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

Exam 141 (EA1) Segment A

Date: Monday, May 19, 1997
Time: 8:30 a.m. - 11:00 a.m.

0011

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. On this examination the symbol "l_x" will be used to represent the number of lives at age x.

5. This examination consists of 25 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). 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 one 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.

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 141(EA1) Segment A";

    (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.

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1997

Data for Question 1

Market value of a pension fund:

Date	Value Before Cash Flow
1/1/97	$1,000,000
7/1/97	1,030,000
X	1,025,000
12/31/97	1,150,000

Total cash flow in fund in 1997:

Date	Contributions	Benefit Payments
7/1/97	$ 0	$50,000
X	100,000	0

The time-weighted and dollar-weighted rates of return for the fund are equal.

Question 1

In what range is X?

[A] Before 8/1/97

[B] 8/1/97 to 8/31/97

[C] 9/1/97 to 9/30/97

[D] 10/1/97 to 10/31/97

[E] 11/1/97 or after

1997

Data for Question 2

Date of a loan: 1/1/97.

Date of first repayment: 1/31/97.

Frequency of repayments: Monthly.

Number of repayments: 36 months.

Amount of each repayment: $100.

Total interest paid in final 12 repayments: $109.20.

Question 2

In what range is the total interest paid in the middle 12 repayments?

[A] Less than $280

[B] $280 but less than $290

[C] $290 but less than $300

[D] $300 but less than $310

[E] $310 or more

1997

Data for Question 3

Date of a loan: 1/1/92.

Amount of loan: $100,000.

Date of first repayment: 1/31/92.

Frequency of repayments: Monthly.

Number of repayments: 360.

Interest rate: 10% per year, compounded monthly.

The loan is refinanced on 1/1/97 at a revised interest rate of 9% per year, compounded monthly, with the number of remaining monthly repayments reduced to 180.

Question 3

In what range is the reduction, due to the refinancing, in the total interest payments over the life of the loan?

[A] Less than $80,000

[B] $80,000 but less than $85,000

[C] $85,000 but less than $90,000

[D] $90,000 but less than $95,000

[E] $95,000 or more

1997

Data for Question 4

Terms of a loan:

Date of loan: 1/1/97.

Amount of loan: $200,000.

Interest rate: 9% per year, compounded monthly.

Date of first scheduled repayment: 1/31/97.

Frequency of scheduled repayments: Monthly.

Amount of each scheduled repayment: $P.

Number of scheduled repayments: 360.

The borrower makes additional repayments as follows:

Frequency of additional repayments: Each 12/31.

Amount of additional repayments: $P.

Question 4

In what range is the reduction in the number of scheduled repayments due to the additional repayments?

[A] Less than 83

[B] 83 but less than 87

[C] 87 but less than 91

[D] 91 but less than 95

[E] 95 or more

1997

Data for Question 5

Data for two funds:

	Fund A	Fund B
Interest/discount rate for first 10 years	$i^{(4)} = 6\%$	$d^{(12)} = 9\%$
Discount/interest rate for second 10 years	$d^{(4)} = 9\%$	$i^{(12)} = 12\%$
Initial amount in fund	\$W	\$X
Amount in fund at end of 20 years	\$Y	\$Z

There are no contributions to or withdrawals from either fund.

\$W + \$X = \$10,000

\$Y + \$Z = \$57,186

Question 5

In what range is \$Y?

[A] Less than \$27,500

[B] \$27,500 but less than \$28,400

[C] \$28,400 but less than \$29,300

[D] \$29,300 but less than \$30,200

[E] \$30,200 or more

1997

Data for Question 6

Date of a loan: 1/1/97.

Amount of loan: $X.

Date of first repayment: 12/31/97.

Frequency of repayments: Annually.

Number of repayments: 16.

Interest rate: 7% per year, compounded annually.

Amount of each repayment:

First year: $100.
Next 9 years: $200 greater than the prior year's amount.
Final 6 years: $300 less than the prior year's amount.

Question 6

In what range is $X?

[A] Less than $8,300

[B] $8,300 but less than $8,400

[C] $8,400 but less than $8,500

[D] $8,500 but less than $8,600

[E] $8,600 or more

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Data for Question 7

Date of a loan: 1/1/97.

Amount of loan: $1,000,000.

Date of first repayment: 1/31/97.

Type and frequency of repayments: Level and monthly.

Number of repayments: 360.

Interest rate for first 15 years: 7% per year, compounded annually.

Interest rate for last 15 years: 11% per year, compounded annually.

Question 7

In what range is the amount of interest paid in the 204th repayment?

[A] Less than $5,120

[B] $5,120 but less than $5,240

[C] $5,240 but less than $5,360

[D] $5,360 but less than $5,480

[E] $5,480 or more

1997

Data for Question 8

As of 1/1/97, a portfolio of assets consists of the following:

(A) An annuity certain with 20 annual payments of $2,000 beginning on 12/31/2007.

