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

Enrolled Actuaries Basic Examination

EA-1

Date: Thursday, May 8, 2025

INSTRUCTIONS TO CANDIDATES

1. Special conditions generally applicable to all questions on this examination are found on the next page.
2. 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.
3. 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.
4. 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.
5. Do not spend too much time on any one question. If a question seems too difficult, leave it and go on.
6. 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 computer screen.
7. Use the scratch paper booklets provided by Prometric for your scratch work. Extra scratch paper booklets are available if you run out of scratch paper in the booklet provided to you.

Answer Key EA-1 Spring 2025
February 12, 2025

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

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".

If applicable, the preceding conditions should be considered a part of the data for each question, unless otherwise stated or implied.

Data for Question 1 (4 points)

Smith makes deposits at the end of each month for the next 10 years. These deposits earn interest at an annual effective rate of 5.0%.

Each monthly deposit during the first year is $100.

The monthly deposit in each subsequent year is 3% greater than the preceding year's.

X = the value of Smith's account at the end of 10 years.

Question 1

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

(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 2 (4 points)

Smith begins making deposits into a savings account in January.

Timing of deposits	End of each month
Amount of each deposit	$25 each month in the first year, increasing each January 31 thereafter by 12% of the monthly amount for the prior year
Interest rate	12.0% per year, compounded monthly

X= the amount in the savings account immediately after the 216th deposit is made.

Question 2

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

(A) Less than $40,300

(B) $40,300 but less than $40,700

(C) $40,700 but less than $41,100

(D) $41,100 but less than $41,500

(E) $41,500 or more

Data for Question 3 (4 points)

Terms of an annuity:

Payment:	Annually, at end of year
Initial payment:	$8,000
Subsequent payments:	Payments increase by $2,000 per year until the payment reaches $20,000. Payments then decrease by $2,000 per year until the payment reaches $0.

Interest rate: 4.0% per year, compounded annually

X= the present value of this annuity.

Question 3

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

(A) Less than $140,000

(B) $140,000 but less than $142,000

(C) $142,000 but less than $144,000

(D) $144,000 but less than $146,000

(E) $146,000 or more

Data for Question 4 (3 points)

Terms of an annuity:

Payments	\$1,200 for each of the first five years, payable monthly at the beginning of each month; \$2,400 for each of the next five years, payable semi-annually at the beginning of each semi-annual period.

Interest rate: 6.0% per year, compounded quarterly.

X = the present value of the annuity.

Question 4

In what range is X?

(A) Less than \$12,400

(B) \$12,400 but less than \$12,800

(C) \$12,800 but less than \$13,200

(D) \$13,200 but less than \$13,600

(E) \$13,600 or more

Data for Question 5 (3 points)

Provisions of a loan:

Term	8 years
Repayments	Level annual, payable at the end of each year
Interest rate	4.75% per year, compounded annually

The principal portion of the 5th repayment is $699.68.

X= the total amount of interest paid on this loan.

Question 5

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

(A) Less than $1,100

(B) $1,100 but less than $1,400

(C) $1,400 but less than $1,700

(D) $1,700 but less than $2,000

(E) $2,000 or more

Data for Question 6 (2 points)

Terms of a loan:

Interest rate	12.50% per year, compounded monthly
Term	15 years
Amount borrowed	$49,400
Repayments	Payable monthly; first payment due one month after loan is made

X= the principal repaid with the 121st repayment.

Question 6

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

(A) Less than $280

(B) $280 but less than $295

(C) $295 but less than $310

(D) $310 but less than $325

(E) $325 or more

Data for Question 7 (3 points)

Selected data for two bonds:

	Bond A	Bond B
Nominal yield	9.40% per year	Equal to Bond A's effective annual yield
Convertible	Monthly	Semiannually

X = Bond B's effective annual yield.

Question 7

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

(A) Less than 9.50%

(B) 9.50% but less than 9.75%

(C) 9.75% but less than 10.00%

(D) 10.00% but less than 10.25%

(E) 10.25% or more

Data for Question 8 (3 points)

Terms of a bond:

Yield rate	4.0% per year, compounded annually
Term	25 years
Coupon rate	r%, payable annually, starting at the end of the first year
Redemption value	$105.00

The reduction in the market value of the bond in the 10th year is $1.00

X= the price of the bond.

Question 8

In what range is X?

