ChE 477 Test 3 Fall 1995

Time: 2 hours

Problem 1 (40%)

A company is considering putting some insulation on a steam pipe to reduce the heat losses. Two choices are available:

Thickness	Installed Cost	Savings in Energy Costs
1"	$ 500	$160
2"	$1000	$300

The insulation will last 10 years. The company expects a 10% return (on after tax profits) on its investments. The tax rate is 35%. The company is very profitable and expects to be so for the next 10 years. Straight line depreciation is used.

a) What is the incremental return on investment (On an after tax basis)? Based on this, which thickness should be chosen?

b) Based on a venture profit analysis, which thickness do you recommend? Show all your calculations with explanation.

c) Which insulation is recommended based on a net present worth analysis? You can use discrete cash flows and discrete interest rate.

Problem 2 (25%)

A company is interested in purchasing a computer. Two choices are available for payment.

a) $4700 on delivery

b) $1100/yr. for five years. Payments to be made at the end of each year. The first payment is due at end of the first year.

The company can borrow money at 6% effective annual interest rate. Which option should it elect? Why?

Problem 3 (35%)

The pumping costs associated with transporting a fluid in a pipe is given by

$$C_o = 1000\ V\ \$/\text{year}$$

where V = fluid velocity in ft/sec.

Cost of piping is given by

$$C_c = \$2000\ D + \$1000$$

where D = diameter of pipe in inches. Annual depreciation charges are 10%. The interest rate is 9%. What is the optimum pipe diameter to use if we need to transport 1 ft^3/sec of fluid? What is the resulting velocity of fluid in the pipe?

Solution to Test 3

Problem 1

(a) Venture Profit Analysis

~~Change in~~ Increase in Gross Profit by using 2" versus 1" = ΔGP = 300 − 160 = $140/yr

Increase in depreciation = $\frac{\$2000}{10} - \frac{\$1500}{10}$

= $ ~~60/yr~~ $50/yr

~~A~~ ~~Ch~~ Increase in Net Profit Before Taxes = $140 − $~~60~~ 50

= ~~$40~~ $90

Increase in " After Taxes = $~~40~~ 90 (1 − t)

= $~~40~~ 90 (1 − .35)

= ~~$26.00~~ $58.5

~~A~~ Added cost of interest = $2000 × i − $~~1000~~ 500 × i

= $~~2000~~ 1000 × .10 − $~~1000~~ 500 × .1

= $100 − 50

= $50.00

~~Net~~

Net Change in Venture Profit = 58.5 − 50

= $8.5

Hence ~~no~~ choose 2" insulation

30 − 21.5 = 8.5

VPI = 160 − 50 = 110

VPII = •

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(b) Incremental Return on Investment

$$\Delta I = \$1000 - \$520 = \$520$$

$$\Delta(NPAT) = \$58.5$$

$$\Delta ROII = \frac{\$58.5}{\$500}$$

$$= 11.7\%$$

This is greater than 10%. Hence choose 2" insulation

Based on Net Present Worth

~~Actual~~ Change in Cash Flow 2" versus 1"

$\Delta(NPAT) = \$58.5/yr$

$\Delta(Dep) = \$50/yr$

$\therefore \Delta(\text{Cash Flow}) = \$108.5/yr$

Δ Cash Flows

year 0	\$1000 − \$500 = −\$500
year 1	+ \$108.5
2	+ \$108.5
year 10	+ \$108.5

$$\therefore \Delta(NPW) = -500 + 108.5\left[\frac{(1+.1)^{10}-1}{(.1)(1+.1)^{10}}\right]$$

$$= \$166.8 \quad = -246.4 + 413.2$$

Since this is greater than 0, ~~m~~ choose 2" over 1" insulation.

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Problem 2

(a) \$1100 / year for 5 years

has a NPW given by

$$NPW = R \frac{(1+i)^n - 1}{(1+i)^n \cdot i}$$

$$= \$1100 \frac{(1+.06)^5 - 1}{(1+.06)^5 (0.06)}$$

$$= \$4633.00$$

This is less than \$~~5000~~ 4700 demanded now. Hence ~~we~~ choose the option of paying in installments.

Problem 3

$C_o = \$1000\, V$ /year, $V = \frac{4Q}{\pi (\frac{D}{12})^2}$ ft³/sec (ft²)

$C_c = \$2000 D + \$1000$

Let us use the venture profit method.

