

On non-isomorphic quasigroups of small order

L. Chiriac, A. Danilov, N. Lupasco, N. Josu

Tiraspol State University, Chişinău, Republic of Moldova

e-mail: llchiriac@gmail.com, a.danilov@gmail.com, nlupashco@gmail.com,
nboeica1978@gmail.com

A non-empty set G is said to be a *groupoid* relatively to a binary operation denoted by $\{\cdot\}$, if for every ordered pair (a, b) of elements of G there is a unique element $ab \in G$.

A groupoid (G, \cdot) is called a *quasigroup* if for every $a, b \in G$ the equations $a \cdot x = b$ and $y \cdot a = b$ have unique solutions.

A quasigroup (G, \cdot) is called a *Ward quasigroup* if it satisfies the law $(a \cdot c) \cdot (b \cdot c) = a \cdot b$ for all $a, b, c \in G$.

A quasigroup (G, \cdot) is called a *Cote quasigroup* if it satisfies the law $a \cdot (ab \cdot c) = (c \cdot aa) \cdot b$ for all $a, b, c \in G$.

A groupoid (G, \cdot) is called a *Manin quasigroup* if it satisfies the law $a \cdot (b \cdot ac) = (aa \cdot b) \cdot c$ for all $a, b, c \in G$.

We consider the following problem:

Problem 1. How many non-isomorphic Ward quasigroups, Cote quasigroups and Manin quasigroups of order 3, 4, 5, 6 do there exist?

We elaborated algorithms for generating non-isomorphic Ward quasigroups, Cote quasigroups and Manin quasigroups of small order. The results established here are related to the work in ([1,2,3,4,5]). Applying the algorithms elaborated, we prove the following results:

Theorem 1. *There are exactly:*

- 1 non-isomorphic Ward quasigroup of order 3;
- 2 non-isomorphic Ward quasigroups of order 4;
- 1 non-isomorphic Ward quasigroup of order 5;
- 2 non-isomorphic Ward quasigroups of order 6.

Theorem 2. *There are exactly:*

- 3 non-isomorphic Cote quasigroups of order 3;
- 4 non-isomorphic Cote quasigroups of order 4;
- 2 non-isomorphic Cote quasigroups of order 5;
- 3 non-isomorphic Cote quasigroups of order 6.

Theorem 3. *There are exactly:*

- 3 non-isomorphic Manin quasigroups of order 3;
- 4 non-isomorphic Manin quasigroups of order 4;
- 4 non-isomorphic Manin quasigroups of order 5;
- 3 non-isomorphic Manin quasigroups of order 6.

Bibliography

- [1] Belousov V.D., *Foundations of the theory of quasigroups and loops*, Moscow, Nauka, 1967, 223 pp.
- [2] Chiriac L., Bobeica N., Pavel D., *Study on properties of non-isomorphic finite quasigroups using the computer*. Proceedings of the Third Conference of Mathematical Society of Moldova IMCS-50, August 19-23, 2014, Chisinau, Republic of Moldova, 2014, p. 44-47.
- [3] Kiriya L., Bobeica N., Guzun S., Gropa A., Covalschi A. *Identification of nonisomorphic quasigroups*. Second Conference of the Mathematical Society of the Republic of Moldova, Chisinau, August, 17-19, 2004, p.109-110.
- [4] Cote B., Harvill B., Huhn M., Kirchman A., *Classification of loops of generalized Bol-Moufang type*, Quasigroups Related Systems, 19, 2, (2011), p. 193-206.
- [5] Chernov V., Moldovyan N., Shcherbacov V., *On some groupoids of small order*. Proceedings of the 4th Conference of Mathematical Society of Moldova CMSM4, 2017, June 28-July 2, 2017, Chisinau, Republic of Moldova, p.51-54.