## CHAPTER 2 <br> 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

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FV of a lump sum
Answer: a EASY
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
Answer: C EASY
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
Answer: e EASY
3. A company's 2005 sales were $100 million. If sales grow at 8% per year,
    how large will they be }10\mathrm{ years later, in 2015, in millions?
    a. $190.49
    b. $225.54
    c. $188.32
    d. $201.15
    e. $215.89
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FV of a lump sum
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FV of a lump sum
Answer: b EASY
Answer: b EASY
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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5. Suppose a U.S. government bond promises to pay \(\$ 2,249.73\) three years from 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. \(\$ 1,888.92\)
e. \(\$ 2,854.13\)

PV of a lump sum Answer: a EASY
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 Answer: C EASY
7. Suppose a U.S. government bond will pay \(\$ 1,000\) three years from now. 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
Answer: e EASY
8. The U.S. Treasury offers to sell you a bond for \(\$ 613.81\). No payments will 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. \(5.00 \%\)

\section*{Simple growth rate}

Answer: b EASY
9. Sims Inc. earned \(\$ 1.00\) per share in 2000. Five years later, in 2005, it 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. \(13.61 \%\)
d. \(14.28 \%\)
e. \(12.17 \%\)

Number of periods
Answer: e EASY
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
Answer: a EASY
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

FV of an ordinary annuity
Answer: C EASY
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 5 th deposit, 5 years from now?
a. \$14,764.40
b. \(\$ 13,431.83\)
c. \(\$ 16,911.28\)
d. \(\$ 17,843.15\)
e. \(\$ 15,119.76\)
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
Answer: b EASY
14. You want to buy a condo 5 years from now, and you plan to save \(\$ 3,000\) per year, beginning immediately. 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
Answer: d EASY
15. You want to go to grad school 3 years from now, and you can save \(\$ 5,000\) per year, beginning immediately. 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
Answer: a EASY
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. \(\$ 15,119.76\)
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
Answer: e EASY
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 Answer: b EASY
19. What is the PV of an annuity due 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
Answer: d EASY
20. You have a chance to buy an annuity that pays \(\$ 1,000\) at the beginning 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. \(\$ 5,011.87\)
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 immediately. 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
Answer: C EASY
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
Answer: e EASY
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
Answer: b EASY
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 beginning 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. \(\$ 45,119.76\)
25. Suppose you inherited \(\$ 200,000\) and invested it at \(6 \%\) per year. How much 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 Answer: a EASY
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
Answer: C EASY
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 Answer: e EASY
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. \(4.22 \%\)
29. Your girlfriend just won the Power Ball lottery. She has the choice of \(\$ 10,000,000\) 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
Answer: d EASY
30. Assume that you own an annuity that will pay you \(\$ 10,000\) per year for 10 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
Answer: a EASY
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
Answer: C EASY
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. \(\$ 4,854.13\)
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 Answer: b EASY
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 Answer: d EASY
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
Answer: a EASY
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
Answer: C EASY/MEDIUM
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
e. \$9,854.13

FV of a lump sum, semiannually
Answer: e EASY/MEDIUM
38. What's the future value of \(\$ 2,000\) after 3 years if the appropriate interest rate is \(8 \%\), compounded semiannually?
a. \$2,854.13
b. \$2,781.45
c. \(\$ 2,324.89\)
d. \(\$ 2,011.87\)
e. \(\$ 2,530.64\)

PV of a lump sum, semiannually Answer: b EASY/MEDIUM
39. What's the present value of \(\$ 2,000\) discounted back 3 years if the appropriate interest rate is 8\%, compounded semiannually?
a. \$1,110. 34
b. \$1,580.63
c. \(\$ 1,413.68\)
d. \$1,976.84
e. \$1,349.15

FV of an uneven cash flow stream
Answer: d MEDIUM
40. At a rate of \(8 \%\), what is the future 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. \$907.91
b. \(\$ 991.43\)
c. \(\$ 943.46\)
d. \(\$ 975.89\)
e. \(\$ 968.40\)

Interest rate built into an uneven cash flow stream
Answer: a MEDIUM
41. An investment costs \(\$ 1,000(C F\) 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 5 th year. What is the expected rate of return on this investment?
a. \(5.0 \%\)
b. \(6.7 \%\)
c. \(7.1 \%\)
d. \(5.5 \%\)
e. \(5.9 \%\)

Interest rate built into an uneven cash flow stream Answer: c MEDIUM
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
Answer: e MEDIUM
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
Answer: b MEDIUM
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
Answer: d MEDIUM
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
Answer: a MEDIUM
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\%
e. \(5.91 \%\)

Interest charges, simple interest
Answer: C MEDIUM
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
Answer: e MEDIUM
48. Suppose you deposited \(\$ 5,000\) in a bank account that pays \(6 \%\) with daily 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 Answer: b MEDIUM
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
Answer: d MEDIUM
50. 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 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. \(\$ 2,854.13\)

\section*{Comparing the effective cost of two bank loans}

Answer: a MEDIUM
51. Bank \(A\) offers to lend you \(\$ 10,000\) at a nominal rate of \(7 \%\), compounded 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
Answer: c MEDIUM
52. You are buying your first house for \(\$ 220,000\), and are paying \(\$ 30,000\) as a 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
Answer: e MEDIUM/HARD
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
Answer: b MEDIUM/HARD
54. 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 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

\section*{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. \(\$ 83,049\)

\section*{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 years
b. 14 years
c. 15 years
d. 17 years
e. 13 years

\section*{Comparing the effective cost of two bank loans}

Answer: e MEDIUM/HARD
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. \(0.83 \%\)

\section*{Retirement planning}

\section*{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 25 th 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 46 th 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 \(T\) om 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 \(T\) om on January 1, 2045, when they reach age 70?
a. \$6,110
b. \(\$ 6,492\)
c. \(\$ 7,513\)
d. \(\$ 5,976\)
e. \(\$ 8,349\)

\section*{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. \(\$ 128,349\)

\section*{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. \(\$ 15,119.76\)

\section*{Saving for college}

Answer: c HARD
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 Answer: e HARD
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 Answer: b HARD
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. \(91.70 \%\)

\section*{Multiple Choice: Conceptual}
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
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 \(30-y e a r\) 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
Answer: c EASY
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 \(P V\) of a 5-year, \(\$ 200\) ordinary annuity.
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).

\section*{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.

\section*{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.

\section*{Quarterly compounding}
71. Your bank account pays an \(8 \%\) nominal rate of interest. The interest is compounded quarterly. Which of the following statements is CORRECT?
a. The periodic rate of interest is \(2 \%\) and the effective rate of interest is \(4 \%\).
b. The periodic rate of interest is \(8 \%\) and the effective rate of interest is greater than \(8 \%\).
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\%.

\section*{Annuities}

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.
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.

\section*{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.

\section*{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.

\section*{Time value concepts}

Answer: d MEDIUM
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.

\section*{PART II - Questions and Problems from Prior Test Bank not used in Part I}

\section*{Multiple Choice: Problems}

\section*{EASY (\#77 through \#86)}

\section*{Growth rate}

Answer: d
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
Answer: b
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\%
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 years
b. 15 years
c. 18 years
d. 20 years
e. 23 years

Time for a sum to double
Answer: d
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. \(\quad 9.50\)
d. 9.93
e. 10.25

Time for lump sum to grow
Answer: e
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
Answer: c
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. \(\$ 318.71\)
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

\section*{PV of an annuity}

Answer: a
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
Answer: c
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
Answer: b
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

\section*{EASY/MEDIUM (\#87 through \#94)}
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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

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PV of an uneven CF stream

Answer: b
88. A real estate investment has the following expected cash flows:
\begin{tabular}{cc}
\(\frac{\text { Year }}{1}\) & Cash Flows \\
2 & \(\$ 10,000\) \\
3 & 25,000 \\
4 & 50,000 \\
& 35,000
\end{tabular}

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
Answer: c
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\%
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
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 \(C D\) that pays \(10 \%\) semiannually.
e. A bank CD that pays \(9.6 \%\) daily (on a 365 -day basis).

\section*{Effective annual rate}

Answer: b
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
Answer: a
93. Which one of the following investments provides the highest effective rate of return?
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.
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
Answer: a
95. Today is your 23rd 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 th 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 \(65^{\text {th }}\) 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
Answer: a
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 \(2 \frac{1}{2}\) years ( 30 months)?
a. \$ 6,617.77
b. \$ 502.50
c. \(\$ 6,594.88\)
d. \(\$ 22,656.74\)
e. \$ 5,232.43
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 23rd 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 \(42^{\text {nd }}\) and final contribution will take place on her \(64^{\text {th }}\) 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 th birthday?
a. \$ 985,704
b. \(\$ 1,034,489\)
c. \(\$ 1,085,274\)
d. \$1,139,038
e. \$1,254,041

\section*{Time value of money and retirement}

Answer: b
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
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 20th 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 21st birthday. Your 45th and final \(\$ 500\) contribution will occur on your 65 th birthday. You plan to withdraw \(\$ 5,000\) from the account five years from now on your 25 th 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 th 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 \(65^{\text {th }}\) 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. \(\$ 26,350\)

\section*{FV of annuity due}

Answer: e
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 th, and final, contribution will be made on your \(65^{\text {th }}\) birthday. If you earn 10\% a year on your investments, how much money will you have in the account on your 65th 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
Answer: e
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
Answer: d
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
Answer: a
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
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
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. \(\$ 44,873.90\)

\section*{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
Answer: b
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
Answer: c
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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e. \$2,437.56

Answer: a
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 years
b. 10 years
c. 18 years
d. 7 years
e. 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. \(\$ 20,000\)
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
Answer: a
121. What is the present value of the following cash flows, if the discount rate is \(12 \%\) ?

a. \(\$ 3,277\)
b. \$4, 804
c. \(\$ 5,302\)
d. \(\$ 4,289\)
e. \(\$ 2,804\)

PV of uncertain cash flows
Answer: e
122. A 3-year project has the following probability distributions for possible end-of-year cash flows in each of the next three years:
\begin{tabular}{|c|c|c|c|c|c|}
\hline \multicolumn{2}{|r|}{Year 1} & \multicolumn{2}{|r|}{Year 2} & \multicolumn{2}{|r|}{Year 3} \\
\hline Prob & Cash Flow & Prob & Cash Flow & Prob & Cash Flow \\
\hline 0.30 & \$300 & 0.15 & \$100 & 0.25 & \$200 \\
\hline 0.40 & 500 & 0.35 & 200 & 0.75 & 800 \\
\hline 0.30 & 700 & 0.35 & 600 & & \\
\hline & & 0.15 & 900 & & \\
\hline
\end{tabular}

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. \(\$ 1,347.61\)
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

\section*{Effective annual rate}

Answer: b
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 \(12^{\text {th }}\) 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. \(1.00 \%\)
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
Answer: b
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
Answer: a
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 \(30^{\text {th }}\) payment?
a. \$ 8,611.17
b. \$ 8,363.62
c. \(\$ 14,515.50\)
d. \$ 8,637.38
e. \$ 7,599.03

Remaining mortgage balance
Answer: C
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. \(\$ 212,386\)
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

\section*{Amortization}

Answer: c
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. \(\$ 44,589.11\)

\section*{Required annuity payments}

Answer: c
132. A baseball player is offered a 5-year contract that pays him the following amounts at the end of each year:
\[
\begin{array}{rr}
\text { Year 1: } & \$ 1.2 \text { million } \\
\text { Year 2: } & 1.6 \text { million } \\
\text { Year 3: } & 2.0 \text { million } \\
\text { Year 4: } & 2.4 \text { million } \\
\text { Year 5: } & 2.8 \text { million }
\end{array}
\]

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. \(\$ 2.500\)
133. Karen and her twin sister, Kathy, are celebrating their 30 th birthday today. Karen has been saving for her retirement ever since their 25 th birthday. On their \(25^{\text {th }}\) 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 \(65^{\text {th }}\) 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 \(36^{\text {th }}\), and final, contribution will occur on their 65 th 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

\section*{Required annuity payments}

Answer: C
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 \(3 \%\) y 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. \(\$ 34,569\)

Answer: a
135. Today is your \(25^{\text {th }}\) 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. \(\$ 11,160\)

\section*{Monthly vs. quarterly compounding}

Answer: c
136. The First National Bank offers a 5\% nominal interest rate, compounded 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
Answer: d
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. \(1.25 \%\)
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. \(\$ 50,212\)
e. \(\$ 6,667\)

Amortization: repayment of principal
Answer: a
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
Answer: C
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
Answer: e
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. \(14.69 \%\)
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
Answer: d
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
Answer: b
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. \(+\$ 509.81\)
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 th 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 th birthday and the \(25^{\text {th }}\) contribution was made today on their 50 th 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 58th 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 th 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. \(\$ 2,345,546\)

