115.91$ ;  $CF_{20} = -6727.50$ ;  $CF_{21} = -7400.25$ ;  $CF_{22} = -8140.27$ ; I/YR = 6; and solve for NPV = -8,554.84 = PV of health care costs.

Consequently, the government must set aside \$8,554.84 - \$1,082.76 = \$7,472.08.

#### 152. Required annuity payments

#### Answer: b

College cost today = \$10,000, Inflation = 5%.  $CF_0 = $10,000 \times (1.05)^5 = $12,762.82 \times 1 = $12,762.82; CF_1 = $10,000 \times (1.05)^6 = $13,400.96 \times 1 = $13,400.96; CF_2 = $10,000 \times (1.05)^7 = $14,071.00 \times 2 = $28,142.00; CF_3 = $10,000 \times (1.05)^8 = $14,774.55 \times 2 = $29,549.10; CF_4 = $10,000 \times (1.05)^9 = $15,513.28 \times 1 = $15,513.28; CF_5 = $10,000 \times (1.05)^{10} = $16,288.95 \times 1 = $16,288.95.$ 

Financial calculator solution: Enter cash flows in CF register; I/YR = 8; solve for NPV = \$95,244.08. Calculate annuity: N = 5; I/YR = 8; PV = -50000; FV = 95244.08; and solve for PMT = \$3,712.15.

#### 153. Required annuity payments

#### Answer: b

- Step 1: Calculate the present value of college costs at t = 16 (Treat t = 16 as Year 0.): Remember, costs are incurred at end of year.  $CF_0 = 25000; CF_1 = 25000; CF_2 = 50000; CF_3 = 50000; CF_4 = 25000;$  $CF_5 = 25000; I/YR = 8;$  and solve for NPV = \$166,097.03.
- Step 2: Calculate the annual required deposit: N = 16; I/YR = 8; PV = 0; FV = -166097.03; then solve for PMT = \$5,477.36.

#### 154. Required annuity payments

#### Answer: c



|         | 3, and $t = 4$ . We find the PV of an annuity due at $t = 2$ as follows:<br>Set calculator to BEGIN mode. Then enter: |  |  |  |  |  |  |
|---------|---|--|--|--|--|--|--|
|         | N = 3; $I/YR$ = 8; PMT = 44100; FV = 0; and solve for PV =  |  |  |  |  |  |  |
|         | \$122, /42. If he has this amount at t = 2, he can receive the  |  |  |  |  |  |  |
|         | 3 retirement payments.  |  |  |  |  |  |  |
| Step 3: | The \$100,000 now on hand will compound at 8% for 2 years:  |  |  |  |  |  |  |
|         | $(1.08)^2 = (1.08)^2$   |  |  |  |  |  |  |
| Step 4: | So, he must save enough each year to accumulate an additional   |  |  |  |  |  |  |
|         | \$122,742 - \$116,640 = \$6,102:  |  |  |  |  |  |  |
|         | Need at $t = 2$ \$122,742   |  |  |  |  |  |  |
|         | Will have ( 116,640)  |  |  |  |  |  |  |
|         | Net additional needed \$ 6,102  |  |  |  |  |  |  |
| Step 5: | He must make 2 payments, at $t = 0$ and at $t = 1$ , such that they   |  |  |  |  |  |  |
|         | will grow to a total of $6,102$ at t = 2.   |  |  |  |  |  |  |
|         | This is the FV of an annuity due found as follows:  |  |  |  |  |  |  |
|         | Set calculator to BEGIN mode. Then enter:   |  |  |  |  |  |  |
|         | N = 2; $I/YR = 8$ ; $PV = 0$ ; $FV = 6102$ ; and solve for PMT = \$2.716.   |  |  |  |  |  |  |

#### 155. Required annuity payments

Calculate the NPV of payments in Years 1-23:  $CF_0 = 0$ ;  $CF_{1-3} = 25$ ;  $CF_{4-23} = 30$ ; I/YR = 8; and solve for NPV = \$298.25. Difference between the security's price and PV of payments: \$360.39 - \$298.25 = \$62.14. Calculate the FV of the difference between the purchase price and PV of payments, Years 1-23: N = 23; I/YR = 8; PV = -62.14; PMT = 0; and solve for FV = \$364.85. Calculate the value of the annuity payments in Years 24-40: N = 17; I/YR = 8; PV = -364.85; FV = 0; and solve for PMT = \$40.

