

SOCIETY OF ACTUARIES
AMERICAN SOCIETY OF PENSION ACTUARIES
JOINT BOARD FOR THE ENROLLMENT OF ACTUARIES

COURSE P-36OU (EA1) SEGMENT B
JOINT BOARD BASIC EXAMINATION

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the public by the administering organizations.

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EA-1B

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1996

**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) The actuarial cost method and actuarial assumptions have not 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.

1996

Data for Question 1

Normal retirement benefit: 2% of final 3-year average compensation for each year of service up to 25 years.

Early retirement eligibility: Age 62.

Early retirement benefit: Accrued benefit, reduced by 3% for each year by which the benefit commencement date precedes the normal retirement date.

Actuarial cost method: Projected unit credit (based upon actual accrual percentages as of the valuation date).

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 4% per year.

Preretirement decrements: None.

Probability of retirement (assumed to occur at beginning of the year):

At age 62 20%

At age 63 0%

At age 64 0%

At age 65 100%

Valuation data for sole participant:

Date of birth 1/1/46

Date of hire 1/1/84

1996 valuation compensation \$50,000

Selected annuity values:

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

Question 1

In what range is the accrued liability as of 1/1/96?

- (A) Less than \$60,000
- (B) \$60,000 but less than \$62,500
- (C) \$62,500 but less than \$65,000
- (D) \$65,000 but less than \$67,500
- (E) \$67,500 or more

1996

Data for Question 2

Normal retirement benefit:

Before 1996: 60% of final 5-year average compensation.

After 1995: 70% of final 5-year average compensation.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 4% per year.

Preretirement decrements: None.

Retirement age: 65.

Selected valuation results as of 1/1/95:

Present value of future benefits	\$1,500,000
Value of assets	300,000
Normal cost as of 1/1	96,000

As of 1/1/95, all participants were active and under age 55.

There were no deaths, terminations, retirements, or new participants during 1995, and there are no new participants as of 1/1/96.

For each participant, 1996 valuation compensation is 6% higher than 1995 valuation compensation.

Normal cost for 1996 as of 1/1/96: \$122,650.

Question 2

In what range is the value of assets as of 1/1/96?

- (A) Less than \$200,000
- (B) \$200,000 but less than \$300,000
- (C) \$300,000 but less than \$400,000
- (D) \$400,000 but less than \$500,000
- (E) \$500,000 or more

1996

Data for Question 3

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

Eligibility for early retirement: Age 55.

Early retirement benefit: Accrued benefit, reduced for commencement of payments before age 65.

Early retirement adjustment factor at age 55: 0.412.

Actuarial cost method: Individual entry age normal.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement decrements: None.

Retirement age: 65.

Valuation data for participant Smith (active as of 1/1/95):

Date of birth	1/1/41
Date of hire	1/1/70
Date of retirement	12/31/95
Date of benefit commencement	1/1/96

Selected annuity values:

$$\ddot{a}_{55}^{(12)} = 10.78 \quad \ddot{a}_{65}^{(12)} = 8.74$$

Question 3

In what range is the decrease in the accrued liability as of 1/1/96 due to Smith's retirement?

- (A) Less than \$9,000
- (B) \$9,000 but less than \$18,000
- (C) \$18,000 but less than \$27,000
- (D) \$27,000 but less than \$36,000
- (E) \$36,000 or more

1996

Data for Question 4

Benefit: \$20 per month for each year of service.

Actuarial cost method:

Before 1996: Aggregate.

After 1995: Individual aggregate with assets allocated in proportion to the entry age normal accrued liability.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement decrements: None.

Retirement age: 65.

Value of assets as of 1/1/96: \$20,000.

Valuation data for all participants (both active as of 1/1/96):

	<u>Smith</u>	<u>Brown</u>
Date of birth	1/1/56	1/1/41
Date of hire	1/1/91	1/1/81

Selected annuity value:

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

Question 4

In what range is the normal cost for 1996 for Brown as of 1/1/96?

- (A) Less than \$1,500
- (B) \$1,500 but less than \$1,700
- (C) \$1,700 but less than \$1,900
- (D) \$1,900 but less than \$2,100
- (E) \$2,100 or more

1996

Data for Question 5

Plan effective date: 1/1/87.

Normal retirement benefit:

Effective 1/1/87: \$15 per month for each year of service.

Effective 1/1/96: \$18 per month for each year of service.

Actuarial cost method: Individual level premium.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement decrements: None.

Retirement age: 65.

Valuation data for sole participant (active as of 1/1/96):

Date of birth 1/1/57

Date of hire 1/1/82

Value of assets as of 1/1/96: \$5,000.