(VC) Venture cost = $C_o + r\, C_c$

where r = dep + interest charges + maint
$= 0.10 + .09 + 0$
$= 0.19$

$\therefore VC = C_o + .19\,C$

$$= \$1000 \cdot \frac{4\, Q \times (12)^2}{\pi D^2} + 0.19\,[\$2000D + \$1000]$$

$Q = 1$

$$= \cancel{\$1000}\ 4 \times \frac{45{,}836}{D^2} + 380D + 190$$

$\frac{dVC}{dD} = 0$

$$\frac{dVC}{dD} = -\cancel{4}\,4 \times \frac{91{,}672}{D^3} + 380 = 0$$

$\therefore$ $D^* = \cancel{6.225}$ 9.88 in $= .823$ ft

$v^* = 1.877$ ft/sec

B. Joseph **ChE 477** **Test 3**

Open: Text & Bound Volume of Lecture Notes

Time: 55 minutes

Problem 1 (30%)

A company has $1 million to invest. Two choices are available.

Project 1. Requires $700,000 total investment and will generate a cash flow of $200,000/year for 5 years.

Project 2. Requires $8~~0~~00,000 total investment and will generate the following cash flows:

Year	Cash Flow
1	200,000
2	400,000
3	200,000
4	300,000

The company earns an average of 10% return on its other investments.
The company has three options:

1) Invest in project 1
2) Invest in project 2
3) Keep the money in other investments at 10% interest rate

Which option maximizes the net present worth of the company? Explain your answer with calculations.

Problem 2 (25%)

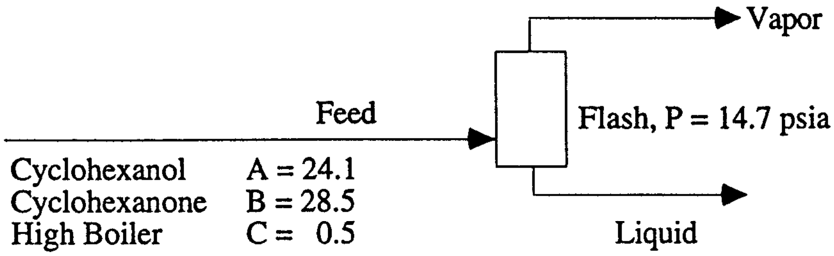
A refinery has a crude distillation unit with a capacity of 45,000 barrels/day. A maximum of 20,000 b/day of crude 1 at $40/barrel and 30,000 b/day of crude 2 at $42/barrel are available. The distillation unit produces the following products per barrel of crude: (All yields are expressed in barrel/barrel)

Products	Yield from Crude 1	Yield from Crude 2	Product Price/Barrel
Naptha	.50	.60	$50.00
Light Oil	.10	.20	$40.00
Heavy oil	.40	.20	$30.00

The maximum demand for naptha is 25,000 b/day, that for light oil is 7500 b/day and that for heavy oil is 15,000 b/day. Formulate an optimization problem to maximize the profit/day. Show all constraints. The independent variables are the amounts of crude 1 and crude 2 to be processed per day. **DO NOT TRY TO SOLVE THIS.** All I want are the objective function and the constraints.

Problem 3 (20 %)

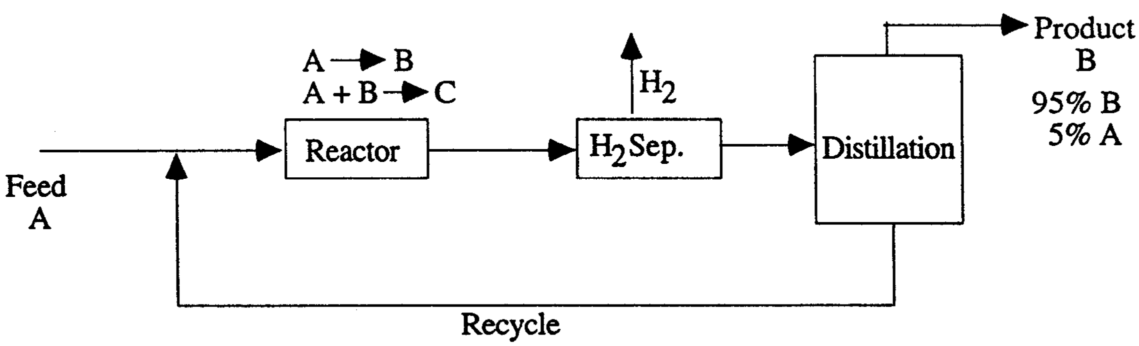
The following problem was simulated using Aspen. But the calculations failed to converge. Explain why it cannot converge.