#### 156. Required annuity payments

#### Answer: a

Answer: c

2 3 4 5 6 7 8 | | | | | | | 0 1 12% 1 9 10 11 12 13 + Savings: 5,000 Contrib. 3,000 3,000 3,000 3,000 3,000 PMT PMT PMT PMT PMT PMT College: 24,433 25,655 26,938 28,285 PV college costs = 88,947 Step 1: Determine college costs: College costs will be  $$15,000(1.05)^{10} = $24,433$  at t = 10,  $$15,000(1.05)^{11} = $25,655 \text{ at } t = 11, $15,000(1.05)^{12} = $26,938$ at t = 12, and  $(1.05)^{13} = (28,285)^{13}$  at t = 13. Step 2: Determine PV of college costs at t = 10: Enter the cash flows into the cash flow register as follows: CF<sub>0</sub> = 24433; CF<sub>1</sub> = 25655; CF<sub>2</sub> = 26938; CF<sub>3</sub> = 28285; I/YR = 12;

and solve for NPV = \$88,947.

Step 3: Determine the value of their savings at t = 4 as follows: N = 4; I/YR = 12; PV = 8000; PMT = 3000; and solve for FV = \$26,926.

Step 4: Determine the value of the annual contributions from t = 5
through t = 10:
N = 6; I/YR = 12; PV = -26926; FV = 88947; and solve for PMT =
-\$4,411.

#### 157. Required annuity payments

#### Answer: a



- Step 1: Compound cash flows from birthdays 25, 26, 27, and 28 to 29<sup>th</sup>
  birthday:
   \$25,000(1.12)<sup>4</sup> + \$2,000(1.12)<sup>3</sup> + \$3,000(1.12)<sup>2</sup> + 4,000(1.12) +
   \$5,000(1.12)<sup>0</sup>
   = \$39,337.98 + \$2,809.86 + \$3,763.20 + \$4,480.00 + \$5,000.00
- \$10,132.62. (Remember to add minus sign as this is a withdrawal.)
  Step 3: Subtract the present value of the withdrawal from the compounded
  values of the deposits to obtain the net amount on hand at
  birthday 29 (after the \$20,000 withdrawal is considered):
  \$55,391.04 \$10,132.62 = \$45,258.42.
- Step 4: Solve for the required annuity payment as follows: N = 11; I/YR = 12; PV = -45258.42; FV = 400000; and solve for PMT = \$11,743.95.

#### 158. Required annuity payments

#### Answer: c

Step 1: Convert the 9% monthly rate to an annual rate. Enter NOM% = 9; P/YR = 12; and solve for EFF% = 9.3807%.

- Step 2: Compute the amount accumulated by age 40. Remember to change P/YR from 12 to 1. BEGIN mode. Then, enter N = 15; I/YR = 9.3807; PV = 0; PMT = 2000; and solve for FV = \$66,184.35.
- Step 3: John needs \$3 million in 25 years. Find the PV of this amount today. Remember to change your calculator back from BEGIN to END mode. Enter N = 25; I/YR = 12; FV = 3000000; PMT = 0; and solve for PV = \$176,469.92.
- Step 4: Find the shortfall today, the difference between the present value of what he needs in 25 years and the present value of what he's accumulated today. \$176,469.92 - \$66,184.35 = \$110,285.57.

Step 5: Find the annuity needed to cover this shortfall. Since the contributions begin today this is an annuity due, so the calculator must be set up in BEGIN mode. (Remember to change your calculator back from BEGIN to END mode after working this problem.) BEGIN mode. Then, enter N = 26; I/YR = 12; PV = -110285.57; FV = 0; and solve for PMT = \$12,471.31 ≈ \$12,471.

