Chapter IV

RESULTS

4.1 The Activity of Co-60 Measured by the Gamma-Gamma Coincidence Counting

4.1.1 The Activity of Co-60, IAEA Standard Source

The Co-60 standard of 1.113 μCi labeled activity on 1st January 1966 had been measured by the coincidence counting system with 180° geometry and the source to detector distance was 4 centimetres. The activity of this source calculated from the coincidence counts were tabulated and compared with the activity calculated from the labeled activity as shown in Table 2.

The Co-60 standard of 10.90 μCi on 1st January 1968 had also been measured with the same geometry, the results are shown in Table 3.

4.1.2 The Activity of Co-60 of the Radiochemical Centre Amersham Products

The Co-60 standard of 11.46 μCi labeled activity on 1st October 1974 (Products of the Radiochemical Centre, Amersham) had been measured with the 180° geometry , 90° geometry and different source to detector distances. The results of the experiment were tabulated in Table 4, 5, 6, 7, 8, 9, 10 and 11.

Table 2

The activity of 1.113 μCi Co-60 standard source

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{8}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
0.339			
0.322			
0.335			
0.404			
0.322	0.347	0.347±0.029	0.30
0.351			
0.318			
0.381			
0.354			

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 3

The activity of 10.90 μCi Co-60 standard source

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{2}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
3.27 3.24 3.36	3.29	3.29±0.06	3.37

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 4

The activity of 11.46 μCi Co-60 source, measured with 180° geometry and 4 centimetres source to detectors distance

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{4}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
6.70 7.01 7.15 6.75 6.68	6.86	6.86±0.21	8.57

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 5

The activity of 11.46 μCi Co-60 source, measured with 180° geometry and 5 centimetres source to detectors distance

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{4}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
6.67 6.55 6.55 6.04 6.89	6.66	6.66±0.14	8.51

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 6

The activity of 11.46 μCi Co-60 source, measured with 180° geometry and 6 centimetres source to detectors distance

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{4}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
6.64 6.20 6.48 6.84 7.12	6.66	6.66±0.35	8.50

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 7

The activity of 11.46 μCi Co-60 source, measured with 180° geometry and 7 centimetres source to detectors distance

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{5}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
6.24			
6.67			
6.62			
6.89	6.64	6.64±0.22	8.50
6.78			
6.61			

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 8

The activity of 11.46 μCi Co-60 source, measured with 90° geometry and 4 centimetres source to detectors distance

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{5}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
7.44			
7.60			
7.22	7.48	7.48±0.15	8.52
7.64			
7.46			
7.53			

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 9

The activity of 11.46 μCi Co-60 source, measured with 90° geometry and 5 centimetres source to detectors distance

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{5}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
7.02			
7.30			
7.70	7.44	7.44±0.25	8.54
7.47			
7.57			
7.60			

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 10

The activity of 11.46 μCi Co-60 source measured with 90° geometry and 6 centimetres source to detectors distance

X (μCi)	$\bar{X}$ (μCi)	$\bar{X}\pm\sqrt{\frac{(X-\bar{X})^2}{5}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
7.40 7.42 7.42 7.65 7.15 7.91	7.49	7.49±0.26	8.53

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

Table 11

The activity of 11.46 μCi Co-60 source, measured with 90° geometry and 7 centimetres source to detectors distance

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{5}}$ (μCi)	Activity Calculated From Labeled Activity (μCi)
7.57 7.27 7.60 7.41 7.53 7.87	7.54	7.54±0.20	8.52

X = The activity of the source calculated from the coincidence counts

$\bar{X}$ = The average activity

4.2 The Activity of Mn-56 Measured by the Gamma-Gamma Coincidence Method

The activity of Mn-56 produced by 5Ci Pu-238/Be neutron source as described in chapter III had been measured with the setup coincidence counting system. The results of the experiment were tabulated in Table 12 and Table 13 for detectors geometry of 180° and 90° respectively.

4.3 The Thermal Neutron Flux at the Position of Irradiation of Manganese Dioxide

The absolute activity of Mn-56 tabulated in Table 12 and 13 had been used in calculation of thermal neutron flux using the simple equation in 3.3.4. The results of the calculation are shown in Table 14

Table 12

The activity of Mn-56 produced by 5Ci Pu-238/Be neutron source, calculated from coincidence counts (180^0 geometry with 3 centimetres source to detectors distance)

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{12}}$ (μCi)
0.037		
0.034		
0.038		
0.033		
0.031		
0.038		
0.035	0.040	0.040 ± 0.007
0.038		
0.045		
0.049		
0.038		
0.050		
0.055		

X = The absolute activity of Mn-56 in 200 milligrams of manganese dioxide

$\bar{X}$ = The average absolute activity of Mn-56

Table 13

The activity of Mn-56 produced by 5 Ci Pu-238/Be neutron source, calculated from coincidence counts (90° geometry with 3 centimetres source to detectors distance)

X (μCi)	$\bar{X}$ (μCi)	$\bar{X} \pm \sqrt{\frac{(X-\bar{X})^2}{5}}$ (μCi)
0.053 0.048 0.042 0.053 0.054 0.046	0.049	0.049 ± 0.005

X = The absolute activity of Mn-56 in 200 milligrams of manganese dioxide

$\bar{X}$ = The average absolute activity of Mn-56

Table 14

The thermal neutron flux measured by irradiation of manganese dioxide and coincidence counting technique

Detector Geometry	Neutron Flux ($n/cm.^2\ sec^1$)
180° , 3 cm.	$8.06 \pm 1.40 \times 10^4$
90° , 3 cm.	$9.86 \pm 1.00 \times 10^4$