Design Specification: Mole fraction of C in vapor = 1%.
Vary: Temperature of the Flash.

Problem 4 (20%)

Consider the cyclohexanone process. A student notices that the waste stream containing C is small. So she decides to eliminate the (high boiler stripper) unit and sets up a process as follows:



However, this simulation fails to converge on the recycle calculations. Increasing the number of interations does not help. Explain why the simulation cannot converge.

Problem 1

Present Worth of Project 1

$$PW_1 = \$1{,}000\,K - \$700{,}0K + \frac{\$200\ K}{(1+.1)} + \quad + \frac{200\ K}{(1.1)^5}$$

$$= \$300K + 181.8 + 165.2 + 150.2 + 136.6 + 124$$

$$= \$1{,}057.8\ K$$

Present Worth of Project 2

$$PW_2 = \$\ 1{,}000\ K - 800K + \frac{200K}{1.1} + \frac{400\ K}{(1.1)^2} + \frac{200\,k}{(1.1)^3} + \frac{300}{(1.1)^4}$$

$$= 200 + 181.8 + 330.5 + 150.2 + 204.9$$

$$= \$\ 1067.4$$

Second project has a higher NPW.

Choose project 2. Better than keeping money in other investments.

(60)

Problem 2

x = crude 1 b/day processed
y = " " " "

Constraints

Capacity: (1) $x + y \le 45{,}000$

(2) $x \ge 0$

(3) $y \ge 0$

Supply: (4) $x \le 20{,}000$

(5) $y \le 30{,}000$

demand: naptha ~~0.5~~

(6) $0.50x + 0.60y \le 25{,}000$

(7) $0.10x + 0.20y \le 7{,}500$

(8) $0.40x + .20y \le 15{,}000$

Objective Function:

Profit per day = $(.50x + 0.60y) * \$50 +$
$(.10x + .20y) * \$40 +$
$(.40x + .20y) * \$30.0 -$
$x * \$40 - y * \$42$

Problem 3

Note that feed contains
mole fraction of C = $\frac{0.5}{24.1 + 28.5 + 0.5} * 100$

$= \underline{\underline{0.94}} \%$

Even if you took all feed with the vapor, the concentration of C in vapor cannot be greater than .94%.

Hence the design specification cannot be met.

Problem 4

In this process, there is no outlet for the C produced in the reactor. Hence it accumulates in the system. A steady state cannot be reached. Hence Aspen+ cannot find a solution.

B. Joseph ChE 477 Fall 1992 (116)

Test 3

Open Textbook and Bound Volume of Lecture Notes Only

5% Neatness, Clarity and Organization

Problem 1 (50%)

A company must replace an existing pump. Two alternatives are being considered. Pump 1 will cost \$5,000 and is guaranteed to last 5 years. It will cost \$1,000/yr. to operate (excluding depreciation charges). Pump 2 will cost \$6,000 and is expected to last 6 years and has operating expenses of \$800/yr. (excludes depreciation charges). The company expects an after tax return of at least 10% on its investments. The tax rate is 35%.

Which pump should be chosen based on purely economic considerations? You should consider the time value of money in your analysis. Note that the two pumps have different expected lives.

Problem 2 (20%)

A two-stage steam jet is used to maintain a distillation column operating at 1.0 psi absolute. It is estimated that 1.0 lbmole/hr. of air must be removed from the column. The leaving air* contains water vapor at a pressure equivalent to the equilibrium vapor pressure of water at 60°F. Estimate the lbs. of steam required per hour to operate the jet. What is the estimated cost of steam \$/hr?

All data needed are available in Peters and Timmerhaus.

Problem 3 (25%)

A concern borrows \$50,000 at an annual, effective, compound interest rate of 10 percent. The concern wishes to pay off the debt in 5 years by making 10 equal semi-annual payments. How much will each payment be? Interest is compounded semi-annually.

