

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

MAY 2000 COURSE EA-1, SEGMENT B
JOINT BOARD BASIC EXAMINATION

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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 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
- (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.

2000

Data for Question 1

Actuarial valuation date: 1/1/2000.

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

Final average compensation: The average of the three calendar year salaries preceding the date of retirement.

Actuarial cost method: Projected unit credit.

Actuarial assumptions:

Preretirement interest:	8% per year
Annual salary increases:	6% per year
Preretirement decrements:	None
Retirement age:	65

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 8.33$$

Data for sole participant:

Date of birth:	1/1/1940
Date of hire:	1/1/1980
Salary during 1999 calendar year	\$35,000

Question 1

In what range is the normal cost as of 1/1/2000?

- (A) Less than \$4,800
- (B) \$4,800 but less than \$5,000
- (C) \$5,000 but less than \$5,200
- (D) \$5,200 but less than \$5,400
- (E) \$5,400 or more

2000

Data for Question 2

Actuarial valuation date: 1/1/2000.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Preretirement decrements:	Mortality only
Retirement age:	58
Salary scale:	4% per year

Selected commutation functions:

$D_{55} = 16,393$
 $D_{56} = 15,709$
 $D_{57} = 15,035$

Data for participant Smith:

Date of birth: 1/1/1945
Date of hire: 12/31/1999

Let $X =$ Smith's normal cost as of 1/1/2000 if the normal cost is calculated as a level percentage of salary.

Let $Y =$ Smith's normal cost as of 1/1/2000 if the normal cost is calculated as a level dollar amount.

Question 2

In what range is $X \div Y$?

- (A) Less than 0.9620
- (B) 0.9620 but less than 0.9810
- (C) 0.9810 but less than 1.0000
- (D) 1.0000 but less than 1.0190
- (E) 1.0190 or more

2000

Data for Question 3

Actuarial valuation date: 1/1/2000.

Actuarial cost method: Unit credit.

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

Early retirement benefit: Accrued benefit, unreduced for commencement on or after age 60.

Actuarial assumptions:

Preretirement decrements: None

Annual effective rate of interest: 7%

Retirement age prior to 1/1/2000: 61

On 1/1/2000 the retirement age assumption is changed to the following:

<u>Age at retirement</u>	<u>Probability of retirement</u>
61	0.4
62	0.6
63	1.0

Retirements occur at the beginning of the year.

Selected annuity values:

$$\ddot{a}_{61}^{(12)} = 8.333$$

$$\ddot{a}_{62}^{(12)} = 8.167$$

$$\ddot{a}_{63}^{(12)} = 8.000$$

Data for sole participant Smith:

Date of birth: 1/1/1960

Date of hire: 1/1/1990

Question 3

In what range is the absolute value of the change in the actuarial accrued liability as of 1/1/2000 due to the change in the retirement age assumption?

- (A) Less than \$295
- (B) \$295 but less than \$310
- (C) \$310 but less than \$325
- (D) \$325 but less than \$340
- (E) \$340 or more

2000

Data for Question 4

Actuarial valuation date: 1/1/2000.

Retirement benefit: \$4,800 per year, payable at the beginning of each year in the form of a 3-year certain and life annuity.

Actuarial assumptions:

Interest rate: 7% per year

Selected commutation functions:

$$N_{63} = 35,623$$

$$N_{64} = 31,010$$

$$N_{65} = 26,867$$

Data for pensioner Smith:

Date of birth: 1/1/1936

Date of retirement: 1/1/1997

Status as of 1/1/2000: Alive

Question 4

In what range is the 1999 experience loss as of 1/1/2000 due to Smith's survival?

- (A) Less than \$1,300
- (B) \$1,300 but less than \$2,600
- (C) \$2,600 but less than \$3,900
- (D) \$3,900 but less than \$5,200
- (E) \$5,200 or more

2000

Data for Question 5

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

Early retirement benefit: Accrued benefit reduced by 5% for each year that retirement precedes age 65.

