SOCIETY OF ACTUARIES

AMERICAN SOCIETY OF PENSION ACTUARIES

JOINT BOARD FOR THE ENROLLMENT OF ACTUARIES

PART 7P(US) (EA1) ~~1st and~~ 2nd Segments

JOINT BOARD PENSION EXAMINATION

This is the May 1987 examination which has been released to the public by the administering organizations.

87

EA-1B

THIS PAGE WAS INTENTIONALLY LEFT BLANK

The following facts should be considered a part of the data for each question, unless otherwise stated or implied.

General Conditions Regarding Plan Provisions

1. "Plan" or "pension plan" means a defined benefit pension plan.

2. The plan is sponsored by a single employer.

3. The normal retirement age is 65.

4. Retirement pensions commence at normal retirement age and are paid monthly for life at the beginning of each month.

5. The plan covers all active employees of the employer; there is no age or service requirement for participation. Thus, when referring to active employees, the terms "employee" and "participant" are synonymous.

6. There are no mandatory employee contributions.

7. Service for purposes of vesting and benefit accrual is credited on the basis of time elapsed from date of hire.

8. When the normal retirement pension is computed as a dollar amount, or as a percentage of pay, for each year of service, the accrued benefit is defined likewise.

9. Actuarial equivalence is based on the mortality table and interest rate assumed for funding purposes.

10. The plan has not been amended since its effective date.

11. Any actuarial valuation encompasses not only all active employees but also retired employees, surviving spouses, and former employees entitled to vested deferred pensions.

12. Expenses are paid directly by the employer, rather than from the assets of the plan, and therefore do not affect the funding of the plan.

13. Where the normal cost under a funding method may be computed as either a level dollar amount or a level percentage of pay, the level-percentage approach is used if the plan benefits are based on pay, and the level-dollar approach if they are not.

14. Neither the cost method method nor the actuarial assumptions have been changed since the plan effective date.

15. The valuation date is the first day of the plan year; i.e., participant data, present value items, asset values, etc., are taken as of that date. Also, normal costs are payable yearly, the first being due on the valuation date.

16. Under the frozen initial liability method, whenever there is a change in either plan or assumptions, the unfunded liability is adjusted by adding to it the increase (positive or negative) in the entry-age-normal accrued liability due to the change. Likewise, under the attained age normal method, the unfunded liability is adjusted by adding to it the increase in the unit-credit accrued liability.

Data for question 1

Normal retirement benefit: $10 per month for each year of service.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest: 8%.
Preretirement terminations other than deaths: None.
Retirement age: 65.

Participant data as of 1/1/87:

Name	Date of Birth	Date of Hire
Smith	1/1/57	1/1/87
Brown	1/1/47	1/1/77
Green	1/1/37	1/1/67

x	N_x	D_x
30	12,570	980
40	5,485	450
50	2,255	200
65	465	55

$$\ddot{a}_{65}^{(12)} = 8$$

Question 1

In what range is the accrued liability as of 1/1/87?

(A) Less than $10,000

(B) $10,000 but less than $20,000

(C) $20,000 but less than $30,000

(D) $30,000 but less than $40,000

(E) $40,000 or more

Data for question 2

Normal retirement benefit: 50% of final year's salary.

Actuarial cost method: Aggregate.

Actuarial assumptions:

   Interest: 8%.
   Salary increases: 6% per year.
   Preretirement deaths and terminations: None.

Selected valuation results as of 1/1/86:

Present value of future benefits for active participants	$950,000
Present value of future benefits for inactive participants	0
Actuarial value of assets	500,000
Annual salaries	1,000,000
Normal cost as of 1/1	60,000

Plan experience during 1986:

   The rate of return on the actuarial value of assets was 10%.
   Salaries increased 5%.
   The normal cost for 1986 was paid at 1/2/86.
   There were no deaths, terminations, retirements, or new participants.
   There were no active participants within two years of the assumed retirement age.

Question 2

In what range is the normal cost rate (as a percentage of salaries) as of 1/1/87?

(A) Less than 5.75%

(B) 5.75% but less than 5.80%

(C) 5.80% but less than 5.85%

(D) 5.85% but less than 5.90%

(E) 5.90% or more

Data for question 3

Early retirement age: 55.

Basis for conversion between annuity forms: Actuarial equivalence.

