MATH 609

Programming Assignment #5

Fall, 2015

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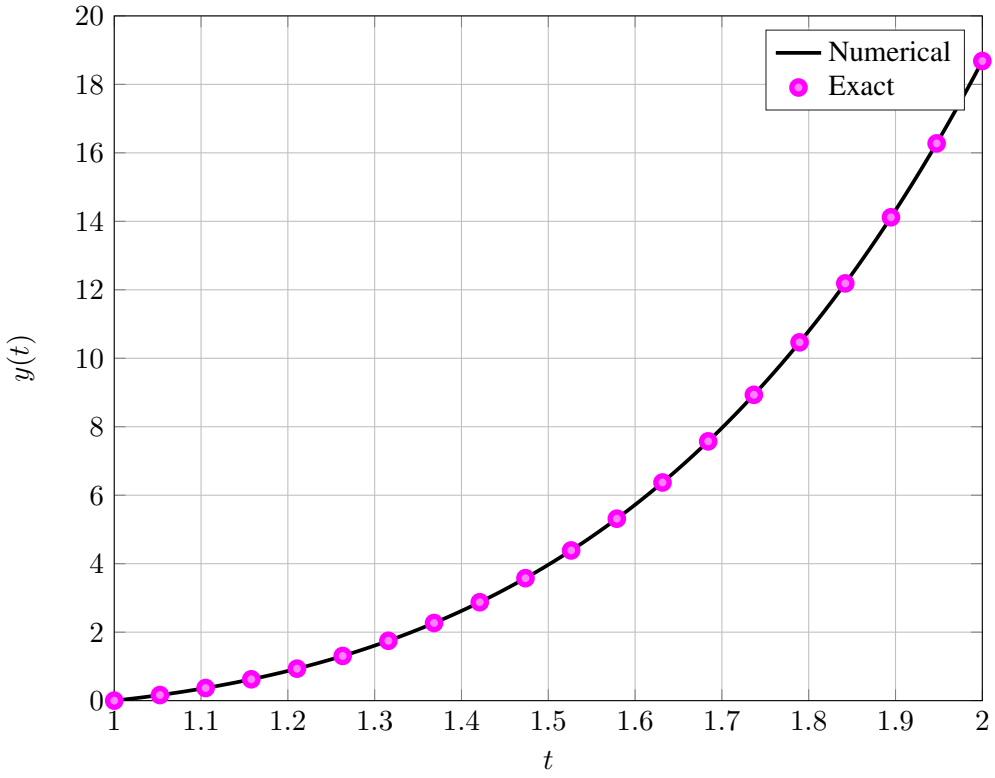


Figure 1: Numerical and exact solutions of the IVP in Eq. 1

1 Specifications

This programming assignment follows algorithms *RK45* and *RK45_Adaptive* as presented in *Numerical Mathematics and Computing* by Kincaid and Cheney.

1.1 Initial Value Problem

$$y'(t) = \frac{2}{t}y + t^2e^t, 1 \leq t \leq 2, y(1) = 0. \tag{1}$$

The numerical solution is compared with the given exact solution in Fig. 1.