(A) Less than $80.00

(B) $80.00 but less than $100.00

(C) $100.00 but less than $120.00

(D) $120.00 but less than $140.00

(E) $140.00 or more

Data for Question 9 (2 points)

The term structure of interest rates is given below:

Length of investment (years)	Spot rate
1	7.00%
2	8.00%
3	8.75%
4	9.25%
5	9.50%

X= the 2-year deferred, 3-year spot rate.

Question 9

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

(A) Less than 10.25%

(B) 10.25% but less than 10.75%

(C) 10.75% but less than 11.25%

(D) 11.25% but less than 11.75%

(E) 11.75% or more

Data for Question 10 (3 points)

Terms of annuity-immediate payable annually:

Annual Payment: $10,000
Number of payments: 5

Term structure of interest rates:

Payment at	Spot rate
1 year	2.2%
2 years	2.5%
3 years	2.7%
4 years	2.8%
5 years	2.9%

Immediately after the first payment has been made, the spot rates will equal the spot rates shown above plus 0.5%.

X = the present value of the remaining four payments immediately after the first payment has been made.

Question 10

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

(A) Less than $37,000

(B) $37,000 but less than $37,250

(C) $37,250 but less than $37,500

(D) $37,500 but less than $37,750

(E) $37,750 or more

Data for Question 11 (3 points)

Asset values for an investment account over a calendar year:

Date	Contribution	Withdrawal	Account value on date, after transaction (if any)
1/1			$ 20,000
3/1	$ 4,000		24,500
9/1		$ 6,000	21,000
12/31			22,000

X = the investment account's dollar-weighted rate of return for the calendar year.

Question 11

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

(A) Less than 17.5%

(B) 17.5% but less than 18.5%

(C) 18.5% but less than 19.5%

(D) 19.5% but less than 20.5%

(E) 20.5% or more

Data for Question 12 (3 points)

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

X= the duration of the bond.

Question 12

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

Data for Question 13 (4 points)

A fund is started by purchasing 10 bonds, redeemable at par, at a yield rate of 5.0% per year, compounded annually.

Terms of each of the ten bonds:

Par value	$100,000
Time-to-maturity	5 years
Coupons	1.0%, payable at the end of each year.

The yield rate at the end of the first year, immediately after the coupon payment, is 3.0% per year, compounded annually. At that time, three of the bonds are sold, with the proceeds from the sale remaining in the fund.

X= the unrealized gain immediately following the sale of the three bonds.

Question 13

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

(A) Less than $42,000

(B) $42,000 but less than $44,000

(C) $44,000 but less than $46,000

(D) $46,000 but less than $48,000

(E) $48,000 or more

Data for Question 14 (3 points)

Smith (age 35) is a participant in a retirement plan that has the following provisions:

Pension benefit	45% of final average salary earned over the three years preceding retirement, payable in equal monthly installments
Retirement age	62

Smith's annual salary for the upcoming year is $50,000.

Assumptions:

Interest	6.0% per year, compounded annually
Salary increases	3.0% per year
Monthly annuity at age 62	11.50

There are no decrements before age 62

X= the present value of Smith's projected retirement benefit at age 35.

Question 14

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

(A) Less than $110,625

(B) $110,625 but less than $112,325

(C) $112,325 but less than $114,025

(D) $114,025 but less than $115,725

(E) $115,725 or more

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Data for Question 15 (3 points)

Smith invests $100,000 in a plot of land that can only be farmed for two years. The land has the following characteristics:

> Unless a drought devastates the crop, the yield at the end of each of the two years will be worth $30,000.
>
> Each year, the probability that a drought devastates the crop is 0.06.
>
> If the crop is devastated during the first year, the land cannot be farmed afterward.
>
> If the crop is devastated during the first year, the land can be sold for $90,000 at the end of the first year. Otherwise, the land can be sold for $90,000 at the end of the second year.

Interest rate: 5.0% per year, compounded annually.

X= the expected present value of the gain on this investment.

Question 15

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

(A) Less than $30,000

(B) $30,000 but less than $31,200

(C) $31,200 but less than $32,400

(D) $32,400 but less than $33,600

(E) $33,600 or more

Data for Question 16 (3 points)

The actuary for a pension plan uses the following assumed rates of retirement (r) for the plan's valuation:

x	$q_x^{(r)}$
60	0.10
61	0.10
62	0.40
63	0.25
64	0.25
65	1.00

Retirements occur on birthdays.

No other decrements apply between age 60 and age 65.

All active participants are under age 60.

X= the average assumed retirement age for the pension plan.

