Solutions to end-of-chapter problems
Engineering Economy, 8th edition
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Chapter 1
Foundations of Engineering Economy

Basic Concepts

1.1 Financial units for economically best.

1.2 Morale, goodwill, dependability, acceptance, friendship, convenience, aesthetics, etc.

1.3 Measure of worth is a criterion used to select the economically best alternative. Some measures are present worth, rate of return, payback period, benefit/cost ratio.

1.4 The color I like, best fuel rating, roomiest, safest, most stylish, fastest, etc.

1.5 Sustainability: Intangible; installation cost: tangible; transportation cost: *tangible*; simplicity: intangible; taxes: tangible; resale value: tangible; morale: intangible; rate of return: tangible; dependability: intangible; inflation: tangible; acceptance by others: intangible; ethics: intangible.

1.6 Examples are: house purchase; car purchase, credit card (which ones to use); personal loans (and their rate of interest and repayment schedule); investment decisions of all types; when to sell a house or car.

Ethics

1.7 *This problem can be used as a discussion topic for a team-based exercise in class.*
(a) Most obvious are the violations of Canons number 4 and 5. Unfaithfulness to the client and deceptive acts are clearly present.
(b) The Code for Engineer's is only partially useful to the owners in determining sound bases since the contractor is not an engineer. Much of the language of the Code is oriented toward representation, qualifications, etc., not specific acts of deceit and fraudulent behavior. Code sections may be somewhat difficult to interpret in construction of a house.
(c) Probably a better source would be a Code for Contractor's or consulting with a real estate attorney.

1.8 Many sections could be identified. Some are: I.b; II.2.a and b; III.9.a and b.

1.9 Example actions are:
- Try to talk them out of doing it now, explaining it is stealing
- Try to get them to pay for their drinks

- Pay for all the drinks himself
- Walk away and not associate with them again

1.10 *This is structured to be a discussion question; many responses are acceptable.* Responses can vary from the ethical (stating the truth and accepting the consequences) to unethical (continuing to deceive himself and the instructor and devise some on-the-spot excuse).

Lessons can be learned from the experience. A few of them are:

- Think before he cheats again.
- Think about the longer-term consequences of unethical decisions.
- Face ethical-dilemma situations honestly and make better decisions in real time.

Alternatively, Claude may learn nothing from the experience and continue his unethical practices.

Interest Rate and Rate of Return

1.11 Extra amount received = 2865 - 25.80*100 = $285
Rate of return = 285/2580
= 0.110 (11%)

Total invested + fee 2865 + 50 = $2915
Amount required for 11% return = 2915*1.11
= $3235.65

1.12 (a) Payment = 1,600,000(1.10)(1.10) = $1,936,000
(b) Interest = total amount paid – principal
= 1,936,000- 1,600,000
= $336,000

1.13 i = [(5,184,000 – 4,800,000)/4,800,000]*100% = 8% per year

1.14 Interest rate = interest paid/principal
= (312,000/2,600,000)
= 0.12 (12%)

1.15 i = (1125/12,500)*100 = 9%
i = (6160/56,000)*100 = 11%
i = (7600/95,000)*100 = 8%
The $56,000 investment has the highest rate of return

1.16 Interest on loan = 45,800(0.10) = $4,580
Default insurance = $900
Set-up fee = 45,800(0.01) = 458
Total amount paid = 4,580 + 900 + 458 = $5938

Effective interest rate = (5,938/45,800)*100 = 12.97%

Terms and Symbols

1.17 P = ?; F = 8*240,000 = $1,920,000; n = 2; i = 0.10

1.18 P = $20,000,000; A = ?; n = 6; i = 0.10

1.19 P = $2,400,000; A = $760,000: n = 5; i = ?

1.20 P = $1,500,000; F = $3,000,000: n = ?; i = 0.20

1.21 F = $250,000; A = ?: n = 3; i = 0.09

Cash Flows

1.22 Well drilling: *outflow*; maintenance: *outflow*; water sales: *inflow*; accounting: *outflow*; government grants: *inflow*; issuance of bonds: *inflow*; energy cost: *outflow*; pension plan contributions: *outflow*; heavy equipment purchases: *outflow*; used-equipment sales: *inflow*; stormwater fees: *inflow*; discharge permit revenues: *inflow*.