The following changes in the assumptions for actuarial equivalence are being considered:

Interest: Increase from 6% to 8%.

Mortality: Change from the 1971 Group Annuity Mortality Table (Males) to the 1971 Group Annuity Mortality Table (Males) set back three years.

Consider the following statements regarding a participant aged 40:

I.   If only the mortality assumption is changed, early retirement benefits in the normal form will increase.

II. If only the interest assumption is changed, early retirement benefits in the normal form will increase.

III. If only the mortality assumption is changed, normal retirement benefits in the life-with-ten-years-certain optional form will increase.

Question 3

Which, if any, of these statements is (are) true?

(A) I and II only

(B) I and III only

(C) II and III only

(D) I, II, and III

(E) The correct answer is not given by (A), (B), (C), or (D) above.

Normal retirement benefit: $1,000 each 1/1 until the retiree dies, then $500 to the surviving spouse (if any) each 1/1 thereafter for life.

Participant data as of 1/1/86: 100 married retirees, all aged 65 with spouses aged 62.

Deaths during 1986: 3 retirees die, leaving their spouses alive, and 2 spouses die, leaving the retirees alive.

There were no new retirees during 1986.

$\ddot{a}_{62} = 9.230$ $\ddot{a}_{62:65} = 7.440$ $p_{62} = .985$

$\ddot{a}_{63} = 9.024$ $\ddot{a}_{63:66} = 7.205$ $p_{65} = .980$

$\ddot{a}_{65} = 8.630$

$\ddot{a}_{66} = 8.409$

Question 4

In what range is the mortality gain for 1986?

(A) Less than $1,250

(B) $1,250 but less than $2,500

(C) $2,500 but less than $3,750

(D) $3,750 but less than $5,000

(E) $5,000 or more

Accrued benefit: $15 per month for each year of service.

Vested benefit: 25% of the accrued benefit for each year of service in excess of 6 years, to a maximum of 100% of the accrued benefit.

Actuarial cost method: Aggregate.

It is assumed that all terminations occur at the beginning of the year.

Assumed retirement age: 65.

Data for sole participant as of 1/1/87:

    Attained age   40
    Age at hire   35

q_x^w is the probability of an employee aged x terminating before age (x + 1) according to the service table for active employees.

l_x is from the service table for active employees.

All commutation functions are based solely on mortality and interest.

Question 5

Which of the following is the expression for the present value as of 1/1/87 of the participant's benefits for vested termination before age 65?

(A) $\quad (180 N_{65}^{(12)}/D_{40})[.25 \sum_{t=42}^{44} q_t^w (t-35)(t-40) + \sum_{t=45}^{64} q_t^w(t-35)]$

(B) $\quad (180 N_{65}^{(12)}/D_{40})[.25 \sum_{t=42}^{44} q_t^w (t-35)(t-41) + \sum_{t=45}^{64} q_t^w(t-35)]$

(C) $\quad (180 N_{65}^{(12)}/D_{40})[.25 \sum_{t=42}^{44} q_t^w (t-35)(t-40)v^{t-40} + \sum_{t=45}^{64} q_t^w(t-35)v^{t-40}]$

(D) $\quad (180 N_{65}^{(12)}/l_{40})[.25 \sum_{t=42}^{44} q_t^w(t-35)(t-40)v^{t-40}l_t/D_t + \sum_{t=45}^{64} q_t^w(t-35)v^{t-40}l_t/D_t]$

(E) $\quad (180 N_{65}^{(12)}/l_{40})[.25 \sum_{t=42}^{44} q_t^w(t-35)(t-41)v^{t-40}l_t/D_t + \sum_{t=45}^{64} q_t^w(t-35)v^{t-40}l_t/D_t]$

Data for question 6

Plan effective date: 1/1/77.

Normal retirement benefit: $500 per month.

Actuarial cost method: Individual level premium, with changes due to plan amendments funded from attained age.

Actuarial assumptions:

Interest: 8%.
Preretirement terminations other than deaths: None.
Retirement age: 65.

Participant data as of 1/1/87 and selected commutation functions:

Age at hire	Attained age (x)	Number of employees	D_x	$N_x - N_{65}$	$N_x^{(12)}$
--	25	0	265	3,390	3,355
25	35	1	125	1,455	1,485
25	45	2	55	570	630
--	55	0	25	170	245
--	65	0	10	0	80

Effective 1/1/87, the plan is amended to increase the normal retirement benefit to $550 per month.

