

**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 1989 examination which has been released to
the public by the administering organizations.**

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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) 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 or voluntary 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 benefit 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.

General Conditions Regarding Funding

- (11) Any actuarial valuation encompasses not only all active employees but also retired employees, beneficiaries, and former employees entitled to vested deferred pensions.
- (12) 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.
- (13) Where the normal cost under an actuarial cost method may be computed as either a level percentage of pay or a level dollar amount, the level percentage approach is used if the plan benefits are based on pay, and the level dollar approach is used if they are not.
- (14) Under the frozen initial liability method, whenever there is a change in either the 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.
- (15) Neither the actuarial cost method nor the actuarial assumptions have been changed since the plan effective date.
- (16) 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.

1989

Data for Question 1

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

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest rate: 6%.

Compensation increases: 4% per year.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole participant:

Date of birth 1/1/59

Date of hire 1/1/84

1989 compensation \$10,000

Selected commutation functions and annuity value:

<u>x</u>	<u>D_x</u>	<u>N_x</u>	<u>⁶D_x</u>	<u>⁶N_x</u>
25	22,499	366,760	59,979	1,920,504
30	16,721	266,509	54,233	1,632,341
65	1,738	17,040	22,244	296,192

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

Question 1

In what range is the normal cost for 1989 as of 1/1/89?

- (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

1989

Data for Question 2

Normal retirement benefit:

Before 1989: \$10 per month for each year of service.

After 1988: \$15 per month for each year of service.

Actuarial cost method: Attained age normal.

Actuarial assumptions:

Interest rate: 6%.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Participant data as of 1/1/89:

	<u>Smith</u>	<u>Brown</u>	<u>Green</u>
Date of birth	1/1/59	1/1/49	1/1/39
Date of hire	1/1/89	1/1/79	1/1/69

Selected commutation functions and annuity value:

<u>x</u>	<u>D_x</u>	<u>N_x</u>
30	16,721	266,509
40	9,205	136,705
50	4,968	65,680
65	1,738	17,040

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

Question 2

In what range is the increase in the unfunded liability as of 1/1/89 due to the change in the normal retirement benefit?

- (A) Less than \$5,000
- (B) \$5,000 but less than \$6,000
- (C) \$6,000 but less than \$7,000
- (D) \$7,000 but less than \$8,000
- (E) \$8,000 or more

1989

Data for Question 3

Normal retirement benefit: \$600 per month for life, with \$300 per month continuing to the participant's surviving spouse for life.

Preretirement death benefit: None.

Actuarial assumptions:

Interest rate: 6%.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole participant:

Date of birth 1/1/29

Spouse's date of birth 1/1/24

Selected probability and annuity values (based on a unisex mortality table and 6% interest):

$${}_{10}P_{60} = 0.80$$

$${}_{12}\ddot{a}_{60}^{(12)} = 127$$

$${}_{12}\ddot{a}_{60:65}^{(12)} = 94$$

$${}_5P_{65} = 0.87$$

$${}_{12}\ddot{a}_{65}^{(12)} = 112$$

$${}_{12}\ddot{a}_{65:70}^{(12)} = 79$$

$${}_{12}\ddot{a}_{70}^{(12)} = 97$$

Question 3

In what range is the present value of the normal retirement benefit as of 1/1/89?

- (A) Less than \$49,500
- (B) \$49,500 but less than \$52,000
- (C) \$52,000 but less than \$54,500
- (D) \$54,500 but less than \$57,000
- (E) \$57,000 or more

1989

Data for Question 4

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

Preretirement death benefit: None.

Actuarial cost method: Projected unit credit.

Actuarial assumptions:

Interest rate: 6%.

Compensation increases: 5% per year.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/44
Date of hire	1/1/69
1988 compensation	\$100,000

After the valuation was done, it was discovered that the assumed mortality rate at age 45 had been incorrectly coded as follows:

	<u>Original Value</u>	<u>Correct Value</u>
q_{45}	.034	.0034

Another valuation was performed to correct this error.

Original accrued liability as of 1/1/89: \$300,000.

Question 4

In what range is the correct accrued liability as of 1/1/89?

- (A) Less than \$275,000
- (B) \$275,000 but less than \$295,000
- (C) \$295,000 but less than \$315,000
- (D) \$315,000 but less than \$335,000
- (E) \$335,000 or more

1989

Data for Question 5

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 6%.

Compensation increases: 5% per year.

Preretirement deaths and terminations: None.

Retirement age: 65.

