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

Exam P360U (EA1) Segment B

Date: Monday, May 19, 1997
Time: 1:00 p.m. - 3:30 p.m.

INSTRUCTIONS TO CANDIDATES

1. Write your candidate number here _____. Your name must not appear.
2. Do not break the seal of this book until the supervisor tells you to do so.
3. Special conditions generally applicable to all questions on this examination are found at the front of this book.
4. On this examination the symbol "a" will be used to represent an annuity.
5. This examination consists of 20 multiple-choice questions.
6. Each question has equal weight. Your score will be based on the number of questions which you answer correctly. No credit will be given for omitted answers and no credit will be lost for wrong answers; hence, you should answer all questions even those for which you have to guess.
7. A separate answer sheet is inside the front cover of this book. During the time allotted for this examination, record all your answers on side 2 of the answer sheet. NO ADDITIONAL TIME WILL BE ALLOWED FOR THIS PURPOSE. No credit will be given for anything indicated in the examination book but not transferred to the answer sheet. Failure to stop writing or coding your answer sheet after time is called will result in the disqualification of your answer sheet or further disciplinary action.
8. Five answer choices are given with each question, each answer choice being identified by a key letter (A to E). Answer choices for some questions have been rounded. For each question, blacken the oval on the answer sheet which corresponds to the key letter of the answer choice that you select.
9. Use a soft-lead pencil to mark the answer sheet. To facilitate correct mechanical scoring, be sure that, for each question, your pencil mark is dark and completely fills only the intended oval. Make no stray marks on the answer sheet. If you have to erase, do so completely.
10. Do not spend too much time on any question. If a question seems too difficult, leave it and go on.
11. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.
12. Clearly indicated answer choices in the test book can be an aid in grading examinations in the unlikely event of a lost answer sheet.
13. Use the blank portions of each page for your scratch work. Extra blank pages are provided at the back of the examination book. Graph paper is also provided at the back of the examination book.
14. When the supervisor tells you to do so, break the seal on the book and remove the answer sheet.
On side 1 of the answer sheet, space is provided to write and to code candidate information. Complete Blocks A through G as follows:

    (a) in Block A, print your name and the name of this test center;

    (b) in Block B, print your last name, first name and middle initial and code your name by blackening the ovals (one in each column) corresponding to the letters of your name; for each empty box, blacken the small rectangle immediately above the "A" oval;

    (c) write your candidate number in Block C (as it appears on your ticket of admission for this examination) and write the number of this test center in Block D (the supervisor will supply the number);

    (d) code your candidate number and center number by blackening the five ovals (one in each column) corresponding to the five digits of your candidate number and the three ovals (one in each column) corresponding to the three digits of the test center number, respectively. Please be sure that your candidate number and the test center number are coded correctly;

    (e) in Block E, code the examination that you are taking by blackening the oval to the left of "Exam P360";

    (f) in Block F, blacken the appropriate oval to indicate whether you are using a calculator; and

    (g) in Block G, sign your name and write today's date. If the answer sheet is not signed, it will not be graded.

On side 2 of your answer sheet, space is provided at the top for the number of this examination book. Enter the examination book number, from the upper right-hand corner of this examination book, in the four boxes at the top of side 2 marked "BOOKLET NUMBER."

15. After the examination, the supervisor will collect this book and the answer sheet separately. DO NOT ENCLOSE THE ANSWER SHEET IN THE BOOK. All books and answer sheets must be returned. THE QUESTIONS ARE CONFIDENTIAL AND MAY NOT BE TAKEN FROM THE EXAMINATION ROOM.

SPRING 1997
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) 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.

1997

Data for Question 1

Plan effective date: 1/1/76.

Normal retirement benefit:

Before 1997: 50% of final 3-year average compensation.
After 1996: 60% of final 3-year average compensation.

Actuarial cost method: Entry age normal.

Actuarial assumptions:

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

Valuation data and results for all participants as of 1/1/97 (before amendment):

	Smith	Brown
Date of hire	1/1/96	1/1/79
Normal cost as of 1/1	$1,840	$1,580

Question 1

In what range is the increase in the accrued liability as of 1/1/97 due to the plan amendment?