Question 6

In what range is the increase, due to the amendment, in the normal cost for 1987 as of 1/1/87?

(A) Less than $50

(B) $50 but less than $150

(C) $150 but less than $250

(D) $250 but less than $350

(E) $350 or more

Data for Question 7

Retirement benefit: 50% of final year's salary.

Actuarial cost method: Aggregate.

Participant data as of 1/1/87:

Attained Age	Salary for 1987
47	$35,000
47	45,000
47	55,000
47	65,000

Original valuation results as of 1/1/87:

Present value of future benefits	$500,000
Actuarial value of assets	100,000
Normal cost as of 1/1	40,000

After the 1/1/87 valuation, it was discovered that an employee with the following data had been omitted:

Attained Age	Salary for 1987
47	$25,000

The valuation was revised to include the previously omitted employee.

Question 7

In what range is the revised normal cost for 1987 as of 1/1/87?

(A) Less than $44,500

(B) $44,500 but less than $45,000

(C) $45,000 but less than $45,500

(D) $45,500 but less than $46,000

(E) $46,000 or more

Data for question 8

Normal retirement benefit: $600 per month.

Actuarial cost method: Individual aggregate. Assets are allocated to each
active participant in proportion to the sum, as of the
prior valuation date, of the participant's normal cost
and allocated assets.

Actuarial assumptions:

Interest: 8%.
Preretirement deaths and terminations: None.
Retirement age: 65.

Selected valuation results as of 1/1/86:

	Age	Normal Cost as of 1/1	Allocated Assets
Smith	40	$510	$ 2,705
Brown	50	274	16,000

Actuarial value of assets as of 1/1/87: $20,000.

There were no deaths, terminations, retirements, or new entrants during 1986.

Question 8

In what range is the normal cost for 1987 as of 1/1/87?

(A) Less than $800

(B) $800 but less than $830

(C) $830 but less than $860

(D) $860 but less than $890

(E) $890 or more

Data for question 9

Actuarial cost method: Unit credit.

Actuarial assumptions:

    Interest: 8%.
    Retirement age: 65.

Selected valuation results:

	1/1/86	1/1/87
Normal cost as of 1/1	$ 10,000	$ 11,000
Accrued liability for actives	135,100	156,000
Accrued liability for inactives	0	0

Actuarial value of assets as of 1/1/86: $0.

Contribution for 1986: $25,000, paid at 7/1/86.

Contribution for 1987: $27,500, paid at 7/1/87.

No benefits were payable for 1986.

The rate of return on the actuarial value of assets was 10% for 1986.

Question 9

In what range is the actuarial gain for 1986 excluding the investment gain?

(A) Less than $300

(B) $300 but less than $500

(C) $500 but less than $700

(D) $700 but less than $900

(E) $900 or more

Data for question 10

Plan provisions:

    Normal retirement benefit: $10 per month for each year of service.
    Normal retirement age: The later of age 65 or age at 10 years of
                           participation.

Actuarial cost method: Aggregate.

Actuarial assumptions:

    Interest: 8%.
    Preretirement deaths and terminations: None.
    Retirement age: Normal retirement age.

Participant data as of 1/1/87:

	Date of Birth	Date of Hire	Date of Participation
Smith	1/1/37	1/1/70	1/1/79
Brown	1/1/22	1/1/62	1/1/79

Actuarial value of assets as of 1/1/87: $10,000.

x	$\ddot{a}_x^{(12)}$
65	8.142
66	7.951
67	7.702

Question 10

In what range is the normal cost for 1987 as of 1/1/87?

(A) Less than $1,500

(B) $1,500 but less than $2,250

(C) $2,250 but less than $3,000

(D) $3,000 but less than $3,750

(E) $3,750 or more

Data for question 11

Normal retirement benefit: 40% of final five-year average salary.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest: 8%.
Salary increases: 6% per year.
Preretirement deaths and terminations: None.
Retirement age: 65.

