SOCIETY OF ACTUARIES

AMERICAN SOCIETY OF PENSION ACTUARIES

JOINT BOARD FOR THE ENROLLMENT OF ACTUARIES

ENROLLED ACTUARIES BASIC EXAMINATION

MAY 2015 EA-1 EXAMINATION

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.”

2015

Data for Question 1 (2 points)

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

Question 1

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

2015

Data for Question 2 (3 points)

You are given the following at 3.0% interest, compounded annually:

x	N_x
88	208
89	153
90	110
91	77
92	53
93	35

Question 2

In what range is ${}_3q_{89}$?

(A) Less than 0.47

(B) 0.47 but less than 0.49

(C) 0.49 but less than 0.51

(D) 0.51 but less than 0.53

(E) 0.53 or more

2015

Data for Question 3 (3 points)

$_{10}E_x = 0.400$

$_{10|}a_x = 7.000$

$\ddot{s}_{x:\overline{10}|} = 15.000$

Question 3

In what range is $\ddot{a}_x$?

(A) Less than 12.70

(B) 12.70 but less than 12.90

(C) 12.90 but less than 13.10

(D) 13.10 but less than 13.30

(E) 13.30 or more

2015

Data for Question 4 (3 points)

On 1/1/2015, 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.

X = The value on 1/1/2015 of the endowment fund.

Question 4

In what range is ***X***?

(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

2015

Data for Question 5 (4 points)

A 25-year bond has 5.5% annual coupons, and is purchased and redeemable at par.

X = the duration of the bond.

Question 5

In what range is ***X***?

(A) Less than 14.0

(B) 14.0 but less than 14.5

(C) 14.5 but less than 15.0

(D) 15.0 but less than 15.5

(E) 15.5 or more

2015

Data for Question 6 (2 points)

The following values are from a life table:

x	l_x
56	8,223,010
57	8,106,161
58	7,980,191
59	7,844,525
60	7,698,698
61	7,542,106
62	7,374,370
63	7,195,099
64	7,003,925
65	6,800,531
66	6,584,614
67	6,355,865

For valuation purposes, the actuary applies a 2-year setback.

Smith is currently age 58.

X = the probability that Smith dies after age 65.

Question 6

In what range is ***X***?

(A) Less than 0.825

(B) 0.825 but less than 0.840

(C) 0.840 but less than 0.855

(D) 0.855 but less than 0.870

(E) 0.870 or more

2015

Data for Question 7 (4 points)

Data from a double-decrement (death and withdrawal) table:

The absolute rate of death at age 50 is 0.035.

The probability of withdrawal is 5 times the probability of death at all ages.

Decrements are uniformly distributed in their associated single decrement tables.

X = the absolute rate of withdrawal at age 50.

Question 7

In what range is ***X***?

(A) Less than 0.162

(B) 0.162 but less than 0.166

(C) 0.166 but less than 0.170

(D) 0.170 but less than 0.174

(E) 0.174 or more

2015

Data for Question 8 (4 points)

Smith (age 65) is eligible to retire with a monthly pension benefit payable under one of the following actuarially equivalent forms of payment:

(1) A straight life annuity of $15,000.

(2) An annuity of $13,500 payable to Smith, with $6,750 continuing to Smith's surviving spouse after Smith's death.

(3) An annuity of $\boldsymbol{X}$ payable to Smith, with 75% of $\boldsymbol{X}$ continuing to Smith's surviving spouse after Smith's death.

All annuity payments are made at the beginning of each month.

Question 8

In what range is $\boldsymbol{X}$?

(A) Less than $12,200

(B) $12,200 but less than $12,500

(C) $12,500 but less than $12,800

(D) $12,800 but less than $13,100

(E) $13,100 or more

2015

Data for Question 9 (2 points)

You are given the following information for a fund:

Date	Account Balance	Deposit
1/1/2014	$500,000	
8/1/2014		$100,000

The dollar-weighted rate of return for 2014 equals 18.46%.

Realized gain for 2014 equals $20,000.