Normal form of benefit: Life annuity.

Actuarial cost method: Unit credit.

Selected commutation functions:

<u>Age x</u>	<u>D_x</u>	<u>N_x</u>
40	652	8761
50	322	3902
60	151	1547
65	99	904

The assumed retirement age is 65.

Data for participant Green:

Date of birth: 1/1/1940
Date of hire: 1/1/1980
Date of retirement: 1/1/2000

Question 5

As of 1/1/2000, in what range is the change in the accrued liability due to Green's retirement?

- (A) Loss of \$6,000 or more
- (B) Loss of more than \$0 but less than \$6,000
- (C) No gain or loss or a gain less than \$6,000
- (D) Gain of at least \$6,000 but less than \$12,000
- (E) Gain of \$12,000 or more

2000

Data for Question 6

Actuarial valuation date: 1/1/2000.

Actuarial cost method: Unit credit.

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

Actuarial assumptions:

Interest rate:

Valuations before 1/1/2000: 7%

Valuations after 12/31/1999: 8%

Preretirement decrements: None

Retirement age: 65

Actual return on assets during 1999: 10%.

Unfunded accrued liability as of 1/1/1999 prior to the 1999 contribution: \$12,000.

Selected annuity values:

	<u>7%</u>	<u>8%</u>
$\ddot{a}_{65}^{(12)}$	9.70	8.74

Data for sole participant:

Date of birth: 1/1/1940

Date of hire: 1/1/1978

The contribution for 1999 was equal to the 1/1/1999 normal cost and was contributed on 1/1/1999.

Question 6

In what range is the unfunded accrued liability as of 1/1/2000?

- (A) Less than \$3,000
- (B) \$3,000 but less than \$5,000
- (C) \$5,000 but less than \$7,000
- (D) \$7,000 but less than \$9,000
- (E) \$9,000 or more

2000

Data for Question 7

Actuarial valuation date: 1/1/2000.

Plan effective date: 1/1/1998.

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

Actuarial cost method: Unit credit.

Actuarial assumptions:

Interest rate:	8% per year
Preretirement decrements:	None
Retirement age:	65

Selected valuation results as of 1/1/1998:

Accrued liability:	\$50,000
Normal cost:	4,000

A contribution of \$6,000 for the 1998 plan year was made on 7/1/1998.

A contribution of \$6,200 for the 1999 plan year was made on 1/1/1999.

Since 1/1/1998 there have been no retirements and all plan participants are under age 62 as of 1/1/1998.

There have been no new entrants since the 1998 valuation.

The actuarial assumptions have always been exactly realized except that the 1999 investment return was 9.5%.

Question 7

In what range is the 1/1/2000 unfunded liability?

- (A) Less than \$48,000
- (B) \$48,000 but less than \$50,000
- (C) \$50,000 but less than \$52,000
- (D) \$52,000 but less than \$54,000
- (E) \$54,000 or more

2000

Data for Question 8

Normal retirement benefit: \$50,000.

Normal form of benefit: Single life annuity, if not married.
 Unreduced joint and 100% survivor annuity, if married.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest rate:	7% per year
Preretirement decrements:	None
Postretirement mortality:	Unisex
Retirement age:	65
Marital status:	Same as marital status on valuation date

Selected data for the sole participant:

Date of birth:	1/1/1936
Date of hire:	1/1/1976
Date of participation:	1/1/1976

On July 1, 1999, the participant got married. Prior to this the participant had never been married.

Selected data for spouse of sole participant:

Date of birth:	1/1/1936
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Selected annuity values: $\ddot{a}_{65}^{(12)} = 8.74$ $\ddot{a}_{65:65}^{(12)} = 6.90$

Question 8

In what range is the increase in the normal cost as of 1/1/2000 due to the change in marital status?