(B) A $10,000 zero coupon bond maturing on 12/31/2001.

Interest rate: 8% per year, compounded annually.

Question 8

In what range is the *modified duration* of the portfolio as of 1/1/97?

[A] Less than 10.70

[B] 10.70 but less than 11.20

[C] 11.20 but less than 11.70

[D] 11.70 but less than 12.20

[E] 12.20 or more

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Data for Question 9

Face amount of a bond: $1,000.

Coupon rate: 7% per year, payable semiannually on each 6/30 and 12/31.

Amortized value of bond as of 6/30/97 (before payment of coupon): $939.33.

Amortized value of bond as of 12/31/97 (before payment of coupon): $943.78.

Question 9

In what range is the annual effective yield rate for the bond?

[A] Less than 8.00%

[B] 8.00% but less than 8.25%

[C] 8.25% but less than 8.50%

[D] 8.50% but less than 8.75%

[E] 8.75% or more

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Data for Question 10

Date of first payment of a perpetuity: 1/1/97.

Amount of each payment: $\frac{\$(n+1)(n+2)}{2}$, where n=0 at 1/1/97 and increases by 1 each 1/1 thereafter.

Interest rate: 25% per year, compounded annually.

Question 10

In what range is the present value of the perpetuity as of 1/1/97?

[A] Less than $70

[B] $70 but less than $90

[C] $90 but less than $110

[D] $110 but less than $130

[E] $130 or more

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Data for Question 11

Frequency of deposits to a savings account: Monthly.

Date of first deposit: 1/31/81.

Amount of each deposit: $25 each month in first year, increasing each January 31 thereafter by 12% over the monthly amount for the prior year.

Interest rate: 12% per year, compounded monthly.

Question 11

In what range is the value of the savings account as of 1/1/99?

[A] Less than $40,300

[B] $40,300 but less than $40,700

[C] $40,700 but less than $41,100

[D] $41,100 but less than $41,500

[E] $41,500 or more

1997

Data for Question 12

Type of insurance policy: Endowment at age 65.

Death benefit: $10,000, payable at end of year of death.

Issue age: 45.

Net annual premium: $350.

Selected commutation functions:

$D_{64} = 12{,}196$ $D_{65} = 11{,}240$

The final premium is not paid, and the reserve at the end of the 19th year is used to provide extended term insurance of $10,000 for the final year plus a pure endowment at the end of that year.

Question 12

In what range is the amount of the pure endowment?

[A] Less than $9,615

[B] $9,615 but less than $9,625

[C] $9,625 but less than $9,635

[D] $9,635 but less than $9,645

[E] $9,645 or more

1997

Data for Question 13

A single premium annuity provides $1,000 at the end of each year if at least one of Smith or Brown is alive and under age 18.

Age of Smith on annuity purchase date: 10.

Age of Brown on annuity purchase date: 14.

Selected annuity factors:

$a_{10:\overline{4}|} = 3.28$ $a_{10:\overline{8}|} = 5.78$ $a_{14:\overline{4}|} = 3.22$

$a_{14:\overline{8}|} = 5.68$ $a_{10:14:\overline{4}|} = 3.12$ $a_{10:14:\overline{8}|} = 5.53$

Question 13

In what range is the net single premium for the annuity?

[A] Less than $5,600

[B] $5,600 but less than $5,700

[C] $5,700 but less than $5,800

[D] $5,800 but less than $5,900

[E] $5,900 or more

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Data for Question 14

Selected values from a two decrement (death and withdrawal) table, where each decrement is distributed uniformly over each year of age:

x	$l_x^{(T)}$
40	100,000
41	93,674
42	87,867

$d_{40}^{(d)} = 213$

$q'^{(d)}_{41} = .0024$

Question 14

In what range is the probability that an individual aged 40 will withdraw before age 42?

[A] Less than 0.11650

[B] 0.11650 but less than 0.11680

[C] 0.11680 but less than 0.11710

[D] 0.11710 but less than 0.11740

[E] 0.11740 or more

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Data for Question 15

A college maintains a stationary population of 15,000 students by annual admissions at ages 18 and 19.

Selected values:

x	l_x	L_x	T_x
18	100,000	97,917	266,668
19	93,750	85,417	168,751
20	75,000	60,417	83,334
21	56,250	22,917	22,917
22	0	0	0

Annual admissions at age 18: 4,000.

Question 15

In what range is the number of annual admissions at age 19?

[A] Less than 2,250

[B] 2,250 but less than 2,500

[C] 2,500 but less than 2,750

[D] 2,750 but less than 3,000

[E] 3,000 or more

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Data for Question 16

Present values of a monthly annuity of $1 payable at the end of each month:

If Smith is alive: $100.

If Brown is alive: $X.

If only Smith is alive: $20.

