

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

Enrolled Actuaries Basic Examination

# EA-1

Date: Tuesday, May 15, 2007  
Time: 8:30 a.m. – 11:00 a.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. On this examination the symbol " $\ell_x$ " will be used to represent the number of lives at age x.
5. This examination consists of 31 multiple-choice questions worth a total of 100 points. The point value for each question is shown in parentheses at the beginning of the question.
6. Your score will be based on the point values of questions that 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 that 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 "Course EA-1."
  - (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.**

**EA-1 Spring 2007  
Answer Key**

<b>Question</b>	<b>Answer</b>	<b>Points</b>
1	B	2
2	C	3
3	E	3
4	D	4
5	C	2
6	A	3
7	E	4
8	D	3
9	E	3
10	D	5
11	D	2
12	C	4
13	B	3
14	C	5
15	B	3
16	A	3
17	D	3
18	C	4
19	D	2
20	C	3
21	B	3
22	B	3
23	B	3
24	A	5
25	A	2
26	D	3
27	D	3
28	C	3
29	B	4
30	D	4
31	C	3
<b>Total</b>		<b>100</b>

Data for Question 1 (2 points)

Smith (age 30) purchases a single premium annuity on 1/1/2007 that has the following characteristics:

Payments:     \$1 annually at the end of each year.

Term:           Payments are for life with the final payment on the 12/31 following Smith's death.

Selected actuarial values:

$$N_{30} = 42738$$

$$N_{31} = 40437$$

Interest rate: 5%, compounded annually.

Question 1

In what range is the single premium for this annuity?

- (A)   Less than \$17.65
- (B)   \$17.65 but less than \$17.70
- (C)   \$17.70 but less than \$17.75
- (D)   \$17.75 but less than \$17.80
- (E)   \$17.80 or more

Data for Question 2 (3 points)

Selected actuarial values:

$$a_x = 10.0$$

$$a_y = 9.0$$

$$a_{xy} = 8.0$$

$$Z = 1000 \left( \sum_{t=0}^{\infty} {}_t p_{xy} \cdot v^{t+1} \right) + 500 \left( \sum_{t=0}^{\infty} v^{t+1} \cdot {}_t q_x \cdot {}_{t+1} p_y \cdot \ddot{a}_{y+t+1} \right)$$

Question 2

In what range is  $Z$ ?

- (A) Less than 8,750
- (B) 8,750 but less than 9,250
- (C) 9,250 but less than 9,750
- (D) 9,750 but less than 10,250
- (E) 10,250 or more

Data for Question 3 (3 points)

Selected actuarial values:

$${}_{20}P_{10} = 0.960$$
$${}_{30}E_{10} \cdot {}_{10}E_{30} = 0.125$$

Interest rate: 5%, compounded annually.

$P =$  The probability that a life age 10 dies after age 40

Question 3

In what range is  $P$ ?

- (A) Less than 0.85
- (B) 0.85 but less than 0.87
- (C) 0.87 but less than 0.89
- (D) 0.89 but less than 0.91
- (E) 0.91 or more

Data for Question 4 (4 points)

Smith (age 60) retires on 1/1/2007 and is offered the following distribution options from a pension plan:

- (1) Life annuity of \$1,000 payable annually commencing on 1/1/2007.
- (2) Lump sum of \$15,000 payable at age 65 if Smith is still alive.

Selected actuarial values:

$$\ell_x = 100 - x; 0 \leq x \leq 100$$

Interest rate: 6%, compounded annually.

$Y =$  The present value of (1) on 1/1/2007

$Z =$  The present value of (2) on 1/1/2007

Question 4

In what range is  $|Y - Z|$ ?

- (A) Less than \$400
- (B) \$400 but less than \$800
- (C) \$800 but less than \$1,200
- (D) \$1,200 but less than \$1,600
- (E) \$1,600 or more

Data for Question 5 (2 points)

Selected values:

$$\ddot{a}_{\overline{2}|}^{(12)} = 1.892447$$

$$a_{\overline{2}|}^{(12)} = 1.883280$$

Interest rate:  $i$ , compounded annually.

