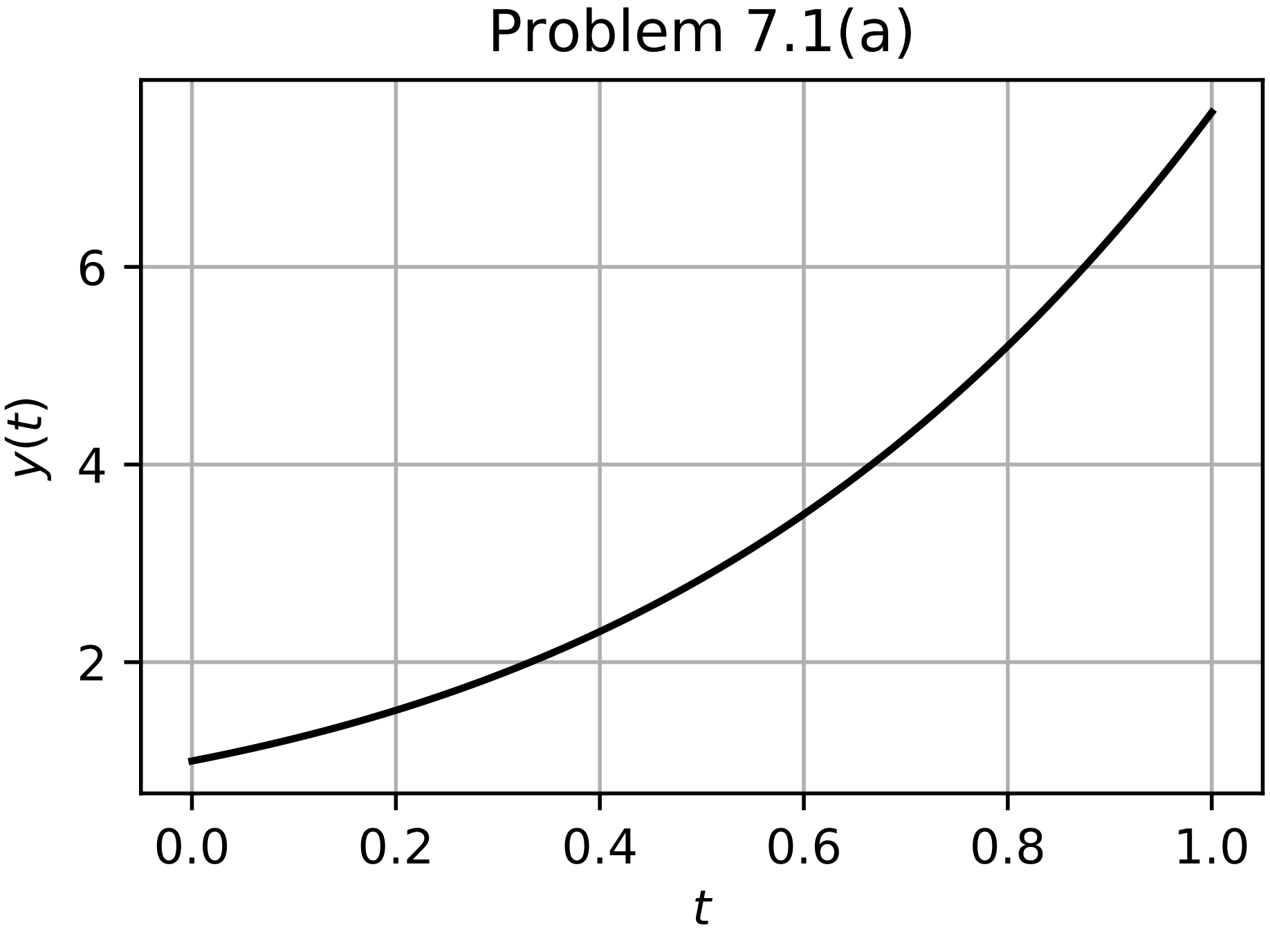
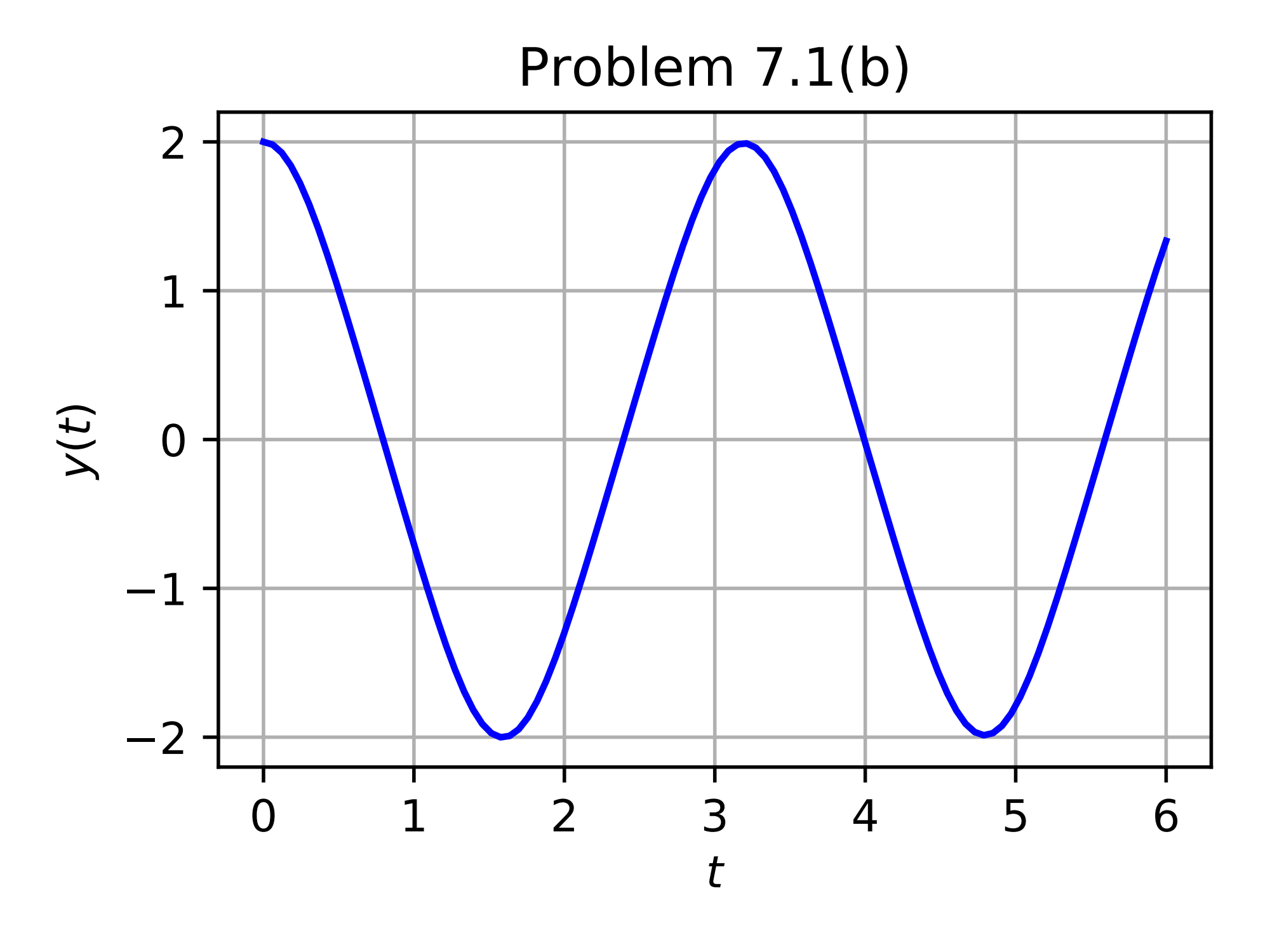
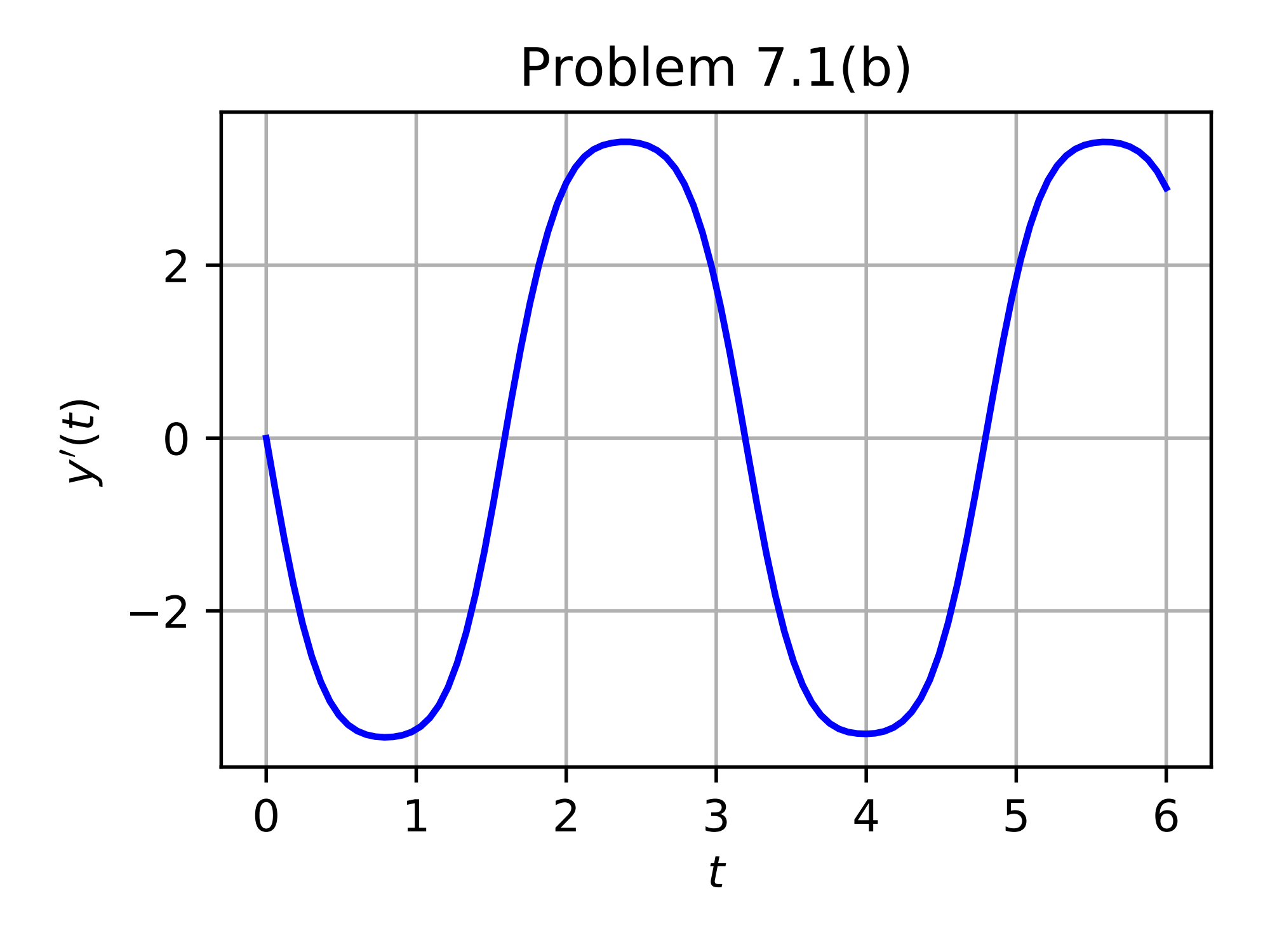
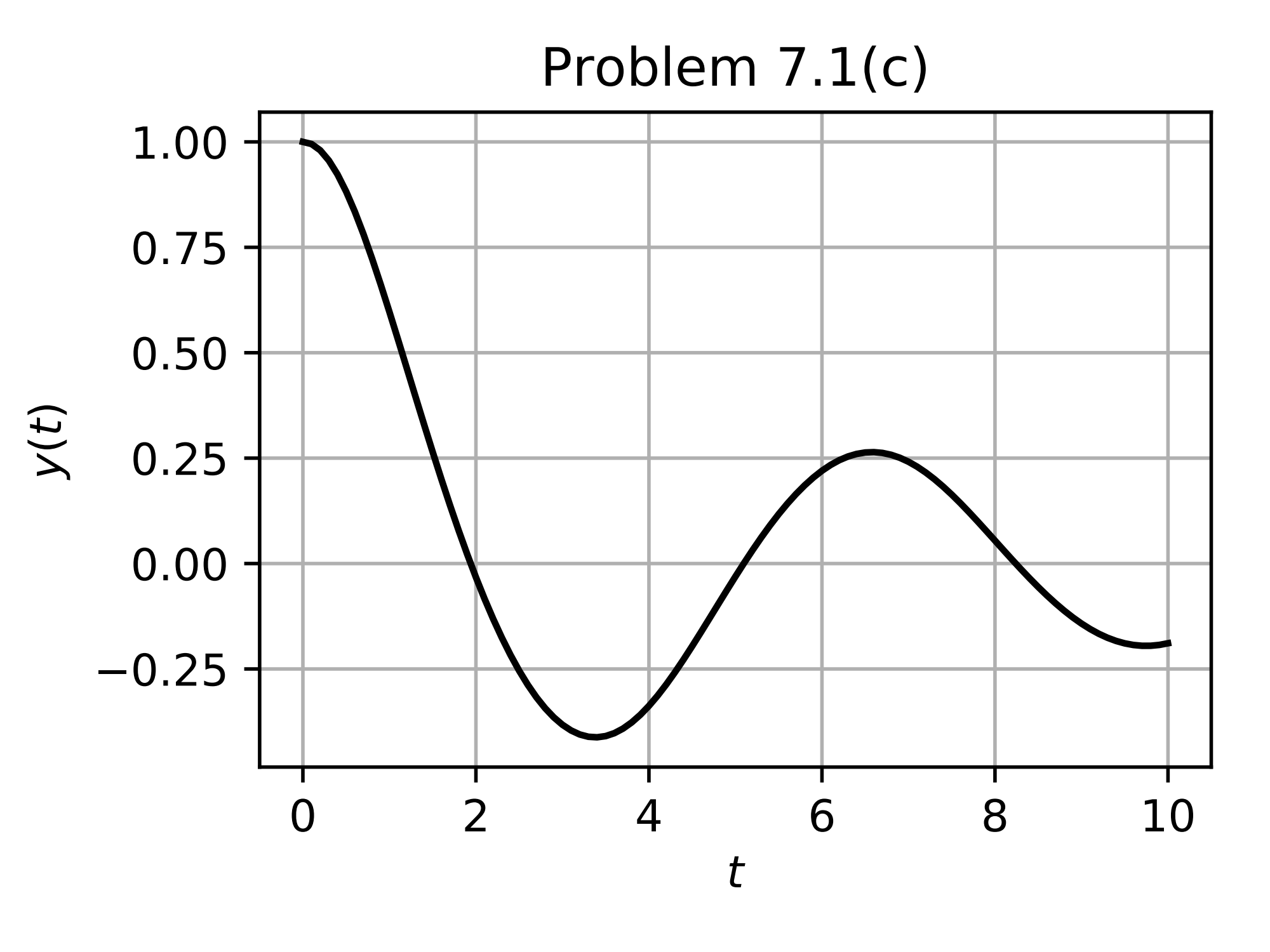
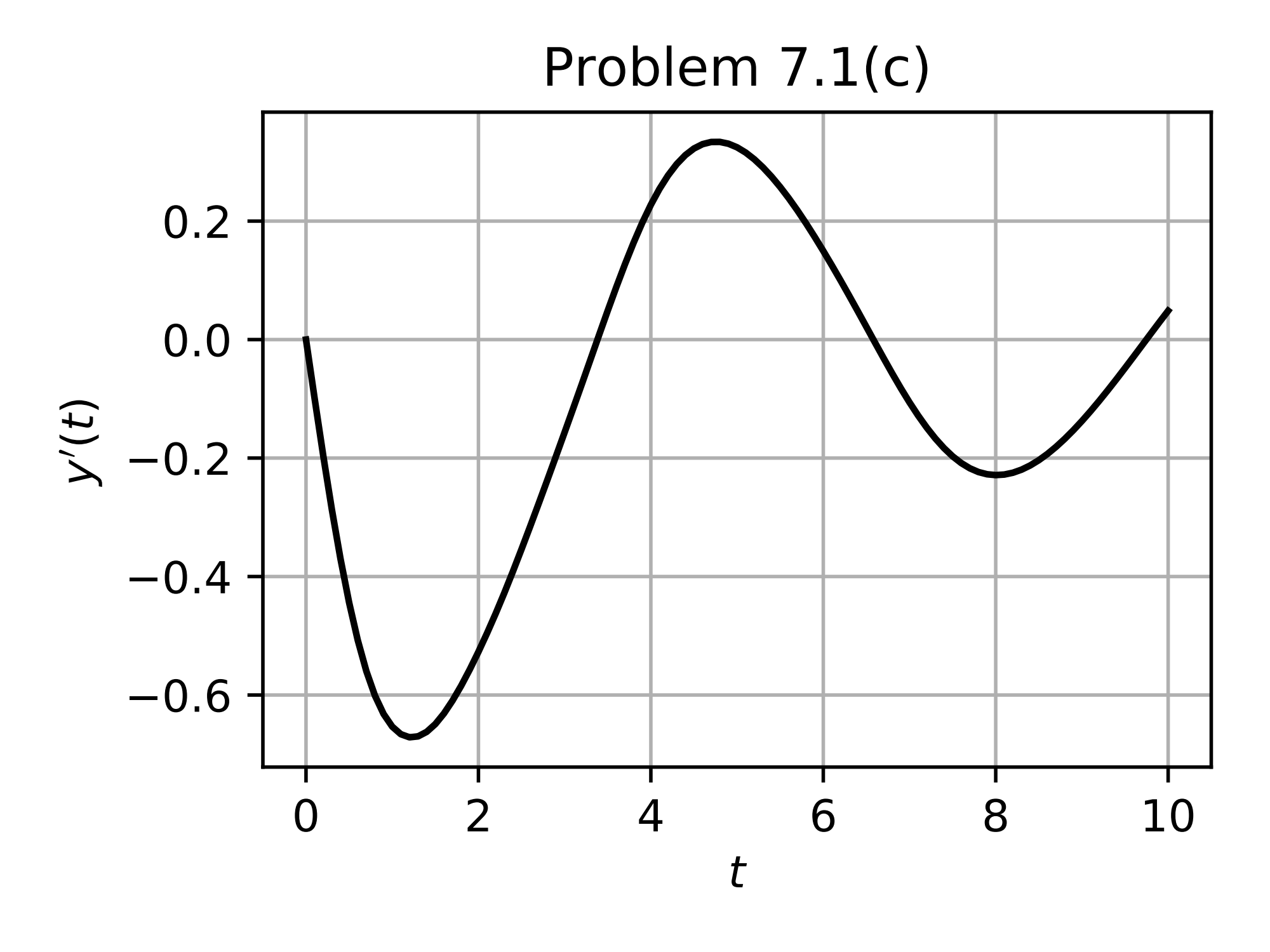
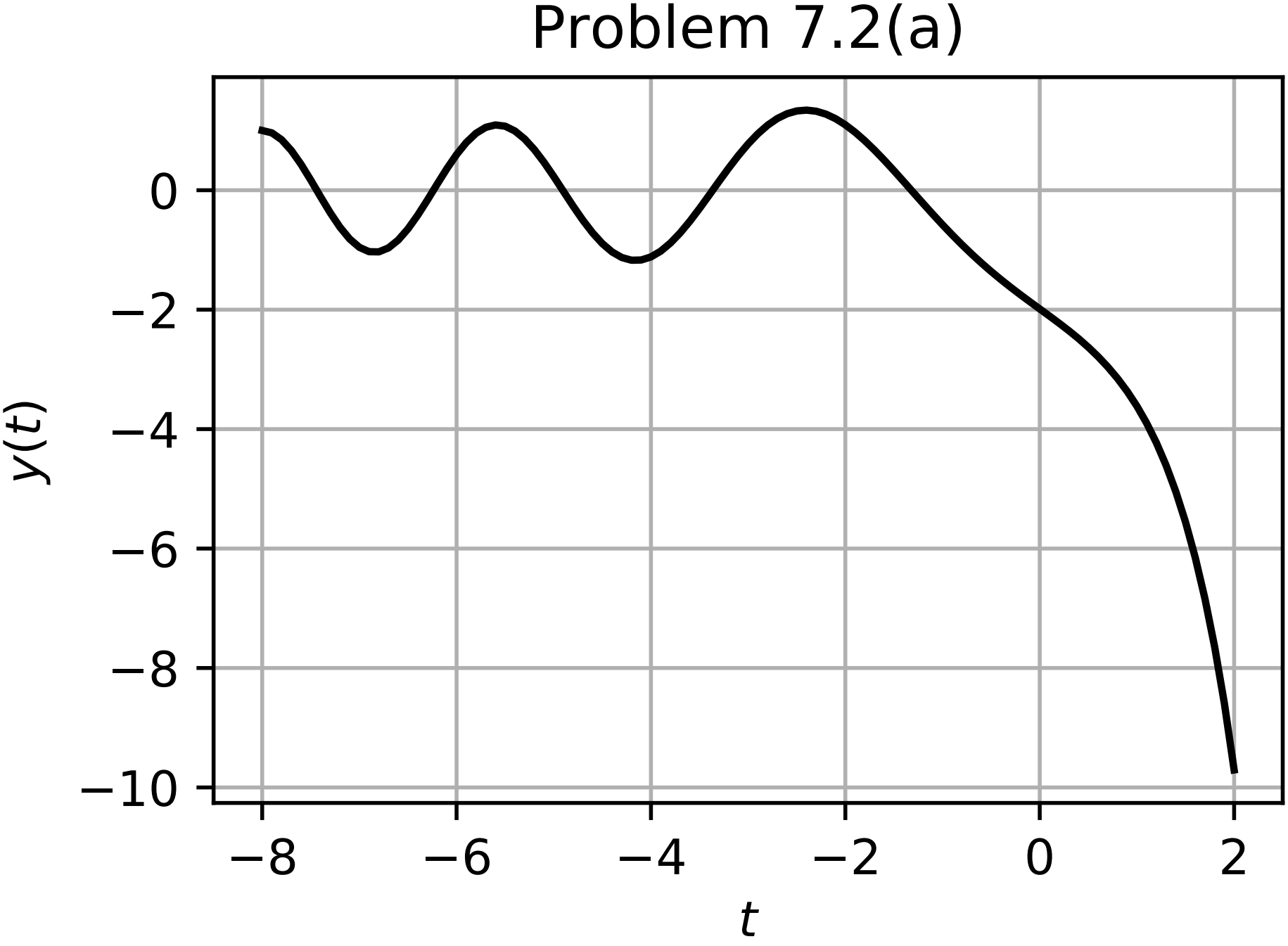

