



**Workshop on Understanding and Evaluating Radioanalytical  
Measurement Uncertainty**

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**Uncertainty in Gamma Spectrometry.  
Exercise 4**

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Symbol	Quantity	Value	Unit	Standard Uncertainty	Relative Standard Uncertainty (%)
c <sub>1</sub>	net count rate (P1) calibr. source	10		0.1	1.0
c <sub>2</sub>	net count rate (P2) calibr. source	9.8		0.098	1.0
A <sub>S</sub>	Activity calibration source	1000		30	3.0
n <sub>1</sub>	net count rate (P1) probl. source	11.1		0.111	1.0
n <sub>2</sub>	net count rate (P2) probl. source	10.3		0.103	1.0
ε <sub>1</sub>	FEP efficiency (P1)	0.01		0.000316228	3.16
ε <sub>2</sub>	FEP efficiency (P2)	0.0098		0.000309903	3.16
a <sub>1</sub>	-	1.11		0.015697771	1.41
a <sub>2</sub>	-	1.051		0.014863673	1.41
X <sub>1</sub>	Activity problem source (P1)	1110		36.81453517	3.32
X <sub>2</sub>	Activity problem source (P2)	1051		34.85840341	3.32
A <sub>x</sub>	Activity problem source			0	

A <sub>x</sub> : Uncertainty budget	$A_x = \frac{X_1 + X_2}{2}$			$A_x = \frac{a_1 + a_2}{2} A_s$		
Source of uncertainty	Expression	Value	Rel. Value	Expression	Value	Rel. Value
X <sub>1</sub>	$\frac{\partial A}{\partial X_1} u(X_1) = \frac{1}{2} u(X_1)$	18.407		$\frac{\partial A_x}{\partial a_1} u(a_1) = \frac{A_s}{2} u(a_1)$	7.849	
X <sub>2</sub>	$\frac{\partial A}{\partial X_2} u(X_2) = \frac{1}{2} u(X_2)$	17.429		$\frac{\partial A_x}{\partial a_2} u(a_2) = \frac{A_s}{2} u(a_2)$	7.432	
-	-			$\frac{\partial A_x}{\partial A_s} u(A_s) = \frac{a_1 + a_2}{2} u(A_s)$	32.415	
<b>SUB TOTAL</b>	$\sqrt{\left(\frac{\partial A}{\partial X_1} u(X_1)\right)^2 + \left(\frac{\partial A}{\partial X_2} u(X_2)\right)^2}$	25.35			34.17	
Correlations between A <sub>1</sub> and A <sub>2</sub>	$2 \frac{\partial A_x}{\partial X_1} \frac{\partial A_x}{\partial X_2} \text{cov}(X_1, X_2) = \frac{1}{2} a_1 a_2 u(A_s)^2$	525.0				
<b>Combined standard uncertainty</b>	$\sqrt{\left[\frac{\partial A}{\partial X_1} u(X_1)\right]^2 + \left[\frac{\partial A}{\partial X_2} u(X_2)\right]^2 + 2 \frac{\partial A_x}{\partial X_1} \frac{\partial A_x}{\partial X_2} \text{cov}(X_1, X_2)}$	34.17				