Question 5

In what range is  $i$ ?

- (A) Less than 5.5%
- (B) 5.5% but less than 5.9%
- (C) 5.9% but less than 6.3%
- (D) 6.3% but less than 6.7%
- (E) 6.7% or more

Data for Question 6 (3 points)

A perpetuity purchased on 1/1/2007 provides annual payments of \$1 beginning on 12/31/2007.

Interest rate: 7.0%, compounded semi-annually.

$X =$  Present value of the perpetuity.

$Y =$  Modified duration of the perpetuity.

Question 6

In what range is  $|X - Y|$ ?

- (A) Less than 0.30
- (B) 0.30 but less than 0.60
- (C) 0.60 but less than 0.90
- (D) 0.90 but less than 1.20
- (E) 1.20 or more

Data for Question 7 (4 points)

Annuity I: 10-year decreasing annuity with annual payments beginning at the end of the first year.  
Payments begin at \$100 and decline by \$10 each year.

Annuity II: 15-year increasing annuity with annual payments beginning at the end of the first year.  
The first payment equals \$30 and each subsequent payment is 5% greater than the one preceding it.

Interest rate: 6.5%, compounded annually.

$X =$  Present value of Annuity I

$Y =$  Present value of Annuity II

Question 7

In what range is  $|X - Y|$ ?

- (A) Less than \$22
- (B) \$22 but less than \$29
- (C) \$29 but less than \$36
- (D) \$36 but less than \$43
- (E) \$43 or more

Data for Question 8 (3 points)

Data from a select and ultimate mortality table:

$x$	$l_{[x]}$	$l_{[x]+1}$	$l_{[x]+2}$	$l_{x+3}$	$x+3$
65	991	980	966	948	68
66	975	963	947	928	69
67	957	944	927	906	70
68	937	923	905	883	71

Question 8

In what range is  ${}_{1|3}q_{[66]+1}$  ?

- (A) Less than 0.06200
- (B) 0.06200 but less than 0.06400
- (C) 0.06400 but less than 0.06600
- (D) 0.06600 but less than 0.06800
- (E) 0.06800 or more

Data for Question 9 (3 points)

Data from a mortality table:

$x$	$q_x$
60	0.0156
61	0.0169
62	0.0184
63	0.0201

Interest rate: 5%, compounded annually.

Question 9

In what range is  $\ddot{a}_{60:62:\overline{3}|}$ ?

- (A) Less than 2.450
- (B) 2.450 but less than 2.550
- (C) 2.550 but less than 2.650
- (D) 2.650 but less than 2.750
- (E) 2.750 or more

Data for Question 10 (5 points)

Smith and Jones (both age 65) purchase an insurance policy that pays \$100,000 at the end of the year of Smith's death, if Jones is then alive.

Selected actuarial values:

$$a_{64:65} = 10.0$$

$$a_{65:65} = 9.9$$

$$q_{64} = 0.002$$

Question 10

In what range is the single premium?

- (A) Less than \$9,000
- (B) \$9,000 but less than \$10,400
- (C) \$10,400 but less than \$11,800
- (D) \$11,800 but less than \$13,200
- (E) \$13,200 or more

Data for Question 11 (2 points)

$$\frac{i^{(12)}}{d^{(12)}} = 1.01$$

Question 11

In what range is the annual rate of interest compounded annually?

- (A) Less than 12.2%
- (B) 12.2% but less than 12.4%
- (C) 12.4% but less than 12.6%
- (D) 12.6% but less than 12.8%
- (E) 12.8% or more

Data for Question 12 (4 points)

Terms of a 30-year loan issued 1/1/2007:

Loan amount: \$1,500

Repayments: Level repayments are made every three years beginning 12/31/2009.

Interest rate: 0.0% for 2007 and 2008;  
5.0%, compounded annually, beginning in 2009.

