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 1993 examination which has been released to the public by the administering organizations.

93

SPRING

EA-1B

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Conditions Generally Applicable to All EA-1 Segment B Examination Questions

The following conditions 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) There are no preretirement death benefits.

(6) 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.

(7) There are no mandatory or voluntary employee contributions.

(8) Service for purposes of vesting and benefit accrual is credited on the basis of time elapsed since date of hire.

(9) When the normal retirement benefit is computed as a dollar amount, or as a percentage of compensation, for each year of service, the accrued benefit is defined likewise.

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

(11) The plan has not been amended since its effective date.

General Conditions Regarding Funding

(12) Any actuarial valuation encompasses not only all active employees but also retired employees, beneficiaries, and former employees entitled to vested deferred pensions.

(13) The valuation date is the first day of the plan year; i.e., participant data, present values, asset values, etc. are as of that date. Also, normal costs are payable annually, the first being due on the valuation date.

(14) Where the normal cost under an actuarial cost method may be computed as either a level percentage of compensation or a level dollar amount, the level percentage approach is used if the plan benefits are based on compensation, and the level dollar approach is used if they are not.

(15) Under the frozen initial liability method, whenever there is a change in the plan, actuarial assumptions, or asset valuation method, the unfunded liability is adjusted by adding to it the increase (positive or negative) in the unfunded 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 unfunded unit credit accrued liability.

(16) Neither the actuarial cost method nor the actuarial assumptions have been changed since the plan effective date.

(17) 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.

(18) Assumed compensation increases first apply to the year immediately following the latest year for which valuation compensation is shown.

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

1993

Data for Question 1

Plan effective date: 1/1/70.

Normal retirement benefit: 50% of final 5-year average compensation.

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.

Valuation data for all participants as of 1/1/93:

	Smith	Brown
Date of birth	1/1/56	1/1/36
Date of hire	1/1/92	1/1/76
Monthly compensation	$2,500	$1,500

Selected annuity value:

$$\ddot{a}^{(12)}_{65} = 10.0$$

Question 1

In what range is the accrued liability as of 1/1/93?

(A) Less than $45,000

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

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

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

(E) $46,500 or more

1993

Data for Question 2

Plan effective date: 1/1/82.

Normal retirement benefit:

Before 1993: \$15 per month for each year of service.
After 1992: \$20 per month for each year of service.

Actuarial cost method: Frozen initial liability.

Asset valuation method:

Before 1993: Actuarial value.
After 1992: Market value.

Assumed interest rate:

Before 1993: 7% per year.
After 1992: 8% per year.

Selected valuation results as of 1/1/93 (based on \$15 benefit level):

	7%	8%
Present value of future benefits	\$450,000	\$350,000
Unfunded liability	60,000	
Actuarial value of assets	225,000	225,000
Market value of assets	250,000	250,000
Accrued liability under entry age normal method	270,000	225,000
Ratio of present value of future working lifetime to number of active participants.	11	10

There were no inactive participants as of 1/1/92 and 1/1/93.

Question 2

In what range is the normal cost for 1993 as of 1/1/93?

(A) Less than \$12,000

(B) \$12,000 but less than \$13,000

(C) \$13,000 but less than \$14,000

(D) \$14,000 but less than \$15,000

(E) \$15,000 or more

1993

Data for Question 3

Normal retirement benefit: \$10,000 per year, payable on 1/1.

Form of payment: Upon the death of the retiree, a reduced payment of \$P will be payable on 1/1 of each subsequent year to the surviving spouse.

Assumed interest rate: 7% per year.

Valuation data for participant Smith:

Date of birth	1/1/23
Date of retirement	1/1/88
Spouse's date of birth	1/1/26

If Smith survives to 1/1/94, but Smith's spouse dies in 1993, the experience gain for 1993 due to mortality will be \$11,300.

If Smith dies in 1993, but Smith's spouse survives to 1/1/94, the experience gain for 1993 due to mortality will be \$K.

Selected annuity values:

$\ddot{a}_{67} = 8.287$ $\ddot{a}_{68} = 8.061$ $\ddot{a}_{70} = 7.603$

$\ddot{a}_{71} = 7.368$ $\ddot{a}_{67:70} = 6.056$

Question 3

In what range is \$K?

(A) Less than \$23,000

(B) \$23,000 but less than \$28,000

(C) \$28,000 but less than \$33,000

(D) \$33,000 but less than \$38,000

(E) \$38,000 or more

1993

Data for Question 4

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

Normal retirement age: 65.