\section*{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. \(\$ 19,785.76\)
147. Foster Industries has a project that has the following cash flows:

e. \$150.75

\section*{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
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 \(25^{\text {th }}\) 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:
\begin{tabular}{ccc} 
Year & Cost per child & \begin{tabular}{c} 
Children in college \\
20
\end{tabular} \\
21 & 62,045 & Dick \\
22 & 66,456 & Dick \\
23 & 71,108 & Dick and Jane \\
24 & 76,086 & Dick and Jane \\
25 & 81,411 & Jane \\
& & Jane
\end{tabular}

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 \(4^{\text {th }}\) 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

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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 \(\$ 100 / y e a r ~ s a v i n g s ~ w i l l ~ s t o p ~ t h e ~ d a y ~ t h e ~ c h i l d ~ e n t e r s ~\) 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
Answer: b
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. \(\$ 6,750\)
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

\section*{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. \(\$ 6,102\)

\section*{Required annuity payments}

Answer: c
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

\section*{HARD (\#156 through \#169)}

\section*{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. \(\$ 6,798\)
157. Today is Rachel's 30th birthday. Five years ago, Rachel opened a brokerage account when her grandmother gave her \(\$ 25,000\) for her 25 th birthday. Rachel added \(\$ 2,000\) to this account on her 26 th birthday, \(\$ 3,000\) on her \(27^{\text {th }}\) birthday, \(\$ 4,000\) on her \(28^{\text {th }}\) birthday, and \(\$ 5,000\) on her 29th birthday. Rachel's goal is to have \(\$ 400,000\) in the account by her 40 th 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 th birthday. Complicating things somewhat is the fact that Rachel plans to withdraw \(\$ 20,000\) from the account on her 35 th 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. \(\$ 9,485.67\)

\section*{Required annuity payments}

Answer: c
158. John is saving for his retirement. Today is his 40 th birthday. John first started saving when he was 25 years old. On his \(25^{\text {th }}\) 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 \(15^{\text {th }}\) (and last) contribution was made last year on his 39th 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 \(65^{\text {th }}\) 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. \(\$ 15,572\)

\section*{Required annuity payments}

Answer: a
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 31st (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. \(\$ 3,994\)
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 occur 48 months from now ( \(t=48\) ). If you buy the car, you 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. \(\$ 349.67\)

\section*{Required annuity payments}

Answer: c
162. Today is Craig's 24 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 \(\$ \mathrm{X}\) into the account each year on his subsequent birthdays until the age of 64 . In other words, Craig plans to make 40 contributions of \(\$ \mathrm{X}\). The first contribution will be made one year from now on his \(25^{\text {th }}\) birthday, and the 40th (and final) contribution will occur on his 64th 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 th birthday and the final one will occur on his 84th 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. \(\$ 2,786.98\)
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 ( \(t=0,1,2, \ldots 40\) ), 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. \(\$ 423.09\)

\section*{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

\section*{Effective annual rate}

Answer: c
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. \(0.44 \%\)

\section*{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
Answer: d
167. Steve and Robert were college roommates, and each is celebrating their 30th birthday today. When they graduated from college nine years ago (on their \(21^{\text {st }}\) 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 (22nd through 30th birthdays). Steve has withdrawn nothing from the account, but Robert made one withdrawal on his 27 th 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 th birthday?
a. \$ 7,832.22
b. \$ 8,879.52
c. \$10,865.11
d. \(\$ 15,545.07\)
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.

\section*{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

\section*{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.

\section*{Required mortgage payment}

Answer: b
170. What is the monthly payment on the mortgage?
a. \$760.66
b. \(\$ 765.10\)
c. \(\$ 772.29\)
d. \(\$ 774.10\)
e. \(\$ 776.89\)

\section*{Remaining mortgage balance}

Answer: e
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 \(21^{\text {st }}\) 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 \(22^{\text {nd }}\) birthday.

Time to accumulate a lump sum
Answer: d
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
Answer: c
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. \(12.66 \%\)
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
Answer: c
174. What is the monthly payment on the mortgage?
a. \(\$ 639.08\)
b. \(\$ 674.74\)
c. \(\$ 678.79\)
d. \(\$ 685.10\)
e. \$691. 32

\section*{Amortization}

Answer: d
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
Answer: d
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

\section*{Remaining mortgage balance}

Answer: c
177. What will be the remaining balance on the mortgage after one year (right after the \(12^{\text {th }}\) payment has been made)?
a. \(\$ 152,879.31\)
b. \(\$ 155,362.50\)
c. \(\$ 158,937.91\)
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.

\section*{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. \(82.17 \%\)
d. \(90.51 \%\)
e. \(91.31 \%\)

\section*{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
Answer: c
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
Answer: b
181. What percentage of the total payments the first year (the first twelve months) will go towards repayment of principal?
a. \(11.88 \%\)
b. \(12.00 \%\)
c. \(13.21 \%\)
d. \(13.55 \%\)
e. \(14.16 \%\)

\section*{Web Appendix 2A}

\section*{Multiple Choice: Problems}
```

PV continuous compounding
Answer: b EASY/MEDIUM
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

Answer: a MEDIUM
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
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

2A-4. In order to purchase your first home you need a down payment of \(\$ 19,000\) 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
Answer: d MEDIUM/HARD
2A-5. You place \(\$ 1,000\) in an account that pays \(7 \%\) interest compounded 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
2A-6. For a 10 -year deposit, what annual rate payable semiannually will 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
2A-7. How much should you be willing to pay for an account today that will 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
```