1.23 Let Rev = Revenues; Exp = Expenses

Year	1	2	3	4	5	Total
Rev, $1000	521	685	650	804	929	
Exp, $1000	610	623	599	815	789	
NCF, $1000	-89	62	51	-11	140	153
Exp/Rev, %	117	91	92	101	85	

(a) Total NCF = $153,000
(b) Last row of the table shows the answers

1.24

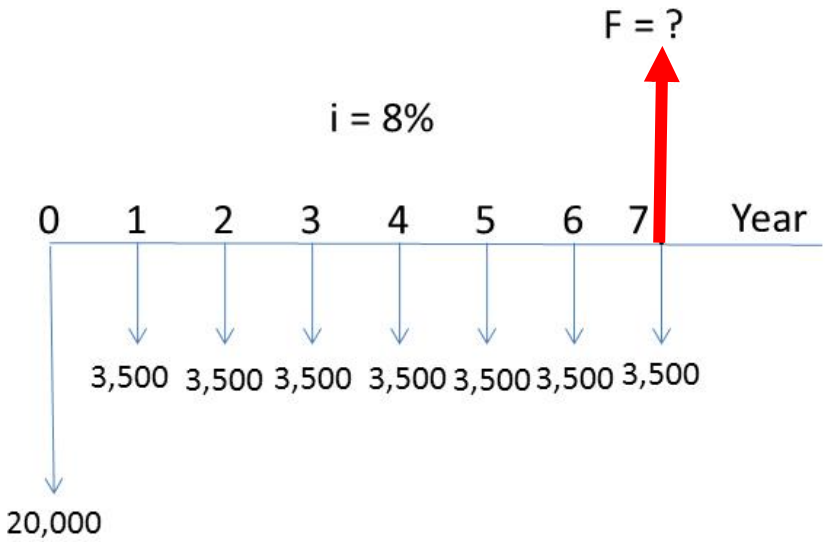
Month	Receipts, $1000	Disbursements, $1000	NCF, $1000
Jan	300	500	-200
Feb	950	500	+450
Mar	200	400	-200
Apr	120	400	-280
May	600	500	+100
June	900	600	+300
July	800	300	+500
Aug	900	300	+600
Sept	900	200	+700
Oct	500	400	+100
Nov	400	400	0
Dec	1800	700	+1100

+3,170

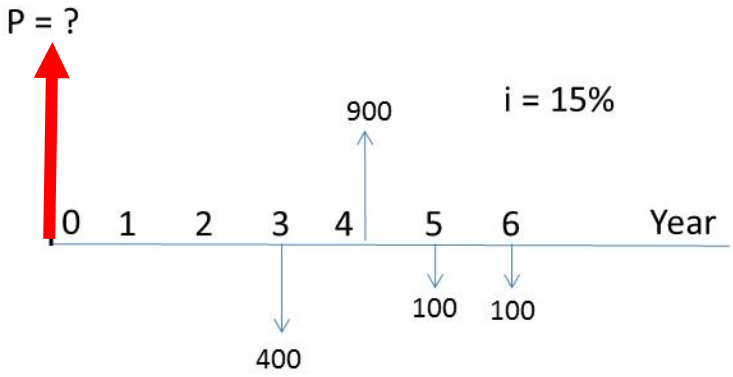
Net cash flow = $3,170 ($3,170,000)

1.25 End-of-period amount for March: 50 + 70 = $120; Interest = 120*0.03 = $3.60
End-of-period amount for June: 120 + 120 + 20 = $260; Interest = 260*0.03 = $7.80
End-of-period amount for September: 260 + 150 + 90 = $500; Interest = $15.00
End-of-period amount for Dec: 500 + 40 + 110 = $650; Interest = $19.50

1.26



1.27



Equivalence

1.28 (a) i = (5000-4275)/4275 = 0.17 (17%)

(c) Price one year later = 28,000 * 1.04 = $29,120

(d) Price one year earlier = 28,000/1.04 = $26,923

(e) Jackson: Interest rate = (2750/20,000)*100
= 13.75%

Henri: Interest rate = (2295/15,000)*100
= 15.30%

(f) 81,000 = 75,000 + 75,000(i)
i = 6,000/75,000
= 0.08 (8%)

