

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

MAY 1999 COURSE P-36OU (EA1) SEGMENT B
JOINT BOARD BASIC EXAMINATION

This is the May 1999 examination which has been released to
the public by the administering organizations.

Spring 1999
EA-1B

**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 or disability 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.

1999

Data for Question 1

Effective date: 1/1/96.

Valuation date: 1/1/99.

Normal retirement benefit: 50% of final year's salary, payable annually on 1/1.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest: 6% per year.

Salary scale: None.

Pre-retirement decrements: None.

Data for sole participant:

Date of birth: 1/1/61

Date of hire: 1/1/96

<u>Year</u>	<u>Valuation Compensation</u>
1996	\$20,000
1997	\$20,000
1998	\$20,000
1999	\$40,000

Selected annuity value:

$$\ddot{a}_{65} = 10.5$$

There have been no gains or losses other than for salary increases.

Question 1

In what range is the normal cost as of 1/1/99?

- (A) Less than \$2,300
- (B) \$2,300 but less than \$2,600
- (C) \$2,600 but less than \$2,900
- (D) \$2,900 but less than \$3,200
- (E) \$3,200 or more

Data for Question 2

1999

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

Actuarial assumptions:

Interest: 7% per year.

Salary scale: 4% per year.

Pre-retirement decrements: None.

Selected valuation results as of 1/1:

	1998	1999
Actuarial value of assets	\$91,500	\$95,800
Accrued liability	114,400	—
Normal cost	—	2,080

Plan experience during 1998:

All assumptions were exactly realized.

There were no new entrants during 1998.

1998 contribution, made 1/1/98: \$3,000.

Question 2

In what range is the accrued liability as of 1/1/99?

- (A) Less than \$119,300
- (B) \$119,300 but less than \$120,800
- (C) \$120,800 but less than \$122,300
- (D) \$122,300 but less than \$123,800
- (E) \$123,800 or more

1999

Data for Question 3

Assumed interest: 7% per year.

Valuation data for all retired participants as of both 1/1/98 and 1/1/99:

	Smith	Brown
Date of birth:	1/1/33	1/1/32
Annual life annuity benefit, payable on each 1/1:	\$12,000	\$15,000

Selected annuity values:

$$\ddot{a}_{65} = 9.194$$

$$a_{65:\overline{1}|} = 0.9135$$

$$a_{65:\overline{2}|} = 1.7460$$

Question 3

As of 1/1/99, in what range is the loss due to mortality experience during 1998?

- (A) Less than \$5,250
- (B) \$5,250 but less than \$5,500
- (C) \$5,500 but less than \$5,750
- (D) \$5,750 but less than \$6,000
- (E) \$6,000 or more

1999

Data for Question 4

Valuation date: 1/1/99.

Normal retirement benefit: \$25 per month for each year of service payable at age 65.
Maximum 25 years of service.

Early retirement benefit: Accrued benefit reduced 2.5% for each year by which the benefit commencement date precedes the normal retirement date.

Actuarial cost method: Unit credit.

Actuarial assumptions:

Interest: 7% per year.

Pre-retirement decrements: None.

Retirement age:

Prior to 1999: 65.

After 1998: 62.

Data for sole participant:

Date of birth: 1/1/40

Date of hire: 1/1/65

Selected annuity values:

$$\ddot{a}_{65}^{(12)} = 9.815$$

$$\ddot{a}_{62}^{(12)} = 10.750$$

Question 4

In what range is the absolute value of the change in accrued liability as of 1/1/99 due to the change in the assumed retirement age.

- (A) Less than \$11,700
- (B) \$11,700 but less than \$13,200
- (C) \$13,200 but less than \$14,700
- (D) \$14,700 but less than \$16,200
- (E) \$16,200

1999

Data for Question 5

Plan effective date: 1/1/97.

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

Pre-retirement death benefit: \$100,000 lump sum, payable at the end of the year of death.

Actuarial assumptions:

Interest: 7% per year.

Salary scale: 4% per year.

Pre-retirement decrements other than mortality: None.

Retirement age: 65.

Valuation data for sole participant:

Date of birth: 1/1/37

Selected valuation results as of 1/1:

	1998	1999
Normal cost:	\$ 5,000	—
Unfunded liability:	20,000	—
Value of assets:	—	\$ 5,000
Present value of future retirement benefits:	—	50,000

Contribution for 1998: \$4,000 paid on 12/31/98.

Selected actuarial values:

$$\ddot{a}_{62:\overline{3}|} = 2.7612$$

$${}_3E_{62} = .77127$$

Question 5

In what range is the 1/1/99 normal cost?