(A) Less than $12,000

(B) $12,000 but less than $13,000

(C) $13,000 but less than $14,000

(D) $14,000 but less than $15,000

(E) $15,000 or more

1997

Data for Question 2

Actuarial cost method: Aggregate.

Mandatory employee contributions: 1.5% of compensation, paid on 1/1.

Voluntary employee contributions for 1997: $10,000, paid on 1/1.

Selected 1/1/97 valuation results:

Present value of all future retirement benefits	$2,500,000
Present value of refunds of mandatory employee contributions upon death or termination	84,000
Present value of other employer-provided death and termination benefits	25,000
Value of assets as of 12/31/96	725,000
Accumulated voluntary employee contributions included in assets as of 12/31/96	35,000
Present value of future compensation	8,400,000
1997 valuation compensation	1,200,000

Question 2

In what range is the employer normal cost for 1997 as of 1/1/97?

(A) Less than $250,000

(B) $250,000 but less than $255,000

(C) $255,000 but less than $260,000

(D) $260,000 but less than $265,000

(E) $265,000 or more

1997

Data for Question 3

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

Actuarial cost method: Individual aggregate (level percentage of compensation).

Actuarial assumptions:

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

Valuation data for participant Smith (active as of 1/1/97):

Date of birth	1/1/55
1997 valuation compensation	$20,800
Allocated value of assets as of 1/1/97	6,000

Selected annuity value:

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

Question 3

In what range is the normal cost attributable to Smith for 1997 as of 1/1/97?

(A) Less than $2,030

(B) $2,030 but less than $2,130

(C) $2,130 but less than $2,230

(D) $2,230 but less than $2,330

(E) $2,330 or more

1997

Data for Question 4

Normal retirement benefit: 2% of final 3-year average compensation for each of the first 20 years of service plus 1.5% of final 3-year average compensation for each of the next 10 years of service.

Actuarial cost method: Projected unit credit, prorated on actual accrual percentages.

Assumed compensation increases: 4% per year.

Valuation data for sole participant:

Date of birth	1/1/42
Date of hire	1/1/77
1996 valuation compensation for 1/1/96 valuation	$50,000
1997 valuation compensation for 1/1/97 valuation	53,000

Accrued liability as of 1/1/96: $97,000.

Selected commutation functions:

$D_{54} = 23{,}593$

$D_{55} = 21{,}867$

Question 4

In what range is the normal cost for 1997 as of 1/1/97?

(A) Less than $4,200

(B) $4,200 but less than $4,600

(C) $4,600 but less than $5,000

(D) $5,000 but less than $5,400

(E) $5,400 or more

1997

Data for Question 5

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

Actuarial cost method: Individual level premium (level dollar amount).

Actuarial assumptions:

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

Valuation data for sole participant (active as of 1/1/97):

Date of birth	1/1/67
Date of hire	1/1/92
1996 valuation compensation for 1/1/96 valuation	$25,000
1997 valuation compensation for 1/1/97 valuation	27,500

Selected annuity value:

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

Question 5

In what range is the increase in the normal cost for 1997 as of 1/1/97 due to compensation increases from 1996 to 1997?

(A) Less than $310

(B) $310 but less than $320

(C) $320 but less than $330

(D) $330 but less than $340

(E) $340 or more

1997

Data for Question 6

Normal retirement benefit: $1,000 per month.

Normal form of payment: Life annuity.

Optional form of payment: Joint and 100% survivor benefit equal to 88% of life annuity benefit.

Assumed form of payment: Life annuity:

Data for Smith:

Date of birth	1/1/32
Spouse's date of birth	1/1/37
Date of retirement	1/1/97

Selected annuity values:

x	$\ddot{a}_x^{(12)}$
60	9.8150
65	8.7358

x	y	$\ddot{a}_x^{(12)} + \ddot{a}_y^{(12)} - \ddot{a}_{xy}^{(12)}$
65	60	11.1165
65	65	10.5755

Question 6

In what range is the experience loss as of 1/1/97 due to Smith's election of the optional form of payment?

