

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

This is the May 1998 examination which has been released to
the public by the administering organizations.

Spring 1998
EA-1B

THIS PAGE WAS INTENTIONALLY LEFT BLANK

**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.

1998

Data for Question 1

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

Actuarial assumptions:

Pre-retirement interest:	7%.
Pre-retirement decrements:	none.
Retirement age:	65.
Salary increases:	3% per year for the first 10 years of service, 2% per year thereafter.

Data for participant Smith:

Date of birth: 1/1/48
Date of hire: 1/1/78
Projected monthly benefit: \$1,000
Compensation as of 1/1/98: \$50,000

Selected annuity value:

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

Question 1

In what range is the normal cost attributable to Smith as of 1/1/98?

- (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

1998

Data for Question 2

Normal retirement benefit: A fixed percentage of the participant's final compensation.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest: 7% per year.

Salary scale: 5% per year.

Pre-retirement decrements: None.

Retirement age: 65.

Value of assets as of 12/31/96: \$75,000.

Normal cost as of 1/1/97: \$17,500.

A \$15,000 contribution was made on 1/1/97 for the 1997 plan year.

The actual rate of investment return was 10.5% for the 1997 calendar year.

Smith was the sole participant on 1/1/97.

Participant data as of 1/1/98:

	<u>Smith</u>	<u>Brown</u>
Date of birth:	1/1/45	1/1/45
Date of hire:	1/1/85	1/1/98
1997 compensation:	\$40,000	-
1998 compensation:	\$42,000	\$37,000

Question 2

In what range is 1/1/98 normal cost?

- (A) Less than \$42,000
- (B) \$42,000 but less than \$43,000
- (C) \$43,000 but less than \$44,000
- (D) \$44,000 but less than \$45,000
- (E) \$45,000 or more

1998

Data for Question 3

Plan data:

Normal retirement age: 65
Employee contributions: Mandatory.

Actuarial cost method: Aggregate (level dollar amount).

Actuarial assumptions:

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

Valuation data as of 1/1/98:

Present value of total benefits:	\$210,000
Present value of future employee contributions:	23,000
Actuarial value of assets:	25,000

Participant data:

Two participants age 55.
Three participants age 53.

Question 3

In what range is the employer normal cost on 1/1/98?

- (A) Less than \$18,000
- (B) \$18,000 but less than \$19,500
- (C) \$19,500 but less than \$21,000
- (D) \$21,000 but less than \$22,500
- (E) \$22,500 or more

1998

Data for Question 4

Valuation date: 1/1/98.

Actuarial cost method: Aggregate.

Normal retirement benefit:

Before 1998: 75% of the average of the final 5 calendar years' compensation, reduced prorate for years of service less than 15.

After 1997: 60% of the average of the final 3 calendar years' compensation, no minimum service.

Actuarial assumptions:

Interest: 7% per year.

Salary scale: 4% per year.

Pre-retirement decrements: None.

Retirement age: 65.

Valuation data for sole participant:

Date of birth: 1/1/38

Date of hire: 1/1/94

1997 compensation: \$45,000

Selected annuity value:

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

Question 4

In what range is the absolute value of the change in normal cost as of 1/1/98 resulting from this change in benefit formula?

- (A) Less than \$9,500
- (B) \$9,500 but less than \$10,500
- (C) \$10,500 but less than \$11,500
- (D) \$11,500 but less than \$12,500
- (E) \$12,500 or more

1998

Data for Question 5

Plan effective date: 1/1/73.

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

Pre-retirement death benefit: \$10,000 (payable at the end of year of death).

Post-retirement death benefit: \$1,000 for each year of service before retirement (payable at the end of year of death).

Actuarial cost method: The normal retirement benefit and the death benefits are funded using the Entry age normal (level dollar amount) funding method.

Actuarial assumptions:

Interest: 7% per year.

Salary scale: 4%.

Pre-retirement decrements other than death: None.

Retirement age: 65.

Valuation data for sole participant:

Date of birth: 1/1/50
Date of hire: 1/1/75
1997 compensation: \$30,000

Selected commutation functions:

x	D_x	N_x
25	5,391	77,800
65	286	2,630

Selected annuity value:

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

Question 5

In what range is the normal cost for 1998 as of 1/1/98?

- (A) Less than \$1,510
- (B) \$1,510 but less than \$1,530
- (C) \$1,530 but less than \$1,550
- (D) \$1,550 but less than \$1,570
- (E) \$1,570 or more

Data for Question 6

1998

Assumed interest rate: 7.0%.

Data for retired participant:

Age of retiree: x

Age of spouse: y

Annual pension benefit: \$10,000 per year payable at the beginning of each year.

Form of payment: Life annuity for participant with 50% continued for life of surviving spouse of participant.

