

1991

Data for Question 5

Date of offering of a perpetuity: 1/1/91.

Dividend dates: 3/31, 6/30, 9/30, and 12/31 each year.

Amount of dividend each quarter in 1991: \$1.

The quarterly dividend each year is 8% greater than the prior year's quarterly dividend.

Purchaser's yield rate: 10% per year, compounded annually.

Question 5

In what range is the purchase price of the perpetuity as of 1/1/91?

- (A) Less than \$207
- (B) \$207 but less than \$212
- (C) \$212 but less than \$217
- (D) \$217 but less than \$222
- (E) \$222 or more

Data for Question 3 (3 points)

Type of Annuity: Annuity-immediate, with 19 annual payments.

Annual Payments: First payment is \$1, increasing each year by \$1 until payment reaches \$10, then decreasing by \$1 each year to the final payment of \$1.

$i = 5\%$  per annum, effective.

Question 3

In what range is the present value of this annuity at the date of purchase?

- (A) Less than \$57
- (B) \$57 but less than \$60
- (C) \$60 but less than \$63
- (D) \$63 but less than \$66
- (E) \$66 or more

Data for Question 8 (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%, compounded annually.

Question 8

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

Data for Question 16 (5 points)

Annuity #1	An amount payable at the end of each quarter beginning with a \$1,000 payment on 3/31/2004. Each subsequent payment is 1% larger than the previous payment. The annuity is paid for 10 years.
Annuity #2	An amount payable at the end of each year beginning with an X payment on 12/31/2004. Each subsequent payment is \$25 less than the previous payment. The annuity is paid for 15 years.
Interest rate	7.00%, compounded annually.

On 1/1/2006, the present value of the remaining payments of Annuity #1 equals the present value of the remaining payments of Annuity #2.

Question 16

In what range is X?

- (A) Less than \$3,550
- (B) \$3,550 but less than \$3,850
- (C) \$3,850 but less than \$4,150
- (D) \$4,150 but less than \$4,450
- (E) \$4,450 or more

Data for Question 25 (3 points)

Smith buys a 10-year decreasing annuity-immediate with annual payments of 10, 9, 8, ..., 1.

On the same date, Smith buys a perpetuity-immediate with annual payments. For the first 11 years, payments are 1, 2, 3, ..., 11. After year 11, payments remain constant at 11.

At an annual effective interest rate of  $i$ , both annuities have a present value equal to  $X$ .

Question 25

In what range is  $X$ ?

- (A) Less than \$26
- (B) \$26 but less than \$28
- (C) \$28 but less than \$30
- (D) \$30 but less than \$32
- (E) \$32 or more

Data for Question 8 (3 points)

$$n|a_{\overline{2n}|} = 8.00407$$

$$n-1|a_{\overline{2n+1}|} = 8.63279$$

$i$  = The annual rate of interest, compounded annually.

Question 8

In what range is  $i$ ?

- (A) Less than 4.80%
- (B) 4.80% but less than 4.90%
- (C) 4.90% but less than 5.00%
- (D) 5.00% but less than 5.10%
- (E) 5.10% or more

2005

Data for Question 17 (4 points)

Smith retires on 1/1/2005 and receives his retirement benefit as a monthly annuity, payable at the end of each month for a period certain of 20 years.

The benefit for the first year is \$2,000 per month. This monthly benefit is increased at the beginning of each year to be 5% larger than the monthly payment in the prior year.

X is the present value on 1/1/2005 of the retirement benefit at a nominal interest rate of 6%, convertible monthly.

Question 17

In what range is X?

- (A) Less than \$405,000
- (B) \$405,000 but less than \$410,000
- (C) \$410,000 but less than \$415,000
- (D) \$415,000 but less than \$420,000
- (E) \$420,000 or more

Data for Question 9 (3 points)

Selected actuarial values:

$$a_{\overline{n}|} = 7.02358$$

$$v^n = 0.50835$$

Question 9

In what range is  $(Ia)_{\overline{3n}|}$ ?

- (A) Less than 119
- (B) 119 but less than 125
- (C) 125 but less than 131
- (D) 131 but less than 137
- (E) 137 or more



2006

Data for Question 17 (3 points)

	<u>Account A</u>	<u>Account B</u>
Deposits	\$100 on 1/1/2006 \$100 on 4/1/2006 \$100 on 7/1/2006 \$100 on 10/1/2006	\$400 on 5/1/2006
Credited interest rate	$\delta = 6.0\%$ at 1/1/2006 $\delta$ increases to 6.35% on 3/1/2006 and remains at this level for the remainder of the year	$d^{(6)}$ for the entire period

At 12/31/2006, Account A and Account B have the same value.

Question 17

In what range is  $d^{(6)}$ ?

- (A) Less than 0.0597
- (B) 0.0597 but less than 0.0602
- (C) 0.0602 but less than 0.0607
- (D) 0.0607 but less than 0.0612
- (E) 0.0612 or more

Data for Question 25 (4 points)

Perpetuity: Annual end-of-year payments starting at \$1 and increasing by \$2 each year

Selected actuarial values:

$$\ddot{s}_{\overline{2n}|} = 72$$

$$\ddot{a}_{\overline{n}|} = 6$$

$$i > 0\%$$

Question 25

In what range is the present value of this perpetuity?

