1. Calculate the present value of an annuity immediate that pays 1000 at the end of each year for 20 years. The interest rate is an annual effective interest rate of 8%.

2. Using a nominal rate of 6% compounded monthly, calculate the present value of an annuity that pays 100 at the end of each month for 20 years.

3. Using an annual effective rate of 6%, calculate the present value of an annuity that pays 100 at the end of each month for 20 years.

4. Using a nominal rate of 6% compounded monthly, calculate the present value of an annuity that pays 100 at the beginning of each month for 20 years.

5. Calculate the accumulated value of an annuity immediate that pays 1000 at the end of each quarter for 20 years. The interest rate is an interest rate of 8% compounded quarterly.

6. Using an annual effective interest rate of 5%, calculate the accumulated value of an annuity that pays 250 at the beginning of each month for 14 years.

7. Jess takes a loan of 18,500 to buy a car. The loan has level monthly payments for 5 years and an interest rate of 12% compounded monthly.

   Determine the amount of the monthly payment.

8. Allison is the beneficiary of an annuity which pays her 1345 at the end of each month for the next five years. Allison takes each payment and invests it in a fund that earns an annual effective interest rate of 8.2%.

   Determine the amount that Allison will have at the end of five years.

9. Danielle borrows 17,000 to be repaid with level annual payments of 1224.93 at the end of each year of n years. The annual effective interest rate on the loan is 4.7%.

   Calculate n .

10. Denis borrows 100,000 to be repaid with quarterly payments of 2000 for 25 years.

    Determine the annual effective interest rate for the loan.

11. Caleb wants to buy a house in 5 years. He wants to accumulate 25,000 by the end of five years so that he can make a down payment on the house. In order to accumulate the 25,000, Caleb will deposit an amount of D at the beginning of each month into an account earning 9% compounded monthly.

    Determine D .

12. Shujing has invested 1000 at the beginning of each year into a bank account which pays an annual effective interest rate of i . At the end of 12 years, Shujing has accumulated 14,123.

    Determine i .

13. For a given interest rate, $s_{\overline{n}|} = 53.436141$ and $a_{\overline{n}|} = 11.272187$. Calculate n .

14. If $d = 0.08$, calculate $a_{\overline{17}|}$.

15. The accumulated value of an n year annuity is four times the present value of the same annuity.

    Calculate $100(1+i)^{2n}$.

16. You are given that $a_{\overline{n}|} = 10.17847$ and $s_{\overline{n}|} = 19.01987$. Calculate $a_{\overline{2n}|}$.

17. You are given $a_{\overline{n}|} = 37.3537$ and $\ddot{a}_{\overline{n}|} = 37.7272$. Calculate n .

18. Danny wants to accumulate a sum of money at age 65 so he can retire. In order to accomplish this goal, he can deposit 80 per month at the beginning of the month or 81 per month at the end of the month. Calculate the annual effective rate of interest earned by Danny.

19. Pratyush is the beneficiary of a Trust that will pay him and his descendants 10,000 at the end of each year in perpetuity.

    Calculate the present value of Pratyush's payments using an annual effective interest rate of 8%.

20. Alec is the beneficiary of a perpetuity that pays him 125 at the beginning of each month. Using an annual effective interest rate of 8%, calculate the present value of Alec's perpetuity.

21. The Purdue Actuarial Club has created a scholarship for actuarial students at Purdue. Current and past actuarial students have contributed 124,800 to this scholarship. The amount of the scholarship is determined assuming that an annual payment will be made at the end of each year forever using an interest rate of 5%.

    Determine the amount of the payment.

22. John is the beneficiary of a trust fund that has 100,000 in the fund. At the end of each month he or his descendants will receive 1000 forever.

    Calculate the annual effective interest rate earned by the trust fund.

23. Christine has inherited $1 million. She has decided to use her inheritance to purchase one of the following:

     a. A 30 year annuity immediate with annual payments of P ; or
     b. A perpetuity due with quarterly payments of 19,607.84.

Both options are based on the same interest rate.

Calculate P .

24. The value of a perpetuity immediate where the payment is P is 800 less than the value of a perpetuity due where the payment if P. Calculate P.

25. A perpetuity is funded by a donation of 500,000. Payments of P are to be made at the end of every second year. In other words, P will be paid at time 2, 4, 6, etc. If the fund earns an annual effective interest rate of 7%, calculate P.

