

**IF COMPOUNDED CONTINUOUSLY,**

USE  $F = Pe^{rt}$

Where:   
 F = future value/amount   
 P = present amount   
 r = interest rate   
 t = time (in years)

**DISCOUNT & INFLATION**

$D = F - P$   
 $D = Fd$   
 $d = \frac{i}{1+i}$

WHERE: D = Discount (amount less)  
 F = original price  
 P = discounted price/  
 new price  
 d = discount rate

\* USE SHIFT-SOLVE TO GET  $i$  KUNG  $d$  ANG GIVEN.

- IF HINAHANAP, ACTUAL RATE OF INTEREST, USE  $I = D; I = Prn$

**INFLATION**

FOR COMMODITY: (price increase of a product/service)

$FC = PC(1+f)^n$  years  
 Future cost → Present cost  
 \* Parang compound interest ang itake!

PURCHASING POWER OF MONEY: (value of your money, decreasing coz of the effect of inflation)

$F = \frac{P}{(1+f)^n}$  years  
 Present worth of money → Future worth of money

IF INVESTED W/ **COMPOUNDING INTEREST** AT THE SAME TIME MAY **INFLATION**:

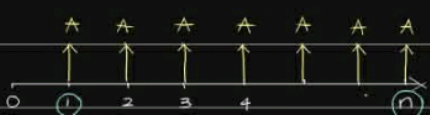
$F = \frac{P(1+i_f)^n}{(1+f)^n}$   
 inflation-adjusted rate  $i_f$    
 inflation rate  $f$   
 \* nagiging  $i_f$  ang interest offered ni bank if may inflation na

OR YOU MAY USE, then:  $F = P(1+i)^n$   
 $i_f = i + f + if$   
 solve actual rate earned

**ANNUITIES**

$F \text{ or } P = A \sum_{x=PP-D}^{LP-D} (1+i)^x$   
 - If solving for F, D = n  
 - If solving for P, D = 0

1. ORDINARY → "end" of each period (monthly, quarterly, etc.)



OR YOU WANT USE,

$$i_f = (1+i)^f + if$$

solve actual rate earned

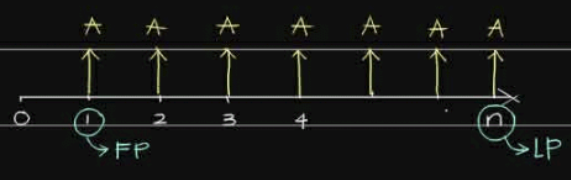
$$F = P(1+i)^n$$

# ANNUITIES

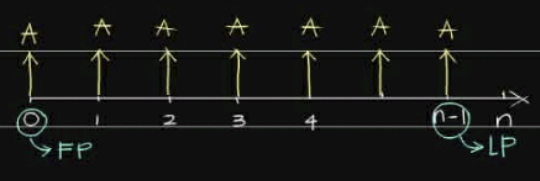
For  $P = A \sum_{x=FP-D}^{LP-D} (1+i)^{-x}$

- If solving for  $F$ ,  $D = n$
- If solving for  $P$ ,  $D = 0$

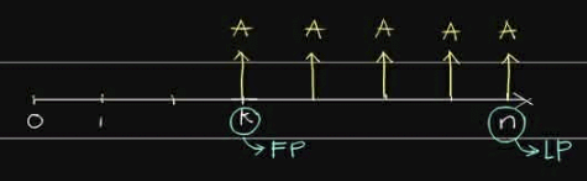
1. ORDINARY → "end" of each period (monthly, quarterly, etc.)



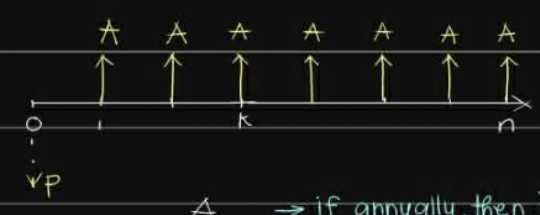
2. ANNUITY DUE → "beginning" of each period



3. DEFERRED → "first payment not on the first period"



4. PERPETUITY → payment is indefinite ( $n = \infty$ )



$$P = \frac{A}{i}$$

→ if annually, then  $i = \text{annually}$

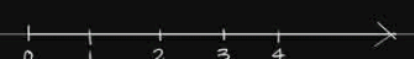
Ex: if  $A$  (monthly), and  $i$  is not, convert  $i$  to monthly using

$$ER = \left(1 + \frac{r}{m}\right)^m - 1$$

# GRADIENTS

1. ARITHMETIC → nag-add or subtracting amount

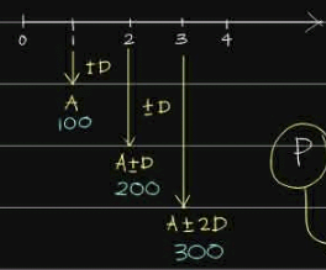
Ex:



# GRADIENTS

1. ARITHMETIC → nag-add or subtract  
ng amount

Ex:



USE ARITHMETIC SEQUENCE  $a_n = a_1 + (n-1)d$

$$P = \sum_{x=1}^n \frac{A + (x-1)(\pm D)}{(1+i)^x}$$

Palaging Present kunin mo!  
If future hangap, use  $F = P(1+i)^n$

USE MODE 3(STAT) - 2(A+Bx)

x	y
1	A(100)
2	A ± D (200)

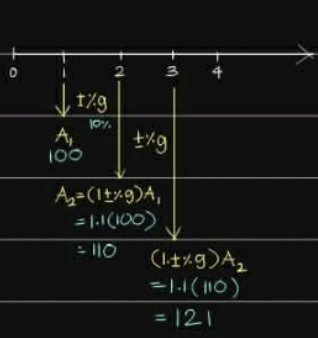
PRESS **AC**

**REG** → get A = — → (A)  
B = — → (B)

GO BACK TO **MODE 1(COMP)**

$$P = \sum_{x=1}^n \frac{A+Bx}{(1+i)^x}$$

2. GEOMETRIC → nag-multiply na per period  
(may percent increase)



USE GEOMETRIC SEQUENCE  $a_n = a_1(1+g)^{n-1}$

$$P = \sum_{x=1}^n \frac{A(1+g)^{x-1}}{(1+i)^x}$$

OR USE MODE 3(STAT) - 6(AB<sup>x</sup>)

x	y
1	A <sub>1</sub>
2	A <sub>2</sub>

PRESS **AC**

**REG** → get A = — → (A)  
B = — → (B)

GO BACK TO **MODE 1(COMP)**

$$P = \sum_{x=1}^n \frac{AB^x}{(1+i)^x}$$

## SEATWORK 2-1

### Continuous Compounding, Discount, Inflation & Annuities

1. the nominal interest rate is 4%. How much is my P10,000 worth in 10 years in a continuously compounded account?

