

Question 1

In this question, give all answers to two decimal places.

At the start of 2021 Maro wants to open a savings account. Bank A offers him an account with 3.5% annual simple interest with an initial deposit of \$5000, and Bank B offers him an account with 2.5% nominal annual interest with an initial deposit of \$4000, compounding annually. The interest for both accounts is paid in monthly deposits.

- (a) Calculate the amount of money Maro would have saved by the start of 2030 if he opens the Bank A account. [2]
- (b) Calculate the amount of money Maro would have saved by the start of 2035 if he opens the Bank B account. [2]
- (c) Find the year in which the amount in the Bank B account would surpass the amount in the Bank A account. [3]

a) Simple interest formula
 $FV = PV(1 + \frac{r}{100}n)$ (not in formula booklet)
 $PV = 5000 \quad n = 9 \quad r = 3.5\%$
 Sub PV, r and n into formula.
 $FV = 5000(1 + \frac{3.5}{100} \cdot 9)$
FV = \$6575

In this question, give all answers to two decimal places.

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- (a) Calculate the amount of money Maro would have saved by the start of 2030 if he opens the Bank A account. [2]
- (b) Calculate the amount of money Maro would have saved by the start of 2035 if he opens the Bank B account. [2]
- (c) Find the year in which the amount in the Bank B account would surpass the amount in the Bank A account. [3]

b) Compound interest formula
 $FV = PV(1 + \frac{r}{100k})^{kn}$ (in formula booklet)
 $PV = 4000 \quad r = 2.5\% \quad k = 1 \quad n = 14$
 Sub PV, r, k and n into formula.
 $FV = 4000(1 + \frac{2.5}{100(1)})^{(1)(14)}$
FV ≈ \$5651.90 (2dp)

In this question, give all answers to two decimal places.

At the start of 2021 Maro wants to open a savings account. Bank A offers him an account with 3.5% annual simple interest with an initial deposit of \$5000, and Bank B offers him an account with 2.5% nominal annual interest with an initial deposit of \$4000, compounded annually. The interest for both accounts is paid in monthly deposits.

- (a) Calculate the amount of money Maro would have saved by the start of 2030 if he opens the Bank A account. [2]
- (b) Calculate the amount of money Maro would have saved by the start of 2035 if he opens the Bank B account. [2]
- (c) Find the year in which the amount in the Bank B account would surpass the amount in the Bank A account. [3]

c) Bank A < Bank B

$$5000 \left(1 + \frac{3.5}{100} n\right) < 4000 \left(1 + \frac{2.5}{100}\right)^n$$

Find n when Bank A = Bank B on your GDC.

$$5000 \left(1 + \frac{3.5}{100} n\right) = 4000 \left(1 + \frac{2.5}{100}\right)^n$$

$$* n = 50.0095$$

When $n = 50$ it's the start of 2071 and
Bank A > Bank B.

When $n = 51$ it's the start of 2072 and
Bank A < Bank B.

The amount in Bank B will surpass the amount in Bank A during 2071.

* Possible GDC methods to find n:

- Use the algebraic solver.
- Graph Bank A and Bank B and find their intersections.

Question 2

Daniel and Jonah have each been given \$5000 to save for university.

Daniel invests his money in an account that pays a nominal annual interest rate of 2.24%, compounded quarterly.

- (a) Calculate the amount Daniel will have in his account after 8 years. Give your answer to 2 decimal places. [3]

Jonah wants to invest his money in an account such that his investment will double in 10 years. Assume the account pays a nominal annual interest of $r\%$, compounded half-yearly.

- (b) Determine the value of r . [3]

a) Compound interest formula

$$FV = PV \left(1 + \frac{r}{100k}\right)^{kn} \quad (\text{in formula booklet})$$

$$PV = 5000 \quad r = 2.24\% \quad k = 4 \quad n = 8$$

Sub PV, r, k and n into formula.

$$FV = 5000 \left(1 + \frac{2.24}{100(4)}\right)^{(4)(8)}$$

$$FV \approx \$5978.31 \quad (2dp)$$

Daniel and Jonah have each been given \$5000 to save for university.

Daniel invests his money in an account that pays a nominal annual interest rate of 2.24%, compounded quarterly.

(a) Calculate the amount Daniel will have in his account after 8 years. Give your answer to 2 decimal places.

[3]

Jonah wants to invest his money in an account such that his investment will double in 10 years. Assume the account pays a nominal annual interest of $r\%$, compounded half-yearly.

(b) Determine the value of r .

