SOCIETY OF ACTUARIES

AMERICAN SOCIETY OF PENSION ACTUARIES

JOINT BOARD FOR THE ENROLLMENT OF ACTUARIES

COURSE P-360U (EA1) Segment B

JOINT BOARD BASIC EXAMINATION

This is the May 1990 examination which has been released to
the public by the administering organizations.

90
SPRING
EA-1B

1990

Type of plan: Contributory.

Rate of employee contribution: 1.5% of compensation.

Death benefit: Refund of employee contributions, with interest to date of
death.

Actuarial cost method: Aggregate.

Valuation results as of 1/1/90:

Present value of future retirement benefits	$1,500,000
Present value of future death benefits	30,000
1990 employee contributions	15,000
Value of assets	400,000
Accumulated employee contributions with interest (included in assets)	60,000
Present value of future compensation	8,000,000
Annual compensation	1,000,000

Question 1

In what range is the employer's normal cost for 1990 as of 1/1/90?

(A) Less than $130,000

(B) $130,000 but less than $135,000

(C) $135,000 but less than $140,000

(D) $140,000 but less than $145,000

(E) $145,000 or more

Data for Question 2

1990

Normal retirement benefit:

> Before 1991: 40% of final 3-year average compensation.
> After 1990: 50% of final 3-year average compensation.

Actuarial cost method: Aggregate.

Actuarial assumptions:

> Interest rate: 7% per year.
> Compensation increases: 5% per year.
> Preretirement deaths and terminations: None.
> Retirement age: 65.

Valuation results as of 1/1/90:

Present value of future benefits	
Active participants	$ 800,000
Inactive participants	0
Value of assets	300,000
Present value of future compensation	11,250,000
1990 compensation	900,000

As of 1/1/90, participants were under age 64.

Contribution for 1990: Normal cost for 1990 as of 1/1/90, paid on 1/1/90.

There were no experience gains or losses due to new participants, deaths, terminations, or retirements during 1990.

There were no new participants as of 1/1/91.

All active participants received an 8% compensation increase from 1990 to 1991.

Normal cost for 1991 as of 1/1/91: $60,000.

Question 2

In what range is the value of assets as of 12/31/90?

(A) Less than $365,000

(B) $365,000 but less than $375,000

(C) $375,000 but less than $385,000

(D) $385,000 but less than $395,000

(E) $395,000 or more

Data for Question 3

Valuation date: 12/31.

Normal retirement benefit: 50% of final 3-year average compensation.

Actuarial cost method: Aggregate.

Actuarial assumptions:

    Interest rate: 7% per year.
    Compensation increases: None.
    Preretirement deaths and terminations: None.
    Retirement age: 65.

Data for only participants:

	Smith	Brown
Date of birth	1/1/26	1/1/45
1990 compensation	-	$30,000
Status as of 12/31/90	Retired	Active
Monthly benefit	$1,000	-

Value of assets as of 12/31/90: $94,650.

Selected annuity value:

$$\ddot{a}^{(12)}_{65} = 8.74$$

Question 3

In what range is the normal cost for 1990 as of 12/31/90?

(A) Less than $3,000

(B) $3,000 but less than $3,400

(C) $3,400 but less than $3,800

(D) $3,800 but less than $4,200

(E) $4,200 or more

Data for Question 4

Retirement benefit:

Before 1990: 1.00% of final average compensation for each year of service.
After 1989: 1.25% of final average compensation for each year of service.

Actuarial cost method: Individual entry age normal.

Valuation results for sole participant as of 1/1/90, before amendment:

Present value of future benefits	$ 4,100
Unfunded liability	800
Value of assets	1,000
Present value of future compensation	46,000
1990 compensation	4,000
Present value of accrued benefits	1,700

Question 4

In what range is the normal cost for 1990 as of 1/1/90 after the amendment?

(A) Less than $220

(B) $220 but less than $230

(C) $230 but less than $240

(D) $240 but less than $250

(E) $250 or more

Data for Question 5

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

Vesting eligibility: 100% after 5 years of service.

Preretirement death benefit: None.

Actuarial cost method: Unit credit.

Actuarial assumptions:

Interest rate: 7% per year.
Preretirement terminations other than deaths: Occur at end of year.

$$q_x^{(d)} = q_x^{\prime(d)}$$

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/27
Date of hire	1/1/85
Status as of 1/1/90	Active

Selected probabilities and annuity value:

x	q_x^T	$q_x^{(d)}$
63	.069	.019
64	.081	.021
65	.023	.023

$$q_x^T = q_x^{(d)} + q_x^{(w)}$$

$$\ddot{a}_{65}^{(12)} = 8.736$$

Question 5

In what range is the normal cost for 1990 as of 1/1/90?