$$F = Pe^{rt}$$

SOLUTION:

$$F = Pe^{rt}$$

$$F = 10,000e^{0.04(10)}$$

$$r = 4\%$$

$$P = \text{P}10,000$$

$$t = 10 \text{ yrs}$$

$$F = \text{P}14,918.247$$

2. the tag price of a certain commodity is for 100 days. If paid in 31 days, there is a 3% discount. What is the simple interest paid?

equivalent to 32nd to 100th day of interest

$$D = I = Pin$$

$$\text{let } F = 100$$

$$D = 100(0.03) = 3$$

$$P = F - D$$

$$P = 100 - 3 = 97$$

$$I = Pin$$

$$3 = 97(i) \left( \frac{100-31}{360} \right)$$

$$i = 16.136\%$$

ordinary  
paragi  
if not  
mentioned

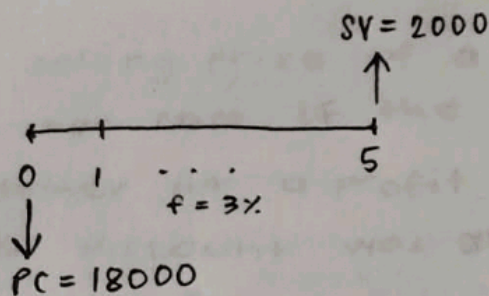
3. A machine has been purchased and installed at a total <sup>commodity</sup> cost of P18,000. The machine will retire at the end of 5 years, at which time it is expected to have a scrap value of P2000 based on current prices. The machine will then be replaced with an exact duplicate. The company plans to establish a reserve fund to accumulate the capital needed to replace the machine. If an average annual rate of inflation of 3% is anticipated, how much capital must be accumulated?

$$\begin{aligned}
 PC &= P18,000 \\
 n &= 5 \text{ yrs} \\
 SV &= P2000 \\
 f &= 3\%
 \end{aligned}$$

for commodity:

$$\begin{aligned}
 FC &= PC(1+f)^n - SV \quad \rightarrow \text{future value} \\
 &= 18000(1+0.03)^5 - 2000
 \end{aligned}$$

$$\boxed{FC = P18,866.933}$$



4. First Benchmark Publisher Inc, invests P100,000 today to be repaid in 5 years in one lump sum at 12% compounded annually. If the rate of inflation is 4% compounded annually, how much profit, in today's pesos, is realized over the five-year period?

PROFIT = INTEREST

$$P = P100,000$$

$$n = 5 \text{ yrs}$$

$$i_f = 12\%$$

$$f = 4\%$$

$$i_f = i + f + if$$

$$0.12 = i + 0.04 + i(0.04)$$

$$i = 0.0769 \rightarrow \textcircled{A}$$

$$F = P(1+i)^n$$

$$= 100,000(1 + \textcircled{A})^5$$

$$F = P144,851.640$$

$$I = F - P$$

$$I = \textcircled{P44,851.640}$$

5. The selling price of a TV set is double that of its net cost. If the TV set is sold to a customer at a profit of 25% of the net cost, how much discount was given to the customer, expressed in percent?

$$SP = 2NC$$

$$PROFIT = SP_n - NC$$

$$= 25\% \text{ of } NC$$

$$= 0.25NC$$

$$d = ?$$

$$\text{Let } NC = 100$$

$$SP = 200$$

$$PROFIT = 0.25NC$$

$$= 0.25(100)$$

$$PROFIT = 25$$

$$25 = SP_n - 100$$

$$SP_n = 125$$

$$D = F - P$$

$$D = 200 - 125$$

$$D = 75$$

$$d = \frac{F - D}{F}$$

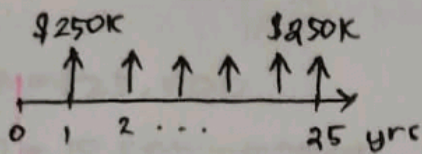
$$= \frac{200 - 75}{200}$$

$$d = \frac{D}{F} = \frac{75}{200}$$

$$d = 0.375$$

$$\textcircled{d = 37.5\%}$$

6. Northern Construction and Engineering plans on opening an office in Duluth. over the next 25 yrs, the office is expected to have a positive cash flow of \$250,000 per year. At an interest rate of 12%, what is the equivalent present worth?



$$P = A \sum_{x=1}^{LP-D} (1+i)^{-x}$$

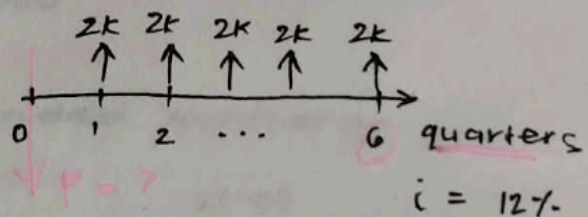
$$x = FP - D$$

$$= 250,000 \sum_{x=1}^{25-0} (1+0.12)^{-x}$$

$$P = \$1,960,784.778$$

7. Money borrowed today is to be paid in 6 equal payments at the end of 6 quarters. if the interest is 12% compounded quarterly. How much was initially borrowed if the quarterly payment is P2000.00?

Annuity is quarterly  
 $i$  given is compounded quarterly,  
 thus, proceed!



$i = 12\%$   
 comp. quar.

$$P = A \sum_{x=1}^{LP-D} (1+i)^{-x}$$

$$x = FP - D$$

$$= 2000 \sum_{x=1}^{6-0} \left(1 + \frac{0.12}{4}\right)^{-x}$$

$$P = P10,834.383$$

8. A farmer bought a tractor costing P25,000 payable in 10 semi-annual payments, each installment payable at the beginning of each period. If the rate of interest is 26% compounded semi-annually, determine the amount of each installment.