#### 159. Required annuity payments

Answer: a

- Step 1 Calculate the cost of tuition in each year:  $(1.05)^{15} = (51,973.20) + (25,000)^{16} = (54,571.86 \times 2)^{15}$  $(109, 143.73; (25, 000(1.05))^{17} = (57, 300.46 \times 2) = (114, 600.92;$  $(25,000(1.05)^{18} = 60,165.48 \times 2 = 120,330.96;$   $(25,000(1.05)^{19} = 60,165.48 \times 2)$ \$63,173.75. Step 2 Find the present value of these costs at t = 15:  $CF_0 = 51973.20$ ;  $CF_1 = 109143.73$ ;  $CF_2 = 114600.92$ ;  $CF_3 = 109143.73$ ;  $CF_2 = 114600.92$ ;  $CF_3 = 109143.73$ ;  $CF_3$ 120330.96; CF<sub>4</sub> = 63173.75; I/YR = 12; and solve for NPV = \$366,579.37. Calculate the FV of Grandma's deposits at t = 15: Step 3 Older son: \$10,000(1.12)<sup>18</sup> = \$ 76,899.66 (Deposit was made 3 years ago.) Younger son: \$10,000(1.12)<sup>17</sup> = \$ 68,660.41 (Deposit was made 2 years ago.)  $Total = \frac{$145, 560.07}{}$ Step 4 Calculate net total amount needed at t = 15: \$366,579.37 - \$145,560.07 = \$221,019.30. Step 5 Calculate the annual required deposits:
- N = 15; I/YR = 12; PV = 0; FV = 221019.30; and solve for PMT = -\$5,928.67.

### 160. Required annuity payments

#### Answer: b

Step 1: Find out what the cost of college will be in six years: Enter the following input data in the calculator: N = 6; I/YR = 5; PV = -20000; PMT = 0; and solve for FV = \$26,801.9128.Step 2: Calculate the present value of his college cost: Enter the following input data in the calculator: N = 6; I/YR = 10; PMT = 0; FV = 26801.9128; and solve for PV = \$15,128.98.Step 3: Find the present value today of the \$15,000 that will be withdrawn in two years for the purchase of a used car: Enter the following input data in the calculator: N = 2; I/YR = 10; PMT = 0; FV = 15000; and solve for PV = \$12,396.69. So in total, in today's dollars, he needs \$15,128.98 + \$12,396.69 = \$27,525.67, and his shortfall in today's dollars is \$25,000 - \$27,525.67 = \$2,525.67. Step 4: Find out how much Bob has to save at the end of each year to make up the \$2,525.67: Enter the following input data in the calculator: N = 6; I/YR = 10; PV = -2525.67; FV = 0; and solve for PMT = \$579.9125 ≈ \$580.

#### 161. Required annuity payments

#### Answer: e

We must find the PV of the amount we can sell the car for in 4 years. Enter the following data into your financial calculator: N = 48; I/YR = 1; FV = 6000; PMT = 0; and solve for PV = \$3,721.56.

This means that the total cost of the car, in present value terms is: \$17,000 - \$3,721.56 = \$13,278.44.

Now, we need to find the lease payment that equates to this present value. Enter the following data into your financial calculator: N = 48; I/YR = 1; PV = 13278.44; FV = 0; and solve for PMT = \$349.67.

## 162. Required annuity payments

#### Answer: c

| Here  | is | the | diagram | of | the | proble | em:    |    |       |         |   |
|-------|----|-----|---------|----|-----|--------|--------|----|-------|---------|---|
| 24    |    | 25  |         |    |     | 64     | 65     |    |       | 84      |   |
| 0     | •  | 1   |         |    |     | 40     | 41     |    |       | 60      |   |
|       | 98 |     | • •     | •  |     |        |        |    | • • • |         |   |
| 1,000 | C  | Х   |         |    |     | Х      | -100,0 | 00 |       | -100,00 | 0 |

Step 1: Determine the PV at his 64<sup>th</sup> birthday of the cash outflows from his 65<sup>th</sup> birthday to his 84<sup>th</sup> birthday. Using a financial calculator, enter the following input data: N= 20; I/YR = 9; PMT = -100000; FV = 0; solve PV = \$912,854.57. This is the amount needed in his account on his 64<sup>th</sup> birthday in order to make 20 withdrawals of \$100,000 from his account. Step 2: Determine the required annual payment (deposit) that will

achieve this goal, given the \$1,000 original deposit. Using a financial calculator, enter the following input data: N = 40; I/YR = 9; PV = -1000; FV = 912854.57; solve for PMT = \$2,608.73.

