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# FALL 2015 EA-2F EXAM SOLUTIONS

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## Fall 2015 EA-2F Exam Solutions

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These solutions were prepared based on the law as in effect at May 31, 2015. 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 3, 2019	Revised solution for problem 48
September 7, 2018	Revised solution for problems 12, 16 and 48
November 2, 2017	Revised solution for problems 47 and 48
September 29, 2017	Revised solution for problems 5, 7, 20 and 35
September 17, 2017	Revised solution for problems 30, 37, 54 and 55
August 10, 2017	Revised formatting in solutions for problems 24 and 29
November 3, 2016	Revised solution for problem 37
October 29, 2016	Revised solutions for problems 2, 18, 33 and 54
August 12, 2016	Original solutions

<u>Exam Year</u>	<u>Pass Mark</u>	<u>Percentage Who passed</u>
2015	112	52.8
2014	112	50.2
2013	103	43.8
2012	103	42.9
2011	111	48.7
2010	109	45.8
2009	107	46.7
2008	112	58.2
2007	112	53.3
2006	113	58.6

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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 2015 exam conditions 31 and 32, 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. Starting in 2011, the applicable percentage became 100%, which simplifies things considerably. In most problems, the modified funding shortfall is identical to the funding shortfall.

4. If the plan satisfies 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 new Shortfall base, as well as the new Shortfall amortization installment.

The new shortfall base is equal to

- 100% 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

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

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### Single employer minimum contribution steps - continued:

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**

2015 exam condition 31 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 31. 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:

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

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**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 2015 exam condition 35. This may be increased by the amount of any "includible employer contributions".
4. The maximum deductible limit is the greater of (1) and (3), but not greater than (2).
5. The UCL limit is equal to  $140\% \times (\text{Current Liability}) - \text{AAV}$ . 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.

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### Problem 1

This problem is a simple one on definitions under IRC 430. The plan has expected expenses of \$5,000 for 2016. The target normal cost is equal to the sum of the expected expenses and the present value of the change in the accrued benefit.

#### I. TRUE

Even though service is frozen at 12/31/2015, the pay is NOT frozen. There will be a benefit accrual for 2016 due to changes in average compensation between 12/31/2015 and 12/31/2016. The target normal cost will be greater than \$5,000 for 2016.

#### II. TRUE

Even though pay is frozen at 12/31/2015, the service is NOT frozen. There will be a benefit accrual for 2016 due to the change in service between 12/31/2015 and 12/31/2016. The target normal cost will be greater than \$5,000 for 2016.

#### III. FALSE

Since the benefit accruals are frozen, the target normal cost is equal to expected expenses of \$5,000 for 2016.

Items I and II are true.

**Answer is B**

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### Problem 2 – Page 1

Similar to 2014 #21
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This is a simplified question on the quarterly contribution requirement. 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 subject to the quarterly contribution requirement?
2. What is the amount of the required quarterly contribution installment?
3. How do you discount the payments made back to the valuation date?

#### **Subject to the quarterly contribution requirement?**

To calculate the required quarterly contribution for 2016, 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 problem states there is a funding shortfall at 01/01/2015, the plan is subject to the quarterly contribution requirement for 2016.

#### **Calculate required quarterly installment**

The next step is calculation of the required annual payment (RAP). The required annual payment (RAP) is defined as the lesser of

- 100% of last year's minimum required contribution or
- 90% of this year's minimum required contribution

In this problem, you are not given any details for calculation of the MRC. Instead, you are given the MRC for both 2015 and 2016. The required annual payment (RAP) is the lesser of the 2015 MRC (525,000) or 90% of the 2016 MRC (550,000). The resulting RAP is 495,000. The 2016 required quarterly installment is 25% of the RAP, which is 123,750.

#### **Calculate 09/15/2016 required contribution**

The problem states a single contribution of 600,000 is paid at 06/01/2016. Some of the required quarterly installments are paid on a timely basis, but the first one is not.

<u>Due date</u>	<u>Required Installment</u>	<u>Amount Available</u>	<u>OVER (UNDER)</u>
04/15/2016	123,750	0	(123,750)
07/15/2016	123,750	600,000	476,250
10/15/2016	123,750	476,250	352,500
01/15/2017	123,750	352,500	228,750

There is no contribution at 04/15/2016, which results in an underpayment of 123,750. There is a contribution of 600,000 at 06/01/2016, which is sufficient to eliminate the underpayment of 123,750, and also to cover the remaining quarterly installments.

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### Problem 2 – Page 2

To determine the value of the prefunding balance at 01/2017, you need to discount all of the contributions paid back to 01/01/2016. The difference between the discounted contribution and the 550,000 MRC is the excess 2016 contribution as of the valuation date. The prefunding balance at 01/2017 (the value of X) is equal to that amount brought forward at the 2016 effective interest rate (EIR).

The key idea of the problem is that the 2016 plan year contributions are normally discounted back to the valuation date using the 2016 effective interest rate (EIR). During any time period for which there is an underpayment of the required quarterly installments, the interest rate used for discounting is increased by 5%.

<u>Due date</u>	<u>Required Installment</u>	<u>Amount Available</u>	<u>OVER (UNDER)</u>	<u>months</u>	
04/15/2016	123,750	0	(123,750)	1.5	of underpayment
06/01/2016	N/A	600,000	476,250	5.0	discount to 01/01/16

The tricky part of this calculation is the present value of the underpayment. The 04/15/16 underpayment is eliminated by the contribution at 06/01/16. The period of underpayment is 1.5 months. The underpayment must be discounted for the period of underpayment using the penalty rate ( $11.0\% = 6.0\% + 5.0\%$ ). It must be discounted for the rest of the period back to 01/01/16 (5.0 months) at the effective rate of 6.0%.

The remaining contributions are discounted using only the EIR of 6.0%. Here is the calculation of the present value of the contributions for 2016:

$$\begin{aligned}\text{PV contrib} &= 123,750(1.11)^{-1.5/12}(1.06)^{-3.5/12} + 476,250(1.06)^{-5/12} \\ &= 120,088 + 464,826 \\ &= 584,914\end{aligned}$$

01/2016

$$\begin{aligned}\text{Excess} &= 584,914 - 550,000 \text{ MRC} \\ &= 34,914\end{aligned}$$

$$\begin{aligned}X &= 34,914(1.06) \\ &= 37,009\end{aligned}$$

**Answer is D**



### NOTES

1. You can also work the problem using simple interest, even though it may be more confusing to set it up. As expected, this produces a result in the same answer range.

$$\begin{aligned} \text{PV contrib} &= 123,750 \{ [1 + 11\%(1.5/12)]^{-1} [1 + 6\%(3.5/12)]^{-1} + 476,250 [1 + 6\%(5/12)]^{-1} \\ &= 119,972 + 464,634 \\ &= 584,606 \end{aligned}$$

$$\begin{aligned} 01/2016 \\ \text{Excess} &= 584,606 - 550,000 \text{ MRC} \\ &= 34,606 \end{aligned}$$

$$\begin{aligned} X &= 34,606(1.06) \\ &= 36,683 \end{aligned}$$

**Answer is D**

2. Based on the rule in the 09/09/2015 final regulation at 1.430(j)-1(c)(3)(ii), you can increase the 06/01/2016 overpayment with interest to the due date for the next required installment. This increases the amount available on and after 07/15/2016, but it does not change the final answer:

<u>Due date</u>	<u>Required Installment</u>	<u>Amount Available</u>	<u>OVER (UNDER)</u>
04/15/2016	123,750	0	(123,750)
06/01/2016		600,000	476,250
07/15/2016	123,750	479,731	355,981
10/15/2016	123,750	361,205	237,455
01/15/2017	123,750	240,939	117,189

$$479,731 = 476,250 * (1.06)^{1.5/12}$$

$$361,205 = 355,981 * (1.06)^{3/12}$$

$$240,939 = 237,455 * (1.06)^{3/12}$$

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### Problem 3 – Page 1

Similar to 2013 #54

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 using the commutation functions 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.

$$EANC = PVB_{EA} / \ddot{a}_{EA:RA-EA}$$

### 01/01/16 data

In this problem, the benefits are not based on pay. As a result, the annuity in the denominator has no salary scale, which simplifies the calculations.

	<b>Smith</b>
Hire age	60
Entry age	60
Past service	1
Total service	5
01/01/16 age	61

Based on the exam conditions, normal retirement age is 65 by default. To calculate the present value of future benefits at entry age, you need to calculate the projected monthly benefit at NRA.

### Accrued Liability

The problem asks for the total accrued liability at 01/01/2016. 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

$$EAN AL = (EANC) \ddot{s}_{EA:CA-EA}$$

The third formula uses the ratio of two annuities (at entry age) times the PVB at the current age:

$$EAN AL = PVB_{CA} * ( \ddot{a}_{EA:CA-EA} / \ddot{a}_{EA:RA-EA} )$$

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### Problem 3 – Page 2

I will use the retrospective formula to calculate the accrued liability. The first step is calculation of the EANC at age 60:

$$\begin{aligned}\text{Proj ben} &= 5(\$1,000) \\ &= 5,000\end{aligned}$$

$$\begin{aligned}\text{PVB}_{65} &= 5,000 \ddot{a}_{65}^{(12)} \\ &= 5,000(N_{65}^{(12)} / D_{65}) \\ &= 5,000(115,172/11,394) \\ &= 50,541\end{aligned}$$

$$\text{EA NC} = \text{PVB}_{\text{EA}} / \ddot{a}_{\overline{\text{EA:RA-EA}}}$$

Since there are no pre-retirement decrements (based on the default exam conditions), the annuity is calculated using only interest:

$$\begin{aligned}\text{EANC}_{60} &= 50,541(1.07)^{-5} / \ddot{a}_{\overline{5}|7.0\%} \\ &= 50,541 / \ddot{s}_{\overline{5}|7.0\%} \\ &= 8,214\end{aligned}$$

Now you can calculate the EAN accrued liability:

$$\text{EAN AL} = (\text{EANC}) \ddot{s}_{\overline{\text{EA:CA-EA}}}$$

	<b>Smith</b>
Entry age	60
01/01/16 age	61
$\ddot{s}_{\overline{\text{EA:CA-EA}}}$	$\ddot{s}_{\overline{1} 7.0\%} = 1.07$
EAN AL	$8,214(1.07)$ $= 8,789$

**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.

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### Problem 4 – Page 1

The key to this problem is knowing a special amortization rule for multiemployer plans. The problem states that the plan is amended on 12/31/2015 to provide a one-time payment for retirees at 12/31/2016. This plan amendment increases the plan's liability by 30,000.

Under IRC 431(b)(7)(G), benefits which are not paid as a life annuity, but for a period less than 15 years, must be amortized over that same period of years. In this question, the increase in liability must be amortized over a one year period.

You are given the outstanding amount of various bases, as well as the remaining number of years. You need to calculate the amortization payments for each base:

$$\begin{aligned}\text{Combined amort} &= 800,000 / \ddot{a}_{8|.07} \\ &= 125,210\end{aligned}$$

$$\begin{aligned}\text{Gain amort} &= 300,000 / \ddot{a}_{13|.07} \\ &= 33,547\end{aligned}$$

$$\begin{aligned}\text{Loss amort} &= 195,000 / \ddot{a}_{14|.07} \\ &= 20,839\end{aligned}$$

$$\begin{aligned}\text{Loss amort} &= 100,000 / \ddot{a}_{15|.07} \\ &= 10,261\end{aligned}$$

The problem asks for the "smallest amount" at 12/31/2016. Based on 2015 exam condition 35, the "smallest amount" reflects offsetting the funding standard account credit balance (CB) against the minimum contribution. Now you can set up the MFSA and calculate the 12/31/16 "smallest amount":

2016 Minimum Funding Standard Account			
Charges		Credits	
Normal Cost	200,000	Credit Balance	25,000
Combined base	125,210	Gain	33,547
Loss	20,839		
Loss	10,261	12/31 minimum	x
Plan change	30,000		
7.0% interest	27,042	7.0% interest	4,098
Total charges	413,352	Total credits	x + 62,645

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### Problem 4 – Page 2

The “smallest amount” at 12/31/16 is  $350,706 = 413,352 - 62,645$ . This includes interest to 12/31, and reflects offsetting the credit balance against the minimum contribution.

**Answer is D**

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### Problem 5 – Page 1

Similar to 2013 #44

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 key to this problem is reading the question carefully. There is a plan amendment effective 01/01/2016. The problem gives you 2016 valuation results that do not reflect that amendment.

The problem asks for the "smallest amount" at 12/31/2016. Based on 2015 exam condition 35, the "smallest amount" reflects offsetting the funding standard account credit balance (CB) against the minimum contribution.

### **2016 Plan amendment**

One simplification to the question is that you do not need to set up a new G/L base at 01/01/2016. The problem gives you the MFSA amortization charges and credits before the plan amendment, which already reflects the G/L base.

The problem gives you different benefit accrual rates for retirement before 01/01/2016 and on and after that date. You can determine the normal cost and accrued liability before and after the plan amendment. The plan amendment only affects the active participants at 01/01/2016 (but there are no inactive participants).

Since the cost method is Unit Credit, both the normal cost and accrued liability will reflect the new benefit level:

		<b>\$25 Benefit Rate before Amendment</b>		<b>\$26 Benefit Rate after amendment</b>
Active accrued Liability		1,000,000	* (26/25) =	1,040,000
Normal cost		35,000	* (26/25) =	36,400
Plan chg base	=	1,040,000 - 1,000,000		
	=	40,000		
Plan amort	=	40,000 / $\ddot{a}_{15 0.06}$		
	=	3,885		

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### Problem 5 – Page 2

Revised 09/29/17

Now you can set up the MFSA and calculate the 12/31/16 “smallest amount”:

2016 Minimum Funding Standard Account			
Charges		Credits	
Normal Cost	36,400	Credit Balance	500
Amortization charges	1,000		
Plan chg amortization	3,885	12/31 minimum	x
6% interest	2,477	6% interest	30
Total charges	<u>43,762</u>	Total credits	<u>x + 530</u>

The “smallest amount” at 12/31/16 is  $43,232 = 43,762 - 530$ . This includes interest to 12/31, and reflects offsetting the credit balance against the minimum contribution.

There is one final step required - you need to check the Full Funding Limitation (FFL).

$$\begin{aligned}\text{\$431 "ERISA" FFL} &= (1+i) \cdot (\text{NC} + \text{AL}) - (1+i) \cdot [\text{lesser (MVA, AAV)} - \text{CB}] \\ &= 1.06 \cdot (36,400 + 1,040,000) - 1.06 \cdot (985,000 - 500)\end{aligned}$$

The FFL is about 100,000 and clearly exceeds the Minimum Funding Standard Account (MFSA) charges less the amortization credits. There is no FFL credit for 2016, and the "smallest amount" is 43,232.

**Answer is D**

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### Problem 6

Similar to 2014 #47

The key to this problem is doing calculations under the Aggregate (AGG) cost method. Another point of the problem is handling of the credit balance.

The normal cost is equal to the present value of future normal costs (PVNC) divided by the average temporary annuity for active participants. In this problem, you are given the present value of future compensation. You must calculate the average temporary annuity including a salary scale.

