

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

COURSE P-360U (EA1) Segment B  
JOINT BOARD BASIC EXAMINATION

This is the May 1991 examination which has been released to  
the public by the administering organizations.

91  
SPRING  
EA-1B

Data for Question 1

Plan effective date: 1/1/91.

Normal retirement benefit: \$10 per month for each year of service up to 30 years.

Preretirement death benefit: None.

Actuarial cost method: Attained age normal.

Actuarial assumptions:

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/41
Date of hire	1/1/71
Status as of 1/1/91	Active

Selected commutation functions:

<u>x</u>	<u>D<sub>x</sub></u>	<u>N<sub>x</sub><sup>(12)</sup></u>
30	1,238	28,056
50	320	3,716
65	97	849

Question 1

In what range is the normal cost for 1991 as of 1/1/91?

- (A) Less than \$150
- (B) \$150 but less than \$350
- (C) \$350 but less than \$550
- (D) \$550 but less than \$750
- (E) \$750 or more

Data for Question 2

Data for all retirees as of 1/1/90:

	<u>Smith</u>	<u>Brown</u>
Age	60	70
Annual benefit	\$54,000	\$24,000
Status as of 12/31/90	Alive	Deceased

Benefits are payable as of 1/1 of each year.

All deaths within a year are assumed to occur at the end of the year.

Selected probabilities of death and annuity values:

<u>x</u>	<u>q<sub>x</sub></u>	<u><math>\bar{a}_x</math></u>
60	.020	9.52
61	.022	9.30
70	.040	7.28
71	.044	7.00

Question 2

In what range is the mortality experience gain for 1990 due to the two retirees?

- (A) Less than \$140,000
- (B) \$140,000 but less than \$145,000
- (C) \$145,000 but less than \$150,000
- (D) \$150,000 but less than \$155,000
- (E) \$155,000 or more

Data for Question 3

Normal retirement benefit for all active and inactive participants:

Before 1991: \$12.00 per month for each year of service.

After 1990: \$12.50 per month for each year of service.

Actuarial cost method: Entry age normal.

Assumed interest rate: 7% per year.

Selected valuation results as of 1/1/90:

Normal cost as of 1/1	\$ 50,000
Accrued liability	800,000
Value of assets	420,000

Contribution for 1990: \$80,000 paid on 7/1/90.

Benefit payments for 1990: \$15,000 paid on 7/1/90.

Selected valuation results as of 1/1/91, after amendment:

Accrued liability	\$890,000
Value of assets	500,000

Question 3

In what range is the experience gain for 1990?

- (A) Less than \$8,000
- (B) \$8,000 but less than \$16,000
- (C) \$16,000 but less than \$24,000
- (D) \$24,000 but less than \$32,000
- (E) \$32,000 or more

Data for Question 4

Normal retirement benefit: 50% of final year's compensation.

Preretirement death benefit: None.

Actuarial cost method: Aggregate.

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases:

Assumption before 1991: None.

Assumption after 1990: 5% per year.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/29
1991 compensation	\$40,000
Status as of 1/1/91	Active

Normal cost for 1991 as of 1/1/91, before change in assumed compensation increases: \$23,615.

Selected commutation functions:

<u>x</u>	<u>D<sub>x</sub></u>	<u>N<sub>x</sub></u>
62	365	3,514
63	335	3,149
64	306	2,814
65	279	2,508
66	254	2,229

Question 4

In what range is the normal cost for 1991 as of 1/1/91?

- (A) Less than \$25,250
- (B) \$25,250 but less than \$27,250
- (C) \$27,250 but less than \$29,250
- (D) \$29,250 but less than \$31,250
- (E) \$31,250 or more

Data for Question 5

Normal retirement benefit: \$2,500 per year, payable as of 1/1 of each year.

Normal form of payment: Annuity payable for the life of the retiree.

For married participants, the plan provides for the following two optional forms of payment which are actuarially equivalent to the normal form of payment.