* air: leaving the column

Solution to Test 3

Problem 1

Cash Flows	Pump 1	Pump 2
Initial Inv.	\$5000	\$6,000
Life	5 years	6 years
Depreciation	\$1000/yr	\$1000/yr
Operating costs	\$1000/yr	\$800/yr
~~Profit~~ Income	\$P/yr	\$P/yr
~~Total~~ ~~Gross~~ Net Profit	P − 2000	P − 1800
NPAT	(P − 2000) * .65	(P − 1800) * .65
Cash Flow	(P − 2000) .65 + 1000 = .65P − 300 = R1	(P − 1800) * .65 + 1000 = .65P − 170 = R2

Δ Cash Flow $(2000 - 1800) * .65 = \$130/yr$ (~~65~~)

Compare cost over a 5 year period.
At end of 5 year period, Pump 2 is still worth \$1000 which will generate an additional cash flow then.

$$\text{NPW of Pump 1} = -5{,}000 + R1\left[\frac{(1+i)^5 - 1}{(1+i)^5 \cdot i}\right]$$

$$= -5000 + R1(3.79)$$

$$= -5000 + (.65P - 300)(3.79)$$

$$= 2.463P - 6137.0$$ (~~3863~~)

$$\text{NPW of Pump 2} = -6000 + R2(3.79) + \frac{1000}{(1+i)^5}$$

$$= -6000 + (.65P - 170)(3.79) + 621$$

$$= 2.463P - 6023.3$$

Pump 2 is slightly better. Hence choose __Pump 2__.

Difference = \$114

Comparing Uniform Annual Costs

Cost of Pump 1.

Initial cost spread over 5 years

$$= \frac{5000}{3.79} = \$1319.2\ /yr$$

Operating Expenses ~~Re~~ = $300/yr.
(After tax)

Net = $1619.2 /yr

Cost of Pump 2

$$\text{Capital} = \frac{6000}{4.35} = \$1377\ /yr$$

Operating Exp = 170 /yr

Total = $1547 /yr

Difference (Decrease of pump 2) = $71.3 /yr

PW of decrease over 5 year period = $270.4

$$\left(\frac{5000}{3.79} + 300\right)3.79 \qquad \left(\frac{6000}{4.35} + 170\right)3.79$$

$$5000 + 300 * 3.79 \qquad 6000\left(\frac{3.79}{4.35}\right) + 170 * 3.79$$

5227

Problem 2

Vapor Pressure of ~~steam~~ water at 60°F from Steam Tables, Table 11, p.884.
= .2563 psi

mole fraction of ~~steam~~ water in mixture

$$= \frac{\text{Vapor pressure}}{\text{total pressure}}$$

$$= \frac{0.2563 \text{ psi}}{\text{~~2.0 in of Hg}} \times \frac{1 \text{ psi}}{\text{~~2.036 in}}} = 0.2563$$

Mole fraction air = .7437

∴ lbmoles of air = ~~$\frac{20.0 \text{ lbs}}{28.8 \text{ lbmole/lb}}$~~ 1 lbmoles/hr

∴ Total flow = $\frac{1 \text{ lbmol/hr}}{.7437}$ = <u>1.344</u> lbmoles/hr

Total ~~weight~~ mass flow

$$= .80 \frac{\text{lbmoles}}{\text{hr } N_2} \times \frac{28 \text{ lb}}{\text{lbmol}} + .20 \frac{\text{lbm}}{\text{hr } O_2} \times \frac{32 \text{ lb}}{\text{lbm}}$$

$$+ .344 \frac{\text{lbmol } H_2O \times 18 \text{ lbs}}{\text{hr} \times 18 \text{ lbmol}}$$

= 35. lbs/hr

wt.% noncondensibles = $\frac{.80 \times 28 + .20 \times 32}{35}$ = 0.82 = 82 %

p523

Steam needed = $\frac{63 \text{ lbs} \times 35 \text{ lb/hr}}{\text{hr} \times 10 \text{ lbs mix}}$

= <u>220.5 lbs/hr</u>

(120)

