

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 7, 2013

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 “ $l_x$ ” will be used to represent the number of lives at age  $x$ .
5. This examination consists of 32 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 2013

## Answer Key

<b>Question</b>	<b>Points</b>	<b>Solution</b>
<b>1</b>	<b>C</b>	
<b>2</b>	<b>E</b>	
<b>3</b>	<b>B</b>	
<b>4</b>	<b>E</b>	
<b>5</b>	<b>A</b>	
<b>6</b>	<b>C</b>	
<b>7</b>	<b>E</b>	
<b>8</b>	<b>B</b>	
<b>9</b>	<b>E</b>	
<b>10</b>	<b>E</b>	
<b>11</b>	<b>C</b>	
<b>12</b>	<b>B</b>	
<b>13</b>	<b>B</b>	
<b>14</b>	<b>A</b>	
<b>15</b>	<b>E</b>	
<b>16</b>	<b>C</b>	
<b>17</b>	<b>B</b>	
<b>18</b>	<b>C</b>	
<b>19</b>	<b>E</b>	
<b>20</b>	<b>E</b>	
<b>21</b>	<b>B</b>	
<b>22</b>	<b>C</b>	
<b>23</b>	<b>D</b>	
<b>24</b>	<b>B</b>	
<b>25</b>	<b>C</b>	
<b>26</b>	<b>E</b>	
<b>27</b>	<b>B</b>	
<b>28</b>	<b>E</b>	
<b>29</b>	<b>B</b>	
<b>30</b>	<b>B</b>	
<b>31</b>	<b>D</b>	
<b>32</b>	<b>B</b>	

## CONDITIONS GENERALLY APPLICABLE TO ALL EA-1 EXAMINATION QUESTIONS

---

If applicable, 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 pre-retirement death or disability benefits.
- (4) Actuarial equivalence is based on the mortality table and interest rate assumed for funding purposes.
- (5) Interest rates that are compounded more frequently than annually are expressed as nominal rates.
- (6) Where multiple lives are involved, future lifetimes are assumed to be independent of each other.
- (7) The term “gross single premium” is equivalent to “contract single premium;” the term “net single premium” is equivalent to “single benefit premium;” the term “gross annual premium” is equivalent to “annual contract premium;” the term “net annual premium” is equivalent to “annual benefit premium.”
- (8) There are no policy loans in effect.
- (9) For a bond, the face amount and the redemption value are the same.
- (10) Interest rate equals yield rate.
- (11) The term “duration” means “Macaulay duration”.

Data for Question 1 (2 points)

The present value of a 15-year monthly annuity-immediate is \$20,600.

Payments are as follows:

<u>Years</u>	<u>Monthly annuity payment</u>
1–7	$X$
8–15	$X + \$300$

Interest rate: 8.0% per year, compounded annually.

Question 1

In what range is  $X$ ?

- (A) Less than \$74.50
- (B) \$74.50 but less than \$75.50
- (C) \$75.50 but less than \$76.50
- (D) \$76.50 but less than \$77.50
- (E) \$77.50 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 2 (3 points)

Consider the following two last survivor annuities:

	Annuity A	Annuity B
Payment Timing	Beginning of Year	End of Year
Payment while both $x$ and $y$ are alive	$R$	$R$
Payment after the first death of $x$ and $y$	$2R$	$\frac{1}{2}R$
Net single premium	\$116	$X$

Selected actuarial values:

$$\ddot{a}_x = 10.00$$

$$\ddot{a}_y = 15.00$$

$$\ddot{a}_{xy} = 7.00$$

Question 2

In what range is  $X$ ?

- (A) Less than \$32
- (B) \$32 but less than \$36
- (C) \$36 but less than \$40
- (D) \$40 but less than \$44
- (E) \$44 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 3 (3 points)

Smith (age 65) purchases an annuity with the following provisions:

Frequency of annuity payments	Monthly, with the first payment made on the purchase date
Amount of each annuity payment	\$50
Death benefit	\$10,000, payable at end of year of death if death occurs during first 10 years, \$0 otherwise

Interest rate: 7.0% per year, compounded annually.

Selected commutation functions:

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

$X$  = the net single premium.

Question 3

In what range is  $X$ ?

- (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



**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 4 (3 points)

Fund balance as of 1/1/2013 \$12,000.