Selected annuity values:

$$\ddot{a}_x = 8.157$$

$$\ddot{a}_y = 10.301$$

$$\ddot{a}_{xy} = 7.281$$

$$\ddot{a}_{x+1} = 7.915$$

$$\ddot{a}_{y+1} = 10.059$$

Question 6

In what range is the loss from mortality if both the retiree and spouse are alive at the end of the first year?

- (A) Less than \$1,350
- (B) \$1,350 but less than \$1,650
- (C) \$1,650 but less than \$1,950
- (D) \$1,950 but less than \$2,250
- (E) \$2,250 or more

1998

Data for Question 7

Plan vesting provision: 100% after 5 years of service.

Actuarial cost method: Entry age normal (level dollar amount, applied on an individual basis).

Actuarial assumptions:

Interest: 7% per year.

Salary scale: None.

Pre-retirement decrements other than death and withdrawal: None.

Selected pre-retirement withdrawal and mortality probabilities taken from a multi-decrement table:

Age x	$q_x^{(w)}$	$q_x^{(d)}$
38	.12	.01
39	.10	.01
40	.08	.01
41	.08	.02
42	.06	.02
43	.04	.04
44	.02	.04
45	.00	.06

Participant data and selected valuation results as of 1/1/98:

	<u>Entry age</u>	<u>Attained age</u>	<u>Normal cost as of 1/1</u>
Smith	38	38	\$1,000
Green	40	43	\$3,000

Question 7

In what range is the accrued liability as of 1/1/98?

- (A) Less than \$8,500
- (B) \$8,500 but less than \$10,500
- (C) \$10,500 but less than \$12,500
- (D) \$12,500 but less than \$14,500
- (E) \$14,500 or more

1998

Data for Question 8

Actuarial cost method: Entry age normal (individual).

Participant data:

Attained age x as of 1/1/97	$q_x^{(d)}$	Number of participants as of 1/1/97	Deaths in 1997	Accrued Liability per participant as of 1/1/98
30	.004	2,000	4	\$ 1,500
40	.005	3,000	10	4,800
50	.008	1,000	10	18,000

There are no inactive participants.

Question 8

In what range is the mortality gain or loss for 1997?

- (A) Loss of more than \$8,000
- (B) Loss of \$8,000 or less
- (C) No gain or loss
- (D) Gain of \$8,000 or less
- (E) Gain of more than \$8,000

1998

Data for Question 9

Normal retirement benefit: 50% of final compensation.

Actuarial cost method: Frozen initial liability.

Selected valuation results for sole participant as of 1/1/98:

	<u>Original assumptions</u>	<u>Revised assumptions</u>
Present value of future compensation	\$70,000	\$77,000
Present value of benefits	12,200	14,200
Unfunded actuarial liability	1,300	
Frozen Initial Liability Normal Cost	460	
Entry Age Normal Cost	400	400
Actuarial value of assets	6,300	6,300

Question 9

In what range is the revised normal cost as of 1/1/98?

- (A) Less than \$425
- (B) \$425 but less than \$475
- (C) \$475 but less than \$525
- (D) \$525 but less than \$575
- (E) \$575 or more

1998

Data for Question 10

Early retirement eligibility: Age 57.

Early retirement benefit: Accrued benefit reduced $\frac{1}{2}\%$ per month for each of the first 60 months, and $\frac{1}{4}\%$ per month for each additional month by which benefit commencement precedes age 65.

A level income option is available at early retirement under which the pension reduces at 62 by the amount of the estimated social security benefit.

Actuarial equivalence is based on the plan's early retirement factors.

The level income pension is actuarially equivalent to the normal pension.

Smith retires at age 57 with an accrued benefit of \$600 per month, payable at age 65, and elects the level income option.

Smith's estimated social security benefit commencing at age 62 is \$400 per month.

Question 10

In what range is Smith's monthly benefit commencing at age 57?

- (A) Less than \$600
- (B) \$600 but less than \$640
- (C) \$640 but less than \$680
- (D) \$680 but less than \$720
- (E) \$720 or more

1998

Data for Question 11

Plan effective date: 1/1/98.

Funding medium: Individual ordinary life insurance policy and a side fund.

Amount of life insurance: 75 times expected monthly pension benefit.

Cash value per \$1,000 at age 65 of insurance policy: \$350.

Actuarial cost method: Individual level premium.

Normal retirement benefit: 40% of final 3 year average salary.

Actuarial assumptions for side fund:

Interest rate: 7% per year.

Pre-retirement decrements: None.

Salary increases: None.

Retirement age: 65.

Data for sole participant:

Date of birth: 1/1/57

Date of hire: 1/1/97

1997 compensation: \$54,000

Selected annuity value:

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

Question 11

In what range is the normal cost for the side fund for 1998 as of 1/1/98?