- (A) Less than \$8,500
- (B) \$8,500 but less than \$9,000
- (C) \$9,000 but less than \$9,500
- (D) \$9,500 but less than \$10,000
- (E) \$10,000 or more

Data for Question 6

1999

Normal retirement benefit: 2% of 5-year final average salary for each year of service.

Actuarial cost method: Entry age normal.

Assumed compensation increases: 4% per year.

1/1/99 valuation data for the sole participant:

Date of birth: 1/1/59

Date of hire: 1/1/94

1999 compensation: \$30,000

Selected commutation functions:

x	D_x	N_x	sN_x	sN_x
35	894,190	12,364,661	3,528,554	83,833,438
40	632,275	8,452,737	3,035,565	67,201,791
65	94,414	868,053	1,208,376	14,869,249

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 8.7358$$

Question 6

In what range is the accumulated value of past normal costs as of 1/1/99?

- (A) Less than \$11,500
- (B) \$11,500 but less than \$12,300
- (C) \$12,300 but less than \$13,100
- (D) \$13,100 but less than \$13,900
- (E) \$13,900 or more

Data for Question 7

1999

Normal retirement benefit:

Before 1/1/99 amendment: 2.0% of final pay for each year of service. Maximum 25 years of service.

After 1/1/99 amendment: 1.5% of final pay for each year of service.

Actuarial assumptions:

Interest: 7.0% per year.

Salary scale: 5.0% per year.

Pre-retirement decrements: None.

Retirement age: 65.

Data for sole participant:

Date of birth: 1/1/49

Date of hire: 1/1/84

1999 pay: \$50,000

Selected annuity value: $\ddot{a}_{65}^{(12)} = 8.74$

X% is the level percent of pay which deposited annually, beginning 1/1/99, would accumulate, based on the actuarial assumptions, to an amount at age 65 sufficient to provide for a monthly annuity equal to the amount by which retirement benefits were reduced.

Question 7

In what range is X%?

- (A) Less than 2.40%
- (B) 2.40% but less than 3.80%
- (C) 3.80% but less than 5.20%
- (D) 5.20% but less than 6.60%
- (E) 6.60% or more

Data for Question 8

1999

Plan effective date: 1/1/95.

Normal retirement benefit:

Before 1/1/99 amendment: \$10 per month for each year of service.
After 1/1/99 amendment: \$K per month for each year of service.

Actuarial cost method: Individual level premium.

Actuarial assumptions:

Interest: 7% per year.
Pre-retirement decrements: None.
Retirement age: 65.

Data for sole participant:

Date of birth: 1/1/55
Date of hire: 1/1/95

Selected annuity values:

$$\ddot{a}_{65}^{(12)} = 8.53$$

Selected actuarial information:

1/1/99 normal cost: \$500.

Before 1/1/99, there were no experience gains or losses.

Question 8

In what range is \$K?

- (A) Less than \$10.50
- (B) \$10.50 but less than \$11.50
- (C) \$11.50 but less than \$12.50
- (D) \$12.50 but less than \$13.50
- (E) \$13.50 or more

1999

Data for Question 9

Retirement benefit on or after normal retirement date: \$20 per month for each year of service.

Early retirement eligibility: Age 60 and 1 year of service.

Early retirement benefit: Accrued benefit reduced 1/20 for each year by which the benefit commencement date precedes the normal retirement date.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest: 7% per year.

Pre-retirement decrements: None.

Probability of retirement on 1/1 of each year:

Age 63: 40%

Age 64: 60%

Age 65: 80%

Age 66: 100%

Data for sole participant:

Date of birth: 1/1/37

Date of hire: 1/1/99

Selected annuity values:

$$\ddot{a}_{63}^{(12)} = 8.96 \quad \ddot{a}_{65}^{(12)} = 8.51$$

$$\ddot{a}_{64}^{(12)} = 8.74 \quad \ddot{a}_{66}^{(12)} = 8.29$$

Question 9

In what range is the normal cost as of 1/1/99?

- (A) Less than \$1,750
- (B) \$1,750 but less than \$1,800
- (C) \$1,800 but less than \$1,850
- (D) \$1,850 but less than \$1,900
- (E) \$1,900 or more

Data for Question 10

Normal retirement benefit:

Basic benefit: \$10 per month for each year of service, maximum 35 years of service.

Additional benefit: 1% of final 3-year average compensation for each year of service, maximum 35 years of service.

Actuarial cost method: Projected unit credit.

Assumed compensation increases: 4% per year.

1/1/99 valuation data for the sole participant:

Date of birth: 1/1/39

Date of hire: 1/1/79

1999 compensation: \$35,000

Selected commutation functions:

x	D_x
40	632,275
60	144,405
65	94,414

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 8.7358$$

Question 10

In what range is the accrued liability as of 1/1/99?