(A) Less than $872

(B) $872 but less than $877

(C) $877 but less than $882

(D) $882 but less than $887

(E) $887 or more

1990

Normal retirement benefit:

    Before 1990: $10 per month for each year of service.
    After 1989: $12 per month for each year of service.

Actuarial cost method: Individual entry age normal.

Actuarial assumptions:

    Interest rate: 7% per year.
    Compensation increases: None.
    Preretirement deaths and terminations: None.
    Retirement age: 65.

Data and valuation results for only participants as of 1/1/90:

	Smith	Brown
Date of birth	1/1/60	1/1/50
Date of hire	1/1/85	1/1/85
Status	Active	Active
Normal cost per $1,000 of projected annual benefit	$42.13	$89.04

Question 6

In what range is the increase in the accrued liability as of 1/1/90 due to the amendment?

(A) Less than $325

(B) $325 but less than $425

(C) $425 but less than $525

(D) $525 but less than $625

(E) $625 or more

Data for Question 7

Actuarial cost method: Frozen initial liability (level dollar amount).

Actuarial assumptions:

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

Data and valuation results for only participants as of 1/1/90:

	Smith	Brown	Green
Date of birth	1/1/20	1/1/55	1/1/45
Status	Retired	Active	Active
Monthly accrued benefit	$1,000	-	-
Monthly projected benefit	-	$5,000	$3,000

Unfunded liability as of 1/1/90: $10,000.

Value of assets as of 1/1/90: $91,200.

Selected annuity values:

$$\ddot{a}_{65}^{(12)} = 8.74 \qquad \ddot{a}_{70}^{(12)} = 7.60$$

Question 7

In what range is the normal cost for 1990 as of 1/1/90?

(A) Less than $9,000

(B) $9,000 but less than $12,000

(C) $12,000 but less than $15,000

(D) $15,000 but less than $18,000

(E) $18,000 or more

1990

Plan effective date: 1/1/89.

Normal retirement age: 63.

Normal retirement benefit: 2.5% of final year's compensation for each year of
                            service.

Actuarial cost method: Projected unit credit.

Actuarial assumptions:

     Interest rate: 8% per year.
     Compensation increases: 4% per year.
     Preretirement deaths and terminations: None.
     Retirement age: 63.

Data for sole participant:

     Date of birth   1/1/55
     Date of hire   1/1/80
     1988 compensation $40,000
     Status as of 1/1/90   Active

Value of assets as of 1/1/89: $0.

Contribution for 1989: $6,000 paid on 4/1/89.

Noninvestment experience gain or loss for 1989: $0.

Unfunded accrued liability as of 1/1/90: $25,000.

Selected annuity value:

     $$\ddot{a}^{(12)}_{63} = 8.582$$

Question 8

In what range is the investment experience gain or loss for 1989?

(A) Gain of $400 or more

(B) Gain of $200 but less than $400

(C) Gain or loss of less than $200

(D) Loss of $200 but less than $400

(E) Loss of $400 or more

Data for Question 9

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

Early retirement benefit: Accrued benefit reduced by 6% for each of the first 5 years and 3% for each of the next 5 years by which commencement of payments precedes age 65.

Actuarial cost method: Frozen initial liability.

Actuarial assumptions:

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

Data for participant Smith:

    Date of birth   1/1/35
    Date of hire   1/1/72
    Status as of 1/1/90   Active

Original valuation results as of 1/1/90:

    Present value of future benefits $662,000
    Unfunded liability   163,250
    Value of assets   142,500
    Normal cost per active participant   195.34
    Number of active participants   150

Selected annuity values:

$$\ddot{a}_{55}^{(12)} = 12.33 \qquad \ddot{a}_{65}^{(12)} = 8.33$$

After the valuation was done, it was discovered that Smith had retired on 12/31/89 and commenced receiving benefits. Another valuation was done to correct this error.

Question 9

In what range is the increase in normal cost for 1990 as of 1/1/90 due to Smith's retirement?

(A)   Less than $0

(B) $0 but less than $100

(C) $100 but less than $200

(D) $200 but less than $300

(E) $300 or more

1990

Data for Question 10

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

Actuarial cost method: Aggregate.

Actuarial assumptions:

    Interest rate: 7% per year.
    Preretirement terminations other than deaths: None.
    Retirement age: 65.

Data for all participants as of 1/1/90:

Age	Number of Part.	Past Service	Status
45	15	20	Active
55	10	30	Active
65	5	40	Retired

Value of assets as of 1/1/90: $300,000.

Selected commutation functions:

x	D_x	N_x
45	4,528	58,163
55	2,187	24,581
65	965	8,872

Question 10

In what range is the normal cost for 1990 as of 1/1/90?

(A) Less than $22,250

(B) $22,250 but less than $24,250

(C) $24,250 but less than $26,250

(D) $26,250 but less than $28,250

(E) $28,250 or more

Data for Question 11

Actuarial cost method: Entry age normal (level dollar amount).