Question 16

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

(A) Less than 62.75

(B) 62.75 but less than 62.90

(C) 62.90 but less than 63.05

(D) 63.05 but less than 63.20

(E) 63.20 or more

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Data for Question 17 (4 points)

Pension plan valuation date: 1/1/2025

Plan provisions:

Normal retirement benefit	\$50 per month per year of service up to a maximum of 30 years
Early retirement benefits	Accrued benefit is reduced by 5.0% per year for retirement before age 65. Benefits are unreduced upon earning 30 years of service

Data for participant Smith and actuarial values at given ages:

Age (x)	Years of service	$q_x^{(r)}$	$\ddot{a}_x^{(12)}$
63	29	0.15	10.5527
64	30	0.30	10.3338
65	31	1.00	10.1081

There are no preretirement decrements other than retirement (r).

Normal retirement age: 65

Interest rate: 7.0%

At the valuation date, Smith is age 63 and is retiring immediately.

X= the absolute value of the gain or loss in the present value of future benefits due to Smith's retirement at age 63.

Question 17

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

(A) Less than \$1,000

(B) \$1,000 but less than \$2,000

(C) \$2,000 but less than \$3,000

(D) \$3,000 but less than \$4,000

(E) \$4,000 or more

Data for Question 18 (4 points)

A pension plan uses a generational mortality table.

The base rates for the mortality table are as of the 2025 calendar year.

An excerpt from the mortality projection scale:

	Age			
Year	60	61	62	63
2026	(0.00063)	0.00054	0.00207	0.00389
2027	(0.00324)	(0.00261)	(0.00135)	0.00027
2028	(0.00522)	(0.00504)	(0.00414)	(0.00279)

Note that in this table, a positive value means a mortality improvement; a negative value means the opposite.

Smith is a participant in the pension plan and is 60 years old in 2025.

Smith's q_{63} in 2028 is projected to be 0.00703.

X= Smith's base rate of mortality in 2025.

Question 18

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

(A) Less than 0.00699

(B) 0.00699 but less than 0.00702

(C) 0.00702 but less than 0.00705

(D) 0.00705 but less than 0.00708

(E) 0.00708 or more

Data for Question 19 (3 points)

Selected values from a one-year select and ultimate mortality table:

$$p_x = 0.955$$
$$q_{[x]} = 0.5q_x$$
$$\ddot{a}_x = 10.00$$

Interest rate: 6.0% per year, compounded annually

Question 19

In what range is $\ddot{a}_{[x]}$?

(A) Less than 10.18

(B) 10.18 but less than 10.20

(C) 10.20 but less than 10.22

(D) 10.22 but less than 10.24

(E) 10.24 or more

Data for Question 20 (3 points)

The following commutation functions were determined using 5.0% interest:

x	D_x	N_x
45	6,121	84,997
46	5,724	78,876
…	…	…
65	1,468	16,407
66	1,358	14,939

X = the annual benefit premium payable at the beginning of the year for a $100,000 20-year term insurance policy issued to a 45-year old with death benefit payable at the end of the year of death.

Question 20

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

(A) Less than $2,000

(B) $2,000 but less than $2,050

(C) $2,050 but less than $2,100

(D) $2,100 but less than $2,150

(E) $2,150 or more

Data for Question 21 (3 points)

Smith (age 50) purchases a 5-year temporary life annuity with $1,500 payable at the end of each year:

Assumptions:

Mortality: $\ell_x = 100 - x$, $0 \le x \le 100$

Interest rate: 5.0% per year, compounded annually

X = the present value of Smith's annuity.

Question 21

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

(A) Less than $5,750

(B) $5,750 but less than $6,250

(C) $6,250 but less than $6,750

(D) $6,750 but less than $7,250

(E) $7,250 or more

Data for Question 22 (3 points)

An annuity is calculated using the following information:

Mortality: ℓ_x=100-x, $0 \le x \le 100$

$\ddot{a}_{\overline{39}|} = 23.4926$

$\ddot{a}_{\overline{40}|} = 23.8082$

Question 22

In what range is a_{60}?

(A) Less than 13.30

(B) 13.30 but less than 13.70

(C) 13.70 but less than 14.10

(D) 14.10 but less than 14.50

(E) 14.50 or more

Data for Question 23 (3 points)

An annuity calculation uses the following information:

k	$a_{\overline{k}\rceil}$	${}_{k\rceil}q_x$
0		0.020
1	0.9000	0.030
2	1.7100	0.050
3	2.4390	0.100
4	3.0951	0.120

Question 23

In what range is $\ddot{a}_{x:\overline{3}\rceil}$?