Question 12

In what range is the principal paid in the 6th repayment?

- (A) Less than \$121
- (B) \$121 but less than \$131
- (C) \$131 but less than \$141
- (D) \$141 but less than \$151
- (E) \$151 or more

Data for Question 13 (3 points)

Interest rate: 6%, compounded annually.

On 1/1/2007, Smith takes a \$100,000 loan repayable at the end of each year for 30 years.

Scenario I: Payments in the first five years equal 50% of the interest on the outstanding balance of the loan at the beginning of the year of payment. Payments in the last 25 years are level at  $X$ .

Scenario II: Payments in the first five years equal 50% of the interest on the original amount of the loan. Payments in the last 25 years are level at  $Y$ .

Question 13

In what range is  $|X - Y|$ ?

- (A) Less than \$75
- (B) \$75 but less than \$115
- (C) \$115 but less than \$155
- (D) \$155 but less than \$195
- (E) \$195 or more

Data for Question 14 (5 points)

On 1/1/2007 Smith (age 30) establishes a fund to provide for retirement at age 65.

Contributions: 5% of gross monthly salary at the end of each month.

2007 annual salary: \$40,000

Assumed salary increases: 4% per year assumed to occur on the first day of each calendar year.

Assumed investment return: 5%, compounded annually.

Mortality before retirement: None.

$X =$  The accumulated value of the fund at retirement.

Question 14

In what range is  $X$ ?

- (A) Less than \$315,000
- (B) \$315,000 but less than \$319,000
- (C) \$319,000 but less than \$323,000
- (D) \$323,000 but less than \$327,000
- (E) \$327,000 or more

Data for Question 15 (3 points)

Selected actuarial values:

$$A_{76} = 0.800$$

$$D_{76} = 400$$

$$D_{77} = 360$$

Interest rate: 3%, compounded annually.

Question 15

In what range is  $A_{77}$  ?

- (A) Less than 0.806
- (B) 0.806 but less than 0.811
- (C) 0.811 but less than 0.816
- (D) 0.816 but less than 0.821
- (E) 0.821 or more

Data for Question 16 (3 points)

Selected actuarial values:

$$a_{\overline{30}|9} = 5.60$$

$${}_{10}E_{30} = 0.35$$

Interest rate: 10.0%, compounded annually.

Question 16

In what range is  $1000P_{\overline{30}|10}$  ?

- (A) Less than 7.70
- (B) 7.70 but less than 10.70
- (C) 10.70 but less than 13.70
- (D) 13.70 but less than 16.70
- (E) 16.70 or more

Data for Question 17 (3 points)

Smith (age  $x$ ) and Jones (age  $y$ ) purchase a joint and survivor annuity with the following annual benefits payable at the beginning of each year:

- (1) \$500 while Smith and Jones are alive;
- (2) \$300 to Jones after Smith dies;
- (3)  $B$  to Smith after Jones dies.

The annuity is actuarially equivalent to a single life annuity with benefits of  $B$  payable to Smith.

Selected actuarial values:

$$\ddot{a}_x = 10.0$$

$$\ddot{a}_y = 14.0$$

$$\ddot{a}_{xy} = 8.0$$

Question 17

In what range is  $B$ ?

- (A) Less than \$580
- (B) \$580 but less than \$640
- (C) \$640 but less than \$700
- (D) \$700 but less than \$760
- (E) \$760 or more

Data for Question 18 (4 points)

Smith (age 55) is entitled to a pension benefit at the beginning of each month of \$750 for life commencing immediately. Smith has the option of electing a Social Security level income option such that the total of Smith's monthly income from the pension plan plus Social Security remains level for Smith's lifetime.

Smith's monthly Social Security benefit is \$1,400 commencing at age 62.

Selected actuarial values:

$$\ddot{a}_{55}^{(12)} = 13.728$$

$$\ddot{a}_{62}^{(12)} = 12.218$$

$${}_7E_{55} = 0.656$$

$X =$  The monthly benefit payable to Smith from age 55 to age 62, assuming Smith elects the Social Security level income option.

