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FALL 2010 EA-2A EXAM SOLUTIONS

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Fall 2010 EA-2A Exam Solutions

These solutions were prepared based on the law as in effect at June 30, 2010. The Pension Protection Act of 2006 (PPA 2006) was included on the syllabus for the first time on the 2007 exam.

These solutions have been compared with those produced by other technical actuaries, and they represent my best understanding of the correct way to solve these problems. As usual, it seems easy to get an answer in the correct range as long as you are not actually taking the exam!

Revision History:

September 7, 2018	Corrected solution for problems 28, 46 and 48
November 1, 2017	Corrected solution for problem 46
August 23, 2017	Corrected solution for problem 36
March 10, 2017	Corrected solution for problem 19
October 18, 2016	Added note to solution for problem 6
July 25, 2015	Corrected solutions for problems 28 and 46
July 16, 2015	Corrected note at end of solution for problem 12
November 3, 2013	Corrected solution for problem 44
October 29, 2013	Corrected solution for problem 50
October 10, 2013	Corrected solution for problem 29
July 31, 2013	Corrected solutions for problems 27, 45 and 51
July 9, 2013	Added note to solution for problem 15
November 12, 2012	Corrected solution for problems 15 and 51
October 22, 2012	Corrected solution for problems 17 and 33
October 18, 2012	Corrected solution for problems 8 and 16
October 9, 2012	Corrected solution for problem 48
September 19, 2012	Corrected solutions for problems 15 and 24
September 13, 2012	Corrected solution for problem 49
September 5, 2012	Corrected solution for problem 12
August 3, 2012	Clarified that IRC 436 was not on the 2010 EA-2A syllabus for problems 8, 23, 41 and 42
June 24, 2012	Corrected solutions for problems 10, 28, 46 and 49
October 28, 2011	Corrected solutions for problems 43 and 50
August 30, 2011	Original solutions

Exam Year	Pass Mark	Percentage Who passed
2010	109	45.8
2009	107	46.7
2008	112	58.2
2007	112	53.3
2006	113	58.6
2005	99	43.0

Fall 2010 EA-2A Exam Solutions

For single employer exam problems involving the minimum contribution, you should use the following sequence of steps:

1. Calculate the Funding shortfall, which is defined as the Funding target less the AAV, after reduction for both the carryover balance (CB) and the prefunding balance (PB).
2. If the Funding shortfall is greater than zero, you should check the Shortfall base exemption. If the Funding shortfall is limited to zero, then you can skip the Shortfall base exemption - all the shortfall and waiver bases are considered fully amortized.
3. The shortfall base exemption is a messy calculation. Define the “modified funding shortfall” as the modified funding target less the modified assets. If the “modified funding shortfall” is less than or equal to zero, then you would not have to set up the Shortfall base.

Modified assets

If any part of the prefunding balance is used to reduce the minimum required contribution, the modified assets are equal to AAV - PB. Otherwise, the modified assets equal the AAV with no reduction.

Based on 2010 exam conditions 27 and 28, the plan sponsor does elect to apply both the CB and the PB against the MRC. As a result, you should set up the modified asset as AAV - PB. In general, the only time you should not do this is when the problem states that the plan sponsor does not elect to apply the CB and the PB against the MRC, or when the plan's funding ratio for the prior year is less than 80% (see note 6 on next page).

Modified funding target

This is equal to the "applicable percentage" times the funding target. WRERA was passed in December of 2008, and it changed the conditions to use values of the applicable percentage less than 100%. ***It is no longer a requirement that a plan have no prior shortfall bases.***

The applicable percentage is equal to 100% for certain plans:

- Plans that were subject to IRC 412(l) in 2007
- Plans that were established after 2007

Here is the table of values for the applicable percentage for all other plans:

Year	2008	2009	2010	2011
Applicable percentage	92%	94%	96%	100%

(next page)

Fall 2010 EA-2A Exam Solutions

Single employer minimum contribution steps - continued:

4. If the plan does satisfy the Shortfall base exemption, the Shortfall amortization installment for the year is zero. If the plan does not satisfy the Shortfall base exemption, you must calculate the amount of the Shortfall base, as well as the Shortfall amortization installment.

The new shortfall base is equal to

- The Applicable percentage times the Funding target
- Minus the Actuarial asset value reduced by both CB and PB
- Minus the present value of prior years' shortfall and waiver amortization installments

$$\text{S/F Amort base} = (\text{Applicable \%})(\text{Funding target}) - (\text{AAV}-\text{CB}-\text{PB}) - (\text{PV of PY Amort})$$

5. If the Funding shortfall is greater than zero, then the Minimum required contribution (MRC) is equal to the sum of the Target normal cost, the shortfall amortizations, and the waiver amortization. If the Funding shortfall is limited to zero, then the Minimum required contribution is equal to the Target normal cost, plus the Funding target less the AAV (after reduction for both the CB and the PB).
6. If the problem asks for the "smallest amount that satisfies the minimum funding standard", you should apply both the CB and the PB towards the MRC. If the problem asks for the "Minimum required contribution", you do not reflect the CB and PB.

Funding ratio

2010 Exam condition 27 states that the plan sponsor's funding ratio for the prior year was at least 80%, so they are eligible to apply both the CB and the PB against the MRC. If a problem gives you the prior year's valuation results, you should not rely on exam condition 27. You should check the "funding ratio" for the prior year to be sure that the plan can apply the CB and the PB towards the MRC.

Fall 2010 EA-2A Exam Solutions

For multiemployer exam problems involving the deductible limit, you should use the following sequence of steps:

1. Calculate the normal cost plus limit adjustments with interest to the earlier of the end of the plan year or the end of the tax year.
2. Calculate the Full Funding Limitation under Section 404 with interest to the end of the plan year. If this is less than the result of step one, then you can skip to step four.
3. Calculate the absolute minimum amount necessary to produce a non-negative credit balance in the Minimum Funding Standard Account. This is the "smallest amount to satisfy the minimum funding standard" as defined in 2010 exam condition 31. This may be increased by the amount of any "includible employer contribution."
4. The maximum deductible limit is the greater of (1) and (3), but not greater than (2).
5. The UCL limit is equal to $140\% \times (\text{Current Liability})$ minus AAV. If this exceeds the deductible limit in step 4, then the final deductible limit will equal the UCL limit. This UCL limit ignores recent benefit improvements for small plans with highly compensated employees.

Fall 2010 EA-2A Exam Solutions

Problem 1

TRUE

Based on the rule at 1.430(d)-1(d)(1)(i), the Funding target and the Target normal cost are based on the plan provisions adopted by the valuation date. The benefits can have a later effective date during the current plan year. The benefit increase that is effective at 07/01/12 is not included, since it does not take effect during the 2011 plan year.

Answer is A

Problem 2

FALSE

The description given sounds very similar to "endangered" status. A plan is in "endangered" status when the plan is not in critical status for plan year, and it satisfies either item below:

- Plan's funded percentage < 80%, or
- Plan has accumulated funding deficiency for plan year, or is projected to have one in any of the succeeding 6 plan years (allowing for amortization extensions under 431(d))

If plan is not in critical status for the plan year, and it satisfies both items above, then the plan is in "seriously endangered" status.

Answer is B

Fall 2010 EA-2A Exam Solutions

Problem 3

FALSE

This is true for single employer plans. But IRC 414(l) has several exceptions, and does not apply to multiemployer plans.

Answer is B

Problem 4

TRUE

See IRC 4971(f)(1)

Answer is A

Fall 2010 EA-2A Exam Solutions

Problem 5

FALSE

The initial excise tax is 10% for a single employer plan, but only 5% for a multiemployer plan.

See IRC 4971(a)(2)

Answer is B

Problem 6

Revised 10/18/16

FALSE

When the prior plan year is a short plan year, the quarterly contribution requirement is 25% times 90% of the current year's minimum required contribution. The prior year's minimum required contribution is ignored.

Answer is B

NOTES

1. The answer above is based on the proposed regulations. Under the final regulation released 09/09/2015, the statement is FALSE, but the reason given above is incorrect. When the prior plan year is a short plan year, then the required annual payment is defined as the lesser of
 - 90% of the minimum required contribution for the current year, or
 - 100% of the minimum required contribution for the prior year times (12 months divided by the length of short plan year in months).
2. When the current plan year is a short plan year, you may have less than four required installments for the year.
3. When the current plan year is a short plan year, the required annual payment is defined as the lesser of
 - 90% of the minimum required contribution for the current year, or
 - 100% of the minimum required contribution for the prior year times (length of short plan year in months divided by 12 months)

Fall 2010 EA-2A Exam Solutions

Problem 7

TRUE

If the 2010 “funding ratio” is at least 80%, then you can apply the carryover balance (CB) and the prefunding balance (PB) towards the minimum required contribution (MRC).

2010 exam condition 27 states the plan sponsor's funding ratio for the prior year is at least 80%. Since this problem gives you the prior year's valuation results, you should not rely on exam condition 27.

The “funding ratio” is defined in IRC 430(f)(3)(C):

$$\begin{aligned}\text{Funding ratio} &= \frac{\text{AAV} - \text{PB}}{\text{Funding Target (non At-Risk)}} \\ &= (90,000,000 - 5,000,000) / 100,000,000 \\ &= 85.0\%\end{aligned}$$

Since the funding ratio is at least 80%, the plan sponsor can elect to apply the CB and PB toward the 2011 MRC.

Answer is A

Fall 2010 EA-2A Exam Solutions

Problem 8 – Page 1

Revised 10/18/12

The key point of this problem appears to be knowledge of IRC 436, which is not a topic on the EA-2A exam syllabus. I'll work the problem based on NOT knowing any calculation detail under IRC 436. Then I will show the solution based on the "official answer".

The problem gives you the 01/01/2010 adjusted funding target attainment percentage (AFTAP), and some valuation results for 2011. It states that the 2011 AFTAP was certified before 04/01/2011. The first difficulty with this problem is that the AFTAP is only defined in IRC 436 (not in IRC 430).

The question gives you the carryover balance (CB) at 01/01/2011 and asks if you can use that to satisfy the "entire 04/15/2011 required quarterly installment". In general, the plan sponsor's funding ratio for the prior year must be at least 80% to apply both the CB and the prefunding balance (PB) against the minimum required contribution (MRC), or the required quarterly installment.

2010 exam condition 27 states the plan sponsor's funding ratio for the prior year is at least 80%. If a problem gives you the prior year's valuation results, you should not rely on exam condition 27. You should check the "funding ratio" for the prior year to be sure that the plan can apply the CB and the PB towards the MRC (or quarterly installment).

One possible trick to the problem is whether you can use the information given about the 2010 AFTAP to determine the value of the 2010 "funding ratio". The "funding ratio" is defined in IRC 430(f)(3)(C). Let PB be the value of the prefunding balance:

$$\text{Funding ratio} = \frac{\text{AAV} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

The AFTAP is defined in IRC 436(j)(2), and it is similar to the funding target attainment percentage (FTAP) defined in 430(d)(2). The AFTAP has an adjustment for any non-HCE annuity purchases (NHAP) in the prior two years.

$$\text{AFTAP} = \frac{\text{NHAP} + \text{AAV} - \text{CB} - \text{PB}}{\text{NHAP} + \text{Funding Target (non At-Risk)}}$$

The problem tells you nothing about annuity purchases for prior years, so you can safely assume they are zero:

$$\text{AFTAP} = \frac{0 + \text{AAV} - \text{CB} - \text{PB}}{0 + \text{Funding Target (non At-Risk)}}$$

You don't know the value of the prefunding balance at 01/01/2010, but it does not matter. Since the funding ratio does not subtract the CB from the numerator, it must be greater than the AFTAP.

Fall 2010 EA-2A Exam Solutions

Problem 8 – Page 2

Revised 10/18/12

As a result, you know that the 2010 funding ratio was greater than 85%. This implies that you can use the 01/01/2011 CB of 15,000 to satisfy the required quarterly installment at 04/15/2011.

Based on this logic, the statement in the problem is true.

Answer is A

The answer sheet shows that credit was given for both answer A and answer B. The original version of the answer sheet showed that the “official answer” to the problem was based on knowing the calculation details under IRC 436.

Since this plan offers a lump sum payment option, it is subject to the IRC 436(d) benefit restrictions on accelerated benefit distributions. In order for the plan to pay lump sum benefits, the AFTAP must be at least 80%. You need to calculate the AFTAP at 01/01/2011 to see if it satisfies IRC 436(d):

$$\text{AFTAP} = \frac{\text{NHAP} + \text{AAV} - \text{CB} - \text{PB}}{\text{NHAP} + \text{Funding Target (non At-Risk)}}$$

$$\begin{aligned}\text{AFTAP} &= \frac{0 + 92,000 - 15,000 - 0}{100,000} \\ &= 77.0\%\end{aligned}$$

Since the AFTAP is less than 80%, there may be a deemed reduction under IRC 436(f)(3). If it is possible to reduce the CB (and PB) enough to increase the AFTAP to 80%, then this reduction must occur as if the employer had elected to do so under IRC 430(f).

It should be clear that a reduction of 3,000 in the CB will increase the AFTAP to 80%.

$$\begin{aligned}\text{AFTAP} &= \frac{0 + 92,000 - (15,000 - 3,000) - 0}{100,000} \\ &= 80.0\%\end{aligned}$$

The remaining CB is only 12,000. You can NOT use the remaining CB of 12,000 to satisfy the entire required quarterly installment at 04/15/2011. Based on this logic, the statement in the problem is false.

Answer is B

NOTE

The key point of this problem appears to be knowledge of IRC 436, which was not a topic on the 2010 EA-2A exam syllabus. As a result, this question was identified as defective, and credit was given for both answers.

Fall 2010 EA-2A Exam Solutions

Problem 9 – Page 1

This is a straightforward problem on calculating the Top Heavy (T-H) minimum. The first step in the problem is calculating the accrued benefit under the plan formula. Then you calculate the T-H minimum to see if it is larger.

12/31/2011 data

Description

Age	32
Past service	3
Benefit service	1

One trick to the problem is that the plan benefit is based on years of benefit service. Benefit service starts at the participant's participation date.

Based on the default exam conditions, there is no age or service requirement for entry into the plan. Smith's participation date is the effective date of 01/01/2011. This is after Smith's hire date, so Smith only has one year of benefit service.

The plan benefit is calculated using average earnings for all years starting at hire date:

$$\begin{aligned}\text{FAE3} &= (40,000 + 45,000 + 50,000) / 3 \\ &= 45,000\end{aligned}$$

$$\begin{aligned}\text{Plan benefit} &= 45,000 * (1.5\%) * (1) \\ &= 675\end{aligned}$$

The problem does not tell you the T-H averaging period. Based on IRC 416(c)(1)(D)(1), the T-H averaging period can not exceed five consecutive years.

In the absence of any specific data in the problem, you should assume the plan uses a T-H averaging period of five years. The participant only has three years of service, so you will calculate their T-H final average earnings using all three years. This is the same pay that was used for the plan benefit:

$$\text{FAE3} = 45,000$$

The T-H minimum is based on years the plan has been T-H. The plan has only been T-H for one year (2011):

$$\begin{aligned}\text{T-H min} &= 45,000 * (2.0\%) * (1) \\ &= 900\end{aligned}$$

Smith's final accrued benefit is the greater of the two, or \$900.

Answer is C

Fall 2010 EA-2A Exam Solutions

Problem 9 – Page 2

NOTES

1. The answer sheet shows that credit was given for both answer C and answer D. The original version of the answer sheet showed that the “official answer” to the problem was D.
2. The answer of D is clearly defective to me. It seems to be based on using only the 2011 pay to calculate the Top Heavy (T-H) minimum:

$$\text{T-H pay} = 50,000$$

$$\begin{aligned}\text{T-H min} &= 50,000 * (2.0\%) * (1) \\ &= 1,000\end{aligned}$$

Answer is D

The definition of T-H pay in IRC 416(c)(D) is really vague. It refers to adjustments for certain "years of service". Pay for a year should be excluded if that year does not count for a "year of service". Based on the definitions in IRC 416, that refers to years when the plan is not T-H. This definition is intended to freeze the T-H pay at the last point the plan was T-H.

My interpretation has always been that the T-H pay is updated each time the plan is found to be T-H. You look back at ALL prior years, and find the five highest consecutive years. This includes years that the plan is NOT Top Heavy.

3. The code (and regulation) state that if any service is disregarded under IRC sections 411(a)(4), (5), or (6), then for the top heavy minimum benefit, salary paid for those years is ignored. But 411(a) concerns vesting service – not benefit accrual service.

Years of service before the plan effective date could have been excluded for vesting, but that is not what the question says. The question says that years of service prior to the plan effective date are excluded for benefit accrual.

The details of IRC 410 and 411 are tested on the EA-2B exam. Since these sections are not on the EA-2A exam syllabus, there should not be any EA-2A exam questions that hinge on fine details of IRC 410 versus 411.

Fall 2010 EA-2A Exam Solutions

Problem 10 – Page 1

This is not a typical §415 problem. It is unusual to have late retirement problems with §415 limits. One key point of the problem is the calculation of the actuarial increase in the §415 dollar limit after age 65. Another key point is that the §415 limits are reduced for service (and participation) less than 10 years.

Earnings for the §415 limit is defined as total compensation (not taxable). Based on the regulation that became final in 2007, earnings under §415 are subject to the §401(a)(17) limit.

At 12/31/10

Age	68
Service	6 years
Participation	5 years

One simplifying factor in this problem is that you do not calculate the plan benefit. The problem only asks for the 415 limit.

415 COMP LIMIT

The §415(b)(1)(B) compensation limit is reduced when service is less than ten years. This limit is based on the highest three consecutive years of pay:

Year	2008	2009	2010
Pay	250,000	250,000	250,000
401(a)(17) limit	230,000	245,000	245,000
Limited pay	230,000	245,000	245,000

$$\begin{aligned} \text{3 year final average pay} &= (230,000 + 245,000 + 245,000)/3 \\ &= 240,000 \end{aligned}$$

$$\begin{aligned} \text{\$415 compensation limit} &= 240,000 * (6/10) \\ &= 144,000 \end{aligned}$$

415 DOLLAR LIMIT

Under §415(b)(1)(A), the dollar limit is reduced when participation is less than ten years. In §415(b)(5)(C), it states that the pro-rata reduction would never be less than 1/10:

$$\begin{aligned} \text{\$415 dollar limit during 2010} &= 195,000 * (5/10) && \text{for ages 62-65} \\ &= 97,500 \end{aligned}$$

Problem 10 – Page 2**Revised 06/24/12**

§415(b)(2)(E)(i) says to use the lesser of 5% and the interest rate specified in the plan to increase the §415 dollar limit after age 65, but here the code is misleading. The examples in the 1.415 regulation clarify the increases in the §415 dollar limit.

Mandated basis - Actuarial increase factor

Here is the short version of what you need to know. If you want to see the long version, check out the notes at the end of this solution.

Actuarial increase factor for 415 dollar limit, based on mandated 5%, applicable mortality:

Death benefit definition	Factor
Waived QPSA, or NO death benefit (complete forfeiture on death)	$N_{65}^{(12)} / N_X^{(12)}$
QPSA death benefit, and plan charges participants for cost of QPSA (default per 2010 exam condition 9)	$N_{65}^{(12)} / N_X^{(12)}$
100% of PV of accrued benefit (no forfeiture on death)	$v^{65-X} (\ddot{a}_{65}^{(12)} / \ddot{a}_X^{(12)})$
QPSA death benefit, and plan does NOT charge for cost of QPSA (treat as no forfeiture on death)	$v^{65-X} (\ddot{a}_{65}^{(12)} / \ddot{a}_X^{(12)})$

You are told that the plan's death benefit is 100% of the present value of the accrued benefit. That means there will be no forfeiture on death.

You should use the $\ddot{a}_{65}^{(12)}$ and $\ddot{a}_{68}^{(12)}$ factors to increase the dollar limit after age 65 on the mandated basis. In this problem, you are given values of these annuities at both 5% and 7.5% interest.

Mandated basis increase factor

$$\begin{aligned}\text{Actuarial increase from 65 to 68} &= (1.05)^3 [\ddot{a}_{65}^{(12)} / \ddot{a}_{68}^{(12)}] \\ &= (1.05)^3 * (12.00 / 11.06) \\ &= 1.2560\end{aligned}$$

Plan basis increase factor

The problem does not clearly define the how the plan benefit is adjusted for late retirement. There are various options available, which could impact the final 415 limit. In the absence of any specific information, I will assume that the plan gives an actuarial increase in benefits upon late retirement. The factor is similar to the mandated basis, but it uses the plan's interest rate of 7.5% for actuarial equivalence:

Fall 2010 EA-2A Exam Solutions

Problem 10 – Page 3

$$\begin{aligned}\text{Actuarial increase from 65 to 68} &= (1.075)^3 [\ddot{a}_{65}^{(12)} / \ddot{a}_{68}^{(12)}] \\ &= (1.075)^3 * (9.85/9.22) \\ &= 1.3272\end{aligned}$$

Final benefit determination

$$\begin{aligned}\$415 \text{ dollar limit at age 68} &= 97,500 * \text{lesser of } [1.2560 \text{ or } 1.3272] \\ &= 122,461\end{aligned}$$

$$\begin{aligned}\text{Life annuity \$415 limit at 68} &= \text{lesser of 3 year comp limit and dollar limit} \\ &= \text{lesser of 144,000 and 122,461} \\ &= 122,461\end{aligned}$$

Answer is C

NOTE

Lengthy discussion of actuarial increases in 1.415 regulation

Actuarial increase of 415 dollar limit above age 65 (LONG version)

If the plan document does not define a life annuity at both age 65 and the late retirement age, then the \$415 dollar limit is increased using a factor calculated based on the mandated mortality and interest rate. If the plan does define a life annuity benefit at both ages, then the \$415 dollar limit is increased using the lower of two factors:

1. Actuarial increase factor based on the mandated mortality and interest rate, and
2. Adjustment ratio for plan benefits after age 65 (as defined in the regulation)

The definition of the actuarial equivalent increase factor (on the mandated mortality and interest rate) will vary depending on the definition of the death benefit. If there is no forfeiture on death, then you can ignore pre-retirement mortality:

$$v^{65-x} (\ddot{a}_{65}^{(12)} / \ddot{a}_x^{(12)})$$

If the death benefit is defined as 100% of the present value of the accrued benefit, then there is no forfeiture upon death. In 1.415(b)-1(e)(3), it states that you may treat a typical Qualified Pre-retirement Survivor Annuity (QPSA) death benefit as resulting in no forfeiture on death. This treatment is only allowed if the plan does not charge for the cost of the QPSA, and if the plan applies the same treatment for all retirement ages (both before age 65 and after age 65).

If there is a forfeiture on death, then you must reflect pre-retirement mortality:

$$(N_{65}^{(12)} / N_x^{(12)}) = (v^{65-x} / {}_{x-65}p_{65}) (\ddot{a}_{65}^{(12)} / \ddot{a}_x^{(12)})$$

Problem 10 – Page 4

Actuarial increase of 415 dollar limit above age 65 (continued)

If there is no death benefit, then there is a full forfeiture upon death. This can happen if the participant is single, or if they are married, and they elect out of the Qualified Pre-retirement Survivor Annuity (QPSA). With a typical QPSA death benefit, there will be a forfeiture on death. Based on exam condition 12, in the absence of any other information, you should assume that the plan does charge the participants for the cost of the QPSA.

Fall 2010 EA-2A Exam Solutions

Problem 11 – Page 1

The key to this problem is the calculation of the Funding target, Target normal cost and the Shortfall amortization base at 01/01/2011 under IRC Section 430. This plan has a funding standard carryover balance (CB) of zero and a prefunding balance (PB) of 2,950 at 01/01/2011.

The problem asks for the "smallest amount" at 04/15/2012. Based on 2010 exam conditions 26 and 27, the plan sponsor elects to offset both the CB and the PB against the minimum contribution under IRC 430. Based on exam condition 31, the "smallest amount" reflects offsetting both the CB and the PB against the minimum contribution.

Valuation calculations

You need to determine values for the Funding target and the Target normal cost at 01/01/2011, for both Smith and Jones.