(A) Less than $12,700

(B) $12,700 but less than $12,900

(C) $12,900 but less than $13,100

(D) $13,100 but less than $13,300

(E) $13,300 or more

1997

Data for Question 7

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

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

Actuarial assumptions:

Compensation increases: 5% per year.
Preretirement terminations other than deaths: None.
Retirement age: 65.

Valuation data for sole participant (active as of 1/1/97):

Date of birth	1/1/57
Date of hire	1/1/87
1997 valuation compensation	$42,000

Selected commutation functions:

x	D_x	N_x	${}^sD_x$	${}^sN_x$
30	1,261,611	17,887,840	5,452,611	164,704,000
40	632,274	8,452,729	4,451,205	114,813,792
64	103,139	971,191	2,341,728	32,355,586
65	94,414	868,052	2,250,810	30,013,858

Question 7

In what range is the accrued liability as of 1/1/97?

(A) Less than $28,000

(B) $28,000 but less than $30,000

(C) $30,000 but less than $32,000

(D) $32,000 but less than $34,000

(E) $34,000 or more

1997

Data for Question 8

Actuarial cost method: Unit credit.

Assumed interest rate: 8% per year.

Selected valuation results:

	1/1/96	1/1/97
Normal cost as of 1/1	$100,000	
Accrued liability	800,000	$1,000,000
Value of assets	400,000	600,000

Contributions for 1996: $100,000 paid on 7/1/96 and $50,000 paid on 12/31/96.

Benefit payments for 1996: $13,000 paid on 12/31/96.

Question 8

In what range is the net experience loss for 1996 from all non-investment sources?

(A) Less than $4,000

(B) $4,000 but less than $14,000

(C) $14,000 but less than $24,000

(D) $24,000 but less than $34,000

(E) $34,000 or more

1997

Data for Question 9

Plan effective date: 1/1/95.

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

Actuarial cost method: Attained age normal.

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	1/1/51
Date of hire	1/1/85
1997 valuation compensation	$52,000

Selected valuation results as of 1/1/96:

Normal cost as of 1/1	$ 6,300
Unfunded liability	45,000
Value of assets	5,000

Contribution for 1996: $7,000 paid on 12/31/96.

Benefit payments for 1996: $0.

There were no experience gains or losses during 1996 from any source other than an investment gain of $900.

Selected annuity value:

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

Question 9

In what range is the normal cost for 1997 as of 1/1/97?

(A) Less than $6,500

(B) $6,500 but less than $7,000

(C) $7,000 but less than $7,500

(D) $7,500 but less than $8,000

(E) $8,000 or more

1997

Data for Question 10

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

Actuarial assumptions:

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

Selected valuation results as of 1/1/96:

Normal cost as of 1/1	$ 50,000
Present value of future benefits	1,400,000
Value of assets	390,000
Unfunded liability	300,000

Contribution for 1996: $75,000 paid on 7/1/96.

Benefit payments during 1996: $0.

There were no experience gains or losses during 1996 from any source other than an investment gain of $6,000.

No participants terminated, died, or retired during 1996, and there are no new participants as of 1/1/97.

Question 10

In what range is the normal cost for 1997 as of 1/1/97?

(A) Less than $48,500

(B) $48,500 but less than $49,000

(C) $49,000 but less than $49,500

(D) $49,500 but less than $50,000

(E) $50,000 or more

1997

Data for Question 11

Actuarial cost method: Aggregate.

Normal form of payment for single participants: Life annuity.

Normal form of payment for married participants: Joint and 100% survivor annuity with benefit equal to:

Before 1/1/97 amendment: Actuarial equivalent of life annuity benefit.
After 1/1/97 amendment: 100% of life annuity benefit.

Assumed form of payment:

Before 1/1/97 amendment: Life annuity for all participants.
After 1/1/97 amendment: Life annuity for single participants; joint and 100% survivor annuity for married participants.

Married participants assumptions: 80% married, with no age difference between spouses.

Selected valuation results as of 1/1/97 (before amendment):

Present value of future benefits	$ 2,000,000
Value of assets	1,050,000
Present value of future compensation	27,000,000
1997 valuation compensation	1,600,000

There are no inactive participants as of 1/1/97.

