GRADE 12 APPLIED
UNIT B PERSONAL FINANCE
SOLVING COMPOUND INVESTMENT FORMULA

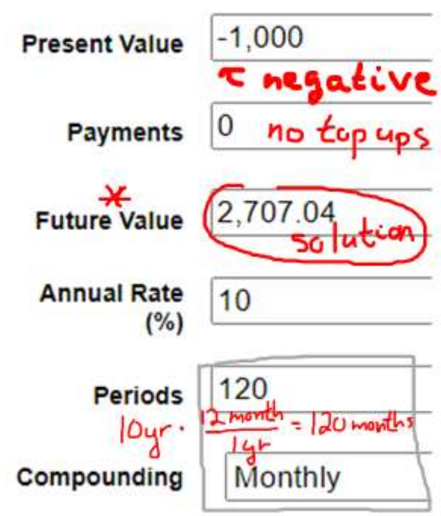
Name:____________
Date: ____________

1. We have calculated some simple calculations to determine the Future Value (**FV**) for a compound interest investment.

$A = P * \left(1 + \frac{r}{s}\right)^{n*s}$ when we did it manually using the meaning of the symbols we learned. We call **A** the '**FV**', and P the '**FV**' in an App.

2. In the TVM App we tend to use it looked like this at right

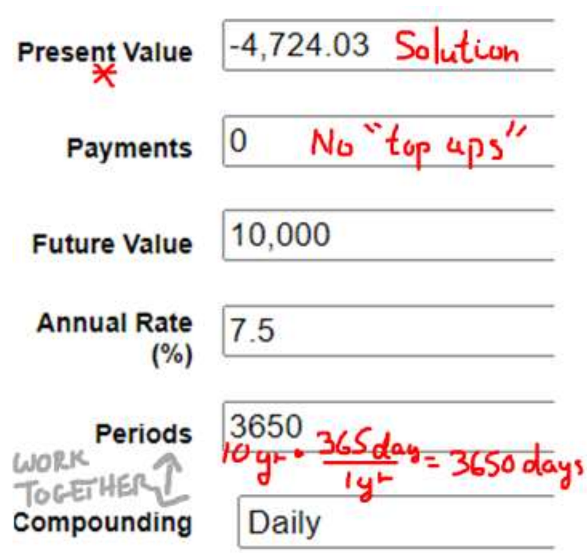
So, investing $1000 [out of your pocket, enter a negative amount , (-)], for 120 monthly periods (ie: 10 years) at 10% Annual Percentage Rate gives you $2,707.04 at the end of those 120 periods (10 years)



3. But what if we want to work the calculation backwards? *i.e*. Solve for other variables besides just the Future Value? The Apps make it so simple

4. How much principal would you have to invest ***today*** (PV; present value) if you want a **F**uture **V**alue, **FV**' of $10,000 in 10 years at an APR of 7.5% compounded daily?

Answer: $4,724.03 deposited today would turn into an **FV** of $10,000 after 10 years.



YOU TRY:

5. How much principal would you have to invest today (PV; present value) if you want a future amount of $10,000 in 10 years at an APR of 7.5% compounded monthly?

Show your inputs and box the solution in a hand-drawn screen shot like this one →.

Curious (compare with previous question which was compounded daily)

PV =
PMT =
FV =
% =
Pds =
Compound Pd =

6. Try that last question manually without an App using the compound interest formula. Complete the calculation we have started below:

$$A = P \cdot (1 + r/s)^{(n \cdot s)}$$

$$10{,}000 = P \cdot \underbrace{\left(1 + \frac{0.075}{12}\right)^{(10 \cdot 12)}}$$ Solve for 'P'

$$10{,}000 = P \cdot 2.112064637$$

$$P = \frac{10{,}000}{2.112064637} = \boxed{}$$

?

7. Determine how much principal would you have to invest today (PV; present value) if you want a future amount of $25,000 in 15 years at an APR of 6.25% compounded monthly?

Show your inputs and the result in this hand-drawn screen shot.

PV =
PMT =
FV =
% =
Pds =
Compound Pd =

8. Are you doing a sanity check on these? Or plugging you answer back into a simple Annual Compounding formula (since the compounding period does not make a huge relative difference for a normal number of years).

Recall we had noticed that the compounding interval did not have a huge effect compared to other inputs It is much easier to work with annual compounding

Plug in your solution into the last question, the **P**rincipal you need to invest into the simple Annual formula **A = P*(1+r/1)**$^{\mathbf{n}\ \text{years}}$. Does it work out close, a bit less perhaps since not compounded as frequently?