Cost of steam = $ (1.5 – 3.20)/1000 lb
p. 875, P+T

using an average figure $ 2.35/1000 lb

Cost of steam needed

$$= 220.5 \frac{lbs}{hr} \times \frac{2.35}{1000\ lbs}$$

$$= \$\ 0.518/hr$$

Problem 3

$$i_{eff} = \left(1 + \frac{i_{nom}}{k}\right)^k - 1$$

For semiannual payments, $k = 2$

$$0.10 = \left(1 + \frac{i_{nom}}{2}\right)^2 - 1$$

$$\therefore \quad 1 + \frac{i_{nom}}{2} = \sqrt{1.1} = 1.0488$$

$$i_{nom} = .0976 = \underline{\underline{9.76\ \%}}$$

$$50{,}000 = R \, \frac{\left(1 + \frac{i_{nom}}{2}\right)^{10} - 1}{\left(\frac{i_{nom}}{2}\right)\left(1 + \frac{i_{nom}}{2}\right)^{10}}$$

$$= 7.768\ R$$

or $\boxed{R = \$6436.65}$

(102)

B. Joseph | ChE 477 | Test 3

Open Text and Bound Volume of Lecture Notes

Time: 55 minutes

Note: 5% is reserved for neatness and clarity

Problem 1 (30%)

A multiple effect evaporator is to be used for evaporating 400,000 lb. of water per day (300 days/year) from a salt solution. The total initial cost for the first effect is $18.000, and each additional effect costs $15,000. The life period is estimated to be 10 years and salvage value at the end of the life period may be assumed to be zero. Straight-line depreciation may be used. Fixed charges ($/year) (other than depreciation) are 15% of the initial cost of equipment. Steam costs $0.50 per 1000 lbs. Pounds of water evaporated per pound of steam equals 0.85 x number of effects. Power costs associated with each effect are shown below:

Number of Effects	Total Power Cost (per 100 lb. of water)
1	$0.10
2	0.15
3	0.17
4 to 10	0.20

All other costs are independent of the number of effects. How many effects should be used for minimum annual cost?

Problem 2 (35%)

A chemical company is considering replacing a batch-wise reactor with a modernized continuous reactor. The old unit cost $40,000 when new 5 years ago, and depreciation has been charged on a straight-line basis using an estimated service life of 15 years and final salvage value of $1000. It is now estimated that the unit has a remaining service life of 10 years and a final salvage value of $1000.

The new unit would cost $70,000 and would result in an increase of $5000 in the gross annual income. It would permit a labor saving of $7000 per year. Additional costs for taxes and insurance would be $1000 per year. The service life is estimated to be 12 years with a final salvage value of $1000. All costs other than those for labor, insurance, taxes, and depreciation may be assumed to be the same for both units. The old unit can now be sold for $5000. What actual return on the incremental investment (before taxes) is realized if the replacement is made?

Problem 3 (30%)

A separation tower has an average liquid flow rate of 90 lb/hr, a vapor flow rate of 100 lb/hr and operated at 20 psig. The liquid density is 35 lb/ft^3 and vapor density is .075 lb/ft^3. The viscosity of the liquid is 1 centipoise.

What type of a column (packed bed or plate type) should be used for this application? Why? Estimate the diameter required for the column.

Problem 1 (103)

$$\text{Total steam cost/year} = 400{,}000 \frac{lb}{day} \times 300 \frac{day}{yr} \times \frac{lb\ steam}{(.85x)\ lb} \times \frac{\$ .50}{1000\ lb\ steam} =$$

Capital cost = 18000 + (x-1) 15,000

Depreciation = 10%

Fixed charges = 15%

$$\text{Total Ann. Cap. cost} = [18{,}000 + (x-1)15{,}000] \times .25$$

$$\text{Power cost} = 400{,}000 \frac{lb}{day} \times \frac{300\ day}{yr} \times \frac{\$ f(x)}{100\ lb}$$

$$= \$ 1{,}200{,}000\, f(x) /yr$$

$$\text{Total} = \frac{\$ 60{,}000}{.85x} + \$ 1{,}200{,}000\, f(x) + [4500 + (x-1)\, 3750]$$

$$\text{for 1 effect} = \frac{60{,}000}{.85} + 120{,}000 + 4500 = 195{,}088$$

$$\text{2 effect} = \frac{60{,}000}{.85 \times 2} + 120{,}000 \times 1.5 + 4500 + 3750 = 223{,}544$$

$$\text{3 effect} = \frac{60{,}000}{.85 \times 3} + 120{,}000 \times 1.7 + 4500 + 3750 + 3750 = 239529.$$

$$\text{4 effect} = \frac{60{,}000}{.85 \times 4} + 120{,}000 \times 2.0 + 4500 + 3 \times 3750 = 273{,}397.$$