Problem 7.1(a)
6
4
2
$y(t)$
0.0
0.2
0.4
0.6
0.8
1.0
t

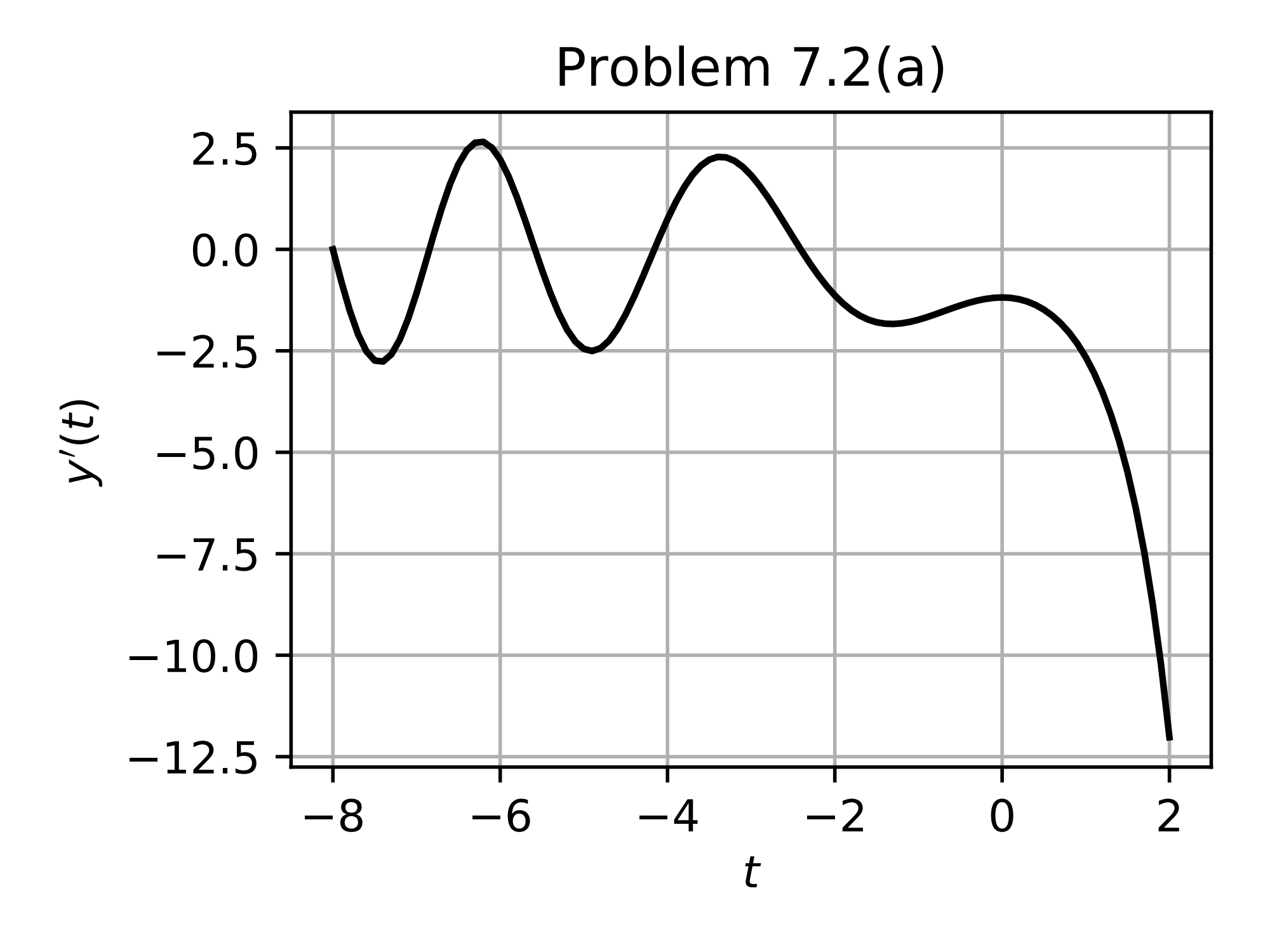

Problem 7.1(b)
2
1
0
−1
−2
y(t)
0
1
2
3
4
5
6
t

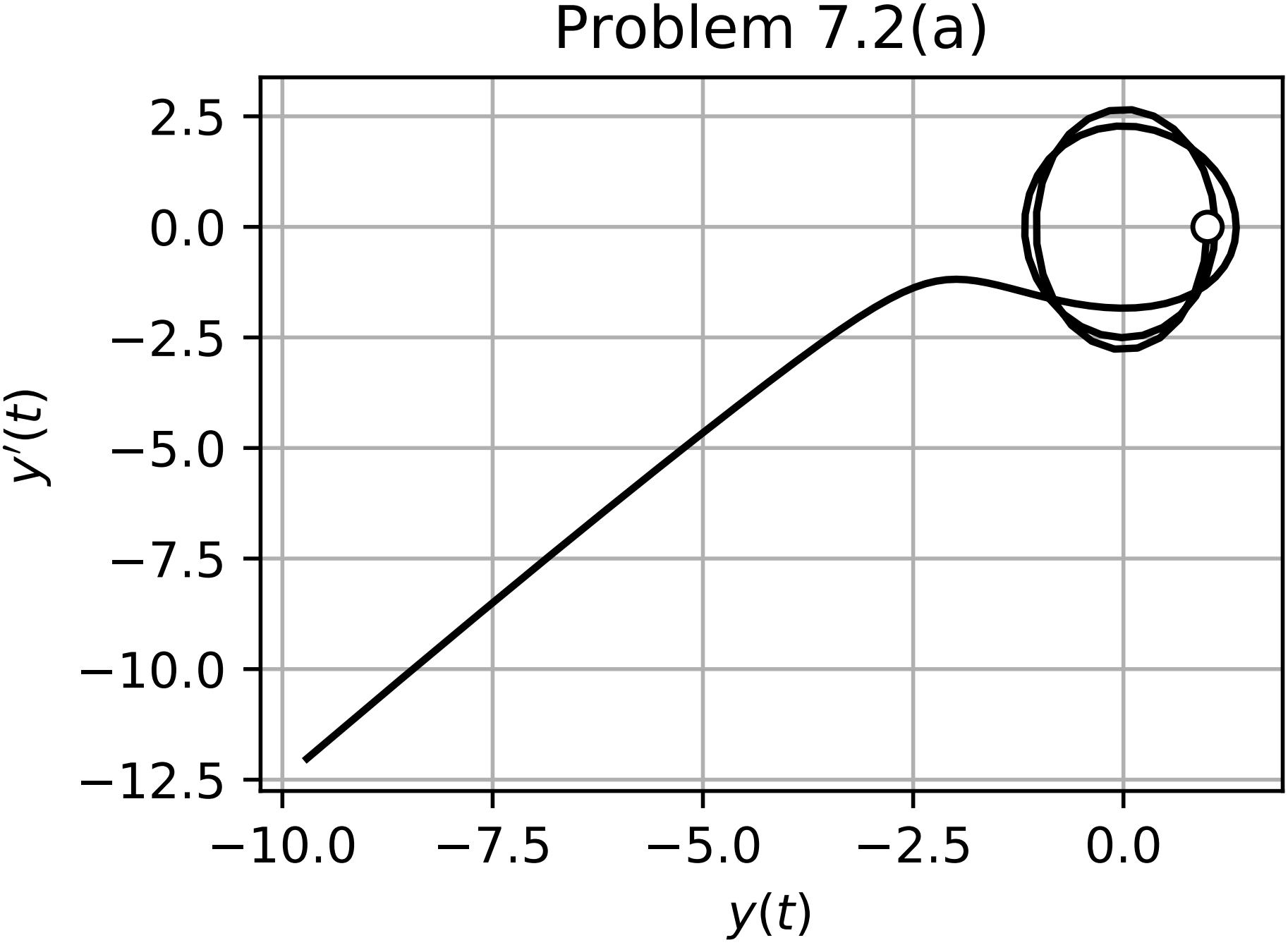

Problem 7.1(b)
2
0
−2
$y'(t)$
0
1
2
3
4
5
6
t

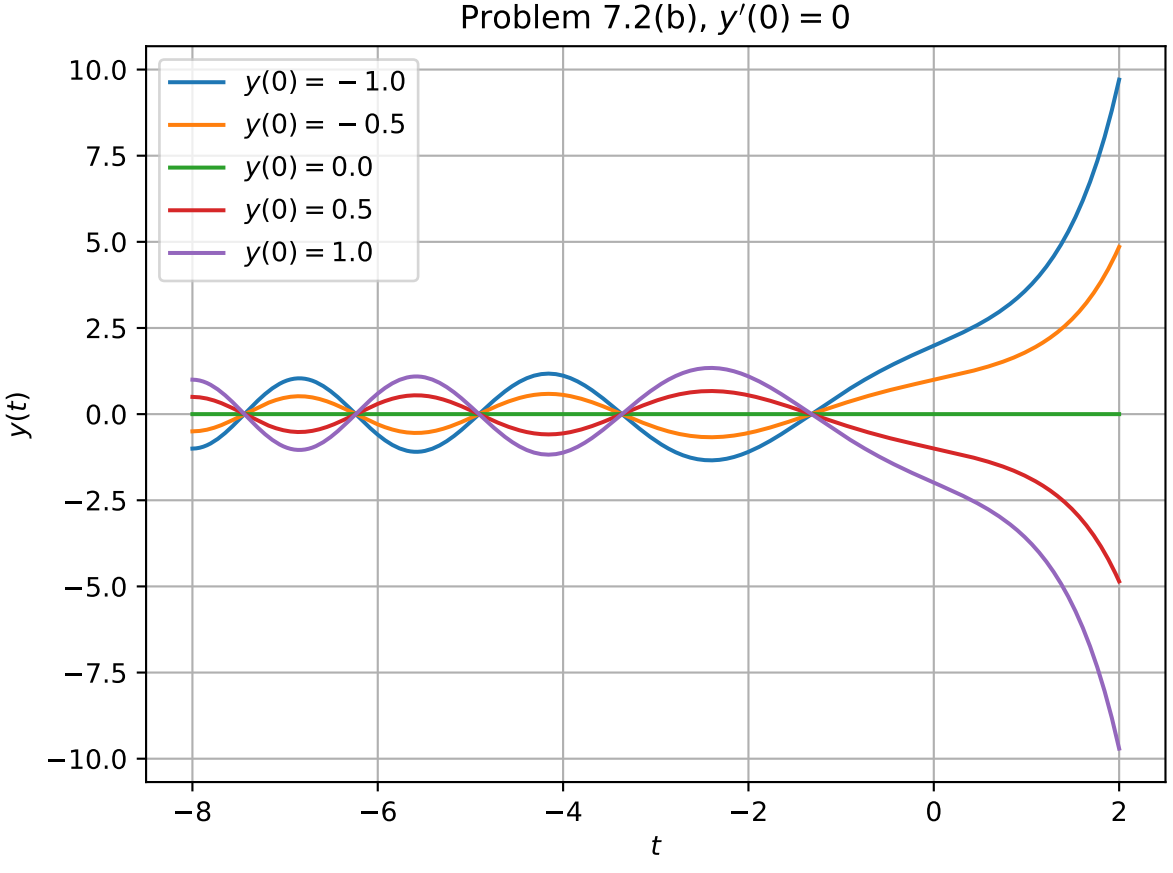

Problem 7.1(c)
1.00
0.75
0.50
0.25
0.00
−0.25
y(t)
0
2
4
6
8
10
t

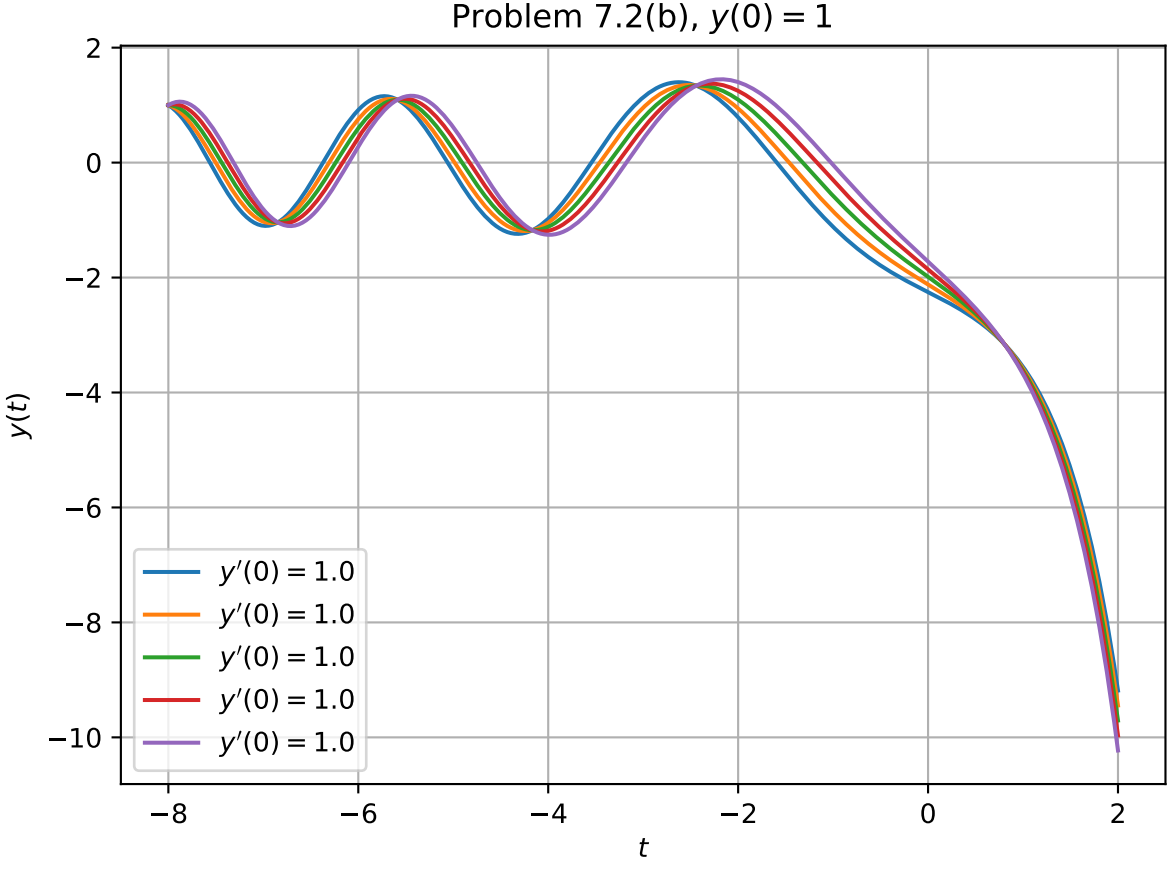

Problem 7.1(c)
0.2
0.0
−0.2
−0.4
−0.6
$y'(t)$
0
2
4
6
8
10
t

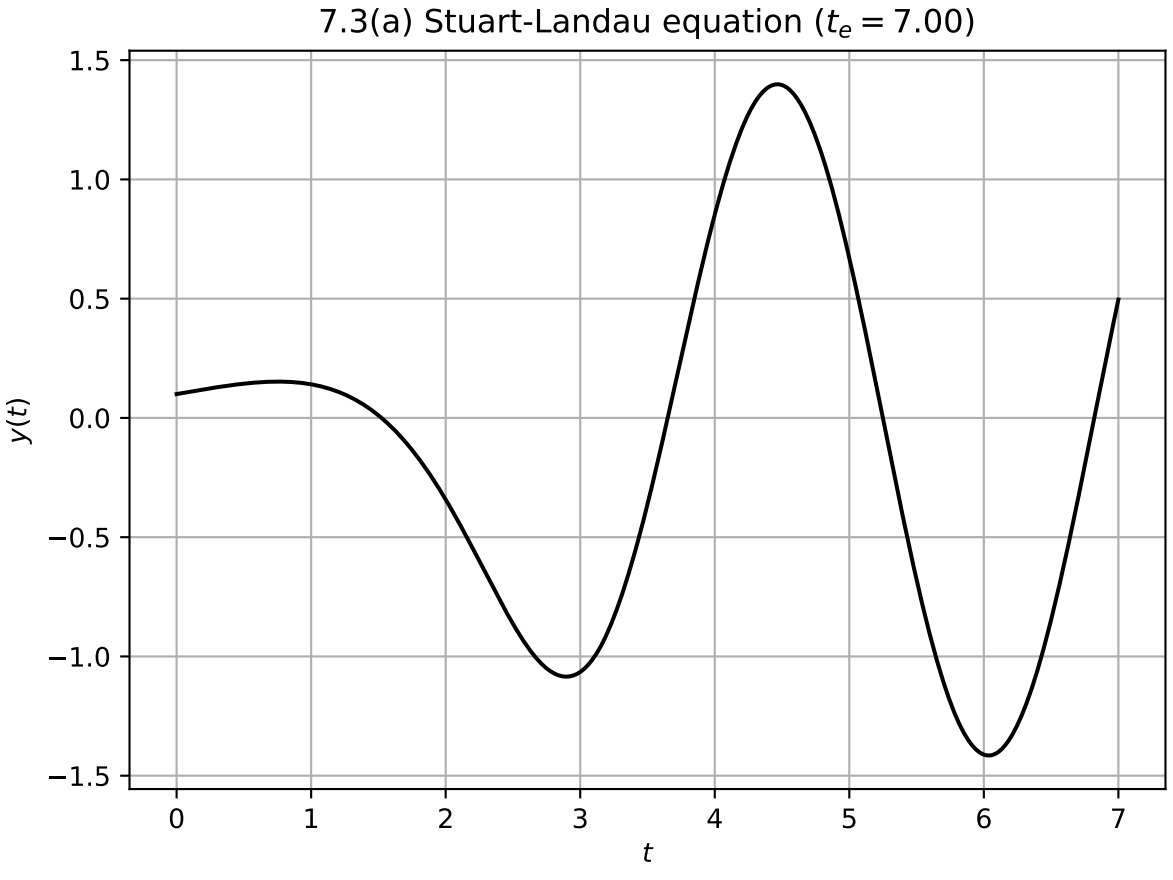

Problem 7.2(a)
0
−2
−4
−6
−8
−10
y(t)
−8
−6
−4
−2
0
2
t

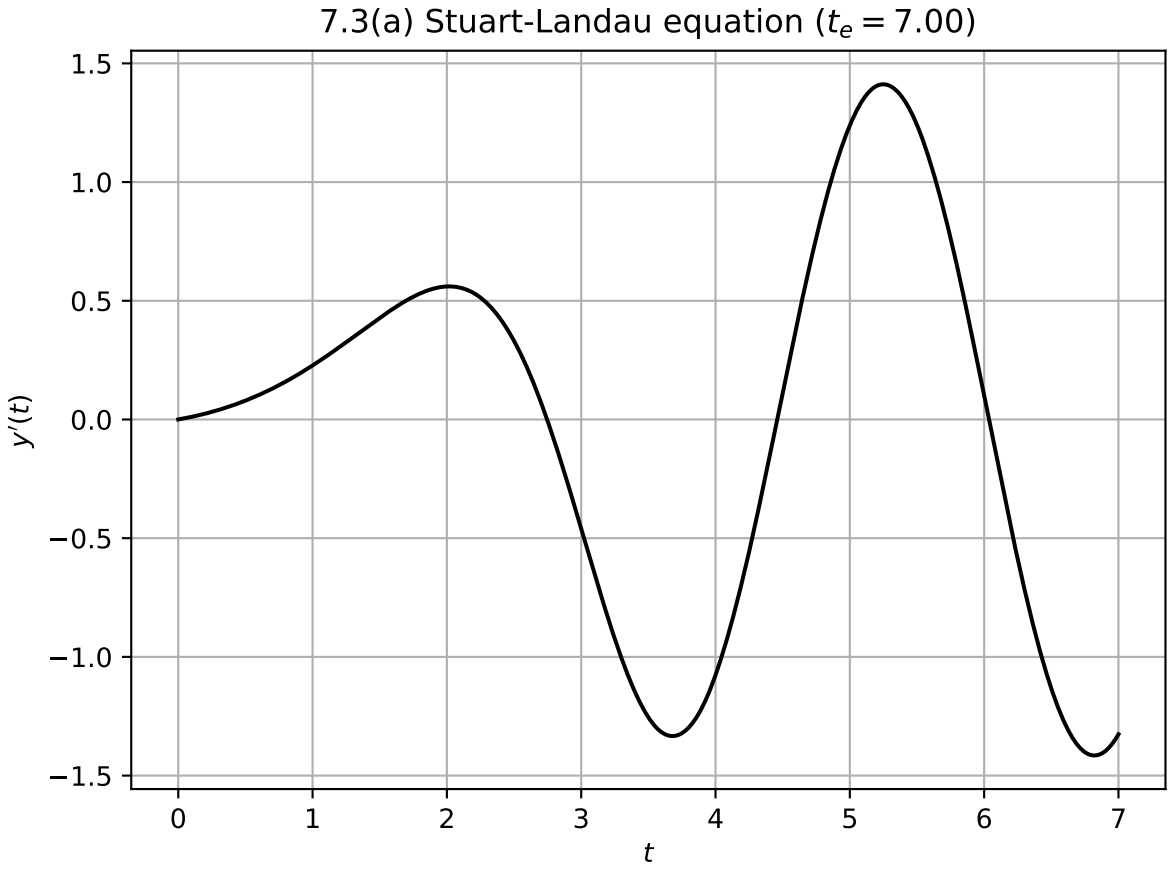

Problem 7.2(a)
2.5
0.0
−2.5
−5.0
−7.5
−10.0
−12.5
$y'(t)$
−8
−6
−4
−2
0
2
t

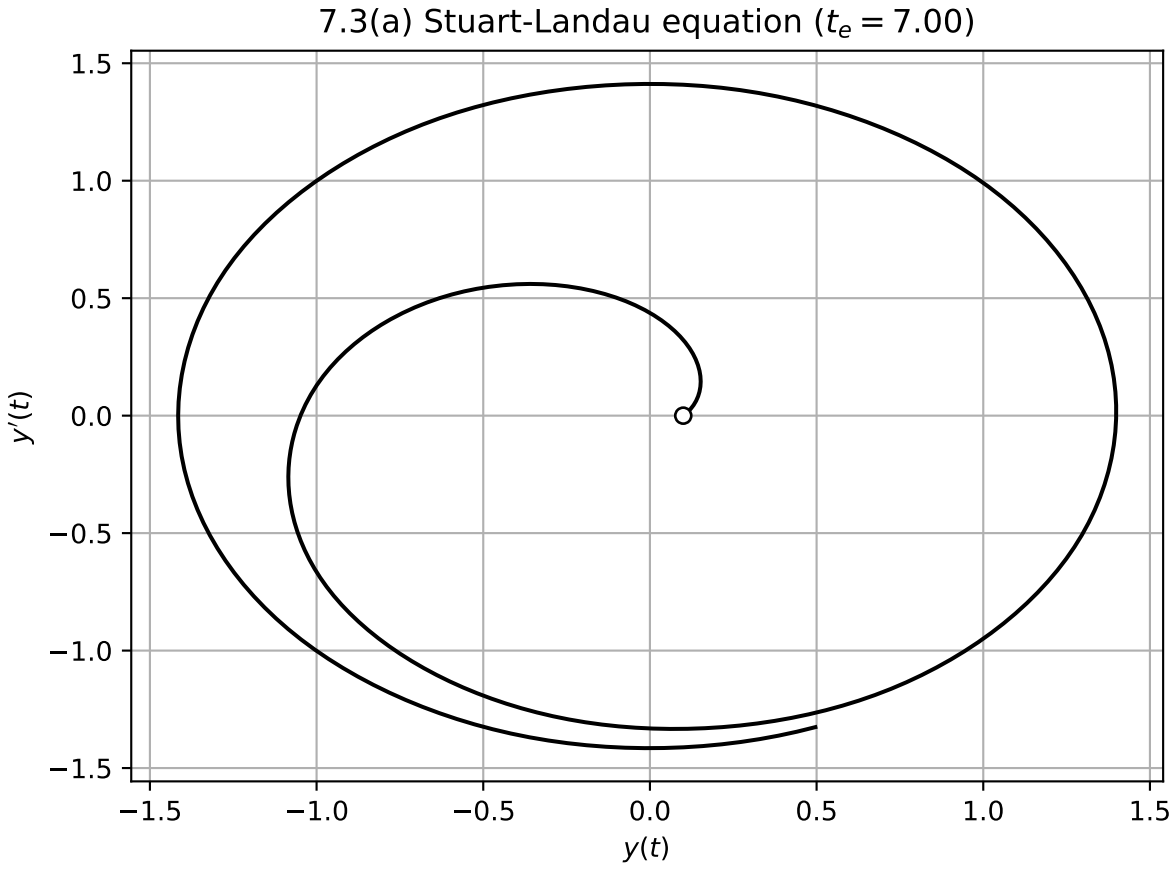

Problem 7.2(a)
2.5
0.0
−2.5
−5.0
−7.5
−10.0
−12.5
$y'(t)$
−10.0
−7.5
−5.0
−2.5
0.0
$y(t)$

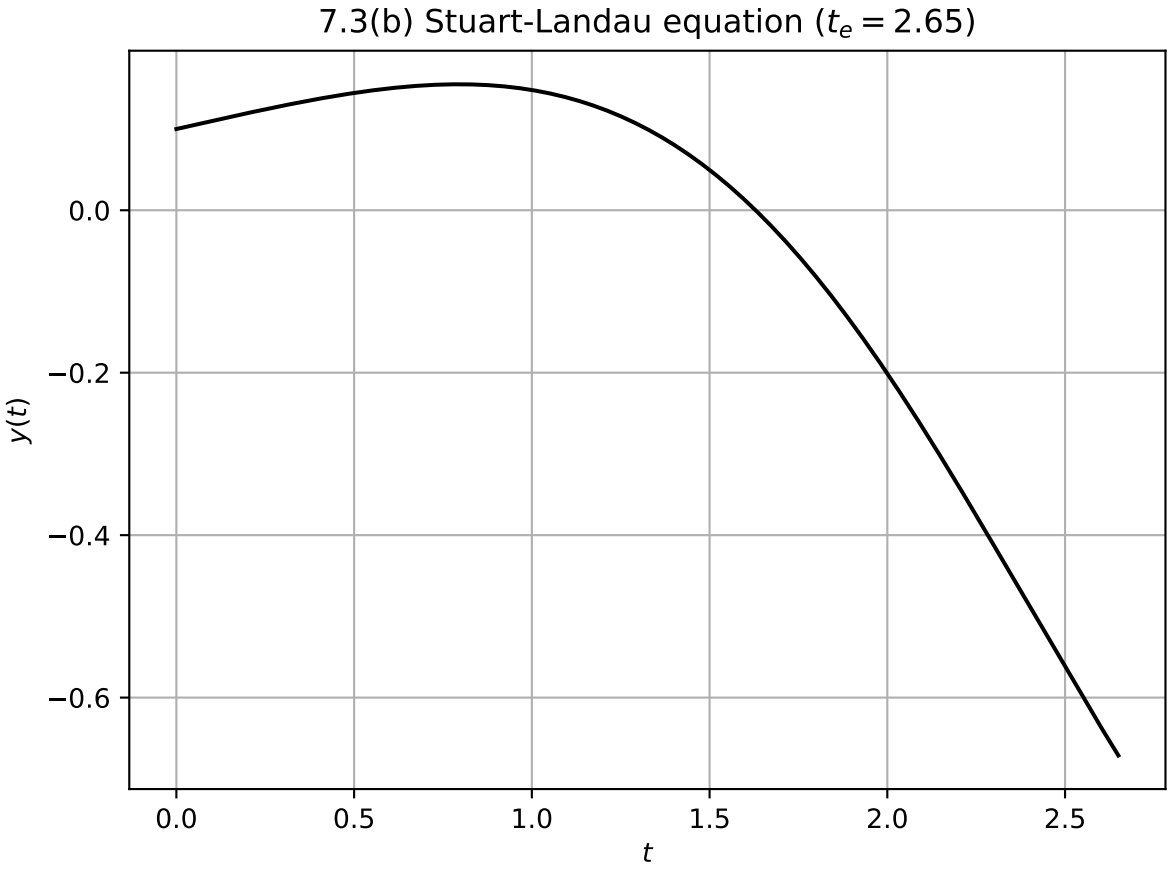

Problem 7.2(b), $y'(0) = 0$
