University of Diyala

Engineering Economy

Lecture 6

3rd Stage

Communication department / Engineering collage

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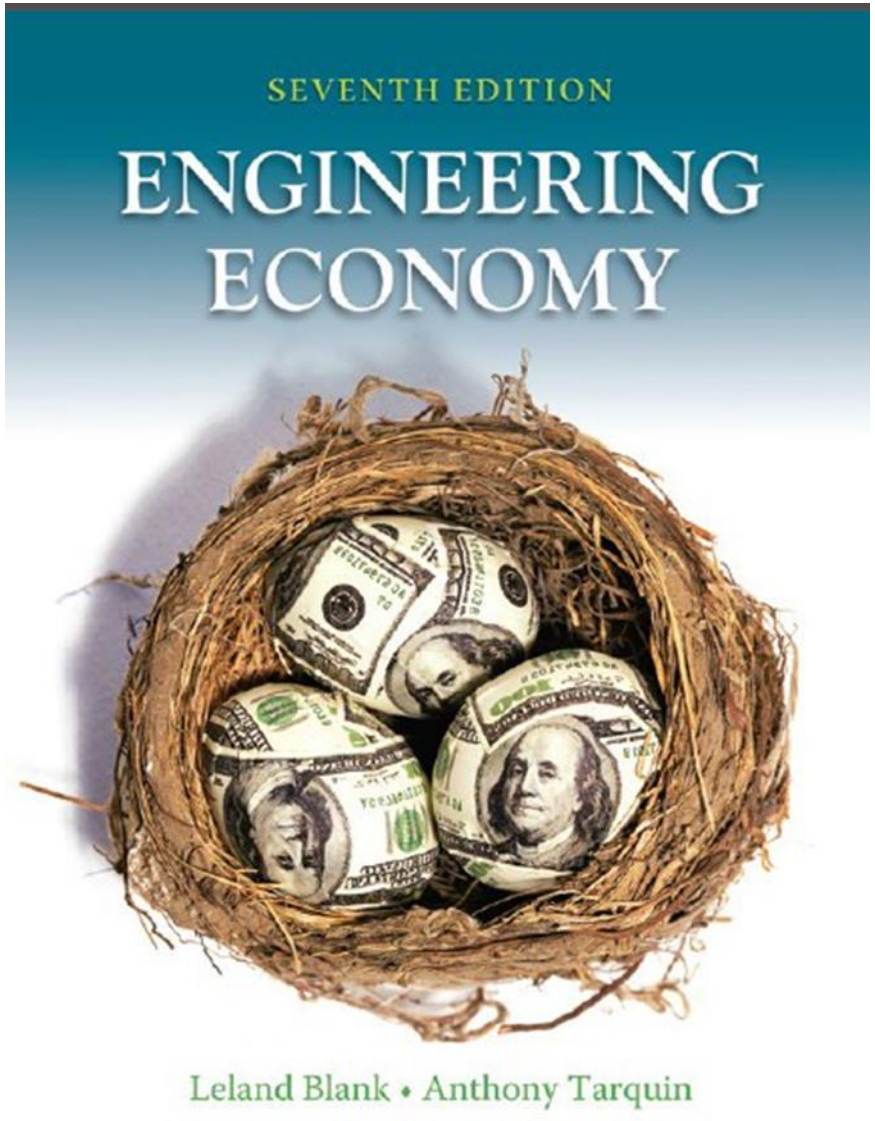


Chapter 2

Factors :How Time and Interest affect Money

Factors and Equivalence

- Present Worth (*P*): present amount at $t = 0$
- Future Worth (*F*): equivalent future amount at $t = n$ of any present amount at $t = 0$
- Annual Amount (*A*): uniform amount that repeats at the end of each year for *n* years
- Uniform Gradient Amount (*G*): uniform gradient amount that repeats at the end of each year, starting at the end of the second year and stopping at the end of year *n*.