Selected annuity value:

$$12\ddot{a}_{65}^{(12)} = 104.83$$

Question 5

In what range is the normal cost for 1996 as of 1/1/96?

- (A) Less than \$500
- (B) \$500 but less than \$550
- (C) \$550 but less than \$600
- (D) \$600 but less than \$650
- (E) \$650 or more

1996

Data for Question 6

Plan effective date: 1/1/96.

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

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement decrements: None.

Retirement age: 65.

Valuation data for sole participant (active as of 1/1/96):

Date of birth 1/1/51

Date of hire 1/1/86

Selected annuity value:

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

Question 6

In what range is the absolute value of the difference in the unfunded liability as of 1/1/96 under the attained age normal cost method and the entry age normal cost method?

- (A) Less than \$1,600
- (B) \$1,600 but less than \$1,700
- (C) \$1,700 but less than \$1,800
- (D) \$1,800 but less than \$1,900
- (E) \$1,900 or more

1996

Data for Question 7

Normal retirement benefit: \$50 per month for each year of service.

Normal form of payment: Life annuity with 120 months certain.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement decrements: None.

Retirement age: 65.

Value of assets as of 1/1/96: \$110,000.

Valuation data for all participants as of 1/1/96:

	<u>Smith</u>	<u>Brown</u>
Date of birth	1/1/29	1/1/51
Date of hire	1/1/74	1/1/86
Status	Retired on 1/1/94	Active

Selected commutation functions:

<u>x</u>	<u>D_x</u>	<u>$N_x^{(12)}$</u>
65	94,414	824,780
67	78,601	651,367
75	33,855	217,236
77	25,541	153,955

After preparing the 1/1/96 valuation, the actuary was informed that Smith died on 12/15/95. The actuary prepared a revised 1/1/96 valuation based upon this information.

Question 7

In what range is the difference in the normal cost for 1996 as of 1/1/96 under the two valuations?

- (A) Less than \$2,450
- (B) \$2,450 but less than \$2,600
- (C) \$2,600 but less than \$2,750
- (D) \$2,750 but less than \$2,900
- (E) \$2,900 or more

Data for Question 8

Age of retiree and spouse at date of retirement: 60.

Actuarially-equivalent annuity options available to retiree and spouse:

Option A: Monthly benefit of $(\$1,000 + \$X)$ for first 5 years of lifetime of retiree, and monthly benefit of $\$X$ for remaining lifetime of retiree.

Option B: Monthly benefit of $\$1,000$ for joint lifetime of retiree and spouse, and monthly benefit of $(\$1,000 - \$X)$ for remaining lifetime of survivor after the first death.

Selected commutation functions and annuity values:

$$D_{60} = 144,405 \quad \ddot{a}_{60}^{(12)} = 9.815 \quad \ddot{a}_{60:60}^{(12)} = 8.094$$

$$D_{65} = 94,414 \quad \ddot{a}_{65}^{(12)} = 8.736$$

Question 8

In what range is $\$X$?

- (A) Less than \$500
- (B) \$500 but less than \$600
- (C) \$600 but less than \$700
- (D) \$700 but less than \$800
- (E) \$800 or more

1996

Data for Question 9

Assumed interest rate: 7% per year.

Valuation data for all retired participants as of 1/1/95:

	<u>Smith</u>	<u>Brown</u>	<u>Green</u>
Date of birth	1/1/35	1/1/30	1/1/25
Monthly benefit (life annuity)	\$4,000	\$5,000	\$6,000

Brown died on 12/31/95. There were no other deaths or new retired participants during 1995.

Selected annuity values:

<u>x</u>	<u>$\ddot{a}_x^{(12)}$</u>
60	9.81
61	9.60
65	8.74
66	8.51
70	7.60
71	7.37

Question 9

In what range is the experience gain during 1995 due to mortality for retired participants?

- (A) Less than \$470,000
- (B) \$470,000 but less than \$475,000
- (C) \$475,000 but less than \$480,000
- (D) \$480,000 but less than \$485,000
- (E) \$485,000 or more

1996

Data for Question 10

Normal retirement benefit: \$20 per month for each year of service up to 25 years.

Actuarial cost method:

Before 1996: Entry age normal.
After 1995: Unit credit.

Actuarial assumptions:

Interest rate: 7% per year.
Preretirement decrements: None.
Retirement age: 65.

Valuation data for sole participant (active as of 1/1/96):

Date of birth 1/1/36
Date of hire 1/1/56

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 9.24$$

Question 10

In what range is the absolute value of the change in the normal cost for 1996 as of 1/1/96 due to the change in the actuarial cost method?

- (A) Less than \$500
- (B) \$500 but less than \$1,000
- (C) \$1,000 but less than \$1,500
- (D) \$1,500 but less than \$2,000
- (E) \$2,000 or more

1996

Data for Question 11

Plan effective date: 1/1/95.