Complete this calculation to see if your solution is reasonable:

$$25{,}000 = \underset{[\text{your solution}]}{\underset{\uparrow}{\quad}} \cdot \left(1+\frac{0.0625}{1}\right)^{(15\cdot 1)}$$

$$25{,}000 = \underset{[\text{your solution}]}{\underset{\uparrow}{\quad}} \cdot (1.0625)^{15}$$

Does your solution check? Y/N

Checking your answer *somehow* is ALWAYS a good idea! Just a rough check is generally all that is necessary.

9. How much principal would you have to invest today (**PV**; present value) if you want a future amount, **FV**, of $1 Million in 36 years at an APR of 8% compounded quarterly?

Show your inputs and the result.

You will start to show your own complete hand-drawn screenshot soon.

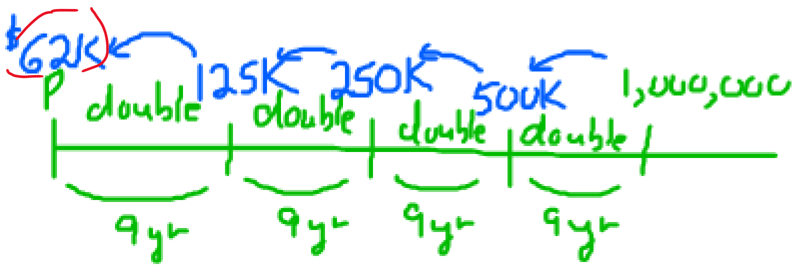
PV =
PMT =
FV =
% =
Pds =
Compound Pd =

10. Check that last solution. Sanity check? Rule of 72? Plug in to the annual formula to see if close; a bit less. Rule of 72 backwards? (How many doublings?)

At 8% a compound investment should double every ______ years

So 36 years is this many doublings : ________

So just doing a quick mental check using the Rule of 72 the PV I need to quadruple my money after 36 years is: _____________



57,753 in the ballpark!

Or quickly check with this easy Annual compounding calculation on any calculator: (since quarterly vs annually is not a overly huge difference)

$$1{,}000{,}000 = P \cdot (1.08)^{36}$$

$$\text{So } P = \frac{1{,}000{,}000}{1.08^{36}} = \boxed{}$$

You finish the calculation

Does your accurate solution form the App seem reasonable? (Y / N)

11. Now just to make sure you had used the App correctly, *you* solve the last question manually. Solve for the P accurately and manually just using the Compound Interest Investment formula and a simple calculator!

$$1{,}000{,}000 = P \cdot \underbrace{\left(1 + \frac{0.08}{4}\right)^{(36 \cdot 4)}}$$

$$1{,}000{,}000 = P \cdot$$

$$P = \; . \; . \; . \; .$$

← You Finish

12. Now let's solve for some of the other variables (aka *parameters, arguments*)

Find the Percentage Rate you Need

13. What percentage rate (APR) would you need if you want to turn $2,000 into $4,000 in 10 years? The account is a daily interest savings account.

Your Hand-drawn Screen Shot:

Show your inputs and the result.

Which rough check did you use to see if the solution is reasonable!

You did a rough check I hope → should double with ~7.2%

14. What percentage rate (APR) would you need if you want to turn $4,000 into $20,000 in 10 years? The interest is compounded monthly

Your Hand-drawn Screen Shot:

Show your inputs and the result.

DETERMINE HOW MANY YEARS FOR AN INVESTMENT TO GROW

16. Lets manipulate the formulae in TVM App. Let's find how many years it would take to achieve a goal.

17. How many years will it take to turn an compounding interest investment of $2,000 into a FV of $4,000 if the interest is an APR of 7.2 % compounded daily.

Your Hand-drawn Screen Shot:

Show your inputs and the result.

Reasonableness check? Rule of 72 says 10 years. $t = 72/7.2 = 10$

19. How many years will it take to turn an investment of $5,000 into a FV of $20,000 if the interest is an APR of 6% compounded semi-annually.

Your Hand-drawn Screen Shot:

Show your inputs and the result.

Notice the double double!
So 12+12 = 24 yr
sounds reasonable

20. **FYI**. Is it possible to do the last question manually just using the compound interest investment formula? (**This would be what students do in Pre-Calculus!**)

$$A = P \cdot \left(1 + \tfrac{r}{s}\right)^{(n \cdot s)}$$

$$\frac{20000}{5000} = \frac{5000 \cdot \left(1 + \frac{0.06}{2}\right)^{n \cdot 2}}{5000}$$

$\Leftarrow$ Pre-calculus method No Apps!