Deposits to the fund: 60 deposits of \$100 on the last day of each month beginning 1/31/2013

Withdrawals from the fund: 20 withdrawals of \$1,000 on the first day of each quarter beginning 1/1/2020

Interest rate: 8.0% per year, compounded monthly.

$X$  = the fund balance as of 12/31/2024.

Question 4

In what range is  $X$ ?

- (A) Less than \$13,500
- (B) \$13,500 but less than \$15,000
- (C) \$15,000 but less than \$16,500
- (D) \$16,500 but less than \$18,000
- (E) \$18,000 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 5 (2 points)

A \$1,000 mortgage is repaid over 20 years by level annual payments at the end of each year computed at 4.0% per year compounded annually.

$X$  = the modified duration of the mortgage.

Question 5

In what range is  $X$ ?

- (A) Less than 9.0
- (B) 9.0 but less than 9.3
- (C) 9.3 but less than 9.6
- (D) 9.6 but less than 9.9
- (E) 9.9 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 6 (3 points)

An insurance company uses a 3-year select period in its calculations.

Given the following survival model for ultimate mortality:

$$l_x = (31 - x), \quad 0 \leq x \leq 31$$

For the 3-year select period:

$$q_{[x]+t} = \left( \frac{t+1}{t+2} \right) q_{x+t}, \quad t = 0, 1, 2$$

Smith was insured one year ago, at age 20.

$X$  = the probability that Smith will die between age 23 and age 24.

Question 6

In what range is  $X$ ?

- (A) Less than 0.0925
- (B) 0.0925 but less than 0.1000
- (C) 0.1000 but less than 0.1075
- (D) 0.1075 but less than 0.1150
- (E) 0.1150 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 7 (3 points)

Given the following:

- I. The probability that two independent lives, a 20-year old and a 40-year old, both survive 20 years is 0.733333
- II. Out of 800 lives at age 20, 96 are expected to die by age 30

Question 7

In what range is  ${}_{30}q_{30}$ ?

- (A) Less than 0.150
- (B) 0.150 but less than 0.155
- (C) 0.155 but less than 0.160
- (D) 0.160 but less than 0.165
- (E) 0.165 or more



**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 8 (4 points)

Given the following selected mortality values:

$${}_n p_{xx} = 0.25$$

$$p_{x+n} = 0.50$$

$$X = {}_n q_x + {}_n q_{xx} - {}_n | q_{xxx}$$

Question 8

In what range is  $X$ ?

- (A) Less than 1.14
- (B) 1.14 but less than 1.16
- (C) 1.16 but less than 1.18
- (D) 1.18 but less than 1.20
- (E) 1.20 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 9 (3 points)

Selected annuity values:

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

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

Question 9

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

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 10 (4 points)

Consider the following annuities:

Annuity 1	Annuity 2
10-year decreasing annuity with annual payments beginning at the end of the first year.	15-year increasing annuity with annual payments beginning at the end of the first year.
Payments begin at \$100 and decline by \$10 each year.	The first payment equals \$30 and each subsequent payment is 5.0% greater than the one preceding it.

Interest rate: 6.5% per year, compounded annually.

$X$  = the present value of Annuity 1.

$Y$  = the present value of Annuity 2.

Question 10

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

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 11 (3 points)

Smith (age 65) purchases an annuity-immediate of \$100,000 per annum on 1/1/2013 payable annually for two years.

Mortality rates for 2012 are as follows:

$x$	$q_x$
65	0.0156
66	0.0176

To compute the single premium for this annuity, the seller uses projected mortality and assumes mortality rates will decrease at a rate of 1.5% per year.

Interest rate: 5.0% per year, compounded annually.

Question 11

In what range is the single premium for this annuity?

- (A) Less than \$180,000
- (B) \$180,000 but less than \$181,550
- (C) \$181,550 but less than \$183,100
- (D) \$183,100 but less than \$184,650
- (E) \$184,650 or more



**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 12 (4 points)

Consider a 2-decrement table, reflecting mortality and withdrawal:

$$q_x^{(mortality)} = 0.03$$

$$\mu_x^{(withdrawal)} = 0.20$$

Mortality is uniformly distributed on the single table.

Withdrawal has a constant force of decrement on the single table.

Question 12

In what range is  $q_x^{(mortality)}$  ?