(A) Less than 2.60

(B) 2.60 but less than 2.90

(C) 2.90 but less than 3.20

(D) 3.20 but less than 3.50

(E) 3.50 or more

Data for Question 24 (3 points)

Data from a mortality table:

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

Deaths are uniformly distributed throughout the year.

Question 24

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

(A) Less than 0.025

(B) 0.025 but less than 0.029

(C) 0.029 but less than 0.033

(D) 0.033 but less than 0.037

(E) 0.037 or more

Data for Question 25 (3 points)

The probability that two independent lives, Smith (age 30) and Jones (age 50), both survive 20 years is 0.40.

The probability that Smith dies before age 40 is 0.12.

X= the probability that a 40-year old will not survive to age 70.

Question 25

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

(A) Less than 0.51

(B) 0.51 but less than 0.56

(C) 0.56 but less than 0.61

(D) 0.61 but less than 0.66

(E) 0.66 or more

Data for Question 26 (4 points)

Three annuities with annual payments beginning one year after the issue date:

Annuity I: $2,000 per year payable while at least one of Smith and Jones is alive.

Annuity II: $4,000 per year payable while both Smith and Jones are alive, and $2,000 per year when exactly one of them is alive.

Annuity III: $5,000 per year payable while both Smith and Jones are alive, and $3,000 per year when exactly one of them is alive.

Present value of Annuity I at the issue date: $34,000

Present value of Annuity II at the issue date: $50,000

X= the present value of Annuity III at the issue date.

Question 26

In what range is X?

(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 27 (4 points)

For a two decrement table:

$$p_x^{(\tau)} = 0.72$$
$$q_x'^{(1)} = 0.1$$
$$q_x'^{(2)} = c$$

Decrements (1) and (2) are uniformly distributed throughout each year of age.

Question 27

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

(A) Less than 0.165

(B) 0.165 but less than 0.175

(C) 0.175 but less than 0.185

(D) 0.185 but less than 0.195

(E) 0.195 or more

Data for Question 28 (3 points)

Smith (age 60) is entitled to a structured settlement that provides a lifetime payment of $10,000 at the beginning of each year commencing immediately.

Smith is offered an actuarially equivalent lifetime settlement that would provide payments of X at the beginning of each year commencing immediately, with a minimum of 10 payments.

Values to use for this calculation:

$D_{60} = 5{,}350$
$D_{70} = 1{,}928$
$N_{60} = 53{,}817$
$N_{70} = 18{,}811$

${}_{10}p_{60} = 0.586$

Question 28

In what range is X?

(A) Less than $8,000

(B) $8,000 but less than $9,500

(C) $9,500 but less than $11,000

(D) $11,000 but less than $12,500

(E) $12,500 or more

Data for Question 29 (3 points)

Upon retirement at age 65, Smith's pension benefit, payable as a single life annuity, is $1,200 per month.

Instead of receiving a single life annuity, Smith can elect an annuity that pays $1,080 per month while Smith is alive, reducing upon Smith's death to 50%, payable to Smith's spouse and continuing for the spouse's lifetime. This annuity is actuarially equivalent to the single life annuity.

X = the amount payable to Smith if the benefit reduces to $0.75X$ upon Smith's death.

Question 29

In what range is X?

(A) Less than $1,000

(B) $1,000 but less than $1,030

(C) $1,030 but less than $1,060

(D) $1,060 but less than $1,090

(E) $1,090 or more

Data for Question 30 (4 points)

The following actuarially equivalent forms of payment are available to Smith:

I. A life annuity of $1,000.00, payable annually at the end of each year.

II. A life annuity of $920.08, payable annually at the beginning of each year.

III. A life annuity of X, payable annually at the beginning of each year, plus a single-sum death benefit equal to $5X$, payable at the end of the year of death

Actuarial equivalence is determined using 5.0% interest, compounded annually.

Question 30

In what range is X?

(A) Less than $800

(B) $800 but less than $825

(C) $825 but less than $850

(D) $850 but less than $875

(E) $875 or more

Data for Question 31 (3 points)

Selected values from a mortality table:

$$q_x = 0.10$$
$$q_{x+1} = 0.15$$
$$q_{x+2} = 0.20$$

Deaths are uniformly distributed between consecutive integral ages.

$\boldsymbol{X} = {}_{1.5}q_{x+0.75}$

Question 31

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

(A) Less than 0.1850

(B) 0.1850 but less than 0.2050

(C) 0.2050 but less than 0.2250

(D) 0.2250 but less than 0.2450

(E) 0.2450 or more

****END OF EXAMINATION****