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

```
1. FV of a lump sum
\begin{tabular}{lr} 
N & \(\mathbf{5}\) \\
I/YR & \(\mathbf{1 0 \%}\) \\
PV & \(\mathbf{- \$ 1 0 0}\) \\
PMT & \(\mathbf{\$ 0}\) \\
\hline FV & \(\mathbf{\$ 1 6 1 . 0 5}\) \\
\hline
\end{tabular}
2. FV of a lump sum
\begin{tabular}{lr} 
N & \(\mathbf{3}\) \\
I/YR & \(\mathbf{4 \%}\) \\
PV & \(\mathbf{- \$ 2 , 0 0 0}\) \\
PMT & \(\mathbf{\$ 0}\) \\
\hline FV & \(\mathbf{\$ 2 , 2 4 9 . 7 3}\) \\
\hline
\end{tabular}
3. FV of a lump sum
\begin{tabular}{lr} 
N & \(\mathbf{1 0}\) \\
I/YR & \(\mathbf{8 \%}\) \\
PV & \(\mathbf{- 1 0 0 . 0 0}\) \\
PMT & \(\mathbf{\$ 0 . 0 0}\) \\
\hline FV & \(\mathbf{\$ 2 1 5 . 8 9}\) \\
\hline
\end{tabular}
4. FV of a lump sum
\begin{tabular}{lr} 
N & \(\mathbf{1 0 0}\) \\
I/YR & \(\mathbf{5 \%}\) \\
PV & \(\mathbf{- \$ 1 . 0 0}\) \\
PMT & \(\mathbf{\$ 0 . 0 0}\) \\
\hline FV & \(\mathbf{\$ 1 3 1 . 5 0}\) \\
\hline
\end{tabular}
5. PV of a lump sum
\begin{tabular}{lr} 
N & 3 \\
I/YR & \(\mathbf{6 \%}\) \\
\hline PV & \(\mathbf{\$ 1 , 8 8 8 . 9 2}\) \\
\hline PMT & \(\mathbf{\$ 0}\) \\
FV & \(\mathbf{- 2 , 2 4 9 . 7 3}\) \\
\hline
\end{tabular}

Answer: a EASY

Answer: C EASY

Answer: e EASY

Answer: b EASY

Answer: d EASY
6. PV of a lump sum
\begin{tabular}{lr} 
N & \(\mathbf{1 0 0}\) \\
I/YR & \(\mathbf{1 0 \%}\) \\
\hline PV & \(\mathbf{\$ 0 . 7 3}\) \\
\hline PMT & \(\mathbf{\$ 0}\) \\
FV & \(\mathbf{- \$ 1 0 , 0 0 0}\) \\
\hline
\end{tabular}
7. PV of a lump sum
\begin{tabular}{lr} 
N & \(\mathbf{3}\) \\
I/YR & \(\mathbf{4 \%}\) \\
\hline PV & \(\mathbf{\$ 8 8 9 . 0 0}\) \\
\hline PMT & \(\mathbf{\$ 0}\) \\
FV & \(\mathbf{- \$ 1 , 0 0 0 . 0 0}\)
\end{tabular}
8. Interest rate on a simple lump sum investment

Answer: e
EASY
\begin{tabular}{lr}
\multicolumn{1}{l}{N} & \(\mathbf{1 0}\) \\
\hline I/YR & \(\mathbf{5 . 0 0 \%}\) \\
\hline PV & \(\mathbf{- \$ 6 1 3 . 8 1}\) \\
PMT & \(\mathbf{\$ 0}\) \\
FV & \(\mathbf{\$ 1 , 0 0 0 . 0 0}\)
\end{tabular}
9. Simple growth rate
\begin{tabular}{|lr|}
\multicolumn{1}{l}{N} & \(\mathbf{5}\) \\
\hline I/YR & \(\mathbf{1 4 . 8 7 \%}\) \\
\hline PV & \(\mathbf{- \$ 1 . 0 0}\) \\
PMT & \(\mathbf{\$ 0}\) \\
FV & \(\mathbf{\$ 2 . 0 0}\)
\end{tabular}
10. Number of periods
\begin{tabular}{lr|}
\hline \(\mathbf{N}\) & \(\mathbf{1 4 . 2 1}\) \\
\hline I/YR & \(\mathbf{5 . 0 0 \%}\) \\
PV & \(\mathbf{\$ 1 0 0 . 0 0}\) \\
PMT & \(\mathbf{\$ 0}\) \\
FV & \(\mathbf{\$ 2 0 0 . 0 0}\) \\
\hline
\end{tabular}
11. Number of periods
\begin{tabular}{lr|}
\hline \(\mathbf{N}\) & \(\mathbf{6 . 6 4}\) \\
\hline I/YR & \(\mathbf{1 1 . 0 0 \%}\) \\
PV & \(\mathbf{- \$ 2 . 0 0}\) \\
PMT & \(\mathbf{\$ 0}\) \\
FV & \(\mathbf{\$ 4 . 0 0}\)
\end{tabular}
12. FV of an ordinary annuity
\begin{tabular}{lr} 
N & \(\mathbf{5}\) \\
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
PV & \(\mathbf{\$ 0 . 0 0}\) \\
PMT & \(\mathbf{- \$ 3 , 0 0 0}\) \\
\hline FV & \(\mathbf{\$ 1 6 , 9 1 1 . 2 8}\) \\
\hline
\end{tabular}
13. FV of an ordinary annuity
Answer: e EASY
\begin{tabular}{lr} 
N & \(\mathbf{3}\) \\
I/YR & \(\mathbf{9 . 0 0 \%}\) \\
PV & \(\mathbf{\$ 0 . 0 0}\) \\
PMT & \(\mathbf{- \$ 5 , 0 0 0}\) \\
\hline FV & \(\mathbf{\$ 1 6 , 3 9 0 . 5 0}\) \\
\hline
\end{tabular}
14. FV of an annuity due
BGN mode
\begin{tabular}{lr} 
N & \(\mathbf{5}\) \\
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
PV & \(\mathbf{\$ 0 . 0 0}\) \\
PMT & \(\mathbf{- \$ 3 , 0 0 0}\) \\
\hline FV & \(\mathbf{\$ 1 7 , 9 2 5 . 9 6}\) \\
\hline
\end{tabular}
Answer: d EASY
Answer: a EASY
Answer: c EASY
\begin{tabular}{lr} 
N & \(\mathbf{5}\) \\
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
\hline PV & \(\mathbf{\$ 4 , 2 1 2 . 3 6}\) \\
\hline PMT & \(\mathbf{- \$ 1 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
18. PV of an ordinary annuity

Answer: e EASY
\begin{tabular}{lr} 
N & \(\mathbf{2 0}\) \\
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
\hline PV & \(\mathbf{\$ 5 7 3 , 4 9 6 . 0 6}\) \\
\hline PMT & \(\mathbf{- \$ 5 0 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
19. \(P V\) of an annuity due

BGN mode
\begin{tabular}{lr} 
N & \(\mathbf{5}\) \\
I/YR & \(\mathbf{5 . 0 0 \%}\) \\
\hline PV & \(\mathbf{\$ 1 3 , 6 3 7 . 8 5}\) \\
\hline PMT & \(\mathbf{- \$ 3 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\) \\
\hline
\end{tabular}
20. PV of an annuity due

BGN mode
\begin{tabular}{lr} 
N & 5 \\
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
\hline PV & \(\mathbf{\$ 4 , 4 6 5 . 1 1}\) \\
\hline PMT & \(\mathbf{- \$ 1 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\) \\
\hline
\end{tabular}
21. PV of an annuity due

BGN mode
\begin{tabular}{lr} 
N & \(\mathbf{2 0}\) \\
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
\hline PV & \(\mathbf{\$ 6 0 7 , 9 0 5 . 8 2}\) \\
\hline PMT & \(\mathbf{- \$ 5 0 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
22. Payments on an ordinary annuity
\begin{tabular}{|lr|} 
N & \(\mathbf{1 5}\) \\
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
PV & \(\mathbf{- \$ 2 0 0 , 0 0 0}\) \\
\hline PMT & \(\mathbf{\$ 2 0 , 5 9 2 . 5 5}\) \\
\hline FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline 23. & Payments on an ordinary annuity & Answer: e EASY \\
\hline & N & \\
\hline & I/YR \(\mathbf{8 . 0 0 \%}\) & \\
\hline & PV - \(\mathbf{5 0 0 , 0 0 0}\) & \\
\hline & PMT \$50,926.10 & \\
\hline & FV \(\mathbf{\$ 0 . 0 0}\) & \\
\hline 24. & Payments on an annuity due & Answer: b EASY \\
\hline & BGN mode & \\
\hline & N & \\
\hline & I/YR \(\mathbf{8 . 0 0 \%}\) & \\
\hline & PV \(\quad \mathbf{\$ 5 0 0 , 0 0 0}\) & \\
\hline & PMT \$47,153.80 & \\
\hline & FV \(\mathbf{\$ 0 . 0 0}\) & \\
\hline 25. & Payments on an annuity due & Answer: d EASY \\
\hline & BGN mode & \\
\hline & \(\mathrm{N} \quad 15\) & \\
\hline & I/YR \(\mathbf{6 . 0 0 \%}\) & \\
\hline & PV -\$200,000 & \\
\hline & PMT \$19,426.94 & \\
\hline & FV \(\mathbf{\$ 0 . 0 0}\) & \\
\hline 26. & Years to deplete an ordinary annuity & Answer: a EASY \\
\hline & N 20.91 & \\
\hline & I/YR \(\mathbf{8 . 0 0 \%}\) & \\
\hline & PV -\$500,000 & \\
\hline & PMT \(\quad \mathbf{5 0 , 0 0 0 . 0 0}\) & \\
\hline & FV \(\mathbf{\$ 0 . 0 0}\) & \\
\hline 27. & Years to deplete an annuity due & Answer: C EASY \\
\hline & BGN mode & \\
\hline & \(\mathrm{N} \quad 17.54\) & \\
\hline & I/YR \(\mathbf{8 . 0 0 \%}\) & \\
\hline & PV -\$500,000 & \\
\hline & PMT \(\quad \mathbf{\$ 5 0 , 0 0 0 . 0 0}\) & \\
\hline & FV \(\mathbf{\$ 0 . 0 0}\) & \\
\hline
\end{tabular}
28. Interest rate implicit in an annuity
\begin{tabular}{|lr|}
\hline N & \(\mathbf{2 0}\) \\
\hline I/YR & \(\mathbf{4 . 2 2 \%}\) \\
\hline PV & \(\mathbf{- \$ 1 , 0 0 0 , 0 0 0}\) \\
PMT & \(\mathbf{\$ 7 5 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
29. Interest rate implicit in an annuity

BGN mode
\begin{tabular}{|lr|}
\hline N & \(\mathbf{3 0}\) \\
\hline I/YR & \(\mathbf{3 . 0 8 \%}\) \\
\hline PV & \(\mathbf{- \$ 1 0 , 0 0 0 , 0 0 0}\) \\
PMT & \(\mathbf{\$ 5 0 0 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
30. Interest rate implicit in an annuity

BGN mode
\begin{tabular}{|lr|}
\hline N & \(\mathbf{1 0}\) \\
\hline \(\mathrm{I} / \mathrm{YR}\) & \(\mathbf{2 4 . 6 3 \%}\) \\
\hline PV & \(\mathbf{- \$ 4 5 , 0 0 0}\)
\end{tabular}
\begin{tabular}{lr} 
PMT & \(\mathbf{\$ 1 0 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
31. PV of an annuity due

BGN mode
\begin{tabular}{lr} 
N & \(\mathbf{8}\) \\
I/YR & \(\mathbf{7 . 0 0 \%}\) \\
\hline PV & \(\mathbf{\$ 1 5 9 , 7 3 2}\) \\
\hline PMT & \(\mathbf{- \$ 2 5 , 0 0 0}\) \\
FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
32. PV of an ordinary annuity plus an ending payment

Answer: c EASY
\begin{tabular}{|lr|}
\hline N & \(\mathbf{6}\) \\
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
\hline PV & \(\mathbf{\$ 5 , 9 7 4 . 7 7}\) \\
\hline PMT & \(\mathbf{\$ 1 , 0 0 0}\) \\
FV & \(\mathbf{\$ 1 , 5 0 0}\) \\
\hline
\end{tabular}
33. PV of a perpetuity
\begin{tabular}{lr} 
I/YR & \(\mathbf{6 . 0 0 \%}\) \\
PMT & \(\mathbf{\$ 1 0 0}\) \\
\hline PV & \(\$ 1.666 .67\) \\
\hline
\end{tabular}

PV \$1,666.67 Divide PMT by I.
34. Rate of return on a perpetuity

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\begin{tabular}{lr} 
Cost \((\mathrm{PV})\) & \(\mathbf{\$ 1 , 5 0 0}\) \\
PMT & \(\mathbf{\$ 1 0 5}\) \\
\hline I/YR & \(\mathbf{7 . 0 0 \%}\) \\
\hline
\end{tabular}
35. Dollar payments on a perpetuity

Answer: d EASY
\begin{tabular}{ll} 
Cost (PV) & \(\mathbf{\$ 1 , 5 0 0}\) \\
I/YR & \(\mathbf{8 . 0 0 \%}\) \\
\hline PMT & \(\mathbf{\$ 1 2 0 . 0 0}\) \\
\hline
\end{tabular}
36. PV of an uneven cash flow stream

Answer: a EASY
\begin{tabular}{rccccc} 
I/YR \(=\) & \(\mathbf{8 \%}\) & & \\
& & 0 & 1 & 2 & 3 \\
CFs: & \(\mathbf{\$ 0}\) & \(\mathbf{\$ 1 0 0}\) & \(\mathbf{\$ 3 0 0}\) & \(\mathbf{\$ 0}\) & \(\mathbf{\$ 5 0 0}\) \\
PV of CFs: & \(\$ 0\) & \(\$ 92.59\) & \(\$ 257.20\) & \(\$ 0\) & \(\$ 367.51\) \\
\hline \(\mathbf{P V}=\) & \(\mathbf{\$ 7 1 7 . 3 1}\) & Find the individual PVs and sum them. \\
\(\mathbf{P V}=\) & \(\mathbf{\$ 7 1 7 . 3 1}\) & Automate the process using Excel or a calculator, by inputting \\
\hline
\end{tabular}

PV of an uneven cash flow stream Answer: c EASY/MEDIUM

38. FV of a lump sum, semiannually Answer: e EASY/MEDIUM
\begin{tabular}{lrlr} 
Years & \(\mathbf{3}\) & N = Periods = years x periods \(/ \mathrm{yr}=\) & \(\mathbf{6}\) \\
Periods \(/ \mathrm{Yr}\) & \(\mathbf{2}\) & & \\
PMT & \(\mathbf{\$ 0}\) & & \\
Nom. I/YR & \(\mathbf{8 . 0 0 \%}\) & & \\
PV & \(\mathbf{\$ 2 , 0 0 0}\) & & \(\mathbf{4 . 0 0 \%}\) \\
\hline FV & \(\mathbf{\$ 2 , 5 3 0 . 6 4}\) & Could be found using a calculator, the equation, or Excel. Note \\
\hline \multicolumn{4}{l}{ that we must first convert to periods and rate per period. }
\end{tabular}
39. PV of a lump sum, semiannually

Answer: b EASY/MEDIUM
\begin{tabular}{|c|c|c|c|}
\hline Years & 3 & \(\mathrm{N}=\) Periods \(=\) years x periods \(/ \mathrm{yr}=\) & 6 \\
\hline Periods/Yr & 2 & & \\
\hline PMT & \$0 & & \\
\hline Nom. I/YR & 8.00\% & \(\mathrm{I} /\) Period \(=\) Nom. \(\mathrm{I} /\) Periods per year \(=\) & 4.00\% \\
\hline FV & \$2,000 & & \\
\hline PV & \$1,580.63 & d using a calculator, the equation, or E & \\
\hline
\end{tabular}

44. PV of a lump sum, monthly

\section*{Answer: b MEDIUM}
\begin{tabular}{lrlr} 
Years & \(\mathbf{3}\) & N = Periods = years x periods/yr = & \(\mathbf{3 6}\) \\
Periods/Yr & \(\mathbf{1 2}\) & \\
PMT & \(\mathbf{\$ 0}\) & & \\
Nom. I/YR & \(\mathbf{8 . 0 0 \%}\) & I/Period = Nom. I/Periods per year = & \(\mathbf{0 . 6 7 \%}\) \\
FV & \(\mathbf{\$ 2 , 0 0 0}\) & & \\
\hline PV & \(\mathbf{\$ 1 , 5 7 4 . 5 1}\) & Could be found using a calculator, the equation, or Excel. Note \\
\hline \multicolumn{4}{l}{ that we must first convert to periods and rate per period. }
\end{tabular}
45. APR vs. effective annual rate

Answer: d MEDIUM
\begin{tabular}{lr} 
APR & \(\mathbf{1 5 \%}\) \\
Periods/yr & \(\mathbf{1 2}\) \\
EFF\% & \(\mathbf{1 6 . 0 8 \%}\) \\
&
\end{tabular}
46. Nominal vs. effective annual rate

Answer: a MEDIUM
\begin{tabular}{lr} 
Nominal I/YR & \(\mathbf{6 \%}\) \\
Periods/yr & \(\mathbf{1 2}\) \\
EFF\% & \(\mathbf{6 . 1 7 \%}\) \\
\cline { 2 - 2 } &
\end{tabular}
47. Interest charges, simple interest
\begin{tabular}{lr} 
Nominal I/YR & \(\mathbf{8 \%}\) \\
Days/yr & \(\mathbf{3 6 0}\) \\
Amount borrowed & \(\mathbf{\$ 1 0 , 0 0 0}\) \\
