SOCIETY OF ACTUARIES

AMERICAN SOCIETY OF PENSION ACTUARIES

JOINT BOARD FOR THE ENROLLMENT OF ACTUARIES

COURSE 141 (EA1) SEGMENT A

JOINT BOARD BASIC EXAMINATION

This is the May 1995 examination which has been released to the public by the administering organizations.

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EA-1A

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Conditions Generally Applicable to
All EA-1 Segment A Examination Questions

The following conditions should be considered a part of the data for each question, unless otherwise stated or implied.

(1) The normal retirement age is 65.

(2) Retirement pensions commence at normal retirement age and are paid monthly for life at the beginning of each month.

(3) There are no preretirement death benefits.

(4) Actuarial equivalence is based on the mortality table and interest rate assumed for funding purposes.

(5) Interest rates which are compounded more frequently than annually are expressed as nominal rates.

1995

Data for Question 1

Amount of a loan: $125,000.

Frequency of payments: Monthly, at the end of each month.

Term of loan: 30 years.

Effective annual interest rate: 5%.

Initial monthly payment: $P.

Payments in a given year are level and are 2% greater than those for the previous year.

Question 1

In what range is $P?

[A] Less than $500

[B] $500 but less than $530

[C] $530 but less than $560

[D] $560 but less than $590

[E] $590 or more

1995

Data for Question 2

Market value of pension fund:

1/01/94	$ 100,000
4/01/94	100,000
7/01/94	150,000
10/01/94	140,000
1/01/95	130,000

Cash flow in fund:

Date	Contributions	Benefit Payments
3/31/94	--	$ 10,000
6/30/94	$ 50,000	10,000
9/30/94	--	10,000
12/31/94	--	10,000

Consider the following measures of the fund's rate of return for 1994:

I. Time-weighted rate of return.

II. Dollar-weighted rate of return using simple interest.

III. Effective rate derived by compounding the quarterly rates of return using simple interest during the quarter and assuming a uniform distribution of all cash flows throughout each quarter.

Question 2

Which of the following is true?

[A] I > II > III

[B] I > III > II

[C] II > III > I

[D] III > II > I

[E] The correct answer is not given by [A], [B], [C], or [D] above.

1995

Data for Question 3

Date of a loan: 1/1/95.

Amount of loan: $100,000.

Date of first payment: 1/31/95.

Frequency of payments: Monthly.

Number of payments: 240.

Interest rate: 7% per year, compounded annually.

Date of birth of borrower: 1/1/45.

Upon the borrower's death, no further payments are due under the loan.

Selected commutation functions:

x	D_x	N_x
50	310,647	3,752,218
51	288,694	3,441,571
70	58,623	472,528
71	52,884	413,905

Question 3

In what range is the monthly payment?

[A] Less than $760

[B] $760 but less than $780

[C] $780 but less than $800

[D] $800 but less than $820

[E] $820 or more

1995

Data for Question 4

Selected values from a select and ultimate mortality table:

x	$q_{[x]}$	$q_{[x]+1}$	$q_{[x]+2}$	q_{x+3}
60	.009913	.012038	.013454	.014162
61	.010856	.013183	.014734	.015509
62	.011907	.014459	.016160	.017010
63	.013080	.015882	.017751	.018685
64	.014362	.017439	.019491	.020517

Date Smith was insured: 1/1/94.

Smith's age as of 1/1/95: 61.

Question 4

In what range is the probability as of 1/1/95 that Smith survives to 1/1/2001?

[A] Less than .9110

[B] .9110 but less than .9130

[C] .9130 but less than .9150

[D] .9150 but less than .9170

[E] .9170 or more

1995

Data for Question 5

Terms of an annuity:

Date of first payment: 12/31/95.

Frequency of payments: Annual, at the end of each year.

Amount of payments:
$1,500 per year, payable for the first n years.
$2,500 per year, payable for the next m years.
$3,500 per year, payable for the next 2n years.

Selected annuity values:

$a_{\overline{n}|} = 8.559$ $\quad a_{\overline{m}|} = 9.818$ $\quad v^m = .215$

Question 5

In what range is the present value of the annuity as of 1/1/95?