Assumed retirement age: 65.

Data for sole participant:

Date of birth   1/1/45
Date of hire   1/1/75
Status as of 1/1/90   Active

Projected annual benefit as of 1/1/90: B.

Level annual cost from age 30: P.

Consider the following expressions for the accrued liability for retirement benefits as of 1/1/90:

I. $P \times \dfrac{(N_{30} - N_{45})}{D_{45}}$

II. $B \times \dfrac{N_{65}^{(12)}}{D_{45}} - P \times \dfrac{(N_{45} - N_{65})}{D_{45}}$

III. $B \times \dfrac{N_{65}^{(12)}}{D_{45}} \times \dfrac{N_{30} - N_{45}}{N_{30} - N_{65}}$

Question 11

Which, if any, of these expressions is (are) correct?

(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.

Data for Question 12

Plan effective date: 1/1/80.

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

Actuarial cost method: Entry age normal.

Assumed interest rate: 7% per year.

Data for sole participant:

Date of birth	1/1/55
Date of hire	1/1/80
1989 compensation	$25,000
Status as of 1/1/90	Active

Selected commutation functions and annuity value:

x	s_x/s_{65}	D_x	^sD_x	N_x	^sN_x
25	.1420	1,779,168	6,024,894	25,677,330	193,660,240
35	.2314	894,190	4,932,364	12,364,650	138,500,016
45	.3769	445,008	3,998,400	5,690,850	93,472,528
55	.6139	213,953	3,131,334	2,405,025	57,406,892
65	1.0000	94,414	2,250,810	868,052	30,013,858

$$\ddot{a}_{65}^{(12)} = 8.736$$

Question 12

In what range is the accrued liability as of 1/1/90?

(A) Less than $12,500

(B) $12,500 but less than $17,500

(C) $17,500 but less than $22,500

(D) $22,500 but less than $27,500

(E) $27,500 or more

Data for Question 13

Smith, age 60, is entitled to a pension payable under either Option A or Option B, which are actuarially equivalent.

Option A: A life annuity commencing immediately which pays (P + $500) per month for two years, and P per month thereafter.

Option B: A life annuity commencing immediately which pays $500 per month as long as Smith and his spouse (also age 60) are both alive. Upon the death of either Smith or his spouse, the monthly payment is reduced to ($500 - .50 x P).

Selected commutation functions and annuity values:

$$D_{60} = 147.804 \qquad \ddot{a}_{60}^{(12)} = 9.815$$

$$D_{62} = 125.296 \qquad \ddot{a}_{62}^{(12)} = 9.394$$

$$\ddot{a}_{60:60}^{(12)} = 8.094$$

Question 13

In what range is P?

(A) Less than $440

(B) $440 but less than $540

(C) $540 but less than $640

(D) $640 but less than $740

(E) $740 or more

Data for Question 14

Normal retirement benefit: $1,000 per month.

Basis for conversion for early retirement and between optional forms
of payment: Actuarial equivalence.

Data for sole participant:

Date of birth	1/1/35
Date of retirement	1/1/90
Spouse's date of birth	1/1/38
Form of payment elected	Monthly benefit for life, with 50% continuing to the participant's surviving spouse for life

Selected commutation functions:

x	N_x	$N_{x:x-3}$
51	377	3,234
52	345	2,935
53	316	2,659
54	289	2,403
55	263	2,168
56	240	1,951
61	147	1,106
62	132	978
63	119	862
64	106	757
65	95	661
66	85	575

Question 14

In what range is the spouse's monthly benefit if the participant dies first?

(A)   Less than $164

(B) $164 but less than $165

(C) $165 but less than $166

(D) $166 but less than $167

(E) $167 or more

Data for Question 15

A master trust contains the assets for Plans A, B, and C. Total investment income each year is allocated to each plan in proportion to expected interest, using simple interest.

Trust values and transactions for 1989:

	Plan A	Plan B	Plan C
Value of assets as of 1/1/89	$100,000	$60,000	$ 0
Contributions for 1989:			
3/31/89	20,000	40,000	100,000
6/30/89	20,000	0	0
9/30/89	20,000	40,000	0
12/31/89	20,000	0	200,000
Benefit payments for 1989:			
6/30/89	10,000	15,000	0
12/31/89	10,000	0	5,000

Total investment income for 1989: $100,000.

Question 15

In what range is the value of assets for Plan C as of 1/1/90?

(A) Less than $320,750

(B) $320,750 but less than $333,500

(C) $333,500 but less than $346,250

(D) $346,250 but less than $359,000

(E) $359,000 or more

Data for Question 16

Plan effective date: 1/1/90.