Question 18

In what range is  $X$ ?

- (A) Less than \$1,520
- (B) \$1,520 but less than \$1,550
- (C) \$1,550 but less than \$1,580
- (D) \$1,580 but less than \$1,610
- (E) \$1,610 or more

Data for Question 19 (2 points)

A bond has the following payment structure:

- 1) \$1,000 payable in one year;
- 2) \$1,000 payable in two years;
- 3) 10% yield to maturity.

The 2-year spot rate on the yield curve is 8% when the bond is issued.

Question 19

In what range is the one-year spot rate?

- (A) Less than 12.5%
- (B) 12.5% but less than 13.0%
- (C) 13.0% but less than 13.5%
- (D) 13.5% but less than 14.0%
- (E) 14.0% or more

Data for Question 20 (3 points)

On 1/1/2007, the value of an investment account is \$9,000. On 4/1/2007 the value has increased to  $X$ . On that date,  $W$  is withdrawn. No further deposits or withdrawals are made for the remainder of the year.

On 1/1/2008 the investment account is worth \$8,500.

Time weighted return for 2007 = 16.0%

Dollar weighted return for 2007 = 20.0%

Question 20

In what range is  $X$ ?

- (A) Less than \$10,450
- (B) \$10,450 but less than \$10,650
- (C) \$10,650 but less than \$10,850
- (D) \$10,850 but less than \$11,050
- (E) \$11,050 or more

Data for Question 21 (3 points)

On 1/1/2007, an endowment fund is established to provide scholarships. The fund provides for 1 scholarship at the end of year one, 2 scholarships at the end of year two, and so forth up to 10 scholarships in year ten and each year thereafter.

Amount of each scholarship: \$25,000

Interest rate: 5.0% per year, compounded annually.

Question 21

As of 1/1/2007, what is the present value of the endowment fund?

- (A) Less than \$4,000,000
- (B) \$4,000,000 but less than \$4,100,000
- (C) \$4,100,000 but less than \$4,200,000
- (D) \$4,200,000 but less than \$4,300,000
- (E) \$4,300,000 or more

Data for Question 22 (3 points)

Selected actuarial values:

$$q_x^{(1)} = 0.075$$

$$q_x^{(2)} = 0.095$$

Decrement 1 has a uniform distribution of decrement within each year of its associated single decrement table.

Decrement 2 has a constant force of decrement throughout each year.

Question 22

In what range is  ${}_{0.75}p_x^{(\tau)}$  ?

- (A) Less than 0.8747
- (B) 0.8747 but less than 0.8762
- (C) 0.8762 but less than 0.8777
- (D) 0.8777 but less than 0.8792
- (E) 0.8792 or more

Data for Question 23 (3 points)

A corporation maintains a stationary population by adding 1,000 new entrants age 25 each year. An entrant leaves the corporation only by death before age 65 or by retirement at age 65. All those who remain in service to age 65 retire at that age.

Given:

(1)  ${}_{40}p_{25} = 0.8$

(2) The average age at death of those who die while employed = 55

$S =$  Size of the stationary population

Question 23

In what range is  $S$  ?

- (A) Less than 35,000
- (B) 35,000 but less than 45,000
- (C) 45,000 but less than 55,000
- (D) 55,000 but less than 65,000
- (E) 65,000 or more

Data for Question 24 (5 points)

Data from a two decrement model:

$x$	$q_x^{(1)}$	$q_x^{(2)}$	$q_x^{(\tau)}$	$l_x^{(\tau)}$
68	0.05	0.35	-	-
69	-	-	0.80	1,235
70	0.06	0.94	-	-

Question 24

In what range is  ${}_2q_{68}^{(\tau)}$  ?