Solution to Test 3 /F96

Problem 2

	Old Unit	New Unit
I = Inv.	40,000	70,000
Salvage	1,000	1,000
Rem. Service life	10 yrs	

Present Market Value = $5,000

∴ Annual Depreciation = $\frac{\$5000 - \$1000}{10}$

= $400/yr

(Always use market value for depreciation)

~~So~~ Increase in Sales income = $5,000
(by replacing unit)

~~Incre~~ Depreciation for New unit = $\frac{70000 - \$1000}{12}$

= $5750/yr

Increased depreciation costs = 5750 − 400
= $5350/yr

Labor savings = $7000/yr.

~~Net~~ change in Net Profit before taxes

= 5000 + 7000 − 5350 − 1000
= $5650/yr

Incremental Investment Required = 70,000 − 5,000
= 65,000

(105)

Return on Incremental Investment

$$= \frac{5650}{65000} \times 100 = 8.7\ \%$$

Problem 3

Assume packed tower, check for flooding, compute diameter

$$\frac{L}{G}\sqrt{\frac{\rho_L}{\rho_G}} = \frac{90\ lb/hr}{100\ lb/hr}\sqrt{\frac{.075}{55}}$$

$$= .033$$

From lecture notes, using Fig 19 (Frank)
(Assuming Δp of 0.25 in/ft)

$$\frac{G^2 F \mu^{0.1}}{\rho_G(\rho_L - \rho_G) g_c} = .035$$

F = 155 for Raschig rings 3/4"

$$G^2 = \frac{.035 \times .075 \times (55 - .075) \cdot 32.2}{155 \times 1}$$

$$G = 0.179\ \frac{lb}{s\,ft^2}$$

$$\text{Cross Section Area} = \frac{100\ \frac{lb}{hr}}{0.179\ \frac{lb}{ft^2 s} \times 3600\ \frac{s}{hr}}$$

$$= 0.155\ ft^2$$

$$D = .44\ ft$$

Check flooding:

max liquid flow ~~per~~ velocity

$$> \frac{2\ \text{gpm}}{\text{ft}^2}$$

Actual liq ~~velocity~~ flow $= \frac{90\ \text{lb}}{\text{hr}} \times \frac{1\ \text{hr}}{60\ \text{min}} \times \frac{1\ \text{ft}^3}{55\ \text{lb}} \times 7.5\ \frac{\text{gal}}{\text{ft}^3}$

$= .20$ ~~gal/min~~ gpm

$\therefore$ liq velocity $= \frac{0.20\ \text{gpm}}{.155\ \text{ft}^2}$

$= 1.31\ \text{gpm/ft}^2$

Hence a slightly smaller diameter is needed.

Since diameter is so small, packed column is definitely preferred.

Open Text, Bound Copy of Lecture Notes

Time: 55 Minutes

5% Reserved for Neatness, Clarity, etc.

Problem 1 (15%)

Some of the costs associated with a plant for producing acetylene from natural gas are given below. Classify each item as:

a. Fixed capital cost.
b. Working capital cost.
c. Operating cost.
d. None of the above.

1. Natural Gas.
2. Steam.
3. Steam Plant.
4. Electricity.
5. Solvent Inventory
6. Solvent Makeup.
7. Operating Labor.
8. Construction Labor.
9. Contractor's Fee for Plant Construction.
10. Real Estate Rent.
11. Real Estate Purchase.
12. Interest Payments on Borrowed Money.
13. Depreciation.
14. Royalties.
15. Waste Treatment Plant.

Problem 2 (15%)

The operating costs associated with a sulfuric acid plant are given below.

Fixed Capital Investment	=	$10 Million
Working Capital	=	$ 1 Million
Annual Sales	=	$ 5 Million/Year
Annual Operating Costs (Excluding Depreciation)	=	$ 3 Million/Year
Estimated Life	=	10 Years
Salvage Value	=	0

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Straight-line Method of Depreciation is Used.