Data for sole participant as of 1/1/87:

Date of birth   1/1/32
Date of hire   1/1/77
Salary for 1986 $32,000

Actuarial value of assets as of 1/1/87: $30,000.

$$\ddot{a}_{65}^{(12)} = 8.65$$

Question 11

In what range is the normal cost for 1987 as of 1/1/87?

(A) Less than $5,100

(B) $5,100 but less than $5,400

(C) $5,400 but less than $5,700

(D) $5,700 but less than $6,000

(E) $6,000 or more

Data for question 12

Normal retirement benefit: $20 per month for each year of service.

Early retirement benefit: Accrued benefit with no reduction for early
                           retirement.

Actuarial cost method: Unit credit.

Actuarial assumptions:

    Interest: 8%.
    Preretirement deaths and terminations: None.
    Retirement:

x	Probability of Retirement at Age x
63	20%
64	30%
65	100%

    Retirements occur at the beginning of the year.

Data for sole participant as of 1/1/87:

    Date of birth   1/1/32
    Date of hire   1/1/77

$$\overset{..(12)}{a}_{63} = 8.56 \qquad \overset{..(12)}{a}_{64} = 8.35 \qquad \overset{..(12)}{a}_{65} = 8.14$$

Question 12

In what range is the normal cost for 1987 as of 1/1/87?

(A) Less than $775

(B) $775 but less than $950

(C) $950 but less than $1,125

(D) $1,125 but less than $1,300

(E) $1,300 or more

Data for question 13

Normal retirement benefit: $25 per month for each year of service.

Early retirement benefit: Accrued benefit reduced by 1/15 for each of the
                            first 5 years preceding age 65 and 1/30 for
                            each of the next 5 years.

Actuarial cost method: Unit credit.

Actuarial assumptions:

    Interest: 8%.
    Preretirement terminations other than deaths: None.
    Retirement age: 65.

Data for participant:

    Date of birth   1/1/28
    Date of hire   1/1/63
    Date of retirement   12/31/86

x	D_x	$N_x^{(12)}$
58	440	4,160
59	400	3,740
60	365	3,355
65	230	1,880

Question 13

In what range is the loss in 1986 due to the participant's early retirement?

(A) Less than $3,000

(B) $3,000 but less than $5,000

(C) $5,000 but less than $7,000

(D) $7,000 but less than $9,000

(E) $9,000 or more

Data for question 14

	Date	Amount
Market values of fund:	1/1/87	$50,000
	3/31/87	50,515
	6/30/87	46,705
	9/30/87	48,136
	1/1/88	63,651
Benefits paid:	4/1/87	$5,200
	12/31/87	10,100
		$15,300
Contributions received:	10/1/87	$20,000
	12/31/87	2,700
		$22,700

Question 14

In what range is the dollar-weighted rate of return for 1987?

(A) Less than 11.55%

(B) 11.55% but less than 11.85%

(C) 11.85% but less than 12.15%

(D) 12.15% but less than 12.45%

(E) 12.45% or more

Data for question 15

Normal retirement benefit: 1% of final year's salary for each year of service.

Actuarial cost method: Projected unit credit (service prorated).

Actuarial assumptions:

    Interest: 8%.
    Salary increases: 6% per year.
    Preretirement deaths and terminations: None.
    Retirement age: 65.

Participant data as of 1/1/87:

Name	Date of Birth	Date of Hire	Salary for 1987
Smith	1/1/27	1/1/67	$72,000
Brown	1/1/27	1/1/60	$24,000

$$\ddot{a}_{65}^{(12)} = 8.33$$

Question 15

In what range is the normal cost for 1987 as of 1/1/87?

(A) Less than $5,500

(B) $5,500 but less than $6,000

(C) $6,000 but less than $6,500

(D) $6,500 but less than $7,000

(E) $7,000 or more

Data for question 16

Plan effective date: 1/1/86.

Normal retirement benefit: 50% of final year's salary.

Actuarial cost method: Individual level premium.

Valuation date: 12/31.

Actuarial assumptions:

    Interest: 8%.
    Salary increases: None.
    Preretirement deaths and terminations: None.
    Retirement age: 65.

Data for sole participant:

Date of birth	1/1/32
Date of hire	1/1/77
Salary for 1986	$36,000
Salary for 1987	$30,000

$$\ddot{a}_{65}^{(12)} = 8.33$$

Question 16

In what range is the normal cost for 1987 as of 12/31/87?