The first step is to determine the accrued benefit at the 01/01/2011 valuation date:

	Smith	Jones
Age	41.0	51.0
Past service	11.0	26.0
Accrued benefit	$11.0(50)(12) = 6,600$	$26.0(50)(12) = 15,600$

$$\Delta \text{ Accrued benefit} = 12(50) = 600$$

Segment Interest Rates

The next step is calculation of present values using segment interest rates. Under PPA 2006, you would calculate the present value of a stream of annual benefit payments for a life annuity payable to a person age x (currently in pay status) as follows:

$$\begin{aligned} \text{Present value} &= \sum_{t=0}^4 (1.0500)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=5}^{19} (1.0600)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=20}^{\omega-x} (1.0700)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \end{aligned}$$

You can write the present value formula in terms of annual annuities:

$$\text{Age } x \text{ PV} = \text{Benefit} \left\{ \ddot{a}_{x:\overline{5}|} \text{ at } 5.0\% + (1.06)^{-5} ({}_5 p_x) \ddot{a}_{x+5:\overline{15}|} \text{ at } 6.0\% + (1.07)^{-20} ({}_{20} p_x) \ddot{a}_{x+20} \text{ at } 7.0\% \right\}$$

Fall 2010 EA-2A Exam Solutions

Problem 11 – Page 2

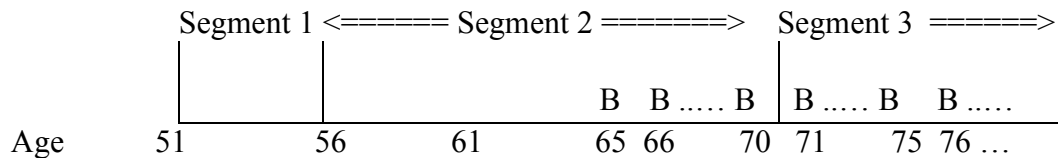
Funding Target – Jones

The Funding Target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability.

	Jones
Age	51.0
Accrued benefit	15,600.0
Δ Accrued ben	600.0

Based on the default exam conditions, normal retirement age is 65, and the benefit is assumed payable monthly, starting at normal retirement age.

The participant is currently 14 years from retirement, so their benefit payments will be valued using the second and third segment rates:



The second segment covers benefit payments from age 56 up to age 70 (15 years). Since normal retirement age is 65, there are 6 years of benefit payments valued using the second segment rate. The third segment rate is used to value benefit payments at and after age 71.

The calculation of the Funding target uses the accrued benefit. Here is the formula for the Funding target using monthly annuity rates:

$$\text{Age 51 FT} = 15,600 * [{}_{14|} \ddot{a}_{51:\overline{6}|}^{(12)}_{seg_2} + {}_{20|} \ddot{a}_{51}^{(12)}_{seg_3}]$$

Notice that the second annuity actually starts 20 years from the valuation date. Now you need to express these annuities in terms of commutation functions.

One important aspect of the problem is that the pre-retirement mortality and post-retirement mortality are the same. This means you can simply use the commutation functions to do all present value calculations, even prior to benefit commencement age.

Fall 2010 EA-2A Exam Solutions

Problem 11 – Page 3

Funding Target – Jones – continued

$$\begin{aligned} {}_{14|}\ddot{a}_{51:\overline{6}|seg_2}^{(12)} &= (v^{14} {}_{14}p_{51}) \ddot{a}_{65:\overline{6}|seg_2}^{(12)} && \text{all at segment 2 rate} \\ &= (D_{65}/D_{51}) * (N_{65}^{(12)} - N_{71}^{(12)}) / D_{65} && \text{all at segment 2 rate} \\ &= (N_{65}^{(12)} - N_{71}^{(12)}) / D_{51} && \text{all at segment 2 rate} \end{aligned}$$

$$\begin{aligned} {}_{20|}\ddot{a}_{51seg_3}^{(12)} &= (v^{20} {}_{20}p_{51}) \ddot{a}_{71seg_3}^{(12)} && \text{all at segment 3 rate} \\ &= (D_{71}/D_{51}) * (N_{71}^{(12)} / D_{71}) && \text{all at segment 3 rate} \\ &= N_{71}^{(12)} / D_{51} && \text{all at segment 3 rate} \end{aligned}$$

$$\begin{aligned} \text{Age 51 FT} &= 15,600 \left[\frac{(22,369 - 12,145)}{4,993} + \frac{5,863}{3,093} \right] \\ &= 15,600[2.0477 + 1.8956] \\ &= 61,515 \end{aligned}$$

Target Normal Cost – Jones

The Target normal cost is defined as the present value of the change in the accrued benefit. It is similar to the traditional Unit Credit normal cost.

$$\begin{aligned} \text{Age 51 NC} &= 600[2.0477 + 1.8956] \\ &= 2,366 \end{aligned}$$

Funding Target – Smith

The Funding Target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability.

	Smith
Age	41.0
Accrued benefit	6,600.0
Δ Accrued benefit	600.0

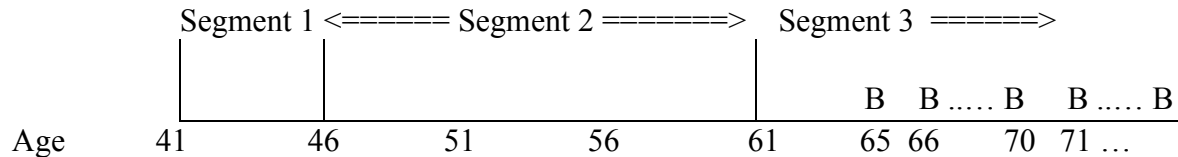
Based on the default exam conditions, normal retirement age is 65, and the benefit is assumed payable monthly, starting at normal retirement age.

Fall 2010 EA-2A Exam Solutions

Problem 11 – Page 4

Funding Target – Smith – continued

The participant is currently 24 years from retirement, so their benefit payments will be valued using the third segment rate:



The calculation of the Funding target uses the accrued benefit. Here is the formula for the Funding target using monthly annuity rates:

$$\text{Age 41 FT} = 6,600 * {}_{24|}\ddot{a}_{41 \text{ seg}_3}^{(12)}$$

Now you need to express these annuities in terms of commutation functions:

$$\begin{aligned} {}_{24|}\ddot{a}_{41 \text{ seg}_3}^{(12)} &= (v^{24} {}_{24}p_{41}) \ddot{a}_{65 \text{ seg}_3}^{(12)} && \text{all at segment 3 rate} \\ &= (D_{65} / D_{41}) * (N_{65}^{(12)} / D_{65}) && \text{all at segment 3 rate} \\ &= N_{65}^{(12)} / D_{41} && \text{all at segment 3 rate} \end{aligned}$$

$$\begin{aligned} \text{Age 41 FT} &= 6,600 [\frac{11,276}{6,156}] \\ &= 6,600 [1.8317] \\ &= 12,089 \end{aligned}$$

Target Normal Cost – Smith

The Target normal cost is defined as the present value of the change in the accrued benefit. It is similar to the traditional Unit Credit normal cost.

$$\begin{aligned} \text{Age 41 NC} &= 600 [1.8317] \\ &= 1,099 \end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 11 – Page 5

2010 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance (PB) and the carryover balance (CB). The problem states that both the CB and the PB are equal to zero at 01/01/2010.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 66,000 - (66,000 - 0 - 0) \\ &= 0\end{aligned}$$

Since the 2010 Funding shortfall is zero, all prior shortfall bases were eliminated.

2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the PB and the CB. The total Funding target for Smith and Jones is $73,604 = 61,515 + 12,089$.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 73,604 - (65,000 - 0 - 2,950) \\ &= 11,554\end{aligned}$$

2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is identical to the previously calculated Funding shortfall:

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

Based on 2010 exam conditions 26 and 27, the plan sponsor elects to offset both the CB and the PB against the minimum contribution under IRC 430. As a result, the calculation above offsets the entire PB against the AAV. In general, the only time you should not do this is when the problem states that the plan sponsor does not elect to apply the CB and the PB against the MRC.

Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. The Applicable percentage times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments

Fall 2010 EA-2A Exam Solutions

Problem 11 – Page 6

$$\begin{aligned}\text{S/F Amort base} &= (\text{Applicable \%}) * (\text{Funding target}) - (\text{AAV-CB-PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * (73,604) - (65,000 - 0 - 2,950) - \text{zero} \\ &= 11,554\end{aligned}$$

As previously discussed, the 2010 Funding shortfall was zero. Any shortfall amortization installments for earlier years were eliminated at 01/01/2010. The present value of all prior shortfall amortizations is zero at 01/01/2011.

$$\begin{aligned}\text{S/F amort} &= 11,554 / 5.9982 \\ &= 1,926\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 1,926 + \text{zero} \\ &= 1,926\end{aligned}$$

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. The shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Minimum required contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date. The total Target normal cost for Smith and Jones is $3,465 = 1,099 + 2,366$.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 3,465 + 1,926 + 0 \\ &= 5,391\end{aligned}$$

Smallest amount

The problem asks for “the smallest amount that satisfies the minimum funding standard”. Since the 2010 Funding shortfall is zero, the prior year’s “funding ratio” was more than 80%. As a result, you can offset the PB against the MRC:

$$\begin{aligned}\text{Smallest contr} &= \text{MRC} - \text{CB} - \text{PB} \\ &= 5,391 - 0 - 2,950 \\ &= 2,441\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 11 – Page 7

The 2011 contribution of X is paid at 04/15/12. You should compare the discounted value (using the 2011 effective interest rate of 6.5%) against the MRC at 01/01/2011:

$$\begin{aligned}\text{PV of contrib} &= X*(1.065)^{-15.5/12} && \text{(using compound interest)} \\ &= 2,441\end{aligned}$$

$$\begin{aligned}X &= 2,441*(1.065)^{15.5/12} \\ &= 2,648\end{aligned}$$

Answer is E

NOTE

You will get the same answer range if you decided to use simple interest:

$$\text{PV of contrib} = X*(1.065)*(1 + .065*(3.5/12)) \quad \text{(using simple interest)}$$

$$\begin{aligned}X &= 2,441*(1 + .065*(3.5/12)) \\ &= 2,649\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 12 – Page 1

One key to this problem is the calculation of the deductible limit under IRC 404(o). You need to know the definition of the cushion amount.

Deductible Limit

The deductible limit is defined as the greater of the minimum contribution required under IRC 430 and the amount under 404(o)(2). IRC 430 defines “the minimum required contribution” as the amount prior to reduction by the carryover balance or the prefunding balance. You don’t have enough information to calculate the shortfall amortization installment in this problem, so you should ignore the minimum contribution.

The maximum deductible limit is defined under 404(o)(2)(A):

Target normal cost + Funding target + Cushion amount - Actuarial asset value

Cushion amount

The Cushion amount is defined as the sum of two pieces:

- (1) 50% of the Funding target, and
- (2) the increase in the Funding target due to allowing for future pay increases.

You can think of the second item as the excess of the Projected Unit Credit accrued liability over the Traditional Unit Credit accrued liability.

Another key point of this problem is the definition of the cushion amount. Under IRC 404(o)(4), it does not include benefit increases within the prior two years that are attributable to Highly Compensated Employees (HCEs). The definition of an HCE is in IRC 414(q), which is not on the EA-2A exam syllabus. This is a minor defect in the problem!

Valuation calculations

You need to calculate the Funding target and the Target normal cost at 01/01/2011. These items are the Unit Credit accrued liability and the Unit Credit normal cost, respectively. In addition, you need to calculate the Projected Unit Credit accrued liability for the cushion amount.

The first step is to determine the accrued benefit at the valuation date, and the benefit accrual during 2011. You must allow for the salary increase during 2011:

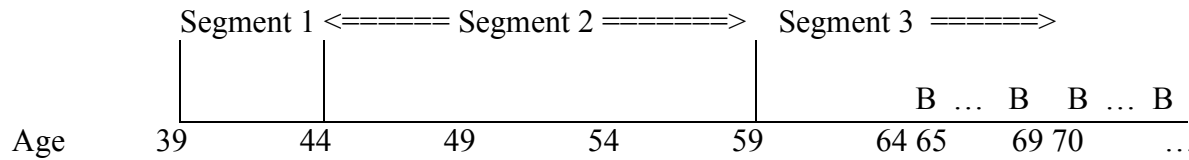
Valuation date	01/01/2011	01/01/2012
Age	39.0	40.0
Past service	9.0	10.0
Prior year pay	100,000	100,000*1.03
Accrued benefit	4.0%(9)(100,000) = 36,000	4.0%(10)(103,000) = 41,200

$$\Delta AB = 5,200$$

Problem 12 – Page 2

Revised 09/05/12

The participant is currently 26 years from retirement, so their benefit payments will be valued using the third segment rate of 7%:



$$\begin{aligned}
 AL &= \text{PV of AB} = \text{Funding target} \\
 &= 36,000(D_{65} / D_{39}) \ddot{a}_{65}^{(12)} \\
 &= 36,000(1+i)^{-26}({}_{26}p_{39}) \ddot{a}_{65}^{(12)} \\
 &= 36,000(1.07)^{-26}(9.989) \\
 &= 61,922
 \end{aligned}$$

There are three segment interest rates, but the benefit payments are discounted back to the valuation date using a single rate, based on which segment they fall into. The present value of the benefit payments at 65 is calculated using the third segment rate of 7%, and they are all discounted to the valuation date at 7%. With no pre-retirement decrements, the D/D terms are only based on the 7% interest rate.

$$\begin{aligned}
 NC &= \text{PV of } (\Delta AB) = \text{Target normal cost} \\
 &= 5,200(D_{65} / D_{39}) \ddot{a}_{65}^{(12)} \\
 &= 5,200(1.07)^{-26}(9.989) \\
 &= 8,944
 \end{aligned}$$

To determine the cushion amount, you need to calculate the PUC accrued liability at 01/01/2011. Under PUC, the accrued liability is defined as the present value of the “funding accrued benefit” (FAB):

$$\text{PUC AL} = \text{PV (FAB)}$$

The 1.412(c)(3)-1 regulation defines "funding accrued benefit":

1. Project pay to retirement age
 2. Calculate the projected benefit
 3. Pro-rate the projected benefit based on service today versus service at retirement.
- This pro-rata calculation must reflect each year's rate of benefit accrual.

For a final average pay plan, you get the same value for the FAB if you apply the benefit formula to past service, but use projected earnings. For a career average pay plan, you must do the calculation as described in the regulations.

Fall 2010 EA-2A Exam Solutions

Problem 12 – Page 3

$$\begin{aligned}\text{Valuation pay at age 38} &= 100,000 && \text{(pay for 2010 plan year, at age 38)} \\ \text{Projected pay at age 64} &= 100,000 \cdot (1.03)^{26} \\ &= 215,659\end{aligned}$$

$$\begin{aligned}\text{Funding accrued benefit} &= 2.0\%(9.0)(215,659) \\ &= 38,819\end{aligned}$$

Note that this calculation does not use the 4% rate of benefit accrual. The calculation of the cushion amount must be based on the prior benefit accrual rate of 2%. This is due to the exclusion in IRC 404(o)(4).

$$\begin{aligned}\text{PUC AL} &= 38,819(D_{65} / D_{39}) \ddot{a}_{65}^{(12)} \\ &= 38,819(1.07)^{-26}(9.989) \\ &= 66,770\end{aligned}$$

$$\begin{aligned}\text{Cushion amount} &= 50\%(\text{Funding target}) + (\text{PUC AL} - \text{Funding target}) \\ &= \text{PUC AL} - 50\%(\text{Funding target}) \\ &= 66,770 - (.50)(2\%/4\%)(61,922) \\ &= 51,290\end{aligned}$$

In the calculation of the cushion amount, the previously calculated Funding target was adjusted to reflect the 2% rate of benefit accrual. Now you can calculate the deductible limit:

Unit Credit normal cost	8,944
+ Funding target	61,922
+ Cushion amount	51,290
Sub-total	<hr/> 122,156
Less unreduced AAV	50,000
Deductible limit	<hr/> 72,156

The final deductible limit is 72,156.

Answer is B

If you did not know that Smith satisfies the HCE definition, you would calculate the deductible limit using a cushion amount that reflects the 4% rate of benefit accrual. The resulting cushion would be 51,290 larger, or 102,580. The resulting deductible limit would be 51,290 larger, or 123,446.

Answer is C

(see notes on next page)

NOTES:

1. This question is clearly defective. The correct calculation of the cushion amount depends on knowing the HCE definition. The details of IRC 414(q) are tested on the EA-2B exam, and are not on the EA-2A syllabus.

Credit was given for both answer ranges B and C. This allows for students who did not know the definition of an HCE.

2. One minor point that could impact a future exam problem is the date of adoption of the plan amendment. In this problem, the plan amendment is effective 01/01/2011. Based on 2010 exam condition 11, the adoption date of the amendment is the same as its effective date.

Based on the rule at 1.430(d)-1(d)(1)(i), the Funding target and the Target normal cost are based on the plan provisions adopted by the valuation date. The benefits can have a later effective date during the current plan year.

Based on the rule at 1.430(d)-1(d)(1)(ii), the plan provisions can be adopted after the valuation date. Under 412(d)(2), the plan administrator must elect retroactive treatment of the amendment. Then the amendment is treated as if it is adopted on the first day of the plan year for purposes of IRC 430.

3. For plans that are not At-Risk, there is an alternative definition of the deductible limit in 404(o)(2)(B):

“Final” At-Risk Target normal cost + “Final” At-Risk Funding target - Actuarial asset value

If this plan had some type of subsidized early retirement benefit, or optional forms of payment, then you would need to calculate the At-Risk values of the Funding target and the Target normal cost. Since there is no early retirement benefit, or optional forms of payment, the At-Risk values are the same as the non-At-risk values. The value of the alternative deductible limit assuming the plan is At-Risk will be lower than the value calculated above (by the cushion amount).

Fall 2010 EA-2A Exam Solutions

Problem 13

This problem is the first question asked on excise taxes related to multiemployer plans in critical status. This question tests WAY too many tiny details from IRC 4971(g).

I. TRUE

This is a bit tricky, and requires careful reading of the code. Under IRC 432(e)(7)(B), it says that failure to make a surcharge payment will be treated as a delinquent contribution. But there is an exception from the excise tax in IRC 4971(g)(1)(A):

“no tax shall be imposed under this section for a taxable year with respect to a multiemployer plan if, for the plan years ending with or within the taxable year, the plan is in critical status pursuant to section 432”

IRC 4971(g)(1)(B) states that the excise tax will be assessed for multiemployer plans that are in endangered status.

II. TRUE

This is true, based on IRC 4971(g)(2)(B):

“The amount of the tax imposed by subparagraph (A) shall be equal to the amount of the required contribution the employer failed to make in a timely manner.”

III. TRUE

IRC 4971(g)(3)(B) clarifies that a plan in critical status which has been certified for three consecutive years that it has not made progress towards the rehabilitation plan will be treated as having an accumulated funding deficiency. The amount of the deficiency is the greater of the minimum required contribution, or the contribution necessary to meet the benchmarks under the rehabilitation plan.

Under IRC 4971(g)(5), the Secretary may waive the excise tax:

“In the case of a failure described in paragraph (2) or (3) which is due to reasonable cause and not to willful neglect, the Secretary may waive part or all of the tax imposed by this subsection. For purposes of this paragraph, reasonable cause includes unanticipated and material market fluctuations ...”

All three items are true.

Answer is D

Fall 2010 EA-2A Exam Solutions

Problem 14 – Page 1

This is a typical §415 problem. The key point of the problem is the calculation of the actuarial reduction factor used to adjust the §415 dollar limit prior to age 62.

Earnings under §415 is defined as total compensation (not taxable). Based on the regulation that became final in 2007, earnings under §415 are subject to the §401(a)(17) limit.

At 12/31/10	Smith
Retirement age	61
Past service	10 years
Participation	9 years

One simplifying factor in this problem is that you do not need to calculate the plan's early retirement benefit. That value is given as 180,000.

415 COMP LIMIT

The §415(b)(1)(B) compensation limit is based on the high consecutive three years. It is reduced when service is less than ten years:

Year	2007	2008	2009	2010
Pay	100,000	125,000	300,000	167,000
401(a)(17) limit	225,000	230,000	245,000	245,000
Limited pay	100,000	125,000	245,000	167,000

$$\begin{aligned}\text{High 3 year average pay} &= (125,000 + 245,000 + 167,000) / 3 \\ &= 179,000\end{aligned}$$

$$\begin{aligned}\text{3 year comp §415 limit} &= 179,000(10/10) \\ &= 179,000\end{aligned}$$

Since Smith has exactly 10 years of service, there is no reduction in the 415 compensation limit.

415 DOLLAR LIMIT

The next step is calculation of the §415 dollar limit under §415(b)(1)(A). The dollar limit is reduced when participation is less than ten years. Smith has 9 years of participation service:

$$\begin{aligned}\text{§415 dollar limit during 2010} &= 195,000 * (9/10) && \text{for ages 62-65} \\ &= 175,500\end{aligned}$$

§415(b)(2)(E)(i) says to use the greater of 5% and the interest rate specified in the plan to reduce the §415 dollar limit prior to age 62, but here the code is misleading. The examples in the 1.415 regulation clarify the reductions in the §415 dollar limit.

Fall 2010 EA-2A Exam Solutions

Problem 14 – Page 2

Mandated basis reduction factor

Here is the short version of what you need to know. If you want to see the long version, check out the notes at the end of the solution to this problem.

Actuarial decrease factor for 415 dollar limit, based on mandated 5%, applicable mortality

Death benefit definition	Factor
Waived QPSA, or NO death benefit (complete forfeiture on death)	$N_{62}^{(12)} / N_X^{(12)}$
QPSA death benefit, and plan charges participants for cost of QPSA (default per 2010 exam condition 9)	$N_{62}^{(12)} / N_X^{(12)}$
100% of PV of accrued benefit (no forfeiture on death)	$v^{62-X} (\ddot{a}_{62}^{(12)} / \ddot{a}_X^{(12)})$
QPSA death benefit, and plan does NOT charge for cost of QPSA (treat as no forfeiture on death)	$v^{62-X} (\ddot{a}_{62}^{(12)} / \ddot{a}_X^{(12)})$

You are told nothing about the plan's death benefit. You should assume the death benefit is the Qualified Pre-retirement Survivor Annuity (QPSA). With a typical QPSA death benefit, there will be a forfeiture on death.

Based on 2010 exam condition 9, in the absence of any other information, you should assume that the plan does charge the participants for the cost of the QPSA. This means that a forfeiture DOES occur upon the death of a participant, and you must reflect pre-retirement mortality in the actuarial reduction prior to age 62.

Mandated basis reduction factor

$$\begin{aligned}\text{Actuarial reduction from 62 to 61} &= N_{62}^{(12)} / N_{61}^{(12)} \\ &= 571,733 / 618,223 \\ &= .9248\end{aligned}$$

Plan basis reduction factor

The plan basis reduction factor is given in the data for the problem.

$$\text{Plan basis reduction from 62 to 61} = .9235$$

Final benefit determination

$$\begin{aligned}\$415 \text{ dollar limit at age 61} &= 175,500 * \text{lesser of } [.9248 \text{ or } .9235] \\ &= 162,074\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 14 – Page 3

Final benefit determination - continued

Life annuity \$415 limit at 61 = lesser of 3 year comp limit and dollar limit
= lesser of 179,000 and 162,074
= 162,074

Final benefit payable at age 61 = lesser of plan benefit and 415 limit
= lesser of 180,000 and 162,074
= 162,074

Answer is B

NOTE

Actuarial reduction of 415 dollar limit below age 62 (LONG version)

If the plan document does not define a life annuity at both age 62 and the early retirement age, then the \$415 dollar limit is reduced using a factor calculated based on the mandated mortality and interest rate. If the plan does define a life annuity benefit at both ages, then the \$415 dollar limit is reduced using the lower of two factors:

1. Actuarial reduction factor based on the mandated mortality and interest rate, and
2. The ratio of the plan's life annuity benefit at the early retirement age divided by the plan's life annuity benefit at age 62, both ignoring the 415 limits

The definition of the actuarial equivalent reduction factor (on the mandated mortality and interest rate) will vary depending on the definition of the death benefit. If there is no forfeiture on death, then you can ignore pre-retirement mortality:

$$v^{62-x} (\ddot{a}_{62}^{(12)} / \ddot{a}_x^{(12)})$$

If the death benefit is defined as 100% of the present value of the accrued benefit, then there is no forfeiture upon death. In 1.415(b)-1(e)(3), it states that you may treat a typical Qualified Pre-retirement Survivor Annuity (QPSA) death benefit as resulting in no forfeiture on death. This treatment is only allowed if the plan does not charge for the cost of the QPSA, and if the plan applies the same treatment for all retirement ages (both before age 62 and after age 65).

If there is a forfeiture on death, then you must reflect pre-retirement mortality:

$$(N_{62}^{(12)} / N_x^{(12)}) = v^{62-x} p_x (\ddot{a}_{62}^{(12)} / \ddot{a}_x^{(12)})$$

If there is no death benefit, then there is a full forfeiture upon death. This can happen if the participant is single, or if they are married, and they elect out of the Qualified Pre-retirement Survivor Annuity (QPSA). With a typical QPSA death benefit, there will be a forfeiture on death. Based on exam condition 12, in the absence of any other information, you should assume that the plan does charge the participants for the cost of the QPSA.