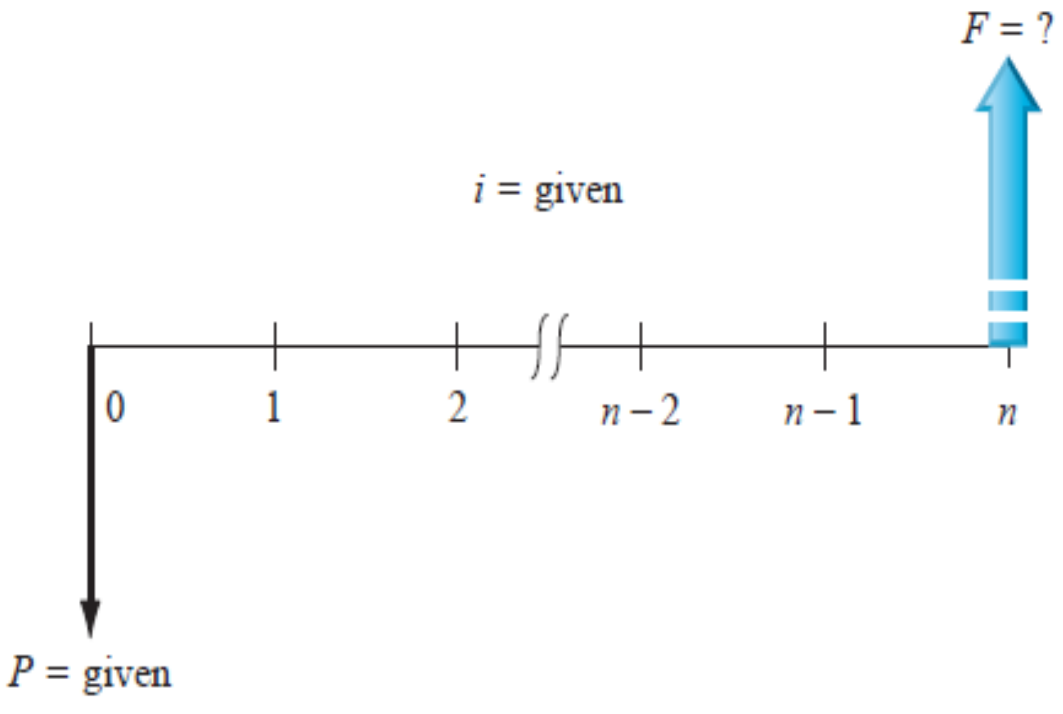
LEARNING OUTCOMES

Purpose: Derive and use the engineering economy factors to account for the time value of money.

SECTION	TOPIC	LEARNING OUTCOME
2.1	*F*/*P* and *P*/*F* factors	• Derive and use factors for single amounts—compound amount (*F*/*P*) and present worth (*P*/*F*) factor.
2.2	*P*/*A* and *A*/*P* factors	• Derive and use factors for uniform series—present worth (*P*/*A*) and capital recovery (*A*/*P*) factors.
2.3	*F*/*A* and *A*/*F* factors	• Derive and use factors for uniform series—compound amount (*F*/*A*) and sinking fund (*A*/*F*) factors.
2.4	Factor values	• Use linear interpolation in factor tables or spreadsheet functions to determine factor values.
2.5	Arithmetic gradient	• Use the present worth (*P*/*G*) and uniform annual series (*A*/*G*) factors for arithmetic gradients.
2.6	Geometric gradient	• Use the geometric gradient series factor (*P*/*A*,*g*) to find present worth.
2.7	Find *i* or *n*	• Use equivalence relations to determine *i* (interest rate or rate of return) or *n* for a cash flow series.

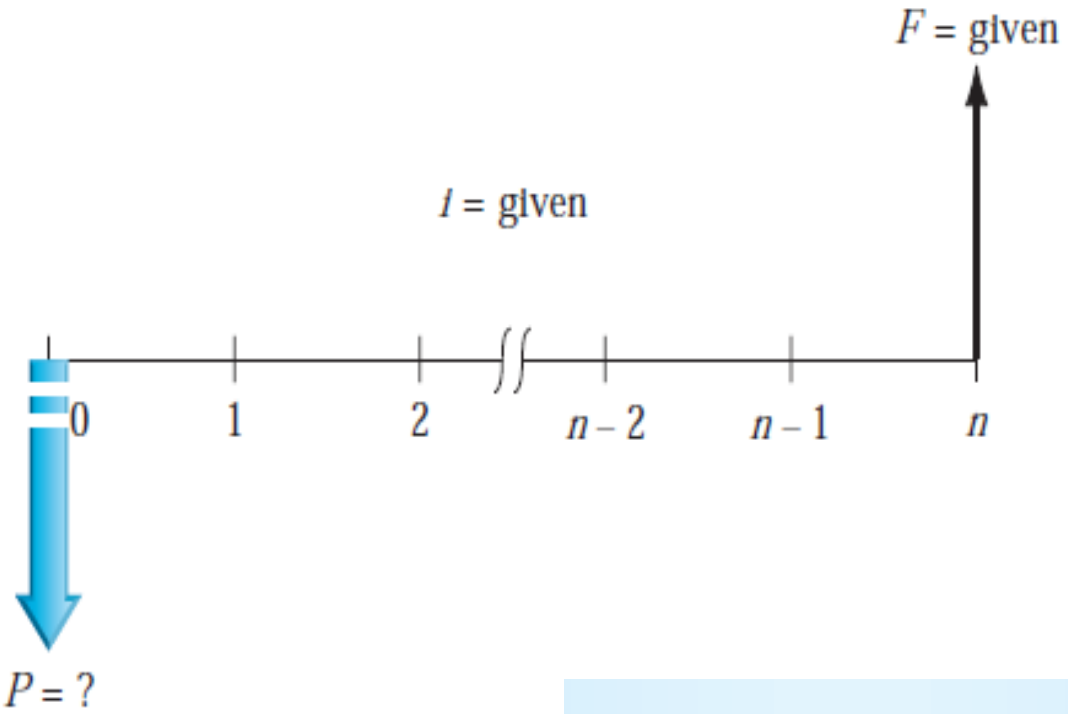
Single-Amount Factors (*F / P* and *P / F*)