$P = P25,000$   
 $n = 10$  semi-annual  
 $i = 26\%$  com. semi-annually

$P = A \sum_{x=0}^{n-1} (1+i)^{-x}$   
 $x = n-1$

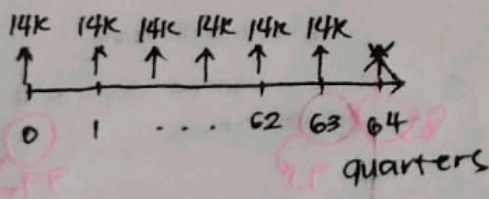
$$A = \frac{25,000}{\sum_{x=0}^{9} (1 + \frac{0.26}{2})^{-x}} = \boxed{P4,077.203}$$

$x = 0-0$

9. Find the difference between the sums of annuity due and ordinary annuity for the following data:

- A periodic payment = P14,000 quarterly
- B term = 16 yrs (4) = 64 quarters
- C interest rate = 10% compounded quarterly

ANNUITY DUE

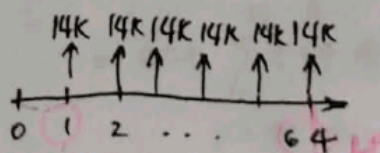


$$F_{AD} = 14000 \sum_{x=0}^{63-64} (1 + \frac{0.1}{4})^{-x}$$

$x = 0-64$

$$F_{AD} = P2213656.624 \rightarrow \text{A}$$

ORDINARY



$$F_{OA} = 14000 \sum_{x=1}^{64-64} (1 + \frac{0.1}{4})^{-x}$$

$x = 1-64$

$$F_{OA} = P2159664.999 \rightarrow \text{B}$$

$$F_{AD} - F_{OA} = \boxed{P53,991.625}$$

10. Find the present value of an annuity of P20,000 payable annually for 8 years, with the first payment at the end of the 11th year, if money is worth 5% compounded annually.

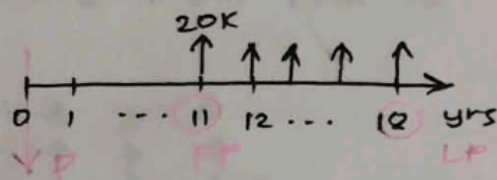
$$P = ?$$

A = P20000 annually

$n = 8$  yrs, 11th to 18th

$$i = 5\%$$

$$P = A \sum_{x=FP-D}^{LP-D} (1+i)^{-x}$$



$$P = 20,000 \sum_{x=11-0}^{18-0} (1+0.05)^{-x}$$

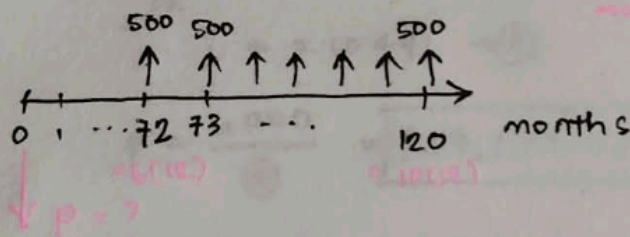
$$P = P79,357.039$$

11. What lump sum of money must be deposited in a bank account at present time so that P500 monthly can be withdrawn for 5 years with the first withdrawal scheduled six years from today? Interest rate is 9% compounded quarterly.

$$P = ?$$

A = P500 monthly for 5 years

$i = 9\%$  comp. quarterly



$$P = A \sum_{x=FP-D}^{LP-D} (1+i)^{-x}$$

$$= 500 \sum_{x=72-0}^{120-0} (1+i)^{-x}$$

$$P = P12,087.219$$

$$\left(1 + \frac{0.09}{4}\right)^4 = (1+i)^{12}$$

$$i = 7.444 \times 10^{-3}$$

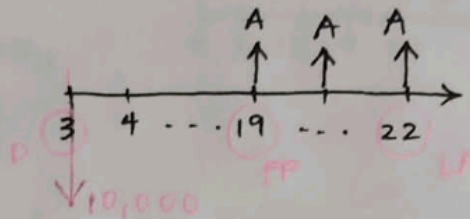
↳ (A)

12. Mr. Tony invested P10,000 now for the college education of his three-year old son. If the fund earns 14% effective, how much will the son get each year starting from 19th to 22nd birthday?  $A = ?$

$$P = P10,000$$

$$A = ?$$

$$i = 14\%$$



$$P = A \sum_{x=FP-D}^{LP-D} (1+i)^{-x}$$

$$A = \frac{10000}{\sum_{x=19-3}^{22-3} (1+0.14)^{-x}} = \boxed{P 24,497.745}$$

13. Find the present worth of perpetuity of P6000 annually with an interest rate of 10% compounded monthly.

$$P = ?$$

$$A = P6000 \text{ annually}$$

$$i = 10\% \text{ comp. monthly}$$

convert to

$$\left(1 + \frac{0.1}{12}\right)^{12} = (1+i)^1$$

$$i = 0.10471 \rightarrow \textcircled{A}$$

$$P = \frac{6000}{\textcircled{A}} = \boxed{P 57,299.439}$$

14. Find the present worth of perpetuity of P6000 annually with an interest rate of 10% annually.

$$P = ?$$

$$A = P6000 \text{ annually} \checkmark$$

$$i = 10\% \text{ annually} \checkmark$$

$$P = \frac{A}{i} = \frac{6000}{0.1} = \boxed{P 60,000}$$

15. Find the present worth of a perpetuity of ₱6000 annually with an interest rate of 10% annually, if the first payment will be given after 3 years.

$$P = ?$$

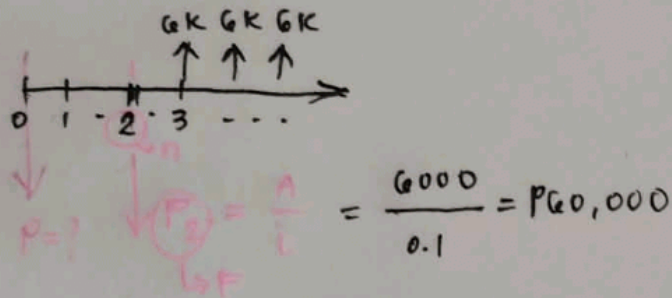
$$A = ₱6000 \text{ annually}$$

$$i = 10\% \text{ annually}$$

$$F = P(1+i)^n$$

$$6000 = P(1+0.1)^2$$

$$P = \boxed{₱49,586.777}$$





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**Sample Problems:**

1. P20,000 is placed in an investment for 10 years. How much is the investment's sum after these 10 years if the investment rate is 7% compounded continuously?

Given:

$$P = \text{P}20,000$$

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

$$r = 7\% = 0.07$$

Required:

$$F = ?$$

Solution:

$$F = Pe^{rt}$$

$$F = 20000e^{0.07(10)}$$

$$F = \mathbf{40,275.054}$$

2. Jackson needs to save \$3,500 for the purchase of a new car. His bank provides a continuous compound interest rate of 3.7% for 18 months. How much does Jackson need to initially invest to reach his savings goal?