Under the Aggregate method, there is no unfunded accrued liability. The general formula for the PVNC allows for any prior amortization bases, which could include waiver amortization bases, or bases due to a change away from the “shortfall method”.

$$\begin{aligned}\text{AGG PVNC} &= \text{PVB} - \text{AAV} - (\text{O/S 431 bases} - \text{CB}) \\ &= 45,000,000 - 35,000,000 - (0 - 50,000) \\ &= 10,050,000\end{aligned}$$

$$\begin{aligned}\text{PVE/E} &= 25,000,000 / 2,500,000 \\ &= 10.00\end{aligned}$$

$$\begin{aligned}\text{AGG NC} &= 10,050,000 / 10.00 \\ &= 1,005,000\end{aligned}$$

The problem asks for the “smallest amount” at 12/31/2016. Based on 2015 exam condition 35, the “smallest amount” reflects offsetting the funding standard account credit balance (CB) against the minimum contribution. Now you can set up the MFSA and calculate the 12/31/16 “smallest amount”:

2016 Minimum Funding Standard Account			
Charges		Credits	
Normal Cost	1,005,000	Credit Balance	50,000
		12/31 minimum	x
6.0% interest	60,300	6.0% interest	3,000
Total charges	<u>1,065,300</u>	Total credits	<u>x + 53,000</u>

The “smallest amount” at 12/31/16 is  $1,012,300 = 1,065,300 - 53,000$ . This includes interest to 12/31, and reflects offsetting the credit balance against the minimum contribution.

**Answer is C**



## Fall 2015 EA-2F Exam Solutions

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### Problem 7 – Page 1

Similar to 2013 #54

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 using the commutation functions 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.

$$EA\ NC = PVB_{EA} / \ddot{s}_{\overline{EA:RA-EA}|}$$

### 01/01/2016 data

In this problem, the benefits are not based on pay. As a result, the annuity in the denominator has no salary scale, which simplifies the calculations. You are given data for one participant.

	<b>Smith</b>
Date of birth	01/01/55
01/01/16 age	61
Date of hire	01/01/10
01/01/16 service	6
Hire / entry age	55

### Accrued Liability

This problem states that the assumed retirement age is changed from 65 to 70. Based on the exam conditions, normal retirement age is 65 by default. One subtle point of the problem is the definition of the benefit after NRA 65.

The problem states that the plan suspends benefits and provides suspension of benefits notices. Based on the rules in the 1.411(b)-2 proposed regulation (covered on the EA-2L exam syllabus), the benefit after age NRA 65 should be calculated based on continuing benefit accrual service.

You must calculate the decrease in the accrued liability due to the change. To calculate the present value of future benefits at entry age, you need to calculate the projected monthly benefit at both age 65 and age 70.

## Fall 2015 EA-2F Exam Solutions

### Problem 7 – Page 2

#### Accrued Liability

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

$$\text{EAN AL} = (\text{EANC}) \ddot{a}_{\overline{\text{EA:CA-EA}}|}$$

The third formula uses the ratio of two annuities (at entry age) times the PVB at the current age:

$$\text{EAN AL} = \text{PVB}_{\text{CA}} * ( \ddot{a}_{\overline{\text{EA:CA-EA}}|} / \ddot{a}_{\overline{\text{EA:RA-EA}}|} )$$

I will use the third formula to calculate the accrued liability. The first step is calculation of the projected benefit, and the present value of future benefits at 01/01/16:

Assumed retirement age	65	70
Entry age	55	55
Total service	10	15
Projected benefit	10(12)(\$45) = 5,400	15(12)(\$45) = 8,100
	$5,400 N_{65}^{(12)} / D_{61}$	$8,100 N_{70}^{(12)} / D_{61}$
PVB at 61	= 5,400(115,172)/15,356 = 40,501	= 8,100(67,909)/15,356 = 35,821

The next step is to calculate the temporary annuity factors, and finally the accrued liability. The annuity factors use annual  $N_x$  commutation functions, which are not given in the problem data:

$$\begin{aligned} \ddot{a}_{55}^{(12)} &= N_{55}^{(12)} / D_{55} \\ &= \ddot{a}_{55} - 11/24 \end{aligned}$$

$$N_{55}^{(12)} = N_{55} - 11/24(D_{55})$$

$$\begin{aligned} N_{55} &= N_{55}^{(12)} + 11/24(D_{55}) \\ &= 290,227 + (11/24)(23,710) = 301,094 \end{aligned}$$

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### Problem 7 – Page 3

Revised 09/29/17

$$N_{61} = 168,534 + (11/24)(15,356) = 175,572$$

$$N_{65} = 115,172 + (11/24)(11,394) = 120,394$$

$$N_{70} = 67,909 + (11/24)(7,638) = 71,410$$

Assumed retirement age

**65**

**70**

$\ddot{a}_{\overline{EA:CA-EA}|}$

$$(N_{55} - N_{61}) / D_{55}$$

$$(N_{55} - N_{61}) / D_{55}$$

$\ddot{a}_{\overline{EA:RA-EA}|}$

$$(N_{55} - N_{65}) / D_{55}$$

$$(N_{55} - N_{70}) / D_{55}$$

EAN AL

$40,501(N_{55} - N_{61}) / (N_{55} - N_{65})$ $= 28,134$	$35,821(N_{55} - N_{61}) / (N_{55} - N_{70})$ $= 19,576$
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The decrease in accrued liability due to the assumption change is  $28,134 - 19,576 = 8,558$ .

**Answer is D**

NOTE

You can also check your work by calculating the EAN accrued liability using one of the other two formulas. See the next page for calculations using the Prospective formula:

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### Problem 7 – Page 4

Revised 09/29/17

Here are the calculations using the Prospective formula:

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

$$\ddot{a}_{\overline{\text{CA:RA-CA}}|}$$

Assumed retirement age

65

70

PVB at entry age 55

$$\ddot{a}_{\overline{\text{EA:RA-EA}}|}$$

EANC

$$\ddot{a}_{\overline{\text{CA:RA-CA}}|}$$

PV of EANC

PV of benefits

EAN AL

	$5,400 N_{65}^{(12)} / D_{55}$ $= 5,400(115,172) / 23,710$ $= 26,231$ $(N_{55} - N_{65}) / D_{55}$ $= (301,094 - 120,394) / 23,710$ $= 7.6213$	$8,100 N_{70}^{(12)} / D_{55}$ $= 8,100(67,909) / 23,710$ $= 23,200$ $(N_{55} - N_{70}) / D_{55}$ $= (301,094 - 71,410) / 23,710$ $= 9.6872$
	$26,231 / 7.6213$ $= 3,442$ $(N_{61} - N_{65}) / D_{61}$ $= (175,572 - 120,394) / 15,356$ $= 3.5933$	$23,200 / 9.6872$ $= 2,395$ $(N_{61} - N_{70}) / D_{61}$ $= (175,572 - 71,410) / 15,356$ $= 6.7831$
	$3,442 * 3.5933$ $= 12,368$	$2,395 * 6.7831$ $= 16,246$
	$40,501 \text{ (prior calcs)}$	$35,821 \text{ (prior calcs)}$
	$40,501 - 12,367$ $= 28,134$	$35,821 - 16,245$ $= 19,576$

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## Fall 2015 EA-2F Exam Solutions

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### Problem 8 – Page 1

Similar to 2014 #44

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. This problem does not give the IRC 430 minimum contribution, so you should ignore that item.

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 three 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.

$$\begin{aligned}\text{Cushion amount} &= 50\%(\text{FT}) + \Delta\text{FT due to pay increases} \\ &= .5(1,000,000) + (1,200,000 - 1,000,000) \\ &= 700,000\end{aligned}$$

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 2015 exam condition 45.

Target normal cost	80,000
+ Funding target	1,000,000
+ Cushion amount	700,000
Sub-total	<u>1,780,000</u>
Less unreduced AAV	800,000
Deductible limit	<u>980,000</u>

In most cases, this will be the final deductible limit - but you need to check the alternative definition, as shown on the next page.

## Fall 2015 EA-2F Exam Solutions

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### Problem 8 – Page 2

You can skip a step here, and save some time. Since the deductible limit is already in answer range E, you do not need to check the alternative definition. The final result could be higher, but it will still be in answer range E.

**Answer is E**

### NOTES

1. Some prior exam problems did not give 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.
2. Just in case you are interested, here are the details we skipped over earlier. 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	1,300,000
Sub-total	1,390,000
Less unreduced AAV	800,000
Deductible limit	590,000

The alternative definition has no effect on the deductible limit. The final deductible limit is 980,000.

## Fall 2015 EA-2F Exam Solutions

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### Problem 9

**TRUE**

This seems to make sense to me, but I don't have anything specific to cite as a basis for the answer. There is nothing in Notice 2009-22 or in the Schedule SB instructions about the assumed earnings rate.

**Answer is A**



## **Fall 2015 EA-2F Exam Solutions**

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### **Problem 10**

**TRUE**

IRC 430(f) specifies that the carryover balance and the prefunding balance are brought forward to the next year using the rate of return on plan assets.

**Answer is A**

## Fall 2015 EA-2F Exam Solutions

### Problem 11 – Page 1

Similar to 2014 #01

This problem is quite unusual, and the key idea is how to handle the unusual death benefit definition. The key to working this is knowing the details of example 3 in the 2009 regulation at 1.430(d)-1(f).

The basic idea is that you must split the death benefit into two parts. “Part A” is the amount equal to the accrued benefit, and “Part B” is the difference between the accrued benefit and 10,000. Part B decreases each year until the accrued benefit exceeds 10,000.

Since Part B does not accrue over years of service, you must use the special rule for funding a flat benefit. At 1.430(d)-1(c)(1)(ii)(D), it states that, for a benefit not based on service, you use a simple pro-rata portion of the benefit to calculate the funding target.

The fraction is 
$$\frac{\text{Service on first day of the plan year}}{\text{Service at time of event where benefit becomes payable}}$$

### Valuation calculations

You need to calculate the Target normal cost at 01/01/2016. The first step is to determine the accrued benefit at the valuation date, and one year later:

Calculation date	01/01/2016	12/31/2016
Age	60	61
Past service	10	11
Prior year's pay	60,000	$(1.05) * 60,000$ $= 63,000$
F AE-5	60,000	$(1/5)(4 * 60,000 + 63,000)$ $= 60,600$
Accrued benefit	$1\%(10)(60,000)$ $= 6,000$	$1\%(11)(60,600)$ $= 6,666$

### Death benefit

The participant is currently eligible for the death benefit (no eligibility condition is specified).

Calculation date	01/01/2016	12/31/2016
Age	60	61
Accrued benefit	6,000	6,666
Total death benefit	10,000 $= 6,000 + 4,000$	10,000 $= 6,666 + 3,334$

## Fall 2015 EA-2F Exam Solutions

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### Problem 11 – Page 2

To determine the normal cost, you need to identify the change in the death benefit each year. It is less confusing to start with the death benefit that would be used for the funding target:

Valuation date	01/01/2016
Current age	60
Total death benefit	10,000 $= 6,000 + 4,000$
Decrement age	61
Death benefit for funding target	$= 6,000 + (10/11)*4,000$
Decrement age	62
Death benefit for funding target	$= 6,000 + (10/12)*4,000$
Decrement age	63
Death benefit for funding target	$= 6,000 + (10/13)*4,000$
Decrement age	64
Death benefit for funding target	$= 6,000 + (10/14)*4,000$ $= 6,000 + 2,857$

For death at age 60, the pro-rata fraction is equal to 10/10. The participant currently has 10 years of service, and the event which causes the benefit to be paid is death at age 60. For death at age 61, the pro-rata fraction is equal to 10/11. For death at age 64, the pro-rata fraction is equal to 10/14.

Now look at the 2017 valuation results:

Valuation date	01/01/2017
Current age	61
Total death benefit	10,000 $= 6,666 + 3,334$
Decrement age	61
Death benefit for funding target	$= 6,666 + (11/11)*3,334$
Decrement age	62
Death benefit for funding target	$= 6,666 + (11/12)*3,334$
Decrement age	63
Death benefit for funding target	$= 6,666 + (11/13)*3,334$
Decrement age	64
Death benefit for funding target	$= 6,666 + (11/14)*3,334$ $= 6,666 + 2,620$

## Fall 2015 EA-2F Exam Solutions

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### Problem 11 – Page 3

For death at age 61, the pro-rata fraction is equal to 11/11. The participant has 11 years of service at 01/01/17, and the event which causes the benefit to be paid is death at age 61. For death at age 62, the pro-rata fraction is equal to 11/12. For death at age 64, the pro-rata fraction is equal to 11/14.

Now you can calculate the change in the death benefit used for the 2016 target normal cost for death at age 64. It is the difference between the benefits shown above for the mortality decrement at age 64:

$$\begin{aligned} \text{Benefit for 2017 valuation} - \text{benefit for 2016 valuation} \\ X &= (6,666 + 2,620) - (6,000 + 2,857) \\ &= 666 - 238 \\ &= 428 \end{aligned}$$

**Answer is A**

That is a lot of work for a 4 point question. This is one of the most tedious calculations ever tested on the EA exams.

This asset valuation question has rarely been asked for a multiemployer plan since PPA was passed. These calculations are almost identical to those for some recent questions on single employer plans.

The approved asset valuation methods in Section 3 of Revenue Procedure 2000-40 are:

- (11) Average value without phase-in
- (12) Average value with phase-in
- (15) Smoothed market value without phase-in
- (16) Smoothed market value with phase-in
- (17) Average value with alternative phase-in.

The plan can change to these asset valuation methods, and get automatic approval for the change in method. The 1.412(c)(2)-1 regulation describes the general requirements for an acceptable asset valuation method.

The Study Note (E2A-62-02) discusses the theory behind various methods, as well as variations which may be acceptable under the regulation, but which do not get automatic approval. If you change to one of these other methods, you would have to apply for approval under Revenue Procedure 2000-40.

For all of these methods, a corridor must be applied for the final actuarial value of assets. The final actuarial value of assets can't be lower than 80% of market value. The final actuarial value of assets can't be greater than 120% of market value. The final test ensures that the resulting AAV falls between 80% and 120% of the market value.

### **(15) Smoothed market value without phase-in**

This method is described in broad terms in Revenue Procedure 2000-40. The Study Note (E2A-62-02) gives a numerical example of the calculation on page 3-4. The basic idea is that you determine a gain or loss each year based on the expected value of assets versus the market value.

The actuarial value of assets is calculated using decreasing fractions of each of the prior years' gain or loss. With a five year average, the fractions are  $\frac{4}{5}$ ,  $\frac{3}{5}$ ,  $\frac{2}{5}$ , and  $\frac{1}{5}$ . With a four year average, the fractions are  $\frac{3}{4}$ ,  $\frac{2}{4}$ , and  $\frac{1}{4}$ . With a three year average, the fractions are  $\frac{2}{3}$  and  $\frac{1}{3}$ .

You are given the G/L amounts for 2011 through 2015. Unlike prior exam problems, you do not need to calculate any missing G/L items.

## Fall 2015 EA-2F Exam Solutions

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### Problem 12 – Page 2

Revised 09/07/18

Preliminary

$$\begin{aligned} 01/16 \text{ AAV} &= 01/16 \text{ MVA} - 4/5(2015 \text{ G/L}) - 3/5(2014 \text{ G/L}) - 2/5(2013 \text{ G/L}) - 1/5(2012 \text{ G/L}) \\ &= 50,000,000 - .80(9,250,000) - .60(-550,000) - .40(4,500,000) - .20(7,250,000) \\ &= 39,680,000 \end{aligned}$$

This preliminary actuarial asset value of 39,680,000 must be compared to the corridors. The final AAV must be limited to be within 20% of the market value.

$$\begin{aligned} 01/16 \text{ AAV} &= \text{Lesser of } [1.20(50,000,000) \text{ and greater of } (39,680,000 \text{ or } .80(50,000,000))] \\ &= 40,000,000 \end{aligned}$$

The bottom end of the corridor produces the final AAV.