$y(0) = -1.0$
$y(0) = -0.5$
$y(0) = 0.0$
$y(0) = 0.5$
$y(0) = 1.0$
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
$y(t)$
−8
−6
−4
−2
0
2
t

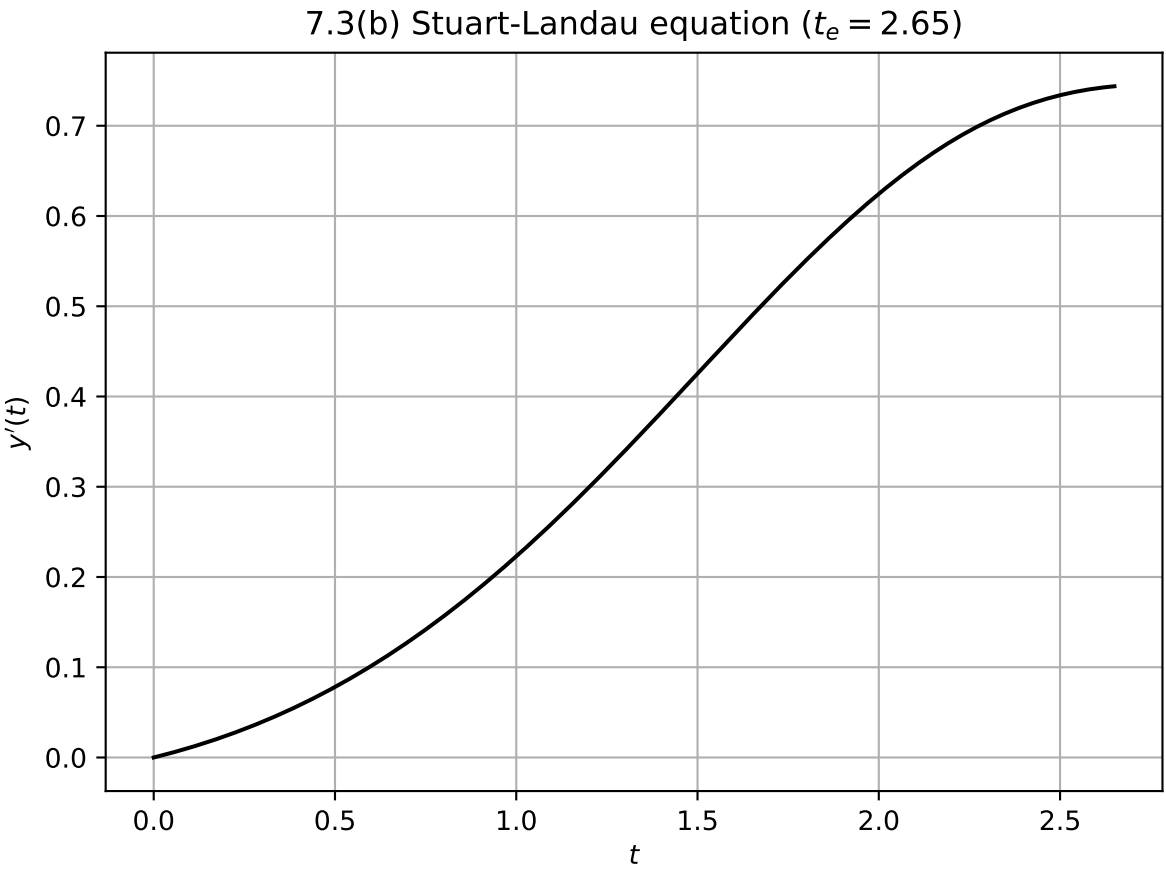

Problem 7.2(b), $y(0) = 1$
$y(t)$
t
$y'(0) = 1.0$
$y'(0) = 1.0$
$y'(0) = 1.0$
$y'(0) = 1.0$
$y'(0) = 1.0$

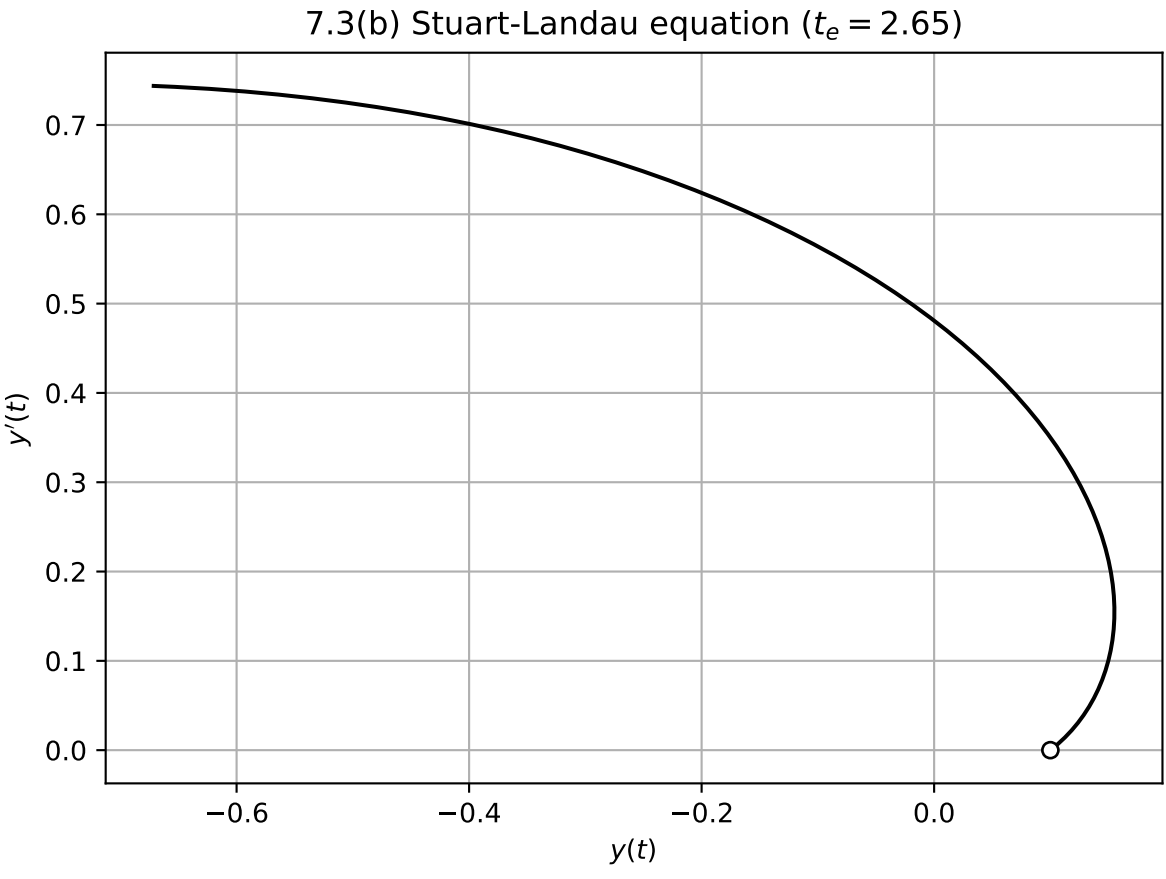

7.3(a) Stuart-Landau equation ($t_e = 7.00$)
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
$y(t)$
0
1
2
3
4
5
6
7
t

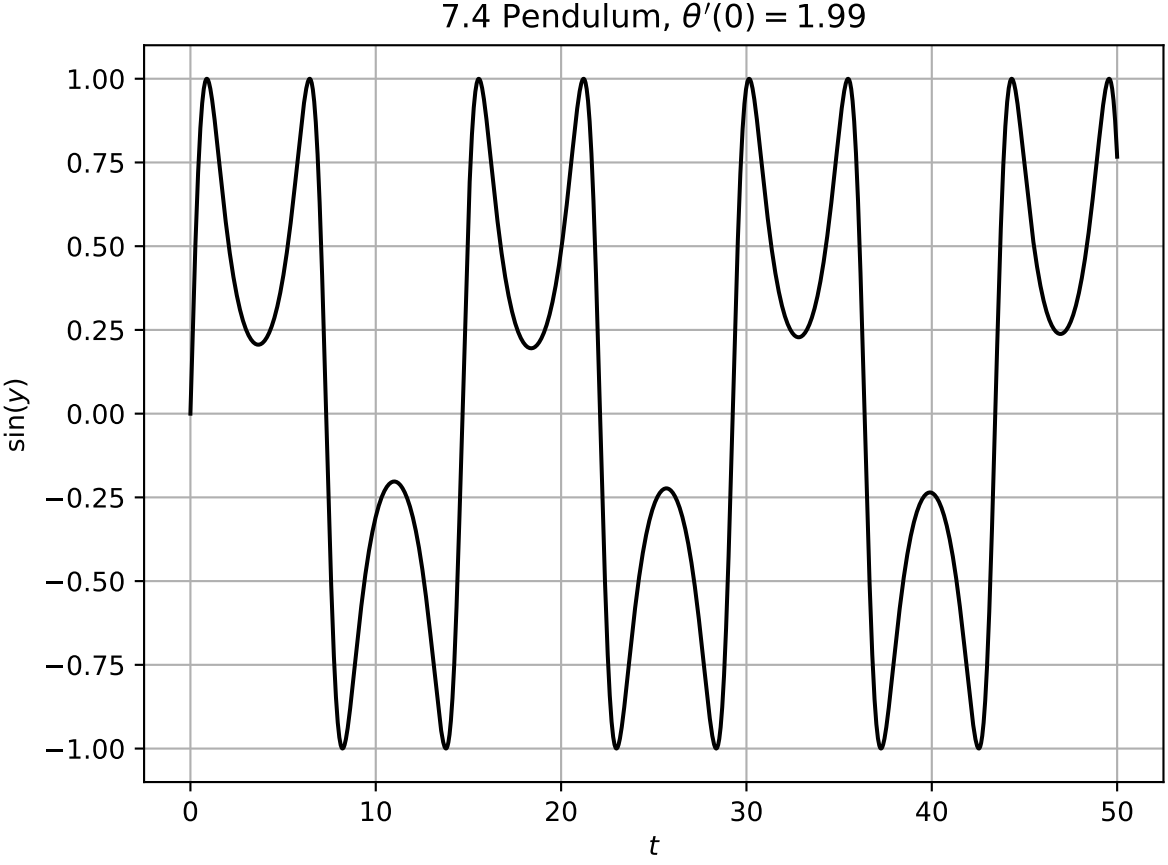

7.3(a) Stuart-Landau equation ($t_e = 7.00$)
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
$y'(t)$
0
1
2
3
4
5
6
7
t

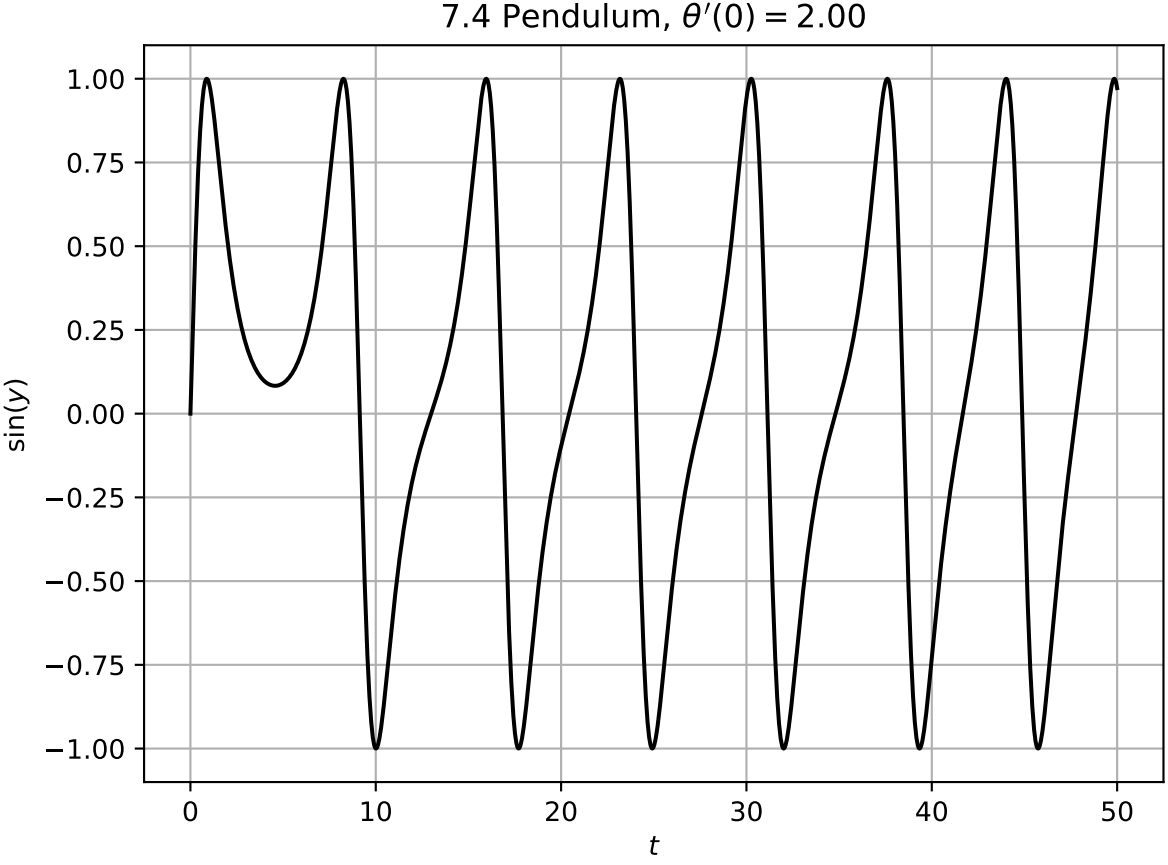

7.3(a) Stuart-Landau equation ($t_e = 7.00$)
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
$y'(t)$
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
$y(t)$