[3]

b) Compound interest formula

$$FV = PV \left(1 + \frac{r}{100k}\right)^{kn} \quad (\text{in formula booklet})$$

$$FV = 10\,000 \quad PV = 5000 \quad k = 2 \quad n = 10$$

Sub FV , PV , k and n into formula and solve for r using your GDC.

$$10\,000 = 5000 \left(1 + \frac{r}{100(2)}\right)^{(2)(10)}$$

$$r \approx 7.05\%$$

Question 3

Alice buys a new coffee machine for \$4499. The value of the coffee machine depreciates by 9% each year.

(a) Find the value of the coffee machine after 5 years. Give your answer correct to 2 decimal places.

[2]

(b) Find the number of years and months it will take for the value of the coffee machine to be approximately \$999.

[3]

The shop offers Alice a finance option in the form of a 1 year loan. Terms of the loan are:

- a 17.2% nominal annual interest rate, compounded monthly
- repayments to be made each month

(c) Find the cost of each monthly repayment. Give your answer correct to 2 decimal places.

[2]

a) Depreciation formula

$$FV = PV \left(1 - \frac{r}{100}\right)^n \quad (\text{not in formula booklet})$$

$$FV = 999 \quad PV = 4499 \quad r = 9\%$$

Sub FV , PV , r and n into formula.

$$999 = 4499 \left(1 - \frac{9}{100}\right)^n$$

$$FV \approx \$1807.52 \quad (2dp)$$

Alice buys a new coffee machine for \$4499. The value of the coffee machine depreciates by 9% each year.

(a) Find the value of the coffee machine after 5 years. Give your answer correct to 2 decimal places.

[2]

(b) Find the number of years and months it will take for the value of the coffee machine to be approximately \$999.

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b) Depreciation formula

$$FV = PV \left(1 - \frac{r}{100}\right)^n \quad (\text{not in formula booklet})$$

$$FV = 999 \quad PV = 4499 \quad r = 9\%$$

Sub FV , PV and r into formula and solve for n using your GDC.

$$999 = 4499 \left(1 - \frac{9}{100}\right)^n$$

$$n = 15.9564$$

$$\therefore 15 \text{ years and 11 months}$$

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- (a) Find the value of the coffee machine after 5 years. Give your answer correct to 2 decimal places.

[2]

- (b) Find the number of years and months it will take for the value of the coffee machine to be approximately \$999.

[3]

The shop offers Alice a finance option in the form of a 1 year loan. Terms of the loan are:

- a 17.2% nominal annual interest rate, **compounded monthly**
- **repayments** to be made **each month**

- (c) Find the cost of each **monthly repayment**. Give your answer correct to 2 decimal places.

[2]

c) Use the finance / TVM solver on your GDC.

N	I%	PV	PMT	FV	P/Y	C/Y	PMT@
12	17.2	4499	-410.76	0	12	12	END

Hence the monthly repayment is \$410.76 (2dp).

Question 4

A new car costs \$20 000 and its value depreciates to \$14 792 after 2 years.

- (a) Calculate

- (i) the **annual rate of depreciation** of the car
- (ii) the value of the car after 5 years. Give your answer correct to 2 decimal places.

[3]

- (b) Find the number of years and months it will take for the car's value to be approximately \$4000.

[3]

Gus purchases the new car from a dealership who offers him a finance option in the form of a 3 year loan. Terms of the loan are:

- a 9% nominal annual interest rate, **compounded monthly**
- **repayments** to be made each month

- (c) Find the monthly repayment that would have to be made. Give your answer correct to 2 decimal places.

[2]

a) i) Depreciation formula

$$FV = PV \left(1 - \frac{r}{100}\right)^n \quad (\text{not in formula booklet})$$

$$FV = 14792 \quad PV = 20000 \quad n = 2$$

Sub FV, PV and n into formula and solve for r using your GDC.

$$14792 = 20000 \left(1 - \frac{r}{100}\right)^2$$

$$r = 14\%$$

ii) $PV = 20000 \quad r = 14\% \quad n = 5$

Sub PV, r and n into formula.

$$FV = 20000 \left(1 - \frac{14}{100}\right)^5$$

$$FV \approx \$9408.54 \quad (2dp)$$

A new car costs \$20 000 and its value depreciates to \$14 792 after 2 years.

(a) Calculate

- (i) the annual rate of depreciation of the car
- (ii) the value of the car after 5 years. Give your answer correct to 2 decimal places.