**Answer is B**

### NOTE

In the calculation of the AAV above, asset gains are treated as positive numbers, and asset losses are treated as negative numbers. Of course this does not match the signs for the asset gains and losses given in the problem. This is a standard “trick” in the asset valuation problems on the exam.

## Fall 2015 EA-2F Exam Solutions

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### Problem 13 – Page 1

Similar to 2011 #31

The key to this problem is calculating the funding target using segment interest rates. This question simply asks for the sum of two funding target values. One value is calculated for an active employee, and another is calculated for a retired employee.

Retired FT = PV of retirement benefit

Active FT = PV of accrued benefit

This problem does not define any present value factors, but it does state that both participants are female. You have to look up the various commutation factors using the tables provided with the exam.

The commutation functions typically include both interest and mortality. Based on 2015 exam condition 18, there are no pre-retirement decrements. The present values should use interest-only discounting prior to benefit commencement age.

### Segment rates

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:

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

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

$$\text{Age } x \text{ PV} = \text{Benefit} \left\{ \ddot{a}_{x:\overline{5}|} \text{ at } 5.0\% + (1.06)^{-5} ({}_5p_x) \ddot{a}_{x+5:\overline{15}|} \text{ at } 6.0\% + (1.07)^{-20} ({}_{20}p_x) \ddot{a}_{x+20} \text{ at } 7.0\% \right\}$$

### Valuation data

Name	Smith	Jones
01/01/2016 Age	60	65
Status	Active	Retired
Annual benefit	-	10,000

## Fall 2015 EA-2F Exam Solutions

### Problem 13 – Page 2

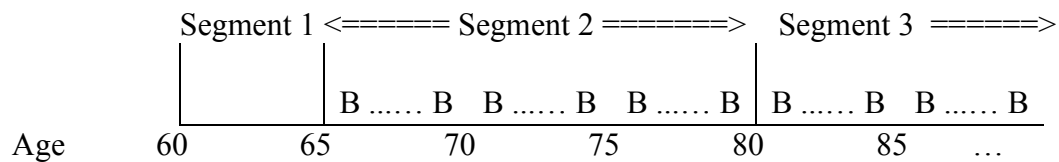
#### Funding Target - Smith

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

I will calculate the funding target for the active employee first. You are not given the accrued benefit for Smith:

Name	<b>Smith</b>
01/01/2016 Age	60
Status	Active
Past service	10
2015 pay	50,000
Accrued benefit	$2\% * 10 * 50,000$ $= 10,000$

Based on the default exam conditions, normal retirement age is 65, and the benefit is assumed payable monthly, starting at normal retirement age. The active participant is currently 5 years from retirement. Smith's benefit payments will be valued using the second and third segment rates:



One important aspect of the problem is that the pre-retirement mortality and post-retirement mortality are not the same. This means you can only use the commutation functions to do present value calculations after benefit commencement age.

Here is the formula for the Funding target using monthly annuity rates:

$$\begin{aligned}
 \text{Age 60 FT} &= 10,000 * [ {}_5| \ddot{a}_{60:\overline{15}| \text{seg}_2}^{(12)} + {}_{20}| \ddot{a}_{60 \text{ seg}_3}^{(12)} ] \\
 &= 10,000 * [ (v^5 {}_5p_{60}) \ddot{a}_{65:\overline{15}| \text{seg}_2}^{(12)} + (v^{20} {}_{20}p_{60}) \ddot{a}_{80 \text{ seg}_3}^{(12)} ]
 \end{aligned}$$

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:

$$\begin{aligned}
 {}_5| \ddot{a}_{60:\overline{15}| \text{seg}_2}^{(12)} &= (v^5 {}_5p_{60}) \ddot{a}_{65:\overline{15}| \text{seg}_2}^{(12)} && \text{all at segment 2 rate} \\
 &= (1.06)^{-5} * (N_{65}^{(12)} - N_{80}^{(12)}) / D_{65} && \text{all at segment 2 rate}
 \end{aligned}$$



## Fall 2015 EA-2F Exam Solutions

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### Problem 13 – Page 3

$$\begin{aligned} {}_{20|}\ddot{a}_{60\text{ seg}_3}^{(12)} &= (v^{20} {}_{20}p_{60}) \ddot{a}_{80\text{ seg}_3}^{(12)} && \text{all at segment 3 rate} \\ &= (1.07)^{-5} * (D_{80}/D_{65}) * (N_{80}^{(12)}/D_{80}) && \text{all at segment 3 rate} \\ &= (1.07)^{-5} * N_{80}^{(12)} / D_{65} && \text{all at segment 3 rate} \end{aligned}$$

Now you need to look up the commutation values based on the female mortality for Smith, and do the arithmetic carefully:

$$\begin{aligned} \text{FT-Smith} &= 10,000[(1.06)^{-5} * \frac{(241,929 - 47,181)}{21,225} + (1.07)^{-5} * \frac{21,161}{11,529}] \\ &= 10,000[.7473(9.1754) + .7130(1.8355)] \\ &= 81,651 \end{aligned}$$

### Funding Target - Jones

Next I will calculate the funding target for the retired employee. Since their benefits are currently in pay status, the PVB is calculated using all three segment rates. The first segment covers benefit payments from age 65 up to age 69 (5 years). The second segment covers benefit payments from age 70 up to age 84 (15 years). The third segment rate is used to value benefit payments at and after age 85.

Here is the formula for the PVB as a retiree using monthly annuity rates:

$$\begin{aligned} \text{FT-Jones} &= 10,000 * [ \ddot{a}_{65:\overline{5}| \text{ seg}_1}^{(12)} + {}_5|\ddot{a}_{65:\overline{15}| \text{ seg}_2}^{(12)} + {}_{20|}\ddot{a}_{65 \text{ seg}_3}^{(12)} ] \\ &= 10,000 * [ \ddot{a}_{65:\overline{5}| \text{ seg}_1}^{(12)} + (v^5 {}_5p_{65}) \ddot{a}_{70:\overline{15}| \text{ seg}_2}^{(12)} + (v^{20} {}_{20}p_{65}) \ddot{a}_{85 \text{ seg}_3}^{(12)} ] \end{aligned}$$

Now you need to express these annuities in terms of commutation functions. Since benefits commence at age 65, you can use commutation functions for everything:

$$\begin{aligned} \ddot{a}_{65:\overline{5}| \text{ seg}_1}^{(12)} &= (N_{65}^{(12)} - N_{70}^{(12)}) / D_{65} && \text{all at segment 1 rate} \\ {}_5|\ddot{a}_{65:\overline{15}| \text{ seg}_2}^{(12)} &= (v^5 {}_5p_{65}) \ddot{a}_{70:\overline{15}| \text{ seg}_2}^{(12)} && \text{all at segment 2 rate} \\ &= (D_{70}/D_{65}) * (N_{70}^{(12)} - N_{85}^{(12)}) / D_{70} && \text{all at segment 2 rate} \\ &= (N_{70}^{(12)} - N_{85}^{(12)}) / D_{65} && \text{all at segment 2 rate} \end{aligned}$$

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### Problem 13 – Page 4

$$\begin{aligned} {}_{20|}\ddot{a}_{65\text{ seg}_3}^{(12)} &= (v^{20} {}_{20}p_{65}) \ddot{a}_{85\text{ seg}_3}^{(12)} && \text{all at segment 3 rate} \\ &= (D_{85}/D_{65}) * (N_{85}^{(12)}/D_{85}) && \text{all at segment 3 rate} \\ &= N_{85}^{(12)} / D_{65} && \text{all at segment 3 rate} \end{aligned}$$

Now you need to look up the commutation values based on the female mortality for Jones, and do the arithmetic carefully:

$$\begin{aligned} \text{FT-Jones} &= 10,000 \left[ \frac{(488,388 - 317,693)}{39,304} + \frac{(151,747 - 21,426)}{21,225} + \frac{9,259}{11,529} \right] \\ &= 10,000[4.3429 + 6.1400 + .8031] \\ &= 112,860 \end{aligned}$$

Total Funding target is  $194,511 = 81,651 + 112,860$ .

**Answer is B**

## Fall 2015 EA-2F Exam Solutions

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### Problem 14

Similar to 2012 #18

The key to this question is knowing how to calculate the minimum contribution under both the Attained Age Normal (AAN) cost method. This is basically the same as the Frozen Initial Liability method, but the Initial Accrued liability is different. Under the AAN method, the IAL is determined based on the Unit Credit method.

The problem gives you the AAN normal cost, which allows you to derive the value of the UAL:

$$\begin{aligned}\text{AAN PVNC} &= \text{PVFB} - \text{AAV} - \text{UAL} \\ &= 815,000 - 350,000 - \text{UAL} \\ &= 465,000 - \text{UAL}\end{aligned}$$

$$\begin{aligned}\text{PVE/E} &= 2,000,000 / 175,000 \\ &= 11.4286\end{aligned}$$

$$\begin{aligned}\text{AAN NC} &= 40,000 \text{ (given)} \\ &= \text{PVNC} / (\text{PVE/E})\end{aligned}$$

$$\begin{aligned}40,000 &= (465,000 - \text{UAL}) / 11.4286 \\ 457,143 &= 465,000 - \text{UAL}\end{aligned}$$

$$\text{AAN UAL} = 7,857$$

The final step is using the actuarial equation of balance to solve for the credit balance:

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

The plan effective date is 01/01/2007, so the IAL was amortized over 30 years. The new PPA 2006 amortization periods became effective on 01/01/2008. There are only 21 years left in the initial accrued liability base at 01/01/2016:

$$\begin{aligned}\text{O/S 431 base} &= 70,000 * ( \ddot{a}_{\overline{21}|.06} / \ddot{a}_{\overline{30}|.06} ) \\ &= 59,825\end{aligned}$$

$$\begin{aligned}7,857 &= 59,825 - \text{CB} - 0 \\ \text{CB} &= 51,968\end{aligned}$$

**Answer is B**

### NOTES

1. If this problem had some MFSA calculations, then it would have been worth 4 points.
2. If you incorrectly use 15 years for the amortization of the IAL, you will fall into answer range A.

## Fall 2015 EA-2F Exam Solutions

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### Problem 15

This problem is a simple one on cost method definitions for multiemployer plans.

TRUE

In general, the cost method should be the same for calculating the maximum deductible limit and the minimum required contribution. This problem asks a slightly different question, which is how to calculate the full funding limitation.

The ERISA full funding limitation (FFL) uses both a normal cost and an accrued liability:

$$\text{\S 431 "ERISA" FFL} = (1+i) \cdot (\text{NC} + \text{AL}) - (1+i) \cdot [\text{lesser}(\text{MVA}, \text{AAV}) - \text{CB}]$$

If the funding calculations use an individual cost method, then the FFL calculation uses the same normal cost and accrued liability. If the funding calculations use an aggregate type cost method, then the FFL calculation uses the Entry Age Normal values.

Since the cost method is Entry Age Normal, the statement is true. If the cost method was an aggregate type cost method, then the statement would be false.

**Answer is A**

### NOTE

The answer for this problem was originally false, but the answer key was changed in January 2016. The implication is that you should not think about the RPA full funding limitation, which is based on the current liability. This conforms to 2015 exam condition 43:

*(43) The full funding limitations based on current liability shall be disregarded if sufficient information to determine such limitations is not provided.*

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.

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. This problem does not give you any details for the 2014 year, so you can not use this approach to work the problem.

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.

### 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 years' gain or loss. The problem states that the averaging period is 3 years. With a three year average, the fraction is  $1/3$ :

$$01/2016 \text{ AAV} = 01/2016 \text{ MVA} - 2/3(2015 \text{ G/L}) - 1/3(2014 \text{ G/L})$$

The problem states that the difference between the actual and expected returns for 2014 is 70,000. That means there was a loss for 2014 equal to 70,000. You need to calculate the value of the G/L for 2015. This is the difference between the expected value and the actual market value given.

## Fall 2015 EA-2F Exam Solutions

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### Problem 16 – Page 2

The first thing you need to calculate is the expected MVA for 2016. You must calculate the expected return on assets for 2015. The problem states that the actuary's assumed annual rate of return on assets is 7.00%. 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 third segment rate for 2015 is 5.00%, so the assumed rate of return is limited to 5.00%.

Based on the 5.00% assumed return, you can calculate the expected return on assets for 2015. The calculation must allow for the timing of the cash flows during the year.

<b>Expected return calculation</b>	<b>5.00%</b>
Plan year	<b>2015</b>
Beginning of year values	
Market value at 1-1	3,500,000
Contribution paid 04/30/2015	100,000
End of year values	
Benefit pmt + expenses	(375,000)
Expected return (simple interest)	178,333

The 12/31 expected MVA equals the sum of the 01/01 MVA and the cash flows plus expected interest for the year:

$$\begin{aligned}01/2016 \text{ eMVA} &= 01/2015 \text{ MVA} + \text{cash flows} + \text{expected interest} \\&= 3,500,000 + 100,000 + (375,000) + 178,333 \\&= 3,403,333\end{aligned}$$

$$\begin{aligned}2015 \text{ G/L} &= 01/2016 \text{ MVA} - 01/2016 \text{ eMVA} \\&= 3,825,000 - 3,403,333 \\&= 421,667 \quad (\text{Gain})\end{aligned}$$

$$\begin{aligned}01/2016 \text{ AAV} &= 01/2016 \text{ MVA} - 2/3(2015 \text{ G/L}) - 1/3(2014 \text{ G/L}) \\&= 3,825,000 - (2/3)(421,667) - (1/3)(-70,000) \\&= 3,567,222\end{aligned}$$

Note that the market values given in the problem do not include the receivable contributions. You must add the present value of the receivable contribution for the prior year that was paid on 09/15/2016. Since this is a 2015 plan year contribution, you use the 2015 effective interest rate:

$$\begin{aligned}\text{Preliminary} \\01/2016 \text{ AAV} &= 3,567,222 + 350,000 / [1 + 4.50\%(8.5/12)] \\&= 3,567,222 + 339,188 \\&= 3,906,411\end{aligned}$$

### Problem 16 – Page 3

Revised 09/07/18

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

To calculate the corridor value, you must add the present value of the receivable contribution to the market value:

$$\begin{aligned} 90\% \text{ corridor} &= .90(3,825,000 \text{ MVA} + 339,188 \text{ PV}) \\ &= .90(4,164,188) \\ &= 3,747,770 \end{aligned}$$

The final actuarial value of assets is not affected by the corridor, and remains 3,906,411.

**Answer is D**

### NOTES

1. In the calculation of the AAV above, asset gains are treated as positive numbers, and asset losses are treated as negative numbers. Of course this does not match the signs for the asset gains and losses given in the problem. This is a standard “trick” in the asset valuation problems on the exam.
2. You can also work this problem using compound interest instead of simple interest. The resulting values are slightly different, but the final result is still in answer range D:

$$\begin{aligned} \text{Expected return} &= 178,306 \\ 01/2016 \text{ MVA} &= 3,403,306 \\ 2015 \text{ G/L} &= 421,694 \quad (\text{Gain}) \end{aligned}$$

$$\begin{aligned} \text{preliminary} \\ 01/2016 \text{ AAV} &= 3,906,460 \\ 90\% \text{ corridor} &= 3,747,830 \\ \text{Final AAV} &= 3,906,460 \end{aligned}$$

## Fall 2015 EA-2F Exam Solutions

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### Problem 17

TRUE

This is a fairly simple problem on rules for waiver bases. Based on 2015 exam condition 51, you should assume this is a single employer plan.

The deadline for submitting a waiver application is 2 ½ months after the end of the plan year (March 15). See IRC 412(c)(5).