Early retirement benefit: Accrued benefit, reduced by 0.5% for each month by which the benefit commencement date precedes the normal retirement date.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest rate: 7% per year.
Preretirement deaths and terminations: None.
Retirement age: 62.

Valuation data for sole participant:

Date of birth	1/1/35
Date of hire	1/1/80
Date of retirement	12/31/92

Selected annuity values:

$\ddot{a}_{58}^{(12)} = 10.22$ $\ddot{a}_{62}^{(12)} = 9.39$ $\ddot{a}_{65}^{(12)} = 8.74$

Question 4

In what range is the experience gain for 1992 due to early retirement?

(A) Less than $1,000

(B) $1,000 but less than $1,025

(C) $1,025 but less than $1,050

(D) $1,050 but less than $1,075

(E) $1,075 or more

1993

Data for Question 5

Plan effective date: 1/1/92.

Normal retirement benefit: \$500 per month.

Actuarial cost method: Entry age normal, where the entry age is the age at hire.

Actuarial assumptions:

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

Data for sole participant:

Date of birth	1/1/52
Date of hire	1/1/82
Status as of 1/1/93	Active

Normal cost for 1992 as of 1/1/92: \$1,500.

Selected commutation functions:

x	D_x	N_x
30	1,262	17,888
40	632	8,453
41	590	

Question 5

In what range is the experience loss for 1992 due to mortality?

(A) Less than \$25

(B) \$25 but less than \$50

(C) \$50 but less than \$75

(D) \$75 but less than \$100

(E) \$100 or more

1993

Data for Question 6

Plan effective date: 1/1/92.

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

Actuarial cost method: Individual level premium.

Actuarial assumptions:

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

Valuation data for sole participant:

Date of birth	1/1/43
Date of hire	1/1/83
1992 compensation for 1/1/92 valuation	$16,000
1993 compensation for 1/1/93 valuation	18,000

Selected annuity value:

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

Question 6

In what range is the normal cost for 1993 as of 1/1/93?

(A) Less than $2,600

(B) $2,600 but less than $2,650

(C) $2,650 but less than $2,700

(D) $2,700 but less than $2,750

(E) $2,750 or more

1993

Data for Question 7

Type of plan:

Before 1993: Contributory.
After 1992: Noncontributory.

Preretirement death or termination benefits: Employee contributions with interest accumulated at 6% per year are returned at the end of the year of death or termination.

Assumed interest rate: 6% per year.

Valuation data for sole participant:

Date of birth	1/1/32
Accumulated employee contributions with interest as of 12/31/92	$15,000

Retirements are assumed to occur at the beginning of the year.

Selected commutation functions:

x	$l_x^{(T)}$	$q_x^{(r)}$
61	1,000	0.0
62	950	0.5
63	465	0.2
64	360	0.2
65	278	1.0

Question 7

In what range is the present value of future preretirement death and termination benefits as of 1/1/93?

(A) Less than $1,200

(B) $1,200 but less than $1,250

(C) $1,250 but less than $1,300

(D) $1,300 but less than $1,350

(E) $1,350 or more

1993

Data for Question 8

Normal retirement benefit:

Before 1993: 40% of final 5-year average compensation.
After 1992: 50% of final 3-year average compensation.

Normal form of payment:

Before 1993: Life annuity.
After 1992: Fully subsidized 100% joint and survivor annuity for married participants. Life annuity for unmarried participants.

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

Actuarial assumptions:

Interest rate: 7% per year.
Compensation increases: 3% per year.
Preretirement deaths and terminations: None.
Retirement age: 65.
Marital characteristics: 80% married; spouse same age as participant.

Valuation data for each of the plan's 100 participants as of 1/1/93:

Date of birth	1/1/53
Date of hire	1/1/80
1993 compensation	$40,000

Selected annuity values:

$\ddot{a}_{65}^{(12)} = 8.736 \qquad \ddot{a}_{\overline{65:65}}^{(12)} = 10.576$

Question 8

In what range is the increase in the accrued liability as of 1/1/93 due to the changes in plan provisions?

(A) Less than $1,550,000

(B) $1,550,000 but less than $1,600,000

(C) $1,600,000 but less than $1,650,000

(D) $1,650,000 but less than $1,700,000

(E) $1,700,000 or more

1993

Data for Question 9

Consider the following actuarially equivalent benefit options available to a 58-year old retiring employee:

I. A monthly benefit of $4,000 for life.

II. A monthly benefit of $3,720 for life. Upon death of the retiree, the surviving spouse will receive a monthly benefit of $1,860 for life.

III. A monthly benefit for life of $4,000 to age 62 and $3,500 thereafter. Upon death of the retiree at any time, the surviving spouse will receive a monthly benefit of $K for life.