#### 163. Annuity due vs. ordinary annuity

#### Answer: e

There is more than one way to solve this problem.

Step 1: Draw the time line:

|      | 25<br>0 r = | 26<br>12% 1 | 27<br>2 |         | 64<br>39 | 65<br>40               |
|------|-------------|-------------|---------|---------|----------|------------------------|
| Bill | PMT         | PMT         | PMT     | - • • • | PMT      | PMT                    |
| Bob  |             | PMT         | PMT     | PMT     | PMT      | FV = \$3M<br>FV = \$3M |

Step 2: Determine each's annual contribution: <u>Bill</u>: He starts investing today, so use the BEGIN mode of the calculator.

Enter the following input data in the calculator: N = 41; I/YR = 12; PV = 0;  $FV = 3,000,000 \times 1.12 = 3360000$ ; and solve for PMT = \$3,487.79. (The FV is calculated as \$3,360,000 because the annuity will calculate the value to the end of the year, until Bill is a second away from age 66. Therefore, since he wants to have \$3,000,000 by age 65, he would have \$3,000,000 × 1.12 one second before he turns 66.) <u>Bob</u>: He starts investing at the end of this year, so use the END mode of the calculator. Enter the following input data in the calculator: N = 40; I/YR = 12; PV = 0; FV = 3000000; and solve for PMT = \$3,910.88.

Step 3: Determine the difference between the two payments: The difference is \$3,910.88 - \$3,487.79 = \$423.09.

#### 164. Amortization

#### Answer: b

Time Line (in thousands): i = 8% 1 2 3 20 Years \_ \_\_\_\_ \_\_\_\_ -•••—  $PMT_{C} = 80 \qquad 80$  $PMT_{R} \qquad PMT_{R}$ 80 80  $PMT_R \longrightarrow FV = 1,000$ Annual PMT Total = PMT<sub>Coupon</sub> + PMT<sub>Reserve</sub> = \$80,000 + PMT<sub>Reserve</sub>. Financial calculator solution: Long way Inputs: N = 20; I/YR = 8; PV = 0; FV = 1000000. Output: PMT = -\$21,852.21. Add coupon interest and reserve payment together Annual PMT<sub>Total</sub> = \$80,000 + \$21,852.21 = \$101,852.21. Total number of tickets = \$101,852.21/\$10.00 = 10,185.22 ≈ 10,186.\* Short way Inputs: N = 20; I/YR = 8; PV = 1000000; FV = 0.

```
Output: PMT = -$101,852.21.
Total number of tickets = $101,852.21/$10.00 ≈ 10,186.*
```

\*Rounded up to next whole ticket.

#### 165. Effective annual rate

```
Time Line:
                                      24 27 Months
                    12
 0
                                     2 2.25
  0
                    1
        i = ?
                                           ____
-8,000
                                          10,000
Numerical solution:
Step 1: Find the effective annual rate (EAR) of interest on the bank
         deposit:
         EAR_{Daily} = (1 + 0.080944/365)^{365} - 1 = 8.43\%.
         Find the EAR of the investment:
Step 2:
            \$8,000 = \$10,000/(1 + i)^{2.25}
         (1 + i)^{2.25} = 1.25
             1 + i = 1.25^{(1/2.25)}
             1 + i = 1.10426
                 i = 0.10426 ≈ 10.43%
Step 3: Difference = 10.43% - 8.43% = 2.0%.
```

Financial calculator solution: Calculate  $EAR_{Daily}$  using interest rate conversion feature Inputs: P/YR = 365; NOM% = 8.0944. Output: EFF% = EAR = 8.43%.