Interest per month & \(\mathbf{\$ 6 6 . 6 7}\) \\
\hline
\end{tabular}
\begin{tabular}{lr} 
Days in month & \(\mathbf{3 0}\) \\
Daily rate & \(\mathbf{0 . 0 2 2 2 \%}\) \\
Interest per day & \(\mathbf{\$ 2 . 2 2}\)
\end{tabular}
48. Fractional time periods
\begin{tabular}{lrlr} 
Nominal I/YR & \(\mathbf{6 \%}\) & Rate/day & \(\mathbf{0 . 0 1 6 7 \%}\) \\
Number of months & \(\mathbf{7}\) & Days on deposit & \(\mathbf{2 1 0}\) \\
Days in year & \(\mathbf{3 6 0}\) & & \\
Days in month & \(\mathbf{3 0}\) & & \\
Amount deposited & \(\mathbf{\$ 5 , 0 0 0}\) & & \\
\hline Ending amount & \(\mathbf{\$ 5 , 1 7 8 . 0 8}\) & &
\end{tabular}
49. Loan amortization: payment Answer: b MEDIUM

I/YR \(\mathbf{8 \%}\)
Years 4
Amount borrowed \(\mathbf{\$ 2 5 , 0 0 0}\)
\begin{tabular}{|l|l|l}
\hline Payments & \(\$ 7,548.02\) & Found with a calculator, as the PMT.
\end{tabular}
50. Loan amortization: interest

Answer: d
MEDIUM
\begin{tabular}{lr|} 
I/YR & \(\mathbf{8 \%}\) \\
Years & \(\mathbf{4}\) \\
Amount borrowed & \(\mathbf{\$ 2 5 , 0 0 0}\) \\
\hline Interest in Year 1 & \(\mathbf{\$ 2 , 0 0 0 . 0 0}\) \\
\hline
\end{tabular}
51. Comparing the effective cost of two bank loans

Answer: a MEDIUM

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.
\begin{tabular}{lr} 
Nominal rate, Bank A & \(\mathbf{7 \%}\) \\
Nominal rate, Bank B & \(\mathbf{8 \%}\) \\
Periods/yr, A & \(\mathbf{1 2}\) \\
Periods/yr, B & \(\mathbf{1}\) \\
EFF\% A & \(\mathbf{7 . 2 3 \%}\) \\
EFF\% B & \(\mathbf{8 . 0 0 \%}\) \\
Difference & \(\mathbf{0 . 7 7 \%}\)
\end{tabular}
52. Mortgage payments

Answer: c MEDIUM
\begin{tabular}{|lr|} 
N & \(\mathbf{3 6 0}\) \\
I & \(\mathbf{0 . 5 8 3 3 \%}\) \\
PV & \(\mathbf{\$ 1 9 0 , 0 0 0}\) \\
\hline PMT & \(\mathbf{- \$ 1 , 2 6 4}\) \\
\hline FV & \(\mathbf{\$ 0 . 0 0}\)
\end{tabular}
53. Loan amortization: principal repayment Answer: e MEDIUM/HARD
\begin{tabular}{lrr} 
Interest rate & \(\mathbf{8 \%}\) & \\
Years & \(\mathbf{4}\) & \\
Amount borrowed & \(\mathbf{\$ 2 5 , 0 0 0}\) & \(\mathbf{\$ 7 , 5 4 8}\) \\
Step 1: Find the PMT & & \(\mathbf{\$ 2 , 0 0 0}\) \\
Step 2: Find the 1st year's interest & \(\mathbf{\$ 5 , 5 4 8}\) \\
Step 3: Subtract the interest from the payment; this is repayment of principal &
\end{tabular}
54. Loan amortization: ending balance

Answer: b MEDIUM/HARD
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 ..... \$86,250Answer: a MEDIUM/HARD
\begin{tabular}{lrrrr} 
Interest rate & \(\mathbf{1 2 \%}\) & & & \\
Periods/year & \(\mathbf{1 2}\) & Years on & Months on & Ending \\
Monthly rate & \(1.00 \%\) & deposit: & deposit: & Amount \\
1st deposit & \(\mathbf{\$ 5 , 0 0 0}\) & \(\mathbf{3}\) & 36 & \(\$ 7,153.84\) \\
2nd deposit & \(\mathbf{\$ 1 0 , 0 0 0}\) & \(\mathbf{2}\) & 24 & \(\$ 12,697.35\) \\
3rd deposit & \(\mathbf{\$ 1 5 , 0 0 0}\) & \(\mathbf{1}\) & 12 & \(\$ 16,902.38\) \\
& & & \(\$ \mathbf{\$ 3 6 , 7 5 3 . 5 7}\) \\
\hline
\end{tabular}
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 \(\quad 15.70\) 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 \(\mathrm{t}=15\) (15 years from now). So, you must live for: \(16-1=\underline{\mathbf{1 5}}\) years.

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.
\begin{tabular}{lr} 
Nominal rate, Bank A & \(\mathbf{6 \%}\) \\
Nominal rate, Bank B & \(\mathbf{7 \%}\) \\
Periods/yr, A & \(\mathbf{1 2}\) \\
Periods/yr, B & \(\mathbf{1}\) \\
EFF\% A & \(\mathbf{6 . 1 7 \%}\) \\
EFF\% B & \(\mathbf{7 . 0 0 \%}\) \\
Difference & \(\mathbf{0 . 8 3 \%}\)
\end{tabular}
59. Retirement planning
\begin{tabular}{lr} 
Tom's retirement account \\
N & \(\mathbf{4 6}\) \\
I/YR & \(\mathbf{1 0 \%}\) \\
PV & \(\mathbf{\$ 0}\) \\
PMT & \(\mathbf{\$ 4 , 0 0 0}\) \\
\hline FV & \(\mathbf{\$ 3 , 1 6 7 , 1 8 1}\) \\
\hline
\end{tabular}

Answer: b MEDIUM/HARD
\begin{tabular}{lr} 
Jerry's retirement account \\
N & \(\mathbf{4 1}\) \\
I/YR & \(\mathbf{1 0 \%}\) \\
PV & \(\mathbf{\$ 0}\) \\
\hline PMT & \(\mathbf{\$ 6 , 4 9 2}\) \\
\hline FV & \(\mathbf{\$ 3 , 1 6 7 , 1 8 1}\)
\end{tabular}

\section*{60. \\ Saving to start a business}

Answer: d HARD

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.
\begin{tabular}{lrccc} 
Nominal interest rate & \(\mathbf{8 \%}\) & Year 5 & & Year 10 \\
& \(\mathbf{\$ 2 0 , 0 0 0}\) & NA & \(\$ 43,178\) \\
Gift & \(\mathbf{\$ 5 , 0 0 0}\) & \(\$ 29,333\) & & \(\$ 43,100\) \\
1st annuity & \(\mathbf{\$ 1 0 , 0 0 0}\) & NA & \\
2nd annuity & \(\mathbf{1 0}\) & & \\
Total years & \(\mathbf{5}\) & & Final amt: & \(\mathbf{\$ 1 4 4 , 9 4 4}\) \\
Annuity years & & &
\end{tabular}
61. Cash flow required to provide a given rate of return Answer: a 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 \(\operatorname{IRR}=9 \%\). 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 \(\operatorname{IRR}=\) \(9 \%\). It turns out to be exactly:
\$10,158.58
\begin{tabular}{cccccccc} 
I/YR \(=\) & \(\mathbf{9 \%}\) & & & & & & \\
\(\mathbf{0}\) & \(\mathbf{1}\) & \(\mathbf{2}\) & \(\mathbf{3}\) & \(\mathbf{4}\) & \(\mathbf{5}\) & \(\mathbf{6}\) & \(\mathbf{7}\) \\
\(-\mathbf{\$ 5 0 , 0 0 0}\) & \(\mathbf{\$ 5 , 0 0 0}\) & \(\mathbf{\$ 1 0 , 0 0 0}\) & \(\mathbf{\$ 1 5 , 0 0 0}\) & \(\mathbf{X}\) & \(\mathbf{X}\) & \(\mathbf{X}\) & \(\mathbf{X}\) \\
\(-\mathbf{\$ 5 0 , 0 0 0}\) & \(\mathbf{\$ 5 , 0 0 0}\) & \(\mathbf{\$ 1 0 , 0 0 0}\) & \(\mathbf{\$ 1 5 , 0 0 0}\) & \(\mathbf{\$ 1 0 , 0 0 0}\) & \(\mathbf{\$ 1 0 , 0 0 0}\) & \(\mathbf{\$ 1 0 , 0 0 0}\) & \(\mathbf{\$ 1 0 , 0 0 0}\) \\
IRR \(=\) & \(\mathbf{8 . 7 8 \%}\) & & & & & &
\end{tabular}

Calculator solution:
Step 1: Use CF register to find the PV of the 4 known cash flows at the end of Year 3. \(-\$ 25,413.29\)
Step2: Now find the FV at the end of Period 3, i.e., compound PV for 3 years.
-\$32,910.95
Step 3: Now find the PMT for a 4-year annuity with the PV.
\begin{tabular}{lr} 
Current college costs & \(\mathbf{\$ 1 6 , 0 0 0}\) \\
College cost inflation & \(\mathbf{4 \%}\) \\
Account return & \(\mathbf{8 \%}\) \\
First 5 payments & \(\mathbf{\$ 3 , 0 0 0}\) \\
Current account balance & \(\mathbf{\$ 9 , 0 0 0}\)
\end{tabular}

First, determine each year of college's costs.
\begin{tabular}{lll} 
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 \((t=13)\) & \(=\) & \(\$ 26,641\)
\end{tabular}

The PV (at \(t=10)\) of all of these college costs is:
\(\$ 89,601\) This is what they need at \(\mathrm{t}=10\).

After the first 5 payments, the college account will have (at \(t=4\) ): \(\quad \$ 29,844.20\)
6 more contributions are left in order to get the required funds for college costs.
\begin{tabular}{|lr|}
\hline N & \(\mathbf{6}\) \\
I & \(\mathbf{8 \%}\) \\
PV & \(\mathbf{- \$ 2 9 , 8 4 4}\) \\
\hline PMT & \(\mathbf{- \$ 5 , 7 5 8}\) \\
\hline FV & \(\mathbf{\$ 8 9 , 6 0 1 . 2 9}\) \\
\hline
\end{tabular}
63. Loan amortization: repayment of principal

Answer: e HARD
\begin{tabular}{|lr|}
\hline N & \(\mathbf{1 2}\) \\
\hline \(\mathbf{I}\) & \(\mathbf{1 . 1 7 \%}\) \\
\hline PV & \(\mathbf{\$ 1 0 0 , 0 0 0}\) \\
PMT & \(\mathbf{\$ 8 , 9 7 8}\) \\
FV & \(\mathbf{\$ 0}\)
\end{tabular}
\(\%\) paid toward prin. \(=\quad 89.06 \%\)

FV
\$0

Amortization schedule(first 4 years)
\begin{tabular}{lcllll} 
Year & Beg. Balance & Payment & Interest & Principal & \begin{tabular}{l} 
End. \\
Balance
\end{tabular} \\
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 & \(\$ 76,288.01\) & \(\$ 8,978\) & \(\$ 889.07\) & \(\$ 8,088.93\) & \(\$ 68,199.08\)
\end{tabular}
64. Loan amortization: interest paid

Answer: b HARD


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.

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

Answer: e MEDIUM

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.

Answer: b MEDIUM

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

Answer: a MEDIUM

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
true. Therefore, answer choice a is the correct answer.
76. Time value concepts Answer: d MEDIUM
77. Growth rate

Answer: d


Financial calculator solution:
Inputs: \(\mathrm{N}=30 ; \mathrm{PV}=-1800 ; \mathrm{PMT}=0 ; \mathrm{FV}=13700\). Output: \(\mathrm{I} / \mathrm{YR}=\) \(7.0 \%\).
78. Interest rate

Answer: b
Time Line:


Financial calculator solution:
Inputs: \(\mathrm{N}=5\); \(\mathrm{PV}=10000\); \(\mathrm{PMT}=-2504.56 ; \mathrm{FV}=0\). Output: \(\mathrm{I} / \mathrm{YR}=\) 8\%.
79. Effect of inflation

Answer: c
Time Line:


Financial calculator solution:
Inputs: \(\mathrm{I} / \mathrm{YR}=4 ; \mathrm{PV}=-1\); \(\mathrm{PMT}=0 ; \mathrm{FV}=0.50\).
Output: \(N=-17.67 \approx 18\) years.
80. Time for a sum to double

Answer: d

I/YR = 7/12; \(P V=-1 ; ~ P M T=0 ; ~ F V=2 ; ~ a n d ~ s o l v e ~ f o r ~ N ~=~ 119.17 ~ m o n t h s ~\) \(=9.93\) years.
81. Time for lump sum to grow

Answer: e
Financial calculator solution:
Inputs: \(I / Y R=10 ; P V=-300000 ; \operatorname{PMT}=0 ; ~ F V=1000000\). Outputs: \(N=12.63\) years.
82. Monthly loan payments

Answer: c
First, find the monthly interest rate \(=0.10 / 12=0.8333 \% / \mathrm{month}\). Now, enter in your calculator \(\mathrm{N}=60\); \(\mathrm{I} / \mathrm{YR}=0.8333\); \(\mathrm{PV}=-13000\); \(\mathrm{FV}=0\); and solve for \(\mathrm{PMT}=\$ 276.21\).
83. FV of an annuity

Answer: e
Time Line:


Financial calculator solution:
Inputs: \(\mathrm{N}=5 ; \mathrm{I} / \mathrm{YR}=15 ; \mathrm{PV}=0\); \(\mathrm{PMT}=-200\). Output: \(\mathrm{FV}=\) \$1,348.48.
84. PV of an annuity

Answer: a
Time Line:


Financial calculator solution:
Inputs: \(\mathrm{N}=5 ; \mathrm{I} / \mathrm{YR}=15 ; \mathrm{PMT}=-200 ; \mathrm{FV}=0\). Output: \(\mathrm{PV}=\$ 670.43\).
85. PV of a perpetuity

Answer: c
\(\mathrm{V}=\mathrm{PMT} / \mathrm{i}=\$ 1,000 / 0.15=\$ 6,666.67\).
86. Required annuity payments

Answer: b
Time line:


Financial calculator solution:
Inputs: \(N=5 ; \quad I / Y R=10 ; ~ P V=-1000 ; ~ F V=0 . \quad\) Output: \(\quad\) PMT \(=\$ 263.80\).
87. Quarterly compounding and FV

Answer: a
Time line:


Financial calculator solution:
Inputs: \(\mathrm{N}=20\); \(\mathrm{I} / \mathrm{YR}=1 ; \mathrm{PV}=-100 ; \mathrm{PMT}=0\). Output: \(\mathrm{FV}=\$ 122.02\).
88. PV of an uneven CF stream

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: \(\mathrm{CF}_{0}=0 ; \mathrm{CF}_{1}=10000 ; \mathrm{CF}_{2}=25000 ; \mathrm{CF}_{3}=50000 ; \mathrm{CF}_{4}=35000 ; \mathrm{I} / \mathrm{YR}=\)
8.
Output: \(\quad \mathrm{NPV}=\$ 96,110.39 \approx \$ 96,110\).
89. Effective annual rate

Answer: c
Bank A: 8\%, monthly.
\[
\begin{aligned}
\operatorname{EAR}_{\mathrm{A}} & =\left(1+\frac{r_{\mathrm{Nom}}}{m}\right)^{\mathrm{m}}-1 \\
& =\left(1+\frac{0.08}{12}\right)^{12}-1=8.30 \%
\end{aligned}
\]

Bank B: 9\%, interest due at end of year \(E A R_{B}=9 \%\).
\[
9.00 \%-8.30 \%=0.70 \% .
\]
90. Effective annual rate

Answer: b

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

Answer: b

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. \(E A R=10.38 \%\).
b. \(E A R=10.47 \%\).
c. \(E A R=10.20 \%\).
d. \(E A R=10.25 \%\).
e. \(E A R=10.07 \%\).

Therefore, the highest effective return is choice b.
92. Effective annual rate

Answer: b

Financial calculator solution:
Inputs: \(\mathrm{N}=10 ; \mathrm{PV}=-35000 ; \mathrm{PMT}=0 ; \mathrm{FV}=100000\). Outputs: \(\mathrm{I} / \mathrm{YR}=\) 11.07\%.
93.

Effective annual rate
Answer: a

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 = 10.2736%.
b. EAR = 10.1846%.
c. EAR = 10.2000%.
d. EAR = 10.2500%.
e. EAR = 10.0339%.
Therefore, the highest effective return is choice a.