Interest plus dividends for 2014 equals $10,000.

There are no other cash flows during 2014.

X = the unrealized gain during 2014.

Question 9

In what range is ***X***?

(A) Less than $75,000

(B) $75,000 but less than $85,000

(C) $85,000 but less than $95,000

(D) $95,000 but less than $105,000

(E) $105,000 or more

2015

Data for Question 10 (4 points)

Smith's salary on 1/1/2015 is $50,000.

On each subsequent 1/1, Smith's salary will increase 4.0% over his salary on the prior 1/1.

On each 12/31, beginning 12/31/2015, Smith will deposit 2.0% of his salary into a fund.

The fund earns an annual effective rate of interest of 5.0%.

X = the accumulated value of Smith's deposits in the fund as of 1/1/2030.

Question 10

In what range is ***X***?

(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

2015

Data for Question 11 (4 points)

Deaths are uniformly distributed over [0,100].

Interest rate: 6.0% per year, compounded annually.

Question 11

In what range is $100a_{60}$?

(A) Less than $1,000

(B) $1,000 but less than $1,005

(C) $1,005 but less than $1,010

(D) $1,010 but less than $1,015

(E) $1,015 or more

2015

Data for Question 12 (3 points)

Selected values from a mortality table:

x	e_x
75	10.5
76	10.0
77	9.6

X = the number expected to die after age 77 out of 10,000 alive at age 75.

Question 12

In what range is ***X***?

(A) Less than 9,000

(B) 9,000 but less than 9,010

(C) 9,010 but less than 9,020

(D) 9,020 but less than 9,030

(E) 9,030 or more

2015

Data for Question 13 (3 points)

Data from a mortality table:

x	q_x
60	0.0156
61	0.0169
62	0.0184
63	0.0201

Interest rate: 5.0% per year, compounded annually.

Question 13

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

2015

Data for Question 14 (4 points)

Terms of a loan:

Date of loan	1/1/2005
Amount of loan	$100,000
Term of loan	360 level monthly repayments
First repayment date	2/1/2005
Interest	12.0% per year, compounded monthly

Immediately after making the 120th repayment, the borrower decides to add ***X*** to each monthly repayment so that the loan will be repaid after having made a total of 160 monthly repayments.

Question 14

In what range is ***X***?

(A) Less than $700

(B) $700 but less than $1,250

(C) $1,250 but less than $1,800

(D) $1,800 but less than $2,350

(E) $2,350 or more

2015

Data for Question 15 (3 points)

Data on a bond:

Face amount	$1,000
Term	10 years
Coupon rate	5.0% per year, payable semi-annually

X = Premium if yield to maturity is 4.0%, compounded annually.

Y = Discount if yield to maturity is 6.0%, compounded annually.

Question 15

In what range is $|\boldsymbol{X}| - |\boldsymbol{Y}|$?

(A) Less than $7

(B) $7 but less than $10

(C) $10 but less than $13

(D) $13 but less than $16

(E) $16 or more

2015

Data for Question 16 (4 points)

Smith is currently age 65 and is electing a pension benefit that has the following actuarial equivalent forms of benefit:

Normal form of benefit:	$1,500 per month, payable immediately as a single life annuity.
Optional form of benefit:	If Smith survives to age 70, a payment of ***X*** per month guaranteed for 5 years, and a single life annuity of ***X*** per month thereafter.

Selected actuarial values:

$i = 6.0\%$ per year, compounded annually

x	D_x	N_x
65	1,000	9,900
70	730	5,474
75	400	3,160

Question 16

In what range is ***X***?

(A) Less than $2,300

(B) $2,300 but less than $2,320

(C) $2,320 but less than $2,340

(D) $2,340 but less than $2,360

(E) $2,360 or more

2015

Data for Question 17 (3 points)

A whole life insurance policy purchased by a 60-year old provides a death benefit of $1,000 payable at the end of the year of death.

Selected actuarial values:

$$i = 6.0\% \text{ per year, compounded annually}$$
$$a_{61} = 11.5069$$
$$q_{60} = 0.004803$$

X = the net single premium for this policy.