- (A) Less than \$59,000
- (B) \$59,000 but less than \$60,000
- (C) \$60,000 but less than \$61,000
- (D) \$61,000 but less than \$62,000
- (E) \$62,000 or more

1999

Data for Question 11

Normal retirement benefit:

Before 1/1/99 amendment: 1% of final 5 year average salary times years of service, maximum 35 years of service.
 After 1/1/99 amendment: 1% of final 3 year average salary times years of service, maximum 35 years of service.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Salary scale: 4% per year.
 Pre-retirement decrements: Mortality only.

1/1/99 valuation data for sole participant:

Date of birth: 1/1/49
 Date of hire: 1/1/79
 1999 compensation: \$30,000

Selected commutation functions:

x	D_x	N_x	sD_x	sN_x
30	1,261,612	17,887,854	4,091,908	103,134,571
50	310,647	3,752,222	2,207,670	40,718,455
65	94,414	868,053	1,208,376	14,861,249

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 8.7358$$

Question 11

In what range is the accrued liability increase as of 1/1/99 due to the change in the normal retirement benefit?

- (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

Data for Question 12

1999

Actuarial cost method: Aggregate.

Selected valuation results for a contributory pension plan as of 1/1/99:

Present value of all future benefits:

Retirement:	\$1,100,000
Disability:	100,000
Death:	50,000

Present value of future compensation: \$5,000,000.

Current compensation: \$500,000.

Value of assets: \$600,000 including past employee contributions.

Employee contributions are 2% of compensation.

Question 12

In what range is the employer's normal cost as of 1/1/99?

- (A) Less than \$52,000
- (B) \$52,000 but less than \$57,000
- (C) \$57,000 but less than \$62,000
- (D) \$62,000 but less than \$67,000
- (E) \$67,000 or more

1999

Data for Question 13

Effective date of plan: 1/1/99.

Monthly retirement benefit: \$25 for each of the first 10 years of service, plus \$30 for each year of service in excess of 10. Maximum service credited is 25 years.

Normal retirement age: 65.

Normal form of benefit: Life annuity.

Actuarial cost method: Attained age normal.

Actuarial assumptions:

Interest: 7% per year.

Pre-retirement decrements: None.

Data for all participants as of 1/1/99 (all active):

<u>Number of Participants</u>	<u>Date of birth</u>	<u>Date of hire</u>
5	1/1/54	1/1/89
2	1/1/49	1/1/94

Selected annuity value:

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

Question 13

In what range is the normal cost as of 1/1/99?

- (A) Less than \$8,500
- (B) \$8,500 but less than \$9,500
- (C) \$9,500 but less than \$10,500
- (D) \$10,500 but less than \$11,500
- (E) \$11,500 or more

1999

Data for Question 14

A plan is established on 1/1/99.

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

Cost method A: Individual aggregate (level dollar amount)

Cost method B: Individual aggregate (level percent of compensation)

Actuarial assumptions:

Interest: 7% per year.

Salary scale: 2.5% per year.

Pre-retirement decrements: None.

Retirement age: 65.

Valuation data as of 1/1/99 for sole participant:

Date of birth:	1/1/40
Date of hire:	1/1/99
1999 valuation compensation:	\$30,000

Selected annuity value.

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

All assumptions will be exactly realized in every year.

Question 14

On what valuation date will the normal cost under cost method B first exceed the normal cost under cost method A?

- (A) Before 1/1/2005
- (B) 1/1/2005
- (C) 1/1/2006
- (D) 1/1/2007
- (E) 1/1/2008 or later

1999

Data for Question 15

Normal retirement benefit: \$30 for each year of service.

Normal form of benefit:

Unmarried participants: Life annuity.

Married participants: Joint & 100% survivor annuity.

Actuarial cost method: Aggregate.

A 1/1/1999 valuation is prepared using the assumption that 70% of the active participants will be married at retirement. The annuity factors are such that the value of the joint & survivor annuity is 125% of the value of a single life annuity. The results of this valuation are:

Present value of future benefits for active participants:	\$ 2,000,000
Present value of future benefits for retirees:	\$ 300,000
Actuarial value of assets:	\$ 1,000,000
Normal cost	\$ 90,000

The assumption regarding married participants was then changed from 70% to 90%. The 1/1/1999 normal cost was revised accordingly.

Question 15

In what range is the revised normal cost?

- (A) Less than \$91,000
- (B) \$91,000 but less than \$96,000
- (C) \$96,000 but less than \$101,000
- (D) \$101,000 but less than \$106,000
- (E) \$106,000 or more

Data for Question 16

Normal retirement benefit:

Before 1/1/99 amendment: 3% of the final year's compensation for each year of credited service. The maximum years of credited service is 20.

After 1/1/99 amendment: 4% of the final year's compensation for each year of credited service. The maximum years of credited service is 25.

Actuarial cost method: Projected unit credit (based on credited service).

