

Mathematics Standard 1 Year 12

Financial Mathematics Topic Guidance

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# Topic focus

*Financial Mathematics* involves the application of knowledge, skills and understanding of number to earning, spending, investing, saving and borrowing money.

Knowledge of financial mathematics enables students to analyse different financial situations, to calculate the best options for given circumstances, and to solve financial problems.

The study of financial mathematics is important in developing students’ ability to make informed financial decisions, to be aware of the consequences of such decisions, and to manage personal financial resources effectively.

# Terminology

|  |  |  |
| --- | --- | --- |
| account balanceannual feeannual interest rateappreciated valuebilling cyclecompound interest creditcredit cardcredit card statement | daily interest ratedeclining-balance method depreciationdepreciation ratefeefuture valueinflationinterest-free period interest payable | interest rateminimum paymentpercentage annual interest ratepresent valuerepaymentsalvage valuesimple interest |

# Use of technology

Prepared spreadsheets can be used to simulate loans and to make related formulae easier to understand and implement. Spreadsheets allow the user to perform ‘what if’ analyses, for example to compare the interest earned on an investment for various periods and interest rates.

The internet should be used as a source of up-to-date information, for example, current values of vehicles, interest rates for personal loans and credit cards as well as terms and conditions for different credit cards.

Online calculators can be used to investigate loan repayments.

Students should be able to create a spreadsheet to simulate a credit card statement, including the calculation of the interest payable and the minimum payment due.

# Background information

Compound interest is a fundamental part of investing and borrowing money. The concept of compounding may be used in developing an understanding of depreciation, and also the growth of populations and the depletion of natural resources.

# General comments

Students require access to current information from a range of sources including, but not limited to, newspapers, journals, magazines, real bills and receipts, and the internet.

Teachers and students should also have access to actual financial information and products, for example, examples of credit card statements should be used in teaching and learning.

Students should be familiar with correct terminology in the topic areas and be able to use this terminology when justifying or explaining their solutions to problems.

Students should have a strong understanding of how the compound interest formula can be used to calculate depreciation by substituting a negative value for $r$.

# Future study

In this topic, students model and solve practical problems and learn about financial concepts that have an important role in areas beyond secondary school. They will be provided with opportunities to become familiar with the terminology used in financial matters and gain many of the financial literacy skills that are vital for them to competently manage their finances in the future.

# Subtopics

* MS-F2: Investment 
* MS-F3: Depreciation and Loans 

## MS-F2: Investment Paperclip icon

### Subtopic focus

The principal focus of this subtopic is to calculate and compare the value of different types of investments, including shares, over a period of time.

Students develop awareness of mechanisms to optimise their financial position, both now and into the future, justifying their thinking and reasoning mathematically.

Within this subtopic, schools have the opportunity to identify areas of Stage 5 content which may need to be reviewed to meet the needs of students.

### Considerations and teaching strategies

* The ‘compounded’ value of a dollar is also known as the ‘future value’ of a dollar.
* In the financial world, the compound interest formula $A=P\left(1+r\right)^{n}$ is known as the future value formula and is expressed as: $FV=PV\left(1+r\right)^{n}$.
* The single amount that needs to be invested when the future value is known can be calculated using the formula: $PV=\frac{FV}{\left(1+r\right)^{n}}$.
* Calculations of simple interest and compound interest should include interest rates expressed other than as ‘per annum’.
* Tables of compounded values of $1, such as the table below, can be used to calculate the amount to which money invested in a compound interest account has grown in a given period.

|  |  |
| --- | --- |
|  | Compounded values of $1 |
| Interest rate per period |
| Periods | 1% | 5% | 10% | 15% | 20% |
| 1 | 1.010 | 1.050 | 1.100 | 1.150 | 1.200 |
| 2 | 1.020 | 1.103 | 1.210 | 1.323 | 1.440 |
| 3 | 1.030 | 1.158 | 1.331 | 1.521 | 1.728 |
| 4 | 1.041 | 1.216 | 1.461 | 1.750 | 2.074 |

### Suggested applications and exemplar questions

* An amount of $3000 is invested and compounded annually at 5%. Use the table of compounded values of $1 above to find the value of the investment after three years.

Solution: Value of investment after three years = 3000 × 1.15 = $3450

* Grandparents wish to save $10 000 for their grandchild’s university expenses, and to have this amount available in eight years’ time. Calculate the single sum they need to invest at 5% pa compounded annually.
* Determine the single sum to be deposited if $10 000 is required in five years’ time and a rate of 3% pa, compounded quarterly, is available.
* A principal of $1000 is invested for three years at an interest rate of 5.6% pa compounded half-yearly. Determine how much needs to be invested to achieve the same interest if the interest rate was 3.5% pa compounded monthly.
* It is predicted that a particular painting will appreciate at a rate of 5% per annum. Calculate its predicted value in 2020 if it was purchased in 2010 for $48 000.
* A family currently pays $320 for some groceries. Assuming a constant annual inflation rate of 2.9%, calculate how much would be paid for the same groceries in 5 years’ time.