- (A) Less than \$1,500
- (B) \$1,500 but less than \$3,500
- (C) \$3,500 but less than \$5,500
- (D) \$5,500 but less than \$7,500
- (E) \$7,500 or more

2000

Data for Question 9

Normal retirement benefit: 50% times the average of final 3 calendar years' compensation, less the amount of an annuity from a prior plan.

Plan effective date: 1/1/1999.

Actuarial valuation date: 1/1/2000.

Actuarial cost method: Individual aggregate (level dollar).

Actuarial assumptions:

Interest rate:	7% per year
Compensation increases:	3.5% per year
Preretirement decrements:	None
Retirement age:	65

Valuation data for sole participant:

Date of birth:	1/1/1950
Date of hire:	1/1/1995
1999 compensation:	\$50,000
Paid-up annuity (payable at age 65):	\$1,250/month (from prior plan)

Actuarial value of assets as of 1/1/2000: \$7,500

Selected annuity value:

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

Question 9

In what range is the normal cost as of 1/1/2000?

- (A) Less than \$6,600
- (B) \$6,600 but less than \$7,400
- (C) \$7,400 but less than \$8,200
- (D) \$8,200 but less than \$9,000
- (E) \$9,000 or more

2000

Data for Question 10

Actuarial valuation date: 1/1/2000.

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

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest rate:	7% per year
Preretirement decrements other than death:	None
Retirement age:	65

Selected valuation data:

Assets as of 1/1/1999:	\$ 3,000
Employer contribution on 12/31/1999:	\$ 934
Assets as of 1/1/2000:	\$ 4,234

Valuation data for sole participant:

Date of birth:	1/1/1959
Date of hire:	1/1/1994
Status on 1/1/2000:	Active

Selected commutation functions:

<u>Age x</u>	<u>D_x</u>	<u>N_x</u>
35	894,190	12,364,661
40	632,275	8,452,737
41	589,655	7,820,462
65	94,414	868,053

Selected annuity value:

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

Question 10

In what range is the absolute value of the experience gain or loss for 1999 measured as of the valuation date?

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

2000

Data for Question 11

Normal retirement benefit: Before 2000: 50% of final 3-year average compensation.
 After 1999: 60% of final year's compensation.

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

Actuarial assumptions:

Interest rate:	7.0% per year
Salary scale:	5.0% per year
Preretirement decrements:	None
Retirement age:	65

Valuation data for sole participant Smith as of January 1, 2000:

Date of birth: 1/1/1945
Date of hire: 1/1/1995

Normal cost for Smith as of January 1, 1995: \$10,000

There have been no gains or losses since 1995.

Question 11

In what range is the increase in accrued liability for Smith as of January 1, 2000 due to the plan amendment?

- (A) Less than \$15,000
- (B) \$15,000 but less than \$17,000
- (C) \$17,000 but less than \$19,000
- (D) \$19,000 but less than \$21,000
- (E) \$21,000 or more

2000

Data for Question 12

Plan effective date: 1/1/2000.

Normal retirement benefit: 60% of final year's salary.

Actuarial cost method: Aggregate

Valuation assumptions:

Interest:	7% per year
Salary increases:	5% per year
Preretirement decrements:	None
Retirement age:	65

Data for sole participant:

Date of birth:	1/1/1955
Annual salary in 1999:	\$50,000

The normal cost determined as of 1/1/2000 was contributed on 1/1/2000.

Plan experience for 2000:

Investment return:	10%
Salary increase:	7%

Selected annuity value:

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

Question 12

In what range is the normal cost for 2001 as of January 1, 2001?

- (A) Less than \$10,750
- (B) \$10,750 but less than \$10,980
- (C) \$10,980 but less than \$11,210
- (D) \$11,210 but less than \$11,440
- (E) \$11,440 or more

2000

Data for Question 13

Normal retirement benefit:

Before 1/1/2000:	\$20 per month per year of service.
After 12/31/1999:	\$25 per month per year of service.

Early retirement benefit: Accrued benefit without reduction.