- (A) Less than 0.0270
- (B) 0.0270 but less than 0.0275
- (C) 0.0275 but less than 0.0280
- (D) 0.0280 but less than 0.0285
- (E) 0.0285 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 13 (3 points)

A pension plan has a shortfall of \$1,000,000.

The shortfall is to be amortized in level annual installments over 7 years using the yield curve below, with the first payment due immediately.

<u>Duration</u>	<u>Spot rate</u>
1	6.19%
2	7.32%
3	7.83%
4	8.03%
5	8.18%
6	8.33%
7	8.50%

$X$  = the annual amortization payment.

Question 13

In what range is  $X$ ?

- (A) Less than \$175,000
- (B) \$175,000 but less than \$180,000
- (C) \$180,000 but less than \$185,000
- (D) \$185,000 but less than \$190,000
- (E) \$190,000 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 14 (3 points)

An organization has 125 members all exact age 62 as of 01/01.

From this group, the following members left during the calendar year, for the reasons shown:

Deaths, all on 06/01:	3
Disabilities, all on 07/01:	5
Terminations, all on 08/01:	10
Retirements, all on 11/01:	4

In addition, 15 new members, each exact age 62 on 01/01, joined the group on 10/01.

None of the 15 new members died, terminated, became disabled, or retired during the year.

$q_{62}$  = the organization's rate of mortality at age 62.

Question 14

In what range is  $q_{62}$ ?

- (A) Less than 0.0255
- (B) 0.0255 but less than 0.0260
- (C) 0.0260 but less than 0.0265
- (D) 0.0265 but less than 0.0270
- (E) 0.0270 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 15 (3 points)

Smith (age 62) has the option to choose one of the following actuarially equivalent benefits:

- I. A life annuity-due of \$30,000 per year, with payments beginning immediately
- II. A \$50,000 lump sum payable immediately; plus  
a 5-year term certain annuity-due that pays  $X$  per year starting at age 65, if Smith survives to age 65

Interest rate: 7.0% per year, compounded annually.

Selected actuarial values:

$$\ddot{a}_{62} = 12.68$$

$${}_n p_x = 0.99^n; \quad x \leq 65$$

Question 15

In what range is  $X$ ?

- (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



**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 16 (3 points)

Given the following actuarial values:

$$q_x = 0.03$$

$$q_{x+1} = 0.04$$

Deaths are uniformly distributed throughout each year.

$$X = {}_{0.25|1.50}q_x$$

Question 16

In what range is  $X$ ?

- (A) Less than 0.050
- (B) 0.050 but less than 0.051
- (C) 0.051 but less than 0.052
- (D) 0.052 but less than 0.053
- (E) 0.053 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 17 (3 points)

Smith borrows \$1,000 from Jones.

The terms of the loan follow:

Repayment period ..... 25 years  
Payments ..... Level annual payments  
Interest..... 4.0% per year, compounded annually

When Jones receives each repayment from Smith, Jones immediately reinvests the entire repayment at a nominal interest rate of 5.0% per year, compounded semiannually.

$X$  = the equivalent level annual yield Jones earns over the 25 years.

Question 17

In what range is  $X$ ?

- (A) Less than 4.59%
- (B) 4.59% but less than 4.61%
- (C) 4.61% but less than 4.63%
- (D) 4.63% but less than 4.65%
- (E) 4.65% or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 18 (3 points)

Smith retires at age 60 and can elect one of the following actuarially equivalent annuity options:

- Option 1      A life annuity of \$1,000 per month, payable at the beginning of each month, commencing at age 60, with the first 60 payments guaranteed
- Option 2      A deferred life annuity of  $X$  per month, payable at the beginning of each month, commencing at age 65

Selected actuarial value:

$${}_{5|}\ddot{a}_{60}^{(12)} = 8.88$$

Interest: 5.0% per year, compounded annually.

Question 18

In what range is  $X$ ?

- (A)    Less than \$1,485
- (B)    \$1,485 but less than \$1,495
- (C)    \$1,495 but less than \$1,505
- (D)    \$1,505 but less than \$1,515
- (E)    \$1,515 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 19 (4 points)

Terms of a bond:

Face amount .....\$1,000  
Term ..... 20 years  
Coupons ..... 4.0% per year, payable quarterly  
Redemption ..... At par  
Yield to maturity ..... 4.5% per year, compounded semiannually

$X$  = the duration of the bond.