```
94. Nominal and effective rates

Answer: b
```

1st investment: Enter the following:
NOM% = 9; P/YR = 2; and solve for EFF% = 9.2025%.
2nd investment: Enter the following:
EFF% = 9.2025; P/YR = 4; and solve for NOM% = 8.90%.

```
95. FV of an annuity

Answer: a

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

Answer: a

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: \(\mathrm{N}=30 ; \mathrm{I} / \mathrm{YR}=8 / 12=0.667 ; \mathrm{PV}=0 ; \mathrm{PMT}=-200\). Output: FV \(=\$ 6,617.77\).
97. PV of an uneven \(C F\) stream

Answer: c

Time Line:


Financial calculator solution (using the cash flow register):
Inputs: \(C F_{0}=0 ; C F_{1}=2000 ; N_{j}=5 ; \mathrm{CF}_{2}=3000 ; \mathrm{N}_{\mathrm{j}}=3 ; \mathrm{CF}_{3}=4000\);
I/YR = 14 .
Output: NPV = \$11,714.
98.

FV of a sum
Answer: b

Time Line:

```

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

```
99. FV of annuity due

Answer: d

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 \(N=42 ; ~ I / Y R=10 ; ~ P V=10000 ; ~ P M T ~=1000\). Output: \(F V=\$ 1,139,038\).
100. Time value of money and retirement

Answer: b

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 \(=0 ; \mathrm{FV}=1000000\); and solve for \(N=38.88\).
BRENDA: \(I / Y R=10 ; P V=-150000 ; P M T=0 ; \mathrm{FV}=1000000\); 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

Answer: d
Time Line:


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 2: Calculate the ending balance 20 years after the initial deposit of \(\$ 100\) was made:
Inputs: \(\mathrm{N}=39 ; \mathrm{I} / \mathrm{YR}=3 ; \mathrm{PV}=-3.00 ; \mathrm{PMT}=0\). Output: \(\mathrm{FV}=\) \$9. 50 .
102. FV of an annuity

Answer: e

Step 1: Determine the effective annual rate: The nominal rate is 6\%, but we need the effective annual rate. Using the calculator, input the following data: \(\mathrm{NOM} \%=6 ; \mathrm{P} / \mathrm{YR}=365\); and solve for \(\mathrm{EFF} \%=6.1831 \%\).

Step 2: Determine the future value of the annuity: \(N=3 ; \quad I / Y R=6.1831 ; P V=-500 ; P M T=-1000 ;\) and solve for FV \(=\$ 3,787.92 \approx \$ 3,788\).

To calculate the solution to this problem, change your calculator to BEGIN mode. Then enter \(\mathrm{N}=35\); I/YR \(=10\); \(\mathrm{PV}=0 ; \mathrm{PMT}=3000\); and solve for \(\mathrm{FV}=\$ 894,380.4160\). 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

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

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

PV today of \(\$ 10,000\) withdrawal 10 years from now:
\(\mathrm{N}=10 ; \mathrm{I} / \mathrm{YR}=12\); \(\mathrm{PMT}=0 ; \mathrm{FV}=10000\); and solve for \(\mathrm{PV}=-\$ 3,219.73\).
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 \(N\), \(I / Y R, ~ P V\), and PMT, solving for FV:
\(\mathrm{N}=45\); \(\mathrm{I} / \mathrm{YR}=12 ; \mathrm{PV}=-1056.86 ; \mathrm{PMT}=500\); and solve for \(\mathrm{FV}=\) \(\$ 505,803.08 \approx \$ 505,803\).
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, \(N=5 ; ~ I / Y R=11 ; ~ P V=0 ; ~ P M T=-3000 ;\) and solve for \(F V=\) \$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, \(N=44 ; ~ I / Y R=10 ; ~ P V=0 ; ~ P M T ~=~-2000 ; ~ a n d ~ s o l v e ~\) for \(\mathrm{FV}=\$ 1,435,809.67\).

Step 2: Now add on to the FV (calculated in Step 1) the last contribution that occurs at \(t=45\) :
\(\$ 1,435,809.67+\$ 2,000.00=\$ 1,437,809.67\).
Financial calculator solution:
\(\mathrm{N}=3 \times 12=36 ; \mathrm{I} / \mathrm{YR}=6 / 12=0.5 ; \mathrm{PV}=-1000 ; \mathrm{PMT}=0\); and solve for
\(\mathrm{FV}=\$ 1,196.68\).
108. FV under monthly compounding

Answer: d

Step 1: Calculate the \(F V\) at \(t=36\) of the first deposit.
Enter \(\mathrm{N}=36 ; \mathrm{I} / \mathrm{YR}=12 / 12=1 ; \mathrm{PV}=-10000 ; \mathrm{PMT}=0\); and solve for \(F V=\$ 14,308\).

Step 2: Calculate the \(F V\) at \(t=36\) of the second deposit. Enter \(N=24 ; ~ I / Y R=12 / 12=1 ; P V=-10000 ; P M T=0\); and solve for \(F V=\$ 12,697\).

Step 3: Calculate the \(F V\) at \(t=36\) of the third deposit. Enter \(N=12 ; ~ I / Y R=12 / 12=1 ; P V=-20000 ; P M T=0\); and solve for \(F V=\$ 22,537\).

Step 4: The sum of the future values gives you the answer, \$49,542.
109. FV under daily compounding

Answer: a

Solve for FV as \(\mathrm{N}=132 ; \mathrm{I} / \mathrm{YR}=4 / 365=0.0110 ; \mathrm{PV}=-2000 ; \mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\$ 2,029.14\).
110. FV under non-annual compounding

Answer: d

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 \(\mathrm{FV}=\$ 5,744.29\).

John's savings will have two components, a lump sum contribution of \(\$ 1,500\) and his monthly contributions. The \(F V\) of his regular savings is: \(N=2 \times\) \(12=24 ; ~ I / Y R=10 / 12=0.8333 ; \mathrm{PV}=0 ; \mathrm{PMT}=-150 ;\) and \(\mathrm{FV}=\$ 3,967.04\). The FV of his previous savings is: \(N=24 ; ~ I / Y R=0.8333 ; ~ P V=-1500 ; ~ P M T\) \(=0\); and \(\mathrm{FV}=\$ 1,830.59\).

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

Answer: c

The effective rate is given by:
\(N O M \%=8 ; ~ P / Y R=4\); and solve for \(E F F \%=8.2432 \%\).

The nominal rate on a semiannual basis is given by: \(E F F \%=8.2432 ; \mathrm{P} / \mathrm{YR}=2\); and solve for \(\mathrm{NOM} \%=8.08 \%\). The future value is given by: \(\mathrm{N}=2.5 \times 2=5 ; \mathrm{I} / \mathrm{YR}=8.08 / 2=4.04 ; \mathrm{PV}=0 ; \mathrm{PMT}=-100\); and solve for \(\mathrm{FV}=\$ 542.07\).
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: \(\mathrm{N}=12 ; \mathrm{I} / \mathrm{YR}=1.75 ; \mathrm{PV}=-1000 ; \mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\) \$1,231.4393. \(N=8 ; ~ I / Y R=1.75 ; ~ P V=-2000 ; ~ P M T=0 ; ~ a n d ~ s o l v e ~ f o r ~ F V\) \(=\$ 2,297.7636 . \mathrm{N}=4 ; \mathrm{I} / \mathrm{YR}=1.75 ; \mathrm{PV}=-3000 ; \mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\$ 3,215.5771\).

Add up the future values for the answer: \(\$ 6,744.78\).
113. FV of an uneven CF stream

Answer: e

First, calculate the payment amounts:
\(\mathrm{PMT}_{0}=\$ 5000, \mathrm{PMT}_{1}=\$ 5500, \mathrm{PMT}_{2}=\$ 6050, \mathrm{PMT}_{3}=\$ 6655, \mathrm{PMT}_{4}=\$ 7320.50\). Then, find the future value of each payment at \(t=5\) : For \(\operatorname{PMT}_{0}, N=5\); I/YR = 14; \(\mathrm{PV}=-5000 ; \mathrm{PMT}=0\); thus, \(\mathrm{FV}=\$ 9,627.0729\). Similarly, for \(\mathrm{PMT}_{1}, \mathrm{FV}=\$ 9,289.2809\), for \(\mathrm{PMT}_{2}, \mathrm{FV}=\$ 8,963.3412\), for \(\mathrm{PMT}_{3}, \mathrm{FV}=\) \(\$ 8,648.8380\), and for \(\mathrm{PMT}_{4}, \mathrm{FV}=\$ 8,345.3700\). 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:
\(\mathrm{N}=5 ; \mathrm{I} / \mathrm{YR}=8 ; \mathrm{PMT}=1000 ; \mathrm{FV}=0\); and solve for \(\mathrm{PV}=\$ 3,992.71\).
b. Enter the following inputs in your calculator:
\(\mathrm{N}=5 ; \mathrm{I} / \mathrm{YR}=8 ; \mathrm{PMT}=0 ; \mathrm{FV}=7000\); and solve for \(\mathrm{PV}=\$ 4,764.08\).
c. \(\mathrm{P}=\mathrm{PMT} / \mathrm{I}=\$ 800 / 0.08=\$ 10,000\).
d. Enter the following inputs in your calculator:
\(\mathrm{N}=7\); \(\mathrm{I} / \mathrm{YR}=8 ; \mathrm{PMT}=0\); \(\mathrm{FV}=8500\); and solve for \(\mathrm{PV}=\$ 4,959.67\).
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e. Enter the following inputs in your calculator:
CF
NPV = \$5,022.10.
The preferred stock issue, statement c, has the largest present value
among these choices.

```
115. PV under monthly compounding

Answer: b

Start by calculating the effective rate on the second security: \(P / Y R=12 ; N O M \%=10 ;\) and solve for \(E F F \%=10.4713 \%\). Then, convert this effective rate to a semiannual rate: \(\mathrm{EFF} \%=10.4713 ; \mathrm{P} / \mathrm{YR}=2\); \(\mathrm{NOM} \%=10.2107 \%\).
Now, calculate the value of the first security as follows: \(\mathrm{N}=10 \times 2=20 ; \mathrm{I} / \mathrm{YR}=10.2107 / 2=5.1054 ; \mathrm{PMT}=500 ; \mathrm{FV}=0\); and solve for \(P V=-\$ 6,175.82\).
116. PV under non-annual compounding

Answer: C

First, find the effective annual rate for a nominal rate of \(12 \%\) with quarterly compounding: \(P / Y R=4 ; N O M \%=12\); and \(E F F \%=12.55 \%\). 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 \(P / Y R=2\); EFF\% \(=12.55\); and \(N O M \%=12.18 \%\). Finally, find the \(P V\) as \(N=2 \times 3=6 ; ~ I / Y R=12.18 / 2=6.09 ; ~ P M T=500\); \(F V=0\); and solve for \(P V=-\$ 2,451.73\).
117. PV of an annuity

Answer: a
Time Line:


Financial calculator solution:
Inputs: \(I / Y R=7 ; ~ P V=-90 ; ~ P M T=10 ; ~ F V=0 . \quad\) Output: \(\quad \mathrm{N}=14.695 \approx 15\)
years.
118. Value of a perpetuity

Answer: c
Time Line:

119. FV of an uneven CF stream

Answer: d

Time Line:


Financial calculator solution:
Calculate PV of the cash flows, then bring them forward to FV using the interest rate.
Inputs: \(C E_{0}=5000 ; \mathrm{CF}_{1}=1000 ; \mathrm{N}_{\mathrm{j}}=5 ; \mathrm{CF}_{2}=2000 ; \mathrm{N}_{\mathrm{j}}=5\); I/YR \(=8\).
Output: \(N P V=\$ 14,427.45\).
Inputs: \(\mathrm{N}=10 ; \mathrm{I} / \mathrm{YR}=8 ; \mathrm{PV}=-14427.45 ; \mathrm{PMT}=0\).
Output: \(\mathrm{FV}=\$ 31,147.79 \approx \$ 31,148\).
120. FV of an uneven CF stream

Answer: c

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: \(C F_{0}=10000 ; C F_{1}=20000 ; C F_{2}=50000 ; ~ I / Y R=6 ;\) and solve for \(\mathrm{NPV}=\$ 73,367.74653\).

Step 2: Calculate the FV 10 years from now of the PV of the deposits: \(\mathrm{N}=10\); \(\mathrm{I} / \mathrm{YR}=6\); \(\mathrm{PV}=-73367.74653\); \(\mathrm{PMT}=0\); and solve for FV = \$131,390.46.
121. PV of an uneven CF stream

Answer: a

Time Line:

```

$P V=$ ?
Financial calculator solution:
Using cash flows
Inputs: $\quad \mathrm{CF}_{0}=0 ; \mathrm{CF}_{1}=1 ; \mathrm{CF}_{2}=2000 ; \mathrm{N}_{\mathrm{j}}=3 ; \mathrm{CF}_{3}=0 ; \mathrm{CF}_{4}=-2000 ; \mathrm{I} / \mathrm{YR}=$ 12.
Output: $\quad \mathrm{NPV}=\$ 3,276.615 \approx \$ 3,277$.

```
122. PV of uncertain cash flows

Answer: e

Time Line:


Calculate expected cash flows
\(\mathrm{E}\left(\mathrm{CF}_{1}\right)=(0.30)(\$ 300)+(0.40)(\$ 500)+(0.30)(\$ 700)=\$ 500\).
\(\mathrm{E}\left(\mathrm{CF}_{2}\right)=(0.15)(\$ 100)+(0.35)(\$ 200)+(0.35)(\$ 600)+(0.15)(\$ 900)=\$ 430\).
\(E\left(\mathrm{CF}_{3}\right)=(0.25)(\$ 200)+(0.75)(\$ 800)=\$ 650\).
Financial calculator solution:
Using cash flows
Inputs: \(\mathrm{CF}_{0}=0 ; \mathrm{CF}_{1}=500 ; \mathrm{CF}_{2}=430 ; \mathrm{CF}_{3}=650 ; \mathrm{I} / \mathrm{YR}=8\). Output: \(\quad \mathrm{NPV}=\$ 1,347.61\).
123. Value of missing payments

Answer: d

Find the \(F V\) of the price and the first three cash flows at \(t=3\).
To do this first find the present value of them.
\(C F_{0}=-5544.87 ; C F_{1}=100 ; C F_{2}=500 ; C F_{3}=750 ; I / Y R=9\); and solve for \(\mathrm{NPV}=-\$ 4,453.15\).

Find the \(F V\) of this present value.
\(\mathrm{N}=3 ; \mathrm{I} / \mathrm{YR}=9 ; \mathrm{PV}=-4453.15 ; \mathrm{PMT}=0 ; \mathrm{FV}=\$ 5,766.96\).

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

Time Line:


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

Answer: c

Your proposal:
\(E A R_{1}=\$ 120 / \$ 1,000\)
\(E A R_{1}=12 \%\).
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 \(r_{\text {Nom }}=12 \%\) :
\(E A R_{2}=\left(1+\frac{0.12}{12}\right)^{12}-1=12.68 \%\).
Difference \(=12.68 \%-12.00 \%=0.68 \%\).
You could also visualize your friend's proposal in a time line format:


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:
\(\mathrm{P} / \mathrm{YR}=12\); \(\mathrm{NOM} \%=12\); and solve for \(\mathrm{EFF} \%=12.68 \%\).
126. EAR and FV of an annuity

Answer: d

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

    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


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:
\(\mathrm{NOM} \%=8 ; \mathrm{P} / \mathrm{YR}=12\); \(\mathrm{EFF} \%=8.30 \%\).
Now use this rate as the interest rate. Remember to switch back \(P / Y R=1\).

Step 2: Find the FV of the annuity:
\(\mathrm{N}=5 ; \mathrm{I} / \mathrm{YR}=8.30 ; \mathrm{PV}=0\); \(\mathrm{PMT}=-5000\); and solve for \(\mathrm{FV}=\) \(\$ 29,508.98\).
128. Remaining loan balance

Answer: a

Step 1: Solve for the monthly payment:
Enter the following input data in the calculator:
\(\mathrm{N}=60 ; \mathrm{I} / \mathrm{YR}=12 / 12=1 ; \mathrm{PV}=-15000 ; \mathrm{FV}=0\); and solve for \(\mathrm{PMT}=\$ 333.6667\).

Step 2: Determine the loan balance remaining after the \(30^{\text {th }}\) payment:
1 INPUT 30 ■ 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

Answer: c

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

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

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

Answer: c

Step 1: Determine the monthly payment of the mortgage:
Enter the following inputs in the calculator:
\(\mathrm{N}=360\); \(\mathrm{I} / \mathrm{YR}=8 / 12=0.6667 ; \mathrm{PV}=-165000 ; \mathrm{FV}=0\); 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

Chapter 2: Time Value of Money
```

Enter CFs:
CF
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:
\(\mathrm{N}=41 ; \mathrm{I} / \mathrm{YR}=10 ; \mathrm{PV}=0 ; \mathrm{PMT}=5000\); and solve for \(\mathrm{FV}=\) \(\$ 2,439,259\).

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:
\(\mathrm{N}=36 ; \mathrm{I} / \mathrm{YR}=10 ; \mathrm{PV}=0\); \(\mathrm{FV}=2439259\); and solve for \(\mathrm{PMT}=\) \$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:
\(\mathrm{N}=5 ; \mathrm{I} / \mathrm{YR}=3 ; \mathrm{PV}=-120000\); \(\mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\) \$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 \(\$ 500\) :
\(\mathrm{N}=360 ; \mathrm{I} / \mathrm{YR}=7 / 12=0.5833 ; \mathrm{PMT}=-500 ; \mathrm{FV}=0\); and solve for \(P V=\$ 75,153.78\).

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:

136. Monthly vs. quarterly compounding

Answer: C
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: \(\mathrm{NOM} \%=5 ; \mathrm{P} / \mathrm{YR}=12\); and solve for \(\mathrm{EFF} \%=5.1162 \%\).

Step 2: Translate the effective rate to a nominal rate based on quarterly compounding:
\(E F F \%=5.1162 ; P / Y R=4 ;\) and solve for \(N O M \%=5.0209 \%\) \(\approx 5.02 \%\).
137. Effective annual rate

Answer: d
\(\operatorname{EAR}_{\text {Qtr }}=\left(1+\frac{0.10}{4}\right)^{4}-1=10.38 \%\).
\(E A R_{D l_{Y}}=\left(1+\frac{0.09}{365}\right)^{365}-1=9.42 \%\).

Difference \(=10.38 \%-9.42 \%=0.96 \%\).
138. Amortization

Answer: c

Time Line:

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% }
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:
\(\mathrm{N}=30 \times 12=360 ; \mathrm{I} / \mathrm{YR}=9 / 12=0.75 ; \mathrm{PV}=-90000 ; \mathrm{FV}=0\); \(\mathrm{PMT}=\) \(\$ 724.16\).

Total payments in the first 2 years are \(\$ 724.16 \times 24=\$ 17,379.85\).
Use the calculator's amortization feature:
\(12 \times 2=24\) 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:
\(\mathrm{N}=360 ; \mathrm{I} / \mathrm{YR}=7.25 / 12=0.604167 ; \mathrm{PV}=-135000 ; \mathrm{FV}=0\); 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: \(\$ 1,623.0048 /(\$ 920.938 \times 12)=0.1469=14.69 \%\).
142. Amortization: remaining mortgage balance

Answer: b
Step 1: Find the monthly mortgage payment by entering the following inputs in your calculator: \(\mathrm{N}=360 ; \mathrm{I} / \mathrm{YR}=8 / 12=0.667 ; \mathrm{PV}=-300000 ; \mathrm{FV}=0\); and solve for \(\operatorname{PMT}=\$ 2,201.29\).

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:
\(\mathrm{N}=48 ; \mathrm{I} / \mathrm{YR}=12 / 12=1 ; \mathrm{PV}=-15000 ; \mathrm{FV}=0\); and solve for \(\mathrm{PMT}=\$ 395.0075\).

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: \(\mathrm{N}=60 ; \mathrm{I} / \mathrm{YR}=12 / 12=1 ; \mathrm{PMT}=-395.0075 ; \mathrm{FV}=0\); and solve for \(P V=\$ 17,757.5787\).

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

Answer: b

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:
\(\mathrm{N}=25 ; \mathrm{I} / \mathrm{YR}=12 ; \mathrm{PV}=-20000 ; \mathrm{PMT}=-5000\); 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:
\(\mathrm{N}=3 ; \mathrm{I} / \mathrm{YR}=12 ; \mathrm{PMT}=0 ; \mathrm{FV}=150000\); and solve for \(\mathrm{PV}=\) \$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 58th birthday, after 8 more annual contributions:
Enter the following input data in the calculator:
\(\mathrm{N}=8\); \(\mathrm{I} / \mathrm{YR}=12\); \(\mathrm{PV}=-899903.601\); PMT \(=-5000\); and solve for \(\mathrm{FV}=\$ 2,289,626.64 \approx \$ 2,289,627\).

First, convert the 9\% return with quarterly compounding to an effective rate of \(9.308332 \%\). With a financial calculator, \(N O M \%=9\); \(P / Y R=4\); \(\mathrm{EFF} \%=9.308332 \%\). (Don't forget to change \(\mathrm{P} / \mathrm{YR}=4 \mathrm{back}\) to \(\mathrm{P} / \mathrm{YR}=1\).) Then calculate the \(F V\) of all but the final payment. BEGIN MODE (1 \(P / Y R) N=9 ; ~ I / Y R=9.308332 ; ~ P V=0 ; ~ P M T=1500\); and solve for \(F V=\) \(\$ 21,627.49\). 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 \(I / Y R=15\), and solve for \(N P V=\) \(-\$ 58.945\). The future value of \(\$ 58.945\) will be the required cash flow. \(\mathrm{N}=4 ; \mathrm{I} / \mathrm{YR}=15 ; \mathrm{PV}=-58.945 ; \mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\$ 103.10\).

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

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:
\(E F F \%=6.167781 \% ; P / Y R=2\); and solve for \(\mathrm{NOM} \%=6.0755 \%\).
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:
\(\mathrm{N}=4 ; \mathrm{I} / \mathrm{YR}=3.037751 ; \mathrm{PV}=1000 ; \mathrm{PMT}=1000\); and solve for \(\mathrm{FV}=\) \(\$ 5,313.14\).

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:
\(\mathrm{N}=6\); \(\mathrm{I} / \mathrm{YR}=6.167781 ; \mathrm{PV}=-5313.14\); \(\mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\) \(\$ 7,608.65 \approx \$ 7,609\).
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. \(\mathrm{N}=40 ; \mathrm{I} / \mathrm{YR}=10 ; \mathrm{PV}=0 ; \mathrm{PMT}=-12000\); and solve for \(\mathrm{FV}=\$ 5,311,110.67\).