Normal retirement benefit: \$50 per month for each year of service.

Actuarial cost method: Frozen initial liability.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement decrements: None.

Retirement age: 65.

Valuation data for sole participant (active as of 1/1/96):

Date of birth 1/1/46

Date of hire 1/1/66

Contribution for 1995: \$5,000 paid on 1/1/95.

Value of assets as of 1/1/96: \$6,000.

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 9.24$$

Question 11

In what range is the unfunded liability as of 1/1/96?

- (A) Less than \$76,000
- (B) \$76,000 but less than \$77,000
- (C) \$77,000 but less than \$78,000
- (D) \$78,000 but less than \$79,000
- (E) \$79,000 or more

1996

Data for Question 12

Normal retirement benefit: $2/12\%$ of final 3-year average compensation for each month of service up to 120 months plus $1/12\%$ of final 3-year average compensation for each additional month of service.

Actuarial cost method: Projected unit credit (based upon actual accrual percentages as of the valuation date).

Actuarial assumptions:

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

Valuation data for sole participant:

Date of birth	1/1/43
Date of hire	10/1/86
1996 valuation compensation	\$50,000

Selected annuity value:

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

Question 12

In what range is the normal cost for 1996 as of 1/1/96?

- (A) Less than \$4,000
- (B) \$4,000 but less than \$4,500
- (C) \$4,500 but less than \$5,000
- (D) \$5,000 but less than \$5,500
- (E) \$5,500 or more

1996

Data for Question 13

Plan effective date: 1/1/96.

Normal retirement benefit: \$1,000 per month.

Preretirement death benefit: \$100,000, payable at end of year of death.

Actuarial cost method:

Method A: Individual level premium for all benefits other than death benefits, plus one year term cost for death benefit.

Method B: Aggregate for all benefits other than death benefits and benefits provided by cash value, plus insurance premium (split funded).

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement decrements other than deaths: None.

Retirement age: 65.

Date of birth for sole participant (active as of 1/1/96): 1/1/56.

Provisions of life insurance policy (purchased on 1/1/96):

Level annual premium \$ 1,585

Projected cash value as of 1/1/2021 41,900

Selected commutation functions and annuity values:

x	D_x	M_x	N_x	$\ddot{a}_x^{(12)}$
40	632,275	79,292	8,452,729	12.91
41	589,655	78,036	7,820,454	12.80
65	94,414	37,625	868,052	8.74

Question 13

In what range is the absolute value of the difference in the normal cost for 1996 as of 1/1/96 between Method A and Method B?

- (A) Less than \$750
- (B) \$750 but less than \$825
- (C) \$825 but less than \$900
- (D) \$900 but less than \$975
- (E) \$975 or more

1996

Data for Question 14

Vesting eligibility: 0% if less than 5 years of service; 100% if 5 or more years of service.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest rate: 8% per year.

Compensation increases: None.

Preretirement decrements other than withdrawals: None.

Selected withdrawal rates:

<u>x</u>	<u>$q_x^{(w)}$</u>
35	.5
36	.4
37	.3
38	.2
39	.1
40 and over	0

Retirement age: 65.

Valuation data for sole participant Smith (active as of 1/1/96):

Entry age	35
Attained age	38

Normal cost for Smith for 1996 as of 1/1/96: \$10,000.

Question 14

In what range is the accrued liability as of 1/1/96?

- (A) Less than \$30,000
- (B) \$30,000 but less than \$50,000
- (C) \$50,000 but less than \$70,000
- (D) \$70,000 but less than \$90,000
- (E) \$90,000 or more

1996

Data for Question 15

Assumed interest rate: 7% per year.

Data as of 1/1/96 for a retiree:

Age of retiree: x .

Age of spouse: y .

Annual benefit: \$10,000 payable each 1/1.

Form of payment: Life annuity for the retiree, with 50% continuing for the life of the spouse if the retiree dies first.

Selected annuity values:

$$\begin{array}{lll} \ddot{a}_x = 8.157 & \ddot{a}_y = 10.301 & \ddot{a}_{xy} = 7.281 \\ \ddot{a}_{x+1} = 7.915 & \ddot{a}_{y+1} = 10.059 & \end{array}$$

Question 15

In what range is the experience loss during 1996 due to mortality if both the retiree and the spouse are still alive as of 12/31/96?

- (A) Less than \$1,350
- (B) \$1,350 but less than \$1,425
- (C) \$1,425 but less than \$1,500
- (D) \$1,500 but less than \$1,575
- (E) \$1,575 or more

1996

Data for Question 16

Normal retirement benefit:

Before 1996: 1.25% of final 5-year average compensation for each year of service.
After 1995: 1.75% of final 3-year average compensation for each year of service.

