

REVIEW SET 4

work before class on December 12, 2008

Note – will not be collected or graded = self correct during class.

NAME : _____

Ch. E. 453

December 12, 2007

Page 1 of 7

FINAL EXAM

Open Book and Notes; Closed Neighbor

Read CAREFULLY and THINK about each problem

Organize and EXPLAIN your work if you desire partial credit !

Think, Show Your Work, and Interpret Your Results

total 150 points

(30 points)

1. Fifty-eight thousand barrels per day (58,000 bpd) of Alaskan crude oil (a barrel of crude oil is 42 gallons) is to be pumped from the North Slope well head to the shipping terminal, a distance of 900 miles (a mile is 5,280 feet). Maximum pressure in the type 316 stainless steel piping system will not exceed 1,000 PSIG and the maximum temperature will not exceed 150 °F. This crude oil has the following constant average properties at the average pumping conditions are : { note - do not use the erroneous Ch. 12 eqn's }

$$\begin{aligned} \text{Density} &= \mathbf{49.05} \text{ Lb/Ft}^3 & \text{Specific Gravity} &= 0.79 &= \mathbf{785.7} \text{ kg/m}^3 \\ \text{Viscosity} &= \mathbf{4,900.} \text{ centipoises} & &= \mathbf{4.9} \text{ Pascal - seconds} \end{aligned}$$

- a) **Recommend an optimum theoretical pipe size for the design.**
- b) **Recommend the optimum practical pipe size for the design.**
- c) **Determine the 3rd Quarter 2007 (M&S = 1,393.0) purchased cost of the recommended practical design pipeline materials.**

CLEARLY STATE and JUSTIFY ALL ASSUMPTIONS
and **EXPLAIN** your reasoning.

(15 points)

2. The November 8, 2007 University of Idaho Trust & Investment Office status report on the Drown Chemical Engineering Scholarship Endowment gives the following data:

Endowment Principle at cost basis as of July 1, 2006 = \$153,359.55

Total FY 2007 dividend & Interest Income = \$6,383.03

FY 2007 realized capital gains = \$4,239.90

Total Returns = \$10,622.93

Portion of Total Distributed s scholarships = \$5,900.00

Endowment Principle at cost basis as of July 1, 2007 = \$158,082.48

- a) From the students receiving scholarships perspective, **what is the effective annual rate of distributed return on the July 1, 2006 principle ?**
- b) From the University Foundation perspective, **what is the effective annual rate of total return on the July 1, 2006 principle ?**
- c) From the students receiving scholarships perspective, **what is the nominal annual rate of distributed return on the July 1, 2006 principle if it was compounded monthly ?**

(20 points)

3. In order to **maximize yield** during the fermentation of potato waste into Lysine for use as poultry feed supplements, an EVOP optimization technique has been ongoing. Enzymes are added to react starches in the potato into glucose followed by the addition of bacteria to ferment the glucose into Lysine. The independent process control variables are reactor temperature, mols of enzyme added, and mols bacteria added. The following experimental results have been obtained :

<u>mols</u> <u>Enzyme</u>	<u>mols</u> <u>Bacteria</u>	<u>°C</u> <u>Temperature</u>	<u>Measured</u> <u>% Yield</u>
3	10	60	4.19
4	10	66	4.53
5	10	60	4.15
4	11	63	4.33
3	10	60	3.88
3	10	60	4.66
5	10	60	4.45
5	10	60	4.63
4	11	63	4.28
4	10	66	3.97
4	10	66	4.62
3	10	60	4.56
4	11	63	4.41
4	10	66	4.77
5	10	60	3.83
5	10	60	4.29

Determine the conditions for the next experiment to be conducted.

(30 points)

4. The Vandal•Con Company currently earns an average after tax rate of return of 11.75 % on all its investments. The board of directors of Vandal•Con is considering four mutually compatible proposals (i.e., all 4 proposals could be accepted, or any combination, or none of them) whose after tax cash flows are specified in Table 4:

Table #4

End of Year	Proposal A	Proposal B	Proposal C	Proposal D
0	-\$ 69,000	-\$ 99,000	-\$ 378	-\$ 43,000
1	\$ 15,000	\$ 19,700	\$ 210	\$ 17,000
2	\$ 15,000	\$ 19,700	\$ 230	\$ 28,000
3	\$ 15,000	\$ 19,700	\$ 0	-\$ 43,000
4	\$ 15,000	\$ 19,700		\$ 22,000
5	\$ 15,000	\$ 19,700		\$ 38,000
6	\$ 15,000	\$ 19,700		\$ 0
7	\$ 15,000	\$ 19,700		
8	\$ 0	\$ 19,700		

Which proposal(s) is (are) acceptable if the board of directors has set a target Minimum Acceptable Discounted Cash Flow Rate of Return ($MARR$) after taxes of 12.9 %?

State all assumptions and explain your reasoning.

Is the discounted cash flow rate of return { $DCFR$ or IRR } less than, equal to, or greater than 12.9 %?

Is it less than, equal to, or greater than 11.75 %?

NAME : _____

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Page 5 of 7

(10 points)

5. Lewis-Clark Memorial Garden's Cemetery in Lewiston, Idaho, charges \$3,500 for purchase a cemetery plot and \$950 to be invested in an endowment fund for perpetual care and maintenance of the plot. At a nominal annual interest rate of 4.74% compounded monthly, **what are the maximum expected annual maintenance charges ?**

(20 points)

6. A gear-type rotary pump for metering caustic materials into a new process at a large chemical production plant must be replaced every 3 years because of rapid corrosive attack.

Original pump purchase cost (new process):	\$7,900.
Cost of each pump installation:	45 % of purchase cost
Annual price inflation (both pump cost & installation):	4.0 % per year
Salvage value (at end of each 3-year period):	5.7 % of purchase cost at time of salvaging
Savings deposit interest rate (discrete annual compounding):	6.4 % per year

What is the theoretical amount of capital that must be available at time zero (new process start-up) so that the pump may continue to be replaced until project shutdown 18 years after start-up? (i.e., present worth of capitalized cost for the actual life of the project)

(25 points)

7. Ten proposed processes have been designed to provide nitrogen blanketing gas to prevent oxidation in a French fry potato oil storage tank. Assume all processes provide the identical quality and quantity of N_2 . One process must be implemented, select the best economic design if the company MARR is 7.5 percent return on any additional investment :

<u>Bid Vendor</u>	<u>Installed Cost, \$</u>	<u>Annual Operating (including depreciation) Costs, \$ / yr</u>	
1	\$ 3,200	\$ 28,300	purchase bulk N_2 gas
2	\$ 71,000	\$ 31,000	purchase bulk liquid N_2
3	\$ 87,000	\$ 27,400	membrane from vendor #1
4	\$ 468,191	\$ 233,183	membrane from vendor #2
5	\$ 71,600	\$ 9,183	membrane from vendor #3
6	\$ 40,600	\$ 11,600	membrane from vendor #4
7	\$ 170,000	\$ 95,600	membrane from vendor #5
8	\$ 660,000	\$ 440,000	membrane from vendor #6
9	\$ 15,000	\$ 179,000	membrane from vendor #7
10	\$ 539,833	\$ 148,625	membrane from vendor #8

All other costs are equal for all the bids. **which of the bids should be accepted?**

Note that all of these costs came directly from your design reports.

For the purpose of this exam question, assume the numbers are all correct!