

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 1992 examination which has been released to
the public by the administering organizations.

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Data for Question 1

Effective date of annuity: 1/1/92.

Date of first payment: 3/31/92.

Frequency of payments: Quarterly.

Number of payments: 40.

Schedule of payments:

<u>Date</u>	<u>Amount</u>
Each 3/31	\$ 1
Each 6/30	2
Each 9/30	3
Each 12/31	4

Interest rate: 7% per year, compounded annually.

Question 1

In what range is the present value of the annuity as of 1/1/92?

- (A) Less than \$63
- (B) \$63 but less than \$66
- (C) \$66 but less than \$69
- (D) \$69 but less than \$72
- (E) \$72 or more

Data for Question 2

Type of contract: Whole life insurance.

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

Interest rate: 8% per year, compounded annually.

Selected commutation functions and probability of death:

$$D_{66} = 47,775.55 \quad N_{66}^{(12)} = 382,153.96 \quad q_{65} = .022562$$

Question 2

In what range is the present value of the death benefit for a life age 65?

- (A) Less than \$3,800
- (B) \$3,800 but less than \$4,100
- (C) \$4,100 but less than \$4,400
- (D) \$4,400 but less than \$4,700
- (E) \$4,700 or more

Data for Question 3

Effective date of contract: 1/1/92.

Duration of contract: 10 years.

Terms of contract: Upon the death of the insured, the contract will pay \$1,000 at the end of the year of the insured's death and \$1,000 at the end of each succeeding year for the duration of the contract.

Interest rate: 7% per year, compounded annually.

Age of insured at issue: 50.

Selected commutation functions:

<u>x</u>	<u>D_x</u>	<u>N_x</u>
50	31,750	383,495
51	29,506	351,745
60	14,759	151,622
61	13,598	136,863

Question 3

In what range is the present value of the contract as of 1/1/92?

- (A) Less than \$200
- (B) \$200 but less than \$225
- (C) \$225 but less than \$250
- (D) \$250 but less than \$275
- (E) \$275 or more

Data for Question 4

Selected values:

$$A_{x:15}^1 = .30 \quad \ddot{a}_{x:15} = 7.00 \quad d = .05$$

Question 4

In what range is $\ddot{s}_{x:15}$?

- (A) Less than 16
- (B) 16 but less than 17
- (C) 17 but less than 18
- (D) 18 but less than 19
- (E) 19 or more

Data for Question 5

Market value of fund:

<u>Date</u>	<u>Amount</u>
1/1/91	\$200,000
4/1/91	200,000
7/1/91	286,000
10/1/91	276,000
1/1/92	260,000

Contributions to fund:

<u>Date</u>	<u>Amount</u>
6/30/91	\$80,000

Benefit payments from fund:

<u>Date</u>	<u>Amount</u>
3/31/91	\$10,000
6/30/91	10,000
9/30/91	10,000
12/31/91	10,000

Consider the following measures of the fund's rate of return for 1991:

- I. Time-weighted rate of return.
- II. Dollar-weighted rate of return using simple interest.
- III. Annual rate of return based on an assumed uniform distribution of all contributions and benefit payments throughout the year using simple interest.

Question 5

Which of the following shows the relative magnitude of these measures?

- (A) $I > III > II$
- (B) II equals III, and $I > II$ or III
- (C) $II > III > I$
- (D) $III > I > II$
- (E) The correct answer is not given by (A), (B), (C), or (D) above.

Data for Question 6

Characteristics of a stationary population of 100 active members:

Entry age into the population: 25.

Preretirement terminations other than deaths: None.

Retirement age from the population: 65.

Number of deaths per year: 2.

Average age at death: 55.

Question 6

In what range is the number of new entrants each year?

- (A) Less than 2.5
- (B) 2.5 but less than 3.5
- (C) 3.5 but less than 4.5
- (D) 4.5 but less than 5.5
- (E) 5.5 or more

Data for Question 7

Effective date of perpetuity: 1/1/92.

Interest rate: 8% per year, compounded annually.