Actuarial cost method:

Before 1/1/2000:	Unit credit.
After 12/31/1999:	Entry age normal.

Actuarial assumptions:

Interest rate:	7% per year
Preretirement decrements:	None
Retirement age:	62

Valuation data for sole participant (active as of 1/1/2000):

Date of birth:	1/1/1945
Date of hire:	1/1/1980

Selected valuation results as of 1/1/1999:

Accrued liability:	\$24,910
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Question 13

In what range is the increase in the 1/1/2000 entry age normal accrued liability due to the plan amendment?

- (A) Less than \$7,000
- (B) \$7,000 but less than \$7,500
- (C) \$7,500 but less than \$8,000
- (D) \$8,000 but less than \$8,500
- (E) \$8,500 or more

2000

Data for Question 14

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

Normal form of benefit: Life annuity.

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: Unit credit.

Actuarial assumptions:

Interest rate: 7% per year

Preretirement decrements: None

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

<u>Age</u>	<u>Probability</u>
60	50%
62	75%
65	100%

Selected annuity values based on post-retirement assumptions:

<u>Age</u>	<u>$\ddot{a}_x^{(12)}$</u>
60	10.248
62	9.849
65	9.206

Valuation data for sole participant (active as of 1/1/2000):

Date of birth: 1/1/1941

Date of hire: 1/1/1980

Question 14

In what range is the 1/1/2000 accrued liability?

- (A) Less than \$31,300
- (B) \$31,300 but less than \$32,250
- (C) \$32,250 but less than \$33,200
- (D) \$33,200 but less than \$34,150
- (E) \$34,150 or more

2000

Data for Question 15

Plan effective date: 1/1/1998.

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

Compensation: Pay rate as of January 1.

Actuarial cost method: Individual level premium.

Actuarial assumptions:

Interest rate:	7% per year
Preretirement deaths and terminations:	None
Salary scale:	0%
Retirement age:	65

Valuation data for sole participant:

Date of birth:	1/1/1950
Date of hire:	1/1/1990

<u>Year</u>	<u>January 1 pay rate</u>
1998	\$50,000
1999	45,000
2000	55,000

Selected annuity value:

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

Question 15

In what range is the normal cost for 2000 as of 1/1/2000?

- (A) Less than \$7,500
- (B) \$7,500 but less than \$8,000
- (C) \$8,000 but less than \$8,500
- (D) \$8,500 but less than \$9,000
- (E) \$9,000 or more

2000

Data for Question 16

Plan effective date: 1/1/1980.

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 terminations other than death:	None
Normal retirement age:	65

Valuation data for only participants as of 1/1/2000:

	<u>Smith</u>	<u>Brown</u>
Date of birth:	1/1/1960	1/1/1942
Date of hire:	1/1/1995	1/1/1982
Monthly compensation:	\$2,500	\$3,500

Selected commutation functions:

<u>Age x</u>	<u>D_x</u>	<u>N_x</u>
35	920	12,727
40	651	8,701
58	174	1,862
65	97	893

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 8.748$$

Question 16

In what range is the accrued liability for 2000 as of 1/1/2000?

- (A) Less than \$97,000
- (B) \$97,000 but less than \$100,000
- (C) \$100,000 but less than \$103,000
- (D) \$103,000 but less than \$106,000
- (E) \$106,000 or more

2000

Data for Question 17

Normal retirement benefit: 2% of final year's compensation for each year of service up to 15 years, plus 1% of final year's compensation for each additional year of service.

Early retirement eligibility: Age 55.

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

Actuarial cost method: Projected unit credit (based on accrual rates).

Actuarial assumptions:

Interest rate:	7% per year
Compensation increases:	4% per year
Decrements prior to age 65:	None, other than retirement

Selected probabilities of retirement (beginning-of-year decrement):

\underline{x}	$\underline{q_x^{(r)}}$
55	0.25
56	0.10
65	1.00

Data for active employee Smith:

Date of birth:	1/1/1955
Date of hire:	1/1/1990
1999 compensation:	\$50,000

Selected annuity value:

$$\ddot{a}_{56} = 12.400$$

Question 17

In what range is the portion of Smith's normal cost as of 1/1/2000 attributable to expected retirement at age 56?