Cash flow diagrams for single-payment factors:
(a) find F, given P
(b) find P, given F



(a)

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



(b)

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

Note:

- Term in parameters or brackets are called factors.
- The factors are represented in standard factor notation such as (F/P,i,n) where the letter to left of slash is what is sought; letter to right represents what is given.

F/P and P/F for spreadsheets:

Future value F is calculated using FV function

= FV(i%,n,,P)

Present value P is calculated using PV function

= PV(i%,n,,F)

Note the use of double commas in each function

TABLE 2–1 *F/P* and *P/F* Factors: Notation and Equations

Factor			Standard Notation	Equation	Excel
Notation	Name	Find/Given	Equation	with Factor Formula	Function
$(F/P,i,n)$	Single-payment compound amount	F/P	$F = P(F/P,i,n)$	$F = P(1 + i)^n$	$= FV(i\%,n,,P)$
$(P/F,i,n)$	Single-payment present worth	P/F	$P = F(P/F,i,n)$	$P = F(1 + i)^{-n}$	$= PV(i\%,n,,F)$

Table 2–1 summarizes the standard notation and equations for the F/P and P/F factors.

Examples:

Sandy, a manufacturing engineer, just received a year-end bonus of $10,000 that will be invested immediately. With the expectation of earning at the rate of 8% per year, Sandy hopes to take the entire amount out in exactly 20 years to pay for a family vacation when the oldest daughter is due to graduate from college. Find the amount of funds that will be available in 20 years by using:

(a) hand solution by applying the factor formula and tabulated value.

Solution:

$$P = \$10{,}000 \qquad F = ? \qquad i = 8\% \text{ per year} \qquad n = 20 \text{ years}$$

(*a*) *Factor formula:* Apply Equation [2.2] to find the future value F. Rounding to four decimals, we have

$$F = P(1 + i)^n = 10{,}000(1.08)^{20} = 10{,}000(4.6610)$$
$$= \$46{,}610$$

Standard notation and tabulated value: Notation for the F/P factor is $(F/P,i\%,n)$.

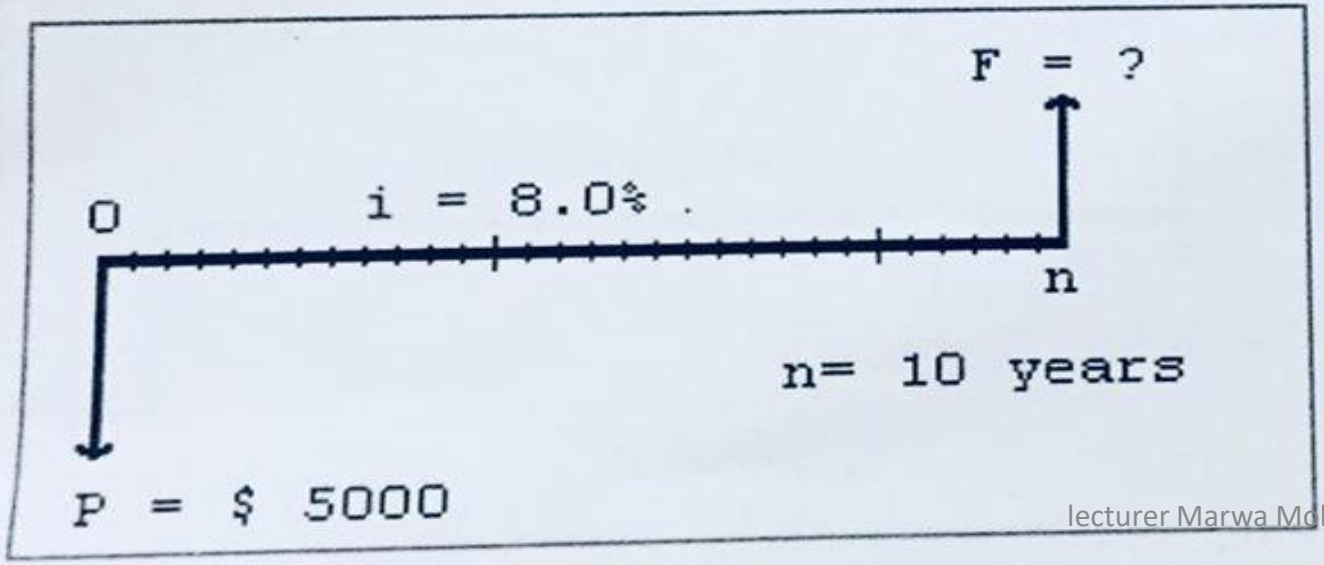
$$F = P(F/P,8\%,20) = 10{,}000(4.6610)$$
$$= \$46{,}610$$