**Answer is A**



## Fall 2015 EA-2F Exam Solutions

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### Problem 18 – Page 1

Similar to 2013 #27

The key point to this problem is the calculation of the liquidity shortfall. You have to construct 12 months of disbursements from the quarterly payments you are given.

The liquidity shortfall for a quarter equals the base amount minus the liquid assets, both at the end of the quarter. It can't exceed the amount which, when added to prior installments for the plan year, increases the funding target attainment percentage (FTAP) to 100% (including the expected increase due to benefits accruing during the year).

Liquid assets are items for which there is a liquid financial market, such as cash, stocks, and bonds. The base amount equals 3 times adjusted disbursements from the plan for the 12 months ending on the last day of the quarter.

Adjusted disbursements equal all disbursements from the plan less the FTAP times the sum of annuity purchases, lump sums, and other accelerated payments. Based on the Schedule SB instructions, the FTAP is calculated by truncating to .01%.

You are given five quarters of data, but your calculation of the adjusted disbursements should only use the four quarters ending 03/31/2016.

$$\begin{aligned}\text{All Disbursements} &= \text{Expenses} + \text{Lump sums} + \text{Annuity payments} + \text{Annuity purchases} \\ &= (7,700-900) + (25,000-2,000) + (104,000-15,000) + 200,000 \\ &= 318,800\end{aligned}$$

$$\begin{aligned}\text{Accelerated payments} &= 23,000 \text{ lump sums} + 200,000 \text{ annuity purchases} \\ &= 223,000\end{aligned}$$

$$\begin{aligned}\text{01/01/2016 FTAP} &= \frac{(\text{AAV} - \text{CB} - \text{PB})}{\text{Non At-Risk FT}} \\ &= (445,000 - 0 - 0) / 700,000 \\ &= 63.57\% \text{ (truncated)}\end{aligned}$$

$$\begin{aligned}\text{Adjusted disburse.} &= 318,800 - .6357(223,000) \\ &= 177,039\end{aligned}$$

$$\begin{aligned}\text{Base amount} &= 3 * 177,039 \\ &= 531,117\end{aligned}$$

$$\begin{aligned}\text{Liquidity Shortfall} &= 531,117 \text{ base amount} - 505,000 \text{ liquid asset at 03/31/2016} \\ &= 26,117\end{aligned}$$

The trick to this calculation is using the correct asset amount. It is incorrect to use the AAV at 01/01/2016

**Problem 18 – Page 2****Revised 10/29/16****Liquidity "CAP"**

The cap on the liquidity shortfall is the amount to increase the FTAP to 100%. I'll identify this amount as "CAP". The problem states that the plan benefits have been frozen since 2002. That means that the calculation of the cap on the liquidity shortfall would use a zero normal cost.

$$100\% \text{ FTAP} = \{ \text{CAP} + (505,000 \text{ liquid asset} - 0 - 0) \} / \{ 700,000 + \text{zero TNC} \}$$

$$\begin{aligned} \text{CAP} &= 100\% * 700,000 - 505,000 \\ &= 195,000 \end{aligned}$$

The final liquidity shortfall is 26,117, since that is less than the cap amount.

**Calculate required quarterly installment**

You should also check the required quarterly installment. The required quarterly installment is defined as the greater of the amount necessary to meet the quarterly contribution requirement and the liquidity requirement. The wording in the problem actually matches that definition.

The required annual payment (RAP) is defined as the lesser of

- 100% of last year's minimum required contribution (MRC) or
- 90% of this year's minimum required contribution

In this problem, you are not given any details for calculation of the MRC. Instead, you are given the MRC for both 2015 and 2016. The required annual payment (RAP) is the lesser of the 2015 MRC (96,000) or 90% of the 2016 MRC (120,000). The resulting RAP is 96,000. The 2016 required quarterly installment is 25% of the RAP, which is 24,000.

X is equal to 26,117. This is the greater of the amount necessary to meet the quarterly contribution requirement and the liquidity requirement.

**Answer is B****NOTES**

1. The calculation of the cap on the liquidity shortfall is not 100% clear in the regulation.
2. Based on the rule in the 09/09/2015 final regulation at 1.430(j)-1(e)(2)(iii), you must separate the disbursements between the 2015 and 2016 plan years. The adjusted disbursements are calculated separately for each plan year, using the FTAP for the valuation date that falls within the plan year:

$$\begin{aligned} \text{2015 Accel. disburse.} &= 17,000 \text{ L.S.} + 200,000 \text{ annuity purchase} \\ &= 217,000 \end{aligned}$$

$$\text{2016 Accel. disburse.} = 6,000 \text{ L.S.}$$

**NOTE 2 - continued**

01/01/2015

$$\text{FTAP} = \frac{(\text{AAV} - \text{CB} - \text{PB})}{\text{Non At-Risk FT}}$$

$$= (420,000 - 0 - 10,000) / 680,000$$

$$= 60.29\% \text{ (truncated)}$$

$$\begin{aligned} \text{Adjusted disburse.} &= 318,800 - .6029(217,000) - .6357(6,000) \\ &= 184,157 \end{aligned}$$

$$\begin{aligned} \text{Base amount} &= 3 * 184,157 \\ &= 552,470 \end{aligned}$$

$$\begin{aligned} \text{Liquidity Shortfall} &= 552,470 \text{ base amount} - 505,000 \text{ liquid asset at 03/31/2016} \\ &= 47,470 \end{aligned}$$

X is equal to 47,470. This is the greater of the amount necessary to meet the quarterly contribution requirement and the liquidity requirement.

**Answer is D**

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## Fall 2015 EA-2F Exam Solutions

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### Problem 19

**FALSE**

This is a strangely worded problem on selection of actuarial assumptions. A plan is amended to allow lump sums during an early retirement window.

It does not make sense that the ONLY assumption related to this plan change is the probability of participants electing the lump sum option. In addition, I would expect the rates of retirement to be affected during the period of the early retirement window.

**Answer is B**

## Fall 2015 EA-2F Exam Solutions

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### Problem 20 – Page 1

Similar to 2013 #44

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 gives you the 2016 valuation results, as well as the Minimum Funding Standard Account (MFSA) information (excluding the new amortization base). You have the 12/31/2015 credit balance (CB), and you must determine the credit balance at 12/31/2016.

It was not 100% clear to me what the “new base” might be. The problem gives you the gain base at 01/01/2016 for the 2015 experience. I used the actuarial balance equation to determine the amount of the “new base”. The calculation is a bit simpler than some other problems, since you are given the values for the outstanding bases:

$$\begin{aligned} 01/2016 \text{ UAL} &= \text{AL} - \text{AAV} \\ &= 10,300,000 - 5,575,000 \\ &= 4,725,000 \end{aligned}$$

$$\begin{aligned} \text{O/S 431 bases} &= 7,490,000 - 1,320,000 - 95,000 + \text{NEW} \\ &= 6,075,000 + \text{NEW} \end{aligned}$$

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

$$\begin{aligned} 4,725,000 &= 6,075,000 + \text{NEW} - 1,350,000 \\ \text{NEW} &= \text{zero} \end{aligned}$$

It appears that the only new base at 01/01/2016 was the experience gain. You need to calculate the amortization payment:

$$\begin{aligned} \text{Gain amort} &= 95,000 / \ddot{a}_{15|0.0625} \\ &= 9,357 \end{aligned}$$

Now you can complete the MFSA to determine the amount of the CB at 12/31/2016:

2016 Minimum Funding Standard Account			
Charges		Credits	
Normal Cost	150,000	Credit Balance	1,350,000
Net amortization charges	1,030,000	Net amortization credits	150,000
		Gain amortization	9,357
		09/01 contribution	600,000
6.25% interest	73,750	6.25% interest	106,835
Total charges	1,253,750	Total credits	2,216,192

## Fall 2015 EA-2F Exam Solutions

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### Problem 20 – Page 2

Revised 09/29/17

The interest on the credits is calculated as  $106,835 = .0625*(1,350,000+150,000+9,357) + .0625*(4/12)(600,000) = 94,335 + 12,500$ .

At 12/31/2016, the plan has a credit balance of  $962,442 = 2,216,192 - 1,253,750$ . Don't forget - you need to check the Full Funding Limitation (FFL):

$$\begin{aligned}\S 431 \text{ "ERISA" FFL} &= (1+i)*(NC + AL) - (1+i)*[\text{lesser (MVA, AAV)} - CB] \\ &= 1.0625*(150,000 + 10,300,000) - 1.0625*(5,575,000 - 1,350,000)\end{aligned}$$

The FFL is about 5,000,000 and clearly exceeds the MFSA charges less the amortization credits. There is no FFL credit for 2016.

**Answer is D**

### NOTE

You could also use compound interest instead of simple interest to do the MFSA calculations. This gives you a slightly different credit balance. The interest on the credits is calculated as  $106,583 = .0625*(1,350,000+150,000+9,357) + 600,000*[(1.0625)^{4/12}-1] = 94,335 + 12,248$ .

At 12/31/2016, the plan has a credit balance of  $962,190 = 1,253,750 - 2,215,940$ . As expected, the result is still in answer range D.

## Fall 2015 EA-2F Exam Solutions

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### Problem 21

**TRUE**

The lookback period chosen by the plan for the 24 month segment rates is immaterial. The 25 year average HATFA rates use the same rule as under MAP-21. Here is the pertinent part of IRC Section 430(h)(2)(C)(iv)(I):

*“If a segment rate ... is less than the applicable minimum percentage, or more than the applicable maximum percentage, of the average of the segment rates described in such clause for years in the 25-year period ending with September 30 of the calendar year preceding the calendar year in which the plan year begins, then the segment rate described in such clause with respect to the applicable month shall be equal to the applicable minimum percentage or the applicable maximum percentage of such average, whichever is closest.”*

**Answer is A**



## Fall 2015 EA-2F Exam Solutions

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### Problem 22 – Page 1

Similar to 2014 #03

The key point to the problem is calculating the Projected Unit Credit (PUC) accrued liability and the normal cost. Under PUC, the accrued liability is defined as the present value of the “funding accrued benefit” (FAB). The normal cost is defined as the present value of the change in the FAB for the year.

$$AL = PV (FAB)$$

$$NC = PV (\Delta FAB)$$

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.

### 01/01/15 valuation calculations

The plan benefit is based on three year final average pay. The normal retirement age is 65 by default. You need to project pay to age 64.

01/2016 Age	55
Past service	10
Total service	20
2015 pay (age 54)	250,000
Projected pay @ 64	$= 250,000 * (1.03)^{10}$
	$= 335,979$

$$\text{FAE3 at age 65} = 265,000 \quad \text{limited by 401(a)(17)}$$

The problem told you to assume that the 401(a)(17) limit for 2016 is equal to 265,000, since the actual 2016 value could not be included in the tables provided with the 2015 exam.

I had to think a bit on this problem to be sure about how to handle the benefit. It is defined as 60% after 30 years of service. The benefit is reduced on a pro-rata basis for less than 30 years. This participant has 20 years of service at retirement:

$$\begin{aligned} \text{Projected benefit @ 65} &= (20/30) * 60\% \\ &= 40\% \end{aligned}$$

## Fall 2015 EA-2F Exam Solutions

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### Problem 22 – Page 2

For this participant, the benefit accrues at the rate of 2% per year:

$$\begin{aligned}\text{Funding Accrued benefit - ARA 65} &= 2.0\%(10)(\text{FAE3})_{65} \\ &= 2.0\%(10)(265,000) \\ &= 53,000\end{aligned}$$

The commutation functions typically include both interest and mortality. Based on 2015 exam condition 18, there are no pre-retirement decrements. The present values should use interest-only discounting prior to benefit commencement age.

You need to look up the commutation functions in the tables given with the exam. You are told that Smith is a male employee, and the interest rate is 6%:

$$\begin{aligned}\text{PUC AL} &= 53,000(v^{10} {}_{10}p_{55}) \ddot{a}_{65}^{(12)} \\ &= 53,000(v^{10})(1.0)(N_{65}^{(12)} / D_{65}) \\ &= 53,000(1.06)^{-10}(228,812/20,977) \\ &= 322,814\end{aligned}$$

**Answer is B**

## Fall 2015 EA-2F Exam Solutions

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### Problem 23

#### TRUE

The description given is the normal definition of the IRC 430 minimum required contribution.

**Answer is A**

#### NOTE

If the value of the plan assets exceeds the Funding target, then you might have a different definition of the IRC 430 minimum required contribution. It depends on the magnitude of the funding balances.

If the Funding shortfall for a year is zero, then there is a different definition of the MRC:

$$\text{Funding S/F} = \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB})$$

All existing shortfall and waiver amortization bases are considered fully amortized. In that case, the MRC is defined as the target normal cost plus the funding target minus the 430(f)(4)(B) assets, all at the valuation date:

$$\text{ALT MRC} = \text{TNC} + \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB})$$

## Fall 2015 EA-2F Exam Solutions

### Problem 24

Similar to 2014 #21

Revised 08/10/17

This is a simplified question on the quarterly contribution requirement. The key point of this question is that you must know how to apply interest adjustments to the funding balances that are applied to meet the quarterly contribution requirement.

The problem states that the 2015 required quarterly installment is 200,000. The effective interest rate (EIR) is 5%.

### Calculate 09/15/2016 required contribution

All of the required quarterly installments are met by the funding balances. There will be an overpayment available at 10/15/2016, but not enough to meet the required installment. The employer must make an additional contribution at that date.

<u>Due date</u>	<u>Required Installment</u>	<u>Amount Available</u>	<u>OVER (UNDER)</u>
01/01/2016		545,000	545,000
04/15/2016	200,000	$552,811 = 545,000(1.05)^{3.5/12}$	352,811
07/15/2016	200,000	$357,141 = 352,811(1.05)^{3.0/12}$	157,141
10/15/2016	200,000	$159,069 = 157,141(1.05)^{3.0/12}$	(40,931)

The sum of the carryover balance and the prefunding balance at 01/01/2016 is 545,000. You should increase this amount with the effective interest rate to each future due date for the required quarterly installment. At 10/15/2016, the accumulated value is less than the required installment. The employer must contribute 40,931 to satisfy the required quarterly installment.

**Answer is A**

### NOTE

You can also work the problem using simple interest. As expected, this produces a result in the same answer range.

<u>Due date</u>	<u>Required Installment</u>	<u>Amount Available</u>	<u>OVER (UNDER)</u>
01/01/2016		545,000	545,000
04/15/2016	200,000	$552,948 = 545,000[1+.05(3.5/12)]$	352,948
07/15/2016	200,000	$357,360 = 352,948[1+.05(3.0/12)]$	157,360
10/15/2016	200,000	$159,327 = 157,360[1+.05(3.0/12)]$	(40,673)

## Fall 2015 EA-2F Exam Solutions

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### Problem 25

**FALSE**

The IRC 430 minimum required contribution (MRC) is defined as of the valuation date. If the employer contribution is paid at a different date, it must be adjusted to the valuation date using the effective interest rate for the plan year.

The excess of the MRC over the discounted contribution is the unpaid minimum required contribution. The excise tax is defined as 10% of the unpaid MRC.

The trick to this question is that it implies that the contribution must be paid by the last day of the plan year. You actually can pay the contribution up until 8 ½ months after the end of the plan year.

**Answer is B**

## Fall 2015 EA-2F Exam Solutions

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### Problem 26

The key to this problem is doing calculations under the Frozen Initial Liability (FIL) cost method. The normal cost is equal to the present value of future normal costs (PVNC) divided by the average temporary annuity for active participants.

You are given valuation results prior to the plan amendment. The problem describes the plan amendment, as well as the effect on the Entry Age Normal accrued liability.

