



Perpetuities

Year 12 General Maths
Units 3 and 4

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Learning Objectives

By the end of the lesson, I would hope that you have an understanding and be able to apply to questions the following concepts:

- To be able to calculate the regular payment from a perpetuity.
- To be able to calculate the investment required to establish a perpetuity.
- To be able to calculate the interest rate of a perpetuity



Recap

This is the final lesson in this series on Finance and Recursion and continues to deal with the more practical side of the work.

In the last lesson we learned more about Interest Only Loans. The most important fact about these loans were that the **Principal Value and the Final Value stayed the same** excepting for a chance of sign.

When we pay only the interest, there is no reduction in the Principal Value.

This can be a very bad thing!

We are now going to use the same idea but for Perpetuities.



Perpetuities

Banks always pay interest. The more money we have, the more interest we gain.

At some point the interest becomes something you might be able to live on, or provide a scholarship from.

When we live on (or remove) only the interest from a bank account (investment) we know that the principal will never get less.

Much like the Interest Only Loans, the PV and FV will stay exactly the same.

And, like we did before, the value of N is largely useless.



Perpetuities: The tricks

You don't always have to use a Finance solver to find the values of Perpetuities.

We know that the value of the payment will be the interest.

Interest can be calculated as such:

$$\frac{\text{Compounding interest rate } \%}{100} \times V_0$$

6% p-a.
monthly

$$\frac{6}{12} = 0.5\%$$



Example

Calculate how much money will need to be invested in a perpetuity account, earning interest of 4.8% per annum compounding monthly, if \$300 will be withdrawn every month.

$$\frac{4.8\%}{12} = 0.4\%$$

$$0.4\% \text{ of } PV = 300$$

$$\text{Solve } \left(\frac{0.4}{100} \times x = 300, x \right)$$

$$x = \underline{\underline{\$75000}}$$



Example

A university mathematics faculty has \$30000 to invest. It intends to award an annual mathematics prize of \$1500 with the interest earned from investing this money in a perpetuity.

What is the minimum interest rate that will allow this prize to be awarded indefinitely?

$$\begin{aligned}N &= 1 \\PV &= -30\,000 \\PV &= +30\,000 \\I &= ? \\Pmt &= 1500 \\P/Y \text{ } C/Y &: 1\end{aligned}$$

$$\underline{\underline{5\%}}$$

$$\frac{1500}{30000} \times 100$$



VCAA Questions

VCAA General Maths
Year: 2021
Paper 2

Question 6 (3 marks)

Sienna invests \$420 000 in a perpetuity from which she will receive a regular monthly payment of \$1890.

The perpetuity earns interest at the rate of 5.4% per annum.

- a. Determine the total amount, in dollars, that Sienna will receive after one year of monthly payments. 1 mark

$$1890 \times 12 = \$22\,680$$

- b. Write down the value of the perpetuity after Sienna has received one year of monthly payments. 1 mark

$$\$420\,000$$



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Paper 2

Question 6 (3 marks)

Sienna invests \$420 000 in a perpetuity from which she will receive a regular monthly payment of \$1890. The perpetuity earns interest at the rate of 5.4% per annum.

- c. Let S_n be the value of Sienna's perpetuity after n months.

Complete the recurrence relation, in terms of S_0 , S_{n+1} and S_n , that would model the value of this perpetuity over time. Write your answers in the boxes provided.

1 mark

$$S_0 = 420\,000, \quad S_{n+1} = 1.0045 \times S_n - 1890$$

$$R = 1 + \frac{r}{100} \\ = 1 + \frac{0.45}{100}$$

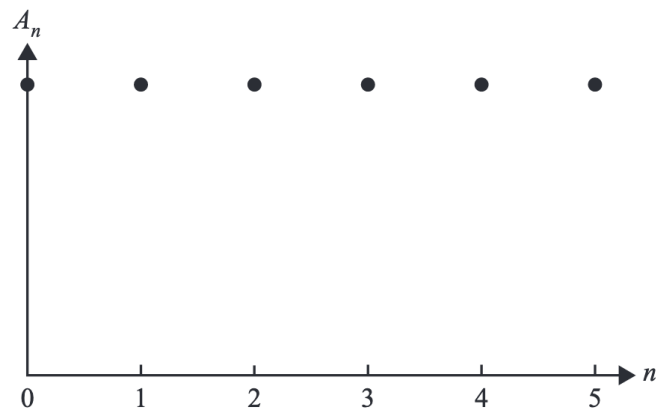
$$r = \frac{5.4\%}{12}$$



VCAA Questions

Question 25

The graph below represents the value of an annuity investment, A_n , in dollars, after n time periods.



A recurrence relation that could match this graphical representation is

- ☒ A. $A_0 = 200\,000$, $A_{n+1} = 1.015A_n - 2500$
- ☐ B. $A_0 = 200\,000$, $A_{n+1} = 1.025A_n - 5000$
- ☐ C. $A_0 = 200\,000$, $A_{n+1} = 1.03A_n - 5500$
- ☐ D. $A_0 = 200\,000$, $A_{n+1} = 1.04A_n - 6000$
- ☐ E. $A_0 = 200\,000$, $A_{n+1} = 1.05A_n - 8000$

VCAA General Maths
Year: 2020
Paper 1



VCAA Questions

VCAA General Maths
Year: 2020
Paper 2

Question 10 (3 marks)

Samuel now invests \$500 000 in an annuity from which he receives a regular monthly payment.

The balance of the annuity, in dollars, after n months, A_n , can be modelled by a recurrence relation of the form

$$A_0 = 500\,000, \quad A_{n+1} = kA_n - 2000$$

R

- c. For what value of k would this investment act as a simple perpetuity?

1 mark

1.004

$$\frac{2000}{500\,000}$$



VCAA Questions

VCAA General Maths
Year: 2019
Paper 2

Question 8 (4 marks)

Phil invests \$200 000 in an annuity from which he receives a regular monthly payment.

The balance of the annuity, in dollars, after n months, A_n , can be modelled by the recurrence relation

$$A_0 = 200\,000, \quad A_{n+1} = 1.0035 A_n - 3700$$

- d. If the payment received each month by Phil had been a different amount, the investment would act as a simple perpetuity.

What monthly payment could Phil have received from this perpetuity?

1 mark

\$700



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