Question 19

In what range is  $X$ ?

- (A) Less than 12.75
- (B) 12.75 but less than 13.00
- (C) 13.00 but less than 13.25
- (D) 13.25 but less than 13.50
- (E) 13.50 or more



**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 20 (3 points)

Smith pays \$950 for an investment that has the following payouts:

At the end of year 3.....	\$500
At the end of year 4.....	\$700

The purchase price of this investment is based on a 2-year spot rate of 5.0% and a 4-year spot rate of 7.0%.

$X$  = the three-year deferred, one year spot rate.

Question 20

In what range is  $X$ ?

- (A) Less than 7.0%
- (B) 7.0% but less than 7.6%
- (C) 7.6% but less than 8.2%
- (D) 8.2% but less than 8.8%
- (E) 8.8% or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 21 (3 points)

A company provides for a lump sum on termination of employment.

The lump sum is equal to 6 months of salary for employees under age 45 who terminate during the year.

All terminations occur at the beginning of the year.

The lump sum is paid in the middle of the year.

Data for all employees under age 45 at 1/1/2013:

$x$	$q_x^{(termination)}$	Total annual salary
30	0.15	\$5,000,000
35	0.10	\$9,000,000
40	0.05	\$6,000,000

There are no causes of decrement other than termination.

Interest rate: 8.0% per year, compounded annually.

$X$  = the one-year term cost of the 2013 “termination benefit” at 1/1/2013.

Question 21

In what range is  $X$ ?

- (A) Less than \$925,000
- (B) \$925,000 but less than \$945,000
- (C) \$945,000 but less than \$965,000
- (D) \$965,000 but less than \$985,000
- (E) \$985,000 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 22 (2 points)

Given the following net single premiums:

$$A_{76} = 0.80$$

$${}_1E_{76} = 0.90$$

Interest rate: 3.0% per year, compounded annually.

Question 22

In what range is  $A_{77}$ ?

- (A) Less than 0.806
- (B) 0.806 but less than 0.809
- (C) 0.809 but less than 0.812
- (D) 0.812 but less than 0.815
- (E) 0.815 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 23 (4 points)

Given the following survival model:

$$l_x = (5-x)^2, \quad 0 \leq x < 5$$

Question 23

In what range is  ${}_1|q_{\overline{2}|3}$ ?

- (A) Less than 0.35
- (B) 0.35 but less than 0.40
- (C) 0.40 but less than 0.45
- (D) 0.45 but less than 0.50
- (E) 0.50 or more



**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 24 (4 points)

Given the following mortality rates for lives as of 01/01/2013:

$x$	$q_x$
50	0.0148
51	0.0159
52	0.0170
53	0.0183

Rates of mortality are expected to decrease at each age by 2.0% per year, compounded annually.

Interest rate: 4.0% per year, compounded annually.

$X$  = the present value of a 3-year annuity due of \$10,000 per year, payable annually on a life age 50 on 01/01/2013.

$Y$  = the present value of a 3-year annuity due of \$10,000 per year, payable annually on a life age 50 on 01/01/2023.

Question 24

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

- (A) Less than \$76
- (B) \$76 but less than \$80
- (C) \$80 but less than \$84
- (D) \$84 but less than \$88
- (E) \$88 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 25 (4 points)

Smith borrows  $\$X$  at a rate of 12.5%, and makes level payments at the end of each year for  $n$  years.

The interest portion of the final payment is \$153.86.

The total principal repaid after the  $(n-1)$  payment is \$6,009.12.

$Y$  = the principal repaid in the first payment.

Question 25

In what range is  $Y$ ?

- (A) Less than \$470
- (B) \$470 but less than \$478
- (C) \$478 but less than \$486
- (D) \$486 but less than \$494
- (E) \$494 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 26 (2 points)

Consider the following bond:

Face value .....\$1,000  
Bond price:.....\$980  
Coupon rate:..... 10.0% annual, payable at end of year  
Risk-free yield rate..... 7.0%, compounded annually  
Term..... 1 year

$X$  = the implicit probability of default.

Question 26

In what range is  $X$ ?