The problem asks for the FIL PVNC after the plan amendment. The problem gives you the FIL PVNC prior to the amendment:

#### Old plan benefits

$$\begin{aligned}\text{FIL PVNC} &= \text{PVB} - \text{AAV} - \text{UAL} \\ 200,000 &= 500,000 - (\text{AAV} + \text{UAL}) \\ \text{AAV} + \text{UAL} &= 500,000 - 200,000 \\ &= 300,000\end{aligned}$$

#### New plan benefits

There are no inactive participants. The projected benefit will increase by 10% for all participants:

$$\begin{aligned}\text{New plan PVB} &= 500,000 \times (1.10) \\ &= 550,000\end{aligned}$$

The UAL must be adjusted by the increase in the EAN accrued liability due to the plan change:

$$\text{New plan UAL} = 20,000 + \text{old plan UAL}$$

$$\begin{aligned}\text{FIL PVNC} &= \text{PVB} - \text{AAV} - \text{UAL} \\ &= 550,000 - (\text{AAV} + 20,000 + \text{old plan UAL}) \\ &= 550,000 - (300,000 + 20,000) \\ &= 230,000\end{aligned}$$

**Answer is C**

## Fall 2015 EA-2F Exam Solutions

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### Problem 27

This is a simplified question on determining the credit balance in the Minimum Funding Standard Account (MFSA). There really is nothing tricky about the solution.

The cost method is immaterial, since you are given the amortization charges and credits for the MFSA. You must assume those MFSA values include any 01/01/2016 experience gain / loss base.

There are two contributions paid for the 2106 plan year. One contribution is paid during the year, and the other is paid after the end of the year. For the 01/15/2017 contribution, you do not apply any interest discount. This is a difference versus single employer plans in the handling of contributions made after the end of the plan year.

Now you can complete the MFSA to determine the amount of the CB at 12/31/2016:

2016 Minimum Funding Standard Account			
Charges		Credits	
Normal Cost	26,000	Credit Balance	19,000
Net amortization charges	75,000	Net amortization credits	40,000
		09/01/16 contribution	51,000
		01/15/17 contribution	20,000
7.0% interest	7,070	7.0% interest	5,320
Total charges	108,070	Total credits	135,320

The interest on the credits is calculated as  $5,320 = .07*(19,000+40,000) + .07*(4/12)(51,000) = 4,130 + 1,190$ .

At 12/31/2016, the plan has a credit balance of  $27,250 = 135,320 - 108,070$ .

**Answer is D**

### NOTES

1. You are not given the accrued liability or asset values, so you can not check the Full Funding Limitation.
2. You could also use compound interest instead of simple interest to do the MFSA calculations. The interest on the credits is calculated as  $5,293 = .07*(19,000+40,000) + 51,000*[(1.07)^{4/12}-1] = 4,130 + 1,163$ . At 12/31/2016, the plan has a credit balance of  $27,223 = 135,293 - 108,070$ . As expected, the result is still in answer range D.

## Fall 2015 EA-2F Exam Solutions

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### Problem 28

Similar to 2012 #41

The key to this problem is knowing the gain / loss formulas. The problem asks for the mortality G/L due to the death of one retiree during 2015.

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

Smith retired at 01/01/2015 at age 65 with a ten year certain and life payment form. Since Smith is retired, the normal cost is zero.

Smith dies at 12/31/2015. They still have a liability for the remaining 9 year certain annuity. Unlike other similar recent exam problems, the benefits are paid monthly.

$$\begin{aligned}AL_0 &= 12,000 * [ \ddot{a}_{10|,06}^{(12)} + (D_{75} / D_{65}) \ddot{a}_{75}^{(12)} ] \\ &= 12,000 * [ \ddot{a}_{10|,06}^{(12)} + N_{75}^{(12)} / D_{65} ] \\ AL_1 &= 12,000 * [ \ddot{a}_{9|,06}^{(12)} ]\end{aligned}$$

You need to look up the commutation functions in the tables given with the exam. You are told that Smith is a male employee, and the interest rate is 6%:

$$\begin{aligned}D_{65} &= 20,977 \\ N_{75}^{(12)} &= 78,491\end{aligned}$$

There is a slight shortcut to 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.

$$\begin{aligned}{}_eAL_1 &= (1+i)(AL_0 + \text{zero}) - (\text{actual benefit payments} + i) \\ &= 1.06 * 12,000 * (N_{75}^{(12)} / D_{65}) - \text{zero} \quad (\text{ignoring period certain benefits}) \\ &= 1.06(12,000)(78,491/20,977) \\ &= 47,595\end{aligned}$$

$$AL_1 = \text{zero} \quad (\text{ignoring period certain benefits})$$

$$\begin{aligned}\text{Non-inv G/L} &= {}_eAL_1 - AL_1 \\ &= 47,595\end{aligned}$$

**Answer is D**



## Fall 2015 EA-2F Exam Solutions

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### Problem 29 – Page 1

Similar to 2014 #03

Revised 08/10/17

The key point to the problem is calculating the Projected Unit Credit (PUC) accrued liability and the normal cost. Under PUC, the accrued liability is defined as the present value of the “funding accrued benefit” (FAB). The normal cost is defined as the present value of the change in the FAB for the year.

$$AL = PV (FAB)$$

$$NC = PV (\Delta FAB)$$

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.

### 01/01/16 valuation calculations

The plan benefit is based on three year final average pay. The normal retirement age is 65 by default. You need to project pay to age 64.

01/2016 Age	58
Past service	31
2015 pay (age 57)	60,000

$$\begin{aligned}\text{Projected pay @ 64} &= 60,000 * (1.03)^7 \\ &= 73,792\end{aligned}$$

$$\begin{aligned}\text{FAE3 at 65} &= 73,792 * (\ddot{a}_{\overline{3}|3.0\%} / 3) \\ &= 71,664\end{aligned}$$

$$\begin{aligned}\text{Funding Accrued ben}_{58} &= 1.0\%(30)(\text{FAE3})_{65} \\ \text{Funding Accrued ben}_{59} &= 1.0\%(30)(\text{FAE3})_{65} \\ \Delta \text{Funding Accrued ben} &= \text{zero}\end{aligned}$$

One point of the problem is that the normal cost is zero. Smith has already accrued the maximum years of benefit service.

## Fall 2015 EA-2F Exam Solutions

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### Problem 29 – Page 2

$$\begin{aligned}\text{Funding Accrued ben}_{58} &= 1.0\%(30)(71,664) \\ &= 21,499\end{aligned}$$

The problem asks for the sum of \$X and \$Y. \$X is the actuarial accrued liability, which is simply the PUC accrued liability. \$Y is the normal cost, which is equal to zero.

The commutation functions typically include both interest and mortality. Based on 2015 exam condition 18, there are no pre-retirement decrements. The present values should use interest-only discounting prior to benefit commencement age.

You need to look up the commutation functions in the tables given with the exam. You are told that Smith is a female employee, and the interest rate is 6%:

$$\begin{aligned}\text{PUC AL} &= 21,499(v^7 {}_7p_{58}) \ddot{a}_{65}^{(12)} \\ &= 21,499(v^7)(1.0)(N_{65}^{(12)} / D_{65}) \\ &= 21,499(1.06)^{-7}(241,929/21,225) \\ &= 162,975\end{aligned}$$

The sum of \$X and \$Y is 162,975.

**Answer is B**

## Fall 2015 EA-2F Exam Solutions

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### Problem 30 – Page 1

Similar to 2013 #41

The key to working this problem is knowing the special rule in the final 1.430 regulations regarding bringing forward the funding balance based on two different interest rates. The calculation is based on the rule shown in example 4 of the final regulation. The portion of the prefunding balance (PB) that is attributed to the sponsor's use of the carryover balance (CB) at the beginning of the year must be increased with interest based on the plan's rate of return on assets.

#### **2015 Carryover balance**

The problem asks for the absolute value of \$X - \$Y, which is the difference between the PB and CB at 01/01/16. The problem states that the plan sponsor elects to use 20,000 of the CB to satisfy the 2016 minimum contribution requirement.

Remaining  
01/2015 CB     =     50,000 - 20,000 reduction  
                     =     30,000

#### **2015 Excess contribution**

You must calculate the amount of the excess contribution at 01/01/2015. You need to compare the present value of the 2015 contribution paid at 07/01/2016 to the MRC. The present value is calculated using the effective rate of interest for the 2015 plan year:

PV of contrib   =    $300,000 * (1.06)^{-18/12}$   
                     =     274,892

Addition to  
2015 PB        =     274,892 - (250,000 MRC - 20,000 CB applied)  
                     =     24,892 excess contribution + 20,000 CB applied

If there was no CB used, then the 01/2016 PB equals the sum of the 01/2015 PB (brought forward using the rate of return on assets for the 2015 plan year) plus the excess contribution (brought forward with the effective rate of interest for the 2015 plan year). But the calculation is not done that way, due to the special rule in the final 1.430 regulations.

The portion of the prefunding balance that is attributed to the sponsor's use of the carryover balance at the beginning of the year must be increased with interest based on the 2015 rate of return on assets.

01/2016 PB     =  $1.06(24,892 \text{ excess contribution}) + 1.10(0 \text{ PB} + 20,000 \text{ CB applied})$   
                     =     48,386

01/2016 CB     =      $30,000 * 1.10$   
                     =     33,000

## Fall 2015 EA-2F Exam Solutions

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### Problem 30 – Page 2

Revised 09/17/17

The absolute value of  $\$X - \$Y$  is 15,386, which is equal to  $48,386 - 33,000$ .

**Answer is B**

### NOTE

You get a slightly different numerical result if you use simple interest. The resulting PV of the contribution is 274,776 and the 01/2016 PB is 48,262. The absolute value of  $\$X - \$Y$  is 15,262. As expected, this is in the same answer range.

## Fall 2015 EA-2F Exam Solutions

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### Problem 31 – Page 1

Similar to 2011 #15

The key to this problem is the determination of the Funding target under IRC Section 430(i). This plan has a funding standard carryover balance (CB) of zero, based on 2015 exam condition 30. The plan has a prefunding balance (PB) of 400,000 at 01/01/2015.

#### **At-Risk Determination**

The problem gives you 2016 valuation data related to the At-Risk values for the Funding target. The problem has one simplification - it states that the plan was in At-Risk status for 2015 and 2016, so you can skip the At-Risk determination.

#### **At-Risk plan - Load factors**

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

2015 exam condition 46 defines terms related to At-Risk plans:

*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).*

This problem gives you the “At-risk funding target” and the “At-risk target normal cost”. You must apply the 5-year transition rule to these values. You are also given both values ignoring the At-Risk assumptions.

#### **At-Risk plan - Weighting factors**

The next step in the problem is determining the “final” value of the At-Risk Funding target (and the target normal cost). 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

## Fall 2015 EA-2F Exam Solutions

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### Problem 31 – Page 2

The “Final” At-Risk value will equal the sum of 2\*20% times the At-Risk value (including any load factors) and (1-2\*20%) times the non-At-Risk value. The plan is in At-Risk status for two consecutive years (2015 and 2016):

$$\begin{aligned}\text{A-R Target NC} &= 40\%*(1,200,000) + 60\%*(1,000,000) \\ &= 1,080,000\end{aligned}$$

$$\begin{aligned}\text{A-R Funding Target} &= 40\%*(18,000,000) + 60\%*(15,000,000) \\ &= 16,200,000\end{aligned}$$

The remainder of this problem is a typical IRC 430 calculation of the shortfall amortization installment.

### **Funding Shortfall**

The problem asks for \$X, which is the 2016 minimum required contribution (MRC). 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:

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 16,200,000 - (10,000,000 - 0 - 0) \\ &= 6,200,000\end{aligned}$$

### **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:

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

### **Shortfall amortization installment**

The plan is not eligible for the shortfall base exemption. You have to set up the 2016 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:

$$\text{S/F Amort base} = 100\%*(\text{Funding target}) - (\text{AAV}-\text{CB}-\text{PB}) - (\text{PV of PY Amortizations})$$

## Fall 2015 EA-2F Exam Solutions

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### Problem 31 – Page 3

This problem gives you the 01/01/2016 outstanding balances of all prior shortfall amortization installments as 4,000,000.

$$\begin{aligned}\text{S/F Amort base} &= 1.0 \times 16,200,000 - (10,000,000 - 0 - 0) - (\text{PV of PY Amortizations}) \\ &= 6,200,000 - 4,000,000 \\ &= 2,200,000\end{aligned}$$

You must calculate the shortfall amortization installment for 2016. You can use the 7 year annuity factor from the lookup tables given with the exam:

$$\begin{aligned}\text{S/F amort} &= 2,200,000 / 5.9982 \\ &= 366,777\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 366,777 + 1,500,000 \\ &= 1,866,777\end{aligned}$$

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.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 1,080,000 + 1,866,777 + 0 \\ &= 2,946,777\end{aligned}$$

**Answer is B**

## Fall 2015 EA-2F Exam Solutions

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### Problem 32

The key to this problem is the special assumptions used to determine the At-Risk Funding target. 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).

The normal retirement age is 65 by default. You need to identify which year each participant will attain age 55:

Name	Birth date	Date attain 55
Smith	01/01/62	01/01/17
Jones	01/01/67	01/01/22
Brown	01/01/72	01/01/27
Green	01/01/77	01/01/32

The cutoff for “11 years from the valuation date” is 01/01/27. For the At-risk funding target, only the participants who reach age 55 prior to that date will be assumed to retire at age 55. The first two participants satisfy that criteria.

**Answer is C**



## Fall 2015 EA-2F Exam Solutions

### Problem 33 – Page 1

Similar to 2013 #52

Revised 10/29/16

There are two key ideas in this problem:

- Calculation of 415 limits
- Calculation of the Funding target

The main point of the problem is correctly calculating the benefits for the Funding target. 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.

Valuation date	<b>01/01/15</b>
Age	37
Past service	7
Participation service	4

### **PLAN BENEFIT**

The plan benefit is based on five year final average pay. You need to apply the §401(a)(17) limit to each year of pay.

Year	Compensation	401(a)(17) limit	Limited pay
2010	100,000	N/A	100,000
2011	300,000	245,000	245,000
2012	100,000	N/A	100,000
2013	100,000	N/A	100,000
2014	300,000	260,000	260,000

5 year average pay  $161,000 = (100,000 + 245,000 + 100,000 + 100,000 + 260,000) / 5$

Accrued benefit  $101,430 = 9\%(7)(161,000)$

The key point of the problem is that you also need to consider the 415 limit.

### **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. Smith has 7 years of service at 01/01/2015:

3 year average pay  $153,333 = (100,000 + 100,000 + 260,000) / 3$

415 COMP3 limit  $107,333 = (7/10) * 153,333$

## Fall 2015 EA-2F Exam Solutions

### Problem 33 – Page 2

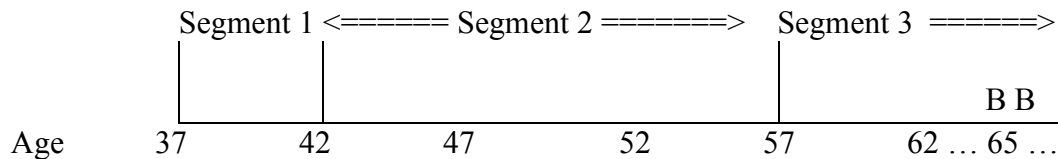
#### 415 DOLLAR LIMIT

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 4 years of participation service at 01/01/2015:

415 dollar limit	$(4/10)*210,000 = 84,000$
Final 415 limit	84,000
Final accrued benefit limited by 415	84,000

#### 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. Since the participant is currently age 37, their benefit payments will be valued using only the last segment rate:



$$\text{Age 37 FT} = (v_{28}^{28} p_{37}) \ddot{a}_{65 \text{ seg}_3}^{(12)} \quad \text{all at segment 3 rate}$$

Based on 2015 exam condition 18, there are no pre-retirement decrements. The present values should use interest-only discounting prior to benefit commencement age.

$$\begin{aligned} \text{Age 37 FT} &= 84,000 * (1.07)^{-28} (1.0)(10.11) \\ &= 127,728 \end{aligned}$$

**Answer is C**

#### NOTE

This is exactly the type of IRC 415 problem that I expect on the EA-2F exam. It is primarily a funding question, and the calculations of the 415 limit were not overly complex.