Actuarial cost method: Entry age normal (level percentage of compensation).

Actuarial assumptions:

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

Valuation data for sole participant Smith (active as of 1/1/96):

Date of birth 1/1/50
Date of hire 1/1/88

Normal cost for Smith for 1988 as of 1/1/88: \$6,500.

Question 16

In what range is the increase in the accrued liability for Smith as of 1/1/96 due to the plan amendment?

- (A) Less than \$34,000
- (B) \$34,000 but less than \$36,000
- (C) \$36,000 but less than \$38,000
- (D) \$38,000 but less than \$40,000
- (E) \$40,000 or more

1996

Data for Question 17

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

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 6% per year.

Compensation increases: 5% per year.

Preretirement decrements other than deaths: None.

Retirement age: 65.

Value of assets as of 1/1/96: \$60,000.

Valuation data for all participants as of 1/1/96:

	<u>Smith</u>	<u>Brown</u>	<u>Green</u>
Status	Active	Terminated Vested	Retired
Age at hire	25	-	-
Attained age	35	50	65
1996 valuation compensation	\$48,000	-	-
Monthly accrued benefit	\$375	\$200	\$300

Selected commutation functions and annuity values:

<u>x</u>	$\frac{{}^3N_x - {}^3N_{65}}{{}^3D_x}$	$\frac{v^{65-x}}{i} \ddot{a}_x^{(12)}$
25	16.7	0.4
30	14.3	0.7
35	12.5	1.0
50	11.1	4.0
65	0.0	10.0

Question 17

In what range is the normal cost for 1996 as of 1/1/96?

- (A) Less than \$5,000
- (B) \$5,000 but less than \$5,200
- (C) \$5,200 but less than \$5,400
- (D) \$5,400 but less than \$5,600
- (E) \$5,600 or more

1996

Data for Question 18

Normal retirement benefit: 2% of final 3-year average compensation for each year of service.

Termination benefit: Accrued benefit payable at normal retirement date.

Vesting: Full and immediate.

Actuarial cost method: Projected unit credit.

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 4% per year.

Preretirement decrements other than withdrawals: None.

Probability of withdrawal (assumed to occur at beginning of year):

1/1/95 valuation: 40% at age 50
25% at age 55
20% at age 60
0% at all other ages

1/1/96 valuation: 50% at age 50
20% at age 55
0% at all other ages

Retirement age: 65.

As of 1/1/96, all participants were active and under age 45.

Question 18

In what range is the ratio of the accrued liability as of 1/1/96 under the revised withdrawal assumptions to the accrued liability as of 1/1/96 under the original withdrawal assumptions?

- (A) Less than 0.990
- (B) 0.990 but less than 1.000
- (C) 1.000 but less than 1.010
- (D) 1.010 but less than 1.020
- (E) 1.020 or more

1996

Data for Question 19

Type of plan: Contributory.

Normal retirement benefit: \$50 per month for each year of service.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement decrements: None.

Retirement age: 65.

As of 1/1/95, all participants were active and under age 63.

Selected valuation results:

	<u>1/1/95</u>	<u>1/1/96</u>
Employer's normal cost as of 1/1	\$ 7,200	
Present value of future benefits	100,000	
Present value of all future employee contributions	25,000	\$ 24,500
Value of plan assets	10,000	22,000

There were no deaths, terminations, retirements, or new participants during 1995, and there are no new participants as of 1/1/96.

Question 19

In what range is the employer's normal cost for 1996 as of 1/1/96?

- (A) Less than \$7,000
- (B) \$7,000 but less than \$7,200
- (C) \$7,200 but less than \$7,400
- (D) \$7,400 but less than \$7,600
- (E) \$7,600 or more

1996

Data for Question 20

Normal retirement benefit: 60% of final 3-year average compensation.

Actuarial cost method: Entry age normal (level percentage of compensation).

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 5% per year.

Preretirement decrements: None.

Retirement age: 65.

Valuation data for sole participant:

Date of birth	1/1/50
Date of hire	1/1/80
1995 valuation compensation for 1/1/95 valuation	\$50,000
1996 valuation compensation for 1/1/96 valuation	50,000

Selected annuity value:

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

Question 20

In what range is the experience gain in 1995 due to a compensation increase other than assumed?

- (A) Less than \$4,000
- (B) \$4,000 but less than \$4,700
- (C) \$4,700 but less than \$5,400
- (D) \$5,400 but less than \$6,100
- (E) \$6,100 or more

ANSWER KEY

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

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

11. C
12. D
13. C
14. E
15. E

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