Given:

$$F = \$3,500$$

$$t = \frac{18}{12}$$

$$= 1.5 \text{ years}$$

$$r = 3.7\% = 0.037$$

Required:

$$P = ?$$

Solution:

$$F = Pe^{rt}$$

$$3,500 = Pe^{0.037(1.5)}$$

$$P = \mathbf{\$3,311.04}$$

II. **Skill-Building Activity (BOARDWORK) / (SEATWORK (ungraded))**

Solve the following problems. Write your solution on a separate sheet of paper.

1. Calculate the final amount for an investment of \$2,000 with an annual interest rate of 6% compounded continuously for 3 years. Compare the results of the computed amount if it is compounded annually, quarterly, monthly, and daily. What can you say or conclude about the relation of the compounding



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$$F_c = \$2394.435$$

$$F_q = \$2382.032$$

$$F_m = \$2391.236$$

$$F_n = \$2393.361$$

$$F_d = \$2394.399$$



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- frequency to the future worth?
2. Calculate the final amount for an investment of \$5,000 with an annual interest rate of 4% compounded continuously for 4 years. **\$ 5867.554**

**C. CHECK**

**I. Check for Understanding**

Solve the following problems. Write your solution on a separate sheet of paper.

1. What is continuous compounding, and how does it differ from other compounding frequencies?
2. How does continuous compounding affect the growth of an investment or savings?

**D. LESSON WRAP UP**

**I. Frequently Asked Questions**

1. Is continuous compounding used in real-world applications?  
While continuously compounding is a theoretical concept, it is used in some finance models and calculations, such as option pricing and risk analysis.
2. Can continuous compounding be used for loans or credit cards?  
Continuous compounding is typically used for investments and savings, rather than loans or credit cards, which often use other compounding frequencies.
3. Is continuous compounding a realistic assumption?  
While continuously compounding is a theoretical concept, it can be a useful assumption in certain financial models and calculations, especially when dealing with complex investments or risk analysis.
4. Can continuous compounding be used for short-term investments?  
Continuous compounding is typically more relevant for long-term investments, as the effect of continuous compounding is more pronounced over longer periods.

**II. Thinking about Learning**

Three things you learned:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Two things that you would like to learn more about:

1. \_\_\_\_\_
2. \_\_\_\_\_

One question you still have:

1. \_\_\_\_\_

(Answers to the tasks in the SAS will be given by your professors)





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4. If the cost of money is 9% and the inflation rate is 5%, what interest rate will take care of the rest of the cost of money and inflation?

Solution:

$$i_r = f + i + fi$$

$$i_r = 0.05 + 0.09 + 0.05(0.09)$$

$$i_r = 0.1445 = 14.45\%$$

II. Skill-Building Activity

Solve the following problems. Write your solution on a separate sheet of paper.

1. A price tag of P1,200 is payable in 60 days but if paid within 30 days it will have a 3% discount. Find the rate of interest. *37.113%*
2. A man borrowed P2,000 from a bank and promised to pay the amount for one year. He received only the amount of P1,920 after the bank collected an advance interest of P80.00. What was the rate of discount? *4%*
3. 12% rate of interest can take care of the cost of money and inflation. If the nominal rate of interest is 6%, what is the rate of inflation? *5.66%*
4. The inflated present worth of P2000 in two years is equal to P1471.07. What is the rate of inflation if the interest rate is equal to 10%? *f = 16.6%*

C. CHECK (SW#1)

1. Check for Understanding

Solve the following problems. Write your solution on a separate sheet of paper.

1. A machine has been purchased and installed at a total cost of P18,000.00. The machine will retire at the end of 5 years, at which time it is expected to have a scrap value of P2,000.00 based on current prices. The machine will then be replaced with an exact duplicate. The company plans to establish a reserve fund to accumulate the capital needed to replace the machine. If an average annual rate of inflation of 3% is anticipated, how much capital must be accumulated? *P 18,866.933*
2. First Benchmark Publisher Inc. invests P100,000 today to be repaid in five years in one lump sum at 12% compounded annually. If the rate of inflation is 4% compounded annually, how much profit, in today's pesos, is realized over the five-year period? *P 44851.64*
3. The selling price of a TV set is double that of its net cost. If the TV set is sold to a customer at a profit of 25% of the net cost, how much discount was given to the customer? *37.5% of net cost*

D. LESSON WRAP UP

1. Frequently Asked Questions

1. How is the discount rate determined?  
The discount rate is determined based on the risk-free rate, risk premium, and other factors.
2. How is inflation measured?  
Inflation is measured using the Consumer Price Index (CPI) or other price indices.





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**II. Skill-Building Activity**

Solve the following problems. Write your solution on a separate sheet of paper.

- SW - 1. Northern Construction and Engineering plans on opening an office in Duluth. Over the next 25 years, the office is expected to have a positive cash flow of \$250,000 per year. At an interest rate of 12%, what is the equivalent present worth?  $\$1,960,784.778$
- SW - 2. Money borrowed today is to be paid in 6 equal payments at the end of 6 quarters. If the interest is 12% compounded quarterly. How much was initially borrowed if the quarterly payment is P2000.00?  $P10,834.358$
- 3. If the equal-payment-series present-worth factor of the investment for 10 equal payments is 6.503, what is the interest rate?  $8.701\%$

**C. CHECK**

**I. Check for Understanding**

Solve the following problems. Write your solution on a separate sheet of paper.

- 1. An engineer wants to start a business that requires the purchase of a P100,000 worth of machine, which will produce a net income of P11,000 per year after deducting operating expenses. The engineer plans to put the machine on sale after 4 years. What must be the resale price to justify the investment if the engineer should make a 12% annual return on the investment?  $P104,779.328$
- 2. Using a credit card, Tim Settles has just purchased a stereo system for \$975. If he makes payments of \$45 per month and the interest rate is 18% compounded monthly, how long will it take to pay off the loan completely?  $2.2 \text{ yrs}$

**D. LESSON WRAP UP**

**I. Frequently Asked Questions**

- 1. How does an ordinary annuity work?  
Ordinary annuities work by providing a fixed or variable payment stream for a specified period. Payments are made at the end of each interval, and interest accrues based on the payment schedule and interest rates.
- 2. What are the benefits of an ordinary annuity?  
Ordinary annuities offer a predictable income stream, regular payments, potential for compound interest, tax advantages, and diversification benefits. They're useful for retirement planning and budgeting.
- 3. What are the drawbacks of an ordinary annuity?  
Ordinary annuities have limited liquidity, fixed payments, fees and charges, inflation risk, interest rate risk, and counterparty risk.

