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

Spring 1998
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 or disability 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.

1998

Data for Question 1

Initial deposit to a fund: $35,000.

Withdrawal from the fund at the end of the fourth year: $70,000.

Value of the fund at the end of the eighth year: $14,000.

No other deposits or withdrawals were made during the eight-year period.

Question 1

In what range is the annual rate of return for the fund during the eight-year period?

[A] Less than 14%

[B] 14% but less than 19%

[C] 19% but less than 24%

[D] 24% but less than 29%

[E] 29% or more

1998

Data for Question 2

Market value of a pension fund on 12/31/96: $60,000.

Contribution made on 10/31/97: $30,000.

Benefit payments made during 1997: $1,000 per month, paid on the first day of each month.

Using simple interest:

Dollar-weighted rate of return for 1997: 7.0%.

Expected rate of return for 1997: 6.0%.

Question 2

In what range is the investment gain for 1997?

[A] Less than $590

[B] $590 but less than $640

[C] $640 but less than $690

[D] $690 but less than $740

[E] $740 or more

Data for Question 3 1998

At age 30, Smith established a savings account with an initial deposit of $5,500. He determined that by making 30 additional annual deposits of $5,500 at each subsequent age he would accumulate $1,000,000 in the savings account at age 61.

At age 45, the annual rate of return from age 30 to age 45 is determined to be 9% per year, compounded annually. If he continues to earn this rate of return to age 61, he will not accumulate $1,000,000 at age 61.

Beginning with the deposit made at age 45, Smith changes the 16 remaining annual deposits to $X in order to accumulate $1,000,000 in the savings account at age 61. He assumes the annual rate of return continues to be 9% per year.

Question 3

In what range is $X?

[A] Less than $7,000

[B] $7,000 but less than $8,000

[C] $8,000 but less than $9,000

[D] $9,000 but less than $10,000

[E] $10,000 or more

1998

Data for Question 4

Terms of an annuity:

Date of first payment: 1/1/99.

Frequency of payments: Monthly.

Amount of each payment:

First 5 years: $500 per month.
Next 5 years: $650 per month.
Final payment: $10,000 on 1/1/2009.

Interest rate: 7% per year, compounded annually.

Question 4

In what range is the present value of the annuity as of 1/1/98?

[A] Less than $50,500

[B] $50,500 but less than $51,500

[C] $51,500 but less than $52,500

[D] $52,500 but less than $53,500

[E] $53,500 or more

1998

Data for Question 5

Date of a loan: 1/1/98.

Amount of loan: $10,000.

Date of each repayment: 12/31.

Repayment schedule:

Years	Repayment Amounts
1998 - 2002:	$1,000.
2003 - 2004:	$0.
2005:	$3,000.
2006 - 2011:	$1,000.
2012:	Balance of loan.

Interest rate: 7% per year, compounded annually.

Question 5

In what range is the amount of interest included in the repayment to be made in 2007?

[A] Less than $425

[B] $425 but less than $450

[C] $450 but less than $475

[D] $475 but less than $500

[E] $500 or more

1998

Data for Question 6

Total face amount of a serial bond: $10,000.

Purchase date: 1/1/98.

Maturity value: $10,000.

Maturity date: 12/31/2017.

Coupon rate: 7% per year, payable on each 12/31.

Yield rate: 12% per year, compounded annually.

5% of the bond will be redeemed at par each 12/31 during the 20-year period 1998 through 2017.

Question 6

In what range is the purchase price of the bond on 1/1/98?

[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

1998

Data for Question 7

Selected annuity values:

$\ddot{a}_{\overline{n+2}|} = 14.030$

$\ddot{s}_{\overline{n}|} = 52.344$

Question 7

In what range is the effective annual interest rate?

[A] Less than 5.00%

[B] 5.00% but less than 5.25%

[C] 5.25% but less than 5.50%

[D] 5.50% but less than 5.75%

[E] 5.75% or more

Data for Question 8 1998

Date of a loan: 1/1/96.

Interest rate: 18% per year, compounded monthly.

Date of first repayment: 1/31/96.

Frequency of repayments: Monthly.

Number of repayments: 36.

Question 8

In what range is the ratio of total interest paid to total principal repaid through the 12/31/97 repayment?

[A] Less than .40

[B] .40 but less than .42

[C] .42 but less than .44

[D] .44 but less than .46

[E] .46 or more

1998

Data for Question 9

Smith is to repay a loan in 30 annual installments of $10,000 each, beginning one year after the date of the loan. Immediately after the seventh payment, Smith borrows an additional $50,000 and combines this loan with the outstanding balance of the original loan.

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

With respect to the combined loan:

Date of first repayment: 1 year after the loans are combined.
Frequency of repayments: Annually.
Number of repayments: 14.

Question 9

In what range is the interest included in the second installment of the combined loan repayment?