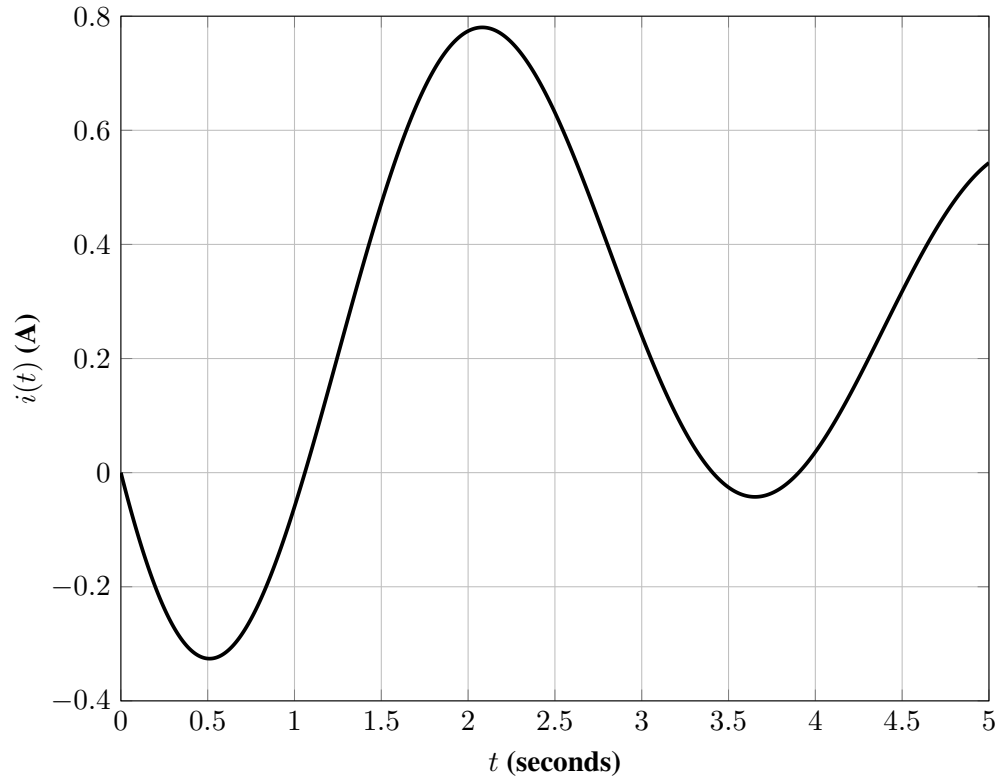
1.2 Current in an RLC Circuit

The numerical solution of the current in the circuit is plotted in Fig. 2. The first picture shows the transient nature of the current whereas in the second, the current approaches a stable value.

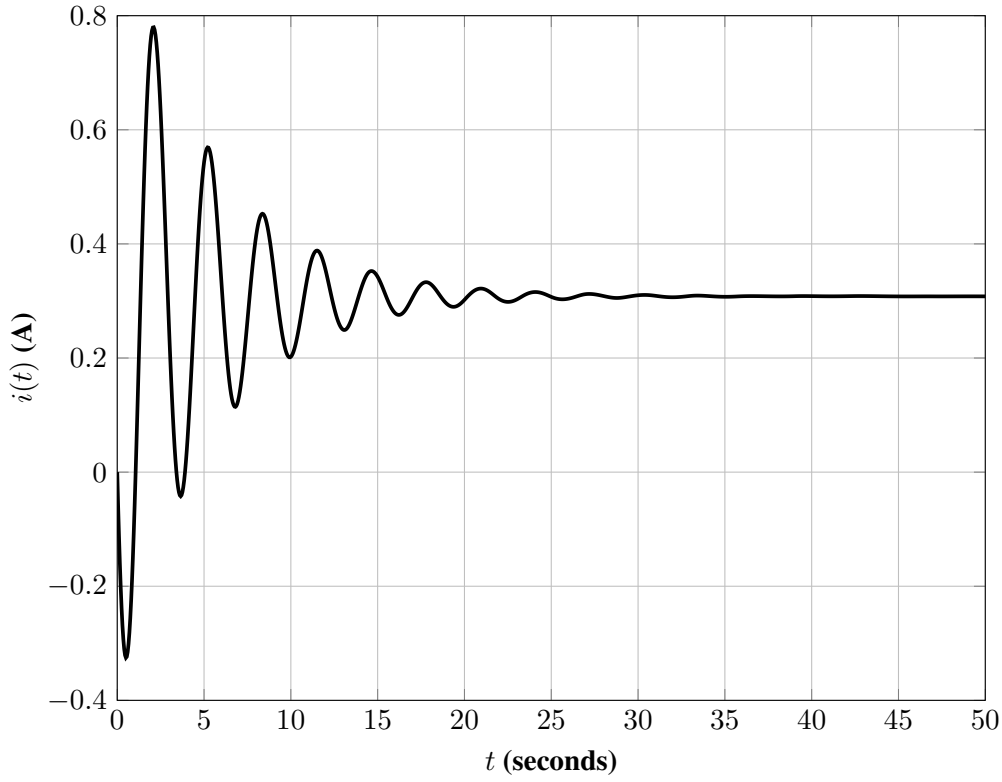
$$i'(t) = CE''(t) + \frac{1}{R}E'(t) + \frac{1}{L}E(t), i(0) = 0.$$
$$E(t) = e^{-.06\pi t} \times \sin(2t - \pi), 0 < t < 5.$$

1.3 Water flow in an inverted conical tank

The water level inside the inverted conical tank is shown in Fig. 3. The tank will be emptied in around 1506 seconds according to the given conditions.



(a)



(b)