Fall 2010 EA-2A Exam Solutions

Problem 14 – Page 4

Actuarial reduction of 415 dollar limit below age 62 - continued

Actuarial decrease factor for 415 dollar limit, based on mandated 5%, applicable mortality

Death benefit definition	Factor
Waived QPSA, or NO death benefit (complete forfeiture on death)	$N_{62}^{(12)} / N_X^{(12)}$
QPSA death benefit, and plan charges participants for cost of QPSA (default per exam condition 12)	$N_{62}^{(12)} / N_X^{(12)}$
100% of PV of accrued benefit (no forfeiture on death)	$v^{62-x} (\ddot{a}_{62}^{(12)} / \ddot{a}_X^{(12)})$
QPSA death benefit, and plan does NOT charge for cost of QPSA (treat as no forfeiture on death)	$v^{62-x} (\ddot{a}_{62}^{(12)} / \ddot{a}_X^{(12)})$

Fall 2010 EA-2A Exam Solutions

Problem 15 – Page 1

Revised 11/12/12

The key to this problem is calculating the normal cost under the Entry Age Normal method. In general, the Entry Age Normal Cost (EANC) is defined as the present value of benefits at entry age, divided by a temporary annuity at entry age. Since the plan benefits are based on pay, the EANC is calculated as a level percentage of salary, and the temporary annuity will include a salary scale.

Level % EANC: $PVB_{EA} / \overbrace{s\ddot{a}_{EA:RA-EA}}^{\text{at entry age - adjust later ages by salary scale}}$

Another key to this problem is that you must know the gain / loss formulas. The problem asks for the G/L due to Smith's termination during 2010.

$$\begin{aligned} \text{Non-inv G/L} &= {}_eAL_1 - AL_1 \\ {}_eAL_1 &= (1+i)(AL_0 + NC_0) - (\text{actual benefit payments} + i) \end{aligned}$$

Age 58 at 01/01/10
 Entry age 50
 Past service 8
 Vesting 100%

To calculate the present value of future benefits, you need to calculate the projected monthly benefit at age 65:

Exit type	Termination	Normal retirement
Exit date	12/31/2010	01/01/2017
Exit age	59	65
Projected service	9	15
Final compensation	100,000	$119,405 = 100,000 \cdot (1.03)^6$
Projected benefit	$9,000 = 1\%(9)(100,000)$	$17,911 = 1\%(15)(119,405)$

The next step is to calculate the present value of benefits at exit age, both as an active and as a vested termination. For the Entry Age normal cost, you also need to calculate the present value of benefits at entry age:

Exit type	Termination	Normal retirement
PVB at exit age	$100\%(9,000)(D_{65} / D_{59}) \ddot{a}_{65}^{(12)}$ $= 9,000(1.06)^{-6}(11.00)$ $= 69,791$	
PVB at entry age		$(17,911)(D_{65} / D_{50}) \ddot{a}_{65}^{(12)}$ $= 17,911(1.06)^{-15}(11.00)$ $= 82,209$

Fall 2010 EA-2A Exam Solutions

Problem 15 – Page 2

Now you need to determine the normal cost and accrued liability at 01/01/2010. These are needed for the expected accrued liability. First you calculate the Entry Age normal cost:

Level % EANC: $PVB_{50} / {}^s\ddot{a}_{50:\overline{15}|}$ EANC at entry age - adjust later ages by salary scale

$$\begin{aligned} {}^s\ddot{a}_{50:\overline{15}|} &= \ddot{a}_{15|j} \quad \text{where } 1+j = (1.06 / 1.03), \quad j = 2.91\% \\ &= 12.3637 \end{aligned}$$

$$\begin{aligned} EANC_{50} &= 82,209 / 12.3637 \\ &= 6,649 \end{aligned}$$

$$\begin{aligned} EANC_{58} &= 6,649 * (1.03)^8 \quad (\text{adjusted with eight years of salary scale}) \\ &= 8,423 \end{aligned}$$

The Entry Age Normal accrued liability can be calculated two different ways – use either the prospective or the retrospective definition. I will use the prospective formula for the accrued liability:

$$EAN \text{ AL} = PVB - PV(EANC)$$

$$PV(EANC) = EANC({}^s\ddot{a}_{58:\overline{7}|})$$

$$\begin{aligned} {}^s\ddot{a}_{58:\overline{7}|} &= \ddot{a}_{7|j} \quad \text{where } j = 2.91\% \\ &= 6.4329 \end{aligned}$$

$$\begin{aligned} PV(EANC) &= 8,423(6.4329) \\ &= 54,185 \end{aligned}$$

$$\begin{aligned} PVB \text{ at } 58 &= (17,911)(D_{65} / D_{58}) \ddot{a}_{65}^{(12)} \\ &= 17,911(1.06)^{-7}(11.00) \\ &= 131,029 \end{aligned}$$

$$\begin{aligned} EAN \text{ AL} &= PVB - PV(EANC) \\ &= 131,029 - 54,185 \\ &= 76,844 \end{aligned}$$

Problem 15 – Page 3**Revised 07/09/13**

You can now calculate the gain / loss due to Smith's termination:

$$\begin{aligned}\text{Non-inv G/L} &= {}_e\text{AL}_1 - \text{AL}_1 \\ {}_e\text{AL}_1 &= (1+i)(\text{AL}_0 + \text{NC}_0) - (\text{actual benefit payments} + i) \\ \text{AL}_1 &= 69,791 \quad (\text{liability as a vested termination}) \\ {}_e\text{AL}_1 &= (1.06)(76,844 + 8,423) - 0 \\ &= 90,383 \\ \text{Non-inv G/L} &= 90,383 - 69,791 \\ &= 20,592\end{aligned}$$

Answer is B**NOTE**

There is an alternate solution technique that gives the same result, without calculating the accrued liability and normal cost at 01/01/2010. This relies on the fact that the expected accrued liability and the actual accrued liability for an active employee at 01/01/2011 must be identical. The reason is that there is no mortality assumption, and the problem implies that Smith's pay increase for 2010 matches the salary scale assumption.

You still must calculate the EANC at age 50. Smith is age 59 at 01/01/2011:

$$\begin{aligned}\text{EANC}_{59} &= 6,649 * (1.03)^9 \\ &= 8,676\end{aligned}$$

The Entry Age Normal accrued liability at 01/01/2011 can be calculated two different ways. This time, I will use the retrospective formula for the accrued liability:

$$\begin{aligned}\text{EAN AL} &= \text{Accumulated prior EANC} \\ &= \text{EANC}({}^s\ddot{s}_{50:\overline{9}|})\end{aligned}$$

$$\begin{aligned}{}^s\ddot{s}_{50:\overline{9}|} &= \ddot{s}_{9|j} \quad \text{where } j = 2.91\% \\ &= 10.4179\end{aligned}$$

$$\begin{aligned}\text{EAN AL}_{59} &= 8,676 * 10.4179 \\ &= 90,383\end{aligned}$$

As expected, this matches the value calculated above. The resulting gain is 20,592.

Fall 2010 EA-2A Exam Solutions

Problem 16 – Page 1

Smith is highly paid, and their compensation is near the 401(a)(17) limit. One point of the question is how the 401(a)(17) limit applies to Smith's pay. Most of the work in the problem is calculating the Funding target.

At 07/01/2011

Age	50
Service	10 years
Participation	10 years

The first step is determining the pay that can be used to calculate Smith's accrued benefit. In general, the 401(a)(17) limit for a calendar year applies to any plan year that begins in that calendar year:

Plan Year Beginning	Applicable 401(a)(17) limit	Plan year Ending	Plan year Pay	Limited pay
07/01/05	210,000	06/30/06	230,000	210,000
07/01/06	220,000	06/30/07	215,000	215,000
07/01/07	225,000	06/30/08	230,000	225,000
07/01/08	230,000	06/30/09	210,000	210,000
07/01/09	245,000	06/30/10	250,000	245,000
07/01/10	245,000	06/30/11	200,000	200,000

The first five consecutive years give the highest value of Smith's average annual compensation:

$$\begin{aligned} \text{5 year average compensation} &= (210,000 + 215,000 + 225,000 + 210,000 + 245,000)/5 \\ &= 221,000 \end{aligned}$$

$$\begin{aligned} \text{Accrued benefit} &= 221,000 * 6\% * 10 \\ &= 132,600 \end{aligned}$$

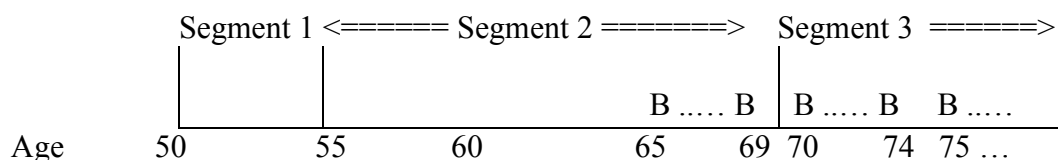
One simplification is that the benefit is low enough that you can ignore the IRC 415 limits. When you calculate the accrued benefit, it is assumed payable at normal retirement age, which is 65 by default.

Funding Target

The Funding Target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability.

Based on the default exam conditions, normal retirement age is 65, and the benefit is assumed payable monthly, starting at normal retirement age. The participant is currently 15 years from retirement, so their benefit payments will be valued using the second and third segment rates.

Funding Target – continued



The second segment covers benefit payments from age 55 up to age 69 (15 years). Since normal retirement age is 65, there are 5 years of benefit payments valued using the second segment rate. The third segment rate is used to value benefit payments at and after age 70.

One important aspect of the problem is that the pre-retirement mortality and post-retirement mortality are not the same. This means you must be careful to only use the commutation functions after benefits commence. Discounting values from the assumed retirement ages back to the valuation date must be done on an interest-only basis.

The calculation of the Funding target uses the accrued benefit. Here is the formula for the Funding target using monthly annuity rates:

$$\text{Age 50 FT} = 132,600 * [{}_{15|} \ddot{a}_{50:\overline{5}| \text{seg}_2}^{(12)} + {}_{20|} \ddot{a}_{50 \text{seg}_3}^{(12)}]$$

Notice that the second annuity actually starts 20 years from the valuation date. Now you need to express these deferred annuities in terms of commutation functions after age 65. For deferral periods prior to age 65, there is no pre-retirement mortality:

$$\begin{aligned} {}_{15|} \ddot{a}_{50:\overline{5}| \text{seg}_2}^{(12)} &= (v^{15} {}_{15}p_{50}) \ddot{a}_{65:\overline{5}| \text{seg}_2}^{(12)} && \text{all at segment 2 rate} \\ &= (1.060)^{-15} * (1.0) * (N_{65}^{(12)} - N_{70}^{(12)}) / D_{65} && \text{all at segment 2 rate} \\ &= (1.060)^{-15} * (N_{65}^{(12)} - N_{70}^{(12)}) / D_{65} && \text{all at segment 2 rate} \end{aligned}$$

$$\begin{aligned} {}_{20|} \ddot{a}_{50 \text{seg}_3}^{(12)} &= (v^{20} {}_{20}p_{50}) \ddot{a}_{70 \text{seg}_3}^{(12)} && \text{all at segment 3 rate} \\ &= (1.065)^{-15} * (1.0) * (D_{70} / D_{65}) * (N_{70}^{(12)} / D_{70}) && \text{all at segment 3 rate} \\ &= (1.065)^{-15} * (N_{70}^{(12)} / D_{65}) && \text{all at segment 3 rate} \end{aligned}$$

$$\text{Age 50 FT} = 132,600 * [(1.060)^{-15} \frac{(240,861 - 149,149)}{20,965} + (1.065)^{-15} \frac{(103,844)}{15,440}]$$

Problem 16 – Page 3

Revised 10/18/12

Funding Target – continued

$$\begin{aligned}\text{Age 50 FT} &= 132,600[.4173(4.3745) + .3888(6.7256)] \\ &= 588,803\end{aligned}$$

Answer is B

NOTE

There is a pattern that occurs in the expression for the Funding target (and target normal cost) when you have no pre-retirement decrements. The interest discount terms all have the same exponent. The exponent is current age minus the assumed retirement age.

Fall 2010 EA-2A Exam Solutions

Problem 17

Similar to 2009 #22

Revised 10/22/12

Smith is highly paid, and their compensation is near the 401(a)(17) limit. The key point of the question is how the 401(a)(17) limit applies to Smith's pay.

The plan document defines the benefit using the highest 36 consecutive months of pay. The problem asks for Smith's accrued benefit at 11/01/2010.

You need to figure out how to apply the calendar year 401(a)(17) limits to their monthly pay values. There is a tiny detail in the regulation at 1.401(a)(17)-1(b)(3)(ii) that addresses this:

"Alternatively, if a plan determines compensation used in determining allocations or benefit accruals for the plan year on the basis of compensation for a 12-consecutive-month period, or periods, ending no later than the last day of the plan year, then the annual compensation limit applies to compensation for each of those periods based on the annual compensation limit in effect for the respective calendar year in which each 12-month period begins."

Period starts	Applicable 401(a)(17) limit	Pay for 12 months	Limited pay
11/01/07	225,000	$225,000 = 2(17,500) + 10(19,000)$	225,000
11/01/08	230,000	$248,000 = 2(19,000) + 10(21,000)$	230,000
11/01/09	245,000	$267,000 = 2(21,000) + 10(22,500)$	245,000

Smith's average monthly compensation is $19,444 = 700,000 / 36$.

Answer is B

NOTES

1. In general, the 401(a)(17) limit for a calendar year applies to any plan year that begins in that calendar year. This is consistent with the rules for applying the compensation threshold under IRC 414(q) for highly compensated employees.
2. Under the 416 regulation, it appears the rule is different. Based on Question T-12, the 416 key employee threshold for a calendar year applies to any plan year that ends in that calendar year.

Fall 2010 EA-2A Exam Solutions

Problem 18

This is the first question asked on the WRERA changes to the definition of the Target normal cost in IRC 430(b)(1). Those changes allow for the addition of expected plan-related expenses and the subtraction of expected mandatory employee contributions.

Funding Shortfall

The first step is calculation of the funding shortfall. If this amount is zero, then the definition of the minimum required contribution (MRC) will be different:

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 33,900,000 - (34,100,000 - 0 - 0) \\ &= \text{zero}\end{aligned}$$

Since the Funding shortfall is zero, all existing shortfall and waiver amortization bases are considered fully amortized.

Target normal cost

The problem states that the plan has mandatory employee contributions that equal 1.0% of pay. You are not given any interest rates, so you can't make any adjustments for expected timing of the employee contributions. You are also given the expected plan-related expenses:

$$\begin{aligned}01/2011 \text{ TNC} &= 1,615,000 + 104,000 \text{ expenses} - 1\%(10,000,000) \text{ EEC} \\ &= 1,619,000\end{aligned}$$

Minimum required contribution

Since the funding shortfall is zero, the Minimum required contribution is equal to the Target normal cost, plus the Funding target less the AAV (after reduction for both the CB and the PB):

$$\begin{aligned}01/2011 \text{ MRC} &= \text{TNC} + \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 1,619,000 + 33,900,000 - (34,100,000 - 0 - 0) \\ &= 1,419,000\end{aligned}$$

Answer is B

Fall 2010 EA-2A Exam Solutions

Problem 19 – Page 1

There are several key ideas in this problem:

- Calculation of the Funding target under IRC Section 430
- Calculation of minimum lump sum value under 417(e)
- Calculation of 415 limits

The problem states that Smith retires on 01/01/2011 and elects to receive a lump sum. The plan lump sum should be calculated based on the plan assumptions for actuarial equivalence.

The plan lump sum value can not be lower than the minimum lump sum under 417(e)(3). This calculation is similar to the Funding target calculation under IRC 430. It is based on a modified set of segment rates, as defined in 417(e)(3)(D).

Earnings under §415 is defined as total compensation (not taxable). Based on the regulation that became final in 2007, earnings under §415 are subject to the §401(a)(17) limit.

At 01/01/11	Smith
Retirement age	65
Past service	20 years
Participation	7 years

Since this participant retires in 2011, you need the 415 dollar limit for 2011. That value was not known when the problem was written, so it is given as 200,000 in the data for the problem.

Plan benefit

This problem does not give any yearly pay history, so you can't compare individual pay values against the 401(a)(17) limit. The participant's accrued benefit at age 65 is a quick calculation:

$$\begin{aligned}\text{Accrued benefit} &= 3\%(20)(235,000) \\ &= 141,000\end{aligned}$$

Plan lump sum

Now you can calculate the lump sum based on the plan's assumptions for actuarial equivalence:

$$\begin{aligned}\text{Lump sum} &= 141,000 \ddot{a}_{65}^{(12)} \\ &= 141,000 * (N_{65}^{(12)} / D_{65}) && \text{using 4.5\% interest} \\ &= 141,000 * (664,276 / 52,992) \\ &= 141,000 * (12.5354) \\ &= 1,767,492\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 19 – Page 2

Segment Interest Rates

The next step is calculation of the 417(e) minimum lump sum using segment interest rates. Under PPA 2006, you would calculate the present value of a stream of annual benefit payments for a life annuity payable to a person age x (currently in pay status) as follows:

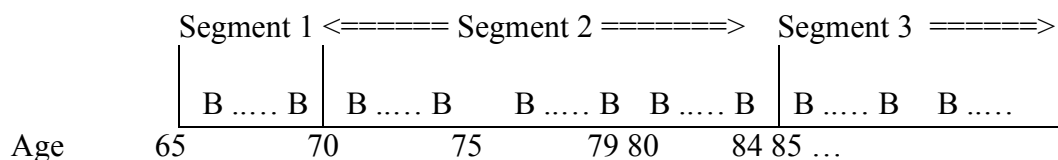
$$\begin{aligned} \text{Present value} &= \sum_{t=0}^4 (1 + \text{seg}_1)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=5}^{19} (1 + \text{seg}_2)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=20}^{\omega-x} (1 + \text{seg}_3)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \end{aligned}$$

417(e) lump sum

The 417(e) lump sum is calculated in a similar manner to the Funding Target under IRC 430. The Funding Target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability.

This problem does not give you the values of the individual segment rates. See the note at the end of the solution for additional discussion of the segment rates under 417(e)(3).

Based on the default exam conditions, normal retirement age is 65, and the benefit is assumed payable monthly, starting at normal retirement age. Since the participant is currently at normal retirement age, their benefit payments will be valued using all three segment rates:



The calculation of the Funding target uses the accrued benefit. Here is the formula for the Funding target using monthly annuity rates:

$$\text{Age 65 FT} = 141,000 * [\ddot{a}_{65:\overline{5}|}^{(12)}_{\text{seg}_1} + \ddot{a}_{5|\overline{65:15}|}^{(12)}_{\text{seg}_2} + \ddot{a}_{20|\overline{65}|}^{(12)}_{\text{seg}_3}]$$

Now you need to express these annuities in terms of commutation functions. Since the participant is retiring at age 65, this is a bit simpler than other problems on the Funding target.

Fall 2010 EA-2A Exam Solutions

Problem 19 – Page 3

Funding Target – continued

$$\ddot{a}_{65:\overline{5}|seg_1}^{(12)} = (N_{65}^{(12)} - N_{70}^{(12)}) / D_{65} \quad \text{all at segment 1 rate}$$

$$\begin{aligned} {}_5|\ddot{a}_{65:\overline{15}|seg_2}^{(12)} &= (v^5 {}_5p_{65}) \ddot{a}_{65:\overline{15}|seg_2}^{(12)} && \text{all at segment 2 rate} \\ &= (N_{70}^{(12)} - N_{85}^{(12)}) / D_{65} && \text{all at segment 2 rate} \end{aligned}$$

$$\begin{aligned} {}_{20}|\ddot{a}_{65seg_3}^{(12)} &= (v^{20} {}_{20}p_{65}) \ddot{a}_{85seg_3}^{(12)} && \text{all at segment 3 rate} \\ &= N_{85}^{(12)} / D_{65} && \text{all at segment 3 rate} \end{aligned}$$

$$\begin{aligned} \text{Age 65 FT} &= 141,000 \left[\frac{(466,449 - 298,073)}{38,856} + \frac{(142,952 - 17,266)}{20,984} + \frac{7,491}{11,398} \right] \\ &= 141,000 [4.3333 + 5.9896 + .6572] \\ &= 1,548,203 \end{aligned}$$

Hard to believe, but after all those calculations, the 417(e) minimum lump sum has no effect. Now you need to calculate the 415 limit to see if it cuts back Smith's lump sum.

415 COMP LIMIT

The §415(b)(1)(B) compensation limit is based on the high consecutive three years. It is reduced when service is less than ten years.

This problem does not give any yearly pay history, so you can't compare individual pay values against the 401(a)(17) limit. The participant's 415 compensation limit is a quick calculation:

$$\begin{aligned} \text{3 year comp §415 limit} &= 235,000(10/10) \\ &= 235,000 \end{aligned}$$

415 DOLLAR LIMIT

The next step is calculation of the §415 dollar limit under §415(b)(1)(A). The dollar limit is reduced when participation is less than ten years. Smith has 7 years of participation service. One minor point of confusion is that the problem specifies 200,000 as the 2011 dollar limit for 415.

$$\begin{aligned} \text{§415 dollar limit - assumed} &= 200,000 * (7/10) && \text{for ages 62-65} \\ &= 140,000 \end{aligned}$$

Problem 19 – Page 4

Revised 03/10/17

415 limit - life annuity

Since Smith is retiring at age 65, there is no adjustment in the 415 dollar limit due to retirement age.

$$\begin{aligned}\text{Life annuity } \$415 \text{ limit at } 65 &= \text{lesser of 3 year comp limit and dollar limit} \\ &= \text{lesser of } 235,000 \text{ and } 140,000 \\ &= 140,000\end{aligned}$$

415 limit - lump sum

You need to calculate the adjustment factors to allow for the lump sum form of payment. IRC §415(b)(2)(E)(i) says to use the lesser of 5% and the interest rate specified in the plan to adjust the \$415 dollar limit for form of payment.

Normally you would calculate three different factors, and take the lesser value. This plan has less than 100 participants, so it meets the exception in the 415 regulation regarding the calculation of the factor using the 417(e) basis. You are given no information on pay values, but it is safe to assume that everyone earns at least \$5,000 in the prior year. This plan has less than 100 participants, and therefore less than 100 employees. This is based on 2010 exam condition 5:

(5) The plan covers all active employees of the employer; there is no age or service requirement for participation. Thus, when referring to active employees, the terms “employee” and “participant” are synonymous.

In this problem, you calculate the lump sum based on two factors (4.5% plan basis and the 5.5% mandated basis), and use the lesser of the two results.

$$\begin{aligned}\text{415 Lump sum benefit} &= 140,000 * (N_{65}^{(12)} / D_{65}) \\ \text{(Mandated basis 5.5\% app. mortality)} &= 140,000 * (328,451 / 28,534) \\ &= 1,611,521\end{aligned}$$

$$\begin{aligned}\text{415 Lump sum benefit} &= 140,000 * (N_{65}^{(12)} / D_{65}) \\ \text{(Plan basis 4.5\% app. mortality)} &= 140,000 * (664,276 / 52,992) \\ &= 1,754,956\end{aligned}$$

The final 415 limit on the lump sum payment form is 1,611,521. Since this is less than the plan lump sum, the final lump sum that can be paid is 1,611,521.

Answer is C

(see notes on next page)

Problem 19 – Page 5

NOTES

1. The 415 limit does not have to be reduced if the payment form is a Qualified joint and survivor annuity. In IRC Section 417, it defines a Qualified joint and survivor annuity as an annuity
 - (1) for the life of the participant with a survivor annuity for the life of the spouse which is not less than 50 percent of (and is not greater than 100 percent of) the amount of the annuity which is payable during the joint lives of the participant and the spouse, and
 - (2) which is the actuarial equivalent of a single annuity for the life of the participant.
2. In general, the adjustment of the 415 limit for form of payment on the mandated basis uses the 5% interest rate. When the form of payment is subject to 417(e)(3), such as a certain only annuity, or a lump sum, the mandated basis uses two calculations: 5.5% interest with applicable mortality, and 105% of the factor using the applicable interest rates with applicable mortality.

In this problem, the plan satisfied the exception to not use any factor based on the 417(e) applicable interest rates. If you incorrectly used that factor, it produced a higher 415 lump sum. As a result, it made no difference in the final answer.