[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

1995

Data for Question 6

Date of a loan: 1/1/89.

Amount of loan: $12,000.

Date of first payment: 1/31/89.

Frequency of payments: Monthly.

Number of payments: 120.

Interest rate: 12% per year, compounded monthly.

No payments were made during 1993. On 1/1/94, the level monthly payments were redetermined without changing the original loan maturity date or interest rate.

Question 6

In what range is the monthly loan payment due 1/31/94?

[A] Less than $195

[B] $195 but less than $205

[C] $205 but less than $215

[D] $215 but less than $225

[E] $225 or more

1995

Data for Question 7

Selected values from a combined disability and mortality table:

$l_{40}^{aa} = 100{,}000$ $\qquad$ $l_{41}^{aa} = 99{,}788$

$r_{40} = .000415$ $\qquad$ $r_{41} = .000430$

$l_{40}^{ii} = 180$ $\qquad$ $l_{41}^{ii} = 187$ $\qquad$ $l_{42}^{ii} = 194$

r_x is the probability of an active life aged x becoming disabled during the year.

Disabled lives are assumed not to recover.

Question 7

In what range is the probability that a disabled life aged 40 will die between age 41 and age 42?

[A] Less than .145

[B] .145 but less than .159

[C] .159 but less than .173

[D] .173 but less than .187

[E] .187 or more

1995

Data for Question 8

Terms of an insurance contract:

$1,000 is payable at the end of the year of Smith's death, but only if Smith dies after Brown.

Effective date of contract: 1/1/95.

Age of Smith as of 1/1/95: 65.

Age of Brown as of 1/1/95: 64.

Selected insurance values:

A_{64}	=	.10	$A_{64:65}^{\;\;1}$	=	.04
A_{65}	=	.12			
$A_{64:65}$	=	.14			

Question 8

In what range is the net single premium for the contract as of 1/1/95?

[A] Less than $45

[B] $45 but less than $55

[C] $55 but less than $65

[D] $65 but less than $75

[E] $75 or more

1995

Data for Question 9

Effective date of a perpetuity: 1/1/95.

Date of first payment: 12/31/95.

Frequency of payments: Annual.

Annual payment: $100 in 1995. Each of the succeeding 9 payments is twice the previous payment. Payments remain at $51,200 thereafter.

Interest rate: 7% per year, compounded annually.

Question 9

In what range is the present value of the perpetuity as of 1/1/95?

[A] Less than $425,000

[B] $425,000 but less than $435,000

[C] $435,000 but less than $445,000

[D] $445,000 but less than $455,000

[E] $455,000 or more

1995

Data for Question 10

33.0% of those who die between ages 30 and 70 die before age 50.

The probability of a person aged 30 dying before age 50 is 20.0%.

Question 10

In what range is the probability that a person aged 50 will survive to age 70?

[A] Less than 40%

[B] 40% but less than 45%

[C] 45% but less than 50%

[D] 50% but less than 55%

[E] 55% or more

1995

Data for Question 11

Interest rate: 7% per year, compounded annually.

Selected commutation functions:

x	N_x
38	9,857,189
39	9,130,583
40	8,452,729
41	7,820,455
42	7,230,800

Question 11

In what range is $1000\, A^{1}_{40:\overline{1}|}$?

[A] Less than 1.50

[B] 1.50 but less than 1.70

[C] 1.70 but less than 1.90

[D] 1.90 but less than 2.10

[E] 2.10 or more

1995

Data for Question 12

Terms of an annuity:

Effective date: 1/1/95.

$1,000 is payable to Smith at the end of each year beginning with the year in which Brown dies.

No payments will be made after the earlier of Smith's death or 12/31/2004.

Smith's age as of 1/1/95: 65.

Brown's age as of 1/1/95: 64.

Selected annuity values:

a_{64}	=	10	a_{65}	=	9
${}_{10|}a_{64}$	=	5.5	${}_{10|}a_{65}$	=	3.5
$a_{64:65:\overline{10}|}$	=	2			

Question 12

In what range is the present value of the annuity as of 1/1/95?

