#### **Task 3. Predator–prey model. Phase space**

The task consists of three questions:

1. Consider the system of differential equations *x*'*=f*(*x*,*y*), *y*'=*g*(*x*,*y*) with given functions *f* and *g*. It is necessary determine its equilibrium states.
2. For the model predator–prey model, three parameters are given. It is necessary to choose other parameters for obtaining a specified effect.
3. Explain one cycle of the system evolution for the chosen parameters.

**Attention**. A situation is possible when, with the given parameter values, the specified effect is impossible. In this situation, one of the specified parameters should be changed so that the specified effect becomes possible.

#### **Variants of the tasks**

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| **№** | **functions** | **parameters** | **effect** |
| 1 | *f* *=* 2(*x*+*y–*2)*y*  *g =* (2*x–y*+2)*x* | *ε*1*=*2, *γ*1*=*1, *х*20=2 | *х*1 decreases *х*2 decreases |
| 2 | *f* *=* 3(*x–*2*y+*2)*x*  *g =* (*x–y*+1)*y* | *γ*1*=*2, *γ*2*=*1/2, *х*10=2 | *х*1 decreases *х*2 increases |
| 3 | *f* *=* (*x–y+*1)*x*  *g =* 2(*x+y*+1)*y* | *ε*1*=*2, *ε*2*=*3, *х*20=1 | *х*1 increases *х*2 decreases |
| 4 | *f* *=* (*x+y–*1)*x*  *g =* 3(*x–y*+1)*y* | *ε*2*=*2, *γ*1*=*1/2, *γ*2*=*1/3 | *х*1 increases  *х*2 increases |
| 5 | *f* *=* 2(2*x–y*+2)*x*  *g =* (*x*+*y–*2)*y* | *γ*1*=*1, *х*10=3, *х*20=2 | *х*1 decreases *х*2 decreases |
| 6 | *f* *=* (*x–y*+1)*y*  *g =* 3(*x–*2*y+*2)*x* | *ε*1*=*2, *ε*2*=*1, *х*10=1 | *х*1 decreases *х*2 increases |
| 7 | *f* *=* 2(*x+y*+1)*y*  *g =* (*x–y+*1)*x* | *γ*2*=*1, *х*10=1, *х*20=2 | *х*1 increases *х*2 decreases |
| 8 | *f* *=* (*x–y*+1)*y*  *g =* 3(*x+y–*1)*x* | *ε*1*=*2, *γ*1*=*1/3, *γ*2*=*1/2 | *х*1 increases  *х*2 increases |
| 9 | *f* *=* (*x–y+*2)*x*  *g =* 5(*x–*2*y*+1)*y* | *ε*2*=*2, *γ*2*=*1/2, *х*20=1 | *х*1 decreases *х*2 increases |
| 10 | *f* *=* 2(*x–*2*y+*1)*x*  *g =* (*x+y*+1)*y* | *ε*2*=*1, *γ*2*=*1/2, *х*10=1 | *х*1 increases *х*2 decreases |
| 11 | *f* *=* (*y–x*+1)*y*  *g =* 3(*x+y–*1)*x* | *ε*2*=*1, *γ*1*=*1, *х*20=2 | *х*1 increases  *х*2 increases |