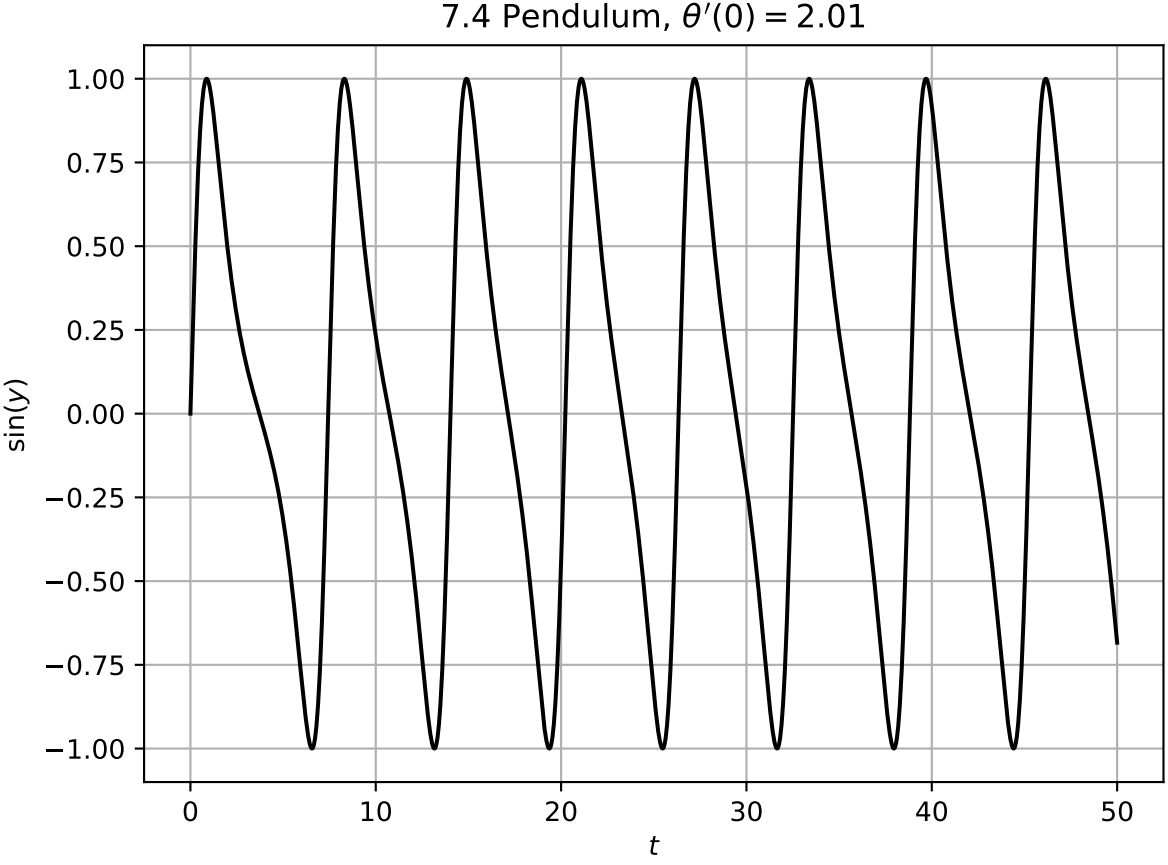

7.3(b) Stuart-Landau equation ($t_e = 2.65$)
0.0
−0.2
−0.4
−0.6
$y(t)$
0.0
0.5
1.0
1.5
2.0
2.5
t

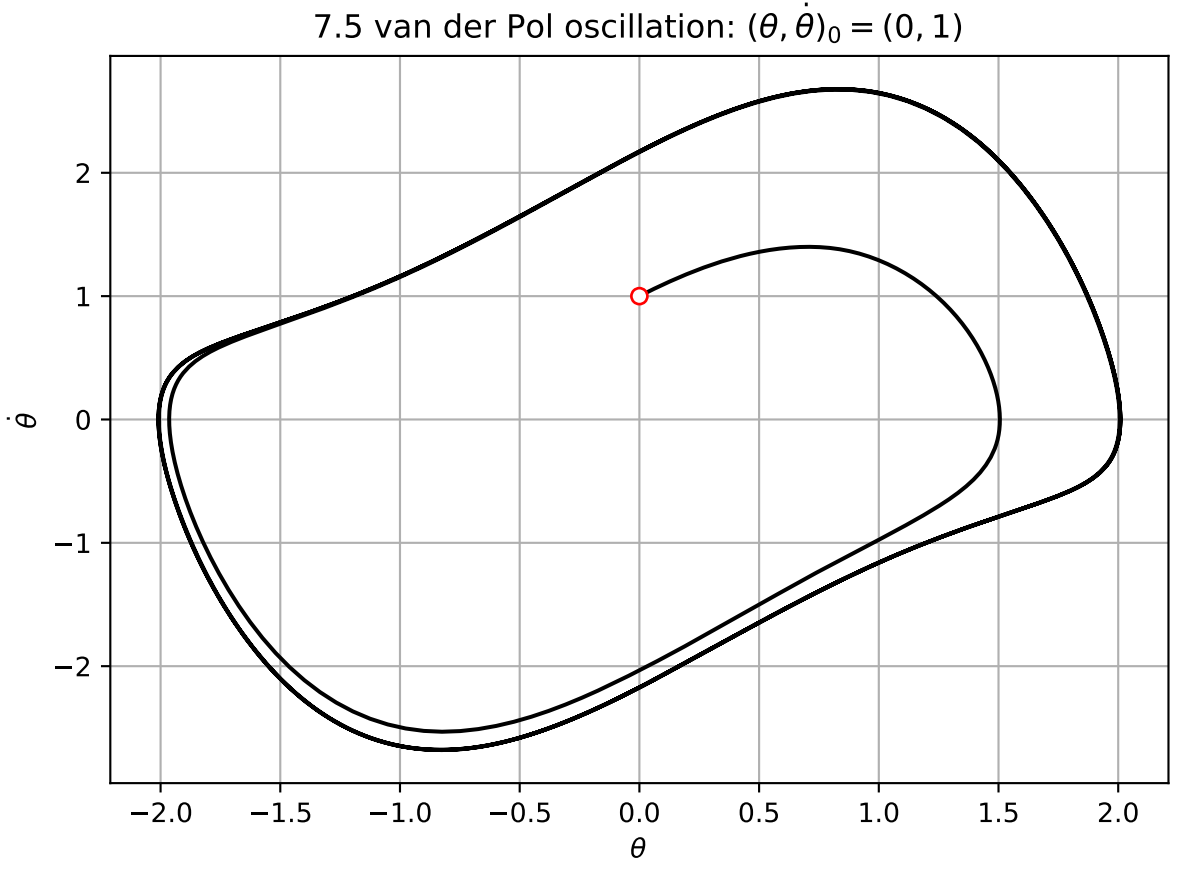

7.3(b) Stuart-Landau equation ($t_e = 2.65$)
$y'(t)$
t
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.0
0.5
1.0
1.5
2.0
2.5

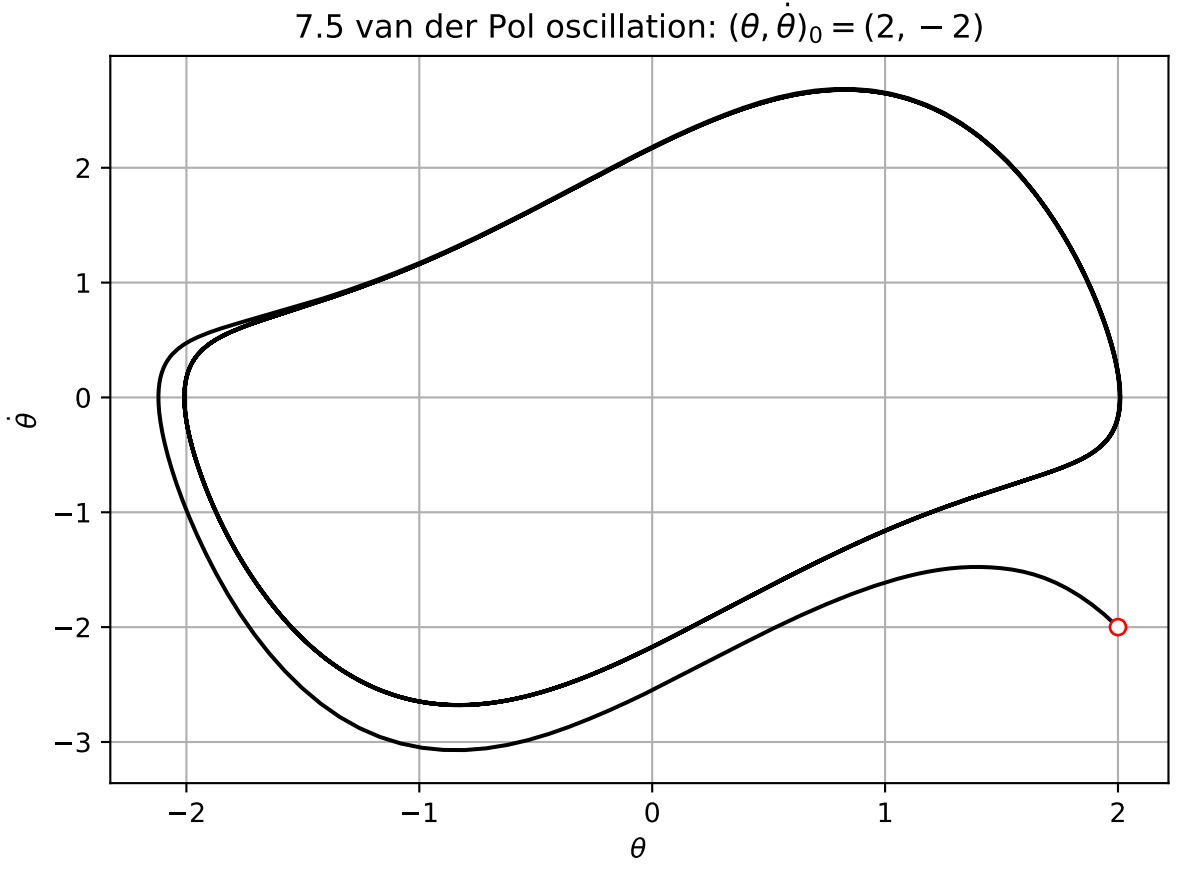

7.3(b) Stuart-Landau equation ($t_e = 2.65$)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
$y'(t)$
−0.6
−0.4
−0.2
0.0
$y(t)$