Calculate EAR of the equal risk investment Inputs: N = 2.25; PV = -8000; PMT = 0; FV = 10000. Output: I/YR = 10.4259  $\approx$  10.43%. Difference: 10.43% - 8.43% = 2.0%.

#### 166. PMT and quarterly compounding

#### Answer: b

| 0 1  | 80   | 81 | 82 | 83 | 84  | 85 |         | 115 | 116 Qtrs |
|------|------|----|----|----|-----|----|---------|-----|----------|
| +100 | +100 |    |    |    |     |    | - • • • |     |          |
| 1400 | PMT  | 0  | 0  | 0  | PMT | 0  |         | 0   | PMT      |

Find the FV at t = 80 of \$400 quarterly payments: N = 80; I/YR = 2; PV = 0; PMT = 400; and solve for FV = \$77,508.78.

Find the EAR of 8%, compounded quarterly, so you can determine the value of each of the receipts: EAR =  $\left(1 + \frac{0.08}{4}\right)^4$  - 1 = 8.2432%.

Now, determine the value of each of the receipts, remembering that this is an annuity due. Put the calculator in BEGIN mode and enter the following input data in the calculator: N = 10; I/YR = 8.2432; PV = -77508.78; FV = 0; and solve for PMT = \$10,788.78  $\approx$  \$10,789.

#### 167. Value of unknown withdrawal

#### Answer: d

- Find out how much Steve and Robert have in their accounts today: Step 1: You can get this from analyzing Steve's account. END mode: N = 9; I/YR = 6; PV = -5000; PMT = -5000; and solve for FV = \$65,903.9747. Alternatively, BEGIN mode: N = 9; I/YR = 6; PV = 0; PMT = -5000; and solve for FV = \$60,903.9747. Then add the \$5,000 for the last payment to get a total of \$65,903.9747. This is also the value of Robert's account today. Step 2: Find out how much Robert would have had if he had never withdrawn anything: END mode: N = 9; I/YR = 12; PV = -5000; PMT = -5000; and solve for FV = \$87,743.6753. Alternatively, BEGIN mode: N = 9; I/YR = 12; PV = 0; PMT = -5000; and solve for FV = \$82,743.6753. Then add the \$5,000 for the last payment to get a total of \$87,743.6753. Step 3: Find the difference in the value of Robert's account due to the withdrawal made:
  - However, since he took money out at age 27, he has only \$65,903.9747. The difference between what he has and what he would have had is:

\$87,743.6753 - \$65,903.9747 = \$21,839.7006.

Step 4: Determine the amount of Robert's withdrawal by discounting the value found in Step 3: N = 3; I/YR = 12; PMT = 0; FV = -21839.7006; then solve for PV = \$15,545.0675  $\approx$  \$15,545.07.

#### 168. Non-annual compounding

#### Answer: a

To compare these alternatives, find the present value of each strategy and select the option with the highest present value.

Option 1 can be valued as an annuity due. Enter the following input data in the calculator: BEGIN mode (to indicate payments will be received at the start of the period) N = 12; I/YR = 12/12 = 1; PMT = -1000; FV = 0; and solve for PV = \$11,367.63.

Option 2 can be valued as a lump sum payment to be received in the future. Enter the following input data in the calculator: END mode (to indicate the lump sum will be received at the end of the year) N = 2; I/YR = 12/2 = 6; PMT = 0; FV = -12750; and solve for PV = \$11,347.45. Option 3 can be valued as a series of uneven cash flows. The cash flows at the end of each period are calculated as follows:  $CF_0 = \$0.00; CF_1 = \$800.00; CF_2 = \$800.00(1.20) = \$960.00; CF_3 = \$960.00$  $(1.20) = \$1,152.00; CF_4 = \$1,152.00(1.20) = \$1,382.40; CF_5 = \$1,382.40$  $(1.20) = \$1,658.88; CF_6 = \$1,658.88(1.20) = \$1,990.66; CF_7 = \$1,990.66$  $(1.20) = $2,388.79; CF_8 = $2,388.79(1.20) = $2,866.54.$ 

To find the present value of this cash flow stream using your financial calculator enter: END mode (to indicate the cash flows will occur at the end of each period) 0 CF<sub>i</sub>; 800 CF<sub>i</sub>; 960 CF<sub>i</sub>; 1152 CF<sub>i</sub>; 1382.40 CF<sub>i</sub>; 1658.88 CF<sub>i</sub>; 1990.66 CF<sub>i</sub>; 2388.79 CF<sub>i</sub>; 2866.54 CF<sub>i</sub> (to enter the cash flows); I/YR = 12/4 = 3; solve for NPV = \$11,267.37.