- (A) Less than \$400
- (B) \$400 but less than \$440
- (C) \$440 but less than \$480
- (D) \$480 but less than \$520
- (E) \$520 or more

2000

Data for Question 18

Normal retirement benefit: \$1,000 per month payable at the beginning of each month.

Normal form of benefit: 15 years certain and life.

Actuarial cost method: Unit credit.

Actuarial assumptions:

Interest rate:	7% per year
Preretirement decrements other than death:	None
Form of payment for death benefits:	Annuity for remaining term certain

Data for participant Smith:

Date of birth:	1/1/1930
Date of retirement:	1/1/1995
Date of death:	12/31/1999

Selected commutation functions based on valuation assumptions:

$\frac{x}{\quad}$	$\frac{D_x}{\quad}$	$\frac{N_x^{(12)}}{\quad}$
69	64,805	507,631
80	17,392	91,357

The beneficiary elected to receive the lump sum value of the remaining payments due upon Smith's death. The lump sum distribution is calculated using an interest rate of 5% per year, with the payment to be made on 1/1/2000.

Question 18

In what range is the experience gain during 1999 due to the death of Smith and the beneficiary's form of payment election?

- (A) Less than \$12,000
- (B) \$12,000 but less than \$14,000
- (C) \$14,000 but less than \$16,000
- (D) \$16,000 but less than \$18,000
- (E) \$18,000 or more

2000

Data for Question 19

Normal retirement age: 65.

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

Late retirement benefit: The greater of the retirement benefit calculated using total service until retirement or the actuarial equivalent of the benefit payable at normal retirement age, calculated using the valuation interest rate.

Death benefit: None.

Assumed interest rate: 5% per year.

Data for participant Smith:

Date of birth:	1/1/1934
Date of hire:	1/1/1969
Date of retirement:	1/1/2000
1996 compensation:	\$56,000
1997 compensation:	\$58,000
1998 compensation:	\$59,000
1999 compensation:	\$60,000

Selected commutation functions:

$\frac{\text{Age } x}{}$	$\frac{D_x}{}$	$\frac{N_x^{(12)}}{}$
65	321,867	3,230,371
66	299,624	2,918,698

Question 19

In what range is Smith's annual retirement benefit commencing on 1/1/2000?

- (A) Less than \$36,000
- (B) \$36,000 but less than \$36,750
- (C) \$36,750 but less than \$37,500
- (D) \$37,500 but less than \$38,250
- (E) \$38,250 or more

2000

Data for Question 20

Valuation date: 1/1/2001.

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

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest:	7% per year
Salary scale:	5% per year
Preretirement decrements other than death:	None
Retirement age:	65

Data for sole participant Smith:

Date of birth:	1/1/1940
Date of hire:	1/1/1975
2000 compensation:	\$50,000
Status:	Active

Selected commutation functions:

\underline{x}	\underline{D}_x	$\underline{{}^sD}_x$	\underline{N}_x	$\underline{{}^sN}_x$
35	894,190	4,932,364	12,364,650	138,500,016
60	144,405	2,697,364	1,483,514	42,615,152
61	133,046	2,609,460	1,339,110	39,917,788
65	94,414	2,250,810	868,052	30,013,858

Selected annuity value: $\ddot{a}_{65}^{(12)} = 8.7358$

Question 20

In what range is the mortality loss for 2000 due to Smith's survival to 1/1/2001?

- (A) Less than \$2,150
- (B) \$2,150 but less than \$2,400
- (C) \$2,400 but less than \$2,650
- (D) \$2,650 but less than \$2,900
- (E) \$2,900 or more

2000

ANSWER KEY

MAY 2000 COURSE EA-1, B

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