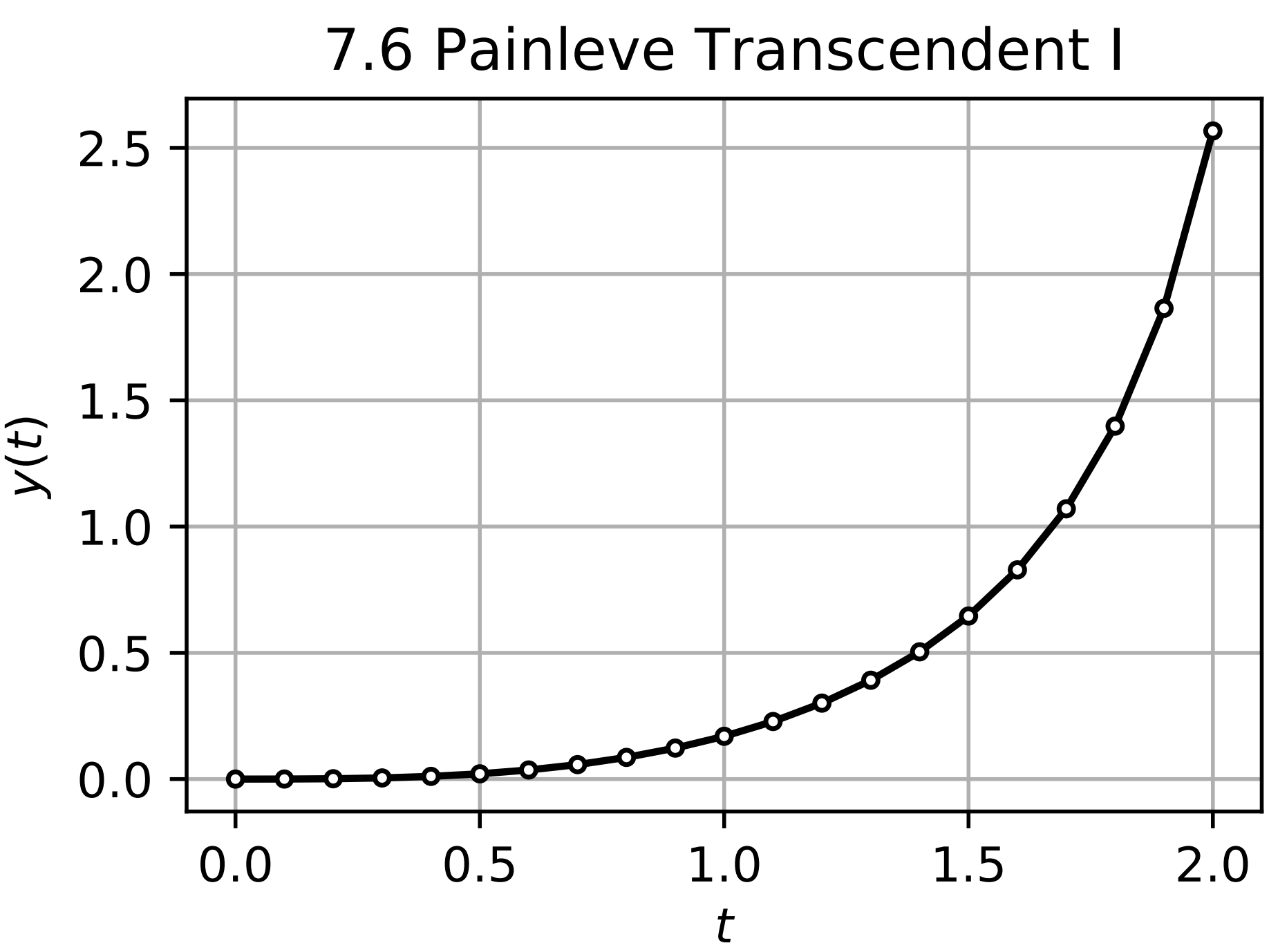

7.4 Pendulum, $\theta'(0) = 1.99$
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
sin(y)
0
10
20
30
40
50
t

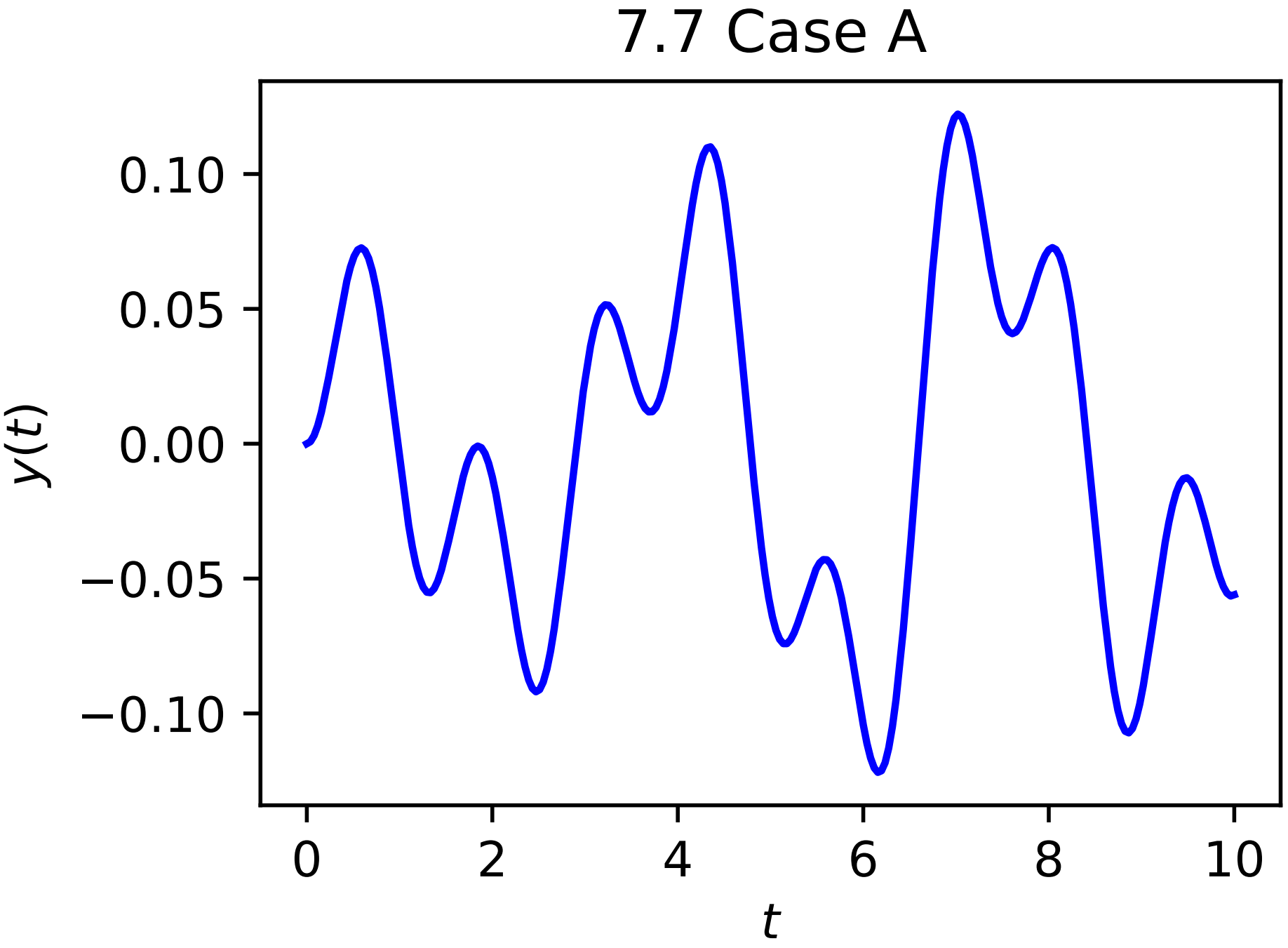

7.4 Pendulum, $\theta'(0) = 2.00$
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
sin(y)
0
10
20
30
40
50
t

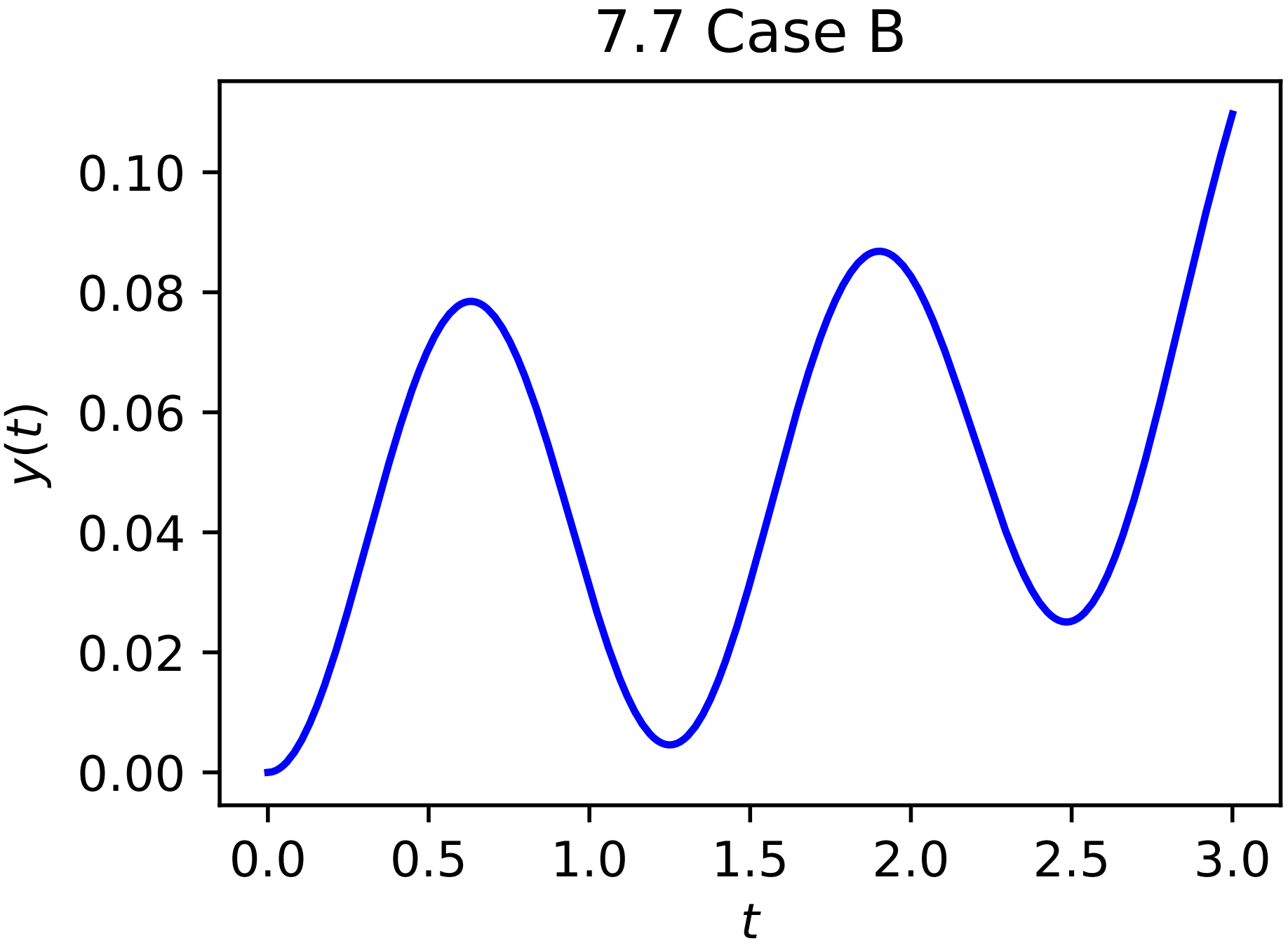

7.4 Pendulum, $\theta'(0) = 2.01$
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
sin(y)
0
10
20
30
40
50
t

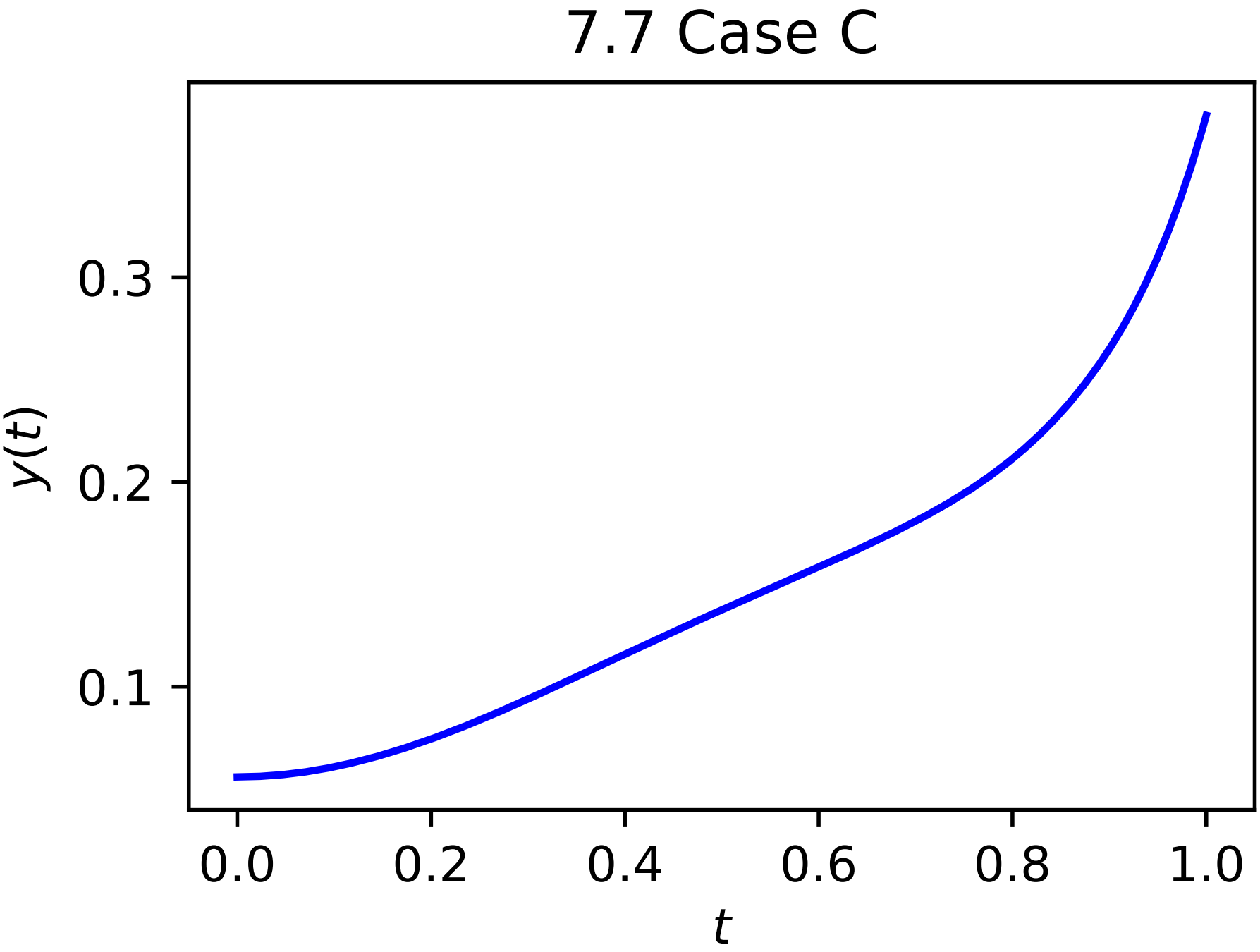

7.5 van der Pol oscillation: $(\theta, \dot{\theta})_0 = (0, 1)$
$\dot{\theta}$
θ
2
1
0
−1
−2
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0

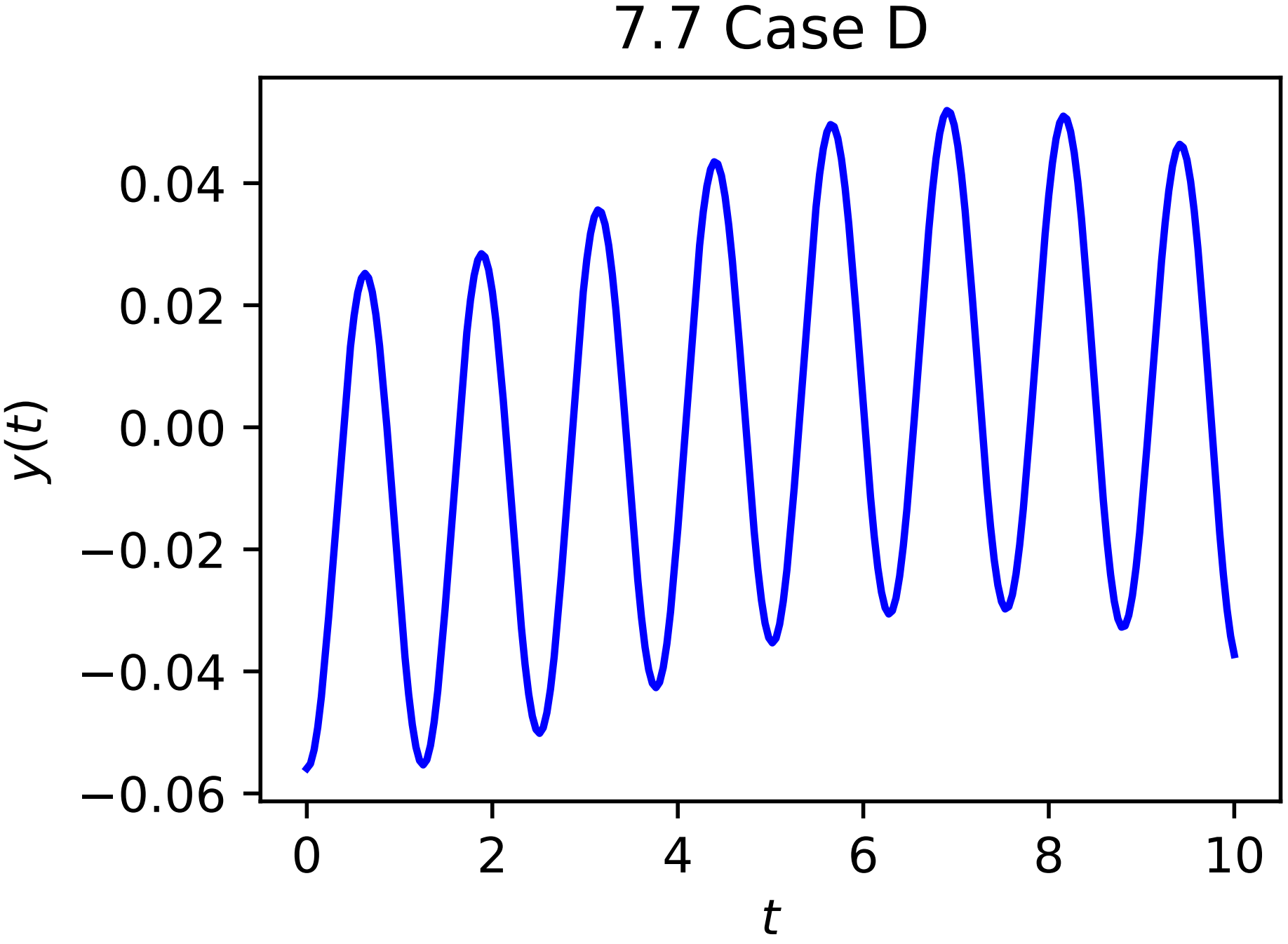

7.5 van der Pol oscillation: $(\theta, \dot{\theta})_0 = (2, -2)$
$\dot{\theta}$
θ
2
1
0
−1
−2
−3
−2
−1
0
1
2