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. \(C F_{0}=58045 ; \mathrm{CF}_{1}=62108 ; \mathrm{CF}_{2}=66,456 \times 2=132912\) (two kids in school); \(\mathrm{CF}_{3}=71,108 \times 2=142216 ; \mathrm{CF}_{4}=76086 ; \mathrm{CF}_{5}=81411 ; \mathrm{I} / \mathrm{YR}=10 ; \mathrm{NPV}=\) \$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 \(t=40\). \(\mathrm{N}=20 ; \mathrm{I} / \mathrm{YR}=10 ; \mathrm{PV}=-433718.02\); \(\mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\) \$2,917,837.96.

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

Time Line:

```

Calculate the PV of CFs 4-8 as of time = 3 at i = 5%
Inputs: CF0 = 0; CF
Output: NPV}= \$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:

-\$8,554.84 PV of health care costs
1,082.76 PV of parents' savings
- \(\mathbf{\underline { \text { 7,472.08 } }}\) Lump sum government must set aside

Find the present value of parent's savings: \(N=18\); \(I / Y R=6\); \(P M T=-\) 100; \(\mathrm{FV}=0\); and solve for \(\mathrm{PV}=\$ 1,082.76\).

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: \(C F_{0}=0 ; \mathrm{CF}_{1-18}=0 ; \mathrm{CF}_{19}=\) -6115.91; \(\mathrm{CF}_{20}=-6727.50 ; \mathrm{CF}_{21}=-7400.25 ; \mathrm{CF}_{22}=-8140.27\); \(\mathrm{I} / \mathrm{YR}=6\); and solve for \(N P V=-8,554.84=P V\) of health care costs.

Consequently, the government must set aside \(\$ 8,554.84\) - \(\$ 1,082.76=\) \$7,472.08.
\(\$ 12,762.82 \times 1=\$ 12,762.82 ; \mathrm{CF}_{1}=\$ 10,000 \times(1.05)^{6}=\$ 13,400.96 \times 1=\)
\(\$ 13,400.96 ; \mathrm{CF}_{2}=\$ 10,000 \times(1.05)^{7}=\$ 14,071.00 \times 2=\$ 28,142.00 ; \mathrm{CF}_{3}=\)
\(\$ 10,000 \times(1.05)^{8}=\$ 14,774.55 \times 2=\$ 29,549.10 ; \mathrm{CF}_{4}=\$ 10,000 \times(1.05)^{9}=\)
\(\$ 15,513.28 \times 1=\$ 15,513.28 ; \mathrm{CF}_{5}=\$ 10,000 \times(1.05)^{10}=\$ 16,288.95 \times 1=\)
\$16,288. 95 .
Financial calculator solution:
Enter cash flows in CF register; \(I / Y R=8 ; ~ s o l v e ~ f o r ~ N P V ~=~ \$ 95,244.08 . ~\)
Calculate annuity:
\(\mathrm{N}=5 ; \mathrm{I} / \mathrm{YR}=8 ; \mathrm{PV}=-50000 ; \mathrm{FV}=95244.08\); and solve for \(\mathrm{PMT}=\$ 3,712.15\).
153. Required annuity payments

Answer: b
```

Step 1: Calculate the present value of college costs at }t=16\mathrm{ (Treat
t = 16 as Year 0.):
Remember, costs are incurred at end of year.
CF0 = 25000; CF 1 = 25000; CF 2 = 50000; CF3 = 50000; CF C = 25000;
CF5 = 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


Step 1: The retirement payments, which begin at \(t=2\), must be: \(\$ 40,000(1+\text { Infl. })^{2}=\$ 40,000(1.05)^{2}=\$ 44,100\).
Step 2: There will be 3 retirement payments of \(\$ 44,100\), made at \(t=2\), \(t=\)

3, and \(t=4\). We find the \(P V\) of an annuity due at \(t=2\) as follows: Set calculator to BEGIN mode. Then enter:
\(\mathrm{N}=3 ; \mathrm{I} / \mathrm{YR}=8 ; \mathrm{PMT}=44100 ; \mathrm{FV}=0\); and solve for \(\mathrm{PV}=\) \(\$ 122,742\). 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: \(\$ 100,000(1.08)^{2}=\$ 116,640\).
Step 4: So, he must save enough each year to accumulate an additional \(\$ 122,742-\$ 116,640=\$ 6,102\) :
Need at \(t=2 \quad \$ 122,742\)
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: \(\mathrm{N}=2\); \(\mathrm{I} / \mathrm{YR}=8 ; \mathrm{PV}=0 ; \mathrm{FV}=6102\); and solve for \(\mathrm{PMT}=\$ 2,716\).
155. Required annuity payments

Answer: c


Calculate the NPV of payments in Years 1-23:
\(C F_{0}=0 ; C F_{1-3}=25 ; C F_{4-23}=30 ; ~ I / Y R=8 ; ~ a n d\) solve for \(N P V=\$ 298.25\).
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:
\(\mathrm{N}=23\); \(\mathrm{I} / \mathrm{YR}=8 ; \mathrm{PV}=-62.14 ; \mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\$ 364.85\).
Calculate the value of the annuity payments in Years 24-40:
\(\mathrm{N}=17\); \(\mathrm{I} / \mathrm{YR}=8 ; \mathrm{PV}=-364.85 ; \mathrm{FV}=0\); and solve for \(\mathrm{PMT}=\$ 40\).
156. Required annuity payments

Answer: a

```

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
 birthday:
\(\$ 25,000(1.12)^{4}+\$ 2,000(1.12)^{3}+\$ 3,000(1.12)^{2}+4,000(1.12)+\) \(\$ 5,000(1.12)^{0}\)
\(=\$ 39,337.98+\$ 2,809.86+\$ 3,763.20+\$ 4,480.00+\$ 5,000.00\) \(=\$ 55,391.04\).
Step 2: Discount \(\$ 20,000\) withdrawal back to 29 th birthday ( 6 years) : \(\mathrm{N}=6 ; \mathrm{I} / \mathrm{YR}=12 ; \mathrm{PMT}=0 ; \mathrm{FV}=20000\); and solve for \(\mathrm{PV}=\) \(\$ 10,132.62\). (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: \(\mathrm{N}=11 ; \mathrm{I} / \mathrm{YR}=12 ; \mathrm{PV}=-45258.42\); \(\mathrm{FV}=400000\); 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 \(N O M \%=9 ; P / Y R=12\); and solve for \(E F F \%=9.3807 \%\).
Step 2: Compute the amount accumulated by age 40. Remember to change P/YR from 12 to 1. BEGIN mode. Then, enter \(\mathrm{N}=15\); \(\mathrm{I} / \mathrm{YR}=\) 9.3807; \(\mathrm{PV}=0 ; \mathrm{PMT}=2000\); and solve for \(\mathrm{FV}=\$ 66,184.35\).

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 \(N=25 ; ~ I / Y R=12 ; ~ F V=3000000 ; ~ P M T=0\); and solve for \(P V=\$ 176,469.92\).
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 \(\mathrm{N}=26\); \(\mathrm{I} / \mathrm{YR}=12\); \(\mathrm{PV}=\) 110285.57; \(\mathrm{FV}=0\); and solve for \(\mathrm{PMT}=\$ 12,471.31 \approx \$ 12,471\).

\section*{159. Required annuity payments}

Answer: a
```

Step 1 Calculate the cost of tuition in each year:
\$25,000(1.05) 15 = \$51,973.20; \$25,000(1.05) 16 = \$54,571.86 < 2 =
\$109,143.73; \$25,000(1.05)17 = \$57,300.46 > 2 = \$114,600.92;
\$25,000(1.05)18 = \$60,165.48 < 2 = \$120,330.96; \$25,000(1.05)19 =
\$63,173.75.
Step 2 Find the present value of these costs at t = 15:
CF0 = 51973.20; CF 1 = 109143.73; CF 2 = 114600.92; CF % =
120330.96; CF4 = 63173.75; I/YR = 12; and solve for NPV =
\$366,579.37.
Step 3 Calculate the FV of Grandma's deposits at t = 15:
Older son: \$10,000(1.12)18= \$ 76,899.66 (Deposit was made 3
years ago.)
Younger son: \$10,000(1.12)17 = \$ 68,660.41 (Deposit was made 2
years ago.) Total = \$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.

```

\section*{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:
\(\mathrm{N}=6\); \(\mathrm{I} / \mathrm{YR}=5 ; \mathrm{PV}=-20000\); \(\mathrm{PMT}=0\); and solve for \(\mathrm{FV}=\) \(\$ 26,801.9128\).
Step 2: Calculate the present value of his college cost:
Enter the following input data in the calculator:
\(\mathrm{N}=6\); \(\mathrm{I} / \mathrm{YR}=10\); \(\mathrm{PMT}=0\); \(\mathrm{FV}=26801.9128\); and solve for \(\mathrm{PV}=\) \$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: \(\mathrm{N}=2 ; \mathrm{I} / \mathrm{YR}=10 ; \mathrm{PMT}=0 ; \mathrm{FV}=15000\); and solve for \(\mathrm{PV}=\)
```

    $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 \approx \$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: \(\mathrm{N}=48 ; \mathrm{I} / \mathrm{YR}=1 ; \mathrm{FV}=6000\); \(\mathrm{PMT}=0\); and solve for \(\mathrm{PV}=\$ 3,721.56\).

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: \(\mathrm{N}=48 ; \mathrm{I} / \mathrm{YR}=1 ; \mathrm{PV}=13278.44 ; \mathrm{FV}=0\); and solve for \(\mathrm{PMT}=\$ 349.67\).
162. Required annuity payments

Answer: c
Here is the diagram of the problem:
24
0
```

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:
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline & \[
\begin{gathered}
25 \\
0
\end{gathered}
\] & \[
26
\] & \[
\begin{gathered}
27 \\
2
\end{gathered}
\] & & \[
\begin{aligned}
& 64 \\
& 39
\end{aligned}
\] & \[
\begin{aligned}
& 65 \\
& 40
\end{aligned}
\] \\
\hline Bill & PMT & PMT & PMT & & PMT & PMT \\
\hline Bob & & PMT & PMT & PMT & PMT & \(F V=\$ 3 \mathrm{M}\) \\
\hline & & PM & & & & \(\mathrm{FV}=\) \$3M \\
\hline
\end{tabular}

Step 2: Determine each's annual contribution:
Bill: He starts investing today, so use the BEGIN mode of the calculator.
Enter the following input data in the calculator:
\(\mathrm{N}=41 ; \mathrm{I} / \mathrm{YR}=12 ; \mathrm{PV}=0 ; \mathrm{FV}=3,000,000 \times 1.12=3360000\); and solve for \(P M T=\$ 3,487.79\). (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 \(\$ 3,000,000 \times 1.12\) one second before he turns 66.)
Bob: 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:
\(\mathrm{N}=40 ; \mathrm{I} / \mathrm{YR}=12 ; \mathrm{PV}=0\); \(\mathrm{FV}=3000000\); and solve for \(\mathrm{PMT}=\) \$3,910.88.

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

\section*{164. Amortization}

Answer: b
```

Time Line (in thousands):

```

```

Financial calculator solution:
Long way Inputs: $N=20 ; ~ I / Y R=8 ; ~ P V=0 ; ~ F V=1000000$. Output: $\mathrm{PMT}=-\$ 21,852.21$.
Add coupon interest and reserve payment together
Annual $\mathrm{PMT}_{\text {Total }}=\$ 80,000+\$ 21,852.21=\$ 101,852.21$.
Total number of tickets $=\$ 101,852.21 / \$ 10.00=10,185.22 \approx 10,186 . *$
Short way Inputs: $N=20 ; ~ I / Y R=8 ; ~ P V=1000000 ; F V=0$.

```
```