## MS-F3: Depreciation and loans Paperclip icon

### Subtopic focus

The principal focus of this topic is to gain an understanding of credit cards and reducing balance loans and that an asset may depreciate in value over time rather than appreciate.

Students develop their understanding of credit and loans in order to make informed financial decisions.

Within this subtopic, schools have the opportunity to identify areas of Stage 5 content which may need to be reviewed to meet the needs of students.

### Considerations and teaching strategies

* Car loans are personal loans with a fixed monthly repayment. These loans are reducing balance loans and may be paid off in less time than the original term by increasing the monthly repayments, or by making additional payments.
* Students use hand-held calculators to create a table of loan repayments for the first few repayments of a loan.
* Given a row in a table of loan repayments, students generate the next row using a hand-held calculator.
* Students use digital technology such as a spreadsheet to calculate the next row, or a particular value for a row/column, in a table of loan repayments, for example, calculate the next row (ie when $N$= 5) in the loan repayment table below.

|  |
| --- |
| Loan table |
|  | Amount = | $50 000 | This table assumes the same number of days in each month,ie $Interest =\frac{ Rate}{12}× Principal$ |
|  | Annual interest rate = | 10% |
|  | Monthly repayment ($R$) = | $600 |  |
| $$N$$ | Principal ($P$) | Interest ($I$) | $$P + I$$ | $$P + I – R$$ |
| 1 | $50 000 | $416.67 | $50 416.67 | $49 816.67 |
| 2 | $49 816.67 | $415.14 | $50 231.81 | $49 631.81 |
| 3 | $49 631.81 | $413.60 | $50 045.40 | $49 445.40 |
| 4 | $49 445.40 | $412.05 | $49 857.45 | $49 257.45 |

Students calculate the depreciation of an asset using the compound interest formula with a negative value of $r$. They compare the effect of this declining-balance method with the straight-line method they used in Year 11.

* Students should have access to credit card statements issued by major Australian financial institutions. Details that could identify an individual need to be changed sufficiently, or deleted, to protect privacy. These details include, but are not limited to, names, account numbers, and addresses.
* Students should access suitable websites that provide information on credit cards and related calculations.
* The calculation of interest and other credit card charges varies between the different issuers of credit cards. Interest is typically charged for retail purchases, cash advances, balance transfers and the amount still owing from the previous month. In this course, the same interest rate will be assumed to apply for all transaction types, and students will be required to calculate interest for amounts still owing from the previous month, cash advances and retail purchases, but not for balance transfers.
* For interest calculations on credit cards, compound interest is to be assumed. It is also to be assumed that interest is calculated on the daily outstanding account balance for each transaction and is applied at the end of the statement period. The daily interest rate is used for this calculation.
* Note: The daily interest rate is the annual percentage rate divided by 365, for example, an annual rate of 16.5% is equivalent to a daily rate of 0.000452 (expressed as a decimal to three significant figures).
* Students should calculate the interest charged, closing balance, minimum payment due given the annual interest rate, opening balance, at least two purchase transactions (item, date, amount), one cash advance (date, amount) and one or more repayments (date, amount).

### Suggested applications and exemplar questions

* Current interest rates for various lending institutions should be compared.
* Plan a spreadsheet for a reducing-balance loan using paper, pen and calculator, and then construct the spreadsheet. Consider car loans, travel loans, loans for capital items, home loans, as well as other types of loans.
* Students use a loan spreadsheet or an online simulator to vary the amount borrowed, the interest rate, and the repayment amount. They determine the answers to suitable ‘what if’ questions. eg What is the effect on the term of the loan and the amount of interest paid if
1. there is an interest rate rise
2. more than the minimum monthly repayment is paid
3. there is an interest rate rise in the case where more than the minimum monthly repayment is already being paid?
* Use a prepared graph of ‘amount outstanding’ versus ‘repayment period’ to determine when a particular loan will be half-paid.
* Students create a credit card statement using a spreadsheet.
* Students compare the costs associated with credit cards from different lenders by making calculations. This should include consideration of the interest rates offered and fees.
* Students can use a spreadsheet or other appropriate digital technology to create a graphical representation comparing the use of two credit cards with different interest rates for the same purchases.
* Credit card payment calculations should involve fees and interest-free periods.
* Calculate and compare the amount of depreciation of motor vehicles for different ages of the vehicles. (The depreciation in the first year of a new car can exceed 35%. For many vehicles, depreciation levels out to between 7% and 10% per annum after the first three years.)