- (A) Less than 0.0450
- (B) 0.0450 but less than 0.0455
- (C) 0.0455 but less than 0.0460
- (D) 0.0460 but less than 0.0465
- (E) 0.0465 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 27 (2 points)

Selected actuarial values:

$$l_x = 1000$$
$$q_x^{(1)} = 0.05$$
$$q_x^{(2)} = 0.03$$
$$q_x^{(3)} = 0.30$$

Decrements (1) and (3) are uniformly distributed throughout the year.

Decrement (2) occurs at the end of the year.

Question 27

In what range is  $d_x^{(2)}$ ?

- (A) Less than 19.5
- (B) 19.5 but less than 20.0
- (C) 20.0 but less than 20.5
- (D) 20.5 but less than 21.0
- (E) 21.0 or more



**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 28 (3 points)

Smith has the option to choose one of the following actuarially equivalent annuities:

- I. A life annuity of \$1,250 per month payable to Smith.
- II. An annuity that provides for the payment of \$1,000 per month to Smith, with \$500 per month continuing to Smith's surviving spouse commencing upon Smith's death.
- III. An annuity that provides for the payment of  $X$  per month to Smith, with  $0.75X$  continuing to Smith's surviving spouse commencing upon Smith's death.

Question 28

In what range is  $X$ ?

- (A) Less than \$875
- (B) \$875 but less than \$885
- (C) \$885 but less than \$895
- (D) \$895 but less than \$905
- (E) \$905 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 29 (3 points)

Terms of a perpetuity:

\$1.00 at the end of year 2;  
\$2.00 at the end of year 4;  
\$3.00 at the end of year 6;  
...  
\$ $k$  at the end of year  $2k$ ;  
...

No payments are made in any other year.

Interest rate: 6.0% per year, compounded annually.

$X$  = the present value of this perpetuity.

Question 29

In what range is  $X$ ?

- (A) Less than \$73.00
- (B) \$73.00 but less than \$76.00
- (C) \$76.00 but less than \$79.00
- (D) \$79.00 but less than \$82.00
- (E) \$82.00 or more

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 30 (3 points)

Values from a mortality table:

$x$	$q_x$
$0 \leq x \leq 35$	$\frac{0.01}{1.01}$
$35 < x \leq 75$	$\frac{0.02}{1.02}$
$x > 75$	1.00

Question 30

In what range is  $e_0$ ?

- (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

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 31 (3 points)

Smith (age 65) has a beneficiary, Jones (age 62).

Smith has the option to choose one of the following actuarially equivalent annuities, with the first payment being made immediately:

- I. \$10,000 per year, payable to Smith at the beginning of each year.
- II.  $X$  per year, payable at the beginning of each year while both Smith and Jones are alive, decreasing to  $0.75X$  upon the first death. All payments cease upon the second death.

Selected actuarial values:

$x$	$\ddot{a}_x$	$\ddot{a}_{x:x-3}$
62	10.6974	9.4604
63	10.4827	9.2108
64	10.2642	8.9590
65	10.0426	8.7060

Question 31

In what range is  $X$ ?

- (A) Less than \$8,700
- (B) \$8,700 but less than \$8,800
- (C) \$8,800 but less than \$8,900
- (D) \$8,900 but less than \$9,000
- (E) \$9,000 or more



**USE THIS PAGE FOR YOUR SCRATCH WORK**

**EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK**

Data for Question 32 (5 points)

Consider the following fund:

<u>Date</u>	<u>Market value</u>	<u>Contribution</u>	<u>Withdrawals</u>
01/01	\$100,000	\$0	\$0
03/31	-	0	20,000
04/01	90,000	0	0
07/01	95,000	0	0
09/30	-	75,000	0
10/01	185,000	0	0
12/31	180,000	0	0

Rates of return on fund:

Time weighted ..... *t*  
Dollar weighted.....*d*  
Dollar weighted assuming cash flows at mid-year ..... *m*

Question 32

Which of the following relationships, if any, is true?

- (A)  $t > m > d$
- (B)  $t > d > m$
- (C)  $m > t > d$
- (D)  $d > t > m$
- (E) The correct answer is not given by (A), (B), (C), or (D) above

**\*\*END OF EXAMINATION\*\***

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**USE THIS PAGE FOR YOUR SCRATCH WORK**

**USE THIS PAGE FOR YOUR SCRATCH WORK**