Payment schedule:

<u>Date</u>	<u>Amount</u>
1/1/92	\$ 10
1/1/93	30
1/1/94	50
1/1/95	70
1/1/96	90
1/1/97 and each 1/1 thereafter	110

Question 7

In what range is the present value of the perpetuity as of 1/1/92?

- (A) Less than \$1,110
- (B) \$1,110 but less than \$1,210
- (C) \$1,210 but less than \$1,310
- (D) \$1,310 but less than \$1,410
- (E) \$1,410 or more

Data for Question 8

Selected values:

$$A_x = .3645 \quad q_x = .007 \quad i = .045$$

Question 8

In what range is a_{x+1} ?

- (A) Less than 13.0
- (B) 13.0 but less than 13.6
- (C) 13.6 but less than 14.2
- (D) 14.2 but less than 14.8
- (E) 14.8 or more

Data for Question 9

Date of loan: 1/1/92.

Amount of loan: \$10,000.

Interest rate: 12% per year, compounded monthly.

Repayment schedule:

<u>Date</u>	<u>Amount</u>
3/1/92	\$600
5/1/92	600
1/1/93	X
2/1/93	X
3/1/93	X
4/1/93	X
5/1/93	X
6/1/93	X
7/1/93	X
8/1/93	X
9/1/93	X
10/1/93	X
11/1/93	X
12/1/93	X

Question 9

In what range is the total interest paid over the term of the loan?

- (A) Less than \$1,715
- (B) \$1,715 but less than \$1,915
- (C) \$1,915 but less than \$2,115
- (D) \$2,115 but less than \$2,315
- (E) \$2,315 or more

Data for Question 10

Terms of deferred annuity contract:

Issue date: 1/1/92.
Monthly benefit: \$250.
Benefit commencement age: 65.
Death benefit prior to age 65: None.
Form of annuity: Life annuity with 10 years certain.
Annual premium payment date: 1/1.

Age of insured at issue: 57.

Selected commutation functions:

<u>x</u>	<u>D_x</u>	<u>N_x</u>
57	194	2,111
65	100	919
75	36	247

Selected interest function:

$$\ddot{a}_{\overline{10}|}^{(12)} = 7.219$$

Question 10

In what range is the net annual premium?

- (A) Less than \$2,000
- (B) \$2,000 but less than \$2,200
- (C) \$2,200 but less than \$2,400
- (D) \$2,400 but less than \$2,600
- (E) \$2,600 or more

Data for Question 11

Face amount of bond: \$1,000.

Purchase date: 1/1/92.

Maturity value: \$1,000.

Coupon rate: 8% per year, compounded annually.

Coupon date: 12/31.

Yield to purchaser: 10% per year, compounded annually.

Amortized value of bond at 1/1/97: \$Z.

Amortized value of bond at 1/1/98: \$Z + \$10.25.

Question 11

In what range is the purchase price of the bond?

- (A) Less than \$860
- (B) \$860 but less than \$870
- (C) \$870 but less than \$880
- (D) \$880 but less than \$890
- (E) \$890 or more

Data for Question 12

Effective date of a joint and survivor annuity: 1/1/92.

Terms of joint and survivor annuity: \$1,000 is paid at the beginning of each month if both annuitants are alive, and \$750 is paid at the beginning of each month if only one annuitant is alive.

Data for annuitants as of 1/1/92:

	<u>Smith</u>	<u>Brown</u>
Age	60	65
Sex	F	M

Selected annuity values:

<u>x</u>	<u>Female</u> $\ddot{a}_x^{(12)}$	<u>Male</u> $\ddot{a}_x^{(12)}$
60	11.2993	10.5959
65	10.1047	9.3452

$$\ddot{a}_{60F:65M}^{(12)} = 8.1620$$

Question 12

In what range is the present value of the joint and survivor annuity as of 1/1/92?

- (A) Less than \$131,000
- (B) \$131,000 but less than \$135,000
- (C) \$135,000 but less than \$139,000
- (D) \$139,000 but less than \$143,000
- (E) \$143,000 or more

Data for Question 13

Date of loan: 1/1/92.