- (A) Less than 0.1175
- (B) 0.1175 but less than 0.1185
- (C) 0.1185 but less than 0.1195
- (D) 0.1195 but less than 0.1205
- (E) 0.1205 or more

Data for Question 25 (2 points)

Consider the following statements concerning bonds:

- I. The duration of a zero-coupon bond is always the term of the bond.
- II. The term of a callable bond varies at the discretion of the issuer.
- III. Serial bonds are issued at different points in time but have identical redemption dates.

Question 25

Which, if any, of the above statement(s) is (are) true?

- (A) I and II only
- (B) I and III only
- (C) II and III only
- (D) I, II, and III
- (E) The correct answer is not given by (A), (B), (C), or (D)

Data for Question 26 (3 points)

Terms of a 10-year bond issued on 1/1/2007:

Face amount	\$1,000
Redemption amount	\$1,000
Coupon rate	4.0% per year, payable semi-annually
Yield rate	5.0% per year, compounded semi-annually

Question 26

What is the total investment return to the purchaser over the lifetime of the bond?

- (A) Less than \$350
- (B) \$350 but less than \$400
- (C) \$400 but less than \$450
- (D) \$450 but less than \$500
- (E) \$500 or more

Data for Question 27 (3 points)

A pension trust statement reported the following information:

<u>Asset Values</u>	<u>1/1/2006</u>	<u>1/1/2007</u>
Book value	\$1,325,000	\$1,450,000
Market value	X	\$1,650,000

<u>Transaction</u>	<u>2006</u>
Contributions	\$250,000
Interest income	\$80,000
Benefit payments	\$55,000
Plan expenses	\$25,000

During 2006, the net change in unrealized gain/loss was exactly 3 times the net realized gain/loss.

Question 27

In what range is X?

- (A) Less than \$1,400,000
- (B) \$1,400,000 but less than \$1,600,000
- (C) \$1,600,000 but less than \$1,800,000
- (D) \$1,800,000 but less than \$2,000,000
- (E) \$2,000,000 or more

Data for Question 28 (3 points)

Selected actuarial values:

$$\ell_{100} = 95,000$$

$$\ell_{101} = 66,500$$

The probability that a person age 100 will survive for at least four months is estimated using the following methods:

- I. Uniform distribution of deaths
- II. Constant force of mortality
- III. Balducci's assumption

Question 28

Which of the following is true?

- (A)  $II < III < I$
- (B)  $I < III < II$
- (C)  $III < II < I$
- (D)  $II < I < III$
- (E) The correct answer is not given by (A), (B), (C), or (D)

Data for Question 29 (4 points)

Selected actuarial values:

$${}_{20}P_{30} = 0.75$$

$${}_{25}P_{50} = 0.55$$

$${}_{20}P_{55} = 0.60$$

$P =$  The probability that two independent lives, age 30 and age 50, will both die between ages 55 and 75.

Question 29

In what range is  $P$ ?

- (A) Less than 0.095
- (B) 0.095 but less than 0.105
- (C) 0.105 but less than 0.115
- (D) 0.115 but less than 0.125
- (E) 0.125 or more

Data for Question 30 (4 points)

Smith has the option of choosing any of the following actuarially equivalent annuities, with the first payment in one year:

- (1) A life annuity of \$1,000 per year.
- (2) A life annuity of  $X$  per year, with 50% of  $X$  payable to Smith's spouse after Smith's death.
- (3) A life annuity of \$875 per year, payable as long as Smith or Smith's spouse survives.

Question 30

In what range is  $X$ ?

- (A) Less than \$920
- (B) \$920 but less than \$925
- (C) \$925 but less than \$930
- (D) \$930 but less than \$935
- (E) \$935 or more

Data for Question 31 (3 points)

$$\ell_{x+1} = 910$$

$$L_x = 930$$

Assume a uniform distribution of deaths over the interval  $[x, x+1]$

Question 31

In what range is  $\mu_{x+0.2}$ ?

- (A) Less than 0.04190
- (B) 0.04190 but less than 0.04230
- (C) 0.04230 but less than 0.04270
- (D) 0.04270 but less than 0.04310
- (E) 0.04310 or more