26. Penelope borrows 10,000 to buy a car. The loan will be repaid with 48 monthly payments. However, the first payment will be deferred and is payable at the end of 6 months. The loan has an interest rate of 12% compounded monthly.

Determine Penelope's monthly payment.

27. Stephanie is the purchased a deferred perpetuity. The perpetuity will pay 100 at the end of each month with the first payment at the end of 10 years or 120 months. The interest rate for this perpetuity is 9% compounded monthly.

Determine the purchase price of this perpetuity.

28. An annuity immediate has 13 annual payments of 800. The annual effective interest rate is 9%.

Calculate the accumulated value of this annuity 5 years after the last payment.

29. An annuity due has 13 annual payments of 800. The annual effective interest rate is 9%.

Calculate the accumulated value of this annuity 5 years after the last payment.

30. A deferred annuity has 15 annual payments of 100 where the first payment is made in 6 years.

    Calculate the current value of this deferred annuity at the end of ten years using an annual effective interest rate of 4.75%.

31. Danielle invests 1000 at the end of each month into an account for nine years. At the end of nine years, Danielle stops making payments but leaves her money in the account for an additional five years.

    Danielle earns an annual effective interest of 9%.

    Calculate the amount that Danielle will have at the end of 14 years.

32. Isaiah has a 30 year mortgage loan on his house. The amount that he borrowed is 250,000 and his interest rate is 7.8% compounded monthly. Isaiah will repay the loan with monthly payments over the 30 years.

    Calculate the outstanding loan balance right after the 120th payment.

33. Luke borrows 25,000 to buy a new car. The loan will be repaid with monthly payments for 5 years at an interest rate of 10.8%. Luke's payment is Q but Luke decides to pay $Q+100$ every month in order to pay the loan off early.

    Determine the outstanding loan balance immediately after the 18th payment.

34. KC borrowed 20,000 to be repaid with annual payments of 2000 for 10 years followed by a payment of P at the end of each of the next 10 years.

    The annual effective interest rate on this loan is 5.75%.

    Calculate the outstanding loan balance right after the 10th payment.

35. Xiao is repaying a loan with monthly payments of 150. The interest rate on the loan is 4.8% compounded monthly.

    Xiao has 14 payments remaining with the next payment due in one month.

    Calculate the outstanding balance on this loan.

36. Ashley borrows 30,000 to buy a new car. Her loan carries a monthly effective interest rate of 1%. She will repay the loan by making monthly payments of 721.70.

    Ashley makes k payments of 721.70. Immediately after the kth payment, she pays off the outstanding balance of her loan by making a payment of 13,608.94.

    Determine k.

37. A loan of 10,000 is being repaid with 20 non-level annual payments. The interest rate on the loan is an annual effective rate of 8%. The loan was originated 4 years ago. Payments of 500 at the end of the first year, 750 at the end of the second year, 1000 at the end of the third year and 1250 at the end of the fourth year have been paid. Calculate the outstanding balance immediately after the fourth payment.

38. Calculate the outstanding balance on the loan in Number 37 one year after the fourth payment immediately before the fifth payment.

39. Rachel is the beneficiary of the Crum Trust which will pays her a perpetuity of 10,000 at the beginning of each year forever. Using an annual effective interest rate of i, this perpetuity has a present value of 135,000.

    Chloe loans 50,000 to Dakota. Dakota will repay the loan with level annual payments of 5000 for n year followed by a smaller payment at the end of $n+1$ years. The annual effective interest rate on the loan is i - the same interest rate used to calculate Rachel's present value.

    Dakota makes the first 4 payments. She then forgets to make the payment at the end of year five, but did make the payments at the end of the sixth, seventh and eighth years.

    Determine the outstanding loan balance at the end of the eighth year right after Dakota's payment.

40. Wenhui is receiving an annuity with 15 annual payments at the beginning of each year. The first five payments are 500. The second five payments are 1000. The final five payments are 2000.

    Using an annual effective interest rate of 7.5%, calculate the present value of Wenhui's payments.

41. Bixiao owns a 10 year annuity with quarterly payments at the end of each quarter. Within each year, the first payment is 100, the second payment is 500, the third payment is 300, and the last payment is 1000. In other words, Bixiao receives 100 at the end of the first quarter, the fifth quarter, the ninth quarter, etc. He also receives 500 at the end of the second quarter, the sixth quarter, the 10th quarter, etc. The amount at the end of the third quarter is 300 as well as at the end of the seventh quarter, the eleventh quarter, etc. Finally, he receives 1000 at the end of the fourth quarter, the eighth quarter, the twelfth quarter, etc.