Tax Rate = 33%

Compute the following: (#/yr)

1. Gross Profit.
2. Net Profit.
3. Net Profit After Taxes.
4. Total Cash Flow From the Project.

Problem 3 (30%)

An existing pump has a book value of $8,000 and market value of $4,000. A new pump will cost $6,000. The new pump will reduce operating costs (excluding depreciation) by $500/year. The company expects 10% return on its investments after taxes. The tax rate is 33%.

a. If both the existing pump and the new pump have a remaining life of ten (10) years, should the replacement be made? Why or why not?

b. If the old pump has a life of five (5) years and the new pump has a life of ten (10) years, should a replacement be made? Why or why not?

Problem 4 (25%)

A company has $1 million to invest. Two choices are available.

Project 1. Required $700,000 total investment and will generate a cash flow of $200,000/year for five (5) years.

Project 2. Requires $800,000 total investment and will generate the following cash flows:

Year	Cash Flow
1	200,000
2	400,000
3	200,000
4	300,000

The company earns an average of 10% return on its other investments. Should the company invest in any one of these projects? Which one? Why?

Problem 5 (10%)

A man deposits $1,000 in his account at the bank which pays compound interest (compounded daily). If at the end of one (1) year the account holds $1,060.00, what is the nominal and effective interest rates paid by the bank?

Solution To Test

Problem 1.

15

1. c	Natural Gas	Operating Cost	c
2 c	Steam	OC	c
3 a	Steam Plant	FC	a
4 c	Electricity	OC	c
5 b	Solvent Inventory	WC	b
6 c	Solvent Makeup	OC	c
7 c	Operating Labor	OC	c
8 a	Construction Labor	FC	a
9 a	Contractors' Fee	FC	a
10 c	Rent	OC	c
11 a	Real Estate Purch	FC	a
12 c	Interest	OC	c
13 c	Depre	OC	c
14 c	Royalt	OC	c
15 a	Wast Treat Plant	FC	a

15

Problem 2

FCI = $10,000 K

WC = $1,000 K

Sales = $ 5,000 K/yr

Op. Cost = $ 3,000 K/yr

~~Dep = $300 K/yr~~

Gross Profit = $2,000 K/yr a

Net Profit = $ 2,000K − Dep

= $ 2,000 K/yr − 1,000 K/yr

= $ 1,000 K/yr b

Taxes = $ 330 K/yr

NPAT = $670 K/yr c

Net Cash Flow = $1670 /yr.

Problem 3

Capital Need = Cost of new Pump − Market Value of Old Pump

= \$6,000 − \$4,000

= \$2000.

Savings in op. cost = \$500/yr

Increase in Dep = $\frac{\$6{,}000}{10} - \frac{\$4{,}000}{10}$

= \$600 − \$400

= \$200/yr

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Saving after dep = \$500 − \$200/y

= \$300/yr

Taxes (33%) = \$99/yr

Saving after tax = \$201/yr

ROII after Taxes = $\frac{\$201/yr}{\$2000}$

= 10.05% ✓

(a) Yes, make Replacement

10 (b) Yes, because increased life mean for service (also dep ~~savings~~ difference is less).

Problem 34

Compare using Net Present Worth

Alternative 1. No Investment

$NPW = \$1,000\ K$

Alternative 2

$NPW = \$300\ K$ (after initial inv)

$+ \frac{200\ K}{yr}\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$

$i = .1$

$n = 5$

(25)

$= \$1058.1\ K$

Alternative 3

$NPW = \$2{,}000\ K +$

$\frac{\$200\ K}{1+i} + \frac{\$400\ K}{(1+i)^2} + \frac{\$200K}{(1+i)^3} + \frac{\$300\ K}{(1+i)^4}$

$= 200 + 181.81 + 330.57 + 150.26 + 204.90$

$= \$1067.54\ K$

Choose Alternative 2 which maximizes NPW

Problem 5

Annual Effective Interest Rate

$$i_{eff} = \frac{\$1060 - \$1000}{\$1000} \times 100$$

$$= \underline{\underline{6\%}}$$

(10) nominal interest rate $= i_n$

$$(1 + i_n/365)^{365} = 1 + i_{eff}$$

$$365 \ln(1 + i_n/365) = \ln(1 + i_{eff})$$

$$i_n = \underline{\underline{5.827\%}}$$