- (A) Less than \$1,000
- (B) \$1,000 but less than \$1,450
- (C) \$1,450 but less than \$1,900
- (D) \$1,900 but less than \$2,350
- (E) \$2,350 or more

1998

Data for Question 12

Plan effective date: 1/1/98.

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

Actuarial cost method: Attained age normal.

Actuarial assumptions:

Interest rate: 7% per year.

Pre-retirement decrements: None.

Retirement age: 65.

Normal cost as of 1/1/98 under the individual level premium method: \$21,508.

Valuation data as of 1/1/98:

Number of participants: 10

Attained age of each: 45

Prior service for each: 10 years

On 1/1/98, the normal cost plus 30-year amortization of the unfunded actuarial liability is contributed.

Question 12

In what range is the contribution made on 1/1/98?

- (A) Less than \$20,000
- (B) \$20,000 but less than \$20,500
- (C) \$20,500 but less than \$21,000
- (D) \$21,000 but less than \$21,500
- (E) \$21,500 or more

1998

Data for Question 13

Normal retirement age: Age 65.

Early retirement eligibility: Age 55.

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

Normal form of payment: Life annuity, payable monthly at beginning of the month.

Optional form of payment: Life annuity with 10 years certain, payable monthly at the beginning of the month.

Assumed interest rate: 7% per year.

Valuation data for all inactive participants as of 1/1/97:

	<u>Smith</u>	<u>Brown</u>
Status	Retired on 1/1/92	Terminated vested
Date of birth	1/1/37	1/1/47
Monthly benefit	\$500	\$600
Payment form	Life annuity with 10 years certain	Life annuity deferred to age 65

Smith died on 12/31/97, there were no other deaths or new inactive participants during 1997.

Selected commutation functions:

<u>Age</u>	<u>D_x</u>	<u>Age</u>	<u>D_x</u>	<u>N_x</u>
50	94,135	60	43,759	449,547
51	87,482	61	40,317	405,788
55	64,834	65	28,610	263,044
56	60,045	66	26,135	234,434

Question 13

In what range is the experience gain during 1997 due to mortality for inactive participants?

- (A) Less than \$36,500
- (B) \$36,500 but less than \$36,700
- (C) \$36,700 but less than \$36,900
- (D) \$36,900 but less than \$37,100
- (E) \$37,100 or more

1998

Data for Question 14

Normal retirement benefit: 75% of final year salary.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 7% per year.

Salary increases: 5% per year.

Pre-retirement decrements: None.

Selected valuation results as of 1/1/97:

Present value of benefits:	
Active:	\$4,087,881
Inactive:	0
Value of assets:	\$500,000
Annual salaries:	\$1,000,000
Normal cost:	\$178,328

Plan experience during 1997:

Rate of return during 1997: 9%.

Salary increases: 4%.

There were no new entrants, deaths, retirements or other terminations of employment.

Normal cost was paid 1/2/97. There were no other contributions during 1997.

Question 14

In what range is the normal cost at 1/1/98?

- (A) Less than \$178,500
- (B) \$178,500 but less than \$181,500
- (C) \$181,500 but less than \$184,500
- (D) \$184,500 but less than \$187,500
- (E) \$187,500 or more

1998

Data for Question 15

Normal retirement benefit: \$35 per month for each year of service.

Normal form of pension payment at retirement:

Before 1998: For the lifetime of the retiree only.

After 1997: For the lifetime of the retiree plus 50% of the retiree's pension for the remaining lifetime of the surviving spouse if any after the death of the retiree.

Actuarial cost method: Unit credit.

Actuarial assumptions:

Interest rate: 7% per year.

Pre-retirement deaths and terminations: None.

Marital status at retirement: 80% of retiring employees are married. Spouse age same as age of retiring employee.

Retirement age: 65.

Valuation data for selected participant Brown (active as of 1/1/98):

Date of birth 1/1/53

Date of hire 1/1/78

Selected annuity values:

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

$$\ddot{a}_{65:65}^{(12)} = 6.549$$

Question 15

In what range is the amount of the increase in the accrued liability for Brown as of 1/1/98 as a result of the change in the plan?

- (A) Less than \$1,000
- (B) \$1,000 but less than \$2,000
- (C) \$2,000 but less than \$3,000
- (D) \$3,000 but less than \$4,000
- (E) \$4,000 or more

1998

Data for Question 16

Plan effective date: 1/1/98.

Normal retirement benefit:

Proposal A: 2% of each year's compensation.

Proposal B: 1.5% of final 5-year compensation for each year of service.

Actuarial cost method: Projected unit credit (service prorate).

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 3% per year.

Pre-retirement terminations other than deaths: None.

Retirement age: 65.