    Using an interest rate of 9% compounded quarterly, determine the present value of this annuity.

42. Kelly is receiving a 30 year annuity makes payments at the end of each year. Payments alternate between 2000 and 3000. In other words, the payments at the end of years 1, 3, 5, etc are 2000 while the payments at the end of years 2, 4, 6, etc are 3000.

    Kelly invests each payment in a fund earning a 6% annual effective interest rate.

    How much does Kelly have at the end of 30 years?

43. Linsu is the beneficiary of an annuity immediate with annual payments for 22 years. The first payment is 1000. The second payment is $1000(1.04)$. The third payment is $1000(1.04)^2$. The payments continue to increase so that each payment is 104% of the prior payment.

    Using an annual effective interest rate of 6.2%, calculate the present value of Linsu's annuity.

44. Payton is receiving payments at the beginning of each quarter for the next 16 years. The first payment is 100, the second payment is 100(1.04), the third payment is $100(1.04)^2$, etc.

    Using an annual effective interest rate of 8%, calculate the present value of Payton's annuity.

45. An annuity has increasing payments at the beginning of each year for 24 years. The first payment is 10,000. Each subsequent payment is 105% of the prior payment.

    Using an annual effective interest rate of 9.2%, calculate the accumulated value of this annuity at the end of 24 years.

46. Joanna is receiving an annuity due with 28 payments. The first payment is 13,000. Each subsequent payment is 95% of the previous payment.

    Calculate the present value of Joanna's annuity at an annual effective rate of 4.5%.

47. An annuity immediate has geometrically increasing payments made annually for 24 years. The first payment is 1000. The second payment is 1000(1.08). The third payment is (1000)(1.08)^2 and payments continue to increase at a rate of 8% each year.

Calculate the present value of this annuity at an annual interest rate of 8%.

48. An annuity due has monthly payments for 7 years. The first payment is 800 with each successive payment being 1% larger than the previous payment. Tony invests each payment in an account that earns 12% compounded monthly.

Calculate the amount that Tony will have in the account at the end of 7 years.

49. A perpetuity makes payments at the end of each year. The first payment is 2000. Each payment thereafter is 103% of the previous payment. Calculate the present value of this perpetuity at an interest rate of 8%.

50. Ash is the beneficiary of a deferred perpetuity with increasing annual payments once the payments begin. The first payment will be in 2000 at the end of 10 years. The second payment will be 2000(1.06) at the end of 11 years. The third payment will be 2000(1.06)^2 at the end of 12 years. The payments will continue forever with each payment being 106% of the prior payment.

Using an annual effective interest rate of 10%, calculate the present value of Ash's payments.

51. Daniel wants to buy an annuity for his mother. Daniel wants it to be an annuity due which pays increasing payments at the beginning of each year for 20 years. The first payment is P. The second payment is $P(1.057)$. The third payment is $P(1.057)^2$. The payments continue to increase in the same pattern with each payment being 105.7% of the prior payment.

Daniel has 100,000 to spend to purchase this annuity. He will pay the present value of the annuity using an annual effective interest rate of 8%.

Determine P.

52. Brian earned a scholarship which pays him a monthly payment at the end of each month for 48 months. The first payment is 50. The second payment is 60. The third payment is 70. The same pattern continues with each payment being 10 greater than the previous payment.

Calculate the present value of the scholarship using an interest rate of 9% compounded monthly.

53. As a retirement benefit, Jeff receives an annuity due with makes annual payments for 20 years. The first payment is 10,000. Each payment thereafter, the payment is 1500 greater than the prior payment. In other words, the first payment is 10,000. The second payment is 11,500. The third payment is 13,000, etc.

    Calculate the present value of this retirement benefit at an annual effective rate of 5%.

54. An annuity pays 100 at the end of the first quarter, 200 at the end of the second quarter, 300 at the end of the third quarter, etc. The payments continue for 5 years.

    Calculate the accumulated value of this annuity using an interest rate of 8% compounded quarterly.

55. An annuity due makes annual payments for 15 years. The first payment is 15,000. The second payment is 14,000. The payments continue in the same pattern until the last payment of 1000 is made.

    Calculate the present value of this annuity at an annual effective interest rate of 7%.

56. Spenser is receiving annuity payments at the end of each quarter for 20 years. The first payment is P. The second payment is $2P$. The third payment is $3P$ and payments continue to increase in the same pattern.

