

LC 2013 (SET D): PAPER 1

QUESTION 4 (25 MARKS)**Question 4 (a) (i)**

Annual interest rate $r_A = 0.4\% \Rightarrow i_A = 0.04$

$(1 + i_M)^{12} = (1 + 0.04)$, where i_M is the monthly interest rate

$$(1 + i_M)^{12} = 1.04$$

$$1 + i_M = 1.04^{\frac{1}{12}}$$

$$i_M = 1.04^{\frac{1}{12}} - 1 = 0.00327$$

$$\therefore r_M = 0.327\%$$

MARKING SCHEME NOTES**Question 4 (a) (i) [Scale 5C* (0, 2, 4, 5)]**

- 2:**
- Any relevant first step
 - Correct statement with no work

- 4:**
- r not as a %

NOTE: Incomplete rounding or incorrect rounding or no rounding gets 4 marks

Question 4 (a) (ii)

Call A the amount of money she saves each month. She saves for 36 months at a monthly interest rate of 0.327%. Her first saving amount A earns interest for 36 months, her second saving amount A earns monthly interest for 35 months and so on.

$$15\,000 = A \times 1.00327^{36} + A \times 1.00327^{35} + \dots + A \times 1.00327^2 + A \times 1.00327^1$$

$$15\,000 = A(1.00327^{36} + 1.00327^{35} + \dots + 1.00327^2 + 1.00327^1)$$

$$15\,000 = A(1.00327^1 + 1.00327^2 + \dots + 1.00327^{35} + 1.00327^{36})$$

This is a geometric series. You can work out the sum of these 36 savings.

$$a = 1.00327, r = 1.00327$$

$$S_{36} = \frac{1.00327(1 - 1.00327^{36})}{1 - 1.00327}$$

$$1500 = A \left[\frac{1.00327(1 - 1.00327^{36})}{1 - 1.00327} \right]$$

$$\therefore A = \frac{15\,000(1 - 1.00327)}{1.00327(1 - 1.00327^{36})} = \text{€}392$$

FORMULAE AND TABLES BOOK**Sequences and series:****Geometric series [page 22]**

$$S_n = \frac{a(1 - r^n)}{1 - r}$$

MARKING SCHEME NOTES**Question 4 (a) (ii) [Scale 10D* (0, 3, 5, 8, 10)]**

- 3:**
- Any relevant step
 - Reference to 1.00327

- 5:**
- Recognises G.P

- 8:**
- Expression for sum of G.P

NOTE: Incomplete rounding or incorrect rounding or no rounding gets 9 marks

OR**Question 4 (a) (ii)**

Find the present value P of having a future value F of €15 000 in your account after 36 months.

$$P = \frac{F}{(1+i_M)^{36}}$$

$$= \frac{15\,000}{1.00327^{36}} = \text{€}13\,336.73$$

FORMULAE AND TABLES BOOK**Financial mathematics: Compound interest [page 30]**

$$F = P(1+i)^t$$

t = Time period (in years)

i = (Annual) rate of interest expressed as a decimal

F = Final value

P = Principal

NOTE: The time period can be months or weeks instead of years provided the interest rate is given for that time period.

You can now ask the question in reverse: How much did I have to pay back every month to repay €13 336.73? Now I can use the amortisation formula.

FORMULAE AND TABLES BOOK**Financial mathematics: Amortisation - mortgages and loans**

(equal repayments at equal intervals) [page 31]

$$A = P \frac{i(1+i)^t}{(1+i)^t - 1}$$

t = Time period (in years)

i = (Annual) rate of interest expressed as a decimal

A = (Annual) repayment amount

P = Principal

NOTE: The time period can be months or weeks instead of years provided the interest rate is given for that time period.

$$A = 13\,336.73 \times \frac{0.00327(1.00327)^{36}}{(1.00327)^{36} - 1} = \text{€}393.30$$

MARKING SCHEME NOTES**Question 4 (a) (ii) [Scale 10D* (0, 3, 5, 8, 10)]**

3: • No present value or incorrect present value

5: • Present value correct

8: • Correct substitution of all values in formula

NOTE: Incomplete rounding or incorrect rounding or no rounding gets 9 marks.

Question 4 (b)

$$\begin{aligned}
 A &= P \frac{i(1+i)^t}{(1+i)^t - 1} \\
 &= 15\,000 \left[\frac{0.00866(1+0.00866)^{36}}{(1+0.00866)^{36} - 1} \right] \\
 &= 15\,000 \left[\frac{0.00866(1.00866)^{36}}{(1.00866)^{36} - 1} \right] = \text{€}487
 \end{aligned}$$

MARKING SCHEME NOTES**Question 4 (b) [Scale 10C* (0, 3, 7, 10)]**

- 3: • Any relevant step
- 7: • Correct substitution of all values in formula
 • Expression for sum of G.P. in solution

NOTE: Incomplete rounding or incorrect rounding or no rounding gets 9 marks.