Arithmetic

Maths Past Exam Questions

Marking Schemes

Higher Level

2013

Paper 1 – Project Maths – Section A – Q4 A

Question 4 **(25 marks)**

(a) Niamh has saved to buy a car. She saved an equal amount at the beginning of each month in an account that earned an annual equivalent rate (AER) of 4%.

(i) Show that the rate of interest, compounded monthly, which is equivalent to an AER of 4% is 0·327%, correct to 3 decimal places.

$$(1+i)^{12} = 1\cdot 04 \Rightarrow 1+i = \sqrt[12]{1\cdot 04} = 1\cdot 003273 \Rightarrow i = 0\cdot 003274$$

Hence, $i = 0\cdot 327\%$

OR

$$(1.00327)^{12} = 1\cdot 039953481$$
$$= 1\cdot 0400$$

$r = 4\%$

(ii) Niamh has €15 000 in the account at the end of 36 months. How much has she saved each month, correct to the nearest euro?

$$15000 = P\left(1\cdot 00327^{36} + 1\cdot 00327^{35} + \cdots + 1\cdot 00327^{2} + 1\cdot 00327\right)$$

$$\Rightarrow P\left[\frac{1\cdot 00327\left(1\cdot 00327^{36} - 1\right)}{1\cdot 00327 - 1}\right] = 15000$$

$$\Rightarrow P[38\cdot 26326387] = 15000$$

$$\Rightarrow P = 392\cdot 02 = €392$$

OR

- Amortisation:

  Step 1: Present Value

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

$$P = \frac{15000}{(1\cdot 04)^3} = 13334\cdot 95 \quad \text{OR} \quad P = \frac{15000}{(1\cdot 00327)^{36}} = 13336\cdot 73$$

  Step 2:

$$A = \frac{(13334\cdot 95)(0\cdot 00327)(1\cdot 00327)^{36}}{1\cdot 00327^{36} - 1}$$

$$= €393\cdot 25$$

$$= €393$$

OR

- Present Value

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

$$P = \frac{15000}{(1\cdot 04)^3} = 13334\cdot 95$$

$$13334\cdot 95 = A\left(\frac{1}{1\cdot 00327} + \frac{1}{(1\cdot 00327)^2} + \ldots\ldots\ldots\ldots \frac{1}{(1\cdot 00327)^{36}}\right)$$

$$13334\cdot 95 = A\left[\frac{\frac{1}{1\cdot 00327}\left(1 - \left(\frac{1}{1\cdot 00327}\right)^{36}\right)}{1 - \frac{1}{1\cdot 00327}}\right]$$

$$A = €393\cdot 25$$

$$A = €393$$

Q4 B

(b) Conall borrowed to buy a car. He borrowed €15 000 at a monthly interest rate of 0·866%. He made 36 equal monthly payments to repay the entire loan. How much, to the nearest euro, was each of his monthly payments?

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

$$= 15000\left[\frac{0\cdot 00866(1+0\cdot 00866)^{36}}{1\cdot 00866^{36} - 1}\right]$$

$$= 486\cdot 77$$

Monthly payment €487

OR

$$15000 = P\left(\frac{1}{1\cdot 00866} + \frac{1}{1\cdot 00866^2} + \cdots + \frac{1}{1\cdot 00866^{36}}\right)$$

$$\Rightarrow P\left[\frac{\frac{1}{1\cdot 00866}\left(1 - \frac{1}{1\cdot 00866^{36}}\right)}{1 - \frac{1}{1\cdot 00866}}\right] = 15000$$

$$\Rightarrow P[30\cdot 8151777] = 15000$$

$$\Rightarrow P = 486\cdot 77$$

Monthly payment €487