## Fall 2015 EA-2F Exam Solutions

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### Problem 34

Similar to 2013 #37

The key point of this question is knowing how to handle post-PPA 2006 waivers. This is a much shorter question than most other recent waiver questions.

#### Waiver amortization

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 2015 waiver is amortized starting in 2016. Based on the regulations, the amount of the waiver amortization payment is determined using the 2015 segment rates. The amortization factor assumes waiver payments starting in 2016, so the segment rates used are 3% for 4 years, and 4% for the fifth year. The amortization factor is calculated using an end of year annuity based on the 1<sup>st</sup> 2015 segment rate for four years, and the 2<sup>nd</sup> 2015 segment rate for one year:

$$\begin{aligned}\text{Amort factor} &= a_{\overline{4}|.03} + (1.04)^{-5} \\ &= 4.5390\end{aligned}$$

You could also use the annuity from the lookup tables with the exam:

$$4.5390 = \ddot{a}_{\overline{6}|.03 \& .04} - 1.0$$

#### Waiver amortization base

You must determine the amount of the waiver base. You need to compare the 01/01/2015 present value of the 12/31/2015 contribution to the MRC. The present value is calculated using the effective rate of interest for the 2015 plan year:

$$\begin{aligned}\text{PV of contrib} &= 20,000 * (1.04)^{-1} \\ &= 19,231\end{aligned}$$

$$\begin{aligned}\text{Unpaid MRC} &= 40,000 - 19,231 \\ &= 20,769\end{aligned}$$

$$\begin{aligned}\text{Waiver amort} &= 20,769 / 4.5390 \\ &= 4,576\end{aligned}$$

**Answer is B**

#### NOTE

The answer ranges on this question are very narrow. As a result, you can not get in the same answer range if you calculate the waiver amortization incorrectly. For example, if you incorrectly use only the first 2016 segment rate of 5%, the amortization factor is 4.3295. The resulting waiver amortization payment is 4,797, which is in the wrong answer range.

## Fall 2015 EA-2F Exam Solutions

### Problem 35

Similar to 2013 #44

Revised 09/29/17

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 01/01/2016. Based on 2015 exam condition 35, the "smallest amount" reflects offsetting the funding standard account credit balance (CB) against the minimum contribution.

The problem gives you the 2016 valuation results, as well as the MFSA information. The MFSA amortization payments exclude the new experience loss amortization base. You need to calculate the amortization payment for the loss base:

$$\begin{aligned}\text{Loss amort} &= 80,000 / \ddot{s}_{15|0.08} \\ &= 8,654\end{aligned}$$

Now you can complete the MFSA to determine the "smallest amount" at 01/01/2016:

2016 Minimum Funding Standard Account			
Charges		Credits	
Normal Cost	40,000	Credit Balance	50,000
Net amortization charges	160,000	Net amortization credits	100,000
Loss amortization	8,654	01/01 contribution	x
8.0% interest	N/A	8.0% interest	N/A
Total charges	208,654	Total credits	x + 150,000

Since the question asked for the 01/01/2016 "smallest amount", you can save time by not reflecting interest to 12/31/2016. The value of X is  $58,654 = 208,654 - 150,000$ .

**Answer is B**

### NOTES

1. This problem seems way too simple to be on the exam.
2. Don't forget - you should at least think about the Full Funding Limitation (FFL):

$$\begin{aligned}\$431 \text{ "ERISA" FFL} &= (1+i)*(NC + AL) - (1+i)*[\text{lesser (MVA, AAV)} - CB] \\ &= 1.08*(40,000 + 3,720,000) - 1.08*(2,590,000 - 50,000)\end{aligned}$$

The FFL is about 1,200,000 and clearly exceeds the Minimum Funding Standard Account (MFSA) charges less the amortization credits. There is no FFL credit for 2016.

## Fall 2015 EA-2F Exam Solutions

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### Problem 36 – Page 1

Similar to 2011 #34

Due to the payment of the minimum at 12/31/2014, you have an unpaid minimum required contribution (MRC) for 2014. Since the 12/31/2015 contribution paid is less than 2015 MRC, you also have an unpaid MRC for 2015.

The question asks for the excise tax on the unpaid minimum required contribution for 2015. The key point of the question is that the unpaid MRC for the 2015 plan year includes any unpaid minimums for all prior years. Other points of the problem are:

- What is the interest adjustment to the unpaid contribution to reflect the payment date?
- How do you calculate the amount subject to excise tax?

#### **2014 unpaid minimum**

The 2014 contribution of 750,000 is paid at 12/31/2014. You should compare the discounted value (using the 2014 effective interest rate of 7%) against the MRC at 01/01/2014. In addition, you should assume the plan sponsor elects to apply the carryover balance (CB) and the prefunding balance (PB) towards the MRC. This is based on 2015 exam conditions 28 and 29.

$$\begin{aligned}\text{PV of contrib} &= 750,000 \times (1.07)^{-1} \\ &= 700,935\end{aligned}$$

01/2014

$$\begin{aligned}\text{Unpaid MRC} &= \text{MRC} - \text{CB} - \text{PB} - (\text{PV of contrib}) \\ &= 750,000 - 0 - 0 - 700,935 \\ &= 49,065\end{aligned}$$

The 2015 contribution of 750,000 is paid at 07/01/16, which is more than two years later. Part of the 2015 contribution must be applied to eliminate the unpaid MRC for 2014. Under the proposed regulation on IRC 4971, you must use the 2014 effective interest rate of 7% to adjust the contribution from 01/01/2014 to 07/01/2016:

01/01/2015

$$\text{Unpaid MRC} = 49,065 \times (1.07)^1$$

07/01/2016

$$\begin{aligned}\text{Unpaid MRC} &= 49,065 \times (1.07)^{2.5} \\ &= 58,108\end{aligned}$$

#### **2015 unpaid minimum**

After eliminating the unpaid 2014 MRC, the remaining 2015 contribution is 691,892 (= 750,000 - 58,108) at 07/01/2016. You should compare the discounted value (using the 2015 effective interest rate of 4%) against the MRC at 01/01/15.

## Fall 2015 EA-2F Exam Solutions

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### Problem 36 – Page 2

01/01/2015

$$\begin{aligned}\text{PV of contrib} &= 691,892 \cdot (1.04)^{-1.5} \\ &= 652,362\end{aligned}$$

01/2015

$$\begin{aligned}\text{Unpaid MRC} &= \text{MRC} - \text{CB} - \text{PB} - (\text{PV of contrib}) \\ &= 850,000 - 0 - 0 - 652,362 \\ &= 197,638\end{aligned}$$

The unpaid minimum for 2015 is 197,638. The excise tax is 10% of this amount, or 19,764.

**Answer is D**

### NOTES

1. IRC 4971 defines the amount of the excise tax. But it does not have a clear definition of the precise date used to determine the unpaid minimum required contribution. The April 15, 2008 proposed regulation on IRC 4971 defines the unpaid minimum contribution as determined at the valuation date.
2. Here is the rule from the proposed regulation regarding the interest adjustment of the unpaid MRC

54.4971(c)-1(d)(2)(i)(A)

*“The correction of an unpaid minimum required contribution under a single employer plan for a plan year requires the contribution, to or under the plan, of the amount that, when discounted to the valuation date for the plan year for which the unpaid minimum required contribution is due at the appropriate rate of interest, equals or exceeds the unpaid minimum required contribution.*

*For this purpose, the appropriate rate of interest is the plan’s effective interest rate for the plan year for which the unpaid minimum required contribution is due except to the extent that the payments are subject to additional interest as provided under section 430(j)(3) or (4).”*

3. The calculations in this problem follow example 2 in the proposed regulation at 54.4971(c)-1(f).
4. You can also work this problem using simple interest. The remaining 2015 contribution is 691,859 (= 750,000 - 58,141) at 07/01/2016. The unpaid 2015 MRC at 01/01/2015 is 197,795 (= 850,000 - 0 - 0 - 652,205). The 10% excise tax is 19,780, which is also in answer range D.

## Fall 2015 EA-2F Exam Solutions

### Problem 37 – Page 1

Similar to 2014 #14

Revised 09/17/17

This problem asks for the present value of benefits for Smith. The key to this problem is handling the mortality decrements correctly in calculating the present value of future death benefits as an active employee.

### 01/01/2016 data

#### Description

Age	62	
Past service	30	
Total service at 65	33	
Projected benefit	48,000 = 20(12)(200)	(20 year maximum benefit service)

The death benefit is a 300,000 lump sum, payable at the end of the year of death. The present value of future benefits must be calculated as a complicated summation:

$$PVB = \sum_{t=0}^2 v^{t+1} {}_t p_{62}^{(T)} q_{62+t}^{(d)} (300,000) + v^3 {}_3 p_{62}^{(T)} (48,000) * \ddot{a}_{65}^{(12)}$$

#### Death benefit liability

Now you can calculate the liability for the death benefit. I will set up a column for each item in the summation formula:

	(1)	(2)	(3)	(4)	(5)		
t	62+t	$v^{t+1}$	${}_t p_{62}^{(T)}$	$q_{62+t}^{(d)}$	${}_t p_{62+t}^{(T)}$	Benefit	(1)(2)(3)(4)
0	62	.9434	1.0000	0.0063	0.9937	300,000	1,783
1	63	.8900	0.9937	0.0075	0.9925	300,000	1,990
2	64	.8396	0.9862	0.0084	0.9916	300,000	<u>2,086</u>
							5.860

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.

#### Retirement benefit liability

$$\begin{aligned} PVB-RET &= v^3 {}_3 p_{62}^{(T)} (48,000) * \ddot{a}_{65}^{(12)} \\ &= (1.06)^{-3} [(1-.0063)(1-.0075)(1-.0084)](48,000)(N_{65}^{(12)} / D_{65}) \\ &= 48,000(.8396)(.9780)(N_{65}^{(12)} / D_{65}) \end{aligned}$$

Note that the commutation functions include both interest and mortality by definition.

**Problem 37 – Page 2****Revised 09/17/17**

You need to look up the commutation functions in the tables given with the exam. You are told that Smith is a male employee, and the interest rate is 6%.

$$\begin{aligned}\text{PVB-RET} &= 48,000(.8396)(.9780)(N_{65}^{(12)} / D_{65}) \\ &= 48,000(.8396)(.9780)(228,812 / 20,977) \\ &= 429,914\end{aligned}$$

The total present value of future benefits is  $435,774 = 429,914 + 5,860$ .

**Answer is A****NOTE**

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

In the original solution, I made a risky assumption which might not be true. I assumed that the pre-retirement mortality rates given were identical to the pre-retirement mortality in the commutation factors. I got lucky, because this approach produces almost identical results:

**Retirement benefit liability**

$$\begin{aligned}\text{PVB-RET} &= v^3 {}_3p_{62}^{(T)} (48,000) * \ddot{a}_{65}^{(12)} \\ &= (D_{65} / D_{62})(48,000)(N_{65}^{(12)} / D_{65}) \\ &= 48,000(N_{65}^{(12)} / D_{62}) \\ &= 48,000(228,812 / 25,547) \\ &= 429,913\end{aligned}$$

The total present value of future benefits is  $435,773 = 429,913 + 5,860$ .



## Fall 2015 EA-2F Exam Solutions

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### Problem 38

Similar to 2013 #44

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 credit balance at 12/31/2016. Based on 2015 exam condition 35, the "smallest amount" reflects offsetting the funding standard account credit balance (CB) against the minimum contribution.

The problem gives you the 2016 valuation results, as well as the MFSA information. The MFSA amortization payments exclude the new experience gain amortization base. You need to calculate the amortization payment for the gain base:

$$\begin{aligned}\text{Gain amort} &= 110,000 / \ddot{s}_{\overline{15}|.06} \\ &= 10,685\end{aligned}$$

Now you can complete the MFSA to determine the credit balance at 12/31/2016:

<b>2016 Minimum Funding Standard Account</b>			
<b>Charges</b>		<b>Credits</b>	
Normal Cost	300,000	Credit Balance	500,000
Net amortization charges	30,000	Net amortization credits	5,000
		Gain amortization	10,685
6.0% interest	19,800	6.0% interest	30,941
Total charges	<u>349,800</u>	Total credits	<u>546,626</u>

The value of the 12/31/2016 credit balance is 196,826 (= 546,626 - 349,800).

**Answer is E**

This problem seems way too simple to be on the exam.

## Fall 2015 EA-2F Exam Solutions

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### Problem 39 – Page 1

Similar to 2014 #43

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:

$$\text{EA NC} = \text{PVB}_{\text{EA}} / \ddot{a}_{\text{EA:RA-EA}}^s$$

Age 57 at 01/01/16

Entry age 55

Past service 2

Total service 10

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
2015 pay - age 56	70,000
Age 64 pay	$95,800 = 70,000(1.04)^8$
Projected benefit	$23,950 = 2.5\%(10)(95,800)$

Now you can calculate the EANC. The first step is to calculate the PV of benefits at entry age. There are no commutation functions given. Based on 2015 exam condition 18, there are no pre-retirement decrements. You need to use an interest-only discount at 7% for periods prior to age 65.

$$\begin{aligned}\text{PVB}_{55} &= 23,950(D_{65} / D_{55}) \ddot{a}_{65}^{(12)} \\ &= 23,950(v^{10} {}_{10}p_{55}) \ddot{a}_{65}^{(12)} \\ &= 23,950(1.07)^{-10}(1.0)(12.41) \\ &= 151,091\end{aligned}$$

## Fall 2015 EA-2F Exam Solutions

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### Problem 39 – Page 2

$$\begin{aligned} \text{EA NC} &= \text{PVB}_{\text{EA}} / {}^s\ddot{a}_{\overline{\text{EA:RA}-\text{EA}}|} \\ &= 151,091 / {}^s\ddot{a}_{\overline{55:10}|} \end{aligned}$$

Now you must calculate the annuity with salary scale. There are no pre-retirement decrements, but you need to evaluate an increasing temporary annuity:

$$\begin{aligned} {}^s\ddot{a}_{\overline{55:10}|} &= [ 1 + (1.04/1.07)^1 + (1.04/1.07)^2 + \dots + (1.04/1.07)^9 ] \\ &= \ddot{a}_{\overline{10}|j} \text{ where } 1+j = 1.07/1.04 \rightarrow j = 2.885\% \\ &= 8.8282 \end{aligned}$$

$$\begin{aligned} \text{EA NC} &= 151,091 / 8.8282 \\ &= 17,115 \end{aligned}$$

The problem asks for the EA NC at 01/01/2016. The value of 17,115 corresponds to the entry age of 55.

The participant is currently age 57, and the EA NC is calculated to be a level percentage of payroll for each age. You need to increase it for two years using the salary scale of 4%:

$$\begin{aligned} \text{EA NC}_{57} &= 17,115 * (1.04)^2 \\ &= 18,511 \end{aligned}$$

**Answer is B**

#### NOTE

The 2014 compensation is a red herring. Hopefully you were not creative enough to find a way to use it in the solution. When you have a salary scale, you should apply it both backward (prior to the valuation date) and forward (prospectively).