[3]

(b) Find the **number of years and months** it will take for the car's value to be **approximately \$4000**.

[3]

Gus purchases the new car from a dealership who offers him a finance option in the form of a 3 year loan. Terms of the loan are:

- a 9% nominal annual interest rate, **compounded monthly**
- repayments to be made each month

(c) Find the monthly repayment that would have to be made. Give your answer correct to 2 decimal places.

[2]

b) Depreciation formula

$$FV = PV \left(1 - \frac{r}{100}\right)^n \quad (\text{not in formula booklet})$$

$$FV = 4000 \quad PV = 20\,000 \quad r = 14\%$$

Sub FV , PV and r into formula and solve for n using your GDC.

$$4000 = 20\,000 \left(1 - \frac{14}{100}\right)^n$$

$$n = 10.67$$

\therefore 10 years and 8 months

A new car costs \$20 000 and its value depreciates to \$14 792 after 2 years.

(a) Calculate

- (i) the annual rate of depreciation of the car
- (ii) the value of the car after 5 years. Give your answer correct to 2 decimal places.

[3]

(b) Find the number of years and months it will take for the car's value to be approximately \$4000.

[3]

Gus purchases the new car from a dealership who offers him a finance option in the form of a **3 year loan**. Terms of the loan are:

- a 9% nominal annual interest rate, **compounded monthly**
- **repayments** to be made **each month**

(c) Find the **monthly repayment** that would have to be made. Give your answer correct to 2 decimal places.

[2]

c) Use the finance / TVM solver on your GDC.

N	I%	PV	PMT	FV	P/Y	C/Y	PMT@
36	9	20 000	-635.99	0	12	12	END

Hence the monthly repayment is \$635.99 (2dp).

Question 5

In this question, give all answers to two decimal places.

Biddy decides to purchase a new van from a dealership which costs \$18 000, however she cannot afford the full amount.

The dealership offers her a finance option in the form of a 4 year loan. Terms of the loan are:

- a 12% nominal annual interest rate, compounded quarterly
- a 15% deposit
- repayments to be made each quarter

(a) Calculate the loan amount Biddy would receive.

[2]

(b) (i) Find the repayment that would have to be made each quarter.

(ii) Find the total amount paid for the van.

[5]

In this question, give all answers to two decimal places.

Biddy decides to purchase a new van from a dealership which costs \$18 000, however she cannot afford the full amount.

The dealership offers her a finance option in the form of a 4 year loan. Terms of the loan are:

- a 12% nominal annual interest rate, compounded quarterly
- a 15% deposit
- repayments to be made each quarter

(a) Calculate the loan amount Biddy would receive.

$$\text{Loan amount} = \$15300$$

[2]

(b) (i) Find the repayment that would have to be made each quarter.

(ii) Find the total amount paid for the van.

[5]

a) Terms of the loan require a 15% deposit.
 \therefore Loan amount = 85% of the van's value.

$$\text{Loan amount} = 18\,000 \times 85\%$$

$$\text{Loan amount} = \$15\,300$$

b) i) Use the finance / TVM solver on your GDC.

N	I%	PV	PMT	FV	P/Y	C/Y	PMT@
16	12	15300	-1218.05	0	4	4	END

Hence the monthly repayment is \$1218.05 (2dp).

ii) Total amount paid = $N \times \text{PMT}$

$$\text{Total amount paid} = 16 \times 1218.05$$

$$\text{Total amount paid} = \$19\,488.74$$

Question 6

In this question, give all answers to two decimal places.

On his 40th birthday, Robert invests \$15 000 into a savings account that pays a nominal annual interest rate of 4.78%, compounded monthly.

- (a) (i) Write an expression for the total value of the investment after n years.
(ii) Find the total amount in the savings account after 3 and 5 years.

[3]

(b) Find the age Robert will be when the amount of money in his account is 1.5 times the initial amount.

[2]

Robert would earn the same amount of interest, compounded quarterly, for 5 years if he deposits his money in a second savings account.

- (c) Calculate the nominal annual interest rate from the second savings account.

[3]

In this question, give all answers to two decimal places.

On his 40th birthday, Robert invests \$15 000 into a savings account that pays a nominal annual interest rate of 4.78%, compounded monthly.

- (a) (i) Write an expression for the total value of the investment after n years.
(ii) Find the total amount in the savings account after 3 and 5 years.

[3]

(b) Find the age Robert will be when the amount of money in his account is 1.5 times the initial amount.

[2]

Robert would earn the same amount of interest, compounded quarterly, for 5 years if he deposits his money in a second savings account.

