November 2000
Course 8P

Society of Actuaries

****BEGINNING OF EXAMINATION 8****
PENSION FUNDING MATHEMATICS SEGMENT

1. *(8 points)* You are the actuary for a company that sponsors two single participant, non-contributory defined benefit pension plans.

You are given, as of January 1, 1999:

	Plan A	Plan B
Plan Provisions		
Retirement Benefit	1.8% of final year's earnings times service	2.0% of final year's earnings times service
Normal Form of Pension	Life only, payable monthly in advance	Life only, payable monthly in advance
Normal Retirement Date	Age 65	Age 65
Other Ancillary Benefits	None	None
Actuarial Assumptions & Method		
Interest Rate	7.0% per year	8.0% per year
Salary Scale	4.5% per year, at end of year	6.0% per year, at end of year
Retirement Age	65	65
Pre-retirement Decrements	None	None
$\ddot{a}_{65}^{(12)}$	10.0	9.0
Cost Method	Projected Unit Credit (linear proration)	Entry Age Normal
Participant Data		
Age	55	45
Service	15	10
Earnings in 1999	\$80,000	\$75,000
Financial Information		
Assets at December 31, 1998	\$25,000	\$50,000

1. (**CONTINUED**)

The company contributed an amount equal to the normal cost for each plan on January 1, 1999. There were no experience gains or losses in 1999.

On January 1, 2000, the assets of the two plans are merged without changing the plan provisions applicable to each member for service prior to January 1, 2000. For service on and after January 1, 2000, each member will accrue benefits under the terms of Plan A.

The plan sponsor needs your advice to decide on the actuarial cost method to fund the merged plan.

(a) Calculate the accrued liability and normal cost at January 1, 1999 for each plan separately.

(b) Calculate the normal cost of the merged plan on January 1, 2000 using the actuarial assumptions for Plan A and the Frozen Initial Liability cost method.

(c) Describe the difference in the expected pattern of the accrued liability and normal cost, for the merged plan, under the following cost methods:

(i) Projected Unit Credit (linear proration)

(ii) Entry Age Normal

(iii) Frozen Initial Liability

Show all work.

2. *(6 points)* Your client sponsors a non-contributory defined benefit pension plan.

You are given:

Plan Provisions

Retirement Benefit	1.5% of final year's earnings times years of service
Normal Form of Payment	Life only, payable monthly in advance
Normal Retirement Age	65
Termination Benefit	Accrued pension, deferred to age 65

Actuarial Assumptions and Methods

Interest Rate	7% per year
Retirement Age	65
Salary Increases	5% at end of year
Termination Rates	10% per year at the end of each of the first three years of service, 0% thereafter
Other Pre-retirement Decrements	None
Actuarial Cost Method	Projected Unit Credit
Asset Method	Market value of assets
$\ddot{a}_{65}^{(12)}$	10

Participant Data:

	Employee A	Employee B
Date of Birth	January 1, 1970	January 1, 1960
Date of Plan Entry	January 1, 1998	January 1, 1995
2000 Earnings	$40,000	$60,000
Termination Date	December 31, 2000	N/A
2001 Earnings	N/A	$70,000

Financial Information

Market Value of Assets at January 1, 2000:	$30,000
Contribution Made at January 1, 2000:	$10,000
Market Value of Assets at January 1, 2001:	$45,000

2. (CONTINUED)

(a) Calculate the accrued liability and normal cost at January 1, 2000.

(b) Calculate the accrued liability and normal cost at January 1, 2001.

(c) Calculate the gains and losses, by source, at January 1, 2001.

Show all work.

3. *(7 points)* You are the consulting actuary for ABC Co. which has a non-contributory defined benefit pension plan for its employees. You are given:

Plan Provisions

Retirement Benefit	2% of final 3 years' average salary times years of service
Normal Form of Payment	Life only, payable at the beginning of the year
Normal Retirement Age	65
Other Ancillary Benefits	None
Effective Date of Plan	January 1, 1999

Actuarial Assumptions and Methods

Interest Rate	8% per year
Salary Scale	5% at end of year
Retirement Age	65
Pre-retirement Decrements	None
$\ddot{a}_{65}$	10.0
Actuarial Cost Method	Attained Age Normal (level percent of pay)
Amortization Method	Initial Unfunded Liability over 15 years, payable in advance

Plan Participants as of January 1, 2000

Age	Service	Salary
50	25 years	$50,000
30	5 years	30,000
40	None	30,000

The value of assets at December 31, 1999 was $20,000. ABC contributes the normal cost and the amortization payment at the beginning of each year.

Employees received a 6% pay increase at December 31, 1999.

There were no employee terminations during 1999.

Calculate, by source, the change in the normal cost percentage from January 1, 1999 to January 1, 2000.

Show all work.

4. *(5 points)* You are the actuary for a non-contributory defined benefit pension plan.

You are given:

Plan Provisions

Retirement Benefit	\$50 per month times years of service
Normal Form of Payment	Life only, payable monthly in advance
Optional Forms of Payment	Actuarial equivalent
Normal Retirement Age	65
Early Retirement Benefit	Accrued retirement benefit, actuarially reduced from age 65

Actuarial Assumptions and Method

Retirement Age	65
Actuarial Cost Method	Entry Age Normal

x	D_x	N_x	$N_x^{(12)}$
30	98,900	1,288,900	1,243,500
56	12,800	142,600	136,800
60	9,200	97,200	93,000
65	6,000	58,000	55,300

$\ddot{a}_{60:56}^{(12)} = 10.6$

Sole Participant Data

Date of Birth	January 1, 1940
Date of Plan Entry	January 1, 1970
Spouse's Date of Birth	January 1, 1944

The sole participant retires on January 1, 2000 and elects a 60% joint and survivor form of payment.

(a) Calculate the participant's monthly retirement pension.

(b) Determine the experience gain or loss due to the participant's early retirement.

Show all work.

5. *(4 points)* You are the actuary for a defined benefit pension plan for hourly paid employees.

You are given:

Plan Provisions

Retirement Benefit	\$40 per month, per year of service
Normal Form of Payment	Life only, payable monthly in advance
Normal Retirement Age	60
Early Retirement Benefit	Unreduced pension upon attainment of 30 years of service
Other Ancillary Benefits	None

Actuarial Assumptions and Method

Interest Rate	7% per year
Retirement Age	Earlier of age 60 or 30 years of service
Number of Hours Worked During a Year	2080
Other Pre-retirement Decrements	None
$\ddot{a}_x^{(12)}$	$13 + 0.2(60 - x)$
Actuarial Cost Method	Entry Age Normal (level dollar)

Plan Participants

Employee	Date of Birth	Date of Plan Entry
Y	January 1, 1958	January 1, 1985
Z	January 1, 1951	January 1, 1982

The following changes are effective January 1, 2001:

- Retirement benefit will be \$43 per month for all years of service.
- Employees will be required to contribute \$0.25 for each hour worked.
- Employees will make an additional contribution of \$520 for each year of past service.

Determine the change in the employer normal cost at January 1, 2001 resulting from the plan changes.

Show all work.

****END OF EXAMINATION 8****