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

Early retirement benefit: Payable immediately without reduction.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 7% per year.
Compensation increases: 7% per year.
Preretirement deaths and terminations: None.
Probability of retiring at age x:

x	
62	50%
63	0%
64	0%
65	100%

Data for sole participant:

Date of birth	1/1/34
Date of hire	1/1/89
1989 compensation	$100,000
Status as of 1/1/90	Active

Selected annuity values:

$$\ddot{a}_{62}^{(12)} = 9.394 \qquad \ddot{a}_{65}^{(12)} = 8.736$$

Question 16

In what range is the normal cost for 1990 as of 1/1/90?

(A) Less than $9,850

(B) $9,850 but less than $10,000

(C) $10,000 but less than $10,150

(D) $10,150 but less than $10,300

(E) $10,300 or more

Data for Question 17

Normal retirement benefit: 1% of final year's compensation for each year
of service up to 30 years.

Actuarial cost method: Projected unit credit.

Actuarial assumptions:

Interest rate: 7% per year.
Compensation increases: 5% per year.
Preretirement terminations other than deaths: None.
Retirement age: 65.

Data for sole participant:

Date of birth	1/1/40
Date of hire	1/1/80
1989 compensation	$40,000
Status as of 1/1/90	Active

Valuation results as of 1/1/89:

Normal cost as of 1/1	$ 2,000
Accrued liability	21,000
Value of assets	12,000

Contribution for 1989: $2,500 paid on 12/31/89.

Investment experience gain or loss for 1989: $0.

Selected commutation functions:

$$D_{49} = 344 \qquad D_{50} = 320 \qquad N_{65}^{(12)} = 849$$

Question 17

In what range is the experience gain for 1989?

(A) Less than $2,000

(B) $2,000 but less than $2,500

(C) $2,500 but less than $3,000

(D) $3,000 but less than $3,500

(E) $3,500 or more

Data for Question 18

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

Actuarial cost method: Entry age normal.

Actuarial assumptions:

    Interest rate: 7% per year.
    Compensation increases: 5% per year.
    Preretirement deaths and terminations: None.
    Retirement age: 65.

Compensation increases before 1990: 5% per year.

Data for sole participant:

    Date of birth   1/1/40
    Date of hire   1/1/85
    1989 compensation $25,000
    Status as of 1/1/90   Active

Value of assets as of 1/1/90: $3,500.

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 8.735$$

Question 18

In what range is the normal cost for 1990 as of 1/1/90?

(A) Less than $1,350

(B) $1,350 but less than $1,500

(C) $1,500 but less than $1,650

(D) $1,650 but less than $1,800

(E) $1,800 or more

Data for Question 19

Plan effective date: 1/1/85.

Normal retirement benefit: 2% of final year's compensation for each year of service.

Actuarial cost method: Individual level premium (benefit increases increase the normal cost).

Actuarial assumptions:

Interest rate: 7% per year.
Compensation increases: None.
Preretirement deaths and terminations: None.
Retirement age: 65.

Data for sole participant:

Date of birth	1/1/60
Date of hire	1/1/85
Monthly compensation:	

1985	$3,500
1986	3,500
1987	3,500
1988	4,000
1989	4,000
1990	4,000

Status as of 1/1/90   Active

Selected annuity value:

$$\ddot{a}^{(12)}_{65} = 9.345$$

Question 19

In what range is the accrued liability as of 1/1/90?

(A) Less than $9,600

(B) $9,600 but less than $9,800

(C) $9,800 but less than $10,000

(D) $10,000 but less than $10,200

(E) $10,200 or more

Data for Question 20

Normal retirement benefit:

Before 1990: 50% of highest 3-year average compensation.
After 1989: 100% of highest 3-year average compensation.

Normal form of payment:

Retirements before 1990: If single, life annuity. If married, 100% joint and survivor annuity (fully subsidized.)
Retirements after 1989: Life annuity.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Preretirement deaths and terminations: None.
Retirement age: 65.
Marital characteristics: 85% of participants are married at the time of retirement; spouses are the same age as participants.

Valuation results as of 1/1/90, before amendments:

Normal cost as of 1/1	$ 94,000
Present value of future benefits for inactive participants (all became inactive before 1990)	500,000
Value of assets	730,000
Present value of future compensation	4,850,000
1990 compensation	375,000

Selected annuity values:

$$\ddot{a}^{(12)}_{65} = 10 \qquad \ddot{a}^{(12)}_{65:65} = 8.2$$

Question 20

In what range is the normal cost for 1990 as of 1/1/90 after the amendments?

(A) Less than $175,000

(B) $175,000 but less than $185,000

(C) $185,000 but less than $195,000

(D) $195,000 but less than $205,000

(E) $205,000 or more

ANSWER KEY

MAY 1990 COURSE P-360U (EA-1) Segment B

1. A
2. E
3. D
4. E
5. C

6. E
7. B
8. D
9. C
10. C

11. D
12. B
13. A
14. B
15. A

16. D
17. C
18. D
19. B
20. B