Selected factor:

$$N^{(12)}_{62} / N^{(12)}_{58} = .6867$$

Question 9

In what range is $K?

(A) Less than $2,000

(B) $2,000 but less than $2,400

(C) $2,400 but less than $2,800

(D) $2,800 but less than $3,200

(E) $3,200 or more

1993

Data for Question 10

Plan effective date: 1/1/90.

Normal retirement benefit:

Effective 1/1/90: \$15 per month for each year of service.
Effective 1/1/93: \$30 per month for each year of service.

Actuarial cost method: Entry age normal.

Assumed preretirement terminations other than deaths: None.

Valuation data for sole participant:

Date of birth	1/1/55
Date of hire	1/1/90
Status as of 1/1/93	Active

Normal cost for 1990 as of 1/1/90: \$2,000.

Selected commutation functions:

x	D_x
35	894
36	835
37	779
38	727

Question 10

In what range is the accrued liability as of 1/1/93?

(A) Less than \$11,000

(B) \$11,000 but less than \$13,000

(C) \$13,000 but less than \$15,000

(D) \$15,000 but less than \$17,000

(E) \$17,000 or more

1993

Data for Question 11

Type of plan: Contributory.

Employee contributions: 1.5% of annual compensation.

Actuarial cost method: Aggregate.

Employee contributions are assumed to be paid on 1/1 of each year.

Selected valuation results as of 1/1/93:

Present value of future benefits:	
Retirement benefits	$2,000,000
Refunds of employee contributions upon death or termination	70,000
Other death and termination benefits	200,000
Value of total assets	500,000
Accumulated employee contributions included in total assets	80,000
Present value of future compensation	7,000,000
Annual compensation	1,000,000

Question 11

In what range is the employer's normal cost for 1993 as of 1/1/93?

(A) Less than $220,000

(B) $220,000 but less than $230,000

(C) $230,000 but less than $240,000

(D) $240,000 but less than $250,000

(E) $250,000 or more

1993

Data for Question 12

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

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

Early retirement benefit: Accrued benefit, reduced by 6% for each year by which the benefit commencement date precedes the normal retirement date.

Actuarial cost method: Unit credit.

Actuarial assumptions:

Interest rate: 7% per year.
Preretirement deaths and terminations: None.
Probability of retirement:

x	$q_x^{(r)}$
64	0.20
65	0.50
66	1.00

Retirements are assumed to occur at the beginning of the year.

Valuation data for sole participant:

Date of birth	1/1/33
Date of hire	1/1/73
Status as of 1/1/93	Active

Selected annuity values:

x	$\ddot{a}_x^{(12)}$
64	10.0
65	9.8
66	9.6

Question 12

In what range is the accrued liability as of 1/1/93?

(A) Less than $24,500

(B) $24,500 but less than $25,000

(C) $25,000 but less than $25,500

(D) $25,500 but less than $26,000

(E) $26,000 or more

1993

Data for Question 13

Normal retirement benefit: 100% of final year's compensation.

Actuarial cost method: Entry age normal (level dollar), where the entry age is the age at hire.

Actuarial assumptions:

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

Valuation data for sole participant:

Date of birth	1/1/48
Date of hire	1/1/78
Date of participation	1/1/88
1992 compensation for 1/1/92 valuation	$60,000
1993 compensation for 1/1/93 valuation	66,000

Selected annuity value:

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

Question 13

In what range is the experience loss for 1992 due to the change in compensation?

(A) Less than $7,500

(B) $7,500 but less than $9,500

(C) $9,500 but less than $11,500

(D) $11,500 but less than $13,500

(E) $13,500 or more

1993

Data for Question 14

Plan effective date: 1/1/91.

Normal retirement benefit: 50% of final 5-year average compensation.

Actuarial cost method: Individual level premium.

Actuarial assumptions:

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

Valuation data for sole participant:

Date of birth	1/1/40
Date of hire	1/1/91
1991 compensation for 1/1/91 valuation	\$100,000
1992 compensation for 1/1/92 valuation	92,000

Selected annuity value:

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

Question 14

In what range is the accrued liability as of 1/1/93?

(A) Less than \$37,700

(B) \$37,700 but less than \$38,100

(C) \$38,100 but less than \$38,500

(D) \$38,500 but less than \$38,900

(E) \$38,900 or more

1993

Data for Question 15

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

Actuarial cost method: Frozen initial liability.

Actuarial assumptions:

Interest rate: 7% per year.
Compensation increases: 4% per year.
Preretirement deaths and terminations: None.
Retirement age: 65.