Valuation results as of 1/1/89:

Normal cost as of 1/1	\$ 31,250
Present value of future benefits	
Active participants	900,000
Inactive participants	100,000
Actuarial value of assets	500,000
Annual compensation	1,000,000

Contribution for 1989: \$31,250 paid on 1/1/89.

During 1989, there were no new entrants to the plan.

There were no experience gains or losses during 1989 other than an experience gain of \$30,000 due to the deaths of three retired participants.

Question 5

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

- (A) Less than \$30,000
- (B) \$30,000 but less than \$31,000
- (C) \$31,000 but less than \$32,000
- (D) \$32,000 but less than \$33,000
- (E) \$33,000 or more

1989

Data for Question 6

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

Early retirement benefit: Accrued benefit reduced by 2% for each year by which commencement of payments precedes age 65.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest rate: 6%.

Preretirement deaths and terminations: None.

Retirement age: 60.

Data for participant Smith:

Date of birth	1/1/30
Date of hire	1/1/68
Date of retirement	12/31/88

Selected commutation functions:

x	D_x	$N_x^{(12)}$
59	275	3,019
60	260	2,751
65	180	1,658

Question 6

In what range is the absolute value of the experience gain or loss for 1988 as of 1/1/89 due to Smith's early retirement?

- (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

1989

Data for Question 7

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%.

Compensation increases: 5% per year.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for sole participant:

Date of birth 1/1/34

Date of hire 1/1/69

1988 compensation \$30,000

Selected annuity value:

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

Question 7

In what range is the accrued liability as of 1/1/89?

- (A) Less than \$50,000
- (B) \$50,000 but less than \$55,000
- (C) \$55,000 but less than \$60,000
- (D) \$60,000 but less than \$65,000
- (E) \$65,000 or more

1989

Data for Question 8

Normal retirement benefit:

Before 1989: \$50 per month for each year of service.

After 1988: \$54 per month for each year of service, applicable to active and inactive participants.

Actuarial cost method: Attained age normal with frozen initial liability.

Actuarial assumptions:

Interest rate: 6%.

Preretirement deaths and terminations: None.

Retirement age: 65.

Selected valuation results:

	<u>1/1/88</u>	<u>1/1/89</u> <u>(\$50 benefit)</u>
Present value of future benefits		
Active participants	\$ 840,000	\$ 550,000
Inactive participants	250,000	570,000
Unfunded liability	300,000	
Actuarial value of assets	250,000	345,000
Present value of future compensation	2,340,000	2,090,000
Annual compensation	360,000	220,000
Entry age accrued liability for actives	690,000	410,000
Unit credit accrued liability for actives	600,000	320,000
Present value of years of future service	100	96
Number of actives (all under age 64)	10	8

Contribution for 1988: \$88,000 paid on 12/31/88.

Question 8

In what range is the normal cost for 1989 as of 1/1/89?

- (A) Less than \$38,000
- (B) \$38,000 but less than \$40,000
- (C) \$40,000 but less than \$42,000
- (D) \$42,000 but less than \$44,000
- (E) \$44,000 or more

1989

Data for Question 9

Plan effective date: 1/1/88.

Normal retirement benefit: 40% of highest 3-year average compensation.

Actuarial cost method: Individual level premium.

Actuarial assumptions:

Interest rate: 6%.

Compensation increases: None.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/45
Date of hire	1/1/88
Rate of compensation for 1988	\$200,000
Rate of compensation for 1989	\$170,000

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 9.35$$

Question 9

In what range is the normal cost for 1989 as of 1/1/89?

- (A) Less than \$14,100
- (B) \$14,100 but less than \$14,600
- (C) \$14,600 but less than \$15,100
- (D) \$15,100 but less than \$15,600
- (E) \$15,600 or more

1989

Data for Question 10

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

Preretirement death benefit: None.

Actuarial cost method: Individual entry age normal.

Actuarial assumptions:

Interest rate: 6%.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Participant data as of 1/1/88:

	<u>Smith</u>	<u>Brown</u>	<u>Green</u>
Date of birth	1/1/58	1/1/38	1/1/28
Date of hire	1/1/83	1/1/68	1/1/78

Green died during 1988. Smith and Brown are still active participants as of 1/1/89.

Selected commutation functions and annuity value:

<u>x</u>	<u>D_x</u>	<u>N_x</u>	$\ddot{a}_{65}^{(12)} = 9.35$
25	2,303	37,539	
30	1,711	27,278	
31	1,613	25,567	
50	509	6,723	
51	477	6,214	
60	260	2,870	
61	241	2,610	
65	178	1,745	

Question 10

In what range is the experience gain for 1988 as of 1/1/89 due to Green's death?