[A] Less than $2,250

[B] $2,250 but less than $3,250

[C] $3,250 but less than $4,250

[D] $4,250 but less than $5,250

[E] $5,250 or more

1995

Data for Question 13

Terms of a whole life insurance policy:

Issue age: 50.
Death benefit: $100,000, payable at the end of year of death.
Net level annual premium: $1,500.
Interest rate: 7% per year, compounded annually.

Terms of a single premium whole life insurance policy:

Issue age: 50.
Death benefit: $K, payable at the end of year of death.
Net single premium: $1,500.
Interest rate: 7% per year, compounded annually.

Both policies use the same mortality table.

Question 13

In what range is $K?

[A] Less than $8,200

[B] $8,200 but less than $8,400

[C] $8,400 but less than $8,600

[D] $8,600 but less than $8,800

[E] $8,800 or more

1995

Data for Question 14

List price of a car: $20,000.

Purchase option I:	Immediate payment of list price less rebate of $X.
Purchase option II:	$500 down payment by purchaser. Level monthly payment at the end of each of the next 60 months. Interest rate: 6% per year, compounded monthly.

$X is determined so that, at an interest rate of 9% per year compounded monthly, the two options are financially equivalent.

Question 14

In what range is the value of $X?

[A] Less than $1,350

[B] $1,350 but less than $1,400

[C] $1,400 but less than $1,450

[D] $1,450 but less than $1,500

[E] $1,500 or more

1995

Data for Question 15

Smith's age as of 1/1/95: 92.

Brown's age as of 1/1/95: 93.

Green's age as of 1/1/95: 94.

Selected values from a mortality table:

x	l_x
92	1,000
93	913
94	822
95	723
96	615
97	498
98	378
99	246
100	143

Question 15

In what range is the probability that at least one of Smith, Brown, or Green will survive to 1/1/2001?

[A] Less than .30

[B] .30 but less than .40

[C] .40 but less than .50

[D] .50 but less than .60

[E] .60 or more

1995

Data for Question 16

Amount of a loan: $10,000.

Frequency of payments: Annual, at the end of each year.

Amount of payments: Level.

Interest rate: 4% per year, compounded annually.

Interest portion of the fourth payment: $225.

Question 16

In what range is the principal portion of the first payment?

[A] Less than $1,090

[B] $1,090 but less than $1,190

[C] $1,190 but less than $1,290

[D] $1,290 but less than $1,390

[E] $1,390 or more

1995

Data for Question 17

Type of insurance policy: Whole life.

Issue age: 55.

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

Discount rate: 6.5% per year, compounded annually.

Selected values:

$\ddot{a}_{56} = 11.22$ $\qquad$ $q_{55} = .10$

Question 17

In what range is the decrease in the net level premium if q_{55} is changed to .01?

[A] Less than $8.10

[B] $8.10 but less than $8.30

[C] $8.30 but less than $8.50

[D] $8.50 but less than $8.70

[E] $8.70 or more

1995

Data for Question 18

Face amount of a bond: $1,000,000.

Purchase price: $980,000.

Purchase date: 1/1/90.

Maturity value: $1,000,000.

Maturity date: 12/31/2009.

Coupon rate: 8% per year, payable semiannually.

Coupon dates: 6/30 and 12/31.

Assumptions as of 1/1/90:

Bond will be redeemed at par on the maturity date.
Yield to maturity: 8.2052% per year, compounded semiannually.

Revised assumptions as of 1/1/95:

Bond will be called at $1,030,000 on 12/31/99 (after coupon payment).

Revised yield to call date (from purchase date): 8.4972% per year, compounded semiannually.

Question 18

In what range is the change in the amortized cost of the bond due to the revised assumptions as of 1/1/95?

[A] Less than $12,500

[B] $12,500 but less than $15,000

[C] $15,000 but less than $17,500

[D] $17,500 but less than $20,000

[E] $20,000 or more

1995

Data for Question 19

Terms of an annuity contract:

Age at first premium payment: 45.

Annual premium: $P.

Number of premium payments: 20.

Age at first annuity payment: 65.

Frequency of annuity payments: Monthly, for life.

Amount of each annuity payment: $100.

If the insured dies before age 65, all premiums paid are returned, without interest, at the end of the year of death.