**II. Thinking about Learning**

Three things you learned:

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_



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Payment terms (annually):  $r = r_A$ ;  $m = m_A = 1$

Required:

$P = ?$

Solution:

The given problem is a general annuity, where the payment period is not the same to the interest period, so we must find the equivalent interest rate of compounded semi-annually to compounded annually.

$$\begin{aligned} ER_A &= ER_S \\ \left(1 + \frac{r_A}{m_A}\right)^{m_A} - 1 &= \left(1 + \frac{r_S}{m_S}\right)^{m_S} - 1 \\ \left(1 + \frac{r_A}{1}\right)^1 - 1 &= \left(1 + \frac{0.08}{2}\right)^2 - 1 \\ 1 + r_A &= \left(1 + \frac{0.08}{2}\right)^2 \\ r_A &= \left(1 + \frac{0.08}{2}\right)^2 - 1 \\ r_A &= 0.0816 = 8.16\% \end{aligned}$$

Each annual payment is made at the beginning of each month, then it's ANNUITY DUE!

Now, we can have the equivalence in the number of payments and the number of interest periods for the use of annuity due.

$$n = mt = 1(8) = 8 \text{ years}$$

$$\begin{aligned} P &= A \left[ \frac{(1+i)^n - 1}{i(1+i)^n} \right] (1+i) \\ P &= 50,000 \left[ \frac{(1+0.0816)^8 - 1}{0.0816(1+0.0816)^8} \right] (1+0.0816) \\ P &= \$309,900.072 \end{aligned}$$

## II. Skill-Building Activity

Solve the following problems. Write your solution on a separate sheet of paper.

- SW - 1. A farmer bought a tractor costing Php 25,000 payable in ten semiannual payments, each installment payable at the beginning of each period. If the rate of interest is 26% compounded semi-annually, determine the amount of each installment.  $P = 4,077.203$
2. A man bought an equipment costing P60,000 payable in 12 quarterly payments each installment payable at the beginning of each period. The rate of interest is 24% compounded quarterly. What is the amount



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- of each payment? **P 6,751.53**
- SW - 3. Find the difference between the sums of annuity due and ordinary annuity for the following data:  
 Periodic payment = P14,000  
 Term = 16 years  
 Interest rate = 10% compounded quarterly **₱ 53,991.625**

**C. CHECK**

**I. Check for Understanding**

Solve the following problems. Write your solution on a separate sheet of paper.

1. A young woman 22 years old has just graduated from college. She accepts a good job and desire to establish her own retirement fund. At the beginning of each year thereafter she plans to deposit P 2,000 in a fund at 15% annual interest. How old will she when the fund has an accumulated value of P 1,000,000? **53 yrs. old**

**D. LESSON WRAP UP**

**I. Frequently Asked Questions**

1. How does an annuity due differ from an ordinary annuity?  
The main difference is the payment timing. Annuity due payments are made at the beginning of each period, while ordinary annuity payments are made at the end of each period.
2. How does annuity due impact my financial planning?  
Annuity due can impact your financial planning by providing a more accurate calculation of future or present value, especially when payments are made at the beginning of each period.

**II. Thinking about Learning**

Three things you learned:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

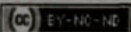
Two things that you would like to learn more about:

1. \_\_\_\_\_
2. \_\_\_\_\_

One question you still have:

1. \_\_\_\_\_

(Answers to the tasks in the SAS will be given by your professors)





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$$P_{Lot} = P100,000 + P_A$$

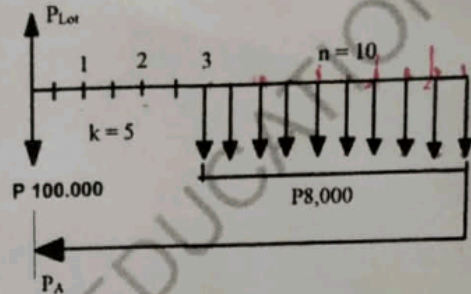
$$P_A = A \left[ \frac{(1+i)^n - 1}{i(1+i)^{k+n}} \right]$$

$$P_A = 8000 \left[ \frac{\left(1 + \frac{0.12}{2}\right)^{10} - 1}{\frac{0.12}{2} \left(1 + \frac{0.12}{2}\right)^{5+10}} \right]$$

$$P_A = P43,999.082$$

$$P_{Lot} = 100,000 + 43,999.082$$

$$P_{Lot} = P143,999.082$$



3. You need P4,000 per year for four years to go to college. Your father invested P5,000 in 7% account for your education when you were born. If you withdraw at the end of your 17<sup>th</sup>, 18<sup>th</sup>, 19<sup>th</sup>, and 20<sup>th</sup> birthday how much will left in the account at the end of your 21<sup>st</sup> birthday?

**Solution:**

Analyze the problem using cash flow diagram, we have an inflow of P4,000 annuity and the remaining money at year 21, outflow of P5,000 deposit as shown in the cash flow.

$$F_{21} = F_0 - F_A$$

$$F_A = A \left[ \frac{(1+i)^n - 1}{i} \right] (1+i)$$

$$F_A = 4000 \left[ \frac{(1+0.07)^4 - 1}{0.07} \right] (1+0.07)$$

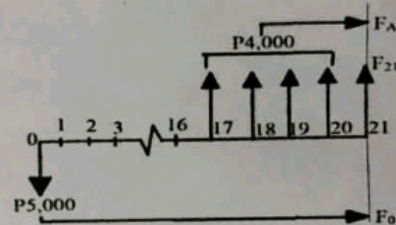
$$F_A = P19,002.956$$

$$F_0 = 5000(1+0.07)^{21}$$

$$F_0 = P20,702.812$$

$$F_{21} = P20,702.812 - P19,002.956$$

$$F_{21} = P1,699.856$$



$$F_{21} = F_0 - F_A$$

## II. Skill-Building Activity

Solve the following problems. Write your solution on a separate sheet of paper.

- Find the present value of an annuity of P20,000 payable annually for 8 years, with the first payment at the end of the 11th year, if money is worth 5% compounded annually. **P79,357.039**
- What lump sum of money must be deposited in a bank account at present time so that Php 500 monthly can be withdrawn for five years with the first withdrawal scheduled six years from today? Interest rate is 9% compounded quarterly. **P7913.346 P10,083.119**
- Mr. Tony invested Php 10,000 now for the college education of his three-year old son. If the fund earns 14% effective, how much will the son get each year starting from 19th to 22nd birthday? **P24497.745**





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P402,042.05

P37,665.752

4. Mr. Luther borrows P600,000 at 12% compounded annually agreeing to repay the loan in 15 equal payments. How much of the original principal is still unpaid after he has made the 8th payment?
5. The present value of an annuity of "P" pesos payable annually for 8 years, with the first payment at the end of 10 years, is P187,481.25. Find the value of "P" if money is worth 5%.
6. Find the present value of an annuity of P30,000 payable annually for 10 years with the first payment at the end of the 10th year, if the money is worth 8% compounded annually. **P100,701.339**

**C. CHECK****I. Check for Understanding**

Solve the following problems. Write your solution on a separate sheet of paper.