As of 1/1/92, all participants are active and under age 63.

Selected valuation results as of 1/1/92:

Present value of future benefits	$1,200,000
Value of assets	500,000
Present value of future compensation	9,500,000

Contribution for 1992: $60,000 paid on 1/1/92.

There were no deaths, terminations, or retirements during 1992, and there are no new participants on 1/1/93.

There were no investment experience gains or losses for 1992, and there was a 10% increase in compensation for all participants from 1992 to 1993.

Selected valuation results as of 1/1/93:

Unfunded liability	$400,000
1993 compensation	750,000

Question 15

In what range is the normal cost for 1993 as of 1/1/93?

(A) Less than $26,100

(B) $26,100 but less than $27,100

(C) $27,100 but less than $28,100

(D) $28,100 but less than $29,100

(E) $29,100 or more

1993

Data for Question 16

Plan effective date: 1/1/80.

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

Vesting eligibility: 100% after one year of service.

Actuarial cost method: Individual entry age normal.

Actuarial assumptions:

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

Valuation data for participant Smith:

Date of birth	1/1/40
Date of hire	1/1/88
Date of termination	12/31/92

Selected annuity value:

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

Question 16

In what range is the experience gain or loss for 1992 due to Smith's termination?

(A) Gain of $3,000 or more

(B) Gain of $1,000 but less than $3,000

(C) Gain or loss of less than $1,000

(D) Loss of $1,000 but less than $3,000

(E) Loss of $3,000 or more

1993

Data for Question 17

Normal retirement benefit: $900 per month.

Preretirement death benefit: None.

Actuarial cost method: Attained age normal.

Actuarial assumptions:

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

Valuation data for sole participant:

Date of birth	1/1/48
Date of hire	1/1/83

Normal cost for 1993 as of 1/1/93: $1,231.

Value of assets as of 1/1/93: $10,000.

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 10.0$$

Question 17

In what range is the unfunded liability as of 1/1/93?

(A) Less than $2,000

(B) $2,000 but less than $4,000

(C) $4,000 but less than $6,000

(D) $6,000 but less than $8,000

(E) $8,000 or more

1993

Data for Question 18

Actuarial cost method: Unit credit.

Assumed preretirement deaths and terminations:

Before 1993: None.
After 1992: Mortality only.

Assumed retirement age: 65.

Date of birth for sole participant (active as of 1/1/93): 1/1/40.

Accrued liability (before change in assumptions) as of 1/1/93: $20,000.

Selected values:

x	l_x
53	8,980,994
65	7,673,269

Question 18

In what range is the decrease in the accrued liability as of 1/1/93 due to the change in actuarial assumptions?

(A) Less than $1,000

(B) $1,000 but less than $1,500

(C) $1,500 but less than $2,000

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

(E) $2,500 or more

1993

Data for Question 19

Valuation date: 12/31/92.

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

Actuarial cost method: Individual aggregate.

Actuarial assumptions:

Interest rate: 7% per year.
Compensation increases: 3% per year.
Preretirement deaths and terminations: None.
Retirement age: 65.

Valuation data for participant Smith:

Date of birth	1/1/40
1992 compensation	$50,000
Allocated assets as of 12/31/92	10,000

Selected annuity value:

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

Question 19

In what range is Smith's normal cost for 1992 as of 12/31/92?

(A) Less than $12,500

(B) $12,500 but less than $13,000

(C) $13,000 but less than $13,500

(D) $13,500 but less than $14,000

(E) $14,000 or more

1993

Data for Question 20

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

Actuarial cost method:

Before 1993: Aggregate.
After 1992: Unit credit.

Actuarial assumptions:

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

Valuation data for sole participant:

Date of birth	1/1/42
Date of hire	1/1/87

Selected valuation results as of 1/1/92:

Normal cost as of 1/1	$ 898
Value of assets	1,000

Contribution for 1992: Normal cost for 1992 as of 1/1/92; paid on 1/1/92.

There were no noninvestment experience gains or losses for 1992.

Actual rate of investment return in 1992: 5%.

Question 20

In what range is the unfunded accrued liability as of 1/1/93?

(A) Less than $700

(B) $700 but less than $800

(C) $800 but less than $900

(D) $900 but less than $1,000

(E) $1,000 or more

ANSWER KEY

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1.	C
2.	E
3.	D
4.	B
5.	B
6.	C
7.	B
8.	B
9.	B
10.	C
11.	C
12.	A
13.	D
14.	C
15.	B
16.	B
17.	B
18.	E
19.	A
20.	E