Selected commutation functions:

x	D_x	N_x	$N_x^{(12)}$	M_x	R_x
45	445,008	5,690,850	5,486,888	72,709	1,572,990
65	94,414	868,052	824,779	37,626	432,669

Question 19

In what range is $P?

[A] Less than $190

[B] $190 but less than $210

[C] $210 but less than $230

[D] $230 but less than $250

[E] $250 or more

1995

Data for Question 20

Interest rate: 7% per year, compounded annually.

Selected values:

Age x	p_x
55	.99
56	.99
57	.99
58	.99
59	.99
60	.95
61	.95
62	.95
63	.95
64	.95
65	.90

$a_{65} = 8.194$

Question 20

In what range is ${}_{10|}\ddot{a}_{55}$?

[A] Less than 3.1

[B] 3.1 but less than 3.2

[C] 3.2 but less than 3.3

[D] 3.3 but less than 3.4

[E] 3.4 or more

1995

Data for Question 21

Amount of a loan: $100,000.

Frequency of payments: Annual, at the end of each year.

Term of loan: 15 years.

Amount of payments: Level.

Interest rate: 7% per year, compounded annually.

The borrower, aged 40, purchases a special 15-year term insurance policy:

Death benefit:	Balance of loan at the end of year of death, including the loan payment then due.
Premiums:	Level annual premiums, payable at the beginning of each year.
Interest rate:	7% per year, compounded annually.

Selected values:

$\ddot{a}_{40:\overline{15}|} = 9.5650$

${}_{15}E_{40} = 0.3384$

Question 21

In what range is the annual premium for the term insurance policy?

[A] Less than $200

[B] $200 but less than $210

[C] $210 but less than $220

[D] $220 but less than $230

[E] $230 or more

1995

Data for Question 22

The present value of a perpetuity which pays $.50 at the end of each year is equal to $a_{\overline{\infty}|}$.

Question 22

In what range is $\ddot{a}_{\overline{\infty}|}$?

[A] Less than 6.10

[B] 6.10 but less than 6.30

[C] 6.30 but less than 6.50

[D] 6.50 but less than 6.70

[E] 6.70 or more

1995

Data for Question 23

Deposit to a fund: $1,300 paid on 1/1/95.

Withdrawals from fund: None.

Discount rate for 1995 through 2000: 7% per year, compounded quarterly.

Interest rate for 2001 through 2005: 8% per year, compounded semiannually.

Force of interest for 2006 through 2011: 6% per year.

Selected value:

$e = 2.71828$

Question 23

In what range is the value of the fund as of 1/1/2012?

[A] Less than $4,200

[B] $4,200 but less than $4,220

[C] $4,220 but less than $4,240

[D] $4,240 but less than $4,260

[E] $4,260 or more

1995

Data for Question 24

Terms of an increasing life insurance policy:

Death benefit: Payable at the end of the year of death.

Initial death benefit: $10,000.

The death benefit increases by $10,000 each year.

The net level annual premium for Premium Option A is $2,500.

The net annual premium for Premium Option B is $X in the first year and increases by $X each year, for life, starting in the second year.

Interest rate for both Premium Options: 7% per year, compounded annually.

Question 24

In what range is $X?

[A] Less than $216

[B] $216 but less than $220

[C] $220 but less than $224

[D] $224 but less than $228

[E] $228 or more

1995

Data for Question 25

Annual payments from an immediate annuity:

$ 500	if exactly one annuitant is alive
750	if exactly two annuitants are alive
1,000	if exactly three annuitants are alive

All annuitants are age 64 as of 1/1/95.

Selected annuity values:

$a_{64} = 25$

$a_{64:64} = 15$

$a_{64:64:64} = 10$

Question 25

In what range is the present value of the annuity as of 1/1/95?

[A] Less than $27,000

[B] $27,000 but less than $28,000

[C] $28,000 but less than $29,000

[D] $29,000 but less than $30,000

[E] $30,000 or more

ANSWER KEY

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1. B
2. B
3. E
4. B
5. E

6. D
7. A
8. E
9. B
10. C

11. D
12. C
13. A
14. A
15. E

16. E
17. A
18. C
19. C
20. E

21. E
22. E
23. B
24. B
25. C

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