## Fall 2015 EA-2F Exam Solutions

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### Problem 40

This is the first question on the corridors for the 25 year averaging of the segment rates. This is a question that I expected to see after MAP-21 was passed. Here are the HATFA corridors:

<u>Year</u>	<u>Applicable minimum percentage</u>	<u>Applicable maximum percentage</u>
2013-2017	90%	110%
2018	85%	115%
2019	80%	120%
2020	75%	125%
After 2020	70%	130%

For 2016, the 90% corridor for the third segment is  $6.975\% = .90(7.75\%)$ . The 24 month average third segment rate for 2016 of 5.0% falls outside the corridor. The third segment rate used for minimum funding in 2016 is increased to 6.975%.

For 2021, the 70% corridor for the third segment is  $4.90\% = .70(7.00\%)$ . The 24 month average third segment rate for 2016 of 5.0% falls within the corridor, and does not need to be adjusted. The third segment rate used for minimum funding in 2021 is equal to 5.00%.

The difference between these two rates is  $1.975\% = 6.975\% - 5.0\%$ .

**Answer is C**

### NOTE

Here are the new corridors (from the 2015 budget bill) which takes effect in 2016. These corridors delay the 85% / 115% corridor for three more years:

<u>Year</u>	<u>Applicable minimum percentage</u>	<u>Applicable maximum percentage</u>
2013-2020	90%	110%
2021	85%	115%
2022	80%	120%
2023	75%	125%
After 2023	70%	130%

Based on the new corridors, the answer to this question will be different. The third segment rate used for minimum funding in 2016 is still equal to 6.975%.

For 2021, the 85% corridor for the third segment is  $5.95\% = .85(7.00\%)$ . The 24 month average third segment rate for 2016 of 5.0% falls outside the corridor. The third segment rate used for minimum funding in 2021 is increased to 5.95%. The difference between these two rates is  $1.025\% = 6.975\% - 5.950\%$ .

## Fall 2015 EA-2F Exam Solutions

### Problem 41 – Page 1

Similar to 2009 #39

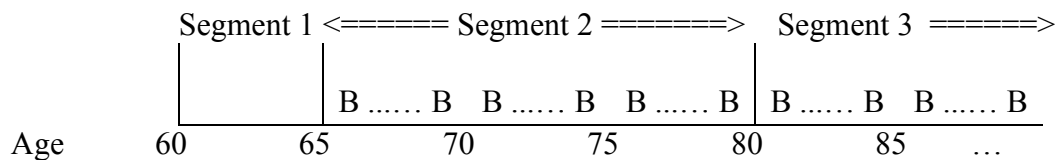
The key to this problem is knowing just a little bit about cash balance plans. In addition, you must know how to calculate the Funding target under IRC Section 430.

In this problem, the assumed payment form is a life annuity. Most other cash balance questions on the exam had an assumed payment form of lump sum. This will be a more typical Funding target calculation, which uses several segment rates to value the stream of annuity payments.

Valuation date	01/01/2016
Age	60
Current account balance	100,000

Normal Retirement age	65
Projected account balance	$121,665 = 100,000(1.04)^5$
Life annuity benefit at 65	$9,964 = 121,665/12.21$

The participant is currently 5 years from retirement. Smith's benefit payments will be valued using the second and third segment rates:



One important aspect of the problem is that the pre-retirement mortality and post-retirement mortality are not the same. Based on the default exam conditions, there is no pre-retirement mortality. This means you can only use the commutation functions to do present value calculations after benefit commencement age.

Here is the formula for the Funding target using monthly annuity rates:

$$\begin{aligned}
 \text{Age 60 FT} &= 9,964 * [ {}_{5|} \ddot{a}_{60:\overline{15}|}^{(12)}_{seg_2} + {}_{20|} \ddot{a}_{60}^{(12)}_{seg_3} ] \\
 &= 9,964 * [ (v^5 {}_5p_{60}) \ddot{a}_{65:\overline{15}|}^{(12)}_{seg_2} + (v^{20} {}_{20}p_{60}) \ddot{a}_{80}^{(12)}_{seg_3} ]
 \end{aligned}$$

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:

$$\begin{aligned}
 {}_{5|} \ddot{a}_{60:\overline{15}|}^{(12)}_{seg_2} &= (v^5 {}_5p_{60}) \ddot{a}_{65:\overline{15}|}^{(12)}_{seg_2} && \text{all at segment 2 rate} \\
 &= (1.06)^{-5} * (N_{65}^{(12)} - N_{80}^{(12)}) / D_{65} && \text{all at segment 2 rate}
 \end{aligned}$$

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### Problem 41 – Page 2

$$\begin{aligned} {}_{20|}\ddot{a}_{60 \text{ seg}_3}^{(12)} &= (v^{20} {}_{20}p_{60}) \ddot{a}_{80 \text{ seg}_3}^{(12)} && \text{all at segment 3 rate} \\ &= (1.07)^{-5} * (D_{80} / D_{65}) * (N_{80}^{(12)} / D_{80}) && \text{all at segment 3 rate} \\ &= (1.07)^{-5} * N_{80}^{(12)} / D_{65} && \text{all at segment 3 rate} \end{aligned}$$

Now you need to look up the commutation values based on the male mortality for Smith, and do the arithmetic carefully:

$$\begin{aligned} \text{FT-Smith} &= 9,964 \left[ \frac{(1.06)^{-5} * (228,812 - 38,423)}{20,977} + \frac{(1.07)^{-5} * 17,349}{11,394} \right] \\ &= 9,964 [ .7473(9.0761) + .7130(1.5226) ] \\ &= 78,398 \end{aligned}$$

**Answer is B**

### NOTE

Other exam problems have tested the determination of the Target normal cost, which is the present value of the change in the accrued benefit during the year. Under a cash balance plan, the accrued benefit increases due to the pay credit for the year.

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### Problem 42

FALSE

Announcement 2010-03 has the requirements for “takeover plans”. It is not entirely clear that the situation in this problem was the result of automatic approval, but it seems like a valid assumption. There is no requirement in 2010-03 that the new actuary perform an experience study of the actuarial assumptions.

**Answer is B**

### NOTE

In Announcement 2010-03, there are several criteria that must be met for automatic approval:

- Change in both the actuarial firm, and the enrolled actuary
- Cost method used by new actuary is substantially the same
- New actuary must demonstrate that the prior year actuarial value of assets, target normal cost and funding target using the new cost method and the old actuarial assumptions are within 5% of the prior actuary’s values

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### Problem 43

FALSE

In general, withdrawal liability payments are considered as employer contributions. IRC 431(b)(7)(A) says that future regulations may provide an offsetting charge so that a withdrawal liability payment would not be considered as an advance funding payment:

*“(A) Withdrawal liability*

*Any amount received by a multiemployer plan in payment of all or part of an employer's withdrawal liability under part 1 of subtitle E of title IV of the Employee Retirement Income Security Act of 1974 shall be considered an amount contributed by the employer to or under the plan. The Secretary may prescribe by regulation additional charges and credits to a multiemployer plan's funding standard account to the extent necessary to prevent withdrawal liability payments from being unduly reflected as advance funding for plan liabilities.”*

**Answer is B**



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### Problem 44

TRUE

A plan is subject to the liquidity requirement if it is also 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.

See 1.430(j)-1(d)(1)(i).

**Answer is A**

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### Problem 45

This is a fairly simple problem on mortality table assumptions. Some of these details have not been tested before.

#### I. FALSE

Only plans with less than 500 participants have the option to use a combined mortality table (for both annuitants and non-annuitants). This option is only available for plans that use static mortality tables (not generational mortality tables).

See 1.430(h)(3)-1(b)(2)

#### II. TRUE

The default assumption for all plans is to use the generational mortality with separate mortality rates for annuitants and non-annuitants.

#### III. FALSE

Only plans with more than 1,000 deaths for a single gender have the option to use a plan-specific mortality table. Since there are only 2,400 participants in total, it seems impossible the plan could have sufficient credible mortality experience.

See 1.430(h)(3)-2

Only item II is true.

**Answer is C**

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### Problem 46 – Page 1

This is a typical IRC 430 calculation of the shortfall amortization installment. The key to the problem is recognizing the importance of the 2014 and 2015 values given.

The problem asks for the "minimum required contribution" at 01/01/16. Based on 2015 exam condition 34, the plan sponsor does not offset the carryover balance (CB) or the prefunding balance (PB) against the minimum contribution under IRC 430.

The plan was exempt from shortfall amortization bases prior to 2014. At 01/01/2014, the shortfall amortization installment is  $200 = 350 - 150$ . At 01/01/2015, the shortfall amortization charge is  $300 = 500 - 200$ . At 01/01/2015, the shortfall amortization installment is 100, which is the increase in the shortfall amortization charge.

### **Funding Shortfall**

You need to determine the new shortfall base at 01/01/2016, and calculate the 2016 minimum required contribution. 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:

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 12,900 - (10,000 - 0 - 500) \\ &= 3,400\end{aligned}$$

### **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:

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

### **Shortfall amortization installment**

The plan is not eligible for the shortfall base exemption. You have to set up the 2016 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:

$$\text{S/F Amort base} = 100\% * (\text{Funding target}) - (\text{AAV} - \text{CB} - \text{PB}) - (\text{PV of PY Amortizations})$$

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### Problem 46 – Page 2

You need to determine the present value of the 2014 and 2015 shortfall amortization installments. There are 6 years remaining for the 2015 installment and 5 years remaining for the 2014 installment. You can use the annuity factors from the lookup tables given with the exam:

$$\begin{aligned}\text{PV of amort} &= 200 * \ddot{a}_{\overline{5}|.05} + 100 * \ddot{a}_{\overline{6}|.05 \& .06} \\ &= 200 * 4.5460 + 100 * 5.2932 \\ &= 1,439\end{aligned}$$

$$\begin{aligned}\text{S/F Amort base} &= 1.0 * 12,900 - (10,000 - 0 - 500) - (\text{PV of PY Amortizations}) \\ &= 3,400 - 1,439 \\ &= 1,961\end{aligned}$$

You must calculate the shortfall amortization installment for 2016. You can use the 7 year annuity factor from the lookup tables given with the exam:

$$\begin{aligned}\text{S/F amort} &= 1,961 / \ddot{a}_{\overline{7}|.05 \& .06} \\ &= 1,961 / 5.9982 \\ &= 327\end{aligned}$$

$$\begin{aligned}\text{S/F charge} &= 327 + 200 + 100 \\ &= 627\end{aligned}$$

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.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 250 + 627 + 0 \\ &= 877\end{aligned}$$

**Answer is D**

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### Problem 47 – Page 1

Similar to 2014 #50

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 01/01/2016. Based on 2015 exam condition 35, the "smallest amount" reflects offsetting the funding standard account credit balance (CB) against the minimum contribution.

### 12/31/2015 Debit balance

The problem states that a waiver was granted for 2015, but does not give you the amount. You need to determine the amount of the deficiency at 12/31/2015. You must set up the 2015 MFSA to calculate it:

2015 Minimum Funding Standard Account			
Charges		Credits	
Normal Cost	500,000	Credit Balance	50,000
Combined amortization charges	200,000		
2014 Loss amortization	80,000	12/31 contribution	50,000
7.5% interest	58,500	7.5% interest	3,750
Total charges	838,500	Total credits	103,750

At 12/31/2015, the plan has a debit balance of  $734,750 = 838,500 - 103,750$ . This is the funding deficiency.

### 2015 amortizations

The main point to this question is that you must set up two new bases at 01/01/2016. One is the amortization base for the waiver that was granted. The waiver base is amortized over 15 years.

In addition, you are given the amount of the 2015 experience loss. The loss base is also amortized over 15 years. You could add the bases together to save a calculation step, but I will handle them separately:

$$\begin{aligned}\text{Waiver amort} &= 734,750 / \ddot{s}_{\overline{15}|.075} \\ &= 77,431\end{aligned}$$

$$\begin{aligned}\text{Loss amort} &= 50,000 / \ddot{s}_{\overline{15}|.075} \\ &= 5,269\end{aligned}$$

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### Problem 47 – Page 2

Revised 11/02/17

#### **2016 MFSA**

Now you can set up the MFSA and calculate the “smallest amount”. Since the problem asks for the smallest amount at 01/01, I won’t bother adding interest to the charges and credits. Otherwise you must do an extra calculation at the end to divide by 1.075:

<b>2016 Minimum Funding Standard Account</b>			
<b>Charges</b>		<b>Credits</b>	
Normal Cost	475,000	Credit Balance	0
Combined amortization charges	200,000		
2014 Loss amortization	80,000	01/01 minimum	x
Waiver amortization	77,431		
2015 Loss amortization	5,269		
7.5% interest	N/A	7.5% interest	N/A
Total charges	837,700	Total credits	x

The “smallest amount” at 01/01/16 is equal to the charges of 837,700 (since the only credit is the contribution).

**Answer is C**

#### **NOTES**

1. You are not given sufficient information in this problem to check the Full Funding Limitation (FFL).
2. Technically you have a debit balance of 734,750 at 01/01/2016. But there is an offsetting MFSA credit at 01/01/2016 equal to the waiver base of 734,750. It saves a bit of arithmetic to simply leave both items out of the MFSA.

This asset valuation question has rarely been asked for a multiemployer plan since PPA was passed. This is such an old topic that this is essentially a trick question! These calculations are almost identical to those for some recent questions on single employer plans.

The approved asset valuation methods in Section 3 of Revenue Procedure 2000-40 are:

- (11) Average value without phase-in
- (12) Average value with phase-in
- (15) Smoothed market value without phase-in
- (16) Smoothed market value with phase-in
- (17) Average value with alternative phase-in.

The plan can change to these asset valuation methods, and get automatic approval for the change in method. The 1.412(c)(2)-1 regulation describes the general requirements for an acceptable asset valuation method.

The Study Note (E2A-62-02) discusses the theory behind various methods, as well as variations which may be acceptable under the regulation, but which do not get automatic approval. If you change to one of these other methods, you would have to apply for approval under Revenue Procedure 2000-40.

For all of these methods, a corridor must be applied for the final actuarial value of assets. The final actuarial value of assets can't be lower than 80% of market value. The final actuarial value of assets can't be greater than 120% of market value. The final test ensures that the resulting AAV falls between 80% and 120% of the market value.

### **(15) Smoothed market value without phase-in**

This method is described in broad terms in Revenue Procedure 2000-40. The Study Note (E2A-62-02) gives a numerical example of the calculation on page 3-4. The basic idea is that you determine a gain or loss each year based on the expected value of assets versus the market value.

The actuarial value of assets is calculated using decreasing fractions of each of the prior years' gain or loss. With a five year average, the fractions are  $\frac{4}{5}$ ,  $\frac{3}{5}$ ,  $\frac{2}{5}$ , and  $\frac{1}{5}$ . With a four year average, the fractions are  $\frac{3}{4}$ ,  $\frac{2}{4}$ , and  $\frac{1}{4}$ . With a three year average, the fractions are  $\frac{2}{3}$  and  $\frac{1}{3}$ .

You are given the G/L amounts for 2012 through 2014. You need to calculate the 2015 G/L item. To do this, you need to calculate the expected market value of assets at 01/01/16.