Output: PMT = -\$101,852.21.

```
Total number of tickets \(=\$ 101,852.21 / \$ 10.00 \approx 10,186 . *\)
*Rounded up to next whole ticket.
165. Effective annual rate

Answer: c


Numerical solution:
Step 1: Find the effective annual rate (EAR) of interest on the bank deposit:
\(E A R_{\text {Daily }}=(1+0.080944 / 365)^{365}-1=8.43 \%\).
Step 2: Find the EAR of the investment: \(\$ 8,000=\$ 10,000 /(1+i)^{2.25}\)
\((1+i)^{2.25}=1.25\)
\(1+i=1.25^{(1 / 2.25)}\)
\(1+i=1.10426\)
\(i=0.10426 \approx 10.43 \%\)
Step 3: Difference \(=10.43 \%-8.43 \%=2.0 \%\).

Financial calculator solution:
Calculate EAR \({ }_{\text {Daily }}\) using interest rate conversion feature
Inputs: \(P / Y R=365 ; \mathrm{NOM}=10.0944\). Output: \(E F F \%=E A R=8.43 \%\).

Calculate EAR of the equal risk investment
Inputs: \(N=2.25 ; \mathrm{PV}=-8000 ; \mathrm{PMT}=0 ; \mathrm{FV}=10000\).
Output: \(I / Y R=10.4259 \approx 10.43 \%\).
Difference: \(10.43 \%-8.43 \%=2.0 \%\).
166. PMT and quarterly compounding

Answer: b


Find the \(F V\) at \(t=80\) of \(\$ 400\) quarterly payments:
\(N=80 ; I / Y R=2 ; P V=0 ; P M T=400 ;\) and solve for \(F V=\$ 77,508.78\).

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

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:
\(\mathrm{N}=10 ; \mathrm{I} / \mathrm{YR}=8.2432\); \(\mathrm{PV}=-77508.78 ; \mathrm{FV}=0\); and solve for PMT = \(\$ 10,788.78 \approx \$ 10,789\).
167. Value of unknown withdrawal

Answer: d

Step 1: Find out how much Steve and Robert have in their accounts today:
You can get this from analyzing Steve's account.
END mode: \(N=9 ; \quad I / Y R=6 ; ~ P V=-5000 ; ~ P M T ~=-5000 ; ~ a n d ~ s o l v e\) for \(\mathrm{FV}=\$ 65,903.9747\).
Alternatively, BEGIN mode: \(N=9\); \(I / Y R=6 ; P V=0 ; P M T=\) -5000; and solve for \(\mathrm{FV}=\$ 60,903.9747\).
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: \(N=9 ; ~ I / Y R=12 ; ~ P V=-5000 ; ~ P M T=-5000 ;\) and solve for \(\mathrm{FV}=\$ 87,743.6753\).
Alternatively, BEGIN mode: \(\mathrm{N}=9\); \(\mathrm{I} / \mathrm{YR}=12\); \(\mathrm{PV}=0 ; \mathrm{PMT}=\) -5000; and solve for \(\mathrm{FV}=\$ 82,743.6753\).
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:
\(N=3 ; \quad I / Y R=12 ; P M T=0 ; F V=-21839.7006\); then solve for \(P V\) \(=\$ 15,545.0675 \approx \$ 15,545.07\).

\section*{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) \(N=12 ; ~ I / Y R=12 / 12=1 ; ~ P M T=-1000 ; ~ F V=0 ; ~ a n d ~ s o l v e ~ f o r ~ P V ~\) \(=\$ 11,367.63\).

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) \(\mathrm{N}=2 ; \mathrm{I} / \mathrm{YR}=12 / 2=6 ; \operatorname{PMT}=0 ; \mathrm{FV}=-12750\); and solve for \(\mathrm{PV}=\) \$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:
\(\mathrm{CF}_{0}=\$ 0.00 ; \mathrm{CF}_{1}=\$ 800.00 ; \mathrm{CF}_{2}=\$ 800.00(1.20)=\$ 960.00 ; \mathrm{CF}_{3}=\$ 960.00\) \((1.20)=\$ 1,152.00 ; \mathrm{CF}_{4}=\$ 1,152.00(1.20)=\$ 1,382.40 ; \mathrm{CF}_{5}=\$ 1,382.40\) \((1.20)=\$ 1,658.88 ; \mathrm{CF}_{6}=\$ 1,658.88(1.20)=\$ 1,990.66 ; \mathrm{CF}_{7}=\$ 1,990.66\) \((1.20)=\$ 2,388.79 ; \mathrm{CF}_{8}=\$ 2,388.79(1.20)=\$ 2,866.54\).

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) \(0 \mathrm{CF}_{j} ; 800 \mathrm{CF}_{j} ; 960 \mathrm{CF}_{j} ; 1152 \mathrm{CF}_{j} ; 1382.40 \mathrm{CF}_{j} ; 1658.88 \mathrm{CF} \mathrm{F}_{\mathrm{j}}\); 1990.66 \(\mathrm{CF}_{j} ; 2388.79 \mathrm{CF}_{j}\); \(2866.54 \mathrm{CF}_{j}\) (to enter the cash flows); I/YR = 12/4 = 3; solve for \(N P V=\$ 11,267.37\).

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

Answer: a

Step 1: Calculate the NPV of purchasing the car by entering the following data in your financial calculator:
\(C F_{0}=-17000 ; \mathrm{CF}_{1-47}=0 ; \mathrm{CF}_{48}=7000 ; \mathrm{I} / \mathrm{YR}=6 / 12=0.5\); and solve for NPV \(=-\$ 11,490.31\).

Step 2: Now, use the NPV calculated in Step 1 to determine the breakeven lease payment that will cause the two NPVs to be equal. Enter the following data in your financial calculator:
\(\mathrm{N}=48 ; \mathrm{I} / \mathrm{YR}=0.5 ; \mathrm{PV}=-11490.31 ; \mathrm{FV}=0\); and solve for \(\mathrm{PMT}=\) \$269.85.
170. Required mortgage payment

Answer: b

Just enter the following data into your calculator and solve for the monthly mortgage payment.
\(N=360 ; ~ I / Y R=7 / 12=0.583333 ; P V=-115000 ; F V=0 ;\) and solve for PMT \(=\$ 765.0979 \approx \$ 765.10\).
171. Remaining mortgage balance

Answer: e

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

Answer: d

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

I/YR = 10; PV = -2000; PMT = -1000; FV = 1000000; and solve for \(\mathrm{N}=46.51\).

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

Answer: c

Now, the time value of money problem has been modified to solve for I/YR. Enter the following data in your calculator:
\(\mathrm{N}=39\); \(\mathrm{PV}=-2000\); PMT \(=-1000 ; \mathrm{FV}=1000000\); and solve for \(\mathrm{I} / \mathrm{YR}=12.57 \%\).
174. Monthly mortgage payments

Answer: c
Enter the following data as inputs in your calculator: \(\mathrm{N}=30 \times 12=360\); \(\mathrm{I} / \mathrm{YR}=7.2 / 12=0.60\); \(\mathrm{PV}=-100000\); \(\mathrm{FV}=0\); solve \(\mathrm{PMT}=\$ 678.79\).
175. Amortization

Answer: d
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

Answer: d
Using your financial calculator, enter the following data inputs:
\(\mathrm{N}=180 ; \mathrm{I} / \mathrm{YR}=7.75 / 12=0.645833 ; \mathrm{PV}=-165000 ; \mathrm{FV}=0\); and solve for \(\mathrm{PMT}=\$ 1,553.104993 \approx \$ 1,553.10\).
177. Remaining mortgage balance

Answer: C
The complete solution looks like this:
\begin{tabular}{|c|c|c|c|c|}
\hline Beginning of Period & Mortgage Balance & Payment & Interest & \begin{tabular}{l}
Ending \\
Mortgage Balance
\end{tabular} \\
\hline 1 & \$165,000.00 & \$1,553.10 & \$1,065.63 & \$164,512.52 \\
\hline 2 & 164,512.52 & 1,553.10 & 1,062.48 & 164,021.89 \\
\hline 3 & 164,021.89 & 1,553.10 & 1,059.31 & 163,528.09 \\
\hline 4 & 163,528.09 & 1,553.10 & 1,056.12 & 163,031.11 \\
\hline 5 & 163,031.11 & 1,553.10 & 1,052.91 & 162,530.91 \\
\hline 6 & 162,530.91 & 1,553.10 & 1,049.68 & 162,027.49 \\
\hline 7 & 162,027.49 & 1,553.10 & 1,046.43 & 161,520.81 \\
\hline 8 & 161,520.81 & 1,553.10 & 1,043.16 & 161,010.86 \\
\hline
\end{tabular}
```

    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:
\(\mathrm{N}=360\); \(\mathrm{I} / \mathrm{YR}=8 / 12=0.6667\); \(\mathrm{PV}=75000\); \(\mathrm{FV}=0\); solve \(\mathrm{PMT}=\) \$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:
\(\mathrm{N}=360 ; \mathrm{I} / \mathrm{YR}=8 / 12=0.6667 ; \mathrm{PV}=75000 ; \mathrm{FV}=0\); and solve for PMT \(=\$ 550.3234\).

Step 2: Calculate new monthly payment:
\(\mathrm{N}=360 ; \mathrm{I} / \mathrm{YR}=7 / 12=0.5833 ; \mathrm{PV}=75000 ; \mathrm{FV}=0\); 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) = \(\$ 51.3465 \approx \$ 51.35\).
180. Monthly mortgage payment

Answer: c
Enter the following data in your calculator:
```

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 \(=\$ 2,931.87 /(\$ 2,931.87+\$ 21,504.50)\) \(=12 \%\).

\section*{WEB APPENDIX 2A SOLUTIONS}

2A-1. PV continuous compounding Answer: b EASY/MEDIUM
\(P V=F V_{n} / e^{\text {in }}=\$ 100,000 / e^{0.09(6)}=\$ 100,000 / 1.7160=\$ 58,275\).
2A-2. FV continuous compounding
Answer: a
MEDIUM
```

Daily compounding:
FV}= PV (1 + 0.06/365) 365(2) = \$1,000(1.12749)= \$1,127.49
Continuous compounding:

```

```

    Difference between accounts $ 2.25
    ```


Numerical solution:
(Constant \(e=2.7183\) rounded.)
\[
\$ 5,438=\mathrm{PVe}^{0.10(10)}
\]
\[
\$ 5,438=\mathrm{PVe}^{1}
\]
\[
P V=\$ 5,438 / e
\]
\[
=\$ 5,438 / 2.7183=\$ 2,000.52 \approx \$ 2,000
\]

Financial calculator solution:
Use ex exponential key on calculator. Calculate EAR with continuous compounding.
Inputs: \(\mathrm{X}=0.10\); press \(\mathrm{e}^{\mathrm{x}}\) key.
Output: \(e^{x}=1.1052\).
\(\mathrm{EAR}=1.1052-1.0=0.1052=10.52 \%\).
Calculate PV of FV discounted continuously
Inputs: \(N=10 ; ~ I / Y R=10.52 ; ~ P M T=0 ; ~ F V=5438\). Output: \(P V=-\$ 2,000\).
2A-4.
Continuous compounded interest rate
Answer: a MEDIUM/HARD

Calculate the growth factor using PV and FV which are given:
\(F V_{n}=P V e^{i n} ; \$ 19,000=\$ 14,014 e^{i 4}\)
\(\mathrm{e}^{\mathrm{i4}}=1.35579\).
Take the natural logarithm of both sides:
i(4) \(\ln \mathrm{e}=\ln 1.35579\).
The natural \(\log\) of \(e=1.0\).
Inputs: 1.35579. Press LN key. Output: LN = 0.30438.
\(i(4) \ln e=\ln 1.35579\)
\(i(4)=0.30438\)
\(i=0.0761=7.61 \%\).
2A-5. Payment and continuous compounding Answer: d MEDIUM/HARD


Account with
continuous
compounding
\[
-1,000
\]
\(\mathrm{FV}_{\mathrm{C}}=\) ? \(=1,233.70\)
Account with
semiannual
compounding
\(P V_{s}=\) ?
\(\mathrm{FV}_{\mathrm{s}}=\) ? \(=1,233.70\)

Step 1: Calculate the FV of the \(\$ 1,000\) deposit at \(7 \%\) with continuous compounding:
Using ex key:
Inputs: \(X=0.21\); press \(e^{x}\) key. Output: \(e^{x}=1.2337\).
```

    FV
    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
\[
\begin{aligned}
& \text { Numerical } \begin{aligned}
& \text { solution: } \\
& e^{(0.04)(10)}=\left(1+\frac{i}{2}\right)^{20} \\
& e^{0.4}=\left(1+\frac{i}{2}\right)^{20} \\
& e^{0.02}=1+\frac{i}{2} \\
& 1.0202=1+\frac{i}{2} \\
& \frac{i}{2}=0.0202 \\
& i=0.0404=4.04 \% .
\end{aligned} \\
& \\
& \\
&
\end{aligned}
\]

\section*{2A-7. Continuous compounding}

Answer: b MEDIUM/HARD
```

Time Line:

```

```

Numerical solution:
\$1,000 = PVe0.10(10) = PVe1.0
PV = \$1,000/e = \$1,000/2.7183 = \$367.88 \approx \$368.
Financial calculator solution:
Use e* exponential key on calculator. Calculate EAR with continuous
compounding.
Inputs: X = 0.10; press ex key. Output: e ex = 1.1052.

```
```

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


Numerical solution:
\[
F V_{20}=\$ 15,000 \mathrm{e}^{0.05(20)}=\$ 40,774.23 \approx \$ 40,774
\]

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 \(e^{x}\) key. Output: \(e^{x}=1.05127\). \(\operatorname{EAR}=1.05127-1.0=0.05127=5.127 \%\).

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

