Solve ODE using numerical methods

1. $y' = 3+ 2x - y \quad y(0) = 2\ , \quad x\in[0;\ 1], \quad h = 0.2$	21. $y' = 3 + 2x + y \quad y(0) = 2 \quad x \in[0;\ 1] \quad h = 0.2$
2. $y' = y - 3x \quad y(1) = 0 \quad x\in[1;\ 2.2] \quad h = 0.3$	22. $y' = 2y - x \quad y(1) = 0 \quad x\in[1;\ 2.2] \quad h = 0.3$
3. $y' = 1- x + y \quad y(1{,}1) = 0 \quad x\in[1.1;\ 1.6] \quad h = 0.1$	23. $y' = -x + y \quad y(1{,}1) = 0 \quad x \in[1.1;\ 1.6] \quad h = 0.1$
4. $y' = y - 7x \quad y(3) = 3 \quad x\in[3;\ 5] \quad h = 0.5$	24. $y' = y - 7x + 2 \quad y(3) = 3\ x \in[3;\ 5] \quad h = 0.5$
5. $y' = 5 - y + x \quad y(1) = 1 \quad x\in[1;\ 5] \quad h = 1$	25. $y' = 5 - y + x \quad y(1) = 1 \quad x \in[1;\ 5] \quad h = 1$
6. $y' = y - 2x + 3 \quad y(0) = 4 \quad x\in[0;\ 1] \quad h = 0.2$	26. $y' = y - 2x + 3 \quad y(0) = 4 \quad x \in[0;\ 1] \quad h = 0.2$
7. $y' = 4 - x + 2y \quad y(0) = 1 \quad x\in[0;\ 1.2] \quad h = 0.3$	27. $y' = 4 - x + 2y \quad y(0) = 1 \quad x\in[0;\ 1.2] \quad h = 0.3$
8. $y' = -8 + 2x - y \quad y(1) = 3 \quad x\in[1;\ 3] \quad h = 0.4$	28. $y' = -8 + 2x - y \quad y(1) = 3 \quad x \in[1;\ 3] \quad h = 0.4$
9. $y' = 2y - 3x \quad y(4) = 0 \quad x\in[4;\ 6] \quad h = 0.5$	29. $y' = 2y - 3x \quad y(4) = 0 \quad x\in[4;\ 6] \quad h = 0.5$
10. $y' = x - 2y \quad y(-1) = 1 \quad x\in[-1;\ 2] \quad h = 0.6$	30. $y' = x^2 - 2y \quad y(-1) = 1 \quad x\in[-1;\ 2] \quad h = 0.5$
11. $y' = 7 - xy \quad y(-2) = 0 \quad x\in[-2;\ 0] \quad h = 0.5$	31. $y' = 5 - x - 2y \quad y(1) = 2 \quad x\in[2;\ 4] \quad h = 0.5$
12. $y' = 2x + y \quad y(2) = 2 \quad x\in[2;\ 3.5] \quad h = 0.5$	32. $y' = y + 3x - 2 \quad y(1) = 2 \quad x \in[1;\ 2] \quad h = 0.2$
13. $y' = 5 + x - y \quad y(2) = 1 \quad x\in[2;\ 4] \quad h = 0.5$	33. $y' = y - 2x \quad y(1) = 2 \quad x \in[1;\ 2.2] \quad h = 0.3$
14. $y' = y + 5x - 1 \quad y(0) = 2 \quad x\in[0;\ 3.2] \quad h = 0.8$	34. $y' = 1- x + y \quad y(1{,}1) = 1 \quad x \in[1.1;\ 1.6] \quad h = 0.1$
15. $y' = y - 5x + 1 \quad y(0) = 2 \quad x\in[0;\ 3.2] \quad h = 0.8$	35. $y' = y - 7x \quad y(3) = 1 \quad x \in[3;\ 5] \quad h = 0.5$
16. $y' = 1- x + y \quad y(0) = 1 \quad x\in[0;\ 2.5] \quad h = 0.5$	36. $y' = x^2+0.1y^2, \quad y(0) = 0.7, \quad x \in[0;\ 2] \quad h = 0.1$
17. $y' = y - 5x \quad y(-1) = 1 \quad x \in[-1;\ 1] \quad h = 0.4$	37. $y' = 0.1x^2+2xy, \quad y(0) = 0.8, \quad x \in[0;\ 2] \quad h = 0.1$
18. $y' = x + 2y \quad y(0) = -1 \quad x\in[0;\ 2] \quad h = 0.4$	38. $y' = x^2+y^2, \quad y(0) = 0.7, \quad x \in[0;\ 2] \quad h = 0.1$
19. $y' = x + y + 2 \quad y(1) = 1 \quad x \in[1;\ 3] \quad h = 0.5$	39. $y' = xy + y^2, \quad y(0) = 0.6, \quad x \in[0;\ 2] \quad h = 0.1$
20. $y' = 3x + 4y \quad y(2) = 1 \quad x\in[2;\ 5] \quad h = 0.5$	40. $y' = 2x + 0.1y^2, \quad y(0) = 0.2, \quad x \in[0;\ 2] \quad h = 0.1$

Solve physics tasks composing ODEs and solving it using numerical methods

1. A charge of 10^{-9} C was transposed to a conductor, however, the latter loses the charge due to some electrostatic leakage. The leakage rate is proportional to the charge on the conductor at the moment. During the first second $dq_{1s} = 10^{-10}$ C has leaked. What charge would be present on the conductor after $\Delta t = 10$ s?

2. A motorboat having speed of 40 km/h in a still water would slow down to 6 km/h once its engine is shut off during 20 s. Assuming friction force of the water proportional to boat's speed, find the boat speed after 2 min of inertial motion. Assume friction force to be $av+bv^3$. Guess reasonable values of a,b.

3. A point mass (m = 1 g) is moving rectilinearly, and the force is proportional to time t and inversely proportional to the velocity. At t=10 s, v = 0.5 m/s, F = $4 \cdot 10^{-5}$ N. Find $v(t$=60 s).

4. A point mass is moving rectilinearly under effect of a force proportional to t^3, where t is time (at t_0=0, v=v_0). There is also friction force proportional to vt. Assuming reasonable proportionality coefficients, find $v(t)$.

5. Find time needed for a body to cool down from 100 ºC to 25 ºC if the ambient temperature is 20 ºC, and 10 min were required for it to cool down from 100 ºC to 60 ºC.

6. Potential difference measured across a coil changed from 2 V down to 1 V within 1 s. Find the current after 10 s if I_0 = 17 A. Coil resistance is 0.12 Ω, inductance is 0.1 H. Assuming that $\varepsilon = \varepsilon_0 \cdot \sin(\omega t)$, find current in 20 s from the beginning of the measurement.

7. A circuit consists of a power supply with e.m.f. ε, inductance L and resistance R connected in series. Assuming linearly increased ε, find current at t=10 s. L = 0.10 H, R = 50 Ω, I(t=0)=0 A. Note that potential difference across a conductor with resistance and inductance is $\Delta\varphi = L\frac{dI}{dt} + RI$.