[A] Less than $10,000

[B] $10,000 but less than $10,500

[C] $10,500 but less than $11,000

[D] $11,000 but less than $11,500

[E] $11,500 or more

Data for Question 10 1998

On August 31, 1998, Smith will make a donation to the benefactor fund of his alma mater to provide for the following:

1. A single four-year tuition scholarship.

   Frequency and amount of tuition payments: Semiannually on each 9/1 and 3/1 in equal amounts.

   Annual tuition for the 1998-1999 school year: $20,000.

   Increase in annual tuition: 2.5% per year, compounded annually.

   Date of first tuition payment from scholarship: 9/1/2001.

2. An annual perpetuity to the school.

   Date of first perpetuity payment: 9/1/2005.

   Amount of first perpetuity payment: $100,000.

   Increase in annual perpetuity payments: 2.5% per year, compounded annually.

Interest rate on benefactor fund: 8% per year, compounded annually.

Question 10

In what range is the amount of the donation?

[A] Less than $1,202,000

[B] $1,202,000 but less than $1,204,000

[C] $1,204,000 but less than $1,206,000

[D] $1,206,000 but less than $1,208,000

[E] $1,208,000 or more

Data for Question 11 1998

Data for a two bond portfolio:

	Bond 1	Bond 2
Face amount	$1,000	$1,000
Term	10 years	13 years
Coupon amount	$90	None
Coupon frequency	Annually	N/A
Modified duration	6.42 years	
Interest rate	9% per year, compounded annually	9% per year, compounded annually

Question 11

In what range is the modified duration of the two bond portfolio?

[A] Less than 7.9 years

[B] 7.9 years but less than 8.4 years

[C] 8.4 years but less than 8.9 years

[D] 8.9 years but less than 9.4 years

[E] 9.4 years or more

Data for Question 12

The purchase price of a ten-year $1,000 zero coupon bond is $620.00.

Forty percent of the bond will be called after 5 years for $320.00.

Question 12

In what range is the yield rate?

[A] Less than 4.95%

[B] 4.95% but less than 5.05%

[C] 5.05% but less than 5.15%

[D] 5.15% but less than 5.25%

[E] 5.25% or more

1998

Data for Question 13

Data from a two decrement (death and withdrawal) table:

The absolute rate of death: .035.

The probability of withdrawal is 5 times the probability of death.

Decrements are assumed to occur uniformly during the year.

Question 13

In what range is the absolute rate of withdrawal?

[A] Less than .162

[B] .162 but less than .166

[C] .166 but less than .170

[D] .170 but less than .174

[E] .174 or more

1998

Data for Question 14

Smith and Brown are the same age.

The probability that at least one will die during the next year is not zero and is equal to 20 times the probability that both will die during the next year.

Question 14

In what range is the probability that exactly one will die during the next year?

[A] Less than .100

[B] .100 but less than .125

[C] .125 but less than .150

[D] .150 but less than .175

[E] .175 or more

Data for Question 15

Selected values:

$_{10}p_{25:35:45} = .770$

$(_5p_{45:50})\ (_5q_{40}) = .029$

$_{15}p_{25} = .975$

Question 15

In what range is $_{20}p_{25}$?

[A] Less than .80

[B] .80 but less than .85

[C] .85 but less than .90

[D] .90 but less than .95

[E] .95 or more

1998

Data for Question 16

Selected values:

n	${}_{n\|}q_{105}$
1	.2667
2	.1000
3	.0267
4	.0067
5	.0000

Interest rate: 8% per year, compounded annually.

Question 16

In what range is $\$1{,}000a_{105}$?

[A] Less than \$550

[B] \$550 but less than \$750

[C] \$750 but less than \$950

[D] \$950 but less than \$1,150

[E] \$1,150 or more

1998

Data for Question 17

Data from a mortality table where deaths are uniformly distributed throughout the year of age:

x	$\overset{o}{e}_x$
50	23.2
51	22.4
52	21.7
53	20.9
54	20.2

Question 17

In what range is ${}_3q_{50}$?

[A] Less than .025

[B] .025 but less than .027

[C] .027 but less than .029

[D] .029 but less than .031

[E] .031 or more

1998

Data for Question 18

Payments under an annual annuity payable at the end of each year:

If annuitants Smith, Brown and Green are all alive:

$200 to Smith, age x
$200 to Brown, age y
$800 to Green, age z

If any of the annuitants die, their portion of the annuity will be equally divided among the surviving annuitant(s).

There are no other death benefits payable.

Selected values:

$a_x = 12$ $a_y = 10$ $a_z = 8$
$a_{xy} = 9$ $a_{xz} = 7$ $a_{yz} = 6$
$a_{xyz} = 5$

Question 18

In what range is the present value of Smith's portion of the annuity?

[A] Less than $4,000

[B] $4,000 but less than $4,500

[C] $4,500 but less than $5,000

[D] $5,000 but less than $5,500

[E] $5,500 or more

Data for Question 19

Provisions of two $100,000 one-year term, single premium, insurance policies:

Policy A: Payable at the end of the year if at least one of Smith, Brown and Green dies during the year.