If only Smith or only Brown is alive: $50.

Question 16

In what range $X?

[A] Less than $85

[B] $85 but less than $95

[C] $95 but less than $105

[D] $105 but less than $115

[E] $115 or more

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Data for Question 17

Terms of an annuity contract:

Date of purchase: 1/1/97.
Date of first payment: 1/1/97.
Amount of each payment: $50.
Frequency of payments: Monthly.
Death benefit: $10,000, payable at end of year of death if death occurs during first 10 years.
Interest rate: 7% per year, compounded annually.

Annuitant's date of birth: 1/1/32.

Selected commutation functions:

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

Question 17

In what range is the net single premium for the annuity contract?

[A] Less than $6,500

[B] $6,500 but less than $7,500

[C] $7,500 but less than $8,500

[D] $8,500 but less than $9,500

[E] $9,500 or more

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Data for Question 18

Selected values from a select and ultimate mortality table:

n	$q_{[x]+n}$ / q_{x+n}
0	.05
1	.65
2	.90
3 or more	1.00

$l_{x+3} = l_{[x]+3}$

l_x = 1,000 - (10 times x)

Question 18

In what range is $l_{[68]+2}$?

[A] Less than 294

[B] 294 but less than 296

[C] 296 but less than 298

[D] 298 but less than 300

[E] 300 or more

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Data for Question 19

Values from a mortality table:

	q_x
For $0 \le x \le 35$	.01/1.01
For $36 \le x \le 75$	.02/1.02
For $76 \le x$	1.00

Question 19

In what range is the curtate expectation of life, e_0?

[A] Less than 48.85

[B] 48.85 but less than 49.35

[C] 49.35 but less than 49.85

[D] 49.85 but less than 50.35

[E] 50.35 or more

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Data for Question 20

Type of insurance policy: Whole life.

Death benefit: $1,000, payable at end of year of death.

$1000\ {}_5V_{40} = 43.46$

Selected commutation functions:

x	D_x	N_x
45	45,482	581,634
46	42,362	

Question 20

In what range is $1000\ {}_6V_{40}$?

[A] Less than 50.00

[B] 50.00 but less than 51.00

[C] 51.00 but less than 52.00

[D] 52.00 but less than 53.00

[E] 53.00 or more

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Data for Question 21

Terms of two actuarially equivalent annuities:

	Annuity A	Annuity B
Date of issue	1/1/97	1/1/97
Issue age	40	40
Type of annuity	Perpetuity	Life
Frequency of payments	Monthly	Monthly
Date of first payment	1/31/97	1/31/97
Amount of each payment	$P	$1,000

Selected commutation functions and probabilities of death:

x	D_x	N_x	q_x
40	651	8,700	0.002125
41	607	8,049	0.002327

Question 21

In what range is $P?

[A] Less than $860

[B] $860 but less than $875

[C] $875 but less than $890

[D] $890 but less than $905

[E] $905 or more

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Data for Question 22

Interest rate: 7% per year, compounded annually.

Selected annuity values:

$\ddot{a}_x^{(12)} = 7.6022$ $\ddot{a}_{x+1}^{(12)} = 7.3683$ $\ddot{a}_{x+2}^{(12)} = 7.1321$

Question 22

In what range is ${}_{1|}q_x$?

[A] Less than .0355

[B] .0355 but less than .0365

[C] .0365 but less than .0375

[D] .0375 but less than .0385

[E] .0385 or more

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Data for Question 23

Terms of an annual premium deferred life annuity contract:

Age at first premium payment: 40.
Number of premium payments: 25.
Age at first annuity payment: 65.
Frequency of annuity payments: Monthly.
Amount of each annuity payment: $1,000.
Death benefit: None.

Selected commutation functions:

x	D_x	$N_x^{(12)}$
40	4,454	52,051
41	4,116	47,752
65	527	4,320
66	477	3,816

Question 23

In what range is the net annual premium?

[A] Less than $1,000

[B] $1,000 but less than $1,050

[C] $1,050 but less than $1,100

[D] $1,100 but less than $1,150

[E] $1,150 or more

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Data for Question 24

Selected values:

x	e_x
63	9.5
64	9.0
65	8.5

Question 24

In what range is the probability that someone age 63 will not survive to age 65?

[A] Less than .099

[B] .099 but less than .104

[C] .104 but less than .109

[D] .109 but less than .114

[E] .114 or more

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Data for Question 25

Type of insurance policy: Whole life.

Death benefit: $10,000, payable at end of year of death.

Net single premium at age 50: $5,000.

Interest rate: 8% per year, compounded annually.

Selected values:

x	l_x
50	100
51	95
52	90
53	85

Question 25

In what range is the net single premium at age 53?

[A] Less than $5,200

[B] $5,200 but less than $5,400

[C] $5,400 but less than $5,600

[D] $5,600 but less than $5,800

[E] $5,800 or more

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