Figure 2: Current in an RLC Circuit (a) $t = 5$ (b) $t = 50$ sec

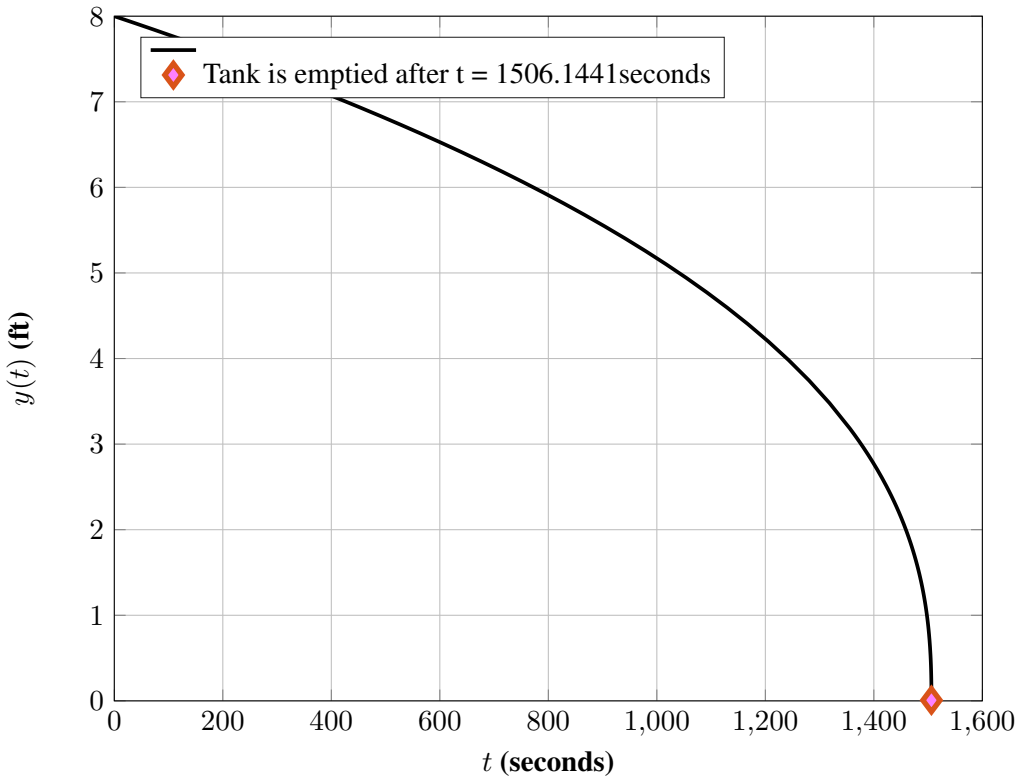


Figure 3: Water level in an inverted conical tank

$$y'(t) = .6\pi r^2\sqrt{2g}\frac{\sqrt{y}}{A(y)}, y(0) = 8$$
$$A(y) = \pi y^2.$$

1.4 Potassium Hydroxide Stoichiometric Equation

The number of potassium hoydroxide formed is shown in Fig. 4.

$$2\,K_2Cr_2O_7 + 2\,H_2O + 3\,S \longrightarrow 4\,KOH + 2\,Cr_2O_3 + 3\,SO_2 \tag{2}$$

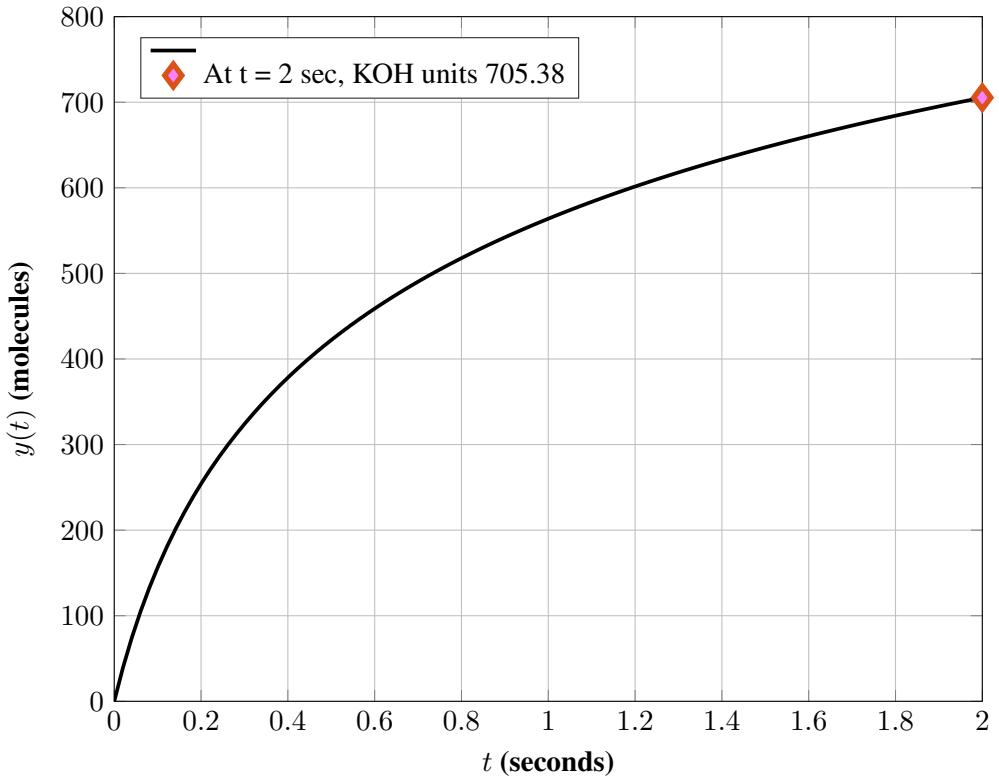


Figure 4: Number of KOH molecules formed