3. In this problem, you are not given the values of the 417(e) segment rates. Even though the problem does not clarify how the 417(e) rates were determined, they must reflect the phase-in from the 30 year Treasury rate to the three segment rates for the yield curve.

It would be more difficult if you were given the unadjusted segment rates and the 30 year Treasury rate. The first step would be to allow for the phase-in rule. The second step would be the lump sum calculation.

The phase-in rule grades in the effect of the yield curve by combining 20% of the segment rates with 80% of the 30 year Treasury rate for 2008. For each year from 2009 through 2011, the percentage weight for the segment rates increases by an additional 20%, and the weight for the Treasury rate decreases by 20%. In 2012, the transition rule is gone, and the present value calculation is solely based on the segment interest rates:

Year	Weight for Segment rate	Weight for 30 year Treasury
2008	20%	80%
2009	40%	60%
2010	60%	40%
2011	80%	20%
2012	100%	0%

Fall 2010 EA-2A Exam Solutions

Problem 20 – Page 1

The key to this problem is the calculation of the Shortfall amortization base at both 01/01/2010 and 01/01/2011 under IRC Section 430. The plan has a carryover balance (CB) equal to zero, and a prefunding balance (PB) equal to 500,000 at 01/01/2010.

The problem asks for the "smallest amount" at 01/01/11. Based on 2010 exam conditions 26 and 27, the plan sponsor elects to offset both the CB and the PB against the minimum contribution under IRC 430. Based on exam condition 31, the "smallest amount" reflects offsetting both the CB and the PB against the minimum contribution (MRC).

The first step in the problem is to go back to 2010 and determine the amount of the shortfall base and the shortfall amortization installment. Then you can do the same calculations for 2011, and determine the 2011 minimum required contribution.

2010 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance and the carryover balance.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 15,500,000 - (15,000,000 - 0 - 500,000) \\ &= 1,000,000\end{aligned}$$

2010 Shortfall Base Exemption

You should think about whether this plan satisfies the shortfall base exemption. I will define the "modified funding shortfall" as the modified funding target less the modified assets. If the "modified funding shortfall" is less than or equal to zero, then you would not have to set up the Shortfall base for 2010:

- Modified funding target: the applicable percentage times the funding target
- In the absence of any information to the contrary, you can assume the applicable percentage is 96%
- Modified assets: if any portion of the prefunding balance is applied toward the minimum required contribution, the modified assets equal AAV - PB. Otherwise, the modified assets equal the AAV with no reduction.

$$\begin{aligned}\text{Modified S/F} &= 96\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= .96 * (15,500,000) - (15,000,000 - 500,000) \\ &= 380,000\end{aligned}$$

The modified shortfall calculation above offsets the entire PB against the AAV. In general, the only time you should not do this is when the problem states that the plan sponsor does not elect to apply the CB and the PB against the MRC, or when the PB is equal to zero.

Fall 2010 EA-2A Exam Solutions

Problem 20 – Page 2

2010 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2010 shortfall amortization base, which is equal to

1. The Applicable percentage times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments:

This problem does not give any information about shortfall amortizations (or shortfall bases) for 2008 and 2009. I wrestled with this a bit, but finally decided that you must assume that there are no shortfall amortization bases prior to 2010. There is no other reasonable assumption you can make, and still work the problem.

$$\begin{aligned}\text{S/F Amort base} &= (\text{Applicable \%}) * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= .96 * 15,500,000 - (15,000,000 - 0 - 500,000) - (\text{PV of PY Amortizations}) \\ &= 14,880,000 - 14,500,000 - \text{zero} \\ &= 380,000\end{aligned}$$

You must calculate the shortfall amortization installment for 2010. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= 380,000 / 5.9982 \\ &= 63,352\end{aligned}$$

Now that you have the 2010 shortfall amortization, you must re-do all those calculations based on the 2011 valuation date.

2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance and the carryover balance.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 16,750,000 - (17,000,000 - 0 - 600,000) \\ &= 350,000\end{aligned}$$

2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is almost identical to the previously calculated Funding shortfall:

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 20 – Page 3

2011 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. 100% times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments:

$$\begin{aligned}\text{S/F Amort base} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * 16,750,000 - (17,000,000 - 0 - 600,000) - (\text{PV of PY Amortizations}) \\ &= 16,750,000 - 16,400,000 - 63,352 * 5.2932 \\ &= 14,663\end{aligned}$$

You must calculate the shortfall amortization installment for 2011. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= 14,663 / 5.9982 \\ &= 2,445\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 63,352 + 2,445 \\ &= 65,797\end{aligned}$$

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. The shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Minimum Required Contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 900,000 + 65,797 + 0 \\ &= 965,797\end{aligned}$$

Smallest amount

The problem asks for “the smallest amount that satisfies the minimum funding standard”. A quick check of the 2010 valuation results shows that the prior year’s “funding ratio” was more than 80%. As a result, you can offset the PB against the MRC:

$$\begin{aligned}\text{Smallest contr} &= \text{MRC} - \text{CB} - \text{PB} \\ &= 965,797 - 0 - 600,000 \\ &= 365,797\end{aligned}$$

Answer is D

Fall 2010 EA-2A Exam Solutions

Problem 21

The key point of this problem is understanding how to calculate the Target normal cost for 2011 for each of these scenarios. The problem states the date of adoption of the plan amendment is prior to 01/01/2011. Based on 2010 exam condition 11, the adoption date of the amendment is the same as its effective date.

Based on the rule at 1.430(d)-1(d)(1)(i), the Funding target and the Target normal cost are based on the plan provisions adopted by the valuation date. The benefits can have a later effective date during the current plan year.

I will define Scenario 0 as the baseline, where no plan amendment is adopted. In this scenario, the Target normal cost (TNC-0) reflects the \$30 rate of benefit accrual for the entire year.

Under Scenario A, the \$30 rate of benefit accrual applies for 7 months, and increases to \$40 for the last 5 months of the year. The Target normal cost will reflect the \$30 and \$40 benefit accrual rates on a pro-rata basis:

$$\text{TNC-A} = (7/12) * (\text{TNC-0}) + (5/12) * (\text{TNC-0}) * (40/30)$$

Under Scenario B, the \$30 rate of benefit accrual applies for 7 months, and drops to \$0 for the last 5 months of the year. The Target normal cost will reflect the \$30 and \$0 benefit accrual rates on a pro-rata basis:

$$\text{TNC-B} = (7/12) * (\text{TNC-0}) + (5/12) * (\text{TNC-0}) * (0)$$

Under Scenario C, the rate of benefit accrual changes to \$40 for all years of service, after the participant earns one hour of service on or after 08/01/2011:

$$\text{TNC-C} = (\text{TNC-0}) * (40/30)$$

Based on these formulas, you can rank the Target normal cost under all three scenarios:

$$\text{TNC-C} > \text{TNC-A} > \text{TNC-B}$$

Answer is C

Fall 2010 EA-2A Exam Solutions

Problem 22 – Page 1

Similar to 2009 #45

The key to this problem is the calculation of the deductible limit under IRC 404(o). You need to know the definition of the cushion amount, and the alternative At-Risk definition of the deductible limit.

Deductible Limit

The deductible limit is defined as the greater of the minimum contribution required under IRC 430 and the amount under 404(o)(2). IRC 430 defines “the minimum required contribution” as the amount prior to reduction by the carryover balance or the prefunding balance. You don’t have enough information to calculate the shortfall amortization installment in this problem, so you should ignore the minimum contribution.

The maximum deductible limit is defined under 404(o)(2)(A):

Target normal cost + Funding target + Cushion amount - Actuarial asset value

The problem gives you the funding target on two sets of assumptions. One uses the At-Risk assumptions, and has been provided for use in the alternative definition of the deductible limit.

Cushion Amount

The Cushion amount is defined as the sum of two pieces:

- (1) 50% of the Funding target, and
- (2) the increase in the Funding target due to allowing for future pay increases.

$$\begin{aligned}\text{Cushion amount} &= 50\%(\text{FT}) + \Delta\text{FT due to pay increases} \\ &= .5(320,000) + (405,000 - 320,000) \\ &= 245,000\end{aligned}$$

Now you can calculate the deductible limit. This calculation uses the non At-Risk funding target. This plan is not in At-Risk status, based on 2010 exam condition 42.

Target normal cost	60,000
+ Funding target	320,000
+ Cushion amount	245,000
Sub-total	625,000
Less unreduced AAV	300,000
Deductible limit	325,000

Fall 2010 EA-2A Exam Solutions

Problem 22 – Page 2

Alternative Deductible Limit: At-Risk

For plans that are not At-Risk, there is an alternative definition of the deductible limit in 404(o)(2)(B):

“Final” At-Risk Target normal cost + “Final” At-Risk Funding target - Actuarial asset value

This calculation uses values determined as if the plan is in At-Risk status. The problem gives you the values of the normal cost and funding target for use in this alternative deductible limit definition.

At-Risk Target normal cost	90,000
+ At-Risk Funding target	500,000
Sub-total	590,000
Less unreduced AAV	300,000
Deductible limit	290,000

The alternative definition does not produce a higher value for the deductible limit. The final deductible limit is 325,000.

Answer is B

NOTE

Some prior exam problems have not given you the At-Risk values of the target normal cost and funding target. If this plan had some type of subsidized early retirement benefit, or optional forms of payment, then you would need to calculate the At-Risk values of the Funding target and the Target normal cost.

Fall 2010 EA-2A Exam Solutions

Problem 23 – Page 1

Revised 08/03/12

The key point of this problem appears to be knowledge of IRC 436, which was not a topic on the 2010 EA-2A exam syllabus. I'll work the problem based on NOT knowing any calculation details under IRC 436. Then I will show the solution based on the "official answer".

You must calculate the Shortfall amortization base at 01/01/2011 under IRC Section 430. The problem states the prefunding balance (PB) is equal to 187,500 at 01/01/2010. You are given no information on the carryover balance (CB), so you should assume that it has a value of zero.

The problem asks for the "smallest amount" at 01/01/11. Based on 2010 exam conditions 26 and 27, the plan sponsor elects to offset both the CB and the PB against the minimum contribution under IRC 430. Based on exam condition 31, the "smallest amount" reflects offsetting both the CB and the PB against the minimum required contribution (MRC).

2010 valuation results

2010 exam condition 27 states the plan sponsor's funding ratio for the prior year is at least 80%. This problem gives you the prior year's funding target attainment percentage (FTAP), so you should not rely on exam condition 27. You should check the 2010 "funding ratio" to be sure that the plan can apply the CB and the PB towards the MRC in 2011.

The "funding ratio" is defined in IRC 430(f)(3)(C). Let PB be the value of the prefunding balance:

$$\text{Funding ratio} = \frac{\text{AAV} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

The FTAP is defined in 430(d)(2):

$$\text{FTAP} = \frac{\text{AAV} - \text{CB} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

Since this plan has a zero carryover balance, the 2010 "funding ratio" is equal to the FTAP. Both are equal to 70%. This means that you can't apply the CB (or PB) towards the 2011 MRC.

2011 Prefunding balance

The problem gives you the 2010 PB as 187,500. The plan sponsor did not increase the PB during 2010. You can calculate the value at 01/01/2011 by increasing the PB with the plan's rate of return on assets:

$$\begin{aligned} \text{01/2011 PB} &= (\text{01/2010 PB})(1 + \text{asset return}) \\ &= 187,500 * (1.0667) \\ &= 200,006 \end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 23 – Page 2

2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance and the carryover balance.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 3,850,000 - (2,500,000 - 0 - 200,006) \\ &= 1,550,006\end{aligned}$$

2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is almost identical to the previously calculated Funding shortfall:

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

2011 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. 100% times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments:

$$\begin{aligned}\text{S/F Amort base} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * 3,850,000 - (2,500,000 - 0 - 200,006) - (\text{PV of PY Amortizations}) \\ &= 3,850,000 - 2,299,994 - 25,000 * 5.2932 \\ &= 1,417,676\end{aligned}$$

You must calculate the shortfall amortization installment for 2011. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= 1,417,676 / 5.9982 \\ &= 236,350\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 236,350 + 25,000 \\ &= 261,350\end{aligned}$$

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. The shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Fall 2010 EA-2A Exam Solutions

Problem 23 – Page 3

Minimum Required Contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 300,000 + 261,350 + 0 \\ &= 561,350\end{aligned}$$

Smallest amount

The problem asks for “the smallest amount that satisfies the minimum funding standard”. Normally you would calculate this by offsetting the CB and the PB:

$$\text{Smallest contr} = \text{MRC} - \text{CB} - \text{PB}$$

Since the prior year’s “funding ratio” is less than 80%, you can not offset any balances. The “smallest amount” is the same as the previously calculated MRC, or 561, 350.

Answer is D

The answer sheet shows that credit was given for both answer C and answer D. The original version of the answer sheet showed that the “official answer” to the problem was based on knowing the calculation details under IRC 436. Now I will work through this problem solution taking IRC 436 into account.

2010 valuation results

2010 exam condition 27 states the plan sponsor's funding ratio for the prior year is at least 80%. This problem gives you the prior year's funding target attainment percentage (FTAP), so you should not rely on exam condition 27. You should check the 2010 "funding ratio" to be sure that the plan can apply the CB and the PB towards the MRC in 2011.

The “funding ratio” is defined in IRC 430(f)(3)(C). Let PB be the value of the prefunding balance:

$$\text{Funding ratio} = \frac{\text{AAV} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

The FTAP is defined in 430(d)(2):

$$\text{FTAP} = \frac{\text{AAV} - \text{CB} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

Since this plan has a zero carryover balance, the 2010 “funding ratio” is equal to the FTAP. Both are equal to 70%. This means that you can’t apply the CB (or PB) towards the 2011 MRC.

Fall 2010 EA-2A Exam Solutions

Problem 23 – Page 4

2011 Prefunding balance

The problem gives you the 2010 PB as 187,500. The plan sponsor did not increase the PB during 2010. You can calculate the value at 01/01/2011 by increasing the PB with the plan's rate of return on assets:

$$\begin{aligned} 01/2011 \text{ PB} &= (01/2010 \text{ PB})(1 + \text{asset return}) \\ &= 187,500 * (1.0667) \\ &= 200,006 \end{aligned}$$

2011 Adjusted Funding target attainment percentage

Since this plan offers a lump sum payment option, it is subject to the IRC 436(d) benefit restrictions on accelerated benefit distributions. In order for the plan to pay lump sum benefits, the Adjusted Funding target attainment percentage (AFTAP) must be at least 80%. If the AFTAP is between 60% and 80%, then the plan can make a partial lump sum payment to participants.

You need to calculate the AFTAP at 01/01/2011 to see if it satisfies IRC 436(d). The AFTAP is defined in IRC 436(j)(2), and it is similar to the funding target attainment percentage (FTAP) defined in 430(d)(2). The AFTAP has an adjustment for any non-HCE annuity purchases (NHAP) in the prior two years.

$$\text{AFTAP} = \frac{\text{NHAP} + \text{AAV} - \text{CB} - \text{PB}}{\text{NHAP} + \text{Funding Target (non At-Risk)}}$$

The problem tells you nothing about annuity purchases for prior years, so you can safely assume they are zero.

$$\begin{aligned} \text{AFTAP} &= \frac{0 + 2,500,000 - 0 - 200,006}{0 + 3,850,000} \\ &= 59.74\% \end{aligned}$$

Since the AFTAP is less than 60%, there may be a deemed reduction under IRC 436(f)(3). If it is possible to reduce the CB (and PB) enough to increase the AFTAP to 60%, then this reduction must occur as if the employer had elected to do so under IRC 430(f).

You should solve for the reduced PB that will increase the AFTAP to 60%.

$$\text{AFTAP} = \frac{0 + 2,500,000 - 0 - \text{PB}}{0 + 3,850,000} = 60.0\%$$

$$\begin{aligned} 01/2011 \text{ PB} &= 2,500,000 - 60.0\% * (3,850,000) \\ &= 190,000 \end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 23 – Page 5

The rest of the problem follows the original solution, with the reduced PB of 190,000.

2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance and the carryover balance.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 3,850,000 - (2,500,000 - 0 - 190,000) \\ &= 1,540,000\end{aligned}$$

2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is identical to the previously calculated Funding shortfall:

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

2011 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. 100% times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments:

$$\begin{aligned}\text{S/F Amort base} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * 3,850,000 - (2,500,000 - 0 - 190,000) - (\text{PV of PY Amortizations}) \\ &= 3,850,000 - 2,310,000 - 25,000 * 5.2932 \\ &= 1,407,670\end{aligned}$$

You must calculate the shortfall amortization installment for 2011. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= 1,407,670 / 5.9982 \\ &= 234,682\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 234,682 + 25,000 \\ &= 259,682\end{aligned}$$

Problem 23 – Page 6

Revised 08/03/12

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. The shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Minimum Required Contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 300,000 + 259,682 + 0 \\ &= 559,682\end{aligned}$$

Smallest amount

The problem asks for “the smallest amount that satisfies the minimum funding standard”. Normally you would calculate this by offsetting the CB and the PB:

$$\text{Smallest contr} = \text{MRC} - \text{CB} - \text{PB}$$

Since the prior year’s “funding ratio” is less than 80%, you can not offset any balances. The “smallest amount” is the same as the previously calculated MRC, or 559, 682.

Answer is C

NOTE

The key point of this problem appears to be knowledge of IRC 436, which was not a topic on the 2010 EA-2A exam syllabus. As a result, this question was identified as defective, and credit was given for both answers.

Problem 24 – Page 1**Revised 09/19/12**

The key to this problem is that you must know the gain / loss formulas. The problem asks for the mortality G/L due to the death of one retiree during 2011.

$$\begin{aligned}\text{Non-inv G/L} &= {}_eAL_1 - AL_1 \\ {}_eAL_1 &= (1+i)(AL_0 + NC_0) - (\text{actual benefit payments} + i)\end{aligned}$$

Since both participants are retired, the normal cost is zero. The first step is to determine the accrued liability at 01/01/2011:

01/01/2011	Smith	Jones
Age	65	65
Retirement age	65	65
Annual benefit	1,000	1,000

Smith and Jones both have the same accrued liability at 01/01/2011:

$$\begin{aligned}AL_0 &= 1,000 * [\ddot{a}_{\overline{10}|.07} + N_{75} / D_{65}] \\ &= 1,000 * [7.5152 + 33,380 / 10,000] \\ &= 10,853\end{aligned}$$

The expected accrued liability values for Smith and Jones at 01/01/2012 are also equal. Since the benefit is paid annually, they both have the same benefit payments during 2011:

$$\begin{aligned}{}_eAL_1 &= (1+i)(AL_0 + NC_0) - (\text{actual benefit payments} + i) \\ &= 1.07 * [10,853 + 0] * 2 - 1.07[1,000] * 2 \\ &= 21,086\end{aligned}$$

Jones and Smith have different accrued liability values at 01/01/2012. For Smith, the liability is a nine year certain annuity. For Jones, the liability is a nine year certain and life annuity.

Jones' Accrued Liability

To value Jones' liability, you need to determine the value of the life annuity at age 66:

$$AL_1 = 1,000 * [\ddot{a}_{\overline{9}|.07} + N_{75} / D_{66}]$$

You can derive the value of D_{66} by using the given values of q_x at ages 65 and 66:

$$\begin{aligned}D_{66} &= v^{66} l_{66} \\ D_{65} &= v^{65} l_{65}\end{aligned}$$

Problem 24 – Page 2**Revised 09/19/12****Jones' Accrued Liability - continued**

$$\begin{aligned} D_{65} / D_{66} &= (1+i) / p_{65} \\ D_{66} &= D_{65} (v^1 p_{65}) \\ &= 10,000(.99/1.07) \\ &= 9,252 \end{aligned}$$

$$\begin{aligned} AL_1 &= 1,000*[\ddot{a}_{9|.07} + N_{75} / D_{66}] \\ &= 1,000*[6.9713 + 33,380 / 9,252] \\ &= 10,579 \end{aligned}$$

Smith's Accrued Liability

$$\begin{aligned} AL_1 &= 1,000*[\ddot{a}_{9|.07}] \\ &= 1,000*[6.9713] \\ &= 6,971 \end{aligned}$$

The mortality gain / loss is the difference between actual and expected AL. This is a gain of $3,536 = 21,086 - (10,579 + 6,971)$.

Answer is A

There is an alternate method for working this problem. You can ignore the annuity payments during the period certain. The reason is that these payments will be made whether the retiree lives or dies, so they do not change the amount of mortality gain / loss.

$$\begin{aligned} AL_0 &= 1,000*[\text{zero} + N_{75} / D_{65}] && \text{(ignoring period certain benefits)} \\ &= 1,000*[33,380/10,000] \\ &= 3,338 \end{aligned}$$

$$\begin{aligned} {}_eAL_1 &= (1+i)(AL_0 + NC_0) - (\text{actual benefit payments} + i) \\ &= 1.07*[3,338]*2 - \text{zero} && \text{(ignoring period certain benefits)} \\ &= 7,143 \end{aligned}$$

$$\begin{aligned} AL_1 &= 1,000*[\text{zero} + N_{75} / D_{66}] && \text{(ignoring period certain benefits)} \\ &= 1,000*[33,380 / 9,252] \\ &= 3,608 \end{aligned}$$

The mortality gain / loss is the difference between actual and expected AL. This is a gain of $3,536 = 7,143 - 3,608$. As expected, this is exactly the same numerical answer previously calculated.

Fall 2010 EA-2A Exam Solutions

Problem 25

This problem is a simple one on selection of funding assumptions.

ASSERTION

This is false. If a participant has post-retirement medical benefits, they would be more likely to retire early. This will increase the cost of the pension benefits.

REASON

This is true. The post-retirement medical benefits are funded separately from the pension benefits.

Answer is D

Fall 2010 EA-2A Exam Solutions

Problem 26 – Page 1

There one key idea to this problem, which is calculation of the plan lump sum value. The problem states that Smith terminates on 01/01/2011 and elects to receive a lump sum. The plan lump sum should be calculated based on the plan assumptions for actuarial equivalence.

In this problem, the plan actuarial equivalence assumptions are the same as those for the minimum lump sum under 417(e)(3). This calculation is similar to the Funding target calculation under IRC 430. It is based on a modified set of segment rates, as defined in 417(e)(3)(D).

At 01/01/11	Smith
Termination age	45
Past service	15 years

Plan benefit

The participant's accrued benefit at age 45 is a quick calculation:

$$\begin{aligned}\text{Accrued benefit} &= 15(12)(100) \\ &= 18,000\end{aligned}$$

Plan lump sum

Now you can calculate the lump sum based on the plan's assumptions for actuarial equivalence. This calculation uses the modified segment interest rates under 417(e). See the note at the end of the solution for additional discussion of the segment rates under 417(e)(3).

Under PPA 2006, you would calculate the present value of a stream of annual benefit payments for a life annuity payable to a person age x (currently in pay status) as follows:

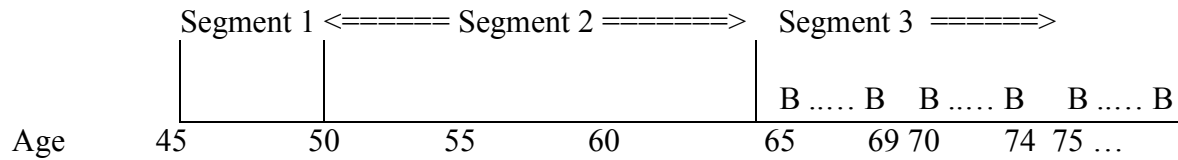
$$\begin{aligned}\text{Present value} &= \sum_{t=0}^4 (1.05)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &\quad + \sum_{t=5}^{19} (1.06)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &\quad + \sum_{t=20}^{\omega-x} (1.07)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t})\end{aligned}$$

The 417(e) lump sum is calculated in a similar manner to the Funding Target under IRC 430. The Funding Target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability.

Fall 2010 EA-2A Exam Solutions

Problem 26 – Page 2

The participant is currently 20 years from retirement, so their benefit payments will be valued using the third segment rate:



Here is the formula for the lump sum using monthly annuity rates:

$$\text{Age 45 LS} = 18,000 * {}_{20|}\ddot{a}_{45 \text{ seg}_3}^{(12)}$$

Now you need to express this annuity in terms of commutation functions:

$$\begin{aligned} {}_{20|}\ddot{a}_{45 \text{ seg}_3}^{(12)} &= (v^{20} {}_{20}p_{45}) \ddot{a}_{65 \text{ seg}_3}^{(12)} && \text{all at segment 3 rate} \\ &= (1.07)^{-20} * (N_{65}^{(12)} / D_{65}) && \text{all at segment 3 rate} \end{aligned}$$

There is one small trick to the calculation, which is that the plan's actuarial equivalence definition has no pre-retirement mortality. That is why the lump is calculated using an interest-only discount prior to age 65.

$$\begin{aligned} \text{Age 45 LS} &= 18,000(.2584)(\frac{116,222}{11,387}) \\ &= 47,476 \end{aligned}$$

Answer is B

NOTE

Even though the problem does not clarify how the 417(e) rates were determined, they must reflect the phase-in from the 30 year Treasury rate to the three segment rates for the yield curve.