Amount of loan: \$10,000,000.

Date of repayment of principal: 12/31/2016.

Method of repayment of principal: Sinking fund.

Date of first payment to sinking fund: 3/31/92.

Frequency of sinking fund payments: Quarterly.

Amount of each sinking fund payment: Level.

Number of payments to sinking fund: 100.

Interest rate for sinking fund: 6% per year, compounded semiannually.

Question 13

In what range is the balance in the sinking fund as of 1/1/2002?

- (A) Less than \$2,375,000
- (B) \$2,375,000 but less than \$2,400,000
- (C) \$2,400,000 but less than \$2,425,000
- (D) \$2,425,000 but less than \$2,450,000
- (E) \$2,450,000 or more

Data for Question 14

Selected life expectancies:

$$e_x = 20.2 \quad e_{x+1} = 19.6 \quad e_{x+2} = 19.0$$

Question 14

In what range is the probability that a life age x will die before attaining age $x+2$?

- (A) Less than .025
- (B) .025 but less than .030
- (C) .030 but less than .035
- (D) .035 but less than .040
- (E) .040 or more

Data for Question 15

Selected values from a combined marriage and mortality table for male lives: .

Age x	Bachelors Living $(bl)_x$	Bachelors Dying $(bd)_x$	Bachelors Marrying $(bm)_x$	Husbands Living $(hl)_x$	Husbands Dying $(hd)_x$
35	83,838	640	7,546	75,252	546
36	75,652	-	-	82,252	-

Marriages and deaths are both assumed to occur uniformly throughout each year.

Question 15

In what range is the probability that a husband living at age 35 will survive to age 36?

- (A) Less than .9930
- (B) .9930 but less than .9932
- (C) .9932 but less than .9934
- (D) .9934 but less than .9936
- (E) .9936 or more

Data for Question 16

Date of loan: 1/1/92.

Amount of loan: \$20,000.

Date of first payment: 1/31/92.

Frequency of payments: Monthly.

Amount of each payment: Level.

Number of payments: 36.

Interest rate: 18% per year, compounded monthly.

On 1/1/93, the loan is renegotiated, and the interest rate is reduced to 12% per year, compounded monthly. All of the other terms of the original loan remain the same.

Question 16

In what range is the reduction in total payments over the duration of the loan due to the renegotiation of the loan?

- (A) Less than \$750
- (B) \$750 but less than \$950
- (C) \$950 but less than \$1,150
- (D) \$1,150 but less than \$1,350
- (E) \$1,350 or more

Data for Question 17

Effective date of reversionary annuity contract: 1/1/92.

Terms of contract: If the male insured dies and his wife survives, she will receive \$10,000 on 12/31 each year for life. However, the contract contains a special restriction which provides that payments otherwise due before 12/31/94 will be forfeited.

Interest rate: 7% per year, compounded annually.

Age of male insured at issue: 65.

Age of wife at issue: 64.

Female mortality: $l_x = 104 - x$.

Male mortality: Female mortality, set forward six years.

Question 17

In what range is the increase in the present value of the contract as of 1/1/92 if the special restriction is removed?

- (A) Less than \$615
- (B) \$615 but less than \$665
- (C) \$665 but less than \$715
- (D) \$715 but less than \$765
- (E) \$765 or more

Data for Question 18

A population consists of 100 lives, all age 70.

Selected probability:

$$p_{70} = .97$$

Question 18

In what range is the probability that 97 or more of the members of the population will survive to age 71?

- (A) Less than 60%
- (B) 60% but less than 70%
- (C) 70% but less than 80%
- (D) 80% but less than 90%
- (E) 90% or more

Data for Question 19

Effective date of retirement income policy: 1/1/92.

Terms of policy: If the insured survives to age 65, monthly payments of \$500 will be paid for life with 5 years certain. If the insured dies before attaining age 65, all net annual premiums paid will be refunded at the end of the year of death.

Interest rate: 3% per year, compounded annually.

Age of insured at issue: 45.

