Financial Mathematics: exam practice

10 questions · 54 marks · worked solutions and markschemes

Name _____ Date _____ Score / 54

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/slai/financial-mathematics-exam-practice

1. **3 marks · Paper 1 style · calculator allowed**

Amira invests €$10\,000$ at a nominal annual interest rate of 5%, compounded annually, for 8 years. Inflation is expected to be 2% per year over this time.

By using the real interest rate, find the real value of the investment after 8 years. **[3]**

2. **4 marks · Paper 1 style · calculator allowed**

David invests €6000 in a bank account that pays 3.5% p.a. **simple interest** for 4 years.

1. Calculate the total interest earned over the 4 years.
2. Calculate the total value of the investment at the end of the 4 years.

3. **5 marks · Paper 1 style · calculator allowed**

A company purchases a new delivery van for €$32\,000$. The value of the van depreciates at a rate of 14% per annum.

1. Find the value of the van after exactly 3 years.
2. Using your GDC, find the exact time (in years) it takes for the van's value to halve.

4. **4 marks · Paper 2 style · calculator allowed**

An amount of €4500 is invested in a bank account that pays a nominal annual interest rate of 3.8%, compounded quarterly.

1. Find the value of the investment after 6 years.
2. Calculate the total interest earned over this period.

5. **5 marks · Paper 2 style · calculator allowed**

Carla borrows €$15\,000$ to buy a car. The loan is repaid with equal monthly payments over 5 years, at a nominal annual interest rate of 6%, compounded monthly.

(a) Find the monthly payment. **[3]**

(b) Find the total amount of interest Carla pays. **[2]**

6. **5 marks · Paper 2 style · calculator allowed**

Jonas saves €200 at the end of every month in an account paying a nominal annual interest rate of 3.6%, compounded monthly.

(a) Find the value of his savings after 10 years. **[3]**

(b) Find how much of this is interest. **[2]**

7. **5 marks · Paper 2 style · calculator allowed**

A machine costs €$80\,000$. Its value falls by 18% each year.

(a) Find the value of the machine after 4 years. **[2]**

(b) Find the number of complete years until the value of the machine is first below €$20\,000$. **[3]**

8. **6 marks · Paper 1 style · calculator allowed**

Isabella invests €$15\,000$ in an account paying 6.5% nominal annual interest, **compounded annually** for 8 years. The average rate of inflation over this period is expected to be 2.4% per year.

1. Calculate the nominal value of the investment after 8 years.
2. Calculate the approximate real interest rate.
3. Calculate the real value of the investment after 8 years, taking inflation into account.

9. **8 marks · Paper 2 style · calculator allowed**

John plans to deposit €500 at the end of each year into an annuity paying a nominal annual interest rate of 6.0%, **compounded annually** for 10 years. He expects the average inflation rate over this period to be 2.5% per year.

1. Calculate the nominal future value of the annuity after 10 years.
2. Calculate the approximate real interest rate.
3. Calculate the real value of the annuity after 10 years by using the real interest rate in your GDC calculations.

10. **9 marks · Paper 2 style · calculator allowed**

A family takes out a mortgage of €$200\,000$ to buy a house. The loan is amortized over 20 years at a nominal annual interest rate of 4.5%, **compounded monthly**. Fixed repayments are made at the end of each month. The monthly repayment is €1265.30, correct to the nearest cent.

1. Using your GDC, calculate the outstanding balance (the amount still owed) at the end of exactly 5 years.
2. Calculate the amount of the principal that has been paid off during the first 5 years.
3. Calculate the total interest paid during the first 5 years.