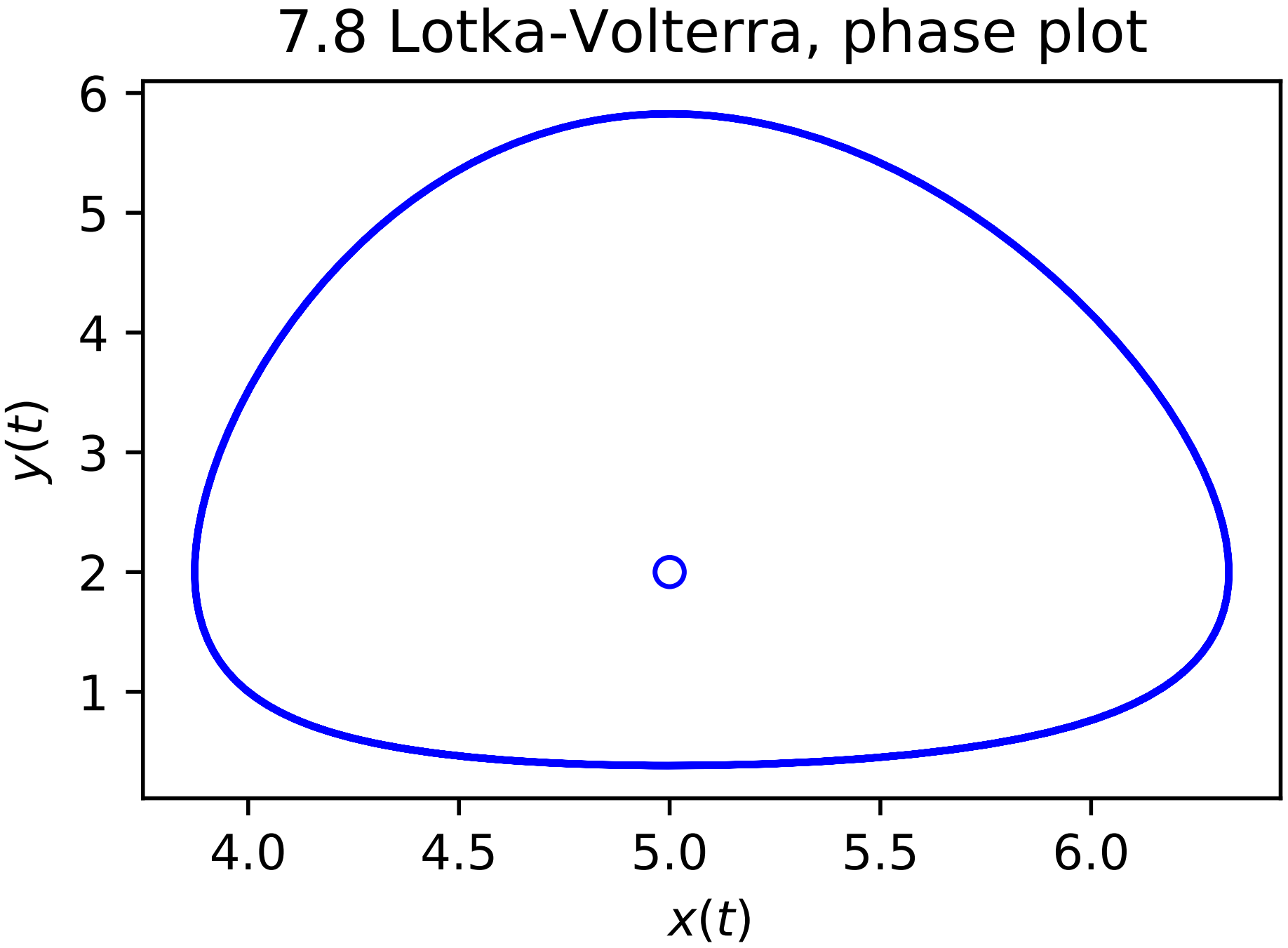

7.6 Painleve Transcendent I
2.5
2.0
1.5
1.0
0.5
0.0
y(t)
0.0
0.5
1.0
1.5
2.0
t

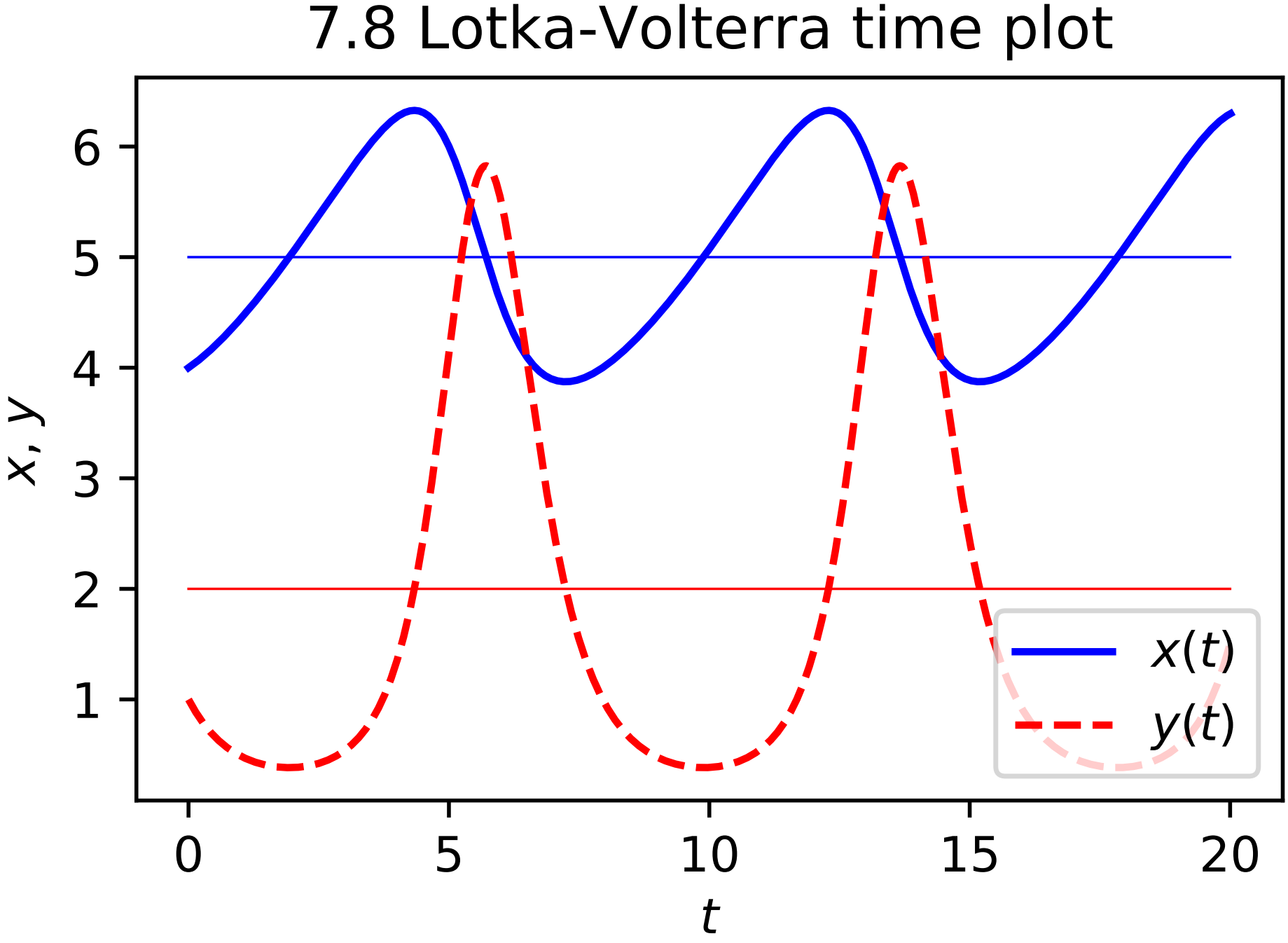

7.7 Case A
0.10
0.05
0.00
−0.05
−0.10
y(t)
0
2
4
6
8
10
t

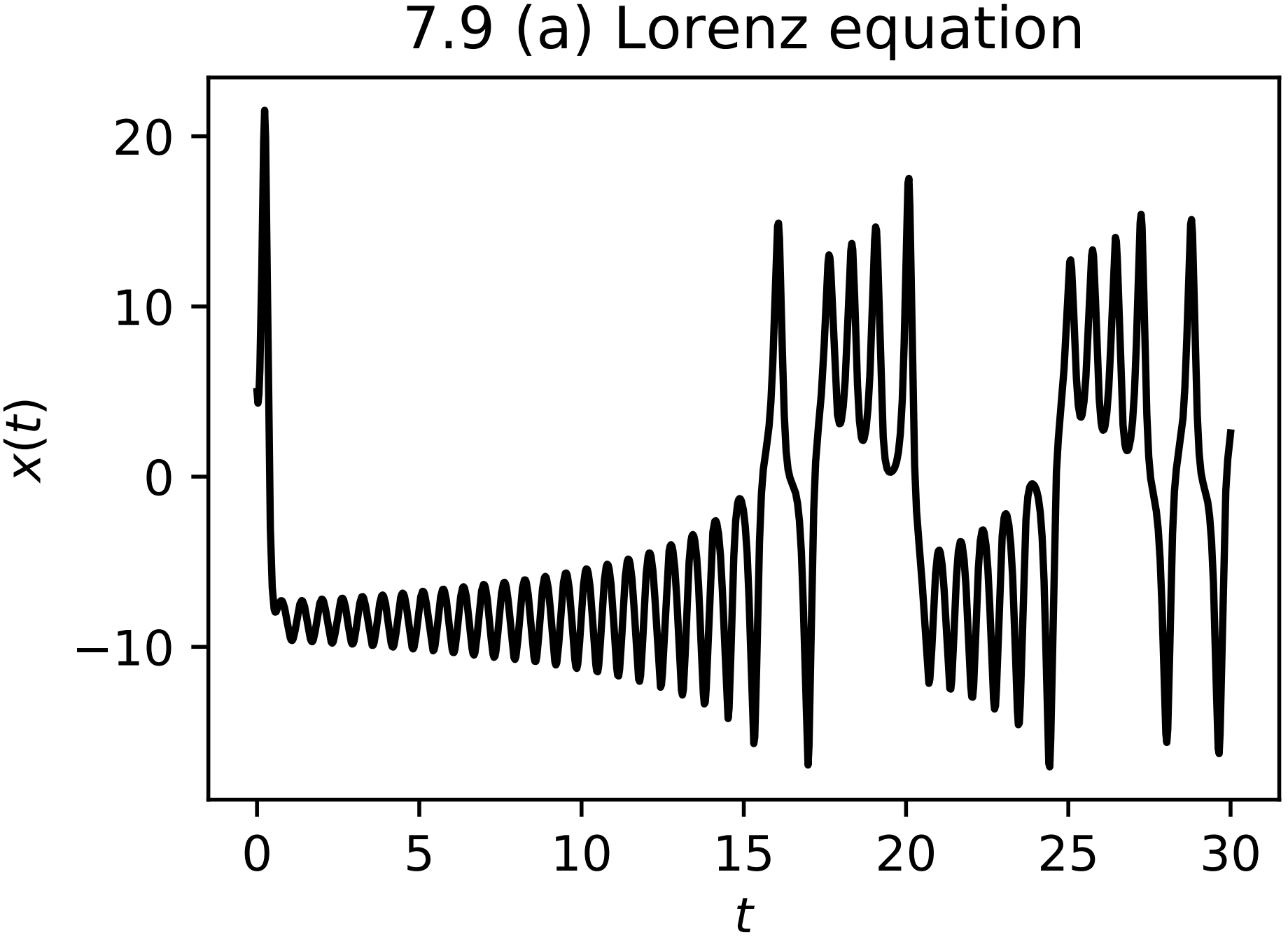

7.7 Case B
0.10
0.08
0.06
0.04
0.02
0.00
y(t)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
t

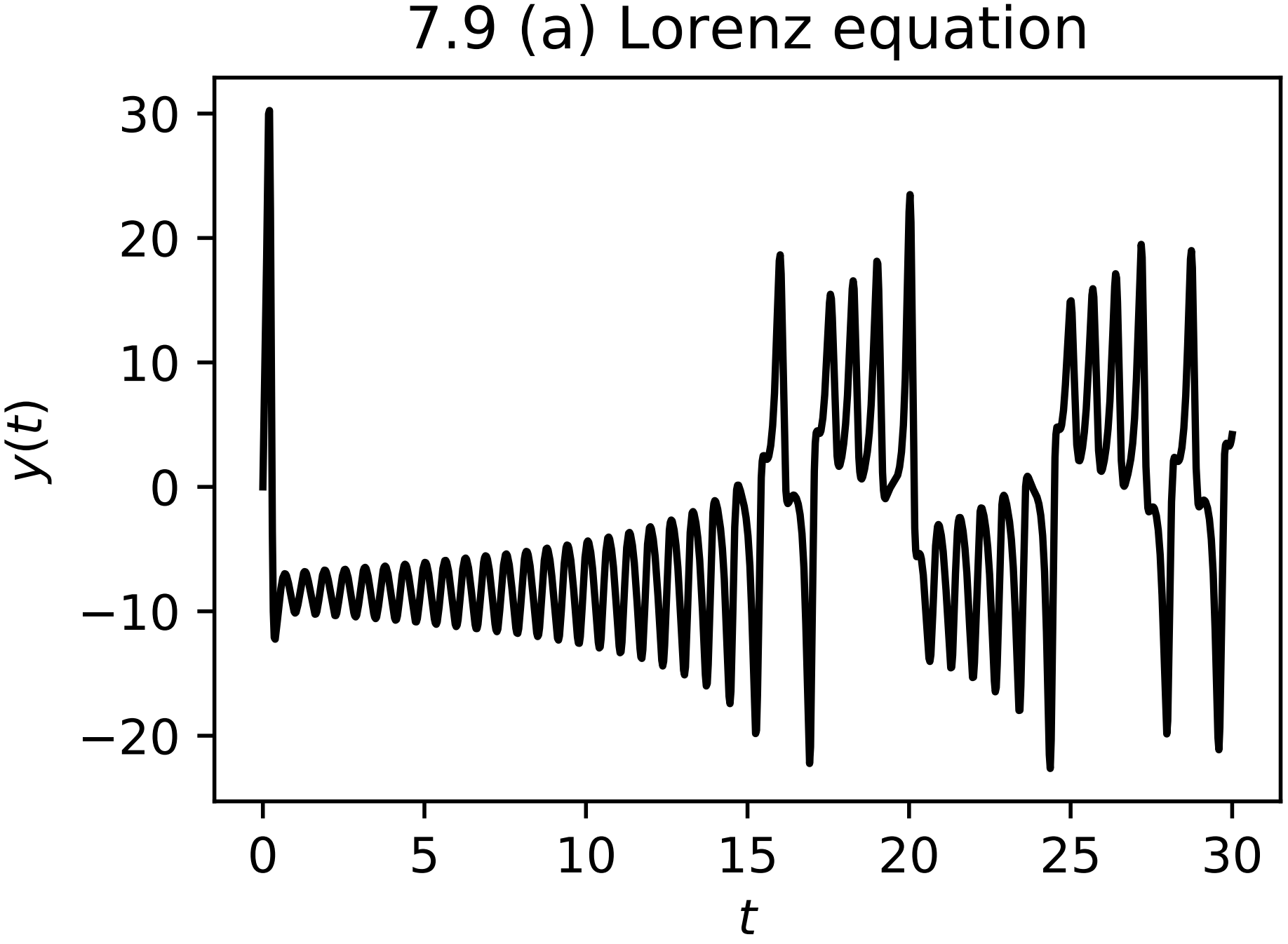

7.7 Case C
0.3
0.2
0.1
y(t)
0.0
0.2
0.4
0.6
0.8
1.0
t

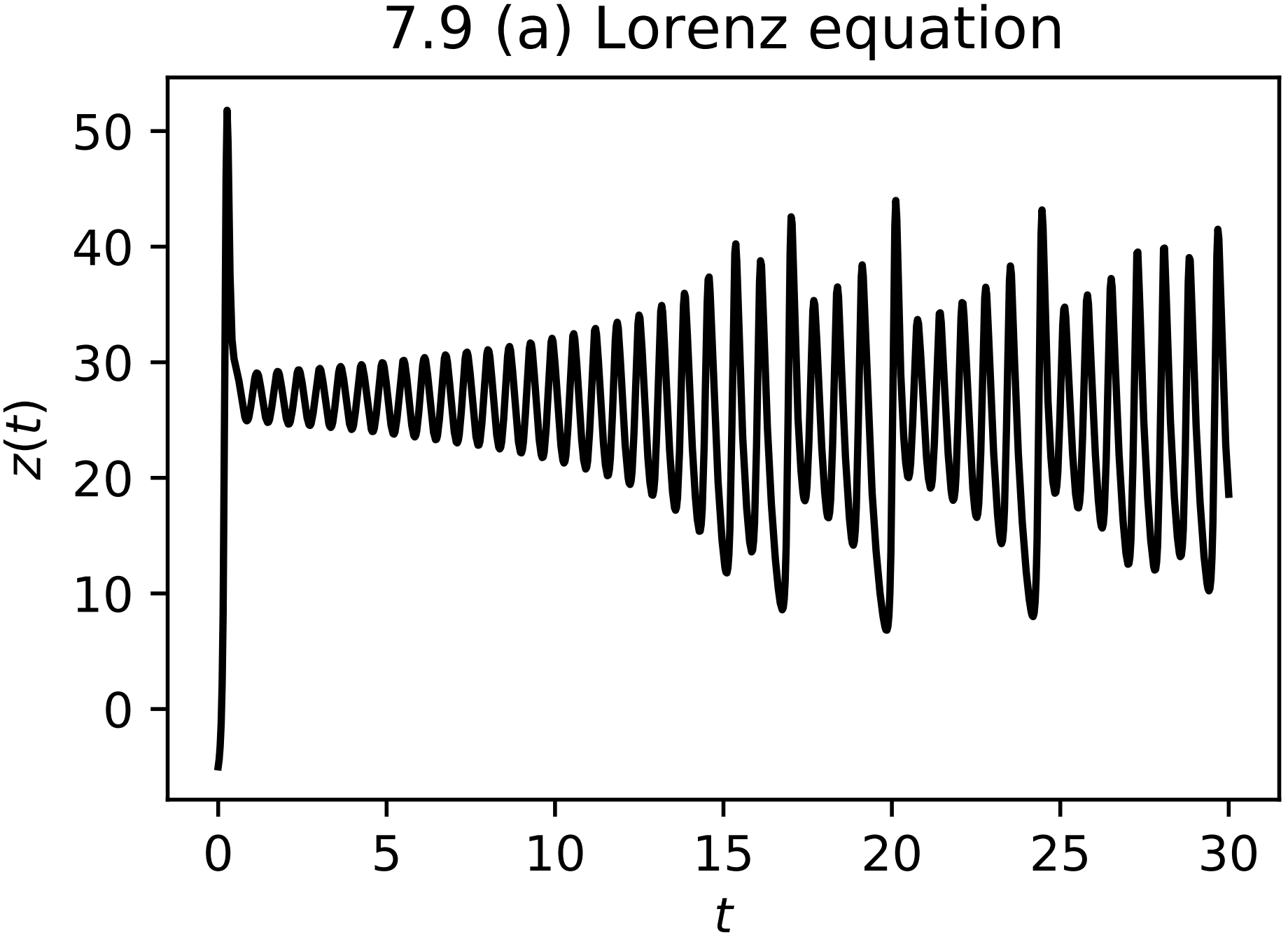

7.7 Case D
0.04
0.02
0.00
−0.02
−0.04
−0.06
y(t)
0
2
4
6
8
10
t

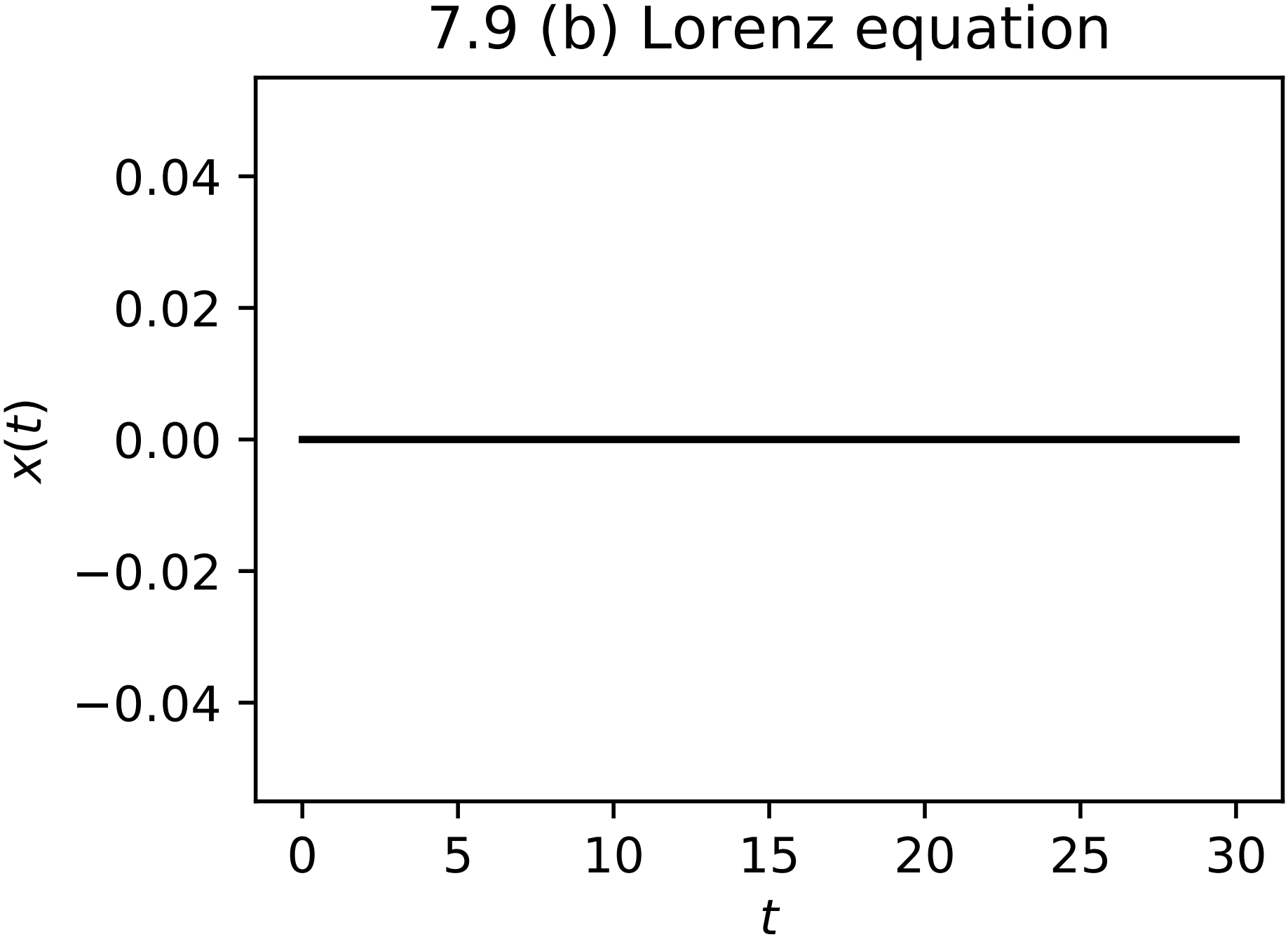

7.8 Lotka-Volterra, phase plot
6
5
4
3
2
1
$y(t)$
4.0
4.5
5.0
5.5
6.0
$x(t)$

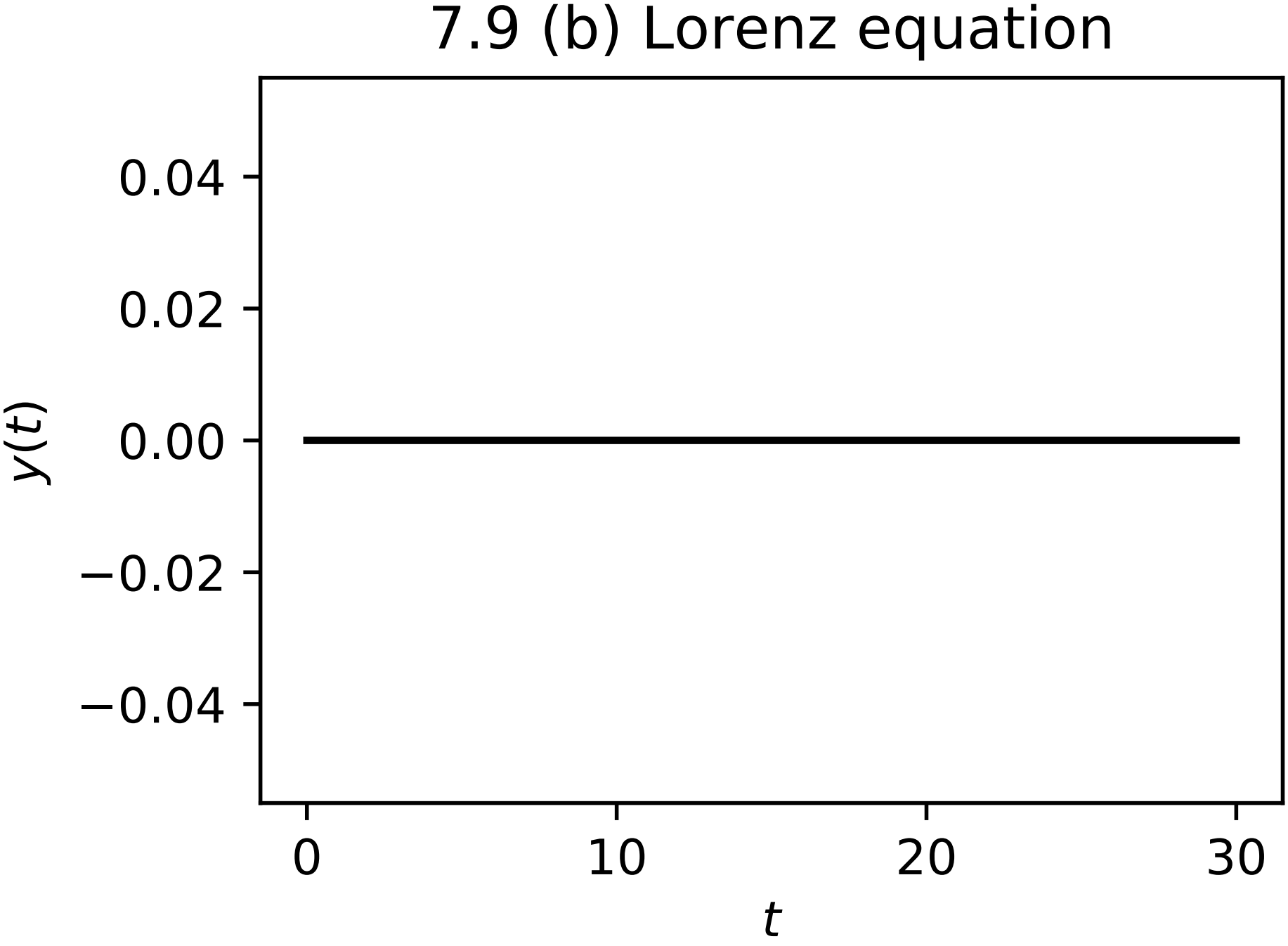

7.8 Lotka-Volterra time plot
6
5
4
3
2
1
x, y
0
5
10
15
20
t
x(t)
y(t)

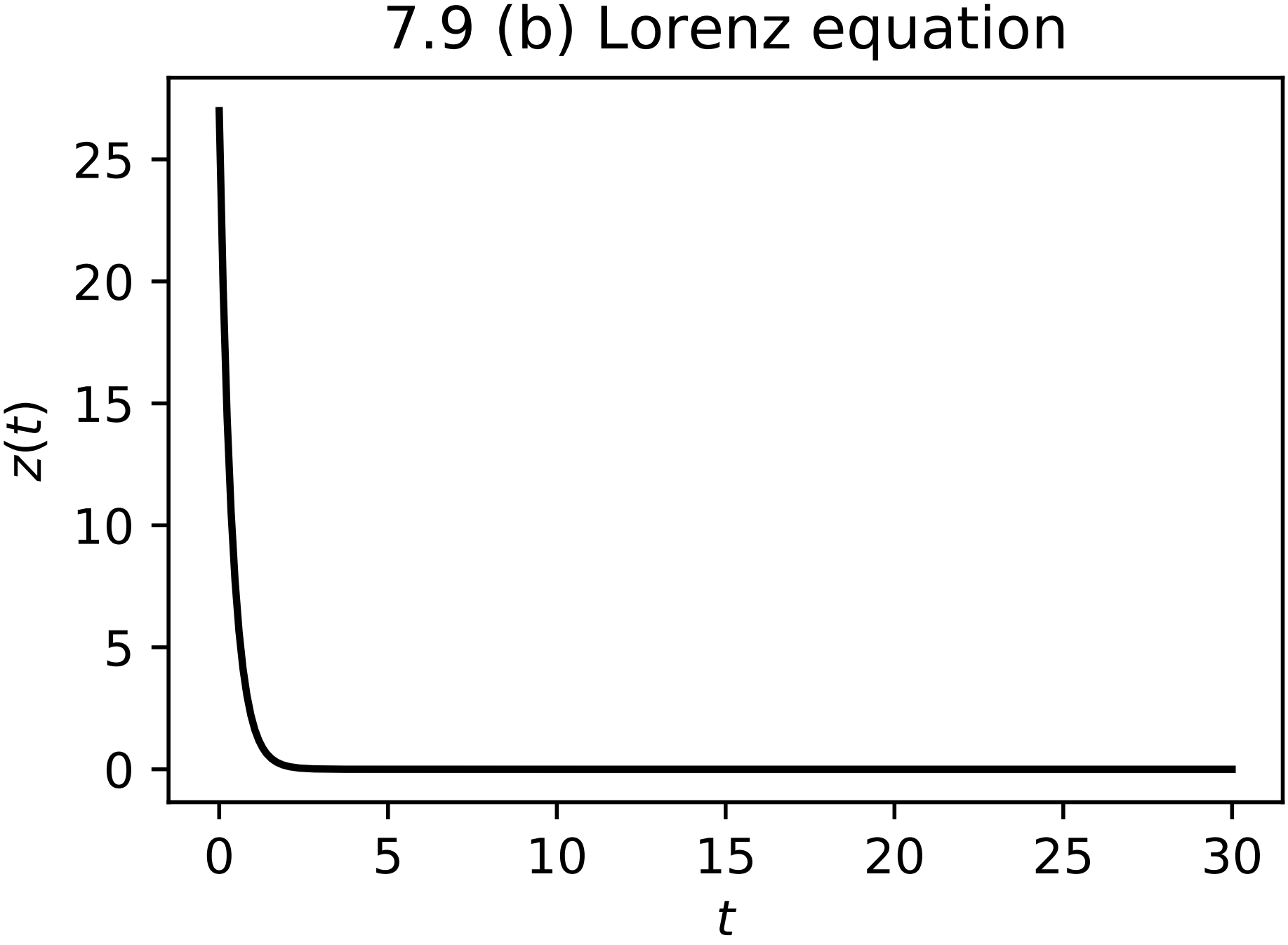

