



Financial Mathematics

A Practical Guide for Actuaries and other Business Professionals

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These are additional problems for our
Chapter 3 material

Question 2.9 is actually for ch 4 material

Ignore Question 2.15

Chapter 2 Practice Questions

Question guide

- Questions 2.1 – 2.9 test material from Sections 2.1 – 2.4.
- Questions 2.10 – 2.17 test material from Sections 2.5 – 2.6.
- Questions 2.18 – 2.20 are from the SOA/CAS Course 2 exam.

Question 2.1

Tyler graduates from college today and turns 22 years old. Starting one year from today, Tyler makes level annual deposits into a savings account that pays 4% per year. How much would Tyler need to deposit at the end of each year to have \$1,000,000 on his 65th birthday?

Question 2.2

Paul expects to receive payments of \$1,000 at the end of each year for 5 years, with payments to start one year from now. Howard expects to receive payments of \$ X at the end of each year for 10 years, with payments to start one year from now. At an annual effective interest rate of 5%, the present values of their cash flows are the same. Determine X .

Question 2.3

Starting today, Matt receives payments of \$20 at the beginning of each of the next three years. Starting three years from now, Matt receives payments of \$10 at the beginning of each of the next three years. The annual effective interest rate is 8%. Calculate the present value of these payments.

Question 2.4

Starting today, Sandy sets aside \$10,000 at the beginning of each year into a bank account that pays an annual effective interest rate of 5.5%. She makes 25 such deposits. Thirty years from today, Sandy uses the accumulated value in the account to purchase an annuity that pays \$ X at the beginning of each year for 25 years. Determine X .

Question 2.5

Find the present value at time 0 of regular payments of \$50 at times 25 years, 26 years, and so on, with the last payment at time 40 years. Use an annual effective interest rate of 12%.

Question 2.6

Find the accumulated value at time 15 years of payments of \$300 at times 5 years, 6 years, and so on, with the last payment at time 10 years. Use an annual effective interest rate of 3% and an annuity-immediate.

Question 2.7

Find the accumulated value at time 15 years of regular payments of \$50 made at times 5 years, 6 years, and so on, with the last payment at time 10 years. Use an annual effective interest rate of 16% and an annuity-due.

Question 2.8

Find the present value at time 2 years of payments of \$400 at times 8 years, 9 years, and so on, with the last payment at time 15 years. Use an annual effective interest rate of 9%.

Question 2.9

\$100 per year is received continuously from time 5 years to time 8 years. Assuming an annual effective interest rate of 4.5%, what is the accumulated value at time 10 years?

Question 2.10

Mary receives payments of \$100 at the beginning of each year, including today, forever. Virginia receives payments of \$X at the end of each year, starting 5 years from today, forever. The present values of their payments are the same at an annual effective interest rate of 10%. Calculate X.

Question 2.11

Payments of \$5,000 are received at the end of each year for 10 years, after which payments of \$1,000 are received at the end of each year forever. The annual effective interest rate is 9%. Determine the present value of these payments.

Question 2.12

Jim invests \$X at time 7 years in order to receive \$500 at the end of each year for 15 years starting at the end of the 10th year. Using an annual effective rate of interest of 4%, find X.

Question 2.13

Alan pays \$4,000 at time n years in order to receive \$438.52 at the end of each year for n years, starting with the $(n+1)$ th year. The annual effective rate of interest is 8%. Find n .

Question 2.14

Martha pays \$1,500 at time 10 years in order to receive \$1,000 at time 11 years and \$1,000 at time 12 years. Find the annual effective rate of interest that she earns on her money.

Question 2.15

Michael pays \$2,500 at time 0 in order to receive \$400 at the end of each year for 7 years with the first payment at the end of the first year. He also receives a lump sum of \$1,000 at time 8 years. Find the annual effective rate of interest that he earns on his money.

Question 2.16

You invest \$320.74 now in order to receive \$40 at the start of each year for n years, with the first payment in exactly 5 years. Using an annual effective rate of interest of 5.6%, find n .

Question 2.17

You invest \$50,000 at time 0 in order to receive payments of \$ X at times 15 years, 16 years, and so on, with the last payment at time 25 years. Using an annual effective rate of interest of 7%, find X .

Question 2.18

SOA/CAS

A perpetuity-immediate pays \$ X per year. Brian receives the first n payments, Colleen receives the next n payments, and Jeff receives the remaining payments. Brian's share of the present value of the original perpetuity is 40%, and Jeff's share is K . Calculate K .

Question 2.19

SOA/CAS

The present values of the following three annuities are equal:

- (i) Perpetuity-immediate paying \$1 each year, calculated at an annual effective interest rate of 7.25%
- (ii) 50-year annuity-immediate paying \$1 each year, calculated at an annual effective interest rate of j %
- (iii) n -year annuity-immediate paying \$1 each year, calculated at an annual effective interest rate of $j-1$ %.

Calculate n .

Question 2.20

SOA/CAS

To accumulate \$8,000 at the end of $3n$ years, deposits of \$98 are made at the end of each of the first n years and \$196 at the end of each of the next $2n$ years.

The annual effective rate of interest is i . You are given $(1+i)^n = 2.0$.

Determine i .

Solutions to practice questions

Chapter 2: Level annuities

Q2.1: \$9,089.89

Q2.2: \$560.69

Q2.3: \$77.76

Q2.4: \$49,839.51

Q2.5: \$22.97

Q2.6: \$2,249.60

Q2.7: \$942.79

Q2.8: \$1,438.90

Q2.9: \$350.22

Q2.10: \$161.05

Q2.11: \$36,781.74

Q2.12: \$5,139.79

Q2.13: 17

Q2.14: 21.5%

~~Q2.15: 9.15%~~

Q2.16: 15

Q2.17: \$17,193.27

Q2.18: 0.36

Q2.19: 30

Q2.20: 12.25%