1. An engineer is thinking of starting a part-time consulting business next September 5, on his 40th birthday. He expects the business will require an initial cash outlay of \$5000, to come from his savings, and will cost \$500 per year ago operate; the business ought to generate \$2000 per year in cash receipts. During the 20 years that he expects to operate the business, he plans to deposit the annual net proceeds in a bank each year, at an interest rate of 8% per year, compounded annually. When he retires, on his 60th birthday, the engineer expects to invest whatever proceeds plus interest he then has from the business in a long-term savings plan that pays 10% per year, compounded annually. What is the maximum amount he could withdraw from the savings plan each year during his retirement and still have the funds last 15 years?
2. Today you invest P100,00 into a fund that pays 25% interest compounded annually. Three years later you borrow P50,000 from a bank at 20% annual interest and invest in the fund. Two years later you withdraw enough money from the fund to repay the bank loan and all interest due on it. Three years from this withdrawal you taking P20,000 per year out of the fund. After five withdrawals you withdrawn the balance in the fund. How much was withdrawn?
3. If P10,000 is deposited each year for 9 years, how much annuity can a person get annually from the bank every year for 8 years starting one year after the 9th deposit is made. Cost of money is 14%.

**D. LESSON WRAP UP****I. Frequently Asked Questions**

1. How does a deferred annuity work?  
A deferred annuity works by accumulating funds over a specified period, and then providing a stream of payments to the annuitant.
2. What are the benefits of a deferred annuity?  
Deferred annuities offer tax-deferred growth, retirement income, and flexibility in payment options.
3. Can I withdraw money from a deferred annuity before the payment phase?  
Withdrawal rules vary, but some deferred annuities may allow partial withdrawal or loans.
4. Can I add a rider to a deferred annuity?  
Yes, some deferred annuities offer riders that provide additional benefits, such as long-term care or income guarantees.
5. How do I choose the right deferred annuity for my needs?



**Required:**

$P = ?$

**Solution:**

$$P = A \left[ \frac{(1+i)^n - 1}{i(1+i)^n} \right]$$

$$P_{5K} = 5000 \left[ \frac{(1+8\%)^5 - 1}{8\%(1+8\%)^5} \right]$$

$P_{5K} = \text{P}19,963,550$

$$F = A \left[ \frac{(1+i)^n - 1}{i} \right]$$

$$F_{10(8K)} = 8000 \left[ \frac{(1+8\%)^5 - 1}{8\%} \right]$$

$F_{10(8K)} = \text{P}46,932.80768$

$P = F(1+i)^{-n}$

$P_{8K} = 46,932.80768(1+8\%)^{-10}$

$P_{8K} = \text{P}21,738,971$

$P = \frac{A}{i}$

$F_{10(10K)} = \frac{10000}{8\%}$

$F_{10(10K)} = \text{P}125,000$

$P = F(1+i)^{-n}$

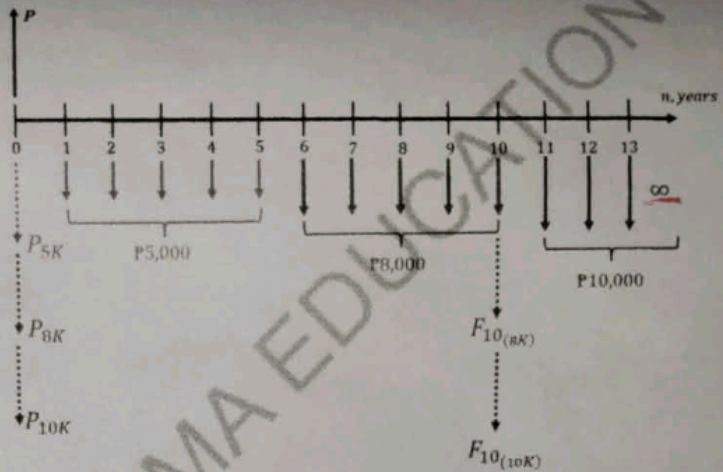
$P_{10K} = 125000(1+8\%)^{-10}$

$P_{10K} = \text{P}57,899,186$

$P = P_{5K} + P_{8K} + P_{10K}$

$P = 19,963,550 + 21,738,971 + 57,899,186$

$P = \text{P}99,601,707$



**II. Skill-Building Activity**

Solve the following problems. Write your solution on a separate sheet of paper.

1. Find the present worth of perpetuity of P6,000 annually with an interest rate of 10% compounded monthly.
2. Find the present worth of perpetuity of P6,000 annually with an interest rate of 10% annually.

*P57,299,439*  
~~P420,000~~  
*P60,000*



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### C. CHECK

#### I. Check for Understanding

Solve the following problems. Write your solution on a separate sheet of paper.

- sw - 1. Find the present worth of perpetuity of ₱6,000 annually with an interest rate of 10% annually, if the first payment will be given after 3 years.  $₱49,586.777$
2. How much money must you deposit today to an account earning 12% so that you can withdraw ₱25,000 yearly indefinitely starting at the end of the 10th year?

#### D. LESSON WRAP UP $₱75,127.089$

#### I. Frequently Asked Questions

1. What are some examples of perpetuities?  
Examples of perpetuities include consoles, preferred stocks, and certain types of investments that provide a fixed income stream
2. What are some advantages of perpetuities?  
Perpetuities provide a predictable income stream and can be used to value assets with indefinite cash flows.
3. What are some disadvantages of perpetuities?  
Perpetuities assume a constant interest rate and payment stream, which may not reflect real-world conditions.