- (c) Calculate the nominal annual interest rate from the second savings account.

[3]

a) i) Compound interest formula

$$FV = PV \left(1 + \frac{r}{100k}\right)^{kn} \quad (\text{in formula booklet})$$

$$PV = 15000 \quad r = 4.78\% \quad k = 12$$

Sub PV, r and k into formula.

$$FV = 15000 \left(1 + \frac{4.78}{100(12)}\right)^{12n}$$

ii) Sub $n=3$ into expression for amount after 3 years.

$$FV = 15000 \left(1 + \frac{4.78}{100(12)}\right)^{(12)(3)}$$

$$FV \approx \$17\,307.94 \quad (2dp)$$

Sub $n=5$ into expression for amount after 5 years.

$$FV = 15000 \left(1 + \frac{4.78}{100(12)}\right)^{(12)(5)}$$

$$FV \approx \$19\,040.64 \quad (2dp)$$

b) Compound interest formula

$$FV = PV \left(1 + \frac{r}{100k}\right)^{kn} \quad (\text{in formula booklet})$$

$$FV = 1.5(15000) = 22500$$

$$PV = 15000 \quad r = 4.78\% \quad k = 12$$

Sub FV, PV, r and k into formula and solve for n using your GDC.

$$22500 = 15000 \left(1 + \frac{4.78}{100(12)}\right)^{12n}$$

$$n = 8.5$$

\therefore 8 years and 6 months

$$\text{Robert will be 48 years and 6 months old.}$$

In this question, give all answers to two decimal places.

On his 40th birthday, Robert invests \$15 000 into a savings account that pays a nominal annual interest rate of 4.78%, compounded monthly.

- (a) (i) Write an expression for the total value of the investment after n years.
 (ii) Find the total amount in the savings account after 3 and 5 years.

FV after 5 years \approx \$19 040.64

[3]

- (b) Find the age Robert will be when the amount of money in his account is 1.5 times the initial amount.

[2]

Robert would earn the same amount of interest, compounded quarterly, for 5 years if he deposits his money in a second savings account.

- (c) Calculate the nominal annual interest rate from the second savings account.

[3]

c) Compound interest formula

$$FV = PV \left(1 + \frac{r}{100k}\right)^{kn} \quad (\text{in formula booklet})$$

$$FV = 19\,040.64 \quad PV = 15\,000 \quad k = 4 \quad n = 5$$

Sub FV, PV, k and n into formula and solve for r using your GDC.

$$19\,040.64 = 15\,000 \left(1 + \frac{r}{100(4)}\right)^{(4)(5)}$$

$r = 4.80\%$

Question 7

Fraser decides to invest in a retirement plan for 25 years. In this plan, he will deposit \$500 at the end of every month, on which he will receive 5.5% nominal annual interest, compounded monthly.

- (a) Find the value of the investment at the end of the 25 years. Give your answer correct to 2 decimal places.

[3]

After the 25 year period, Fraser will start receiving regular monthly payments of \$1250.

- (b) Find the number of years it will take for Fraser's monthly retirement payments to match the total value of the investment at the end of the 25 years.

[2]

- (c) Find the number of years it will take for Fraser's monthly retirement payments to match the total amount he invested.

[3]

a) Use the finance / TVM solver on your GDC.

$$N = 25 \text{ years} \times 12 \text{ months}$$

$$N = 300 \text{ periods}$$

N	I%	PV	PMT	FV	P/Y	C/Y	PMT@
300	5.5	0	-500	321 018.72	12	12	END

Hence the investment's value in 25 years is \$321 018.72 (2dp).

Fraser decides to invest in a retirement plan for 25 years. In this plan, he will deposit \$500 at the end of every month, on which he will receive 5.5% nominal annual interest, **compounded monthly**.

- (a) Find the value of the investment at the end of the 25 years. Give your answer correct to 2 decimal places.

$$FV \approx \$321\,018.72$$

[3]

After the 25 year period, Fraser will start receiving regular monthly payments of \$1250.

- (b) Find the number of years it will take for Fraser's monthly retirement payments to match the total value of the investment at the end of the 25 years.

[2]

- (c) Find the number of years it will take for Fraser's monthly retirement payments to match the total amount he invested.

[3]

Fraser decides to invest in a retirement plan for 25 years. In this plan, he will deposit \$500 at the end of every month, on which he will receive 5.5% nominal annual interest, **compounded monthly**.

- (a) Find the value of the investment at the end of the 25 years. Give your answer correct to 2 decimal places.