**Problem 48 – Page 2****Revised 09/07/18****01/01/16 Asset calculation**

$$\begin{aligned} 01/16 \text{ } _e\text{MVA} &= (1.075) * 186,000 - [1 + .075(9/12)] * 20,000 - [1 + .075(6/12)] * 21,500 \\ &= 198,769 \end{aligned}$$

$$\begin{aligned} \text{MVA G/L} &= 01/16 \text{ MVA} - 01/16 \text{ } _e\text{MVA} \\ &= 207,000 - 198,769 \\ &= 8,231 \quad (\text{Gain}) \end{aligned}$$

**Preliminary**

$$\begin{aligned} 01/16 \text{ AAV} &= 01/16 \text{ MVA} - 4/5(2015 \text{ G/L}) - 3/5(2014 \text{ G/L}) - 2/5(2013 \text{ G/L}) - 1/5(2012 \text{ G/L}) \\ &= 207,000 - .80(8,231) - .60(-20,000) - .40(-5,000) - .20(-10,000) \\ &= 216,415 \end{aligned}$$

This preliminary actuarial asset value of 216,415 must be compared to the corridors. The final AAV must be limited to be within 20% of the market value.

$$\begin{aligned} 01/16 \text{ AAV} &= \text{Lesser of } [1.20(207,000) \text{ and greater of } (216,415 \text{ or } .80(207,000))] \\ &= 216,415 \end{aligned}$$

The corridor has no impact on the AAV.

**Answer is C****NOTES:**

1. In the calculation of the preliminary AAV above, asset gains are treated as positive numbers, and asset losses are treated as negative numbers. Of course this does not match the signs for the asset gains and losses given in the problem.
2. If you used compound interest to calculate the expected market value, the MVA at 01/2016 and the G/L value for 2015 are slightly different. As expected, the final value falls in the same answer range.

$$\begin{aligned} 01/16 \text{ } _e\text{MVA} &= 198,773 \\ 2015 \text{ G/L} &= 8,227 \\ 01/16 \text{ AAV} &= 216,418 \quad (\text{corridor does not apply}) \end{aligned}$$



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### Problem 49

TRUE

Based on IRC 412(c)(1)(A), you can waive the minimum funding standard for no more than 3 of any 15 consecutive years. The year 2000 no longer falls within the prior 15 years (from 2002 through 2016).

**Answer is A**

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### Problem 50

FALSE

This is the second time a question has been asked on the “surcharge for critical status” in IRC 432(e)(7). On the 2010 exam, problem 13 tested whether non-payment of the surcharge was subject to an excise tax for failure to meet minimum funding.

If a plan is in critical status, the surcharge is 5% of the otherwise required contribution for the first year. For successive years in critical status, the surcharge is 10% of the otherwise required contribution.

The plan was first in critical status for the plan year ending 09/30/15. The question asks about the second plan year ending 09/30/16, so the surcharge is 10%. The required contribution is based on the collective bargaining agreement:

$$\begin{aligned}\text{Required cont} &= 700,000(2.20) \\ &= 1,540,000\end{aligned}$$

$$\begin{aligned}10\% \text{ surcharge} &= 1,540,000(10\%) \\ &= 154,000\end{aligned}$$

**Answer is B**

### NOTE

The surcharge does not remain in force indefinitely. It terminates after a collective bargaining agreement is negotiated which reflects the terms of a new contribution schedule in the rehabilitation plan. The problem states that the collective bargaining agreement is modified on 12/31/16, but that is after the end of the plan year in question.

See IRC 432(e)(7)(C) and IRC 432(e)(1)(B)(i)

## Fall 2015 EA-2F Exam Solutions

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### Problem 51

Similar to 2012 #07

This is a straightforward question on the calculation of the prefunding balance at 01/01/2016. This problem is simpler than some other exam questions, since it does not involve the special rule in the final 1.430 regulations regarding bringing forward the prefunding balance (PB) based on two different interest rates.

#### **“Smallest amount”**

The plan sponsor paid the “smallest amount” for 2015. Based on 2015 exam condition 35, the “smallest amount” reflects offsetting both funding balances against the minimum 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.

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Shortfall amort charge} + \text{Waiver amort charge} \\ &= 425,000 + 75,000 + \text{zero} \\ &= 500,000\end{aligned}$$

$$\begin{aligned}\text{Smallest contr} &= \text{MRC} - \text{CB} - \text{PB} \\ &= 500,000 - 300,000 - 300,000 \\ &= \text{zero}\end{aligned}$$

#### **Remaining PB**

The next step is to calculate the amount of the PB at 01/01/2015, after applying both balances toward the MRC. This is based on 2015 exam conditions 31 and 32. Based on IRC 430(f)(3)(B), the carryover balance must be applied toward the MRC (and eliminated) before you make any elections for the prefunding balance.

$$\begin{aligned}\text{Remaining} \\ \text{2015 PB} &= 300,000 \text{ PB} + 300,000 \text{ CB} - 500,000 \text{ MRC} \\ &= 100,000\end{aligned}$$

#### **2016 Prefunding balance**

$$\begin{aligned}\text{01/2016 PB} &= 1.20(100,000 \text{ PB}) \\ &= 120,000\end{aligned}$$

**Answer is D**

## **Fall 2015 EA-2F Exam Solutions**

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### **Problem 52**

This is a straightforward question on the rules for extension of amortization periods.

#### **ASSERTION**

This is true. Under IRC 431(d)(1), there is an automatic extension of five years.

#### **REASON**

This is false. Under IRC 431(d)(2), there is an extension for an additional five years. This is actually defined as ten years, minus any extension granted under IRC 431(d)(1).

**Answer is C**

### Problem 53 – Page 1

Similar to 2010 #36

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. Can the plan sponsor elect to apply the CB / PB against the required quarterly contribution installment?
3. What is the amount of the required quarterly contribution installment?

#### **Subject to the quarterly contribution requirement?**

To calculate the required quarterly contribution for 2016, 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 problem gives a Funding shortfall of 500,000 for 2015, the plan sponsor is subject to the quarterly contribution requirement for 2016.

#### **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 2015 and 2016.

The required annual payment (RAP) is the lesser of the 2015 MRC or 90% of the 2016 MRC, which is  $580,500 = 90\% \times 645,000$ . The 2016 required quarterly installment is 25% of the RAP, which equals 145,125.

#### **Apply CB / PB towards required quarterly installment?**

The problem says nothing about use of the funding balances. 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. Based on 2015 exam condition 31, you can safely assume that the plan sponsor's funding ratio for the prior year is at least 80%.

The problem asks for X, which is the smallest amount of prefunding balance at 01/01/2016 that can be elected on 04/15/2016 to satisfy the 2016 quarterly contribution requirement. In order to apply any of the prefunding balance towards the quarterly contribution requirement, you must first apply the 12,000 CB (based on IRC 430(f)(3)(B)).

For both of these balance elections, you are allowed to accumulate the amount using the effective interest rate up to 04/15/2016. This makes sense, since the funding balance reflects contributions already in the trust fund 01/01/2016.

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### Problem 53 – Page 2

You are told that the employer contributes 10,000 for 2016 on 04/15/2016. Now you can determine the value of X:

Installment

$$145,125 = 10,000 \text{ contrib} + (X + 12,000 \text{ CB})(1.065)^{3.5/12}$$

$$X + 12,000 = 135,125(1.065)^{-3.5/12}$$

$$X = 120,666$$

**Answer is B**

### NOTES

1. If a problem gives you the prior year's valuation results, you should not rely on exam condition 31. 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):

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

2. If you used simple interest to calculate X, the result is slightly different. As expected, the final value falls in the same answer range:

$$145,125 = 10,000 \text{ contrib} + (X + 12,000 \text{ CB})[1 + (.065)(3.5/12)]$$

$$X + 12,000 = 135,125/[1 + (.065)(3.5/12)]$$

$$X = 120,611$$

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### Problem 54 – Page 1

The key point of this question is reading it VERY carefully. It took me a minute to figure out the point of this question.

The problem asks for the "smallest amount" at 01/01/2015. Based on 2015 exam condition 35, the "smallest amount" reflects offsetting both funding balances against the minimum contribution. In this problem, the balances are both equal to zero.

The Funding Target is defined as the present value of the accrued benefit. It is similar to the traditional Unit Credit accrued liability. The Target normal cost is defined as the present value of the increase in the accrued benefit during the year.

#### At 01/01/2015

Age	63
Service	3 years

#### "2014 limit" calculations

The problem gives you certain valuation results for 2015, but the Target normal cost is not correct. The given results are based on the 2014 values for both the 401(a)(17) limit and the 415 limit. You need to figure out the difference between what is given, and the results using the 2015 values for both the 401(a)(17) limit and the 415 limit.

Plan Year Beginning	Applicable 401(a)(17) limit	Compensation	Limited comp
01/01/12	250,000	290,000	250,000
01/01/13	255,000	295,000	255,000
01/01/14	260,000	300,000	260,000
01/01/15	260,000	300,000	260,000

Note that the 2014 limits are used for the 2015 plan year, which matches how the values for the Target normal cost and Funding target were determined.

Calculation date	01/01/2015	12/31/2015
Age	63	64
Past service	3	4
Highest consecutive FAE3	$(250,000 + 255,000 + 260,000)/3$ = 255,000	$(255,000 + 260,000 + 260,000)/3$ = 258,333
Accrued benefit	$255,000(3)(6.5\%)$ = 49,725	$258,333(4)(6.5\%)$ = 67,167

It should be clear that the benefits are small enough that the 415 limits do not apply.

## Fall 2015 EA-2F Exam Solutions

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### Problem 54 – Page 2

#### **"2014 limit" calculations - continued**

The difference in the accrued benefit is used for the Target normal cost of 80,000:

$$\begin{aligned}\Delta \text{ accrued ben} &= 67,167 - 49,725 \\ &= 17,442\end{aligned}$$

The present value factor for the normal cost is  $4.5866 = 80,000 / 17,442$ . Note that the Funding target of 240,000 is correct. The Funding target is based on the accrued benefit at 01/01/2015, which does not reflect the increases in the 2015 limits.

#### **"2015 limit" calculations**

Now you should redetermine the accrued benefit at 12/31/2015 based on the correct value of the 401(a)(17) limit. Then you can get the correct Target normal cost to determine the "smallest amount" at 01/01/2015.

<b>Plan Year Beginning</b>	<b>Applicable 401(a)(17) limit</b>	<b>Compensation</b>	<b>Limited comp</b>
01/01/12	250,000	290,000	250,000
01/01/13	255,000	295,000	255,000
01/01/14	260,000	300,000	260,000
01/01/15	265,000	300,000	265,000

Calculation date	01/01/2015	12/31/2015
Age	63	64
Past service	3	4
Highest consecutive FAE3	$(250,000 + 255,000 + 260,000)/3$ $= 255,000$	$(255,000 + 260,000 + 265,000)/3$ $= 260,000$
Accrued benefit	$255,000(3)(6.5\%)$ $= 49,725$	$260,000(4)(6.5\%)$ $= 67,600$

It should be clear that the benefits are small enough that the 415 limits do not apply. The difference in the accrued benefit is used to calculate the Target normal cost:

$$\begin{aligned}\Delta \text{ accrued ben} &= 67,600 - 49,725 \\ &= 17,875\end{aligned}$$

$$\begin{aligned}\text{Target NC} &= 17,875(4.5866) \\ &= 81,988\end{aligned}$$



**“Smallest amount” calculation**

The problem asks for the “smallest amount” at 01/01/2015. Now you need to follow the usual steps to calculate the funding shortfall and the shortfall amortization payment.

**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.

$$\begin{aligned}\text{Funding S/F} &= \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 240,000 - (240,000 - 0 - 0) \\ &= \text{zero}\end{aligned}$$

**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. Since the funding shortfall is zero, the MRC has a different definition:

$$\begin{aligned}\text{MRC} &= \text{TNC} + \text{Funding target} - (\text{AAV} - \text{CB} - \text{PB}) \\ &= 81,988 + 240,000 - (240,000 - 0 - 0) \\ &= 81,988\end{aligned}$$

**“Smallest amount”**

$$\begin{aligned}\text{Smallest contr} &= \text{MRC} - \text{CB} - \text{PB} \\ &= 81,988 - 0 - 0 \\ &= 81,988\end{aligned}$$

**Answer is C**

**NOTE**

There is a flaw in the problem data, which produces a different answer range. You can calculate the present value factor using the Funding target, which gives  $4.8265 = 240,000 / 49,725$ . The resulting target normal cost is  $17,875(4.8265) = 86,275$ . This falls in answer range E.

## Fall 2015 EA-2F Exam Solutions

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### Problem 55

Similar to 2009 #39

Revised 09/17/17

The key to this problem is knowing just a little bit about cash balance plans. In addition, you must know how to calculate the Funding target under IRC Section 430.

In 2009 exam question 39, the problem required you to calculate the Funding target, which was based on the current hypothetical account balance. In that problem, the participant was not eligible for the death benefit, so it was not used for the calculation.

The main point of this problem is determination of the Funding target based on the death benefit. Here the participant is covered, since there is no eligibility condition for the death benefit.

Valuation date	01/01/2016
Age	62
Past service	N/A
Account balance	100,000

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 benefits for death at ages 62, 63 and 64 is calculated using the first segment rate of 5%.

The mortality decrements are given in the problem, and they occur at the beginning of each year of age. You need to allow for the probability of survival to future ages, and subsequent death. The Funding target for death benefits must be calculated as a complicated summation:

$$\begin{aligned} FT &= \sum_{t=0}^2 (1.05)^{-t} {}_t p_{62}^{(T)} q_{62+t}^{(d)} (\text{Death Ben})_{62+t} \\ &= (1.05)^{-0} (1.0)(.0060)(100,000)(1.04)^0 && \text{(death at age 62)} \\ &+ (1.05)^{-1} (1-.0060)(.0069)(100,000)(1.04)^1 && \text{(death at age 63)} \\ &+ (1.05)^{-2} (1-.0060)(1-.0069)(.0077)(100,000)(1.04)^2 && \text{(death at age 64)} \\ &= 100,000(.0060 + .0068 + .0075) \\ &= 2,025 \end{aligned}$$

**Answer is A**

## Fall 2015 EA-2F Exam Solutions

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### Problem 56

Similar to 2012 #07

This is a straightforward question on the calculation of the prefunding balance at 01/01/2016. This problem is simpler than some other exam questions, since it does not involve the special rule in the final 1.430 regulations regarding bringing forward the prefunding balance (PB) based on two different interest rates.

### Excess contribution

The first step is to calculate the amount of the excess contribution at 01/01/2015. 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 2015 plan year:

$$\begin{aligned}\text{PV of contrib} &= 750,000 \times (1.06)^{-1} \\ &= 707,547\end{aligned}$$

$$\begin{aligned}\text{Addition to} \\ \text{2015 PB} &= 707,547 - 500,000 \text{ MRC} \\ &= 207,547 \text{ excess contribution}\end{aligned}$$

### 2016 Prefunding balance

$$\begin{aligned}01/2016 \text{ PB} &= 1.12(100,000 \text{ PB}) + 1.06(207,547 \text{ excess}) \\ &= 332,000\end{aligned}$$

**Answer is D**

## Fall 2015 EA-2F Exam Solutions

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### Problem 57

FALSE

This is a bit of a trick question. On the Schedule SB, the actuary certifies that the assumptions used in the valuation correspond to their best estimate.

**Answer is B**

#### NOTE

There was quite a bit of discussion on this at the Actuarial Outpost. The question states that the assumptions not prescribed by law should conform to the plan sponsor's best estimate of experience.

This seems correct, since the actuary could not specify assumptions such as salary scale, retirement rates and turnover rates without getting input from the plan sponsor. But the actuary makes the final decision of what assumptions are used - and they may not 100% agree with the plan sponsor.