7.9 (a) Lorenz equation
20
10
0
−10
x(t)
0
5
10
15
20
25
30
t

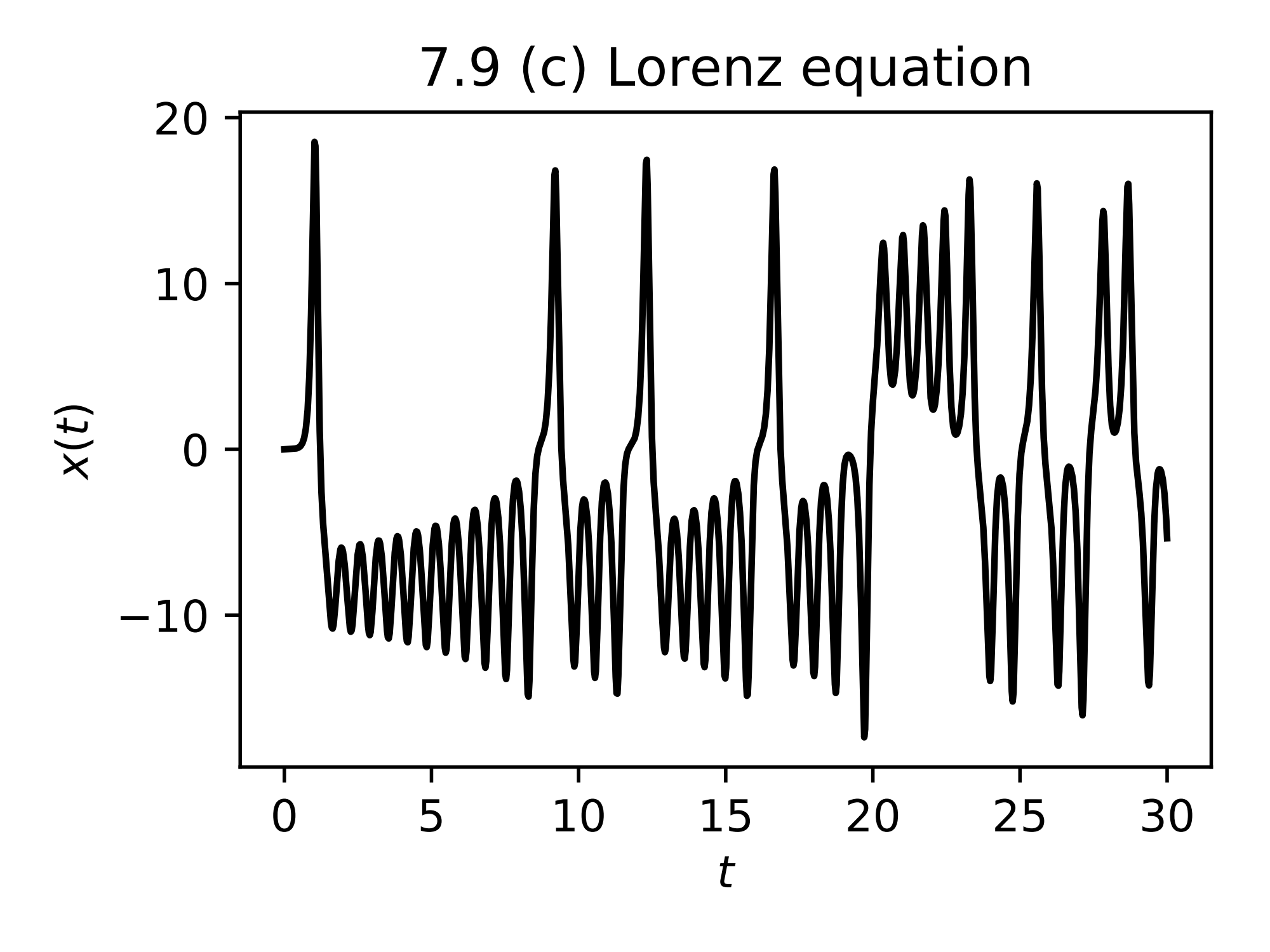

7.9 (a) Lorenz equation
30
20
10
0
−10
−20
y(t)
0
5
10
15
20
25
30
t

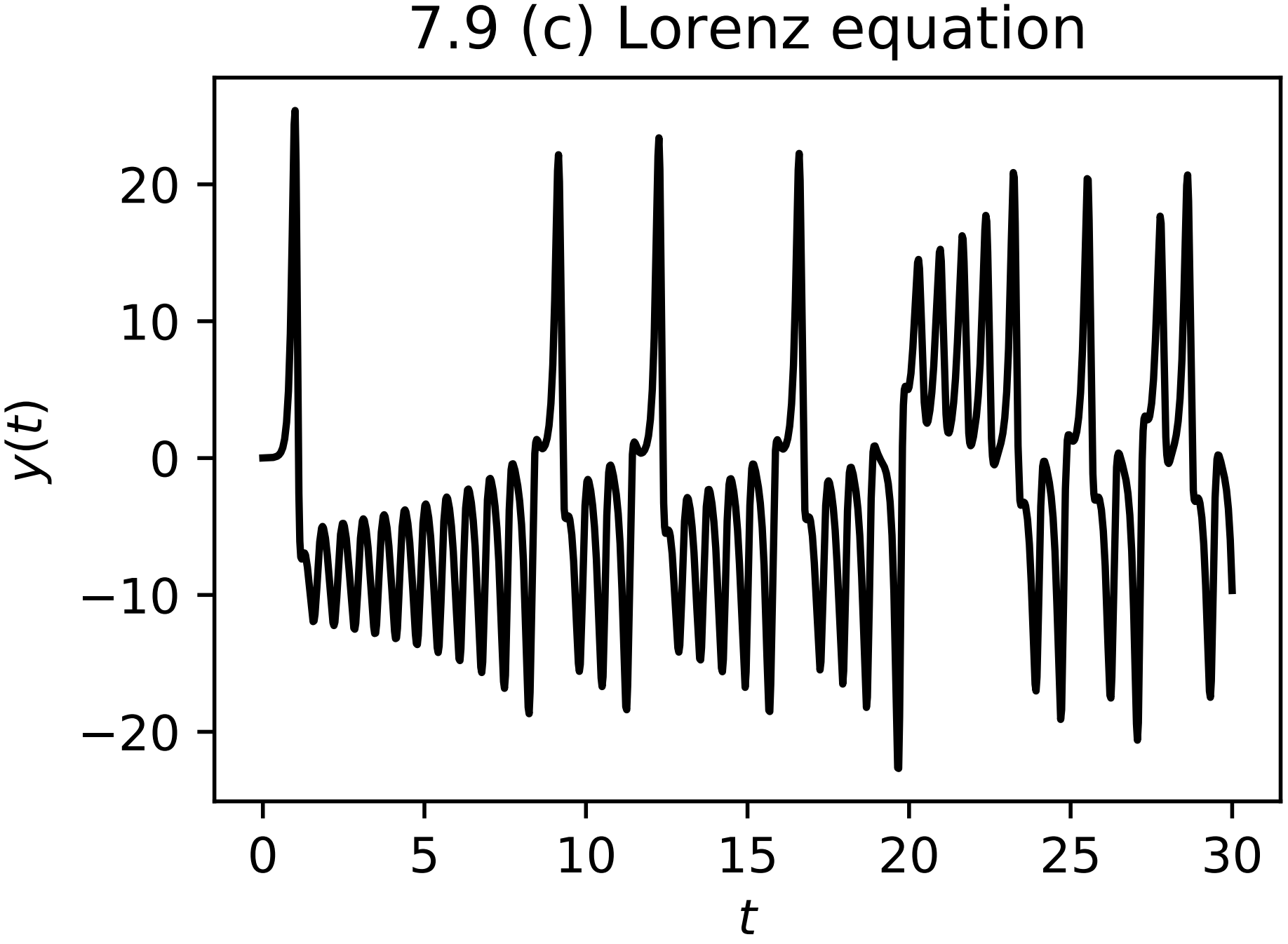

7.9 (a) Lorenz equation
50
40
30
20
10
0
z(t)
0
5
10
15
20
25
30
t

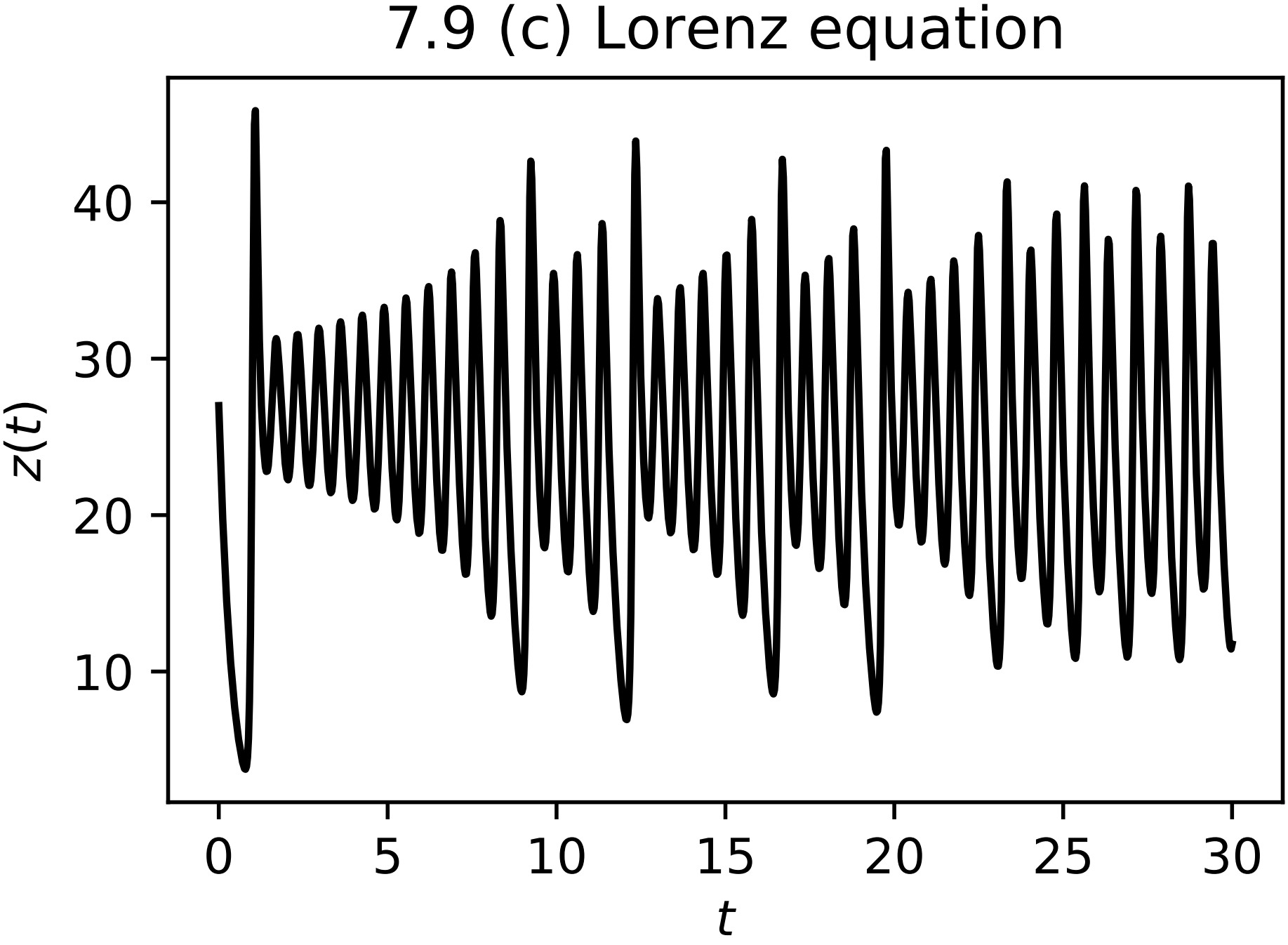

7.9 (b) Lorenz equation
0.04
0.02
0.00
−0.02
−0.04
x(t)
0
5
10
15
20
25
30
t

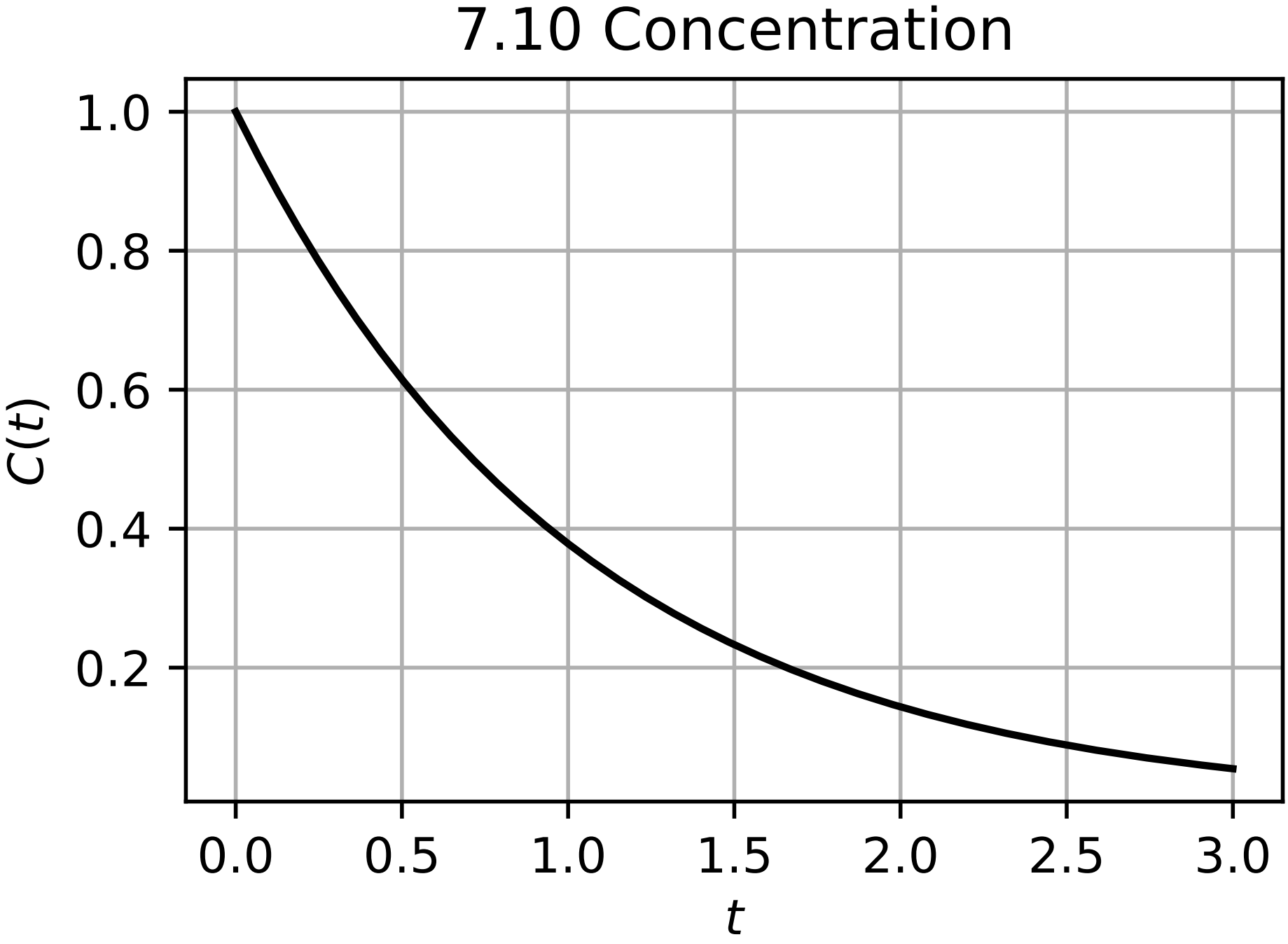

7.9 (b) Lorenz equation
0.04
0.02
0.00
−0.02
−0.04
y(t)
0
10
20
30
t

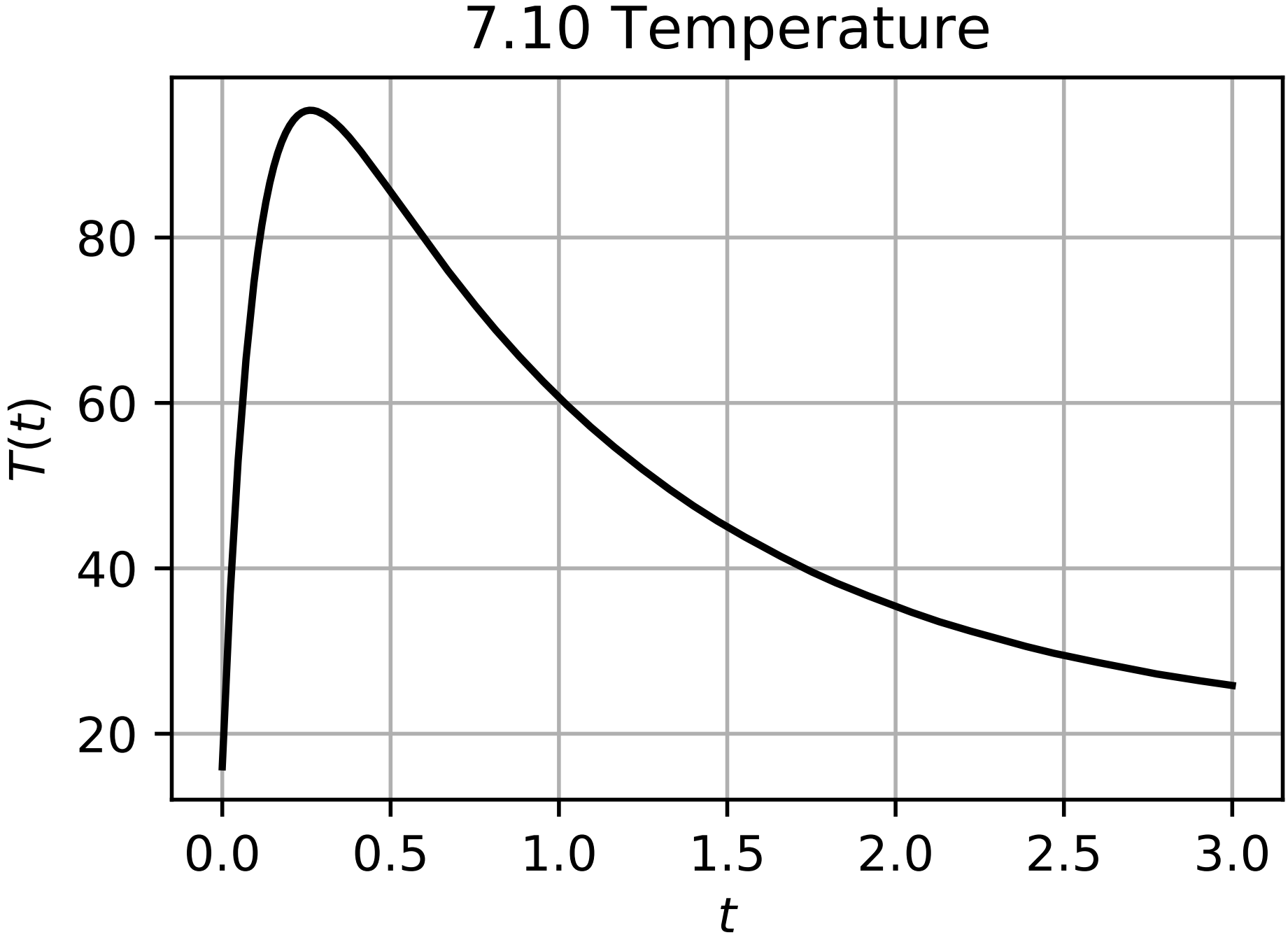

7.9 (b) Lorenz equation
25
20
15
10
5
0
z(t)
0
5
10
15
20
25
30
t

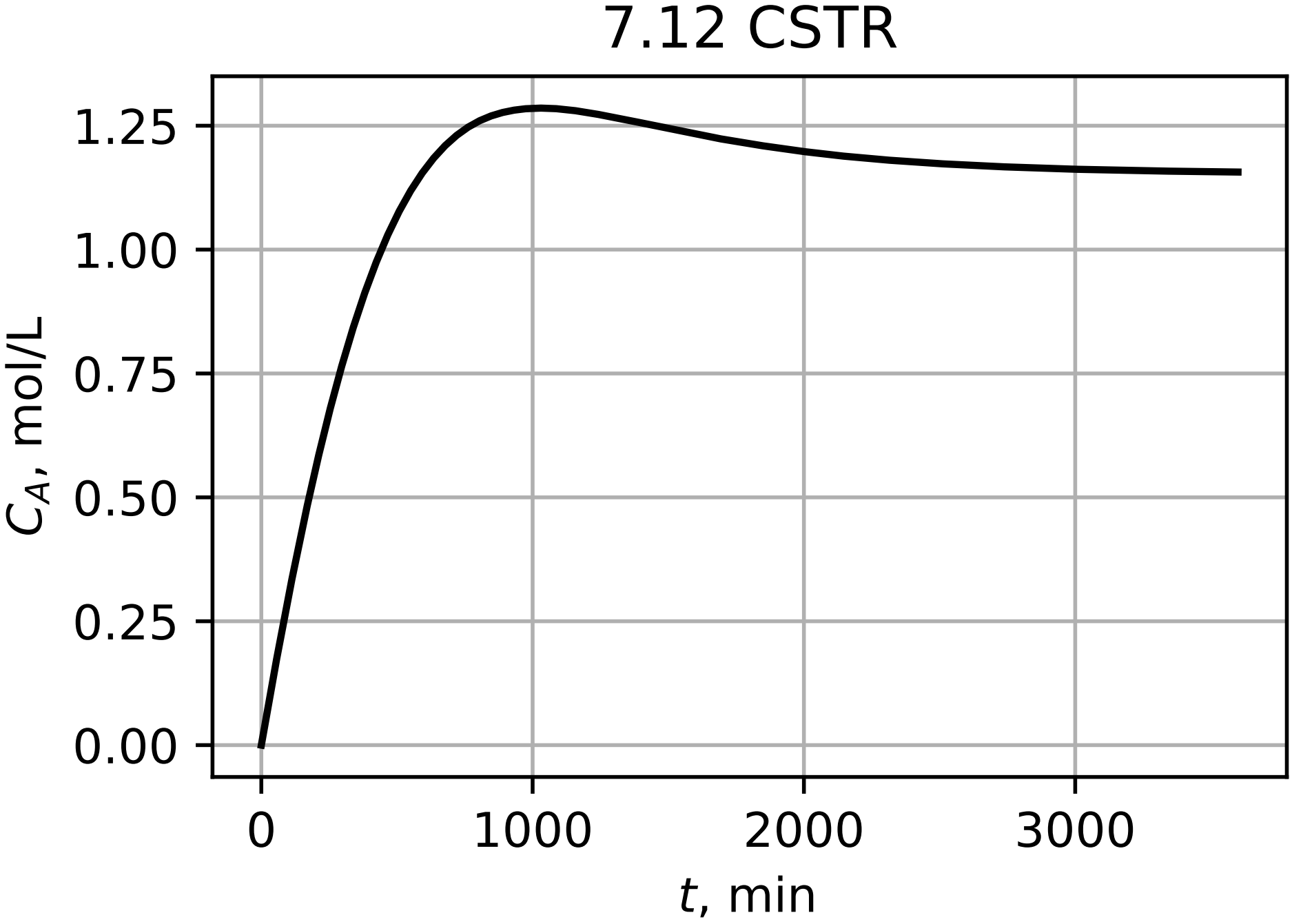

7.9 (c) Lorenz equation
20
10
0
−10
$x(t)$
0
5
10
15
20
25
30
t

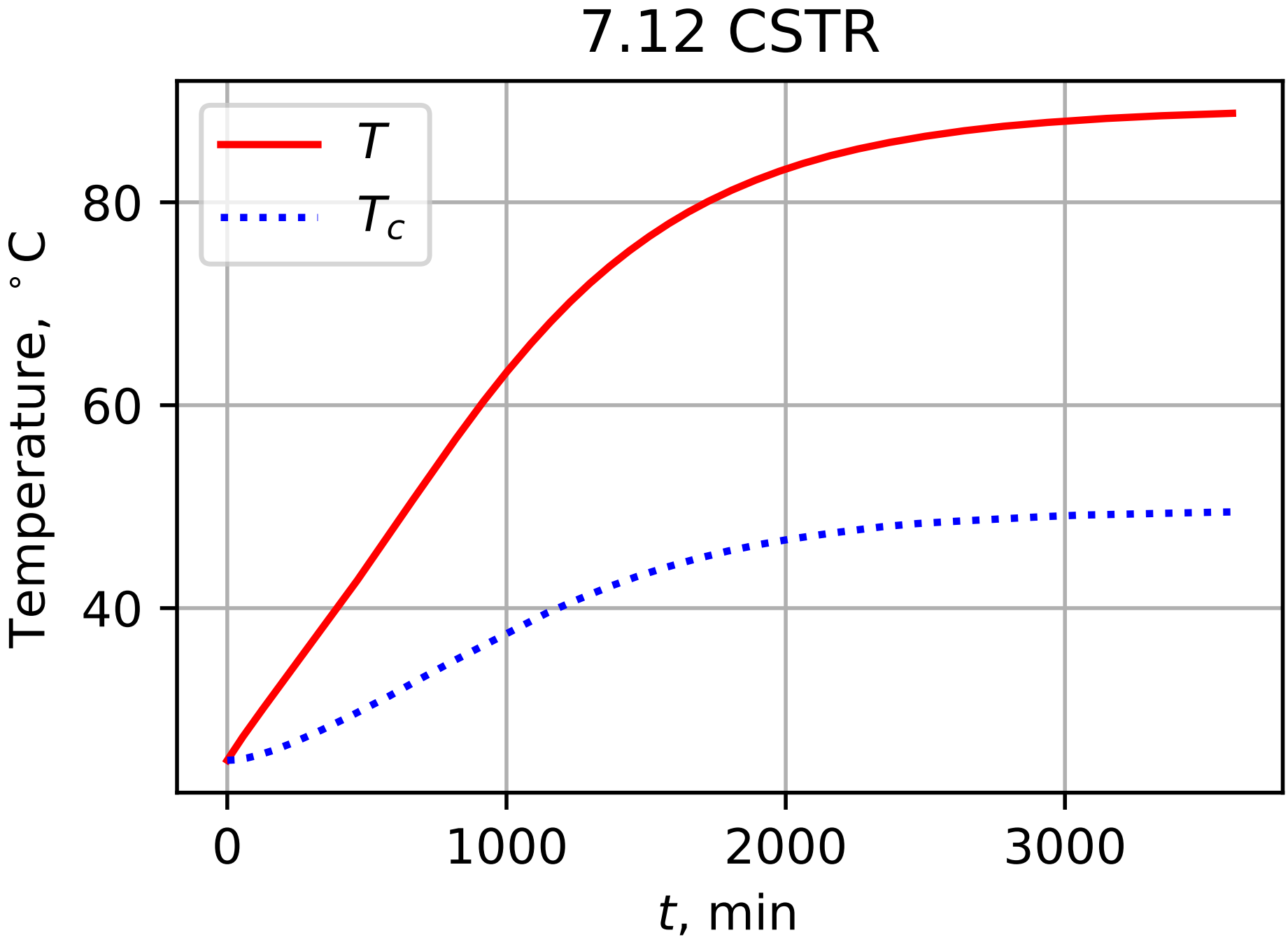

7.9 (c) Lorenz equation
20
10
0
−10
−20
y(t)
0
5
10
15
20
25
30
t

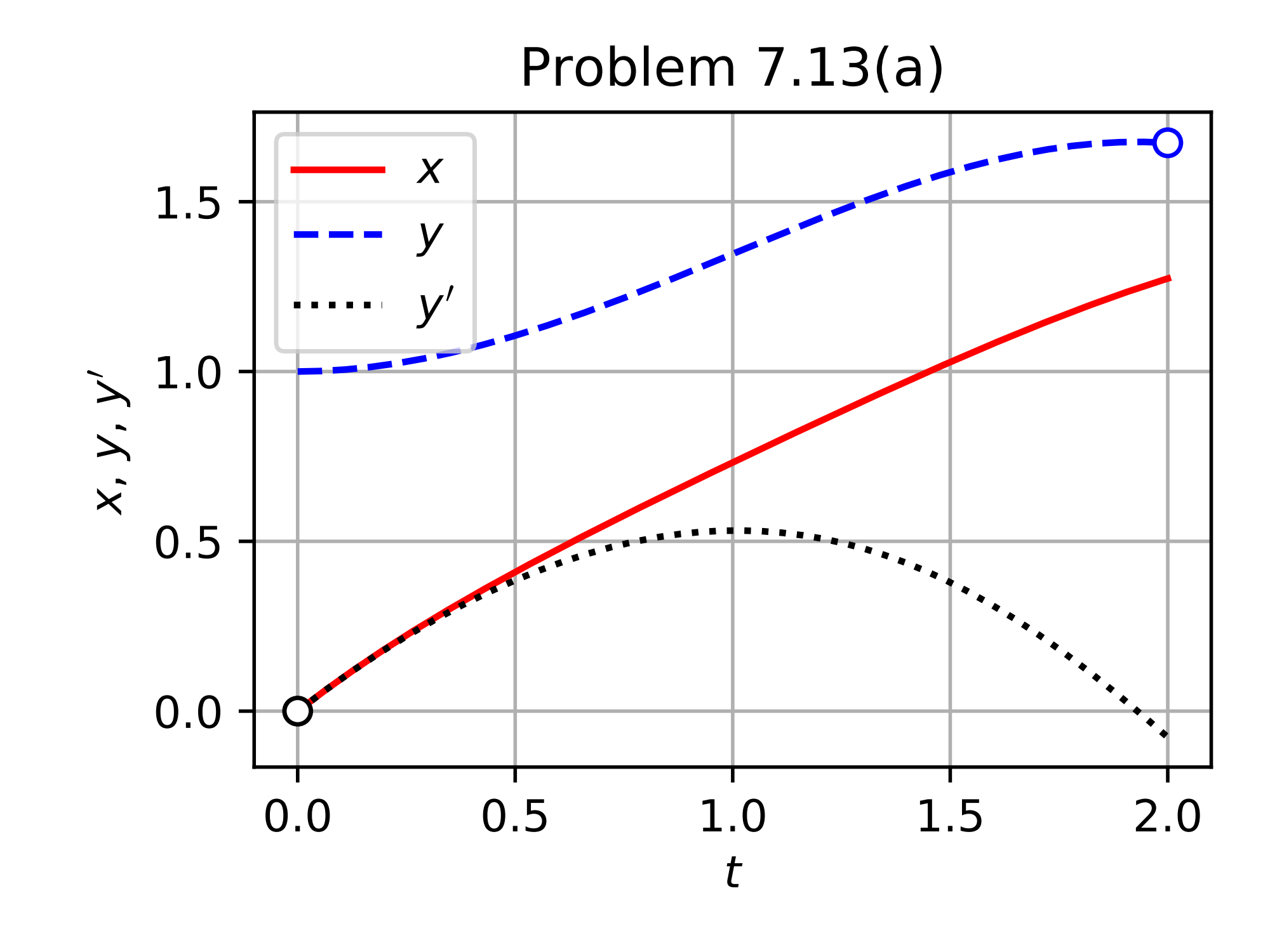