1.29 (a) Profit = 8,000,000*0.28
= $2,240,000

(b) Investment = 2,240,000/0.15
= $14,933,333

1.30 P + P(0.10) = 1,600,000
1.1P = 1,600,000
P = $1,454,545

1.31 Equivalent present amount = 1,000,000/(1 + 0.10)
= $909,091
Discount = 790,000 – 909,091
= $119,091

1.32 Total bonus next year = (this year's bonus + interest) + next year's bonus
= [4,000 + 4,000(0.10)] + 4,000
= $8,400

1.33 (a) Early-bird: 20,000 – 20,000(0.10) = $18,000

(b) Equivalent future amount = 18,000(1 + 0.06)
= $19,080

Savings = 20,000 - $19,080
= $920

Simple and Compound Interest

1.34 (a) F = P + Pni
1,000,000 = P + P(3)(0.20)
1.60P = 1,000,000
P = $625,000

(b) $P(1+i)(1+i)(1+i) = 1{,}000{,}000$
$P = 1{,}000{,}000/[(1+0.20)(1+0.20)(1+0.20)]$
$= \$578{,}704$

1.35 $F = P + Pni$
$120{,}000 = P + P(3)(0.07)$
$1.21P = 120{,}000$
$P = \$99{,}173.55$

1.36 $F = 240{,}000(1+ 0.12)^3$
$= \$337{,}183$

1.37 (a) $F = P + Pni$
$10{,}000 = 5000 + 5000(n)(0.12)$
$5000 = 600n$
$n = 8.33$ years

(b) $10{,}000 = 5000 + 5000(n)(0.20)$
$n = 5$ years

1.38 (a) Total due; compound interest $= 150{,}000(1.05)(1.05)(1.05)$
$= \$173{,}644$

Total due; simple interest $= P + Pni$
$= 150{,}000 + 150{,}000(3)(0.055)$
$= 150{,}000 + 24{,}750$
$= \$174{,}750$

Select the 5% compound interest rate

(b) Difference $= 174{,}750 - 173{,}644$
$= \$1106$

1.39 $90{,}000 = 60{,}000 + 60{,}000(5)(i)$
$300{,}000\ i = 30{,}000$
$i = 0.10$ (10% per year)

1.40 Simple: $F = 10{,}000 + 10{,}000(3)(0.10)$
$= \$13{,}000$

Compound: $13{,}000 = 10{,}000(1 + i)\ (1 + i)\ (1 + i)$
$(1 + i)^3 = 1.3000$
$3\log(1 + i) = \log 1.3$

$$3\log(1 + i) = 0.1139$$
$$\log(1 + i) = 0.03798$$
$$1 + i = 1.091$$
$$i = 9.1\% \text{ per year}$$

Spreadsheet function: = RATE(3,,-10000,13000) displays 9.14%

1.41 Follow plan 4, Example 1.16 as a model

A is 9900 – 2000 = $7900
B is 7900(0.10) = $790
C is 7900 + 790 = $8690
D is 8690 – 2000 = $6690

1.42 (a) Simple:

$$F = P + Pni$$
$$2{,}800{,}000 = 2{,}000{,}000 + 2{,}000{,}000(4)(i)$$
$$i = 10\% \text{ per year}$$

(b) Compound:

$$F = P(1 + i)(1 + i)(1 + i)(1 + i)$$
$$2{,}800{,}000 = 2{,}000{,}000(1 + i)^4$$
$$(1 + i)^4 = 1.4000$$
$$\log(1 + i)^4 = \log 1.400$$
$$4\log(1 + i) = 0.146$$
$$\log(1 + i) = 0.0365$$
$$(1 + i) = 10^{0.0365}$$
$$(1 + i) = 1.0877$$
$$i = 8.77\%$$

(c) Spreadsheet function: = RATE(4,,-2000000,2800000)

MARR and Opportunity Cost

1.43 Bonds - debt; stock sales – equity; retained earnings – equity; venture capital – debt; short term loan – debt; capital advance from friend – debt; cash on hand – equity; credit card – debt; home equity loan - debt.

1.44 WACC = 0.40(10%) + 0.60(16%) = 13.60%

1.45 WACC = 0.05(10%) + 0.95(19%) = 18.55%

The company should undertake the inventory, technology, warehouse, and maintenance projects.

1.46 Let x = percentage of debt financing; Then, 1- x = percentage of equity financing

$0.13 = x(0.28) + (1-x)(0.06)$
$0.22x = 0.07$
$x = 31.8\%$

Recommendation: debt-equity mix should be 31.8% debt and 68.2% equity financing

1.47 Money: The opportunity cost is the loss of the use of the $5000 plus the $100 interest.

Percentage: The 30% estimated return on the IT stock is the opportunity cost in percentage.