Choose the alternative with the highest present value, and hence select Choice 1 (Answer a).

#### 169. Breakeven annuity payment

### Step 1: Calculate the NPV of purchasing the car by entering the following data in your financial calculator:

 $CF_0 = -17000$ ;  $CF_{1-47} = 0$ ;  $CF_{48} = 7000$ ; I/YR = 6/12 = 0.5; and solve for NPV = -\$11,490.31.

Now, use the NPV calculated in Step 1 to determine the breakeven Step 2: lease payment that will cause the two NPVs to be equal. Enter the following data in your financial calculator:

> N = 48; I/YR = 0.5; PV = -11490.31; FV = 0; and solve for PMT = \$269.85.

#### 170. Required mortgage payment

Just enter the following data into your calculator and solve for the monthly mortgage payment.

N = 360; I/YR = 7/12 = 0.583333; PV = -115000; FV = 0; and solve for PMT= \$765.0979 ≈ \$765.10.

#### 171. Remaining mortgage balance

With the data still input into your calculator, press 1 INPUT 60 🔳 AMORT = displays Interest: \$39,157.2003 = displays Principal: \$6,748.6737 = displays Balance: \$108,251.3263

#### 172. Time to accumulate a lump sum

You must solve this time value of money problem for N (number of years) by entering the following data in your calculator:

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# Answer: b

Answer: a

# Answer: e

Answer: d
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# I/YR = 10; PV = -2000; PMT = -1000; FV = 1000000; and solve for N = 46.51.

Because there is a fraction of a year and the problem asks for whole years, we must round up to the next year. Hence, the answer is 47 years.

#### 173. Required annual rate of return

Now, the time value of money problem has been modified to solve for I/YR. Enter the following data in your calculator: N = 39; PV = -2000; PMT = -1000; FV = 1000000; and solve for I/YR = 12.57%.

#### 174. Monthly mortgage payments

Enter the following data as inputs in your calculator: N= $30\times12 = 360$ ; I/YR=7.2/12=0.60; PV=-100000; FV=0; solve PMT = \$678.79.

#### 175. Amortization

Determine the mortgage payment, then input:

- 1 INPUT 36 AMORT
- = Interest: \$21,280.8867
- = Principal: \$3,155.4885
- = Balance: \$96,844.5115.

The percentage that goes to principal =  $\frac{\$3,155.49}{36 \times \$678.79} = \frac{\$3,155.49}{\$24,436.44} = 12.91\%$ .

#### 176. Monthly mortgage payments

Using your financial calculator, enter the following data inputs: N = 180; I/YR = 7.75/12 = 0.645833; PV = -165000; FV = 0; and solve for PMT =  $$1,553.104993 \approx $1,553.10$ .

#### 177. Remaining mortgage balance

The complete solution looks like this:

| Beginning | Mortgage     |            |            | Ending           |
|-----------|--------------|------------|------------|------------------|
| of Period | Balance      | Payment    | Interest   | Mortgage Balance |
| 1         | \$165,000.00 | \$1,553.10 | \$1,065.63 | \$164,512.52     |
| 2         | 164,512.52   | 1,553.10   | 1,062.48   | 164,021.89       |
| 3         | 164,021.89   | 1,553.10   | 1,059.31   | 163,528.09       |
| 4         | 163,528.09   | 1,553.10   | 1,056.12   | 163,031.11       |
| 5         | 163,031.11   | 1,553.10   | 1,052.91   | 162,530.91       |
| 6         | 162,530.91   | 1,553.10   | 1,049.68   | 162,027.49       |
| 7         | 162,027.49   | 1,553.10   | 1,046.43   | 161,520.81       |
| 8         | 161,520.81   | 1,553.10   | 1,043.16   | 161,010.86       |