Example: Finding Future Value

A person deposits $5000 into an account which pays interest at a rate of 8% per year. The amount in the account after 10 years is closest to:

(A) $2,792 (B) $9,000 (C) $10,795 (D) $12,165

The cash flow diagram is:



Solution:

F = P(F/P,i,n)

= 5000(F/P,8%,10)

= 5000(2.1589)

= $10,794.50

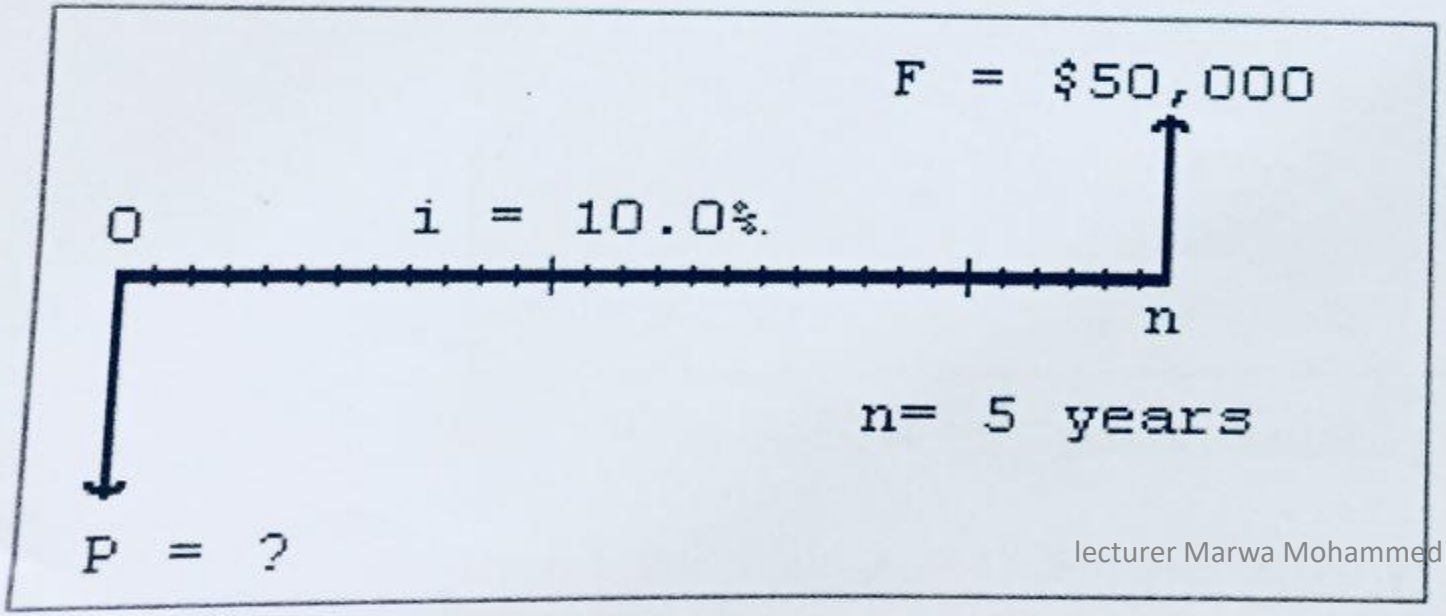
Answer is (C)

Example: Finding Present Value

A small company wants to make a single deposit now so it will have enough money to purchase a backhoe costing $50,000 five years from now. If the account will earn interest of 10% per year, the amount that must be deposited now is nearest to:

(A) $10,000 (B) $ 31,050 (C) $ 33,250 (D) $319,160

The cash flow diagram is:



Solution:

P = F(P/F,i,n)

= 50,000(P/F,10%,5)

= 50,000(0.6209)

= $31,045

Answer is (B)