- (A) Less than \$130
- (B) \$130 but less than \$142
- (C) \$142 but less than \$154
- (D) \$154 but less than \$166
- (E) \$166 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 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

2007

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

2007

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 6 (3 points)

$$s_{\overline{n}} = 10.0$$

$$\ddot{s}_{\overline{n}} = 11.0$$

Question 6

In what range is  ${}_n|\ddot{a}_{\overline{2n}|}$ ?

- (A) Less than 3.8
- (B) 3.8 but less than 4.0
- (C) 4.0 but less than 4.2
- (D) 4.2 but less than 4.4
- (E) 4.4 or more

Data for Question 7 (3 points)

$$\ddot{a}_{\overline{10}|} - \ddot{a}_{\overline{9}|} = 0.50$$

$$X = \frac{(s_{\overline{19}|} - s_{\overline{18}|})^2}{(\ddot{s}_{\overline{9}|} - \ddot{s}_{\overline{8}|})^3}$$

Question 7

In what range is  $X$  ?

- (A) Less than 1.50
- (B) 1.50 but less than 1.70
- (C) 1.70 but less than 1.90
- (D) 1.90 but less than 2.10
- (E) 2.10 or more



Data for Question 1 (2 points)

Terms of a 5-year annuity-certain:

Payment amount	\$100
Payment frequency	Monthly, with payments at the beginning of each month
Interest rate	5% per year, compounded quarterly

Question 1

In what range is the present value of the annuity?

- (A) Less than \$5,190
- (B) \$5,190 but less than \$5,260
- (C) \$5,260 but less than \$5,330
- (D) \$5,330 but less than \$5,400
- (E) \$5,400 or more

2009

Data for Question 3 (3 points)

Terms of a 10-year annuity-certain:

Payments	\$100 per year payable annually with the first payment on January 1, 2012
Interest	The interest rates used to value the annuity as of January 1, 2009 are given by the following annual spot rates:

<u>Years</u>	<u>Spot rate</u>
2009-2013	5%
2014-2018	6%
2019-2023	7%

$X$  = the present value of the annuity as of January 1, 2009.

Question 3

In what range is  $X$ ?

- (A) Less than \$650
- (B) \$650 but less than \$685
- (C) \$685 but less than \$720
- (D) \$720 but less than \$755
- (E) \$755 or more

Data for Question 8 (2 points)

$$\ddot{a}_{\overline{n}|} = 6.091836$$

$$\ddot{a}_{\overline{n+1}|} = 6.381005$$

Question 8

In what range is  $\ddot{s}_{\overline{n}|}$ ?

- (A) Less than 20.10
- (B) 20.10 but less than 20.50
- (C) 20.50 but less than 20.90
- (D) 20.90 but less than 21.30
- (E) 21.30 or more

2009

Data for Question 14 (3 points)

Interest = 6% per year, compounded annually.

$X =$  Present value of a perpetuity that pays \$1 at the end of the 2<sup>nd</sup> year, \$2 at the end of the 4<sup>th</sup> year, \$3 at the end of the 6<sup>th</sup> year, continuing to pay \$ $k$  at the end of the  $2k^{\text{th}}$  year.

Question 14

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

2009

Data for Question 16 (2 points)

An annuity provides level annual payments of \$1,000 at the end of each year for four years.

Term structure of interest rates as of 1/1/2009:

<u>Length of investment</u>	<u>Spot rate</u>
1 year	4.00%
2 years	5.00%
3 years	5.75%
4 years	6.25%

$X$  = the present value of the payments as of 1/1/2009.

Question 16

In what range is  $X$ ?

- (A) Less than \$3,460
- (B) \$3,460 but less than \$3,510
- (C) \$3,510 but less than \$3,560
- (D) \$3,560 but less than \$3,610
- (E) \$3,610 or more

2009

Data for Question 20 (2 points)

Terms of a 9-year annuity due:

Payments	\$100 per year payable annually	
Interest	Applicable annual spot rates:	
	<u>Years</u>	<u>Applicable spot rate</u>
	1 - 5	5.00%
	6 - 9	6.00%

$X$  = the present value of the annuity.

Question 20

In what range is  $X$ ?

- (A) Less than \$693
- (B) \$693 but less than \$713
- (C) \$713 but less than \$733
- (D) \$733 but less than \$753
- (E) \$753 or more

## 2010

### Data for Question 24 (3 points)

A pension plan has a shortfall of \$1,000,000 as of 1/1/2010.

The shortfall is to be amortized in level annual installments over 7 years using the yield curve below, with the first payment due 1/1/2010.

<u>Date</u>	<u>Spot rate</u>
12/31/2010	6.19%
12/31/2011	7.32%
12/31/2012	7.83%
12/31/2013	8.03%
12/31/2014	8.18%
12/31/2015	8.33%
12/31/2016	8.50%

$X$  = the annual amortization payment due on 1/1/2010.

### Question 24

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

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