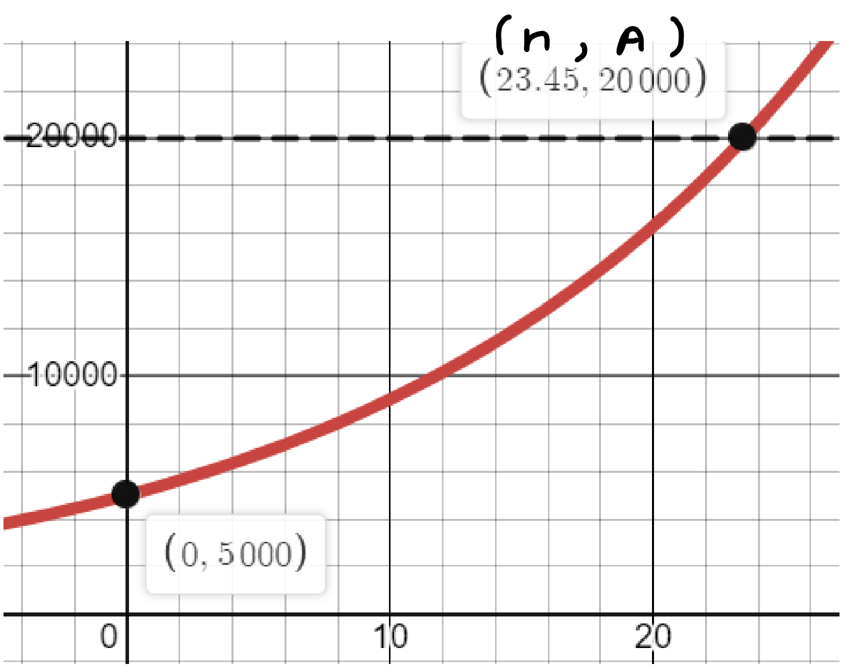
$$4 = (1.03)^{n \cdot 2}$$

$$\ln(4) = n \cdot 2 \cdot \ln(1.03)$$

$$n = \frac{\ln(4)}{2\ln(1.03)} = 23.44977...$$

In Applied Math you get to use technology tools, thankfully!

We will learn how to solve equation by **graphing** soon too! You do not need fancy Algebra if you know how to graph.



Did lines by graphing in Grade 11.

Word Problems

(Manually draw a 'screen shot' to show all your inputs and answer)

Kira purchases a sofa for $1015.87 (taxes included). The department store offers her a promotion of 0% interest with no payments for **up to** one year. If Kira does not pay the amount in full ***within*** one year, interest will be charged from the date of purchase at an annual rate of 28.80%, compounded monthly.

a) If Kira does not make any payments, what will the department store bill her one year after the date of purchase? (she had not paid within the one year).
b) State a different compounding period such that the overall cost of the sofa is lower than if the annual interest rate were compounded monthly. (does it make much of a difference really for one year?)

13. According to the Rule of 72, a reasonable estimate for the time it would take to double an investment of $24,000.00 at an interest rate of 6.00%, compounded monthly is:

Select the one best answer:

A. 3 years B. 4 years C. 12 years D. 18 years

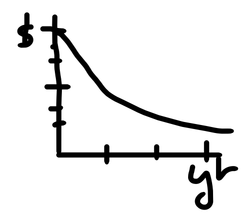
14. Imani is going to buy a car. She can afford monthly payments of $600.00. The dealer offers two financing options:

Option 1: financing over 60 months at a rate of 0.90% compounded monthly

Option 2: financing over 60 months at a rate of 2.90% compounded monthly with an instant rebate of $3000.00 at the time of purchase

Which option allows Imani to purchase a more expensive car?

15. Salwa bought a new computer system for $6,000.00. She anticipates the value of the system to *depreciate* at a rate of 15% per year ('year on year'). What will the computer system be worth at the end of 3 years? (hint: use **negative** 15% growth, since it is not growing , it is depreciating!)



Depreciate: To go down in value by some percentage every year. It is like exponential growth of an investment but ***decaying*** in value instead of decreasing. In our exponential growth for investments we have had it going up in value by $(1 + \text{a bit})^{n}$, in depreciation we have $(1 - \text{a bit})^{n}$ so an asset slowly ***decays*** exponentially in value. We will be doing lots of work with exponential growth and exponential decay in our Functions Unit!