IB MATHS AA SL · UNIT 1

Financial Math: exam practice

10 questions · 50 marks · worked solutions and markschemes

Name _____ Date _____ Score / 50

- 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/slaa/financial-math-exam-practice

1. **3 marks · Paper 1 style · no calculator**

A machine bought for €$20,000$ depreciates at a constant rate of 12% per year. Write down an exact expression, using logarithms, for the number of years t it will take for the machine's value to halve.

2. **3 marks · Paper 2 style · calculator**

Lena invests €4000 at a nominal annual interest rate of 5%, compounded monthly.

Find the value of her investment after 6 years, to the nearest euro. **[3]**

3. **5 marks · Paper 2 style · calculator**

Aidan invests €5000 in a savings account that pays a nominal annual interest rate of $r\%$, compounded quarterly. After 5 years, the value of the investment has grown to €7000. Find the value of r, correct to two decimal places.

4. **6 marks · Paper 2 style · calculator**

On 1st January 2021, Nerys invests €P in an account that pays a nominal annual interest rate of 4.2%, compounded monthly. The amount of money in Nerys' account at the end of each year follows a geometric sequence with common ratio, r.

1. Find the exact value of r, giving your answer to four decimal places.
2. Nerys makes no further deposits to or withdrawals from the account. Find the year in which the amount of money in Nerys' account will become double the amount she invested.

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

Amelia sets a target of saving €$20\,000$. She invests her initial €9000 in an account that offers an interest rate of 7% per annum compounded annually.

1. Find the value of Amelia's investment after 5 years to the nearest hundred euros.
2. Determine the number of years required for Amelia's investment to reach the target.

6. **5 marks · Paper 1 style · no calculator**

Sophia agrees to a repayment plan where she pays €d in the first month and then €k each subsequent month. After three months in total, she has paid €1200. After six months in total, she has paid €2100. Find the values of d and k.

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

A car is bought for €$28\,000$. Its value falls by 15% each year.

(a) Find the value of the car after 3 years. **[2]**

(b) Find the number of complete years after which the value of the car is first less than €$10\,000$. **[3]**

8. **5 marks · Paper 2 style · calculator**

Two savings accounts are offered for an investment of €6000. Account A pays 4.8% per year compounded annually. Account B pays a nominal annual rate of 4.7% compounded quarterly.

(a) Find the value of the investment after 10 years in account A. **[2]**

(b) Find the value of the investment after 10 years in account B. **[2]**

(c) State which account gives more after 10 years. Justify your answer. **[1]**

9. **7 marks · Paper 1 style · no calculator**

Ana saves money each month. She saves €40 in the first month and each month after that she saves €6 more than in the month before.

(a) Find how much she saves in the 12th month. **[2]**

(b) Find the total amount she has saved after 12 months. **[2]**

(c) Find the first month in which her total savings exceed €2000. **[3]**

10. **6 marks · Paper 2 style · calculator**

Marco invests €2500 in an account that pays a nominal annual interest rate of $r\%$, compounded monthly. After 8 years the investment is worth €3800.

(a) Find the value of r, correct to 2 decimal places. **[3]**

(b) Using this value of r, find the number of complete months until the investment first exceeds €5000. **[3]**

Answers and worked solutions

Question 1

3 marks

Answer: $t = \ln(0.5)/\ln(0.88)$

Set up the equation:
$20000(1-0.12)^t = 10000 \implies 0.88^t = 0.5$ **M1**

Take logs of both sides: $t \ln 0.88 = \ln 0.5$ **(M1)**
$t = \frac{\ln 0.5}{\ln 0.88}\ (\approx 5.42)$ **A1**