(A) Less than $7,400

(B) $7,400 but less than $7,800

(C) $7,800 but less than $8,200

(D) $8,200 but less than $8,600

(E) $8,600 or more

Data for question 17

Normal retirement benefit: $20 per month for each year of service.

Actuarial cost method: Unit credit.

Actuarial assumptions:

    Interest: 7%.
    Preretirement deaths and terminations: None.
    Retirement age: 65.

Data for sole participant:

    Date of birth   1/1/23
    Date of hire   1/1/81

Unfunded accrued liability as of 1/1/86: $2,000.

Contribution for 1986: Normal cost as of 1/1 paid at 1/1/86.

Investment return for 1986: 11%.

As of 1/1/87, the assumed interest rate is changed to 8%.

	7%	8%
$\ddot{a}^{(12)}_{65}$	10	9

Question 17

In what range is the unfunded accrued liability as of 1/1/87?

(A) Less than $350

(B) $350 but less than $700

(C) $700 but less than $1,050

(D) $1,050 but less than $1,400

(E) $1,400 or more

Data for question 18

Normal retirement benefit: $10 per month for each year of service.

Early retirement benefit: Accrued benefit reduced by 6% for each year by which the early retirement age precedes age 65.

Actuarial cost method: Entry age normal.

It is assumed that there are no terminations prior to retirement other than by death.

Assumed retirement age: 60.

Data for sole participant:

    Date of birth   1/1/37
    Date of hire   1/1/77

x	D_x	N_x	$\ddot{a}_x^{(12)}$
40	652	8,761	12.98
50	322	3,902	11.66
60	151	1,547	9.79
65	99	904	8.67

Question 18

In what range is the accrued liability as of 1/1/87?

(A) Less than $5,000

(B) $5,000 but less than $7,000

(C) $7,000 but less than $9,000

(D) $9,000 but less than $11,000

(E) $11,000 or more

Data for question 19

Normal retirement benefit: $10 per month for each year of service.

Actuarial cost method: Frozen initial liability.

Actuarial assumptions:

Interest: 8%.
Preretirement deaths and terminations: None.
Retirement age: 65.

Valuation dates:

For 1986 plan year: 12/31/86.
For 1987 plan year: 1/1/87.

Selected valuation results as of 12/31/86:

Present value of future benefits $900,000
Unfunded liability $400,000
Normal cost as of 12/31 $30,000

Actuarial value of assets as of 12/31/86: $200,000, prior to contribution for
1986.

Contribution for 1986: $60,000, paid at 12/31/86.

There is no change in participant data between 12/31/86 and 1/1/87.

Question 19

In what range is the normal cost for 1987 as of 1/1/87?

(A) Less than $27,500

(B) $27,500 but less than $28,750

(C) $28,750 but less than $30,000

(D) $30,000 but less than $31,250

(E) $31,250 or more

Data for question 20

Plan effective date: 1/1/86.

Normal retirement benefit: 30% of final year's salary.

Actuarial cost method: Individual level premium.

Initial valuation date: 12/31/86.

Actuarial assumptions:

Interest: 8%.
Salary increases: None.
Preretirement deaths and terminations: None.
Retirement age: 65.

Data for sole participant:

Date of birth   1/1/42
Salary for 1986 $200,000

$$\overset{..(12)}{a}_{65} = 8.40$$

Question 20

In what range is the normal cost for 1986 as of 12/31/86?

(A) Less than $10,000

(B) $10,000 but less than $10,050

(C) $10,050 but less than $10,100

(D) $10,100 but less than $10,150

(E) $10,150 or more

ANSWER KEY

May 1987 Part 7P (U.S.) (EA1)

1st segment		2nd segment	
1.	C	1.	B
2.	D	2.	B
3.	B	3.	B
4.	C	4.	E
5.	E	5.	E
6.	C	6.	C
7.	B	7.	E
8.	B	8.	E
9.	C	9.	D
10.	D	10.	E
11.	A	11.	C
12.	B	12.	C
13.	B	13.	D
14.	D	14.	D
15.	E	15.	D
16.	C	16.	A
17.	C	17.	A
18.	B	18.	B
19.	D	19.	B
20.	D	20.	A
21.	D		
22.	D		
23.	C		
24.	D		
25.	B		