Exercises for Spreadsheets

1.48 (a) PV is P; (b) PMT is A; (c) NPER is n; (d) IRR is i; (e) FV is F; (f) RATE is i

1.49 (a) PV(i%,n,A,F) finds the present value P
(b) FV(i%,n,A,P) finds the future value F
(c) RATE(n,A,P,F) finds the compound interest rate i
(d) IRR(first_cell:last_cell) finds the compound interest rate i
(e) PMT(i%,n,P,F) finds the equal periodic payment A
(f) NPER(i%,A,P,F) finds the number of periods n

1.50 (a) (1) F = ?; i = 8%; n = 10; A = $3000; P = $8000
(2) A = ?; i = 12%; n = 20; P = $-16,000; F = 0
(3) P = ?; i = 9%; n = 15; A = $1000; F = $600
(4) n = ?; i = 10%; A = $-290; P = 0; F = $12,000
(5) F = ?; i = 5%; n = 5; A = $500; P = $-2000

(b) (1) negative
(2) positive
(3) negative
(4) positive (years)
(5) can't determine if 5% per year will cover the 5 withdrawals of $500

1.51 Spreadsheet shows relations only in cell reference format. Cell E10 will indicate $64 more than cell C10.

	A	B	C	D	E
1	Initial amount =	1000		i =	0.1
2					
3		Simple		Compound	
4	Year	Interest, $	Total, $	Interest, $	Total, $
5	0		= B1		= B1
6	1	= B1*E1	= C5 + B6	= $E5 * E1	= E5 + D6
7	2	= B1*E1	= C6 + B7	= $E6 * E1	= E6 + D7
8	3	= B1*E1	= C7 + B8	= $E7 * E1	= E7 + D8
9	4	= B1*E1	= C8 + B9	= $E8 * E1	= E8 + D9
10	Total	=SUM(B6:B9)	= C9	=SUM(D6:D9)	= E9

Additional Problems and FE Review Questions

1.52 Answer is (d)

1.53 Answer is (b)

1.54 Answer is (c)

1.55 Answer is (b)

1.56 $F = P + Pni$

$2P = P + P(n)(0.05)$

$n = 20$ years

Answer is (d)

1.57 Amount now $= 10{,}000 + 10{,}000(0.10)$

$= \$11{,}000$

Answer is (c)

1.58 Move both cash flows to year 0 and solve for i

$1000(1 + i) = 1345.60/(1 + i)$

$(1 + i)^2 = 1345.60/1000$

$(1 + i) = 1.16$

$i = 16\%$

Answer is (d)

1.59 F in year 2 at 20% compound interest $= P(1.20)(1.20) = 1.44P$

For simple interest, $F = P + Pni = P(1 + ni)$

$P(1 + 2i) = 1.44P$

$(1 + 2i) = 1.44P$

i = 22%

Answer is (c)

1.60 WACC = 0.70(16%) + 0.30(12%)
= 14.8%

Answer is (c)

1.61 Amount available = total principal in year 0 + interest for 2 years + principal added year 1 + interest for 1 year
= $850{,}000(1+0.15)^2 + 200{,}000\ (1+0.15)$
= 1,124,125 + 230,000
= $1,354,125

Answer is (a)

Solution to Case Study, Chapter 1

There is no definitive answer to case study exercises. The following is only an example.

Renewable Energy Sources for Electricity Generation

3. LCOE approximation uses $1/(1.05)^{11} = 0.5847$ and LCOE last year = 0.1022.
Let $X_{11} = I_{11} + M_{11} + F_{11}$

With the limited data, to estimate the value of X_{11} set the LCOE for year 11 equal to the consumer cost for year 10.

$$0.1027 = 0.1022 + \frac{(0.5847)X_{11}}{(0.5847)(5.052 \text{ billion})}$$

$$0.5847X_{11} = (0.0005)(2.9539 \text{ billion})$$

$$X_{11} = \$2.526 \text{ million}$$

If the sum of investments (I_{11}), M&O (M_{11}) and fuel (F_{11}) is significantly different than $2.526 million, the breakeven value for year 11 may change. Next step is to find the values of I, M and F for year 11.