7.9 (c) Lorenz equation
40
30
20
10
z(t)
0
5
10
15
20
25
30
t

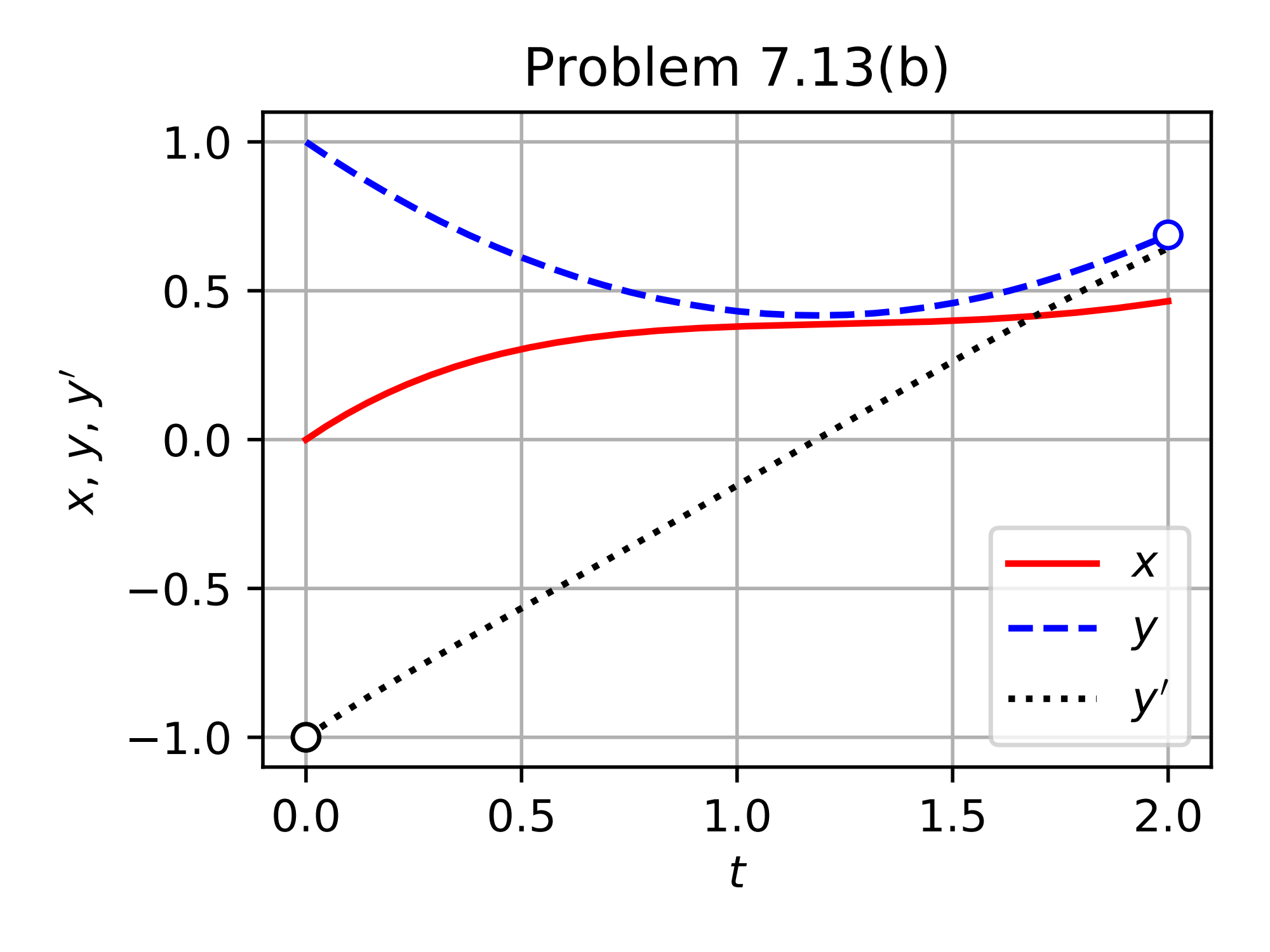

7.10 Concentration
1.0
0.8
0.6
0.4
0.2
C(t)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
t

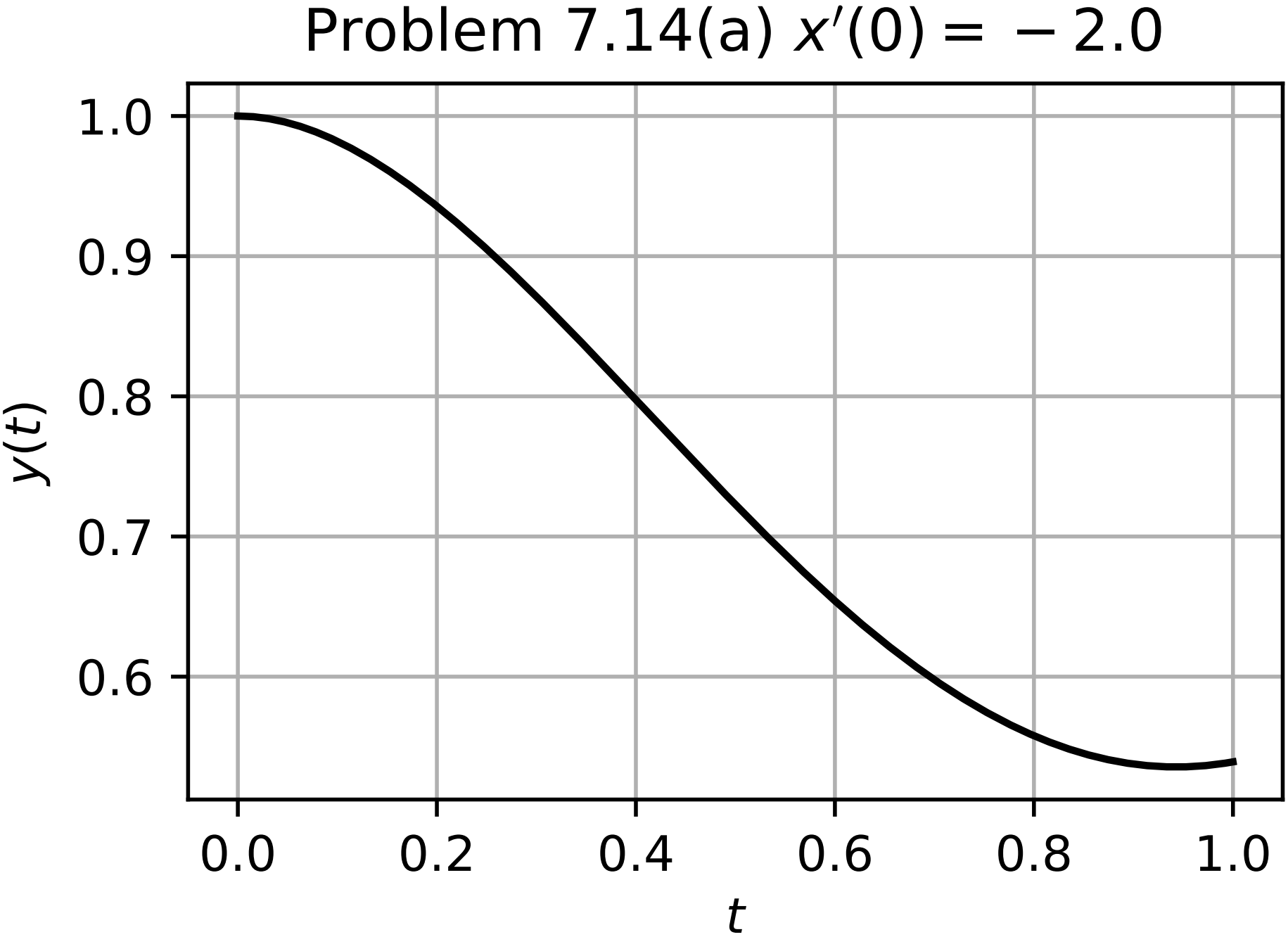

7.10 Temperature
80
60
40
20
T(t)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
t

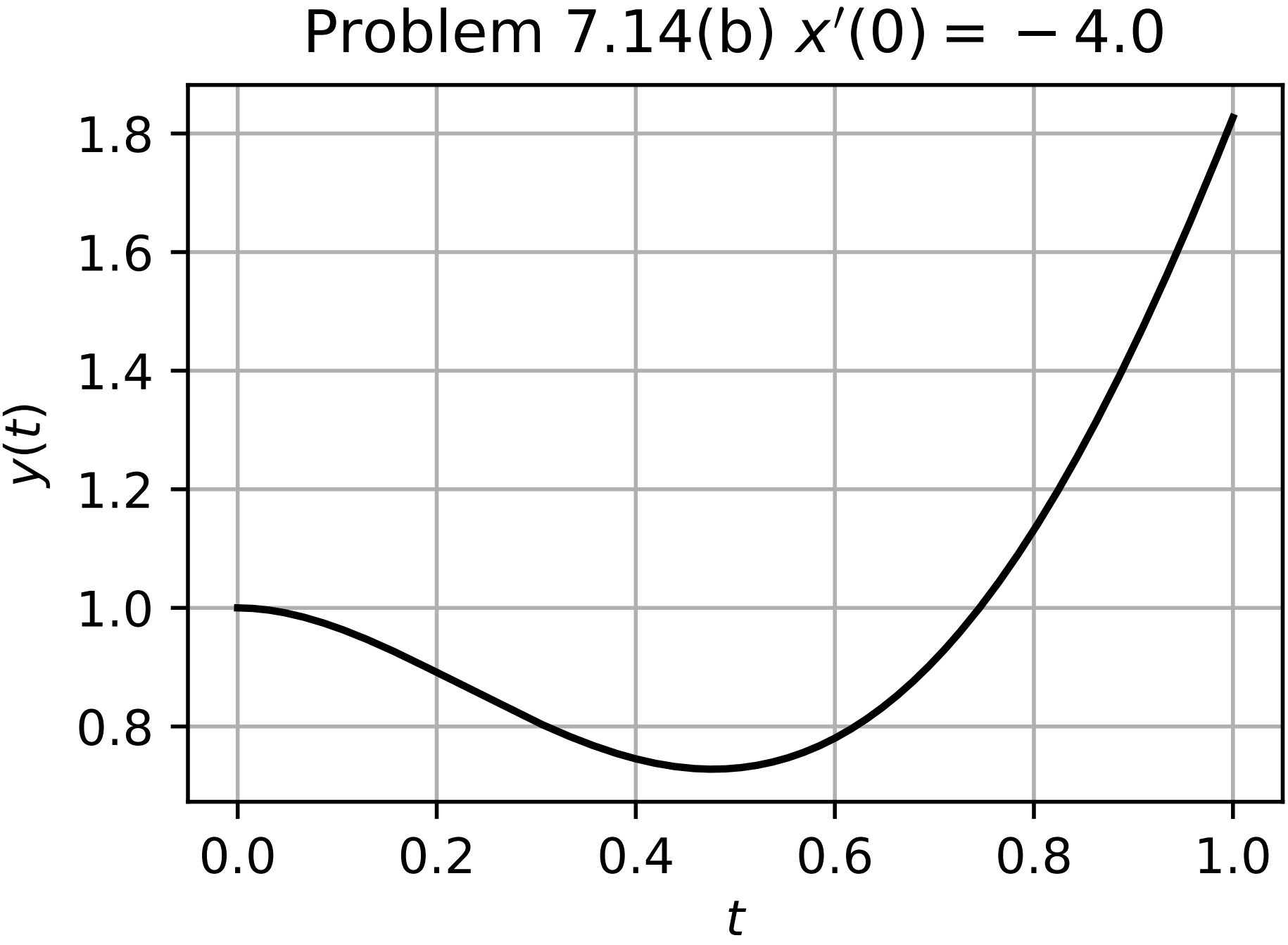

7.12 CSTR
1.25
1.00
0.75
0.50
0.25
0.00
C_A, mol/L
0
1000
2000
3000
t, min


7.12 CSTR
T
T_c
80
60
40
Temperature, ˚C
0
1000
2000
3000
t, min


Problem 7.13(a)
x
y
y′
1.5
1.0
0.5
0.0
x, y, y′
0.0
0.5
1.0
1.5
2.0
t


Problem 7.13(b)
1.0
0.5
0.0
−0.5
−1.0
x, y, y'
0.0
0.5
1.0
1.5
2.0
t
x
y
y'


Problem 7.14(a) $x'(0) = -2.0$
1.0
0.9
0.8
0.7
0.6
$y(t)$
0.0
0.2
0.4
0.6
0.8
1.0
t


Problem 7.14(b) $x'(0) = -4.0$
1.8
1.6
1.4
1.2
1.0
0.8
$y(t)$
0.0
0.2
0.4
0.6
0.8
1.0
t