It would be more difficult if you were given the unadjusted segment rates and the 30 year Treasury rate. The first step would be to allow for the phase-in rule. The second step would be the lump sum calculation.

The phase-in rule grades in the effect of the yield curve by combining 20% of the segment rates with 80% of the 30 year Treasury rate for 2008. For each year from 2009 through 2011, the percentage weight for the segment rates increases by an additional 20%, and the weight for the Treasury rate decreases by 20%. In 2012, the transition rule is gone, and the present value calculation is solely based on the segment interest rates.

Fall 2010 EA-2A Exam Solutions

Problem 27 – Page 1

Similar to 2006 #23

Revised 07/31/13

The problem asks for the "smallest amount" at 12/31/2011. Based on exam condition 31, the "smallest amount" reflects offsetting the funding standard account credit balance (CB) against the minimum contribution.

You need to use the actuarial equation of balance to solve for the UAL. Then you can determine the FIL normal cost, and the minimum contribution.

$$01/01/11 \text{ UAL} = \text{O/S 431 bases} - \text{CB} - \text{ARA}$$

The plan effective date is 01/01/1983. There are only 2 years left in the initial accrued liability base at 01/01/2011:

$$\begin{aligned} \text{O/S 431 base} &= 5,000,000 * (\ddot{a}_{2|.07} / \ddot{a}_{30|.07}) \\ &= 728,508 \end{aligned}$$

$$\begin{aligned} \text{UAL} &= 728,508 - 400,000 - 0 \\ &= 328,508 \end{aligned}$$

$$\begin{aligned} \text{PVNC} &= \text{PVFB} - \text{AAV} - \text{UAL} \\ &= 35,000,000 - 30,000,000 - 328,508 \\ &= 4,671,492 \end{aligned}$$

$$\begin{aligned} \text{PVE/E} &= 80,000,000 / 8,000,000 \\ &= 10.0 \end{aligned}$$

$$\begin{aligned} \text{NC} &= 4,671,492 / 10.0 \\ &= 467,149 \end{aligned}$$

To set up the MFSA, you need to determine the amortizations for the 431 bases. There is only the IAL base, which had a 30 year amortization period:

$$\begin{aligned} \text{IAL amort} &= 5,000,000 / \ddot{a}_{30|.07} \\ &= 376,572 \end{aligned}$$

(next page)

Fall 2010 EA-2A Exam Solutions

Problem 27 – Page 2

Now you can set up the MFSA and calculate the 12/31/11 “smallest amount”:

2011 Minimum Funding Standard Account			
Charges		Credits	
Normal Cost	467,149	Credit Balance	400,000
IAL amortization	376,572	12/31 minimum	x
7% interest	59,060	7% interest	28,000
Total charges	902,782	Total credits	x + 428,000

The “smallest amount” at 12/31/11 is $474,782 = 902,782 - 428,000$. This includes interest to 12/31, and reflects offsetting the credit balance against the minimum contribution.

Answer is C

Problem 28 – Page 1

Revised 09/07/18

The IRS released Notice 2009-22 in March 2009. It includes two detailed examples of the asset valuation method in IRC 430(g)(3), which include determination of the adjustment for expected earnings. The first example is very similar to the one in the 1.430(g)-1 proposed regulation. It is essentially a three year average market value calculation. The second example shows calculation of the average market value over the four prior quarters of the plan year.

There are two calculation techniques shown for the first example in Notice 2009-22. The first one requires calculation of the adjusted cash flows, which are used to adjust market values from prior dates up to the valuation date. Then the average market value is calculated. The final actuarial value of assets must be limited to be within 10% of the market value.

The second calculation method in Notice 2009-22 is based on the technique shown in Revenue Procedure 2000-40. The actuarial value of assets is calculated using decreasing fractions of each of the prior year's gain or loss. The alternate calculation is shown at the end of this solution.

This problem states the AAV uses the average market value over three years. The first step is calculation of the adjusted cash flows, which are used to adjust market values from prior dates up to the valuation date.

You must calculate the expected return each year. The problem states that the actuary's assumed annual rate of return on assets is 7.5%. As described in Notice 2009-22, you must limit the assumed return on assets so it does not exceed the third segment rate at each valuation date. The result is that the assumed rate of return is limited to 7.0% each year.

Based on the 7.0% assumed return, you can calculate the expected return on assets for 2009 and 2010. The calculation is very simple, since there are no cash flows during the year. There is no expected interest on the benefit payments, since they occur at 12/31:

Expected return calculation	7.00%	7.00%
Plan year	2009	2010
Beginning of year values		
Market value at 1-1	2,100,000	2,200,000
END of year values		
Benefit payments + expenses	(50,000)	(50,000)
Expected return (compound)	147,000	154,000

Problem 28 – Page 2**Revised 09/07/18**

Now you can calculate the cash flow adjustment each year. This is the sum of the cash flows and the expected return:

Adjustment for year

Year	2009	2010
Trust assets at 1-1	2,100,000	2,200,000
Market value at 1-1	2,100,000	2,200,000
Receivable contribution	-	-
Benefit payments	(50,000)	(50,000)
Expenses	-	-
Expected return (compound)	<u>147,000</u>	<u>154,000</u>
Adjustment for year	97,000	104,000

Now you can calculate the adjusted market values. Each prior year's market value must be increased to reflect cash flows and expected interest from the date the market value is determined up to 01/01/2011:

Average market value calculation

Year	2009	2010	2011
Market value at 1-1	2,100,000	2,200,000	1,900,000
Adjustment for 2009	97,000		
Adjustment for 2010	<u>104,000</u>	<u>104,000</u>	
Adjusted fair market value	2,301,000	2,304,000	1,900,000

The preliminary actuarial asset value (AAV) is the average of the three adjusted market values:

$$2,168,333 = (2,301,000 + 2,304,000 + 1,900,000) / 3.$$

This preliminary actuarial asset value of 2,168,333 must be compared to the corridors. The final AAV must be limited to be within 10% of the market value.

The bottom of the corridor is 90% of market value, or 1,710,000. The top of the corridor is 110% of market value, or 2,090,000. The final actuarial value of assets is 2,090,000.

The increase in the actuarial value of assets due to the method change is 190,000, which equals 2,090,000 minus 1,900,000.

Minimum Required Contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\text{MRC} = \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge}$$

The problem states that there have been no prior shortfall amortization installments. As a result the shortfall amortization charge is equal to the 2011 shortfall amortization installment. You need to determine the impact of the change in asset valuation method on the 2011 shortfall amortization base.

2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance and the carryover balance.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 2,100,000 - (\text{AAV} - 12,000 - 0)\end{aligned}$$

The AAV is less than 2,100,000 both before and after the method change. The change in the funding shortfall is equal to change in the AAV, or 190,000:

$$\Delta \text{Funding S/F} = 190,000$$

You are given the shortfall amortization factor for 2011:

$$\begin{aligned}\Delta \text{S/F amort} &= 190,000/5.9982 \\ &= 31,676\end{aligned}$$

Answer is D

NOTE

There is an alternative solution for this problem. You can use an asset valuation technique from Revenue Ruling 2000-40 (pre-PPA 2006), and produce exactly the same AAV.

Method 15 - Smoothed market value without phase-in

The actuarial value of assets equals the market value less a decreasing fraction (i.e., $[n-1]/n$, $[n-2]/n$, etc. where n is the number of years in smoothing period) of the G/L for each of the prior $n-1$ years. The G/L is defined as the difference between the expected value and market value of assets at the valuation date. The expected value is calculated by bringing forward all cash flows with interest at the valuation rate up to this year's valuation date. If the expected value is less than the market value, the difference is a gain (and vice versa).

Problem 28 – Page 4**Revised 06/24/12**

The actuarial value of assets is calculated using decreasing fractions of each of the prior year's gain or loss. The problem states that the averaging period is 3 years. With a three year average, the fractions are 2/3 and 1/3:

$$01/11 \text{ AAV} = 01/2011 \text{ MVA} - 2/3(2010 \text{ G/L}) - 1/3(2009 \text{ G/L})$$

You need to calculate the values of the G/L for both 2010 and 2009. This is the difference between the expected values (previously calculated) and the actual market values given.

So the first thing you need to calculate is the expected MVA each year. The calculation uses the same numbers as the adjustment for the year. The 12/31 expected MVA equals the sum of the 01/01 MVA and the adjustment for the year:

$$\begin{aligned} 01/2010 \text{ eMVA} &= 01/2009 \text{ MVA} + \text{adjustment for 2009} \\ 2,197,000 &= 2,100,000 + 97,000 \end{aligned}$$

$$\begin{aligned} 01/2011 \text{ eMVA} &= 01/2010 \text{ MVA} + \text{adjustment for 2010} \\ 2,304,000 &= 2,200,000 + 104,000 \end{aligned}$$

$$\begin{aligned} 2009 \text{ G/L} &= 01/2010 \text{ MVA} - 01/2010 \text{ eMVA} \\ &= 2,200,000 - 2,197,000 \\ &= 3,000 \quad (\text{Gain}) \end{aligned}$$

$$\begin{aligned} 2010 \text{ G/L} &= 01/2011 \text{ MVA} - 01/2011 \text{ eMVA} \\ &= 1,900,000 - 2,304,000 \\ &= -404,000 \quad (\text{Loss}) \end{aligned}$$

$$\begin{aligned} 01/11 \text{ AAV} &= 01/11 \text{ MVA} - 2/3(2010 \text{ G/L}) - 1/3(2009 \text{ G/L}) \\ &= 1,900,000 - (2/3)(-404,000) - (1/3)(3,000) \\ &= 2,168,333 \end{aligned}$$

This preliminary actuarial asset value of 2,168,333 must be compared to the corridors. The top of the corridor is 110% of market value, or 2,090,000. The final actuarial value of assets is 2,090,000.

This is identical to the earlier result calculated using the method in Notice 2009-22.

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Problem 29

Revised 10/10/13

This problem is a fairly simple question on selection of actuarial assumptions.

I. TRUE

This is basically a direct quote from IRC 430(h)(1).

II. FALSE

The definition of actuarial assumptions is essentially the same for single employer plans and multiemployer plans. Under PPA 2006, each assumption must be reasonable.

See IRC 431(c)(3)

III. FALSE

In IRC 430(h), it states that all plans must use pre-retirement mortality. This requirement goes against common practice for small plans, which often use no pre-retirement mortality.

The final regulations allow use of no pre-retirement mortality for certain small plans. This option is only allowed for plans with less than 100 participants who are not in pay status. That means that pre-retirement mortality must be assumed for plans with 100 or more participants who are not in pay status.

The statement given is false for two reasons. The threshold is incorrect, and it is not based on all participants.

Only item I is true.

Answer is B

Fall 2010 EA-2A Exam Solutions

Problem 30 – Page 1

Similar to 2008 #5

In general, the Top Heavy (T-H) determination date is the last day of the preceding plan year. An exception to this is the first plan year, when the determination date is the last day of the first plan year. To determine if the defined benefit plan is T-H for the 2011 plan year, the determination date would be December 31, 2010.

Based on questions T-24 and T-25 of the 1.416 regulation, the present value of accrued benefits for the DB plan (or account balance for the DC plan) is calculated as of the valuation date in the 12 month period ending on the determination date. This problem is a bit simpler than some others on IRC 416, since you are not given any information regarding valuation dates.

You should add together the present value of vested and non-vested accrued benefits and the account balances as of the determination date for all participants and the key employees. The amounts should exclude values for terminated employees who have not been employed in the 12 months ending on the determination date, or values for former key employees.

These amounts should include distributions (including benefit payments) within the 12 months ending on the determination date. These amounts should also include any in-service distributions within the 5 years ending on the determination date.

One of three definitions must be satisfied for an employee to be a key employee. They would have to satisfy at least one of these definitions within the 12 month period ending on the determination date:

- (i) Officer with 2010 compensation > 160,000 (2010 value)
- (ii) Someone with more than 5% of the stock ownership
- (iii) Someone with more than 1% of the stock ownership with pay > 150,000

Employee 1 is a key employee, based upon stock ownership. Employee 3 is a key employee, based upon stock ownership and pay in excess of 150,000.

Since employee 2 did not have any ownership during 2010, they are no longer a key employee. Employee 2 satisfies the definition of a “former key employee”. As such, they should be excluded completely from the T-H ratio calculation.

You are told that there are rollover account balances for several employees. The key point of the problem is whether you know how to handle this rollover information. This is the second exam question regarding rollovers under IRC 416.

The handling of rollovers is covered in the 1.416 regulation, at question T-32. The general rule is that a plan which receives unrelated rollovers ignores the rollover accounts for T-H testing under IRC 416. The plan making the unrelated rollovers would include the rollover accounts for T-H testing under IRC 416.

Fall 2010 EA-2A Exam Solutions

Problem 30 – Page 2

Based on the fact that the rollovers come from a plan of another employer, they satisfy the definition of an “unrelated rollover”. That means you should ignore the rollover information for T-H testing.

One minor trick to the question is that the data given already includes the value of the unrelated rollovers. You must subtract those values prior to calculating the T-H ratio. As described earlier, you should exclude employee 2 from the calculations, since they are a “former key employee”.

	Key?	DB Plan PV of AB	Unrelated Rollover	Difference
Employee 1	Yes	450,000	0	450,000
Employee 2	No	N/A	N/A	N/A
Employee 3	Yes	200,000	0	200,000
Employee 4	No	100,000	75,000	25,000
Other 25 ees	No	400,000	0	400,000

The Top heavy ratio is

$$60.5\% = 650,000 / (650,000 + 425,000)$$

Answer is D

NOTES:

1. The fact that employees 1, 2 and 3 are officers does not affect their status as a key employee in this problem. If they were not owners, then the problem would have to give you compensation values to determine if they were key employees.
2. In IRC 416(i), there is a limit on the number of officers counted as key employees. No more than 50 employees (or, if less, the greater of 3 employees or 10% of all employees) shall be treated as officers. This limit has never been tested on prior EA exams.

Fall 2010 EA-2A Exam Solutions

Problem 31 – Page 1

This is the second question asked on the WRERA changes to the definition of the Target normal cost in IRC 430(b)(1). Those changes allow for the addition of expected plan-related expenses and the subtraction of expected mandatory employee contributions.

The problem asks for the "smallest amount" at 01/01/11. Based on 2010 exam conditions 26 and 27, the plan sponsor elects to offset both the CB and the PB against the minimum contribution under IRC 430. Based on exam condition 31, the "smallest amount" reflects offsetting both the CB and the PB against the minimum required contribution (MRC).

Funding Shortfall

The first step is calculation of the funding shortfall. If this amount is zero, then the definition of the minimum required contribution (MRC) will be different:

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 5,200,000 - (5,500,000 - 200,000 - 500,000) \\ &= 400,000\end{aligned}$$

2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is almost identical to the previously calculated Funding shortfall:

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

2011 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. 100% times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments:

$$\begin{aligned}\text{S/F Amort base} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * 5,200,000 - (5,500,000 - 200,000 - 500,000) - (\text{PV of PY Amortizations}) \\ &= 5,200,000 - 4,800,000 - \text{zero} \\ &= 400,000\end{aligned}$$

The problem states that the plan was exempt from setting up shortfall amortization bases prior to 2011.

Fall 2010 EA-2A Exam Solutions

Problem 31 – Page 2

You must calculate the shortfall amortization installment for 2011. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= 400,000 / 5.9982 \\ &= 66,687\end{aligned}$$

$$\text{S/F charge} = 66,687$$

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. The shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Target normal cost

The problem states that there are 27,500 of expected plan-related expenses:

$$\begin{aligned}\text{01/2011 TNC} &= 350,000 + 27,500 \text{ expenses} \\ &= 377,500\end{aligned}$$

Minimum Required Contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 377,500 + 66,687 + 0 \\ &= 444,187\end{aligned}$$

Smallest amount

The problem asks for “the smallest amount that satisfies the minimum funding standard”.

$$\text{Smallest contr} = \text{MRC} - \text{CB} - \text{PB}$$

One minor trick to the problem is that the plan sponsor elects to apply the entire CB, but only 150,000 of the PB towards the MRC.

$$\begin{aligned}\text{Smallest contr} &= \text{MRC} - \text{CB} - \text{PB} \\ &= 444,187 - 200,000 - 150,000 \\ &= 94,187\end{aligned}$$

Answer is E

Fall 2010 EA-2A Exam Solutions

Problem 32 – Page 1

The key to this problem is the calculation of the Funding target under IRC 430(d). In addition, you must know the additional assumptions required for calculating the At-Risk Funding target under IRC 430(i).

Valuation calculations

You need to determine values for the regular Funding target and the At-Risk Funding target at 01/01/2011. The problem gives the annual accrued benefit as 10,000 at 01/01/2011. Based on the 01/01/1956 birth date, Smith is age 55.

Segment Interest Rates

The next step is calculation of present values using segment interest rates. Under PPA 2006, you would calculate the present value of a stream of annual benefit payments for a life annuity payable to a person age x (currently in pay status) as follows:

$$\begin{aligned} \text{Present value} &= \sum_{t=0}^4 (1.0500)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=5}^{19} (1.0600)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=20}^{\omega-x} (1.0700)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \end{aligned}$$

You can write the present value formula in terms of annual annuities:

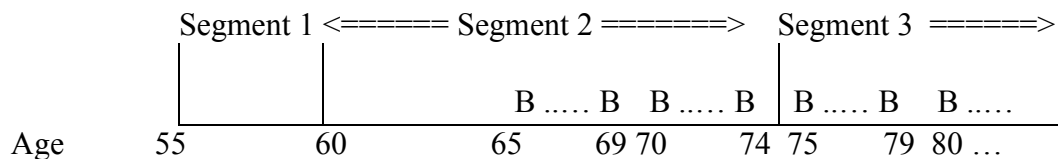
$$\text{Age } x \text{ PV} = \text{Benefit} \{ \ddot{a}_{x:\overline{5}|} \text{ at } 5.0\% + (1.06)^{-5} ({}_5 p_x) \ddot{a}_{x+5:\overline{15}|} \text{ at } 6.0\% + (1.07)^{-20} ({}_{20} p_x) \ddot{a}_{x+20} \text{ at } 7.0\% \}$$

Non At-Risk Funding Target

The Funding Target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability.

Based on the default exam conditions, normal retirement age is 65, and the benefit is assumed payable monthly, starting at normal retirement age.

The participant is currently 10 years from retirement, so their benefit payments will be valued using the second and third segment rates:



Fall 2010 EA-2A Exam Solutions

Problem 32 – Page 2

Non At-Risk Funding Target - continued

The second segment covers benefit payments from age 65 up through age 74 (10 years). Since normal retirement age is 65, there are 10 years of benefit payments valued using the second segment rate. The third segment rate is used to value benefit payments at and after age 75.

The calculation of the Funding target uses the accrued benefit. Here is the formula for the Funding target using monthly annuity rates:

$$\text{Age 55 FT} = 10,000 * [{}_{10|} \ddot{a}_{55:\overline{10}|}^{(12)} \text{seg}_2 + {}_{20|} \ddot{a}_{55 \text{ seg}_3}^{(12)}]$$

Notice that the second annuity actually starts 20 years from the valuation date. Now you need to express these annuities in terms of commutation functions.

One important aspect of the problem is that the pre-retirement mortality and post-retirement mortality are the same. This means you can simply use the commutation functions to do all present value calculations, even prior to benefit commencement age.

$$\begin{aligned} {}_{10|} \ddot{a}_{55:\overline{10}|}^{(12)} &= (v^{10} {}_{10}p_{55}) \ddot{a}_{65:\overline{10}|}^{(12)} && \text{all at segment 2 rate} \\ &= (N_{65}^{(12)} - N_{75}^{(12)}) / D_{55} && \text{all at segment 2 rate} \end{aligned}$$

$$\begin{aligned} {}_{20|} \ddot{a}_{55 \text{ seg}_3}^{(12)} &= (v^{20} {}_{20}p_{55}) \ddot{a}_{75 \text{ seg}_3}^{(12)} && \text{all at segment 3 rate} \\ &= N_{75}^{(12)} / D_{55} && \text{all at segment 3 rate} \end{aligned}$$

$$\begin{aligned} \text{Age 55 FT} &= 10,000 \left[\frac{(231,910 - 81,453)}{39,470} + \frac{38,046}{23,550} \right] \\ &= 10,000 [3.8119 + 1.6155] \\ &= 54,275 \end{aligned}$$

At-Risk Funding Target

The problem asks for the At-Risk Funding target (prior to the phase-in calculation). The At-Risk Funding target is based on the assumption that all participants who become eligible for retirement within 11 years from the valuation date will retire at the earliest possible age (but not before the end of the current plan year). In addition, the Funding target must be based on the most valuable benefit payment form (the one with the highest present value).

Fall 2010 EA-2A Exam Solutions

Problem 32 – Page 3

At-Risk Funding Target - continued

The participant is eligible for retirement at age 55, but you do not use an assumed retirement age before the end of the plan year. The At-Risk Funding target is based on the early retirement benefit, assumed payable at age 56. The accrued benefit is reduced by 3% per year prior to age 65:

$$\begin{aligned}\text{Age 56 ben} &= 10,000 * (1 - 3\%(65-56)) \\ &= 7,300\end{aligned}$$

The participant is currently one year from retirement, so their benefit payments will be valued using all three segment rates:

	Segment 1 <=====				Segment 2 =====>				Segment 3 =====>					
	B B				B B B B B B				B B B					
Age	55	56	...	59	60		65	69	70	74	75	79	80	...

$$\text{At-Risk FT} = 7,300 * [{}_1| \ddot{a}_{55:4| \text{seg}_1}^{(12)} + {}_5| \ddot{a}_{55:15| \text{seg}_2}^{(12)} + {}_{20}| \ddot{a}_{55 \text{seg}_3}^{(12)}]$$

Now you need to express these annuities in terms of commutation functions.

$$\begin{aligned}{}_1| \ddot{a}_{55:4| \text{seg}_1}^{(12)} &= (v^1 {}_1p_{55}) \ddot{a}_{56:4| \text{seg}_1}^{(12)} && \text{all at segment 1 rate} \\ &= (N_{56}^{(12)} - N_{60}^{(12)}) / D_{55} && \text{all at segment 1 rate}\end{aligned}$$

$$\begin{aligned}{}_5| \ddot{a}_{55:15| \text{seg}_2}^{(12)} &= (v^5 {}_5p_{55}) \ddot{a}_{60:15| \text{seg}_2}^{(12)} && \text{all at segment 2 rate} \\ &= (N_{60}^{(12)} - N_{75}^{(12)}) / D_{55} && \text{all at segment 2 rate}\end{aligned}$$

$$\begin{aligned}{}_{20}| \ddot{a}_{55 \text{seg}_3}^{(12)} &= (v^{20} {}_{20}p_{55}) \ddot{a}_{75 \text{seg}_3}^{(12)} && \text{all at segment 3 rate} \\ &= N_{75}^{(12)} / D_{55} && \text{all at segment 3 rate}\end{aligned}$$

$$\begin{aligned}\text{At-Risk FT} &= 7,300 [\frac{(919,914 - 691,251)}{66,478} + \frac{(356,431 - 81,453)}{39,470} + 1.6155] \\ &= 7,300 [3.4397 + 6.9668 + 1.6155] \\ &= 87,760\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 32 – Page 4

At-Risk Funding Target - continued

The final trick to this question is applying the load factors for the At-Risk Funding target. This is clearly defined in 2010 exam condition 43:

The terms “at-risk funding target” and “at-risk target normal cost” mean the funding target and target normal cost calculated reflecting additional actuarial assumptions and loading factors (if applicable) for a plan in at-risk status prior to the application of any five-year transition as described in IRC section 430(i)(5).