Selected annuity values:

$12\ddot{a}_{65}^{(12)} = 104.83$ $\qquad$ $12\ddot{a}_{\overline{65:65}}^{(12)} = 126.9$

Question 11

In what range is the increase in the normal cost for 1997 as of 1/1/97 due to the plan amendment?

(A) Less than $19,000

(B) $19,000 but less than $21,000

(C) $21,000 but less than $23,000

(D) $23,000 but less than $25,000

(E) $25,000 or more

Data for Question 12 1997

Actuarial cost method: Individual aggregate (level dollar). Assets are allocated first to inactive participants; the remaining assets are allocated to each active participant in proportion to the sum of the prior year's normal cost and allocated assets.

Actuarial assumptions:

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

Valuation data for all participants and selected valuation results:

	Smith	Brown	Green
Date of birth	1/1/62	1/1/57	1/1/60
Normal cost as of 1/1/96	$ 12,000	$ 7,500	$ 6,800
Allocated value of assets as of 1/1/96	35,000	41,000	27,000
Present value of future benefits as of 1/1/97	212,000	136,000	11,000
Status as of 1/1/97	Active	Active	Terminated 12/31/96

Value of assets as of 1/1/97: $115,000.

Question 12

In what range is the normal cost for 1997 as of 1/1/97?

(A) Less than $16,000

(B) $16,000 but less than $17,000

(C) $17,000 but less than $18,000

(D) $18,000 but less than $19,000

(E) $19,000 or more

1997

Data for Question 13

Normal retirement benefit: $1,500 per month.

Normal form of payment: Life annuity.

Actuarially-equivalent optional form of payment available to married participants:

> Annuity certain of $X per month for the first 120 months, plus, after 120 months, an annuity of $X per month for life of participant and $X/2 per month for life of spouse if participant dies first.

Actuarial assumptions:

> Interest rate: 7% per year.
> Preretirement terminations other than deaths: None.
> Retirement age: 65.

Date of birth of Smith: 1/1/32.

Date of birth of Smith's spouse: 1/1/32.

Selected commutation functions and annuity values on the valuation basis:

x	D_x	N_x
65	965	8,872
75	346	2,379

$\ddot{a}^{(12)}_{\overline{10}|} = 7.29$ $\quad \ddot{a}^{(12)}_{65} = 8.74$ $\quad \ddot{a}^{(12)}_{65:65} = 6.90$ $\quad \ddot{a}^{(12)}_{75} = 6.42$ $\quad \ddot{a}^{(12)}_{75:75} = 4.60$

Smith retires on 1/1/97 and elects the optional form of payment for married participants.

Quesiton 13

In what range is $X for Smith?

(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

1997

Data for Question 14

Plan effective date: 1/1/82.

Normal retirement benefit: $25 per month for first year of accrual, with each subsequent year's accrual being 2% greater than the prior year's accrual.

Actuarial cost method: Unit credit.

Actuarial assumptions:

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

Value of assets as of 1/1/97: $17,810.

Valuation data for sole participant (active as of 1/1/97):

Date of birth	1/1/47
Date of hire	1/1/82

Selected annuity value:

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

Question 14

In what range is the unfunded liability as of 1/1/97?

(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

1997

Data for Question 15

Plan effective date: 1/1/97.

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

Actuarial cost method: Attained age normal.

Actuarial assumptions:

Preretirement terminations other than deaths: None.
Retirement age: 65.

Valuation data for all 100 participants (all active as of 1/1/97):

Date of birth	1/1/62
Date of hire	1/1/92

Selected commutation functions and annuity values:

$D_{65} = 94{,}414$ $\quad N_{65} = 868{,}052$

$\ddot{a}_{35} = 13.8278$ $\quad \ddot{a}_{35:\overline{30}|} = 12.8570$

Question 15

In what range is the normal cost for 1997 as of 1/1/97?

(A) Less than $46,000

(B) $46,000 but less than $49,000

(C) $49,000 but less than $52,000

(D) $52,000 but less than $55,000

(E) $55,000 or more

1997

Data for Question 16

Termination benefit: None

Actuarial cost method: Entry age normal.