Question 17

In what range is ***X***?

(A) Less than $255

(B) $255 but less than $285

(C) $285 but less than $315

(D) $315 but less than $345

(E) $345 or more

2015

Data for Question 18 (4 points)

An asset portfolio includes the following zero-coupon bonds at the beginning of a year:

Years to maturity	Face amount
3	$10,000
5	$20,000
7	$30,000

The term structure of interest rates is:

	Interest rates	
Length of investment	Beginning of year	End of year
1 year	3.00%	0.50%
2 years	2.75%	0.75%
3 years	2.75%	1.00%
4 years	3.00%	1.25%
5 years	3.25%	1.75%
6 years	3.25%	1.75%
7 years	3.50%	2.00%

No zero-coupon bonds are sold or purchased during the year.

X = the change in the market value of the zero-coupon bonds during the year.

Question 18

In what range is ***X***?

(A) Less than $3,000

(B) $3,000 but less than $4,000

(C) $4,000 but less than $5,000

(D) $5,000 but less than $6,000

(E) $6,000 or more

Data for Question 19 (3 points)

Data from a select and ultimate mortality table:

n	$q_{[x]+n} \div q_{x+n}$
0	0.05
1	0.65
2	0.90
≥ 3	1.00

$$l_x = 1000 - 10x, \quad 0 \leq x \leq 100$$

$$l_{x+3} = l_{[x]+3}$$

$$\boldsymbol{X} = l_{[68]+2}$$

Question 19

In what range is $\boldsymbol{X}$?

(A) Less than 294

(B) 294 but less than 296

(C) 296 but less than 298

(D) 298 but less than 300

(E) 300 or more

2015

Data for Question 20 (3 points)

Present values of a monthly joint life annuity of $1, payable at the end of each month:

If Smith is alive	$100
If Jones is alive	***X***
If only Smith is alive	$20
If only Smith or only Jones is alive	$50

Question 20

In what range is ***X***?

(A) Less than $85

(B) $85 but less than $95

(C) $95 but less than $105

(D) $105 but less than $115

(E) $115 or more

2015

Data for Question 21 (2 points)

Selected actuarial values:

$$l_{x+1} = 960$$
$$L_x = 975$$

Deaths follow uniform distribution between x and $x+1$.

Question 21

In what range is $1000m_x$?

(A) Less than 30.0

(B) 30.0 but less than 30.5

(C) 30.5 but less than 31.0

(D) 31.0 but less than 31.5

(E) 31.5 or more

2015

Data for Question 22 (3 points)

Terms of a loan:

Repayment period	10 years
Payments	Annual payments, payable at the end of each year The principal portion of the payment at the end of the tth year is \$100t, $t = 1, 2, 3, \ldots, 10$
Interest rate	4.0% per year, compounded annually

X = the present value of the interest portions of the 10 payments at $t = 0$.

Question 22

In what range is ***X***?

(A) Less than \$950

(B) \$950 but less than \$1,100

(C) \$1,100 but less than \$1,250

(D) \$1,250 but less than \$1,400

(E) \$1,400 or more

2015

Data for Question 23 (3 points)

Given the following information:

Account balance as of 1/1/2015	$50,000
Contribution made 4/1/2015	$4,000
Withdrawal on 7/1/2016	$7,000
Account balance as of 10/1/2016	$52,000

X = the annualized rate of return from 1/1/2015 to 10/1/2016 using the dollar-weighted method.

Question 23

In what range is ***X***?

(A) Less than 6.0%

(B) 6.0% but less than 7.5%

(C) 7.5% but less than 9.0%

(D) 9.0% but less than 10.5%

(E) 10.5% or more

2015

Data for Question 24 (3 points)

Given the following mortality rates as of 1/1/2014:

x	q_x
50	0.0157
51	0.0167
52	0.0176
53	0.0187

It is assumed that rates of mortality decrease by 3.0% per year, compounded annually.

Interest is 5.0% per year, compounded annually.