IRC 430(i)(1)(A) defines the load factors that are used in calculating the Funding target and the Target normal cost on an At-Risk basis. The Funding target equals the sum of

- PV of all benefits accrued or earned under the plan
 - As of the beginning of the plan year
 - Using assumptions in 430(i)(1)(B), plus
- For plans in At-risk status for at least 2 of the 4 preceding plan years, a loading factor of \$700 per participant, plus 4% of the Funding target, ignoring 430(i) rules

The plan has previously been determined to be in At-Risk status for 2008 through 2010, so both of the additional load factors should be applied:

Funding target using 430(i)(1)(B) assump	87,760
4% load	2,171 = 4%*54,275
Per participant load	<u>700</u> = 700*1
At-Risk Funding target	90,631

Now you can calculate the difference between the non-At-Risk Funding target and the At-Risk Funding target. The difference is $36,356 = 90,631 - 54,275$.

Answer is C

Problem 33

Revised 10/22/12

This problem is a tricky one on the definition of deductible limit and the cushion amount.

ASSERTION

This is false - but the explanation is not very simple.

Since both the Funding target and the Target normal cost are the same for both plans, it appears the deductible limit is equal for both plans. The only way that Plan A's deductible limit could be larger is if the calculation of the Cushion amount is different for the two plans.

The Cushion amount is defined as the sum of two pieces: (1) 50% of the Funding target, and (2) the increase in the Funding target due to allowing for future pay increases. You can think of the second item as the excess of the Projected Unit Credit accrued liability over the Traditional Unit Credit accrued liability.

Since Plan A's benefits are pay-related, it seems like the Cushion amount for Plan A would be greater than that for Plan B. But that is not necessarily true. There is one special case where Plan A could not allow for future salary increases:

- All participants in Plan A are at or above the 404(l) limit (same as 401(a)(17) limit), and
- The plan is not covered by the PBGC, so you can not project future increases in the 404(l) limit. Unlike the spring exam, there is no default exam condition that states the plan is covered by the PBGC.

REASON

This is true. The benefit formula for Plan B is not pay-related. As a result, you can not reflect future pay increases in the calculation of the cushion amount.

Answer is D

NOTE

There is a second explanation why the assertion is false, which is based on the alternative "At-Risk" deductible limit (only calculated for non-At-Risk plans). Assume Plan B has a subsidized early retirement benefit (but Plan A does not), and some participants are eligible to retire within the next 11 years.

The non-At-Risk calculations of the Target normal cost and Funding target do not include the subsidized early retirement benefit, since they are based on assumed retirement at age 65. The At-Risk calculations must include the value of the subsidized early retirement benefit, based on the earliest possible benefit commencement date (but not before the end of the plan year). A very large impact could cause the final deductible limit for Plan B to exceed that value for Plan A.

Fall 2010 EA-2A Exam Solutions

Problem 34 – Page 1

The key to this problem is figuring out what the question is actually asking for. Apparently it is not the 2015 target normal cost of 33,000. It is also not the Target normal cost using At-Risk assumptions of 40,000.

The only logical conclusion is that the correct answer is the At-Risk Target normal cost using the At-Risk assumptions, and also allowing for the phase-in calculation. But the first step is to determine if the plan is in At-Risk status for 2015.

The problem gives you the information required to determine which prior years the plan was in At-Risk status. You must know the definition for a plan to be in At-Risk status. One part of the definition is that a plan must have at least 501 participants for one day of the prior plan year. The problem states that the plan has always had at least 600 participants.

The second part of the definition is based on values of the Funding target attainment percentage (FTAP) for the prior year. A plan is At-Risk for a year if

1. The FTAP for the prior year (on a non-At-Risk basis) is less than 80%, and
2. The FTAP for the prior year (using 430(i)(1)(B) assumptions) is less than 70%

There is a transition rule which reduces the 80% for years prior to 2011. The plan years in this problem fall after the expiration of the transition rule, so you can ignore it. The FTAP is defined as the ratio of the plan assets (reduced by PB and CB) to liabilities:

$$\text{FTAP (non At-Risk)} = \frac{\text{AAV} - \text{CB} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

$$\text{FTAP using 430(i)(1)(B)} = \frac{\text{AAV} - \text{CB} - \text{PB}}{\text{Funding Target (430(i)(1)(B))}}$$

Valuation date	01/01/2012	01/01/2013	01/01/2014
AAV	940,000	900,000	880,000
CB / PB	Assumed 0	Assumed 0	Assumed 0
AAV - CB	940,000	900,000	880,000
FT - non-At-Risk	1,000,000	1,200,000	1,150,000
FTAP non-At-Risk	94.0% = 940/1,000	75.0% = 900/1,200	76.5% = 880/1,150
FT - 430(i)(1)(B)	1,300,000	1,500,000	1,450,000
FTAP 430(i)(1)(B)	72.0% = 940/1,300	60.0% = 900/1,500	60.7% = 880/1,450
At-Risk status for following plan year?	NO	YES	YES

Fall 2010 EA-2A Exam Solutions

Problem 34 – Page 2

IRC 430(i)(1)(A) defines the load factors that are used in calculating the Funding target and the Target normal cost on an At-Risk basis. The Target normal cost equals the sum of

- PV of the benefit accrual during the plan year
 - As of the beginning of the plan year
 - Using assumptions in 430(i)(1)(B), plus
- For plans in At-risk status for at least 2 of the 4 preceding plan years, a loading factor of 4% of the Target normal cost, ignoring 430(i) rules

The problem states that the plan was not in At-Risk status for 2011 or for 2012. The plan is in At-Risk status for both the 2014 and 2015 plan years.

Since the plan was not in At-Risk status for at least two plan years prior to 2015, the 4% load factor does not apply.

At-Risk plan - Weighting factors

IRC 430(i)(5) defines weighting factors that are used in calculating the “final values” of the Funding target and the Target normal cost on an At-Risk basis:

Consecutive years plan has been in at-risk status	Percent of item based on 430(i) rules	Percent of item ignoring 430(i) rules
1	20%	80%
2	40%	60%
3	60%	40%
4	80%	20%
5	100%	zero

The plan is in At-Risk status for 2014 through 2015, for two consecutive years. The “Final” At-Risk value will equal the sum of 40% times the At-Risk value and (1-40%) times the non-At-Risk value:

$$\begin{aligned}\text{Target normal cost} &= 40\%*(40,000) + 60\%*(33,000) \\ &= 35,800\end{aligned}$$

Answer is B

Fall 2010 EA-2A Exam Solutions

Problem 35 – Page 1

Similar to 2007 #34

This problem asks for the “change in liability” due to the change in assumptions. This wording of the question seems intentionally vague. Since the cost method is Unit Credit, the best interpretation is that you should calculate the change in the Unit Credit accrued liability.

The Unit Credit accrued liability is defined as the present value of the actual accrued benefit. The key to this problem is handling the multiple retirement decrements correctly in calculating the Accrued liability as an active employee.

01/01/2011 data

Description

Age 55
Past service 10

There are two different sets of assumptions. Under the old assumptions, there are two early retirement decrements at ages 55 and 62. Under the new assumptions, there is one early retirement decrement at age 62. With multiple retirement decrements, the accrued liability must be calculated as a complicated summation:

$$AL = \sum_{t=0}^{10} v^t p_{55+t}^{(T)} q_{55+t}^{(r)} (ER \text{ Ben})_{55+t} \ddot{a}_{55+t}^{(12)}$$

This problem is somewhat simplified, since the early retirement benefit is unreduced. The first step is to calculate the participant’s accrued benefit at the valuation date:

$$\begin{aligned} \text{Accd ben} &= 12(40)(10) \\ &= 4,800 \end{aligned}$$

Accrued Liability - Old Assumptions

The second step is to calculate the Accrued Liability under the old assumptions. You only need to do calculations at the ages with retirement decrements:

	(1)	(2)	(3)		(4)	(5)	(6)	
t	<u>55+t</u>	<u>v^t</u>	<u>_tp^(T)₅₅</u>	<u>q^(r)_{55+t}</u>	<u>p^(T)_{55+t}</u>	<u>ERB_{55+t}</u>	<u>$\ddot{a}^{(12)}_{55+t}$</u>	<u>(1)(2)(3)(4)(5)</u>
0	55	1.000	1.000	0.10	0.90	4,800	11.10	5,328
7	62	.6028	0.900	0.25	0.75	4,800	9.86	6,419
10	65	.4852	0.675	1.00	0.00	4,800	9.25	<u>14,541</u>
								26,288

The column which shows the one year probability of survival is not used in the summation. But it is used to develop the value of column 2 at the next calculation age.

Fall 2010 EA-2A Exam Solutions

Problem 35 – Page 2

Accrued Liability - New Assumptions

The third step is to calculate the Accrued Liability under the new assumptions. One minor trick to the problem is that the annuity values are also different under the new assumptions:

	(1)	(2)	(3)		(4)	(5)	(6)
t	$55+t$	v^t	${}_tP_{55}^{(T)}$	${}_tq_{55+t}^{(r)}$	${}_tP_{55+t}^{(T)}$	ERB_{55+t}	$\ddot{a}_{55+t}^{(12)}$
7	62	.6028	1.000	0.30	0.70	4,800	10.59
10	65	.4852	0.700	1.00	0.00	4,800	10.05
							<u>16,384</u>
							25,576

The change in the Accrued liability is $712 = 26,288 - 25,576$.

Answer is B

NOTE

There is a lot of arithmetic in this problem. One easy way to miss it is to not be careful enough in calculating the probability of survival to each age.

Problem 36 – Page 1

Revised 08/23/17

The key point of this question is that you must know numerous definitions related to the quarterly contribution requirement. There are several steps in the solution to this question:

1. Is the plan sponsor is subject to the quarterly contribution requirement?
2. Is there a prefunding balance (PB) available at 01/01/2011 to satisfy the required quarterly contribution installment?
3. Can the plan sponsor elect to apply the PB against the required quarterly contribution installment?
4. What is the amount of the required quarterly contribution installment?

Subject to the quarterly contribution requirement?

To calculate the required quarterly contribution for 2011, you must first determine that the plan is subject to the quarterly contribution requirements. In IRC 430(j)(3), it states that plans with a funding shortfall for the preceding plan year are subject to the quarterly contribution requirements. Since the 2010 Funding target attainment percentage (FTAP) is 90%, there is a Funding shortfall at that date. So the plan sponsor is subject to the quarterly contribution requirement for 2011.

Amount of 01/01/2011 PB

You are given information about the minimum required contribution (MRC) and the actual contribution for the 2010 plan year. The plan has a zero carryover balance (CB) at 01/01/2010, so the CB will always be zero.

You can calculate the amount of the excess contribution at 01/01/2010. You need to compare the present value of the actual contribution to the MRC. The present value is calculated using the effective rate of interest for the 2010 plan year:

$$\begin{aligned}\text{PV of contrib} &= 125,000 \times (1.07)^{-9.5/12} \\ &= 118,481\end{aligned}$$

$$\begin{aligned}\text{Excess contrib} &= 118,481 - 100,000 \\ &= 18,481\end{aligned}$$

The 01/01/2010 PB is equal to zero. The 01/01/2011 PB is calculated based on the 2010 excess contribution brought forward with the effective rate of interest for the 2010 plan year.

$$\begin{aligned}\text{01/2011 PB} &= 18,481 \times (1.07) + (\text{zero PB}) \times (1.05) \\ &= 19,774\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 36 – Page 2

Apply PB towards required quarterly installment?

The problem states that the employer elects to apply the CB and PB towards the required quarterly installment. But this election may not actually go into effect.

In general, the plan sponsor's funding ratio for the prior year must be at least 80% to apply both the CB and the PB against the MRC, or the required quarterly installment. 2010 exam condition 27 states the plan sponsor's funding ratio for the prior year is at least 80%.

If a problem gives you the prior year's valuation results, you should not rely on exam condition 27. You should check the "funding ratio" for the prior year to be sure that the plan can apply the CB and the PB towards the MRC (or quarterly installment):

$$\text{Funding ratio} = \frac{\text{AAV} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

Since the 2010 FTAP is equal to 90%, the "funding ratio" is also equal to 90%:

$$\text{FTAP} = \frac{\text{AAV} - \text{CB} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

Calculate required quarterly installment

The next step is calculation of the required annual payment (RAP). This is the lesser of 100% of last year's minimum required contribution (MRC) or 90% of this year's MRC.

The MRC is defined in IRC 430 as the sum of the target normal cost, the shortfall amortizations and the waiver amortizations. It does not reflect any offset of the carryover balance (CB) or the prefunding balance (PB). In this problem, you are not given any details for calculation of the MRC. Instead, you are given the MRC for both 2010 and 2011.

The required annual payment (RAP) is the lesser of the 2010 MRC or 90% of the 2011 MRC, which is $100,000 = 100\% \times 100,000$. The 2011 required quarterly installment is 25% of the RAP, which is 25,000.

The problem asks for $X + Y$, which is the sum of the smallest amounts paid at 04/15/2011 and 07/15/2011 to satisfy the 2011 quarterly contribution requirement. You should increase the PB to 04/15/11 using the 2011 effective interest rate. X is the difference between that amount and the required quarterly installment.

$$\begin{aligned} 25,000 &= X + 19,774(1.07)^{3.5/12} \\ X &= 25,000 - 20,169 \\ &= 4,831 \end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 36 – Page 3

There is no calculation necessary for Y. The PB was eliminated, so the employer must pay 25,000 to meet the required quarterly installment at 07/15/2011.

$$\begin{aligned} X + Y &= 25,000 + 4,831 \\ &= 29,831 \end{aligned}$$

Answer is A

NOTE

In the 10/15/2009 regulation, there is a special rule about the relationship between two dates:

1. The due date for a required quarterly installment, and
2. The date that the plan sponsor makes the election to apply the CB (or PB) towards the MRC

If the plan sponsor elects to apply the CB (or PB) towards the MRC after the due date for a quarterly installment, then you use a interest different rate to adjust for the time period from the quarterly installment due date up to the plan sponsor's date of election. Instead of using the effective rate of interest, you use the effective rate plus 5% (the penalty rate). This is counter-intuitive, to say the least. See the example in the regulation at 1.430(f)-1(d)(1).

In this problem, the employer made the election to apply the CB and PB towards the MRC on the due date for each quarterly installment. The additional 5% penalty rate was not used to discount any payments.

Fall 2010 EA-2A Exam Solutions

Problem 37

This problem may be the last one on the definition of the applicable percentage and the shortfall base exemption. Starting in 2011, the applicable percentage is 100% for all plans.

Define the “modified funding shortfall” as the modified funding target less the modified assets. If the “modified funding shortfall” is less than or equal to zero, then you would not have to set up the Shortfall base for 2010.

- Modified funding target: the applicable percentage times the funding target
- In the absence of any information to the contrary, you can assume the applicable percentage for 2010 is 96%.
- Modified assets: if any portion of the prefunding balance is applied toward the minimum required contribution, the modified assets equal AAV - PB. Otherwise, the modified assets equal the AAV with no reduction.

$$\begin{aligned}\text{Mod FT} &= 96\%(10,000) \\ &= 9,600\end{aligned}$$

$$\begin{aligned}\text{Mod AAV} &= 9,700 - 0 \\ &= 9,700\end{aligned}$$

$$\begin{aligned}\text{Mod S/F} &= 9,600 - 9,700 \\ &= \text{zero}\end{aligned}$$

The plan is exempt from establishing a shortfall base at 01/01/2010.

Answer is A

Fall 2010 EA-2A Exam Solutions

Problem 38 – Page 1

The key to this problem is the calculation of the deductible limit under IRC 404(o). This is the first question since PPA 2006 that had information about a non-deducted contribution.

Deductible Limit

The deductible limit is defined as the greater of the minimum contribution required under IRC 430 and the amount under 404(o)(2). IRC 430 defines “the minimum required contribution” as the amount prior to reduction by the carryover balance or the prefunding balance. You don’t have enough information to calculate the shortfall amortization installment in this problem, so you should ignore the minimum contribution.

The maximum deductible limit is defined under 404(o)(2)(A):

Target normal cost + Funding target + Cushion amount - Actuarial asset value

The problem gives you the funding target on two sets of assumptions. One uses the At-Risk assumptions, and has been provided for use in an alternative definition of the deductible limit.

Cushion Amount

The Cushion amount is defined as the sum of two pieces:

- (1) 50% of the Funding target, and
- (2) the increase in the Funding target due to allowing for future pay increases.

$$\begin{aligned}\text{Cushion amount} &= 50\%(\text{FT}) + \Delta\text{FT due to pay increases} \\ &= .5(220,000) + (280,000 - 220,000) \\ &= 170,000\end{aligned}$$

Now you can calculate the deductible limit. This calculation uses the non At-Risk funding target. This plan is not in At-Risk status, based on 2010 exam condition 42.

Target normal cost	15,000
+ Funding target	220,000
+ Cushion amount	170,000
Sub-total	405,000
Less AAV minus NDC	228,000
Deductible limit	177,000

Non-deducted contribution

This calculation of the deductible limit reflects a reduction in the AAV by the amount of the non-deducted contribution. This is consistent with determination of asset values under the old 404 regulations:

$$\text{AAV} - \text{NDC} = 228,000 = 240,000 \text{ AAV} - 12,000 \text{ NDC}$$

Fall 2010 EA-2A Exam Solutions

Problem 38 – Page 2

Alternative Deductible Limit: At-Risk

For plans that are not At-Risk, there is an alternative definition of the deductible limit in 404(o)(2)(B):

“Final” At-Risk Target normal cost + “Final” At-Risk Funding target - Actuarial asset value

This calculation uses values determined as if the plan is in At-Risk status. The problem gives you the values of the normal cost and funding target for use in this alternative deductible limit definition.

At-Risk Target normal cost	17,000
+ At-Risk Funding target	235,000
Sub-total	252,000
Less AAV minus NDC	228,000
Deductible limit	24,000

The alternative definition does not produce a higher value for the deductible limit. The final deductible limit is 177,000.

Answer is C

The answer sheet shows that credit was given for both answer B and answer C. The original version of the answer sheet showed that the “official answer” to the problem was based on adjusting the IRC 404 assets to reflect the non-deductible contribution.

This adjustment is based on the old IRC 404 regulations, which were released in 1982. Most actuaries believe that this adjustment for non-deducted contributions should be made.

There are no regulations that clarify how this should be handled under post-PPA 2006 rules. If you do not adjust the assets for the non-deductible contribution, the deductible limit is 12,000 lower:

Target normal cost	15,000
+ Funding target	220,000
+ Cushion amount	170,000
Sub-total	405,000
Less unreduced AAV	240,000
Deductible limit	165,000

Answer is B

Problem 38 – Page 3

NOTE

Some prior exam problems have not given you the At-Risk values of the target normal cost and funding target. If this plan had some type of subsidized early retirement benefit, or optional forms of payment, then you would need to calculate the At-Risk values of the Funding target and the Target normal cost.

Fall 2010 EA-2A Exam Solutions

Problem 39 – Page 1

Similar to 2008 #39

This is a basic question on your understanding of segment interest rates. Under PPA 2006, you would calculate the present value of a stream of annual benefit payments for a life annuity payable to a person age x (currently in pay status) as follows:

$$\begin{aligned} \text{Present value} &= \sum_{t=0}^4 (1.040)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=5}^{19} (1.060)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=20}^{\omega-x} (1.080)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \end{aligned}$$

You can write the present value formula in terms of annual annuities:

$$\text{Age } x \text{ PV} = \text{Benefit} \{ \ddot{a}_{x:\overline{5}|} \text{ at } 4.0\% + (1.06)^{-5} ({}_5 p_x) \ddot{a}_{x+5:\overline{15}|} \text{ at } 6.0\% + (1.08)^{-20} ({}_{20} p_x) \ddot{a}_{x+20} \text{ at } 8.0\% \}$$

You need to calculate the Funding target at 01/01/2011 allowing for retirement decrements at ages 62 and 65. The first step is to determine the accrued benefit at the valuation date:

Valuation date	01/01/2011
Age	60
Past service	30
Accrued benefit	$1.5\%(30)(100,000)$ $= 45,000$

The Funding target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability.

Funding target - assumed retirement at 65

It is easier to construct the formulas for the Funding target based on assumed retirement at age 65. Then there are “just a few” modifications in those formulas to develop the Funding target based on assumed retirement at age 62.

With retirement assumed at age 65, their benefit payments will be valued using the second and third segment rates:

	Segment 1 <=====			Segment 2 =====>			Segment 3 =====>	
		B	B	B	B	B	B	B
Age	60	65	70	75	80	85	...	

Fall 2010 EA-2A Exam Solutions

Problem 39 – Page 2

Funding target - assumed retirement at 65 - continued

One important aspect of the problem is that the pre-retirement mortality and post-retirement mortality are not the same. This means you must be careful to only use the commutation functions after benefit commencement age. Discounting values from the assumed retirement ages back to the valuation date must be done on an interest-only basis.

Here is the expression for the portion of the Funding target based on assumed retirement at 65. There is an interest-only discount for the five years between age 60 and age 65:

$$FT-ARA\ 65 = 75\%(45,000)(1.0)[(1.06)^{-5}(\ddot{a}_{65:\overline{15}|}^{(12)}_{seg_2}) + (1.08)^{-5}(v^{15}_{15p65})(\ddot{a}_{80}^{(12)}_{seg_3})]$$

Now you need to express these annuities in terms of commutation functions:

$$\ddot{a}_{65:\overline{15}|}^{(12)}_{seg_2} = (N_{65}^{(12)} - N_{80}^{(12)}) / D_{65} \quad \text{all at segment 2 rate}$$

$$\begin{aligned} (v^{15}_{15p65})(\ddot{a}_{80}^{(12)}_{seg_3}) &= (D_{80}/D_{65})*(N_{80}^{(12)}/D_{80}) && \text{all at segment 3 rate} \\ &= (N_{80}^{(12)}/D_{65}) && \text{all at segment 3 rate} \end{aligned}$$

$$\begin{aligned} FT-ARA\ 65 &= 45,000(.75)[(1.06)^{-5}\frac{(21,570 - 3,530)}{2,030} + (1.08)^{-5}\frac{(1,590)}{1,100}] \\ &= 33,750[.7473(8.8867) + .6806(1.4455)] \\ &= 257,324 \end{aligned}$$

Funding target - assumed retirement at 62

The participant is currently 2 years from retirement, based on the first decrement age of 62. You must calculate this portion of the Funding target using the reduced accrued benefit at age 62:

$$\begin{aligned} \text{Age 62 ben} &= 45,000(1 - 6\%(65-62)) \\ &= 45,000*.82 \\ &= 36,900 \end{aligned}$$

With retirement assumed at 62, the benefit payments will be valued using all three segment rates:

	Segment 1 <=====			Segment 2 =====>			Segment 3 =====>		
	B B B			B B B B B B			B B B B		
Age	60	62	65	70	75	80	85	...	

Fall 2010 EA-2A Exam Solutions

Problem 39 – Page 3

Funding target - assumed retirement at 62 - continued

Here is the expression for the portion of the Funding target based on assumed retirement at 62. There is an interest-only discount for the two years between age 60 and age 62:

$$\begin{aligned} \text{FT-ARA } 62 = & 36,900(.25)[(1.04)^{-2}(\ddot{a}_{62:\overline{3}|}^{(12)}_{\text{seg}_1}) + (1.06)^{-2}(v^3 p_{62})(\ddot{a}_{65:\overline{15}|}^{(12)}_{\text{seg}_2}) \\ & + (1.08)^{-2}(v^{18} p_{62})(\ddot{a}_{80}^{(12)}_{\text{seg}_3})] \end{aligned}$$

Now you need to express these annuities in terms of commutation functions:

$$\ddot{a}_{62:\overline{3}|}^{(12)}_{\text{seg}_1} = (N_{62}^{(12)} - N_{65}^{(12)}) / D_{62} \quad \text{all at segment 1 rate}$$

$$\begin{aligned} (v^3 p_{62})(\ddot{a}_{65:\overline{15}|}^{(12)}_{\text{seg}_2}) &= (D_{65} / D_{62}) (N_{65}^{(12)} - N_{80}^{(12)}) / D_{65} && \text{all at segment 2 rate} \\ &= (N_{65}^{(12)} - N_{80}^{(12)}) / D_{62} && \text{all at segment 2 rate} \end{aligned}$$

$$\begin{aligned} (v^{18} p_{62})(\ddot{a}_{80}^{(12)}_{\text{seg}_3}) &= (D_{80} / D_{62}) * (N_{80}^{(12)} / D_{80}) && \text{all at segment 3 rate} \\ &= (N_{80}^{(12)} / D_{62}) && \text{all at segment 3 rate} \end{aligned}$$

That is the most confusing part of this problem. If you can write down the commutation functions correctly, there is only a bit of arithmetic to produce the final answer.

$$\begin{aligned} \text{FT-ARA } 62 = & 36,900(.25)[(1.04)^{-2} \frac{55,610 - 43,270}{4,460} + (1.06)^{-2} \frac{21,570 - 3,530}{2,480} + \\ & (1.08)^{-2} \frac{1,590}{1,390}] \\ = & 9,225[.9246(2.7668) + .8900(7.2742) + .8573(1.1439)] \\ = & 92,368 \end{aligned}$$

The total Funding target is $349,692 = 92,368 + 257,324$.