Policy B: Payable at the end of the year if at least one of Smith and Green dies during the year.

Gross premium (contract premium):

Policy A: $8,000.

Policy B: $5,000.

Expense load for each policy: 7% of the net premium (benefit premium).

Interest rate: 7% per year, compounded annually.

Question 19

In what range is the probability that Brown will survive for one year?

[A] Less than .9670

[B] .9670 but less than .9680

[C] .9680 but less than .9690

[D] .9690 but less than .9700

[E] .9700 or more

1998

Data for Question 20

Three annuities with annual payments commencing on 12/31/98:

Annuity A: Pays $2,000 per year while at least one of Smith and Brown is alive.

Annuity B: Pays $4,000 per year while both Smith and Brown are alive, and $2,000 per year when exactly one of them is alive.

Annuity C: Pays $5,000 per year while both Smith and Brown are alive, and $3,000 per year when exactly one of them is alive.

Present value of Annuity A at 1/1/98: $34,000.

Present value of Annuity B at 1/1/98: $50,000.

Question 20

In what range is the present value of Annuity C at 1/1/98?

[A] Less than $66,000

[B] $66,000 but less than $68,000

[C] $68,000 but less than $70,000

[D] $70,000 but less than $72,000

[E] $72,000 or more

Data for Question 21 1998

Terms of a contributory pension plan:

Employee contributions: 5% of annual compensation.
Frequency of contributions: Annually, each 12/31.
Interest on contributions: 7% per year.

Effective 1/1/98 no further employee contributions will be made.

The preretirement death benefit is equal to the employee contributions with interest to the date of death.

Data for participant Smith:

Date of birth: 1/1/53.
Date of plan participation: 1/1/88.
1988 compensation: $35,000.
Actual compensation increases: 4% per year.

Valuation interest rate: 7%.

Selected commutation functions:

x	D_x
35	8,942
45	4,450
65	944

Question 21

In what range is the present value of Smith's preretirement death benefit as of 1/1/98, assuming he will retire at age 65?

[A] Less than $4,900

[B] $4,900 but less than $5,100

[C] $5,100 but less than $5,300

[D] $5,300 but less than $5,500

[E] $5,500 or more

1998

Data for Question 22

l_x = 1,000 times (100 - x), $x \leq 100$.

Interest rate: 6% per year, compounded annually.

Question 22

In what range is a_{70}?

[A] Less than 8.4

[B] 8.4 but less than 8.7

[C] 8.7 but less than 9.0

[D] 9.0 but less than 9.3

[E] 9.3 or more

1998

Data for Question 23

Annual contributions to a savings account are expected to accumulate to $100,000 at the end of 5 years. Contributions are paid in equal installments at the beginning of each year of the 5 year period. Upon the contributor's death, the value of the savings account is paid at the end of the year of death.

A 5-year decreasing term insurance policy is purchased to insure that a total of $100,000, including the savings account balance, will be paid at the end of the year of death. Level annual premiums are paid at the beginning of each year for the insurance policy.

The interest rate is 7% per year, compounded annually for both the savings account and the insurance policy.

Selected commutation functions:

x	N_x
40	8,452,729
41	7,820,455
45	5,690,850
46	5,245,842

Question 23

In what range is the annual premium for the insurance policy for a person age 40?

[A] Less than $500

[B] $500 but less than $1,500

[C] $1,500 but less than $2,500

[D] $2,500 but less than $3,500

[E] $3,500 or more

Data for Question 24 1998

Terms of pension plan:

Annual retirement benefit: 50% of the final year's compensation rate, payable monthly for life.

Preretirement death benefit: 200% of the annual compensation rate in the year of death, payable at the end of the year of death.

Actuarial assumptions:

Interest rate: 7% per year, compounded annually.
Compensation rate increases: 4% per year, effective each 1/1.
Preretirement terminations other than death: None.

Data for sole participant on 1/1/98:

Date of birth: 1/1/36.
Date of retirement: 12/31/2000.
1998 compensation rate: $40,000.

Selected values:

x	q_x
62	0.0170
63	0.0187
64	0.0205

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

Question 24

In what range is the present value of future benefits as of 1/1/98?

[A] Less than $147,500

[B] $147,500 but less than $149,500

[C] $149,500 but less than $151,500

[D] $151,500 but less than $153,500

[E] $153,500 or more

Data for Question 25

Interest rate: 7% per year, compounded annually.

Selected commutation functions:

x	N_x
64	294,298
65	263,044
66	234,434
67	208,299
68	184,481

Question 25

In what range is $a_{64:65:\overline{2}|}$?

[A] Less than 1.55

[B] 1.55 but less than 1.65

[C] 1.65 but less than 1.75

[D] 1.75 but less than 1.85

[E] 1.85 or more

ANSWER KEY

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1. C
2. A
3. C
4. B
5. C

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

11. A
12. B
13. B
14. D
15. D

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

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

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