#### II. Thinking about Learning

Three things you learned:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Two things that you would like to learn more about:

1. \_\_\_\_\_
2. \_\_\_\_\_

One question you still have:

1. \_\_\_\_\_

(Answers to the tasks in the SAS will be given by your professors)



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## QUIZ 2.1

2. A company invests P10,000 today to be repaid in five years in one lump sum at 12% compounded annually, how much profit in present day pesos is realized over five years?

$$P = P10,000$$

$$I = ?$$

$$n = 5 \text{ yrs}$$

$$F = P(1+i)^n$$

$$i = 12\%$$

$$= 10000(1+0.12)^5$$

$$I = F - P$$

$$I = \text{P}7,623.417$$

$$F = P17,623.417$$

3. (CE Board May 2022) In 1991, the average cost of a house was P1,000,000. If the annual inflation rate is 6%, what is the value of a house of the same model in 1996?

$$FC = ?$$

$$FC = PC(1+f)^n$$

$$PC = \text{P}1\text{M}$$

$$f = 6\%$$

$$n = 1996 - 1991$$

$$= 5 \text{ yrs}$$

$$FC = 1\text{M}(1+0.06)^5$$

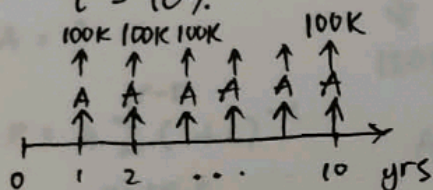
$$FC = \text{P}1,338,225.578$$

5. (CE Board May 2019) A machine cost P400,000 to purchase with a life of 10 years with no salvage value. If the rate of interest is 10% per annum compounded annually, compute the equivalent uniform annual cost of the machine if it will cost P100,000 per year to operate?

$$P = P400,000$$

$$n = 10 \text{ yrs}$$

$$i = 10\%$$



$$P = A \sum_{x=0}^{n-1} (1+i)^{-x}$$

$$x = n-1$$

$$A = \frac{400000}{\sum_{x=0}^{10-1} (1+0.1)^{-x}} = P65,098.158$$

$$x = 1-0$$

$$EAC = P65,098.158 + 100000$$

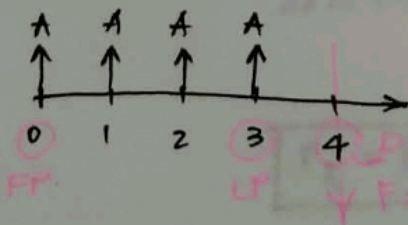
$$EAC = P165,098.158$$

6. Mr. Franklin wants to save for a new sports car that he expects will cost \$38,000, 4 years from now. How much money will he have to save each year and deposit in a savings account at the beginning of each year that pays 6.25% per year compounded annually to buy the car in 4 years.

$$F = \$38,000$$

$$n = 4 \text{ yrs}$$

$$i = 6.25\%$$



$$F = A \sum_{x=0}^{n-1} (1+i)^{-x}$$

$$x = n-1$$

$$A = \frac{38,000}{\sum_{x=0}^{4-1} (1+0.0625)^{-x}}$$

$$x = 0-4$$

$$A = \$8145.245$$

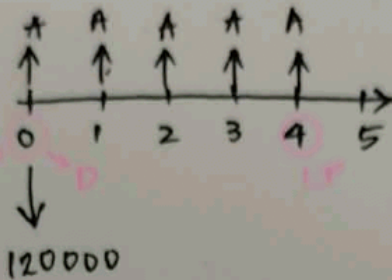
7. A contractor bought a concrete mixer at P120,000 if paid in cash. the mixer may also be purchased by installment to be paid within 5 years. If money is worth 8%, the amount of each annual payment, if all payments are made at the beginning of each year, is:

$$P = P120,000$$

$$n = 5 \text{ yrs}$$

$$i = 8\%$$

$$A = ?$$



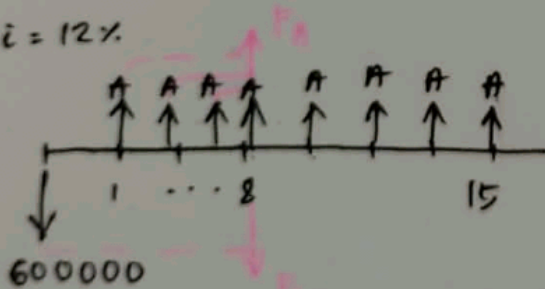
$$P = A \sum_{x=0}^{n-1} (1+i)^{-x}$$

$x = 0-4$

$$A = \frac{120000}{\sum_{x=0}^{4} (1+0.08)^{-x}} = \boxed{P27,828.495}$$

$x = 0-4$

9. Mr. Luther borrows P600,000 at 12% compounded annually, agreeing to repay the loan in 15 equal payments. How much of the original principal is still unpaid after he has made the 8th payment?  
 $i = 12\%$



$$P = A \sum_{x=1}^{n} (1+i)^{-x}$$

$x = 1-15$

$$A = \frac{600000}{\sum_{x=1}^{15} (1+0.12)^{-x}} = P88,094.544$$

$x = 1-15$

$\hookrightarrow \textcircled{A}$

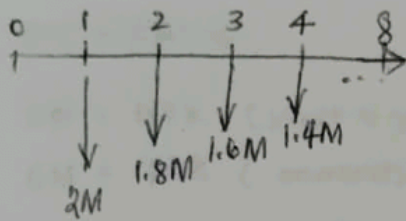
$$F_8 = 600000(1+0.12)^8 - 88,094.544 \sum_{x=1}^{8} (1+0.12)^{-x}$$

$x = 1-8$

$$\boxed{F_8 = P402,042.05}$$

SEATWORK 2.2

①



$dG = -P200,000$

$n = 8 \text{ yrs}$

$i = 12\%$

$FAC = ?$

$$P_T = \sum_{x=1}^n \frac{A + (x-1)G}{(1+i)^x}$$

$$= \sum_{x=1}^8 \frac{2M + (x-1)(-200000)}{1.12^x}$$

$P_T = P7040989.629$

$$FAC = \frac{P_T}{\sum_{x=1}^n (1+i)^{-x}} = \frac{7040989.629}{\sum_{x=1}^8 (1.12)^{-x}}$$

$FAC = P1,417,371.218$

②

$P = ?$

$A = P40K$

$G = -3K$

$n = 5 \text{ yrs}$

$i = 13\%$

$$P_T = \sum_{x=1}^5 \frac{40K + (x-1)(-3K)}{(1.13)^x}$$

$P_T = P\$122,148.522$

③

$n = 15 \text{ yrs}$

$A = \$5000$

$\%G = 20\%$

$i = 6\%$

$P = ?$

$$P = \sum_{x=1}^{15} \frac{A(1+\%G)^{x-1}}{(1+i)^x} = \sum_{x=1}^{15} \frac{5000(1+0.2)^{x-1}}{1.06^x}$$