Valuation data for sole participant:

Date of birth 1/1/68

Date of hire 1/1/98

1998 compensation \$50,000

Selected commutation functions:

x	D_x	N_x
30	1,261,611	17,887,840
65	94,414	868,052

Question 16

In what range is the absolute value of the difference in the normal cost as of 1/1/98 under Proposal A and Proposal B?

- (A) Less than \$150
- (B) \$150 but less than \$300
- (C) \$300 but less than \$450
- (D) \$450 but less than \$600
- (E) \$600 or more

1998

Data for Question 17

Normal retirement benefit: 2% of final year's compensation for each year of service up to 20 years, plus 1% of final year's compensation for each additional year of service up to a maximum retirement benefit of 50% of final year's compensation.

Early retirement eligibility: Age 62.

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

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

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increase: 4% per year.

Pre-retirement decrements: None.

Probability of retirement (assumed at beginning of year):

x	$q_x^{(r)}$
62	.30
63	.00
64	.00
65	1.00

Valuation data for only participants (both active as of 1/1/98):

	<u>Smith</u>	<u>Brown</u>
Date of birth	1/1/45	1/1/38
Date of hire	1/1/77	1/1/67
1998 valuation compensation	\$50,000	\$60,000

Selected annuity values: $\ddot{a}_{62}^{(12)} = 9.39$
 $\ddot{a}_{65}^{(12)} = 8.74$

Question 17

In what range is the accrued liability as of 1/1/98?

- (A) Less than \$348,000
- (B) \$348,000 but less than \$352,000
- (C) \$352,000 but less than \$356,000
- (D) \$356,000 but less than \$360,000
- (E) \$360,000 or more

Data for Question 18

1998

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

Early retirement eligibility: Age 55.

Early retirement benefit: Accrued benefit, reduced $1/15$ for each of the first 5 years, and $1/30$ for each of the next 5 years by which commencement precedes the Normal Retirement Date.

Special early retirement program effective 7/1/97 to 6/30/98:

Employees who elect early retirement are granted a "3 + 3" special subsidy under which:

1. Accrued benefit is calculated assuming an additional 3 years of service, and
2. The early retirement benefit is calculated reducing by 3 the number of years by which benefit commencement precedes the Normal Retirement Date.

Actuarial cost method: Individual entry age normal.

Actuarial assumptions:

Interest rate: 7% per year.

Pre-retirement decrements other than death: None.

Retirement age: 65.

Data for selected participant Smith:

Date of birth: 1/1/41
Date of hire: 1/1/81
Early retirement date: 1/1/98

Selected commutation functions:

x	D_x	N_x
40	192	2,561
57	56	604
60	44	450
65	29	263

Question 18

In what range is the increase in accrued liability, as of 1/1/98, due to Smith's election to retire?

- (A) Less than \$3,400
(B) \$3,400 but less than \$4,000
(C) \$4,000 but less than \$4,600
(D) \$4,600 but less than \$5,200
(E) \$5,200 or more

1998

Data for Question 19

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

Actuarial cost method: Frozen initial liability.

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 4% per year.

Pre-retirement decrements: None.

Retirement age: 65.

Selected valuation results as of 1/1/97:

Participants:	All active and under age 60
Annual compensation:	\$ 1,000,000
Present value of future compensation:	18,000,000
Normal cost:	80,000
Amortization of unfunded liability:	70,000
Value of assets:	1,500,000

Experience during 1997:

Contribution: \$200,000 made on 3/31/97

Investment return: 10%

Compensation increase: 4% (on 1/1/98)

There were no new entrants; all participants active at the beginning of the year were active at the end of the year.

Question 19

In what range is the normal cost as of 1/1/98?

- (A) Less than \$78,000
- (B) \$78,000 but less than \$79,000
- (C) \$79,000 but less than \$80,000
- (D) \$80,000 but less than \$81,000
- (E) \$81,000 or more

Data for Question 20

1998

Effective date of plan: 1/1/95.

Benefit formula:

Before 1/1/98: \$10 per month per year of service.

After 12/31/97: \$12 per month per year of service.

Retirement age: 65.

Actuarial cost method: Individual level premium.

Valuation assumptions:

Pre-retirement decrements: None.

Interest rate: 7% per year.

Participant data:

	<u>Smith</u>	<u>Brown</u>
Date of birth	1/1/35	1/1/45
Date of hire	1/1/93	1/1/96

Selected annuity value:

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

Question 20

In what range is the normal cost as of 1/1/98?

- (A) Less than \$2,100
- (B) \$2,100 but less than \$2,250
- (C) \$2,250 but less than \$2,400
- (D) \$2,400 but less than \$2,550
- (E) \$2,550 or more

ANSWER KEY

MAY 1998 COURSE P-360U (EA-1) SEGMENT B

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