Student Name: _____

TSSM
Creating VCE Success

GENERAL MATHEMATICS 2024

Unit 3
Key Topic Test 8 - Recursion and Financial Modelling: Compound Interest Investments and Loans with Periodic Payments

Recommended writing time*: 45 minutes
Total number of marks available: 25 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers, approved CAS calculator and one bound reference book.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 7 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

The following information relates to Question 1, 2 and 3

James borrows $420 000 for a home loan at 5.2% interest compounding monthly. He makes monthly repayments of $2550 until the loan is fully repaid.

Question 1

The balance of the loan after 6.5 years is closest to:

A. $373 121

B. $824 511

C. $415 198

D. $-\$350\,000$

E. $352 427

Question 2

The number of months until the loan is fully repaid will be:

A. 288 **B.** 289 **C.** 290

D. 291 **E.** 292

Question 3

The amount of the final repayment will be closest to:

A. $2550

B. $1855

C. $695

D. $692

E. $690

Question 4

Rayana invests \$55 000 in shares earning 6.8% per annum compounding quarterly and also adds regular quarterly payments of \$3000. The recurrence relation to model this investment is:

A. $V_0 = 55\,000,\ V_{n+1} = 1.017 \times V_n + 3000$

B. $V_0 = 55\,000,\ V_{n+1} = 1.017 \times V_n - 3000$

C. $V_0 = 55\,000,\ V_{n+1} = 1.068 \times V_n + 3000$

D. $V_0 = 55\,000,\ V_{n+1} = 3000 \times V_n + 1.017$

E. $V_0 = 55\,000,\ V_{n+1} = 1.068 \times V_n - 3000$

Question 5

The value, J_n, of Juan's business investment after n months is modelled by the recurrence relation:

$$J_0 = 40\,000, \qquad J_{n+1} = 1.0035 \times J_n + 1200$$

Which of the following is not true:

A. Juan's initial contribution was \$40 000

B. After 3 months the value of Juan's investment is \$44 034.09

C. The investment is earning 4.1% interest per annum

D. Juan is making a \$1200 payment each month

E. After 3 months, the investment has earnt \$434.09 in interest (to the nearest cent)

SECTION B - Short-answer questions

Instructions for Section B

- Answer each question in the space provided.
- Please provide appropriate workings and use exact answers unless otherwise specified.

Question 1 (9 marks)

The value of Paul's retirement investment, P_n , after n months of his final year of employment follows the recursion relation:

$$P_0 = 725\,000, \qquad P_{n+1} = 1.009 \times P_n + 1200$$

a. Find the amount that Paul is continuing to contribute to the retirement investment each month of his final year of employment.

_____

1 mark

b. Find the annual interest rate that Paul's retirement investment is earning.

_____

_____

1 mark

c. Show recursively, that the value of Paul's retirement investment after 3 months is \$748 384.20.

_____

_____

_____

2 marks

d. Find the amount of interest that Paul's retirement investment has accrued over the first 3 months. Answer to the nearest dollar.

_____

_____

_____

2 marks

e. At the end of his final year of employment, Paul retires. He then lives off his retirement investment, withdrawing $9245 each month for living expenses whilst it continues to earn the same rate of interest. How long will the retirement investment last? Answer to the nearest month.

3 marks

1 + 1 + 2 + 2 + 3 = 9 marks

Question 2 (11 marks)

Jasmine borrows $712 000 for a home loan, at 6.66% p.a. compounding monthly over 25 years. Jasmine makes regular and equal monthly payments over the life of the loan.

a. Find the amount of the monthly repayment.

2 marks

b. Find the balance of the loan after 5 years

2 marks

c. State the recurrence relation, for the value of the loan, J_n after n months.

_____

_____

2 marks

d. Find the amount of the final payment.

_____

_____

_____

_____

2 marks

After 15 years Jasmine decides to increase her payments to $5050 each month.

e. How many months earlier will she now repay the loan?

_____

_____

_____

1 mark

f. Under this arrangement, how much interest will she pay on the loan? Answer to the nearest dollar.

_____

_____

_____

_____

_____

2 marks

2 + 2 + 2 + 2 + 1 + 2 = 11 marks

END OF KEY TOPIC TEST