Actuarial assumptions:

Interest rate: 7% per year.
Compensation increases: None.
Preretirement decrements other than terminations: None.
Selected probabilities of termination:

x	$q_x^{(\tau)}$
37	.50
38	.40
39	.30
40	.20
41	.10

Retirement age: 65.

Valuation data for all participants and selected valuation results as of 1/1/97:

	Smith	Brown	Green
Date of birth	1/1/59	1/1/58	1/1/56
Date of participation	1/1/96	1/1/96	1/1/94
Normal cost as of 1/1	$1,000	$2,500	$4,500

Question 16

In what range is the accrued liability as of 1/1/97?

(A) Less than $34,000

(B) $34,000 but less than $38,000

(C) $38,000 but less than $42,000

(D) $42,000 but less than $46,000

(E) $46,000 or more

1997

Data for Question 17

Retirement benefit:

$500 per month, reduced by 1/15 for each of the first 5 years and by 1/30 for each of the next 5 years by which benefits commence before age 65.

Actuarial assumptions:

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

Effective 1/1/97, two participants aged 56 and 63 retire and elect to commence receiving benefits immediately.

Selected annuity values:

x	$\ddot{a}_x^{(12)}$
56	10.5993
63	9.1775
65	8.7358

Question 17

In what range is the increase in the present value of benefits as of 1/1/97 due to the retirements?

(A) Less than $6,000

(B) $6,000 but less than $7,000

(C) $7,000 but less than $8,000

(D) $8,000 but less than $9,000

(E) $9,000 or more

1997

Data for Question 18

Normal retirement benefit: $500 per month.

Normal form of payment: Life annuity.

Optional forms of payment:

(A) Lump sum of $60,000.

(B) $400 per month for life of spouse, and $500 per month for life of retiree if spouse dies first.

(C) $K/12 per month for life of retiree, and $K/24 per month for life of spouse if retiree dies first.

Each optional form of payment is actuarially equivalent to the normal form of payment.

Actuarial equivalence is based on unisex mortality.

The retiree and the spouse are the same age.

Question 18

In what range is $K?

(A) Less than $4,200

(B) $4,200 but less than $4,600

(C) $4,600 but less than $5,000

(D) $5,000 but less than $5,400

(E) $5,400 or more

1997

Data for Question 19

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

Actuarial cost method: Frozen initial liability.

Actuarial assumptions:

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

Selected valuation results for sole participant:

	1/1/96	1/1/97
Normal cost as of 1/1	$ 12,000	$12,000
Present value of future benefits	400,000	
Unfunded liability	80,000	
Value of assets (before contribution)	200,000	
Valuation compensation for plan year	80,000	83,200

Contribution for 1996: $22,645 paid on 1/1/96.

The only experience gains or losses during 1996 were from investments and compensation increases.

The sole participant as of 1/1/96 was active and under age 63.

Question 19

In what range was the rate of return on assets during 1996?

(A) Less than 6.50%

(B) 6.50% but less than 7.50%

(C) 7.50% but less than 8.50%

(D) 8.50% but less than 9.50%

(E) 9.50% or more

1997

Data for Question 20

Plan effective date: 1/1/92.

Actuarial cost method: Frozen initial liability.

Assumed interest rates:

Valuations before 1996: 7% per year.
Valuations after 1995: 8% per year.

Normal cost for 1995 as of 1/1/95: $10,000.

Unfunded liability as of 1/1/95: $60,000.

Selected valuation results as of 1/1/96:

	7%	8%
Normal cost as of 1/1	$11,000	$10,000
Entry age normal accrued liability	70,000	63,000
Value of assets	50,000	50,000

Contributions for 1995: $5,000 paid on 1/1/95 and $5,000 paid on 7/1/95.

Contributions for 1996: $4,000 paid on 1/1/96 and $4,000 paid on 7/1/96.

Question 20

In what range is the unfunded liability as of 1/1/97?

(A) Less than $54,000

(B) $54,000 but less than $59,000

(C) $59,000 but less than $64,000

(D) $64,000 but less than $69,000

(E) $69,000 or more

1997 EA-1(B)

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