- (A) Less than \$19,900
- (B) \$19,900 but less than \$20,100
- (C) \$20,100 but less than \$20,300
- (D) \$20,300 but less than \$20,500
- (E) \$20,500 or more

1999

Data for Question 11

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

Early retirement benefit: Accrued benefit reduced by 1/15 for each year by which commencement of payments precedes age 65.

Actuarial cost method: Unit credit.

Actuarial assumptions:

Interest rate: 6%.

Preretirement deaths and terminations: None.

Retirement:

Before 1989: 100% retire at age 65.

After 1988: 40% retire at age 62; remainder retire at age 65.

Data for sole participant:

Date of birth 1/1/27

Date of hire 1/1/79

Selected annuity values:

$$\ddot{a}_{62}^{(12)} = 10.10 \quad \ddot{a}_{65}^{(12)} = 9.35$$

Question 11

In what range is the increase in the accrued liability as of 1/1/89 due to the change in the assumed retirement age?

- (A) Less than \$2,000
- (B) \$2,000 but less than \$5,000
- (C) \$5,000 but less than \$8,000
- (D) \$8,000 but less than \$11,000
- (E) \$11,000 or more

1989

Data for Question 12

Normal retirement benefit: 25% of final year's compensation.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest rate: 6%.

Compensation increases: 3% per year.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for sole participant:

Date of birth 1/1/39

Date of hire 1/1/72

Present value of future benefits as of 1/1/89: \$110,000.

Question 12

In what range is the accrued liability as of 1/1/89?

- (A) Less than \$65,000
- (B) \$65,000 but less than \$75,000
- (C) \$75,000 but less than \$85,000
- (D) \$85,000 but less than \$95,000
- (E) \$95,000 or more

1989

Data for Question 13

Plan effective date: 1/1/88.

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

Actuarial cost method: Individual level premium.

Actuarial assumptions:

Interest rate:

Before 1989: 8%.

After 1988: 6%.

Compensation increases: None.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/53
Date of participation	1/1/88
Rate of compensation for 1988	\$24,000
Rate of compensation for 1989	\$28,800

Selected values for $\ddot{a}_{65}^{(12)}$:

Before 1989: 8.1958

After 1988: 9.3452

Question 13

In what range is the increase in the accrued liability as of 1/1/89 due to the change in the actuarial assumptions?

- (A) Less than \$560
- (B) \$560 but less than \$615
- (C) \$615 but less than \$670
- (D) \$670 but less than \$725
- (E) \$725 or more

1989

Data for Question 14

Plan effective date: 1/1/89.

Actuarial cost method: Individual aggregate with side fund.

Actuarial assumptions:

Interest rate: 6%.

Compensation increases: None.

Preretirement deaths and terminations: None.

Retirement age: 65.

Preretirement death benefit: 100 times the monthly projected retirement benefit;
provided by a whole life insurance policy.

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

	<u>Smith</u>	<u>Brown</u>
Age	60	57
Monthly projected retirement benefit	\$500	\$200
Present value of retirement benefits	41,900	14,072
Allocated assets	7,500	0
Annual premium as of 1/1	3,000	1,000
Cash value at age 65 per \$1,000 of insurance	200	250

Question 14

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

- (A) Less than \$11,000
- (B) \$11,000 but less than \$11,600
- (C) \$11,600 but less than \$12,200
- (D) \$12,200 but less than \$12,800
- (E) \$12,800 or more

1989

Data for Question 15

Normal retirement age:

Before 1989: 65.

After 1988: 64.

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

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 8%.

Preretirement deaths and terminations: None.

Retirement age: Normal retirement age.

Data for sole participant:

Date of birth 1/1/34

Date of hire 1/1/64

Actuarial value of assets as of 1/1/89: \$10,000.

Selected annuity values:

$$\ddot{a}_{64}^{(12)} = 8.35 \quad \ddot{a}_{65}^{(12)} = 8.14$$

Question 15

In what range is the increase in the normal cost for 1989 as of 1/1/89 due to the change in the normal retirement age?

- (A) Less than \$600
- (B) \$600 but less than \$650
- (C) \$650 but less than \$700
- (D) \$700 but less than \$750
- (E) \$750 or more

1989

Data for Question 16

Plan effective date: 1/1/88.