Option A: Annuity payable for the life of the retiree. After the retiree's death, the surviving spouse will receive an annual payment each 1/1 equal to 50% of the amount payable to the retiree.

Option B: Annuity payable during the joint life of the retiree and the retiree's spouse. After either's death, the survivor will receive an annual payment each 1/1 equal to 50% of the amount payable during their joint lifetime.

Data for sole participant:

Date of birth	1/1/26
Date of retirement	1/1/91
Spouse's date of birth	1/1/29

Present value of future benefits as of 12/31/90: \$26,000.

Initial annual benefit under Option B: \$2,376.

Selected annuity value:

$$\ddot{a}_{65:\overline{25}|} = 9.42$$

Question 5

In what range is the initial annual benefit under Option A?

- (A) Less than \$2,000
- (B) \$2,000 but less than \$2,100
- (C) \$2,100 but less than \$2,200
- (D) \$2,200 but less than \$2,300
- (E) \$2,300 or more

Data for Question 6

Assumed interest rate: 7% per year.

Age of sole retiree as of 1/1/90: 70.

Retirement benefit: \$10,000 per year, payable as of 1/1 of each year for the life of the retiree.

Status of retiree as of 1/1/91: Alive.

Selected annuity value and life expectancies:

$$\ddot{a}_{70} = 7.326 \quad e_{70} = 13.80 \quad e_{71} = 13.25$$

Question 6

In what range is the mortality experience loss for 1990 due to the retiree?

- (A) Less than \$2,000
- (B) \$2,000 but less than \$2,300
- (C) \$2,300 but less than \$2,600
- (D) \$2,600 but less than \$2,900
- (E) \$2,900 or more

Data for Question 7

Normal retirement benefit: \$500 per month.

Postretirement death benefit: \$5,000 payable at the end of the month of death.

Accrued benefit: The normal retirement benefit and the postretirement death benefit are accrued and prorated on service.

Actuarial cost method: Projected unit credit (prorated on service).

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for sole participant:

Date of birth 1/1/31

Date of hire 1/1/66

Status as of 1/1/91 Active

Present value at age 65 of postretirement death benefit: \$2,100.

Question 7

In what range is the normal cost for 1991 as of 1/1/91?

- (A) Less than \$1,250
- (B) \$1,250 but less than \$1,300
- (C) \$1,300 but less than \$1,350
- (D) \$1,350 but less than \$1,400
- (E) \$1,400 or more



Data for Question 8

Normal retirement benefit: 1% of final 3-year average compensation for each year of service.

Preretirement death benefit: None.

Actuarial cost method: Projected unit credit.

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 5% per year.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole plan participant:

Date of birth 1/1/35

Status as of 1/1/90 and 1/1/91 Active

The sole participant received an 8% increase in compensation from 1990 to 1991.

Selected probability of death:

$$q_{45} = .009$$

Question 8

In what range is the percentage increase in the normal cost for 1991 as of 1/1/91 over the normal cost for 1990 as of 1/1/90?

- (A) Less than 6.5%
- (B) 6.5% but less than 8.5%
- (C) 8.5% but less than 10.5%
- (D) 10.5% but less than 12.5%
- (E) 12.5% or more

Data for Question 9

Preretirement death benefit: A lump sum payment of \$5,000 for each year of service, payable at the end of the year of death. A year of service is granted for the year of death regardless of when a participant dies in such year.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Date for sole participant:

Date of birth	1/1/31
Date of hire	1/1/71
Status as of 1/1/91	Active

Selected commutation functions:

<u>x</u>	<u>D<sub>x</sub></u>
60	14,863
61	13,694
62	12,600
63	11,575
64	10,616
65	9,718
66	7,926

Question 9

In what range is the present value of the future preretirement death benefits as of 1/1/91?