    The accumulated value of Spenser's annuity is 75,000 using a quarterly effective interest rate of 2%.

    Determine P.

57. Queenie is the beneficiary of a trust fund that will make a payment on each of her birthdays with the final payment on her 60th birthday. Today is Queenie's 20th birthday and she will receive the first payment of 50,000. Each subsequent payment will be 1000 less than the prior payment. In other words, she will receive 49,000 on her 21st birthday, 48,000 on her 22nd birthday, etc.

    Calculate the present value of Queenie's payments at an annual effective interest rate of 5%.

58. Sarah is receiving a perpetuity of 1000 payable at the beginning of each year. John is receiving a perpetuity immediate that pays 200 at the end of year one, 400 at the end of year two, 600 at the end of year three, etc. The present value of Sarah's perpetuity is equal to the present value of John's perpetuity if the present values are calculated at i. Calculate i.

59. An annuity pays 10 at the end of year 2, and 9 at the end of year 4. The payments continue decreasing by 1 each two year period until 1 is paid at the end of year 20. Calculate the present value of the annuity at an annual effective interest rate of 5%.

60. A perpetuity immediate makes annual payments. The first payment is 500. Each subsequent payment is 25 greater than the prior payment until the payments reach 750. Thereafter, all payments will be 750.

    Calculate the present value of this perpetuity at an annual interest rate of 6%.

61. Suyi invests 1000 at the end of each year for 20 years into Fund A. Fund A earns an annual effective interest rate of 5%. At the end of end of each year, the interest is removed from Fund A and invested in Fund B. Fund B earns an annual effective interest rate of 8%. What is the total amount that Suyi will have at the end of 20 years.

62. Ryan invests 100,000 in Fund A today which earns an annual effective interest rate of 8% interest. The interest on Fund A is paid at the end of each year into Fund B which earns an annual effective interest rate of 9%. The interest on Fund B is also paid out at the end of each year into Fund C which earns an annual effective interest rate of 10%. At the end of 12 years, Ryan liquidates all three Funds. How much does Ryan have?

63. Colleen invests P into Fund A at the start of each year for 25 years. Fund A earns an annual effective interest rate of 10%.

    At the end of each year, Colleen withdraws the interest from Fund A and deposits it into Fund B which earns an annual effective interest rate of 6%.

    At the end of 25 years, Colleen has a total of 135,000 in both accounts.

    Determine P.

64. Will has a loan of 50,000 which is being repaid with annual payments of 6000 followed by a smaller drop payment. The loan has an interest rate of 7%. Calculate the amount of the drop payment.

65. Daniel borrowed 30,000 to be repaid with monthly payments of 1000 with the final payment being a balloon payment. The interest rate on the loan is 14.4% compounded monthly.

    Calculate the amount of the balloon payment.

66. Mingjing has a loan of 50,000 which is being repaid with monthly payments of 1500. The final payment will be a Balloon payment of B. The interest rate on the loan is 18% compounded monthly.

Aiman has an identical loan except the last payment is a Drop payment of D.

Calculate B-D.

Answers

1. 9818.15
2. 13,958.08
3. 14,138.43
4. 14,027.87
5. 193,771.96
6. 60,376.42
7. 411.52
8. 98,587.31
9. 23
10. 6.4922%
11. 328.99
12. 2.4814%
13. 23
14. 8.7133
15. 1600
16. 15.6255
17. 47
18. 16.075%
19. 125,000
20. 19,552.95
21. 6240
22. 12.6825%
23. 90,873.61
24. 800
25. 72,450
26. 276.77
27. 5479.96
28. 28,253.30
29. 28,253.30
30. 1331.45
31. 250,176.52
32. 218,397.76 You may get a slightly different answer due to rounding but it should be within 0.50.
33. 16,909.36
34. 8927.00
35. 2038.32
36. 33
37. 9770.23
38. 10,551.85
39. 45,661.93
40. 9424.76
41. 12,260.30
42. 196,494.13

43. 16,775.06
44. 12,844.22
45. 1,310,871.17
46. 133,083.90
47. 22,222.22
48. 155,011.77
49. 40,000
50. 21,204.88
51. 6087.55
52. 10,877.64
53. 285,972.46
54. 23,916.59
55. 90,064.74
56. 12.75
57. 661,250.05
58. 20%
59. 38.25
60. 11,400.04
61. 36,101.23
62. 263,566.84
63. 1682.02
64. 5648.39
65. 1409.82
66. 1487.65