Question 2

3 marks

Answer: €5396

$4000\left(1+\frac{0.05}{12}\right)^{12\times 6}$ **(M1)(A1)**

€5396 **A1**

Question 3

5 marks

Answer: $r = 6.79$

Set up the compound interest equation:
$5000\left(1+\frac{r}{400}\right)^{4\times 5} = 7000$ $M1$**A1**
Isolate the power: $\left(1+\frac{r}{400}\right)^{20} = 1.4$ **(M1)**
Take the 20th root:
$1+\frac{r}{400} = 1.4^{\frac{1}{20}} = 1.016965\ldots$ **(A1)**
$r = 400(1.016965\ldots - 1) = 6.79$ (2 d.p.) **A1**

Question 4

6 marks

Answer: (a) $r = 1.0428$; (b) 2037

1. **Formula:** The monthly multiplier is $1+\frac{4.2}{12\times 100} = 1.0035$. **(M1)**
   To find the annual multiplier r, raise to the power of 12: $r = (1.0035)^{12}$. **(M1)**
   $r = 1.042818\ldots \implies r = 1.0428$. **A1**
2. **Formula:** $1.0428^n = 2$. **(M1)**
   CG50: `MENU C (Financial) -> F2 (Compound Interest)`.
   Set `I% = 4.2`, `PV = -100`, `PMT = 0`, `FV = 200`, `P/Y = 12`, `C/Y = 12`. Press `F1 (n)`.
   $n = 198.39$ months. **(A1)**
   Divide by 12: $198.39/12 \approx 16.53$ years.
   $2021 + 16 = 2037$. **A1**

Question 5

5 marks

Answer: (a) €12600; (b) 12 years

1. **Formula:** $9000(1.07)^5$. **(M1)**
   $FV = 12622.965\ldots$ **(A1)**
   Nearest hundred: €12 600. **A1**
2. **Formula:**
   $9000(1.07)^n = 20000 \implies 1.07^n = \frac{20}{9}$. **(M1)**
   CG50 Financial: `I% = 7`, `PV = -9000`, `FV = 20000`. Solve n: $n = 11.8$.
   Interest is added once a year, so the target is reached after 12 years. **A1**

Question 6

5 marks

Answer: $d = 600$; $k = 300$

Total after three months: $d + 2k = 1200$ **M1**
Total after six months: $d + 5k = 2100$ **M1**
Subtract the equations to eliminate d: $3k = 900$ **M1**
$k = 300$ **A1**
Substitute back: $d = 1200 - 2(300) = 600$ **A1**

Question 7

5 marks

Answer: (a) €17 195.50; (b) 7 years

(a)

$28\,000 \times 0.85^3$ **(M1)**

€17 195.50 **A1**

(b)

$28\,000 \times 0.85^n < 10\,000$ **(M1)**

$n > 6.335\ldots$ **(A1)**

7 years **A1**

Question 8

5 marks

Answer: (a) €9588.80; (b) €9573.70

(a)

6000×1.048^{10} **(M1)**

€9588.80 **A1**

(b)

$6000\left(1+\frac{0.047}{4}\right)^{40}$ **(M1)**

€9573.70 **A1**

(c)

Account A, since $9588.80 > 9573.70$ **R1**

Question 9

7 marks

Answer: (a) €106; (b) €876; (c) the 21st month

(a)

$u_{12} = 40 + 11 \times 6$ **(M1)**

€106 **A1**

(b)

$S_{12} = \frac{12}{2}(40 + 106)$ **(M1)**

€876 **A1**

(c)

$\frac{n}{2}(80 + 6(n-1)) > 2000$ **(M1)**

$3n^2 + 37n - 2000 > 0$, $n > 20.4\ldots$ **(A1)**

the 21st month **A1**

Question 10

6 marks

Answer: (a) $r = 5.25$; (b) 159 months

(a)

$2500\left(1+\frac{r}{1200}\right)^{96} = 3800$ **(M1)(A1)**

$r = 5.25$ (5.2504…) **A1**

(b)

$2500\left(1+\frac{5.25}{1200}\right)^{m} > 5000$ **(M1)**

$m > 158.78\ldots$ **(A1)**

159 months **A1**

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