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#### Answer: c

#### Answer: d

# Answer: c

Answer: d

Answer: c

| 9  | 161,010.86 | 1,553.10 | 1,039.86 | 160,497.62 |
|----|------------|----------|----------|------------|
| 10 | 160,497.62 | 1,553.10 | 1,036.55 | 159,981.06 |
| 11 | 159,981.06 | 1,553.10 | 1,033.21 | 159,461.16 |
| 12 | 159,461.16 | 1,553.10 | 1,029.85 | 158,937.91 |

Alternatively, using your financial calculator, do the following (with the data still entered from the previous problem):

1 INPUT 12 ■ AMORT = Interest: \$12,575.172755 = Principal: \$6,062.087161 = Balance: \$158,937.912839

# 178. Amortization

#### Answer: d

Step 1: Find the monthly payment:

N=360; I/YR=8/12=0.6667; PV=75000; FV=0; solve PMT = \$550.3234.

- Step 2: Calculate value of monthly payments for the first year:
- Total payments in the first year =  $$550.3234 \times 12 = $6,603.8812$ . Step 3: Determine amount of interest during first year:
  - 1 INPUT 12 🔳 AMORT
    - = Interest: \$5,977.3581
  - = Principal: \$626.5227
  - = Balance: \$74,373.4773
- Step 4: Calculate the percentage that goes towards interest: \$5,977.3581/\$6,603.8812 = 0.9051, or 90.51%.

# 179. Amortization

#### Answer: a

Step 1: Calculate old monthly payment:

N = 360; I/YR = 8/12 = 0.6667; PV = 75000; FV = 0; and solve for PMT = \$550.3234.

Step 2: Calculate new monthly payment:

N = 360; I/YR = 7/12 = 0.5833; PV = 75000; FV = 0; and solve for PMT = \$498.9769.

Step 3: Calculate the difference between the 2 mortgage payments:

This represents a savings of (\$550.3234 - \$498.9769) = \$51.3465 ≈ \$51.35.

180. Monthly mortgage payment Enter the following data in your calculator:

# Answer: c

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N = 360; I/YR = 7.2/12 = 0.60; PV = 300000; FV = 0; and solve for PMT = \$2,036.3646  $\approx$  \$2,036.36.

# 181. Amortization

Answer: b

Using a financial calculator and the above information: 1 INPUT 12 ■ AMORT = Interest: \$21,504.5022 = Principal: \$2,931.8730 = Balance: \$297,068.1270

The percent paid toward principal = \$2,931.87/(\$2,931.87 + \$21,504.50) = 12%.

# **WEB APPENDIX 2A SOLUTIONS**

| 2A-1. | PV continuous compounding   | g  | Answer: b             | EASY | MEDIUM |
|-------|---|--|-----------------------|------|--------|
|       | $PV = FV_n/e^{in} = $100,000/e^{in}$  | 0.09(6) = \$100,000/1.7160 =                                     | = \$58,275.           |      |        |
| 2A-2. | FV continuous compounding   | g  | Answei                | r: a | MEDIUM |
|       | Daily compounding:<br>$FV_2 = PV (1 + 0.06/365)^{363}$<br>Continuous compounding: | <sup>5(2)</sup> = \$1,000(1.12749) =                             | \$1,127.49            |      |        |
|       | FV <sub>2</sub> = PVe <sup>in</sup> = \$1,000(e <sup>0.059</sup><br>Diff          | <sup>(2)</sup> ) = \$1,000(1.12524) =<br>erence between accounts | \$1,125.24<br>\$ 2.25 |      |        |
| 2A-3. | Continuous compounding  |  | Answe                 | r: b | MEDIUM |