Answer is B

NOTE

There is a pattern that occurs in both of the Funding target expressions. The interest discount terms all have the same exponent. The exponent is current age minus the assumed retirement age.

Fall 2010 EA-2A Exam Solutions

Problem 40 – Page 1

This is the first question asked on the EA-2A exam regarding post-PPA 2006 waivers. It is a relatively straightforward question, since the problem gives you the waiver amortization factor.

This problem asks for “the minimum required contribution”. Based on 2010 exam condition 30, this amount does not reflect a reduction for the funding standard carryover balance (CB) or for the prefunding balance (PB).

The key to this problem is the calculation of the Shortfall amortization base at 01/01/2011 under IRC Section 430. The plan was set up after PPA 2006, so the CB is equal to zero. You are told that the minimum required contribution (MRC) was paid for 2010, so the PB is zero at 01/01/2011.

2010 Waiver amortization

The first step is to calculate the waiver amortization payment. The problem gives you the waiver amortization factor, and the amount of the waiver base at 01/01/2009.

This problem would have been harder if it gave you the segment rates for 2009 and 2010, and you had to calculate the amortization factor for the waiver. The rules in the proposed regulation for calculating the waiver amortization are a bit unusual. At 1.430(a)-1(d)(1), it states that the waiver amortization installment is calculated using the segment rates for the year that the waiver is granted - NOT for the year the first amortization payment is paid.

The first waiver amortization payment is at 01/01/10. In this problem, the 2009 segment rates are used to determine the waiver amortization factor. The amortization factor is calculated using an end of year annuity based on the 1st segment rate for 2009 for four years, and the 2nd segment rate for 2009 for one year.

$$\begin{aligned}\text{Waiver amort} &= 40,000 / 4.6228 \\ &= 8,653\end{aligned}$$

2010 Shortfall amortization installment

The second step is to calculate the shortfall amortization installment. The problem gives you the 7 year amortization factor for the 2010 shortfall:

$$\begin{aligned}\text{S/F amort} &= 9,000 / 5.9253 \\ &= 1,519\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 40 – Page 2

2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the PB and the CB.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 300,000 - (280,000 - 0 - 0) \\ &= 20,000\end{aligned}$$

2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is almost identical to the previously calculated Funding shortfall.

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

Based on 2010 exam conditions 26 and 27, the plan sponsor elects to offset both the CB and the PB against the minimum contribution under IRC 430. As a result, the calculation above offsets the entire PB against the AAV. In general, the only time you should not do this is when the problem states that the plan sponsor does not elect to apply the CB and the PB against the MRC.

2011 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. 100% times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments.

There are four years left in the amortization of the 2010 waiver, and six years left in the amortization of the 2010 shortfall base. You can directly calculate the 4 year amortization factor for the 2010 waiver, which is $\ddot{a}_{\overline{4}|.05}$, or 3.7232. The problem gives you the 6 year amortization factor for the 2010 shortfall as 5.2932.

$$\begin{aligned}\text{S/F Amort base} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * 300,000 - (280,000 - 0 - 0) - (8,653 * 3.7232 + 1,519 * 5.2932) \\ &= 20,000 - 40,256 \\ &= -20,256\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 40 – Page 3

You must calculate the shortfall amortization installment for 2011. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= -20,256 / 5.9982 \\ &= -3,377\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 1,519 - 3,377 \\ &= \text{zero}\end{aligned}$$

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. Here is the minor trick in the problem - the shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Minimum Required Contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 30,000 + \text{zero} + 8,653 \\ &= 38,653\end{aligned}$$

Answer is D

Fall 2010 EA-2A Exam Solutions

Problem 41 – Page 1

There are two key points to the solution of this problem. One is how you calculate the Shortfall amortization base at 01/01/2011 under IRC Section 430. The other point is how to bring forward the carryover balance (CB) and the prefunding balance (PB) to 01/01/2011.

2009 and 2010 Shortfall amortization installments

The first step is to calculate the shortfall amortization installments for the prior years. The problem gives you the shortfall amortization factors used for all years:

$$\begin{aligned} \text{2009 S/F amort} &= 1,330,000 / 5.9982 \\ &= 221,733 \\ \text{2010 S/F amort} &= 200,000 / 5.9982 \\ &= 33,343 \end{aligned}$$

2011 Carryover balance

The problem gives you the 2010 values for the CB and PB. The plan sponsor “did not elect to apply” the CB or the PB during 2010. I assume that means they did not apply the balances towards the minimum required contribution (MRC).

You can calculate the value of the CB at 01/01/2011 by increasing it with the plan’s rate of return on assets for 2010:

$$\begin{aligned} \text{01/2011 CB} &= (\text{01/2010 CB})(1 + \text{asset return}) \\ &= 480,000 * (1 - 20\%) \\ &= 384,000 \end{aligned}$$

You can verify the value of the PB at 01/01/2011 using the negative 20% return on assets. It appears that the plan sponsor did not increase the PB during 2010.

2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the PB and the CB.

$$\begin{aligned} \text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 6,920,000 - (5,600,000 - 384,000 - 50,000) \\ &= 1,754,000 \end{aligned}$$

2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is almost identical to the previously calculated Funding shortfall.

Fall 2010 EA-2A Exam Solutions

Problem 41 – Page 2

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

Based on 2010 exam conditions 26 and 27, the plan sponsor elects to offset both the CB and the PB against the minimum contribution under IRC 430. As a result, the calculation above offsets the entire PB against the AAV. In general, the only time you should not do this is when the problem states that the plan sponsor does not elect to apply the CB and the PB against the MRC.

2011 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. 100% times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments.

There are five years left in the amortization of the 2009 shortfall base, and six years left in the amortization of the 2010 shortfall base. The problem gives you the amortization factors:

$$\begin{aligned}\text{S/F Amort base} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * 6,920,000 - (5,600,000 - 384,000 - 50,000) - (\text{PV of PY Amortizations}) \\ &= 6,920,000 - 5,166,000 - (221,733 * 4.5459 + 33,343 * 5.2932) \\ &= 1,754,000 - 1,184,470 \\ &= 569,530\end{aligned}$$

You must calculate the shortfall amortization installment for 2011. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= 569,530 / 5.9982 \\ &= 94,950\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 221,733 + 33,343 + 94,950 \\ &= 350,027\end{aligned}$$

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. The shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Answer is B

(see note on next page)

NOTE

Why does the problem state that the plan does not offer any accelerated benefit distributions? This is related to the deemed reductions in the CB and PB under IRC 436. If the plan offers accelerated benefit distributions and the adjusted funding target attainment percentage (AFTAP) is less than 80%, then a deemed reduction may occur at 01/01/2011.

It is unclear how the problem could be worded to test this idea. Several other questions on the 2010 exam tested the details of IRC 436, and were ruled defective questions. IRC 436 was not a topic on the 2010 EA-2A exam syllabus.

Fall 2010 EA-2A Exam Solutions

Problem 42

Similar to 2009 #19

Revised 08/03/12

This problem is a simple one on definitions under IRC 430.

I. TRUE

The prior year's "funding ratio" must be at least 80% for a plan to apply the prefunding balance and carryover balance toward the minimum required contribution. The assets in this calculation do not reflect any reduction by the carryover balance:

$$\begin{aligned}\text{Funding ratio} &= \frac{\text{AAV} - \text{PB}}{\text{Funding target (non At-Risk basis)}} && \text{(prior year valuation results)} \\ &= \frac{1,000,000 - 150,000}{1,000,000} = 85.0\%\end{aligned}$$

II. TRUE

A plan is subject to quarterly contributions if it is a single employer plan, and there was a funding shortfall for the prior plan year.

$$\begin{aligned}2010 \text{ S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 1,000,000 - (1,000,000 - 100,000 - 150,000) \\ &= 250,000\end{aligned}$$

III. FALSE

$$\begin{aligned}2011 \text{ S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 1,250,000 - (1,250,000 - 100,000 - 300,000) \\ &= 400,000\end{aligned}$$

Items I and II are true.

Answer is A

NOTE

Why does the problem state that the plan does not offer any accelerated benefit distributions?

This is related to the deemed reductions in the CB and PB under IRC 436. If the plan offers accelerated benefit distributions and the adjusted funding target attainment percentage (AFTAP) is less than 80%, then a deemed reduction may occur at 01/01/2011.

It is unclear how the problem could be worded to test this idea. Several other questions on the 2010 exam tested the details of IRC 436, and were ruled defective questions. IRC 436 was not a topic on the 2010 EA-2A exam syllabus.

Fall 2010 EA-2A Exam Solutions

Problem 43 – Page 1

Revised 10/28/11

This is a basic question on your understanding of calculations using 417(e) segment interest rates. In this problem, you need to calculate the lump sum distribution.

In general, you must do two lump sum calculations. One uses the plan assumptions, and the other uses the mandated assumptions in 417(e)(3). The final lump sum can't be less than the value under the mandated assumptions. In this problem, the plan basis for lump sum calculations is the same as the 417(e)(3) applicable interest rate, so there is only one calculation.

01/01/2011 Age 45

Accrued benefit 2,500 / mo

Based on the default exam conditions, normal retirement age is 65, and the benefit is assumed payable monthly, starting at normal retirement age. The participant is 20 years from normal retirement age, so their benefit payments will be valued using the third segment rate.

One minor point of interpretation is the definition of the plan basis for lump sum distributions. The “applicable interest rate using a 3-month lookback” is the 417(e) segment rates for October 2010. The determination of the 417(e) rates must also reflect the phase-in rule under 417(e) - there is no option not to use the phase-in.

The phase-in rule grades in the effect of the yield curve by combining 20% of the segment rates with 80% of the 30 year Treasury rate for 2008. For each year from 2009 through 2011, the percentage weight for the segment rates increases by an additional 20%, and the weight for the Treasury rate decreases by 20%. In 2012, the transition rule is gone, and the present value calculation is solely based on the segment interest rates:

Year	Weight for Segment rate	Weight for 30 year Treasury
2008	20%	80%
2009	40%	60%
2010	60%	40%
2011	80%	20%
2012	100%	0%

The next step is to apply the phase-in rule to the third segment rate for October 2010. Since this lump sum calculation is for the 2011 plan year, you combine 20% of the 30 year Treasury rate with 80% of the segment rate:

$$\begin{aligned}\text{Segment rate 3} &= .20(4.0\%) + .80(7.0\%) \\ &= 6.4\%\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 43 – Page 2

Revised 10/28/11

$$\begin{aligned}\text{Plan Lump sum} &= 2,500(12)(v^{20} {}_{20}p_{45}) \ddot{a}_{65}^{(12)} && \text{at segment rate 3} \\ &= 2,500(12)(1.064)^{-20}(1.0)(10.53) \\ &= 91,352\end{aligned}$$

The plan actuarial equivalence basis has no pre-retirement mortality. The final lump sum is the greater of the plan lump sum and the 417(e) lump sum. As described earlier, the plan lump sum is defined to be the same as the 417(e) lump sum.

The result is 91,352.

Answer is B

Fall 2010 EA-2A Exam Solutions

Problem 44 – Page 1

Similar to 2008 #46

The key to this problem is that you must know how to do calculations under the Entry Age Normal method. But you have retirement decrements, and you need to calculate the Entry Age Normal accrued liability.

In general, the Entry Age Normal Cost (EANC) is defined as the present value of benefits at entry age, divided by a temporary annuity at entry age. The complicating factor in this problem is the retirement decrements at ages 60 and 65:

$$EANC = \frac{PVB_{EA}}{\ddot{a}_{EA:RA-EA}}$$

Age 57 at 01/01/11

Entry age 48

Past service 9

This participant is eligible to retire at age 62. To calculate the present value of future benefits, you need to calculate the projected monthly benefit at ages 62 and 65. The present value calculation allows for 50% of the participant to retire at age 62, and the remaining 50% to retire at age 65:

Retirement age	62	65
Projected service	14	17
Projected benefit	31,080 = 14(12)(185)	37,740 = 17(12)(185)
Early retirement Reduction factor	1 - (65-62)(3%) = .91	1.00
PVB at entry age	50%(.91)(31,080)(D ₆₂ / D ₄₈) $\ddot{a}_{62}^{(12)}$	50%(37,740)(D ₆₅ / D ₄₈) $\ddot{a}_{65}^{(12)}$

There are no commutation functions given prior to age 62. Based on 2010 exam condition 15, there are no pre-retirement decrements. You need to use an interest-only discount at 7% for periods prior to each assumed retirement age.

PVB at entry age	$50\%(.91)(31,080)(v^{14} {}_{14}p_{48}) \ddot{a}_{62}^{(12)}$ $= .5(28,283)(1.07)^{-14} (N_{62}^{(12)} / D_{62})$ $= 5,484(154,707/14,268)$ $= 59,466$	$50\%(37,740) (v^{17} {}_{17}p_{48}) \ddot{a}_{65}^{(12)}$ $= .5(37,740)(1.07)^{-17} (N_{65}^{(12)} / D_{65})$ $= 5,974(116,222/11,387)$ $= 60,971$
------------------	--	--

Problem 44 – Page 2**Revised 11/03/13**

The total PVB at entry age 48 is $120,437 = 59,466 + 60,971$. Now you must calculate the temporary annuity from entry age to 65, allowing for the retirement decrements at ages 62 and 65. With no retirement decrements, this is the expression for the temporary annuity:

$$\begin{aligned}\ddot{a}_{\overline{48:17}|} &= (N_{48} - N_{65}) / D_{48} && \text{(no retirement decrements)} \\ &= \ddot{a}_{\overline{17|.07|}}\end{aligned}$$

With a 50% decrement at age 62, you can think of the temporary annuity as the sum of two temporary annuities: 50% of the temporary annuity assuming retirement at age 62 plus 50% of the temporary annuity assuming retirement at age 65:

$$\begin{aligned}\ddot{a}_{\overline{48:17}|} &= .50(N_{48} - N_{62}) / D_{48} + .50(N_{48} - N_{65}) / D_{48} && \text{(with retirement decrements)} \\ &= .50(\ddot{a}_{\overline{14|.07|}} + \ddot{a}_{\overline{17|.07|}}) \\ &= 9.9022\end{aligned}$$

There are three ways to calculate the EAN accrued liability. The prospective and retrospective formulas require you to calculate the Entry Age Normal cost:

Prospective

$$\text{EAN AL} = \text{PVB} - \text{PV}(\text{EANC})$$

Retrospective

$$\text{EAN AL} = (\text{EANC}) \ddot{s}_{\overline{48:9}|}$$

The third formula uses the ratio of two annuities (at entry age) times the PVB at the current age:

$$\begin{aligned}\text{EAN AL} &= \text{PVB} * \left(\frac{\ddot{a}_{\overline{\text{EA:CA-EA}|}}}{\ddot{a}_{\overline{\text{EA:RA-EA}|}}} \right) \\ &= \text{PVB} * \left(\frac{\ddot{a}_{\overline{48:9}|}}{\ddot{a}_{\overline{48:17}|}} \right)\end{aligned}$$

$$\begin{aligned}\text{PVB}_{57} &= \text{PVB}_{48} * (D_{57} / D_{48}) \\ &= 120,437 * (1.07)^9 \\ &= 221,419\end{aligned}$$

$$\begin{aligned}\ddot{a}_{\overline{48:9}|} &= \ddot{a}_{\overline{9|.07|}} \\ &= 6.9713\end{aligned}$$

Problem 44 – Page 3

Revised 11/03/13

Finally, you can calculate the EAN accrued liability:

$$\begin{aligned}\text{EAN AL} &= \text{PVB}_{57} * (\ddot{a}_{48:9} / \ddot{a}_{48:17}) \\ &= 221,419 * (6.9713 / 9.9022) \\ &= 155,883\end{aligned}$$

Answer is C

NOTE

You can also check your work by calculating the EAN accrued liability using one of the other two formulas:

Retrospective AL

$$\text{EAN AL} = (\text{EANC}) \ddot{s}_{48:9}$$

$$\begin{aligned}\text{EANC} &= \text{PVB}_{48} / \ddot{a}_{48:17} \\ &= 120,437 / 9.9022 \\ &= 12,163\end{aligned}$$

$$\begin{aligned}\ddot{s}_{48:9} &= \ddot{s}_{9|.07} \\ &= 12.8164\end{aligned}$$

$$\begin{aligned}\text{EAN AL} &= 12,163(12.8164) \\ &= 155,883\end{aligned}$$

Prospective AL

$$\begin{aligned}\text{EAN AL} &= \text{PVB} - \text{PV}(\text{EANC}) \\ &= \text{PVB}_{57} - \text{EANC}(\ddot{a}_{57:8})\end{aligned}$$

$$\begin{aligned}\ddot{a}_{57:8} &= .50(N_{57} - N_{62}) / D_{57} + .50(N_{57} - N_{65}) / D_{57} && \text{(with retirement decrements)} \\ &= .50(\ddot{a}_{5|.07} + \ddot{a}_{8|.07}) \\ &= 5.3883\end{aligned}$$

$$\begin{aligned}\text{EAN AL} &= 221,419 - 12,163(5.3883) \\ &= 155,883\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 45 – Page 1

The key to this problem is calculation of the Funding target under IRC 430(d). The participant retired two years ago with a certain and life payment form.

The Funding Target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability.

01/01/2011

Smith

Age

67

Accrued benefit

12,000

Segment Interest Rates

The next step is calculation of present values using segment interest rates. Under PPA 2006, you would calculate the present value of a stream of annual benefit payments for a life annuity payable to a person age x (currently in pay status) as follows:

$$\begin{aligned} \text{Present value} &= \sum_{t=0}^4 (1.0500)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=5}^{19} (1.0600)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \\ &+ \sum_{t=20}^{\omega-x} (1.0700)^{-t} {}_t p_x^{(T)} (\text{Benefit Payment}_{x+t}) \end{aligned}$$

You can write the present value formula in terms of annual annuities:

$$\text{Age } x \text{ PV} = \text{Benefit} \left\{ \ddot{a}_{x:\overline{5}| \text{ at } 5.0\%} + (1.06)^{-5} ({}_5 p_x) \ddot{a}_{x+5:\overline{15}| \text{ at } 6.0\%} + (1.07)^{-20} ({}_{20} p_x) \ddot{a}_{x+20 \text{ at } 7.0\%} \right\}$$

Funding Target

The participant is currently in pay status, so their benefit payments will be valued using all three segment rates. There are eight years left in the certain period for their optional form:

	Segment 1 <=====				Segment 2 =====>				Segment 3 =====>					
	B	B	....	B	B	....	B	B	....	B	B	....	B	....
Age	67	68		71	72		76	77		81	82		86	87
														91
														92 ...

$$\text{FT} = 12,000 * \left[\ddot{a}_{\overline{5}| \text{ seg}_1}^{(12)} + {}_5 \ddot{a}_{\overline{3}| \text{ seg}_2}^{(12)} + {}_8 \ddot{a}_{\overline{67:12}| \text{ seg}_2}^{(12)} + {}_{20} \ddot{a}_{\overline{67} \text{ seg}_3}^{(12)} \right]$$

Fall 2010 EA-2A Exam Solutions

Problem 45 – Page 2

Now you need to express these annuities in terms of commutation functions. The problem gives you the value of the certain annuity at the two segment rates as 6.53:

$$\ddot{a}_{5|seg_1}^{(12)} + \ddot{a}_{3|seg_2}^{(12)} = 6.53 \quad (\text{given})$$

$$\ddot{a}_{8|67:12|seg_2}^{(12)} = (v^8 p_{67}) \ddot{a}_{75:12|seg_2}^{(12)} \quad \text{all at segment 2 rate}$$

$$= (N_{75}^{(12)} - N_{87}^{(12)}) / D_{67} \quad \text{all at segment 2 rate}$$

$${}_{20|}\ddot{a}_{67seg_3}^{(12)} = (v^{20} {}_{20}p_{67}) \ddot{a}_{87seg_3}^{(12)} \quad \text{all at segment 3 rate}$$

$$= N_{87}^{(12)} / D_{67} \quad \text{all at segment 3 rate}$$

$$FT = 12,000 \left[6.53 + \frac{(81,019 - 11,214)}{18,277} + \frac{4,792}{9,743} \right]$$

$$= 12,000[6.53 + 3.8193 + .4918]$$

$$= 130,093$$

Answer is C

NOTES

1. There is a small trap in the data given for this problem. You should not try to shortcut the problem by using the factors based on the effective interest rate.

The effective interest rate is determined based on the Funding target for the entire plan. You don't know anything about the population of the plan, so there is no guarantee that the effective interest rate would produce a similar present value as the segment rates for Smith.

2. Since the certain annuity factor is rounded to two places, the final result only has three significant digits. I really should round the other results to three significant digits:

$$FT = 12,000[6.53 + 3.82 + .492]$$

$$= 130,104$$

$$= 130,000$$

(also to three significant digits)

NOTES - continued

3. A minor point of interest is the factor given for the annuity certain payable monthly, based on the segment interest rates. I tried to match the factor given for the 8 year certain annuity, but I did not get too close:

$$\ddot{a}_{5|seg_1}^{(12)} + \ddot{a}_{5|3|seg_2}^{(12)} = 6.53 \quad (\text{given})$$

$${}_5|\ddot{a}_{3|6.0\%}^{(12)} = \ddot{a}_{8|6.0\%}^{(12)} - \ddot{a}_{5|6.0\%}^{(12)}$$

Now I will calculate the annuities using the equivalent monthly interest rates.

$$\begin{aligned} \ddot{a}_{5|5.0\%}^{(12)} &= (1/12) * \ddot{a}_{60|j} & \text{where } (1+j)^{12} = 1.05 \rightarrow j = .4074\% \\ &= 4.4459 \end{aligned}$$

$$\begin{aligned} {}_5|\ddot{a}_{3|6.0\%}^{(12)} &= (1/12) * (\ddot{a}_{96|k} - \ddot{a}_{60|k}) & \text{where } (1+k)^{12} = 1.06 \rightarrow k = .4868\% \\ &= 6.4098 - 4.3480 \end{aligned}$$

$$\begin{aligned} \ddot{a}_{5|seg_1}^{(12)} + \ddot{a}_{5|3|seg_2}^{(12)} &= 4.4459 + 2.0618 \\ &= 6.5076 \end{aligned}$$

I did not expect such a large difference between this calculation and the annuity factor of 6.53.

Problem 46 – Page 1

Revised 09/07/18

The IRS released Notice 2009-22 in March 2009. It includes two detailed examples of the asset valuation method in IRC 430(g)(3), which include determination of the adjustment for expected earnings. The first example is very similar to the one in the 1.430(g)-1 proposed regulation. It is essentially a three year average market value calculation. The second example shows calculation of the average market value over the four prior quarters of the plan year.

There are two calculation techniques shown for the first example in Notice 2009-22. The first one requires calculation of the adjusted cash flows, which are used to adjust market values from prior dates up to the valuation date. Then the average market value is calculated. The final actuarial value of assets must be limited to be within 10% of the market value.

The second calculation method in Notice 2009-22 is based on the technique shown in Revenue Procedure 2000-40. The actuarial value of assets is calculated using decreasing fractions of each of the prior year's gain or loss. The alternate calculation is shown at the end of this solution.

This problem states the AAV uses the average market value over one year. The first step is calculation of the adjusted cash flows, which are used to adjust market values from prior dates up to the valuation date.

You must calculate the expected return for 2010. The problem states that the actuary's assumed annual rate of return on assets is 8.0%. As described in Notice 2009-22, you must limit the assumed return on assets so it does not exceed the third segment rate at each valuation date. The result is that the assumed rate of return is limited to 7.0%.

Based on the 7.0% assumed return, you can calculate the expected return on assets for 2010. The calculation must allow for the timing of the cash flows during the year. You are told that all the cash flows occur at mid-year:

Expected return calculation	7.00%
Plan year	2010
Beginning of year values	
Market value at 1-1	580,000
Middle of year values	
Benefit pmt + expenses + contrib	(35,000)
Expected return (compound)	39,396

Fall 2010 EA-2A Exam Solutions

Problem 46 – Page 2

Revised 09/07/18

Now you can calculate the cash flow adjustment for 2010. This is the sum of the cash flows and the expected return:

Adjustment for year

Year	2010
Trust assets at 1-1	580,000
Market value at 1-1	580,000
Receivable contribution	144,285
Benefit payments	(50,000)
Expenses	(35,000)
Contribution paid 07/01/10	50,000
Expected return (compound)	<u>39,396</u>
Adjustment for year	148,681

The 2011 market value excluding receivables was given in the problem as 795,000. After including the discounted value of the receivable contribution for 2010, the total market value is 939,285 (795,000 + 144,285).