- (A) Less than \$7,600
- (B) \$7,600 but less than \$7,700
- (C) \$7,700 but less than \$7,800
- (D) \$7,800 but less than \$7,900
- (E) \$7,900 or more

Data for Question 10

Normal retirement benefit: 2% of final 3-year average compensation for each year of service.

Early retirement eligibility: Age 60.

Early retirement benefit: Accrued benefit, reduced by 1/15 for each year by which the benefit commencement date precedes the normal retirement date.

Actuarial cost method: Projected unit credit.

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 5% per year.

Preretirement deaths and terminations: None.

Retirement age:

Before 1991: 65.

After 1990: 62.

Data for sole participant:

Date of birth	1/1/51
Date of hire	1/1/89
1991 compensation	\$21,000
Status as of 1/1/91	Active

Selected annuity values:

$$\ddot{a}_{62}^{(12)} = 9.40 \quad \ddot{a}_{65}^{(12)} = 8.75$$

Question 10

In what range is the change in the accrued liability as of 1/1/91 due to the change in the assumed retirement age?

- (A) Decrease of \$370 or more
- (B) \$0 or decrease of less than \$370
- (C) Increase of more than \$0 but less than \$370
- (D) Increase of \$370 but less than \$740
- (E) Increase of \$740 or more

Data for Question 11

Plan effective date: 1/1/91.

Normal retirement benefit: \$10 per month for each year of service.

Preretirement death benefit: None.

Actuarial assumptions:

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for all active participants as of 1/1/91 and selected commutation functions:

<u>Age</u>	<u>Number of Participants</u>	<u>Past Service</u>	<u>D<sub>x</sub></u>	<u>N<sub>x</sub></u>	<sup>(12)</sup> <u>N<sub>x</sub></u>
30	0	-	1,336	18,946	18,334
40	2	10	670	8,953	8,646
50	0	-	329	3,974	3,823
60	2	10	153	1,571	1,501
65	0	-	100	919	873

There are no inactive participants as of 1/1/91.

Question 11

In what range is the absolute value of the difference in the normal cost for 1991 as of 1/1/91 determined under the entry age normal method applied on an individual basis versus that determined under the entry age normal method applied on an aggregate basis?

- (A) Less than \$100
- (B) \$100 but less than \$200
- (C) \$200 but less than \$300
- (D) \$300 but less than \$400
- (E) \$400 or more

Data for Question 12

Plan effective date: 1/1/86.

Normal retirement benefit:

Before 1991: 30% of final year's compensation.

After 1990: 40% of final year's compensation.

Actuarial cost method: Frozen initial liability.

Actuarial assumptions:

Interest rate: 7% per year.

Compensation increases: 5% per year.

Preretirement deaths and terminations: None.

Retirement age: 65.

Selected valuation results as of 1/1/90:

Normal cost as of 1/1	\$ 25,000
Present value of future benefits	700,000
Unfunded liability	275,000
Present value of future compensation	5,675,000
1990 compensation	500,000

Contribution for 1990: \$50,000 paid on 12/31/90.

As of 1/1/90, there were no inactive participants and no active participants were over age 63. There were no new participants, deaths, terminations, or retirements during 1990. There are no new participants on 1/1/91.

All participants received a 10% increase in compensation from 1990 to 1991.

Selected valuation results as of 1/1/91, after amendment:

Value of assets	\$250,000
Accrued liability under entry	
age normal cost method	550,000

Question 12

In what range is the normal cost for 1991 as of 1/1/91?

- (A) Less than \$30,700
- (B) \$30,700 but less than \$32,700
- (C) \$32,700 but less than \$34,700
- (D) \$34,700 but less than \$36,700
- (E) \$36,700 or more

Data for Question 13

Actuarial cost method: Frozen initial liability (level dollar amount).

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for all participants:

	<u>Smith</u>	<u>Brown</u>	<u>Green</u>
Age	45	55	65
Annual projected benefit	\$20,000	\$20,000	\$20,000
Status as of 1/1/91	Active	Active	Retired

Unfunded liability as of 1/1/91: \$12,000.