[3]

After the 25 year period, Fraser will start receiving regular monthly payments of \$1250.

- (b) Find the number of years it will take for Fraser's monthly retirement payments to match the total value of the investment at the end of the 25 years.

[2]

- (c) Find the number of years it will take for Fraser's monthly retirement payments to match the total amount he invested.

[3]

$$b) N = \frac{FV}{P/Y \times PMT}$$

$$FV = 321\,018.72 \quad P/Y = 12 \quad PMT = 1250$$

Sub FV , P/Y and PMT into formula.

$$N = \frac{321\,018.72}{12 \times 1250}$$

$$N = 21.4 \text{ years}$$

$$c) N = \frac{\text{Amount invested}}{P/Y \times PMT}$$

$$\text{Amount invested} = 500 \times 300$$

$$\text{Amount invested} = 150\,000$$

$$P/Y = 12 \quad PMT = 1250$$

Sub the amount invested, P/Y and PMT into formula.

$$N = \frac{150\,000}{12 \times 1250}$$

$$N = 10 \text{ years}$$

Question 8

In this question, give all answers to two decimal places.

Lily takes a mortgage of \$220 000 to purchase a house at a nominal annual interest rate of 4.18%, compounded monthly. She agrees to pay the bank \$1600 at the end of every month to amortise the loan.

(a) Find

- (i) the number of years and months it will take Lily to pay back the loan
- (ii) the total amount Lily will pay to purchase the house.

Lily wants to pay off the loan within 10 years.

(b) Calculate the new monthly payment required to do this and justify this decision.

In this question, give all answers to two decimal places.

Lily takes a mortgage of \$220 000 to purchase a house at a nominal annual interest rate of 4.18%, compounded monthly. She agrees to pay the bank \$1600 at the end of every month to amortise the loan.

(a) Find

- (i) the number of years and months it will take Lily to pay back the loan
- (ii) the total amount Lily will pay to purchase the house.

Lily wants to pay off the loan within 10 years.

(b) Calculate the new monthly payment required to do this and justify this decision.

a) i) Use the finance / TVM solver on your GDC.

N	I%	PV	PMT	FV	P/Y	C/Y	PMT@
187.48	4.18	220 000	-1600	0	12	12	END

$$N = 187.48$$

$$\text{Number of years} = \frac{187.48}{12}$$

$$\text{Number of years} = 15.62$$

[4]

\therefore 15 years and 8 months

[3]

ii) Total amount paid = $N \times \text{PMT}$

$$\text{Total amount paid} = 187.48 \times 1600$$

$$\text{Total amount paid} = \$299\,970.16 \text{ (2dp)}$$

b) Use the finance / TVM solver on your GDC.

$$N = 10 \text{ years} \times 12 \text{ months}$$

$$N = 120 \text{ periods}$$

N	I%	PV	PMT	FV	P/Y	C/Y	PMT@
120	4.18	220 000	-2246.26	0	12	12	END

[4]

Hence the new monthly repayment is \$2246.26 (2dp).

The decision to pay off the loan faster means Lily will end up paying less overall.

[3]

Question 9

At the beginning of each year, Nala invests \$2500 in a savings account that pays a nominal annual rate of 3.5%, compounded half-yearly.

(a) Find the number of years it will take until Nala has \$80 000 in her account.

[3]

At the beginning of each year, Jessica invests \$3500 in a savings account that pays a nominal annual interest rate of $r\%$, compounded quarterly. After 20 years Jessica has \$120 000 in her account.

(b) Determine the value of r .

[3]

a) Use the finance / TVM solver on your GDC.

N	I%	PV	PMT	FV	P/Y	C/Y	PMT@
21.26	3.5	0	-2500	80 000	1	2	BEGIN

$$N \approx 21.3 \text{ years}$$

At the beginning of each year, Nala invests \$2500 in a savings account that pays a nominal annual rate of 3.5%, compounded half-yearly.

(a) Find the number of years it will take until Nala has \$80 000 in her account.

[3]

At the beginning of each year, Jessica invests \$3500 in a savings account that pays a nominal annual interest rate of $r\%$, compounded quarterly. After 20 years Jessica has \$120 000 in her account.

(b) Determine the value of r .

[3]

b) Use the finance / TVM solver on your GDC.

N	I%	PV	PMT	FV	P/Y	C/Y	PMT@
20	4.8056	0	-3500	120 000	1	4	BEGIN

$$\therefore r \approx 4.80\%$$