On 1/1/2024, a 50-year old purchases a $10,000 3-year temporary life annuity, with the first payment at age 50.

X = the value as of 1/1/2024 of this annuity.

Question 24

In what range is ***X***?

(A) Less than $28,200

(B) $28,200 but less than $28,400

(C) $28,400 but less than $28,600

(D) $28,600 but less than $28,800

(E) $28,800 or more

2015

Data for Question 25 (4 points)

Given the following:

i	= 5.0% per year, compounded annually
D_{49}	= 6,587.11
d_{49}	= 790
$1000A_{50}$	= 450.426

Question 25

In what range is N_{50} ?

(A) Less than 70,000

(B) 70,000 but less than 72,500

(C) 72,500 but less than 75,000

(D) 75,000 but less than 77,500

(E) 77,500 or more

2015

Data for Question 26 (4 points)

A perpetuity pays $25,000 at the end of each year.

The effective annual interest rate is 10.0%.

X = the duration of the perpetuity.

Question 26

In what range is ***X***?

(A) Less than 9.1

(B) 9.1 but less than 9.6

(C) 9.6 but less than 10.1

(D) 10.1 but less than 10.6

(E) 10.6 or more

2015

Data for Question 27 (4 points)

Terms of a bond:

Face amount	$1,000
Annual coupons	4.0%
Term	3 years
Purchase price	$974.21

The spot rates at the time the bond is issued are:

Year	Spot rate
1	3.0%
2	4.0%
3	Unknown

Future interest rates are the forward interest rates implicit in the initial yield curve.

Immediately after the first coupon payment, the investor sells the bond.

X = the investor's total realized return on the bond.

Question 27

In what range is ***X***?

(A) Less than ($20)

(B) ($20) but less than $0

(C) $0 but less than $20

(D) $20 but less than $40

(E) $40 or more

2015

Data for Question 28 (3 points)

Given the following in a service table:

Number of active members at exact age 40	1,500
Number of voluntary terminations between exact ages 40 and 41	30
Number of disability retirements between exact ages 40 and 41	10
Number of involuntary terminations between exact ages 40 and 41	20
Number of deaths between exact ages 40 and 41	12

All decrements are uniform over the year of age 40 to 41.

X = the rate of mortality at age 40 in the associated single decrement table.

Question 28

In what range is ***X***?

(A) Less than 0.008150

(B) 0.008150 but less than 0.008170

(C) 0.008170 but less than 0.008190

(D) 0.008190 but less than 0.008210

(E) 0.008210 or more

2015

Data for Question 29 (3 points)

Data from a select and ultimate mortality table:

x	$q_{[x]}$	$q_{[x]+1}$	$q_{[x]+2}$	$x+2$
71	0.057	0.070	0.082	73
72	0.060	0.072	0.085	74
73	0.062	0.075	0.088	75
74	0.063	0.077	0.090	76

$\boldsymbol{X} = {}_4q_{[71]+1}$

Question 29

In what range is $\boldsymbol{X}$?

(A) Less than 0.270

(B) 0.270 but less than 0.280

(C) 0.280 but less than 0.290

(D) 0.290 but less than 0.300

(E) 0.300 or more

Data for Question 30 (3 points)

$l_x = 100 - x$ for $49 < x \leq 100$

$i = 4.0\%$ per year, compounded annually.

Question 30

In what range is N_{50}?

(A) Less than 98.0

(B) 98.0 but less than 102.0

(C) 102.0 but less than 106.0

(D) 106.0 but less than 110.0

(E) 110.0 or more

2015

Data for Question 31 (3 points)

Selected actuarial values:

$$l_{65} = 1,000$$
$$l_{65.5} = 975$$

Deaths are uniformly distributed over each year of age between consecutive integral ages.

Question 31

In what range is $\mu_{65.4}$?

(A) Less than 0.0505

(B) 0.0505 but less than 0.0508

(C) 0.0508 but less than 0.0511

(D) 0.0511 but less than 0.0514

(E) 0.0514 or more

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Answer Key EA-1 Spring 2015

January 27, 2015

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

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