Value of assets as of 1/1/91: \$208,800.

The contribution for 1991 is equal to the normal cost for 1991 as of 1/1/91 plus a 10-year amortization payment as of 1/1/91 toward the unfunded liability as of 1/1/91.

Selected annuity values:

<u>x</u>	<u><math>\ddot{a}_x^{(12)}</math></u>
45	12.33
55	10.78
65	8.74

Question 13

In what range is the contribution for 1991 as of 1/1/91?

- (A) Less than \$9,000
- (B) \$9,000 but less than \$10,000
- (C) \$10,000 but less than \$11,000
- (D) \$11,000 but less than \$12,000
- (E) \$12,000 or more

Data for Question 14

Actuarial cost method: Aggregate.

Selected valuation results as of 1/1/91:

Present value of all future benefits	\$10,850,000
Present value of future death and termination benefits due to accumulated and future employee contributions (included above)	850,000
Present value of future employee contributions	2,000,000
Value of assets, including \$1,200,000 of accumulated employee contributions	4,800,000
Present value of future compensation	50,600,000
Annual compensation	3,500,000

Question 14

In what range is the increase in the employer's normal cost for 1991 as of 1/1/91 if future employee contributions were discontinued and all accumulated employee contributions were refunded to participants as of 12/31/90?

- (A) Less than \$100,000
- (B) \$100,000 but less than \$120,000
- (C) \$120,000 but less than \$140,000
- (D) \$140,000 but less than \$160,000
- (E) \$160,000 or more

Data for Question 15

Plan effective date: 1/1/85.

Normal retirement benefit:

Before 1991: \$10 per month for each year of service.  
After 1990: \$15 per month for each year of service.

Preretirement death benefit: None.

Actuarial cost method: Frozen initial liability.

Actuarial assumptions:

Interest rate: 7% per year.  
Preretirement terminations other than deaths: None.  
Retirement age: 65.

Data for sole participant:

Date of birth 1/1/36  
Date of hire 1/1/86  
Status as of 1/1/91 Active

Selected valuation results as of 1/1/91, before amendment:

Present value of future benefits	\$6,942
Unfunded liability	1,800
Value of assets	1,000

Selected commutation functions and annuity value:

<u>x</u>	<u>D<sub>x</sub></u>	<u>N<sub>x</sub></u>
50	94,002	1,135,407
55	64,742	727,747
65	28,570	262,659

$\ddot{a}_{65}^{(12)} = 8.74$

Question 15

In what range is the increase in the normal cost for 1991 as of 1/1/91 due to the amendment?

- (A) Less than \$200
- (B) \$200 but less than \$275
- (C) \$275 but less than \$350
- (D) \$350 but less than \$425
- (E) \$425 or more



Data for Question 16

Plan effective date: 1/1/91.

Normal retirement benefit: 2% of final year's compensation for each year of service.

Actuarial assumptions:

Interest rate: 8% per year.

Compensation increases: None.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for all participants:

	<u>Smith</u>	<u>Brown</u>
Date of birth	1/1/31	1/1/61
Date of hire	1/1/66	1/1/91
1991 compensation	\$90,000	\$12,000
Status as of 1/1/91	Active	Active

Selected annuity value:

$$\bar{a}_{65}^{(12)} = 9.345$$

Question 16

In what range is the excess (shortfall) of the normal cost for 1991 as of 1/1/91 determined under the level dollar aggregate method over that determined under the level dollar individual aggregate method?

- (A) Less than \$(50,000)
- (B) \$(50,000) but less than \$(25,000)
- (C) \$(25,000) but less than \$0
- (D) \$0 but less than \$25,000
- (E) \$25,000 or more

Data for Question 17

Plan effective date: 1/1/89.

Normal retirement benefit: \$35 per month for each year of service.