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10 Years 0 i = e<sup>0.10</sup> 1 . . . . . . PV = ?FV = 5,438Numerical solution: (Constant e = 2.7183 rounded.)  $$5,438 = PVe^{0.10(10)}$  $$5,438 = PVe^{1}$ PV = \$5,438/e= \$5,438/2.7183 = \$2,000.52  $\approx$  \$2,000. Financial calculator solution: Use ex exponential key on calculator. Calculate EAR with continuous compounding. Inputs: X = 0.10; press  $e^x$  key. Output:  $e^{x} = 1.1052$ . EAR = 1.1052 - 1.0 = 0.1052 = 10.52%. Calculate PV of FV discounted continuously Inputs: N=10; I/YR=10.52; PMT=0; FV=5438. Output: PV=-\$2,000. 2A-4. Continuous compounded interest rate Answer: a MEDIUM/HARD Calculate the growth factor using PV and FV which are given:  $FV_n = PV e^{in}; $19,000 = $14,014 e^{i4}$  $e^{i4} = 1.35579.$ Take the natural logarithm of both sides: i(4) ln e = ln 1.35579. The natural log of e = 1.0. Inputs: 1.35579. Press LN key. Output: LN = 0.30438.  $i(4) \ln e = \ln 1.35579$ i(4) = 0.30438i = 0.0761 = 7.61%. 2A-5. Payment and continuous compounding Answer: d MEDIUM/HARD  $0 I_c = e^{0.07} 1$ 2 3 Years 6-months 6 I<sub>s</sub> = 4% 2 4 Periods \_ Account with continuous  $FV_c = ? = 1,233.70$ compounding -1,000 Account with semiannual compounding  $PV_s = ?$  $FV_s = ? = 1,233.70$ Step 1: Calculate the FV of the \$1,000 deposit at 7% with continuous compounding: Using ex key: Inputs: X = 0.21; press e<sup>x</sup> key. Output: e<sup>x</sup> = 1.2337.

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 $FV_n = \$1,000 e^{0.07(3)} = \$1,000(1.2337) = \$1,233.70.$ 

Step 2: Calculate the PV or initial deposit: Inputs: N = 6; I/YR = 4; PMT = 0; FV = 1233.70. Output: PV = -\$975.01.

#### 2A-6. Continuous compounding

Answer: d MEDIUM/HARD

Numerical solution:  

$$e^{(0.04)(10)} = \left(1 + \frac{i}{2}\right)^{20}$$
  
 $e^{0.4} = \left(1 + \frac{i}{2}\right)^{20}$   
 $e^{0.02} = 1 + \frac{i}{2}$   
 $1.0202 = 1 + \frac{i}{2}$   
 $\frac{i}{2} = 0.0202$   
 $i = 0.0404 = 4.04\%$ .

Answer: b MEDIUM/HARD 2A-7. Continuous compounding Time Line: 10 Years 0 i = 10.52% 1 2 -I----••• – \_ PV = ? FV = 1,000Numerical solution:  $\$1,000 = PVe^{0.10(10)} = PVe^{1.0}$  $PV = \$1,000/e = \$1,000/2.7183 = \$367.88 \approx \$368.$ Financial calculator solution: Use e<sup>x</sup> exponential key on calculator. Calculate EAR with continuous compounding. Inputs: X = 0.10; press e<sup>x</sup> key. Output: e<sup>x</sup> = 1.1052.

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EAR = 1.1052 - 1.0 = 0.1052 = 10.52%.

Calculate PV of FV discounting at the EAR: Inputs: N = 10; I/YR = 10.52; PMT = 0; FV = 1000. Output: PV =  $-$367.78 \approx $368$ .

# 2A-8. Continuous compounding

Answer: b HARD

Time Line: 0 i = 5.127% 1 2 20 Years PV = -15,000 FV = ?

Numerical solution:  $FV_{20} = $15,000e^{0.05(20)} = $40,774.23 \approx $40,774.$ 

Financial calculator solution: (Note: We carry the EAR to 5 decimal places for greater precision in order to come closer to the correct exponential solution.) Inputs: X = 0.05; press e<sup>x</sup> key. Output: e<sup>x</sup> = 1.05127. EAR = 1.05127 - 1.0 = 0.05127 = 5.127%.

```
Calculate FV compounded continuously at EAR = 5.127%
Inputs: N = 20; I/YR = 5.127; PV = -15000; PMT = 0.
Output: FV = $40,773.38 \approx $40,774.
```