Now you can calculate the adjusted market values. Each prior year's market value must be increased to reflect cash flows and expected interest from the date the market value is determined up to 01/01/2011:

Average market value calculation

Year	2010	2011
Market value at 1-1	580,000	939,285
Adjustment for 2010	<u>148,681</u>	
Adjusted fair market value	728,681	939,285

The preliminary actuarial asset value (AAV) is the average of the two adjusted market values:

$$833,983 = (728,681 + 939,285) / 2.$$

This preliminary actuarial asset value of 833,983 must be compared to the corridors. The final AAV must be limited to be within 10% of the market value.

The bottom of the corridor is 90% of market value, or 845,356. The top of the corridor is 110% of market value, or 1,033,213. The final actuarial value of assets is 845,356.

Answer is C

(see note on next page)

NOTE

There is an alternative solution for this problem. You can use an asset valuation technique from Revenue Ruling 2000-40 (pre-PPA 2006), and produce exactly the same AAV.

Method 15 - Smoothed market value without phase-in

The actuarial value of assets equals the market value less a decreasing fraction (i.e., $[n-1]/n$, $[n-2]/n$, etc. where n is the number of years in smoothing period) of the G/L for each of the prior $n-1$ years. The G/L is defined as the difference between the expected value and market value of assets at the valuation date. The expected value is calculated by bringing forward all cash flows with interest at the valuation rate up to this year's valuation date. If the expected value is less than the market value, the difference is a gain (and vice versa).

The actuarial value of assets is calculated using decreasing fractions of each of the prior year's gain or loss. The problem states that the averaging period is 2 years. With a two year average, the fraction is $1/2$:

$$01/11 \text{ AAV} = 01/2011 \text{ MVA} - 1/2(2010 \text{ G/L})$$

You need to calculate the value of the G/L for 2010. This is the difference between the expected value (previously calculated) and the actual market value given.

So the first thing you need to calculate is the expected MVA each year. The calculation uses the same numbers as the adjustment for the year. The 12/31 expected MVA equals the sum of the 01/01 MVA and the adjustment for the year:

$$\begin{aligned} 01/2011 \text{ eMVA} &= 01/2010 \text{ MVA} + \text{adjustment for 2010} \\ 728,681 &= 580,000 + 148,681 \end{aligned}$$

$$\begin{aligned} 2010 \text{ G/L} &= 01/2011 \text{ MVA} - 01/2011 \text{ eMVA} \\ &= 939,285 - 728,681 \\ &= 210,604 \quad (\text{Gain}) \end{aligned}$$

$$\begin{aligned} 01/11 \text{ AAV} &= 01/11 \text{ MVA} - 1/2(2010 \text{ G/L}) \\ &= 939,285 - (1/2)(210,604) \\ &= 833,983 \end{aligned}$$

This preliminary actuarial asset value of 833,983 must be compared to the corridors. The bottom of the corridor is 90% of market value, or 845,356. The final actuarial value of assets is 845,356.

This is identical to the earlier result calculated using the method in Notice 2009-22.

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Fall 2010 EA-2A Exam Solutions

Problem 47

The key to this problem is the calculation of the deductible limit under IRC 404(o). You need to know the definition of the cushion amount.

Deductible Limit

The deductible limit is defined as the greater of the minimum contribution required under IRC 430 and the amount under 404(o)(2). IRC 430 defines “the minimum required contribution” as the amount prior to reduction by the carryover balance or the prefunding balance. You don’t have enough information to calculate the shortfall amortization installment in this problem, so you should ignore the minimum contribution.

The maximum deductible limit is defined under 404(o)(2)(A):

Target normal cost + Funding target + Cushion amount - Actuarial asset value

Cushion Amount

The Cushion amount is defined as the sum of two pieces:

- (1) 50% of the Funding target, and
- (2) the increase in the Funding target due to allowing for future pay increases.

Cushion amount = 50%(FT) + Δ FT due to pay increases

This problem has a minor twist - you can not calculate the Cushion amount based on the information given. But you can write an expression that represents the cushion:

Cushion amount = 50%(1,600,000) + Δ FT due to pay increases
= 800,000 + X

Deductible Limit

Now you can develop an expression for the deductible limit:

Target normal cost	90,000
+ Funding target	1,600,000
+ Cushion amount	800,000 + X
Sub-total	2,490,000 + X
Less unreduced AAV	1,760,000
Deductible limit	730,000 + X

The deductible limit must be at least 730,000.

Answer is A

Problem 48 – Page 1

Revised 09/07/18

The IRS released Notice 2009-22 in March 2009. It includes two detailed examples of the asset valuation method in IRC 430(g)(3), which include determination of the adjustment for expected earnings. The first example is very similar to the one in the 1.430(g)-1 proposed regulation. It is essentially a three year average market value calculation. The second example shows calculation of the average market value over the four prior quarters of the plan year.

There are two calculation techniques shown for the first example in Notice 2009-22. The first one requires calculation of the adjusted cash flows, which are used to adjust market values from prior dates up to the valuation date. Then the average market value is calculated. The final actuarial value of assets is must be limited to be within 10% of the market value.

The second calculation method in Notice 2009-22 is based on the technique shown in Revenue Procedure 2000-40. The actuarial value of assets is calculated using decreasing fractions of each of the prior year's gain or loss. This exam problem does not include enough information to use this alternate calculation method.

This problem states the AAV is calculated “using annual asset values over two years of experience.” This is a bit vague, but implies that you are actually calculating the average using market values at the beginning and at the end of the two years. So the average is really calculated using market values for three years. The first step is calculation of the adjusted cash flows, which are used to adjust market values from prior dates up to the valuation date.

You must calculate the expected return each year. The problem states that the actuary’s assumed annual rate of return on assets is 7.0%. As described in Notice 2009-22, you must limit the assumed return on assets so it does not exceed the third segment rate at each valuation date. The result is that the assumed rate of return is limited to 6.0% for 2009.

You can calculate the expected return on assets for 2009 and 2010. The calculation is very simple, since all cash flows occur at mid-year:

Expected return calculation	6.00%	7.00%
Plan year	2009	2010
Beginning of year values		
Market value at 1-1	1,700,000	2,500,000
Middle of year values		
Benefit pmt + contributions	31,000	33,000
Expected return (compound)	102,916	176,135

(next page)

Fall 2010 EA-2A Exam Solutions

Problem 48 – Page 2

Revised 09/07/18

Now you can calculate the cash flow adjustment each year. This is the sum of the cash flows and the expected return:

Adjustment for year

Year	2009	2010
Trust assets at 1-1	1,700,000	2,500,000
Market value at 1-1	1,700,000	2,500,000
Receivable contribution	-	-
Benefit payments at 07/01	(31,000)	(33,000)
Expenses	-	-
Contribution paid 07/01	62,000	66,000
Expected return (compound)	<u>102,916</u>	<u>176,135</u>
Adjustment for year	133,916	209,135

Now you can calculate the adjusted market values. Each prior year's market value must be increased to reflect cash flows and expected interest from the date the market value is determined up to 01/01/2011:

Adjusted market value calculation

Year	2009	2010	2011
Market value at 1-1	1,700,000	2,500,000	2,450,000
Adjustment for 2009	133,916		
Adjustment for 2010	<u>209,135</u>	<u>209,135</u>	
Adjusted fair market value	2,043,052	2,709,135	2,450,000

The preliminary actuarial asset value (AAV) is the average of the three adjusted market values:

$$2,400,729 = (2,043,052 + 2,709,135 + 2,450,000) / 3.$$

This preliminary actuarial asset value of 2,400,729 must be compared to the corridors. The final AAV must be limited to be within 10% of the market value.

The bottom of the corridor is 90% of market value, or 2,205,000. The top of the corridor is 110% of market value, or 2,695,000. The final actuarial value of assets is 2,400,729.

Answer is C

NOTE

If you use simple interest to calculate the expected return, your values for 2009 and 2010 will be slightly larger. The final AAV is 2,400,747.

Fall 2010 EA-2A Exam Solutions

Problem 49 – Page 1

Revised 06/24/12

The key to this problem is that you must know how to do calculations under the Entry Age Normal method. The main point of this question is handling of the salary scale when you calculate the Entry Age Normal accrued liability.

In general, the Entry Age Normal Cost (EANC) is defined as the present value of benefits at entry age, divided by a temporary annuity at entry age. With a salary scale assumption, the EANC is defined so that it is equal to a level percentage of pay at each age.

$$EANC = PVB_{EA} / {}^s\ddot{a}_{\overline{EA:RA-EA}|}$$

Age 50 at 01/01/11

Entry age 33

Past service 17

Based on the exam conditions, normal retirement age is 65 by default. To calculate the present value of future benefits, you need to calculate the projected monthly benefit at age 65.

Retirement age	65
Projected service	15
2010 pay - age 49	100,000
Age 64 pay	$155,797 = 100,000(1.03)^{15}$
Projected benefit	$77,898 = 50\%(155,797)$
PVB at entry age	$77,898(D_{65} / D_{33}) \ddot{a}_{65}^{(12)}$

There are no commutation functions given. Based on 2010 exam condition 15, there are no pre-retirement decrements. You need to use an interest-only discount at 6% for periods prior to age 65.

The problem asks for the accrued liability at 01/01/2011. There are three ways to calculate the EAN accrued liability. The prospective and retrospective formulas require you to calculate the Entry Age Normal cost:

Prospective

$$EAN AL = PVB - PV(EANC)$$

Retrospective

$$EAN AL = (EANC) {}^s\ddot{s}_{\overline{33:17}|}$$

Fall 2010 EA-2A Exam Solutions

Problem 49 – Page 2

Revised 09/13/12

The third formula uses the ratio of two annuities (at entry age) times the PVB at the current age:

$$\begin{aligned}\text{EAN AL} &= \text{PVB} * \left(\frac{{}^s\ddot{a}_{\overline{\text{EA:CA}-\text{EA}}}|}}{{}^s\ddot{a}_{\overline{\text{EA:RA}-\text{EA}}}|}} \right) \\ &= \text{PVB} * \left(\frac{{}^s\ddot{a}_{\overline{33:17}}|}}{{}^s\ddot{a}_{\overline{33:32}}|}} \right)\end{aligned}$$

Now you must evaluate these annuities. There are no pre-retirement decrements, but you need to evaluate an increasing temporary annuity:

$$\begin{aligned}{}^s\ddot{a}_{\overline{33:17}}| &= [1 + (1.03/1.06)^1 + (1.03/1.06)^2 + \dots + (1.03/1.06)^{16}] \\ &= \ddot{a}_{\overline{17}|j} \text{ where } 1+j = 1.06/1.03 \rightarrow j = 2.913\% \\ &= 13.6454\end{aligned}$$

$${}^s\ddot{a}_{\overline{33:32}}| = \ddot{a}_{\overline{32}|2.913\%} = 21.2343$$

Now you can calculate the PVB at current age, and then the EAN accrued liability:

$$\begin{aligned}\text{PVB at age 50} &= 77,898(D_{65} / D_{50}) \ddot{a}_{65}^{(12)} \\ &= 77,898(v^{15} {}_{15}p_{50}) \ddot{a}_{65}^{(12)} \\ &= 77,898(1.06)^{-15}(11.3119) \\ &= 367,685\end{aligned}$$

$$\begin{aligned}\text{EAN AL} &= 367,685(13.6454 / 21.2343) \\ &= 236,278\end{aligned}$$

Answer is D

NOTE

You can also check your work by calculating the EAN accrued liability using one of the other two formulas. I will leave that as an exercise for the student.

Fall 2010 EA-2A Exam Solutions

Problem 50 – Page 1

The key to this problem is the calculation of the Shortfall amortization base at both 01/01/2010 and 01/01/2011 under IRC Section 430. Both the carryover balance (CB) and the prefunding balance (PB) are equal to zero at 01/01/2010.

The problem asks for the "smallest amount" at 01/01/11. Based on 2010 exam conditions 26 and 27, the plan sponsor elects to offset both the CB and the PB against the minimum contribution under IRC 430. Based on exam condition 31, the "smallest amount" reflects offsetting both the CB and the PB against the minimum contribution.

The first step in the problem is to go back to 2010 and determine the amount of the shortfall base and the shortfall amortization installment. Then you can do the same calculations for 2011, and determine the 2011 minimum required contribution.

2010 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance and the carryover balance.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 850,000 - (636,000 - 0 - 0) \\ &= 214,000\end{aligned}$$

2010 Shortfall Base Exemption

You should think about whether this plan satisfies the shortfall base exemption. I will define the "modified funding shortfall" as the modified funding target less the modified assets. If the "modified funding shortfall" is less than or equal to zero, then you would not have to set up the Shortfall base for 2010:

- Modified funding target: the applicable percentage times the funding target
- In the absence of any information to the contrary, you can assume the applicable percentage is 96%
- Modified assets: if any portion of the prefunding balance is applied toward the minimum required contribution, the modified assets equal AAV - PB. Otherwise, the modified assets equal the AAV with no reduction.

$$\begin{aligned}\text{Modified S/F} &= 96\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= .96 * (850,000) - (636,000 - 0) \\ &= 180,000\end{aligned}$$

The modified shortfall calculation above offsets the entire PB against the AAV. In general, the only time you should not do this is when the problem states that the plan sponsor does not elect to apply the CB and the PB against the MRC, or when the PB is equal to zero.

Fall 2010 EA-2A Exam Solutions

Problem 50 – Page 2

2010 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2010 shortfall amortization base, which is equal to

1. The Applicable percentage times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments:

The problem states that no shortfall bases were established for 2008 and 2009.

$$\begin{aligned}\text{S/F Amort base} &= (\text{Applicable \%}) * (\text{Funding target}) - (\text{AAV-CB-PB}) - (\text{PV of PY Amortizations}) \\ &= .96 * 850,000 - (636,000 - 0 - 0) - (\text{PV of PY Amortizations}) \\ &= 180,000\end{aligned}$$

You must calculate the shortfall amortization installment for 2010. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= 180,000 / 5.9982 \\ &= 30,009\end{aligned}$$

Now that you have the 2010 shortfall amortization, you must re-do all those calculations based on the 2011 valuation date.

2010 Minimum Required Contribution

The problem states that the 2010 plan year contribution was 200,000 at 01/01/2010. You need to calculate the amount of the minimum required contribution (MRC) to see how much excess contribution is made at 01/01/2010. Based on 2010 exam condition 26, the plan sponsor elects to credit the maximum amount of such excess towards the prefunding balance.

In general, the MRC is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 100,000 + 30,009 + 0 \\ &= 130,009\end{aligned}$$

2011 Prefunding balance

There is an excess contribution of 69,991 (equal to 200,000 minus 130,009) at 01/01/2010. This amount must be brought forward to 01/01/2011 with the 2010 effective interest rate:

$$\begin{aligned}\text{01/2011 PB} &= (\text{01/2010 excess}) * (1 + \text{effective rate}) \\ &= 69,991 * (1.060) \\ &= 74,190\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 50 – Page 3

Option 1 versus Option 2

There are two sets of calculations you must make for 2011. If the plan sponsor chooses Option 1, they elect to reduce the entire PB to zero. If the plan sponsor chooses Option 2, they do not elect to reduce any of the PB. This will affect the amount of the shortfall base for 2011, as well as the 2011 MRC.

Option 1 - 2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance and the carryover balance.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 986,800 - (902,000 - 0 - 0) \\ &= 84,800\end{aligned}$$

Option 1 - 2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is identical to the previously calculated Funding shortfall:

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

Option 1 - 2011 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. 100% times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments:

$$\begin{aligned}\text{S/F Amort base} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * 986,800 - (902,000 - 0 - 0) - (\text{PV of PY Amortizations}) \\ &= 986,800 - 902,000 - 30,009 * 5.2932 \\ &= -74,044\end{aligned}$$

You must calculate the shortfall amortization installment for 2011. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= -74,044 / 5.9982 \\ &= -12,344\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 30,009 - 12,344 \\ &= 17,665\end{aligned}$$

Fall 2010 EA-2A Exam Solutions

Problem 50 – Page 4

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. The shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Option 1 - 2011 Minimum Required Contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 120,000 + 17,665 + 0 \\ &= 137,665\end{aligned}$$

Option 1 - 2011 Smallest amount

The problem asks for “the smallest amount that satisfies the minimum funding standard”:

$$\begin{aligned}\text{Smallest contr} &= \text{MRC} - \text{CB} - \text{PB} \\ &= 137,665 - 0 - 0 \\ \text{X} &= 137,665\end{aligned}$$

Now you need to re-do all the 2011 calculations based on not reducing any portion of the 74,190 PB.

Option 2 - 2011 Funding Shortfall

The funding shortfall is defined as the excess of the funding target over the 430(f)(4)(B) assets, which equals the actuarial value of assets less the prefunding balance and the carryover balance.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 986,800 - (902,000 - 0 - 74,190) \\ &= 158,990\end{aligned}$$

Option 2 - 2011 Shortfall Base Exemption

You do not need to think too much about whether this plan satisfies the shortfall base exemption. The transition rule for the applicable percentage expired at the end of the 2010 plan year. The modified funding shortfall is almost identical to the previously calculated Funding shortfall:

$$\begin{aligned}\text{Modified S/F} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{PB}) \\ &= \text{NOT zero}\end{aligned}$$

Option 2 - 2011 Shortfall amortization installment

The plan is not eligible for the shortfall base exemption. You have to set up the 2011 shortfall amortization base, which is equal to

1. 100% times the Funding target
2. Minus the Actuarial asset value reduced by both CB and PB
3. Minus the present value of prior years' shortfall and waiver amortization installments

Fall 2010 EA-2A Exam Solutions

Problem 50 – Page 5

Revised 10/28/11

$$\begin{aligned}\text{S/F Amort base} &= 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations}) \\ &= 1.0 * 986,800 - (902,000 - 0 - 74,190) - (\text{PV of PY Amortizations}) \\ &= 986,800 - 827,810 - 30,009 * 5.2932 \\ &= 147\end{aligned}$$

You must calculate the shortfall amortization installment for 2011. You are given the 7 year annuity factor:

$$\begin{aligned}\text{S/F amort} &= 147 / 5.9982 \\ &= 24\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 30,009 + 24 \\ &= 30,033\end{aligned}$$

The shortfall amortization charge is defined as the sum of all the shortfall amortizations. The shortfall amortization charge is limited so it is never less than zero. It is allowable for any individual shortfall amortization installment to be less than zero.

Option 2 - 2011 Minimum Required Contribution

In general, the minimum required contribution (MRC) is defined as the target normal cost plus the shortfall amortization charge and the waiver amortization charge, all at the valuation date.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 120,000 + 30,033 + 0 \\ &= 150,033\end{aligned}$$

Option 2 - 2011 Smallest amount

The problem asks for “the smallest amount that satisfies the minimum funding standard”. Based on the exam conditions, this reflects a reduction in the MRC due to the CB and PB:

$$\text{Smallest contr} = \text{MRC} - \text{CB} - \text{PB}$$

2010 Exam condition 27 states that the plan sponsor's funding ratio for the prior year was at least 80%, so they are eligible to apply both the CB and the PB against the MRC. Since this problem gives you the prior year's valuation results, you should not rely on exam condition 27. You should check the "funding ratio" for the prior year to be sure that the plan can apply the CB and the PB towards the MRC.

The “funding ratio” is defined in IRC 430(f)(3)(C):

$$\text{Funding ratio} = \frac{\text{AAV} - \text{PB}}{\text{Funding Target (non At-Risk)}}$$

Fall 2010 EA-2A Exam Solutions

Problem 50 – Page 6

Revised 10/29/13

$$\begin{aligned}\text{Funding ratio} &= (636,000 - 0) / 850,000 \\ &= 74.82\%\end{aligned}$$

Since the funding ratio is less than 80%, the plan sponsor can NOT elect to apply the CB and PB toward the 2011 MRC:

$$\begin{aligned}\text{Smallest contr} &= \text{MRC} - \text{CB} - \text{PB} \\ &= 150,033 - 0 - 0 \\ Y &= 150,033\end{aligned}$$

The question asks for X minus Y. The answer is $-12,368 = 137,665 - 150,033$.

Answer is B

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Problem 51 – Page 1**Revised 07/31/13**

With an individual cost method, there are two things to be aware of. One is that you should check the Full Funding Limitation (FFL) if you have sufficient information. The other is that you should check for experience gains or losses each year.

The problem asks for the "smallest amount" at 12/31/2011. Based on exam condition 31, the "smallest amount" reflects offsetting the funding standard account credit balance (CB) against the minimum contribution.

2010 G/L calculation

The hidden trick in this question is that you need to set up a gain / loss base for 2010. You must know the non-investment G/L formula. The problem specifies the cost method as Entry age normal, but that does not affect the solution. The G/L calculations are the same for all individual cost methods.

Since there were no cash flows prior to 12/31/2010, the investment G/L is zero for 2010. The only source of G/L is the non-investment G/L.

$$\text{Non-inv G/L} = {}_e\text{AL}_1 - \text{AL}_1$$

$$\begin{aligned} {}_e\text{AL}_1 &= (1+i)(\text{AL}_0 + \text{NC}_0) - (\text{actual benefit payments} + i) \\ &= 1.07*(1,000,000 + 200,000) - 0 \\ &= 1,284,000 \end{aligned}$$

$$\text{AL}_1 = 1,184,000$$

$$\begin{aligned} \text{Total G/L} &= \text{non-inv G/L since the investment G/L is zero} \\ &= {}_e\text{AL}_1 - \text{AL}_1 \\ &= 1,284,000 - 1,184,000 \\ &= 100,000 \text{ gain} \end{aligned}$$

2011 CB calculation

The problem does not give you the value of the CB at 01/01/2011. You need to use the actuarial equation of balance to solve for the CB. Then you can complete the minimum funding standard account (MFSA).

$$01/01/11 \text{ UAL} = \text{O/S 431 bases} - \text{CB} - \text{ARA}$$

The plan effective date is 01/01/2010, so there are 14 years left in the MFSA amortization base for the Initial accrued liability.

$$\text{O/S 431 base} = 1,000,000 * (\ddot{a}_{\overline{14}|.07} / \ddot{a}_{\overline{15}|.07})$$

Fall 2010 EA-2A Exam Solutions

Problem 51 – Page 2

Revised 11/12/12

$$\text{O/S 431 base} = 960,205$$

$$\begin{aligned}\text{UAL} &= \text{AL} - \text{AAV} \\ &= 1,184,000 - 350,000 \\ &= 834,000\end{aligned}$$

$$\begin{aligned}01/01/11 \text{ UAL} &= \text{O/S 431 bases} - \text{CB} - \text{ARA} \\ 834,000 &= (960,205 \text{ IAL base} - 100,000 \text{ gain base}) - \text{CB} - \text{zero}\end{aligned}$$

$$\begin{aligned}\text{CB} &= 960,205 - 100,000 - 834,000 \\ &= 26,205\end{aligned}$$

To set up the MFSA, you need to determine the amortizations for the 431 bases. Both the IAL base and the gain base have a 15 year amortization period:

$$\begin{aligned}\text{IAL amort} &= 1,000,000 / \ddot{a}_{15|.07} \\ &= 102,612\end{aligned}$$

$$\begin{aligned}\text{Gain amort} &= -100,000 / \ddot{a}_{15|.07} \\ &= -10,261\end{aligned}$$

Now you can set up the MFSA and calculate the 12/31/11 “smallest amount”:

2011 Minimum Funding Standard Account

Charges		Credits	
Normal Cost	220,000	Credit Balance	26,205
IAL amortization	102,612	Gain amortization	10,261
		12/31 minimum	x
7% interest	22,583	7% interest	2,553
Total charges	345,195	Total credits	x + 39,019

The “smallest amount” at 12/31/11 is 306,175 = 345,195 - 39,019. This includes interest to 12/31, and reflects offsetting the credit balance against the minimum contribution.

Answer is E

NOTE

Since you have an individual cost method, you should also think about the Full Funding Limitation. Since the UAL is very large, it should be clear that the FFL does not have any effect on the MFSA.

Fall 2010 EA-2A Exam Solutions

Problem 52

This problem is a simple one on selection of funding assumptions.

ASSERTION

This is true. When a retirement window is offered, more participants may opt to retire early to take advantage of any special window benefits. After the retirement window ends, there will be less incentive to retire early.

REASON

This sounds like a reasonable explanation.

Answer is A