Selected commutation functions:

<u>x</u>	<u>D_x</u>	<u>N_x</u>	<u>M_x</u>	<u>R_x</u>
45	2,393	44,455	1,098	26,751
65	996	10,607	687	8,076
70	706	6,217	525	4,958

Question 19

In what range is the net annual premium for the policy as of 1/1/92?

- (A) Less than \$1,950
- (B) \$1,950 but less than \$2,250
- (C) \$2,250 but less than \$2,550
- (D) \$2,550 but less than \$2,850
- (E) \$2,850 or more

Data for Question 20

Date of loan: 1/1/91.

Amount of loan: \$100,000.

Date of first payment: 1/31/91.

Frequency of payments: Monthly.

Amount of each payment: Level.

Number of payments: 180.

Interest rates: 12% per year, compounded monthly, for 1991-1995;
9% per year, compounded monthly, for 1996-2000;
6% per year, compounded monthly, for 2001-2005.

Question 20

In what range is the amount of each payment?

- (A) Less than \$950
- (B) \$950 but less than \$1,025
- (C) \$1,025 but less than \$1,100
- (D) \$1,100 but less than \$1,175
- (E) \$1,175 or more

Data for Question 21

Date of loan: 1/1/90.

Amount of loan: \$170,000.

Date of first payment: 12/31/90.

Frequency of payments: Annual.

Amount of each payment: Redetermined each year, with the outstanding balance
reamortized over the remaining term of the loan.

Number of payments: 20.

Interest paid on 12/31/90: \$11,900.

Interest paid on 12/31/91: \$13,268.

Interest rate for 1992: Same as interest rate for 1991.

Question 21

In what range is the payment due 12/31/92?

- (A) Less than \$16,000
- (B) \$16,000 but less than \$16,500
- (C) \$16,500 but less than \$17,000
- (D) \$17,000 but less than \$17,500
- (E) \$17,500 or more

Data for Question 22

Date of retirement: 1/1/91.

Monthly benefit: \$1,000 at the beginning of each month.

Form of payment: Life annuity with 5 years certain.

Interest rate: 8% per year, compounded annually.

Present value as of 1/1/91: \$120,000.

Probability of surviving to 1/1/92: 99.5%.

Question 22

In what range is the present value of future benefits as of 1/1/92 if the retiree survives to 1/1/92?

- (A) Less than \$116,950
- (B) \$116,950 but less than \$117,150
- (C) \$117,150 but less than \$117,350
- (D) \$117,350 but less than \$117,550
- (E) \$117,550 or more

Data for Question 23

Date of loan: 1/1/92.

Amount of loan: \$1,000,000.

Date of first payment: 1/31/92.

Frequency of payments: Monthly.

Amount of each payment: Level.

Number of payments: 360.

Interest rate: $X\%$ per year, compounded monthly.

Portion of monthly payment due on 9/30/97 applied to interest: 94.473%.

Portion of monthly payment due on 10/31/97 applied to interest: 94.418%.

Question 23

In what range is X ?

- (A) Less than 12.00%
- (B) 12.00% but less than 12.25%
- (C) 12.25% but less than 12.50%
- (D) 12.50% but less than 12.75%
- (E) 12.75% or more

Data for Question 24

Interest rate: 8% per year, compounded annually.

P_x (whole life premium): .05

Question 24

In what range is a_x ?

- (A) Less than 6.5
- (B) 6.5 but less than 7.0
- (C) 7.0 but less than 7.5
- (D) 7.5 but less than 8.0
- (E) 8.0 or more

Data for Question 25

Selected values:

$$A_{50} = .1771 \quad A_{51} = .1867 \quad A_{52} = .1966$$

$$A_{50:\overline{1}}^1 = .9207 \quad A_{50:\overline{2}}^1 = .8472$$

Question 25

In what range is $A_{50:\overline{2}}^1$?

- (A) Less than .005
- (B) .005 but less than .010
- (C) .010 but less than .015
- (D) .015 but less than .020
- (E) .020 or more

ANSWER KEY

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