Answers and worked solutions

Question 1

3 marks

Answer: €12 667.70

real rate $5\% - 2\% = 3\%$ (A1)

$10\,000 \times 1.03^8$ (M1)

€12 667.70 A1

Question 2

4 marks

Answer: (a) 840; (b) 6840

1. $I = \frac{C \times r \times t}{100} = \frac{6000 \times 3.5 \times 4}{100}$. (M1)
   $I =$ €840. A1
2. $Total = 6000 + 840$. (M1)
   $=$ €6840. A1

Question 3

5 marks

Answer: (a) 20353.79; (b) 4.60

1. Apply depreciation for 3 years:
   $V = 32000(1 - 0.14)^3 = 32000(0.86)^3$ (M1)
   $V =$ €20 353.79 A1
2. Set the value equal to half the cost:
   $16000 = 32000(0.86)^t \implies 0.5 = 0.86^t$ (M1)
   Solve using GDC graph intersection or solver: (M1)
   $t = 4.60$ years ($4.5957\ldots$) A1

Question 4

4 marks

Answer: (a) 5646.30; (b) 1146.30

1. $N = 6 \times 4 = 24$ periods, $I\% = 3.8$, $PV = -4500$, $P/Y = C/Y = 4$ (M1)
   $FV = 4500\left(1 + \frac{3.8}{400}\right)^{24}$ M1
   $FV =$ €5646.30 A1
2. Interest
   $= 5646.30 - 4500 =$ €1146.30 A1

Question 5

5 marks

Answer: (a) €289.99; (b) €2399.40

(a)

$N = 60$, $I\% = 6$, $PV = 15\,000$, $FV = 0$, $P/Y = C/Y = 12$ (M1) (A1)

€289.99 A1

(b)

$60 \times 289.99 - 15\,000$ (M1)

€2399.40 A1

Question 6

5 marks

Answer: (a) €28 837.14; (b) €4837.14

(a)

$N = 120$, $I\% = 3.6$, $PV = 0$, $PMT = -200$, $P/Y = C/Y = 12$ (M1) (A1)

€28 837.14 A1

(b)

$28\,837.14 - 120 \times 200$ (M1)

€4837.14 A1

Question 7

5 marks

Answer: (a) €36 169.74; (b) 7 years

(a)

$80\,000 \times 0.82^4$ (M1)

€36 169.74 A1

(b)

$80\,000 \times 0.82^n < 20\,000$ (M1)

$n > 6.98\ldots$ (A1)

7 years A1

Question 8

6 marks

Answer: (a) 24824.94; (b) 4.1; (c) 20686.98

1. Nominal $FV = 15000(1.065)^8$ (M1)
   $=$ €24 824.94 ($24824.935\ldots$) A1
2. Real rate $\approx$ nominal rate $-$ inflation rate $= 6.5\% - 2.4\% = 4.1\%$ (M1)A1
3. Use the real rate: Real
   $FV = 15000(1.041)^8$ (M1)
   $=$ €20 686.98 ($20686.980\ldots$) A1

Question 9

8 marks

Answer: (a) 6590.40; (b) 3.5; (c) 5865.70

1. GDC App:
   $N = 10$, $I\% = 6.0$, $PV = 0$, $PMT = -500$, $P/Y = 1$, $C/Y = 1$ (M1)(A1)
   $FV =$ €6590.40 A1
2. Real rate $\approx$ nominal rate $-$ inflation
   $= 6.0\% - 2.5\% = 3.5\%$ (M1)A1
3. GDC App with the real rate:
   $N = 10$, $I\% = 3.5$, $PV = 0$, $PMT = -500$, $P/Y = 1$, C/Y (M1)(A1)
   Real $FV =$ €5865.70 A1

Question 10

9 marks

Answer: (a) 165399.98; (b) 34600.02; (c) 41317.98

1. Monthly repayment
   $PMT = -1265.30$ (or the unrounded value $-1265.2987\ldots$ found with $N = 240$) (M1)
   GDC TVM:
   $N = 60$, $I\% = 4.5$, $PV = 200000$, $PMT = -1265.30$, P/Y = (A1)
   Outstanding balance:
   $FV = -165\,399.98\ldots \implies$ €165 399.98
   (accept €165 399.90 from the rounded repayment, or €165 400) A1
2. Principal paid
   $= 200000 - 165399.98$ (M1)
   $=$ €34 600.02 (accept €34 600.10)
   A1
3. Total repayments in 5 years
   $= 60 \times 1265.30$ (M1)
   $=$ €75 918 (A1)
   Interest
   $=$ total repaid $-$ principal paid $= 75918 - 34600.02$ (M1)
   $=$ €41 317.98 (accept €41 317.90)
   A1

Every solution is also on ibmathrevision.com/slai/financial-mathematics-exam-practice
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