Actuarial cost method: Attained age normal.

Actuarial assumptions:

Interest rate: 8% per year.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/45
Date of hire	1/1/69
Status as of 1/1/91	Active

Selected valuation results as of 1/1/90:

Normal cost as of 1/1	\$ 1,296
Unfunded liability	12,818
Value of assets	3,000

Contribution for 1990: \$3,000 paid on 12/31/90.

Benefit payments for 1990: \$0.

There were no experience gains or losses during 1990 from any source other than an experience gain from investments of \$500.

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 8.00$$

Question 17

In what range is the normal cost for 1991 as of 1/1/91?

- (A) Less than \$1,250
- (B) \$1,250 but less than \$1,265
- (C) \$1,265 but less than \$1,280
- (D) \$1,280 but less than \$1,295
- (E) \$1,295 or more

Data for Question 18

Plan effective date: 1/1/82.

Normal retirement benefit: \$25 per month for each year of service.

Preretirement death benefit: None.

Actuarial cost method: Individual level premium.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement terminations other than deaths: None.

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/50
Date of hire	1/1/81
Status as of 1/1/91	Active

Selected commutation functions and annuity value:

<u>x</u>	<u>D<sub>x</sub></u>	<u>N<sub>x</sub></u>
31	1,540	25,240
32	1,500	24,000
41	900	13,050
42	860	12,150
65	200	1,792

$$\ddot{a}_{65}^{(12)} = 8.5$$

Question 18

In what range is the present value of future normal costs as of 1/1/91?

- (A) Less than \$8,800
- (B) \$8,800 but less than \$9,100
- (C) \$9,100 but less than \$9,400
- (D) \$9,400 but less than \$9,700
- (E) \$9,700 or more

Data for Question 19

Normal retirement benefit: \$15 per month for each year of service up to 30 years.

Early retirement eligibility: Age 55.

Early retirement benefit:

Less than 30 years of service: Accrued benefit, reduced by 6% for each year by which the benefit commencement date precedes the normal retirement date.

30 or more years of service: Accrued benefit, unreduced for early commencement of payments.

Actuarial assumptions:

Interest rate: 7% per year.

Preretirement deaths and terminations: None.

Probability of retirement:

Less than 30 years of service: 10% at the beginning of each year.

30 or more years of service: 40% at the beginning of each year.

Age 65: 100%.

Data for sole participant:

Date of birth 1/1/29

Date of hire 1/1/63

Status as of 1/1/91 Active

Selected commutation functions:

<u>x</u>	<u>D<sub>x</sub></u>	<u>N<sub>x</sub><sup>(12)</sup></u>
62	3,704	34,796
63	3,403	31,230
64	3,121	27,956
65	2,857	24,956

Question 19

In what range is the present value of future benefits as of 1/1/91?

- (A) Less than \$39,100
- (B) \$39,100 but less than \$40,100
- (C) \$40,100 but less than \$41,100
- (D) \$41,100 but less than \$42,100
- (E) \$42,100 or more

Data for Question 20

Plan effective date: 1/1/90.

Normal retirement benefit: 75% of final 3-year average compensation.

Actuarial cost method: Individual level premium (level dollar amount).

Actuarial assumptions:

Interest rate: 8% per year.

Compensation increases: 4% per year.

Preretirement deaths and terminations: None.

Retirement age: 65.

Data for sole participant:

Date of birth	1/1/48
1990 compensation	\$43,500
1991 compensation	46,000
Status as of 1/1/91	Active

Selected annuity value:

$$\ddot{a}_{65}^{(12)} = 8.5$$

Question 20

In what range is the increase in the normal cost for 1991 as of 1/1/91 over the normal cost for 1990 as of 1/1/90?

- (A) Less than \$100
- (B) \$100 but less than \$200
- (C) \$200 but less than \$300
- (D) \$300 but less than \$400
- (E) \$400 or more

ANSWER KEY

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