$P = \$193,886.136$

④

$C = ?$

$FC = P1.5M$

$OM = P150K$

$i = 15\%$

$$C = FC + \frac{RC - SV}{(1+i)^n - 1} + \frac{OM}{i}$$

$C = 1.5M + 0 + \frac{150K}{0.15}$

$C = P2.5M$

5)  $C = ?$

$FC = P15M$

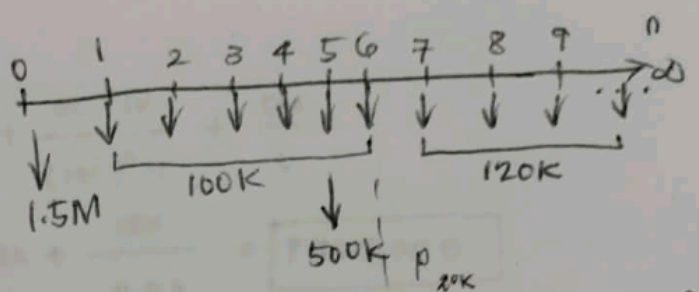
$OM = 100K$  (first 6 yrs)

$OM = 120K$  (onwards)

$RC = 500K$

$n = 5$  yrs

$i = 12\%$



$$C = 15M + \frac{100K}{0.12} + \frac{20K}{0.12} (1.12)^{-6} + \frac{500K}{1.12^5 - 1}$$

$C = P6,573,645.737$

6)  $FC = P100K$

$n = 15$  yrs

$SV = P4K$

$AOC = P18K$

$i = 8\%$

$AC = Ci$

$$= 0.08 \left[ 100K + \frac{100K - 4K}{1.08^{15} - 1} + \frac{18K}{0.08} \right]$$

$AC = P29,535.636$

7)  $FC = P150K$

$n = 10$  yrs

$SV = 5000$

$AMC = 10000$

$i = 0.12$

$$P_{MC} = \frac{10,000}{0.12} = P83,333.333$$

8)  $FC = P10,000$

$n = 5$  yrs

$RC = P11,000$

$i = 5\%$

$AC = Ci$

$$= 0.05 \left[ 10000 + \frac{11000}{1.05^5 - 1} \right]$$

$AC = P2490.723$

QUIZ NO. 2

Gradients, Capitalized Cost and Annual Costs

1. An item is purchased for P100,000. Annual costs are P18,000. Using 8% interest, what is the capitalized cost of perpetual service?
2. What is the present worth of a three P40,000 deposit in the first to third years, and amounts decreasing by P2,000 per year for five years at an interest rate of 10% per year?
3. Determine the capitalized cost of a research laboratory, which requires P5,000,000 for the original construction, P100,000 at the end of every year for the first 6 years, and then P120,000 each year thereafter for operating expenses and P500,000 every 5 years for replacement with interest at 12% per annum.
4. A manufacturing plant installed a new boiler at a total cost of P150,000. It is estimated to have a useful life of ten years with the scrap value of P5,000. Annual maintenance cost is P10,000. If the interest is 12% compounded annually, determine the capitalized cost.
5. The salary of Mr. Cruz was increased by 30% every 2 years beginning January 1, 1982. By how much will his salary be after 6 years, expressed in percent?

$$D = 100(0.03) = 3$$

$$P = F - D$$

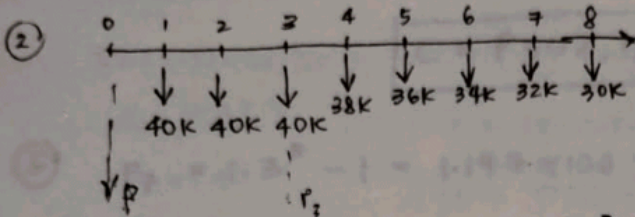
$$i = 10.156\%$$

QUIZ 2.2

①  $FC = P100,000$   
 $OM = P18,000$   
 $i = 8\%$

$$C = FC + \frac{RC - SV}{(1+i)^n - 1} + \frac{OM}{i}$$

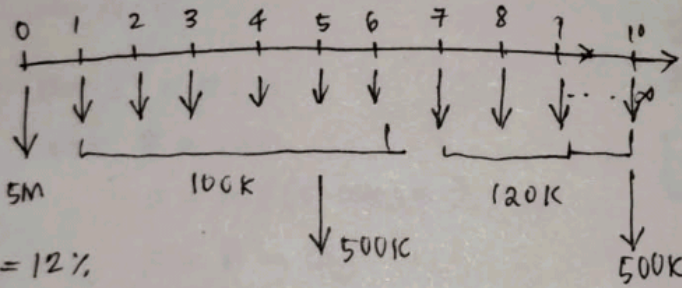
$$= 100k + \frac{18k}{0.08} = \boxed{P325,000}$$



$$P_T = 40000 \sum_{x=1-0}^{3-0} (1.1)^{-x} + \left[ \sum_{x=4-3}^{8-3} \frac{38000 + (x-1)(-2000)}{1.1^x} \right] (1.1)^{-3}$$

$$\boxed{P_T = P197,390.153}$$

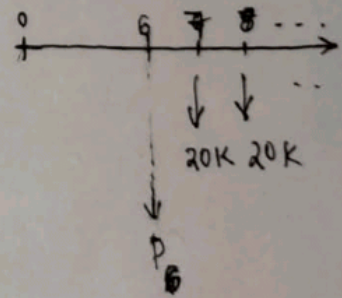
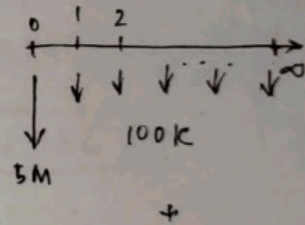
③



$i = 12\%$

$$C = 5M + \frac{100K}{0.12} + \frac{20K}{0.12} (1.12)^{-6} + \frac{500K}{1.12^5 - 1}$$

$$\boxed{C = P6,573,645.737}$$



$$\textcircled{4} \quad FC = P150K \quad AMC = 10K$$

$$n = 10 \text{ yrs} \quad i = 12\%$$

$$SV = 5K$$

$$C = 150K + \frac{150K - 5K}{1.12^{10} - 1} + \frac{10K}{0.12}$$

SOLUTION:

$$C = P302,189.198$$

$$\textcircled{5} \quad F_7 = 1.3^3 - 1 = 1.197 \times 100\% \approx 119.7\%$$

2. the tag price of a certain commodity is for 100 days. If paid in 31 days, there is a 3% discount. What is the simple interest paid?

$$D = I = Pin$$

$$\text{let } F = 100$$

$$D = 100(0.03) = 3$$

$$P = F - D$$

$$P = 100 - 3 = 97$$

$$I = Pin$$

$$3 = 97(i) \left( \frac{100 - 31}{360} \right)$$

$$i = 16.136\%$$