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

Actuarial cost method: Attained age normal with frozen initial liability.

Actuarial assumptions:

Interest rate: 8%.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole participant:

Date of birth 1/1/38

Date of hire 1/1/65

Contribution for 1988: \$3,000 paid on 12/31/88.

Selected commutation functions and annuity value:

<u>x</u>	<u>D_x</u>	<u>N_x</u>
50	322	3902
51	298	3580
65	99	904

$$\ddot{a}_{65}^{(12)} = 8.67$$

Question 16

In what range is the normal cost for 1989 as of 1/1/89?

- (A) Less than \$1,225
- (B) \$1,225 but less than \$1,250
- (C) \$1,250 but less than \$1,275
- (D) \$1,275 but less than \$1,300
- (E) \$1,300 or more

1989

Data for Question 17

Plan effective date: 1/1/84.

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

Actuarial cost method: Individual level premium.

Actuarial assumptions:

Interest rate: 6%.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole participant:

Date of birth 1/1/39

Date of hire 1/1/79

Selected commutation functions and annuity value:

<u>x</u>	<u>D_x</u>	<u>N_x</u>
40	941	13,971
45	694	9,789
50	508	6,712
55	366	4,472
65	178	1,741

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

Question 17

In what range is the accrued liability as of 1/1/89?

- (A) Less than \$4,000
- (B) \$4,000 but less than \$6,000
- (C) \$6,000 but less than \$8,000
- (D) \$8,000 but less than \$10,000
- (E) \$10,000 or more

1989

Data for Question 18

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

Early retirement benefit: Accrued benefit reduced by 6% for each year by which commencement of payments precedes age 65.

Actuarial assumptions:

Interest rate: 6%.

Preretirement deaths and terminations: None.

Retirement age:

	Probability at Age x of
<u>x</u>	<u>Retiring at Age x</u>

63	50%
64	20%
65	100%

Data for sole participant:

Date of birth	1/1/26
Date of hire	1/1/73

Selected annuity values:

$\ddot{a}_{63}^{(12)} = 9.85$	$\ddot{a}_{64}^{(12)} = 9.60$	$\ddot{a}_{65}^{(12)} = 9.35$
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Question 18

In what range is the present value of future benefits as of 1/1/89?

- (A) Less than \$24,800
- (B) \$24,800 but less than \$25,800
- (C) \$25,800 but less than \$26,800
- (D) \$26,800 but less than \$27,800
- (E) \$27,800 or more

1989

Data for Question 19

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

Early retirement benefit: Accrued benefit reduced by 5% for each year by which commencement of payments precedes age 65.

Preretirement death benefit: 50% of early retirement benefit payable monthly to the participant's spouse for life.

Actuarial assumptions:

Interest rate: 6%.

Preretirement death decrement: 2% at the beginning of each year.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Marital characteristics: 90% of participants are married at the time of death; spouses are the same age as participants.

Data for sole participant:

Date of birth 1/1/26

Date of hire 1/1/59

Selected annuity values:

$$\ddot{a}_{63}^{(12)} = 9.85 \quad \ddot{a}_{64}^{(12)} = 9.60 \quad \ddot{a}_{65}^{(12)} = 9.35$$

Question 19

In what range is the present value of preretirement death benefits as of 1/1/89?

- (A) Less than \$1,135
- (B) \$1,135 but less than \$1,145
- (C) \$1,145 but less than \$1,155
- (D) \$1,155 but less than \$1,165
- (E) \$1,165 or more

1989

Data for Question 20

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

Normal form of payment:

Retirements before 1989: Life annuity.

Retirements after 1988:

Single retirees: Life annuity.

Married retirees: Joint and 50% survivor annuity.

Actuarial cost method: Aggregate.

Actuarial assumptions:

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 1/1/89, before change in normal form of payment:

Normal cost as of 1/1	\$ 85,000
Present value of future benefits for retired participants	400,000
Actuarial value of assets	600,000
Present value of future compensation	4,200,000
Annual compensation	350,000

Selected unisex annuity values:

$$\ddot{a}_{65}^{(12)} = 9.90 \quad \ddot{a}_{65:65}^{(12)} = 7.82$$

Question 20

In what range is the normal cost for 1989 as of 1/1/89?

- (A) Less than \$90,000
- (B) \$90,000 but less than \$95,000
- (C) \$95,000 but less than \$100,000
- (D) \$100,000 but less than \$105,000
- (E) \$105,000 or more

ANSWER KEY

MAY 1989 COURSE P-360U (EA2)

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