Actuarial assumptions:

Interest rate: 7% per year.
 Salary scale: 2% per year.
 Pre-retirement decrements: None.
 Retirement age: 65.

Selected valuation data as of 1/1/99 for all participants:

	Smith	Brown	Green
Date of birth:	01/01/49	01/01/51	01/01/39
Date of hire:	01/01/74	01/01/76	01/01/94
1999 valuation compensation:	\$30,000	\$40,000	\$50,000

Selected annuity value:

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

Question 16

In what range is the increase in the normal cost as of 1/1/99 as a result of the change in the normal retirement benefit?

- (A) Less than \$4,500
- (B) \$4,500 but less than \$6,000
- (C) \$6,000 but less than \$7,500
- (D) \$7,500 but less than \$9,000
- (E) \$9,000 or more

Data for Question 17

Plan effective date: 1/1/99.

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

Form of payment:

Unmarried participants: Single life annuity.

Married participants: Participant receives 90% of the single life annuity amount. Upon the death of the participant, the surviving spouse receives 60% of the participant's amount for life.

Actuarial cost method: Projected unit credit.

Actuarial assumptions:

Interest: 7% per year.

Salary scale: 4% per year.

Pre-retirement decrements: None.

Marital status upon retirement: 85% retiring with an eligible spouse, with no age difference between spouses.

Retirement age: 65.

1/1/99 valuation data for sole participant:

Date of birth: 1/1/57

Date of hire: 1/1/87

1999 Compensation: \$75,000

Contribution for 1999: \$7,000 paid on 7/1/99.

Selected unisex annuity values:

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

$$\ddot{a}_{65:65}^{(12)} = 6.90$$

Question 17

In what range is the expected unfunded liability as of 12/31/99?

- (A) Less than \$85,000
- (B) \$85,000 but less than \$87,000
- (C) \$87,000 but less than \$89,000
- (D) \$89,000 but less than \$91,000
- (E) \$91,000 or more

Data for Question 18

1999

Plan effective date: 1/1/85.

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

Actuarial cost method:

Before 1999:	Unit credit.
After 1998:	Entry age normal.

Actuarial assumptions:

Interest: 7% per year.
Pre-retirement decrements: None.
Retirement age: 65.

Data for sole participant:

Date of birth:	1/1/54
Date of hire:	1/1/84

Normal cost as of 1/1/99 under unit credit method: \$675.

Question 18

In what range is the absolute value of the change in the accrued liability as of 1/1/99 due to the change in the actuarial cost method?

- (A) Less than \$6,000
- (B) \$6,000 but less than \$6,200
- (C) \$6,200 but less than \$6,400
- (D) \$6,400 but less than \$6,600
- (E) \$6,600 or more

1999

Data for Question 19

Plan effective date: 1/1/80.

Retirement benefit: 2% of final 3-year average compensation for each year of service, limited to 30 years, payable unreduced on or after age 62.

Actuarial cost method: Aggregate.

Actuarial assumptions:

	Before 1999	After 1998
Pre-retirement interest:	7% per year	6% per year
Post-retirement interest:	7% per year	7% per year
Salary scale:	4% per year	4% per year
Pre-retirement decrements:	None	None
Retirement age:	62	65

Selected data for sole participant:

Date of birth: 1/1/54
Date of hire: 1/1/86

Selected valuation data as of 1/1/99:

Value of assets: \$50,000
1999 compensation: \$60,000

Selected annuity values based on 7% interest:

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

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

Question 19

In what range is the absolute value of the change in the normal cost as of 1/1/99 due to the changes in actuarial assumptions?

- (A) Less than \$750
- (B) \$750 but less than \$1,500
- (C) \$1,500 but less than \$2,250
- (D) \$2,250 but less than \$3,000
- (E) \$3,000 or more

Data for Question 20

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

Pre-retirement termination benefit: None

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

Actuarial assumptions:

Interest: 7% per year.

Salary scale: 5% per year.

Pre-retirement decrements other than withdrawals: None.

Retirement age: 65.

Select withdrawal probabilities:

t	$q_{[x]+t}$
0	8%
1	4%
2	2%
3 or greater	0%

Data for sole participant for 1/1/99 valuation:

Date of birth: 1/1/67

Date of hire: 1/1/99

Date of entry in the plan: 1/1/99

1999 Compensation: \$75,000

Selected annuity value:

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

Question 20

In what range is the normal cost as of 1/1/99?

- (A) Less than \$7,900
- (B) \$7,900 but less than \$8,400
- (C) \$8,400 but less than \$8,900
- (D) \$8,900 but less than \$9,400
- (E) \$9,400 or more

1999

ANSWER KEY

MAY 1999 COURSE P-360U (EA-1) SEGMENT B

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

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