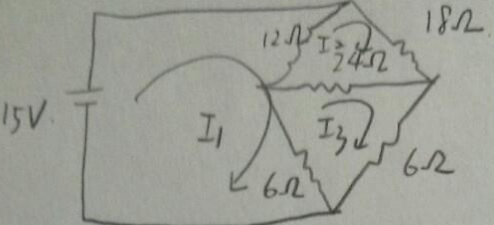


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Problem1:

(1)


$$\begin{aligned} & -15 + 12(I_1 - I_2) + 6(I_1 - I_3) = 0 \\ & \begin{cases} 12(I_2 - I_1) + 18I_2 + 24(I_2 - I_3) = 0 \\ 6(I_3 - I_1) + 24(I_3 - I_2) + 6I_3 = 0 \end{cases} \\ & \begin{cases} 12I_1 - 12I_2 + 6I_1 - 6I_3 - 15 = 0 \\ 12I_2 - 12I_1 + 18I_2 + 24I_2 - 24I_3 = 0 \\ 6I_3 - 6I_1 + 24I_3 - 24I_2 + 6I_3 = 0 \end{cases} \\ & \begin{cases} 18I_1 - 12I_2 - 6I_3 - 15 = 0 \\ -12I_1 + 54I_2 - 24I_3 = 0 \\ -6I_1 - 24I_2 + 36I_3 = 0 \end{cases} \\ & \begin{cases} 6I_1 - 4I_2 - 2I_3 - 5 = 0 \\ -2I_1 + 9I_2 - 4I_3 = 0 \\ -I_1 - 4I_2 + 6I_3 = 0 \end{cases} \end{aligned}$$

(2)

我用 Jacobi Method，精確度到小於 10^{-4} ，迴圈數總共計算 33 次。

Problem2:

(1)

2. (1).

$$\begin{cases} x(t+\Delta t) = x(t) + V(t)\Delta t \\ V(t+\Delta t) = V(t) + a(t)\Delta t \end{cases} \quad \text{Euler's method,}$$

$$m \frac{d^2}{dt^2} x(t) + \beta \frac{d}{dt} x(t) + k x(t) = 0.$$

$$m a(t) + \beta V(t) + k x(t) = 0.$$

$$a(t) = \frac{1}{m} (-\beta V(t) - k x(t)).$$

$$\begin{cases} x(t+\Delta t) = x(t) + V(t)\Delta t \\ V(t+\Delta t) = V(t) - \frac{1}{m} (\beta V(t) + k x(t)) \Delta t \end{cases}$$

$$x(0) = -10. (\text{cm}) = -0.1 (\text{m}).$$

$$V(0) = 0 (\text{m/s}).$$

(2)

找最高和最低點，得到半周期，再乘以 2 等於週期(T)，頻率(f)=1/T。

Problem3

(a)

3. (a). $\mathcal{E}(t) = IR + V_C(t).$

$$I_C(t) = C \frac{dV_C(t)}{dt}.$$

$$\mathcal{E}(t) = RC \frac{dV_C(t)}{dt} + V_C(t) \quad \#.$$

(b)

(b).

$$V_c(t+\Delta t) = V_c(t) + \frac{dV_c(t)}{dt} \Delta t.$$
$$\frac{dV_c(t)}{dt} = \frac{\varepsilon(t) - V_c(t)}{RC}$$
$$V_c(t+\Delta t) = V_c(t) + \left(\frac{\varepsilon(t) - V_c(t)}{RC} \right) \Delta t.$$

(c)(d)

電壓源依時間做變化， $V_c(t)$ 依(b)小題的公式， $V_R(t)=E-V_c(t)$ 即可得 $V_R(t)$ 。

Problem4:

(a)

4. (a.)

$$V_s(t) = L \frac{dI(t)}{dt} + I(t)R + V_c(t)$$
$$V_s(t) = L \frac{dI(t)}{dt} + I(t)R + \frac{1}{C} \int I(t) dt + \underbrace{V_c(0)}_0$$
$$\frac{dV_s(t)}{dt} = L \frac{d^2 I(t)}{dt^2} + R \frac{dI(t)}{dt} + \frac{1}{C} I(t).$$

#

(b)

(b).

$$\begin{cases} I(t+\Delta t) = I(t) + I'(t)\Delta t \\ I'(t+\Delta t) = I'(t) + I''(t)\Delta t \end{cases}$$
$$I''(t) = \frac{1}{L} \left(\frac{dV_s(t)}{dt} - R I'(t) - \frac{1}{C} I(t) \right)$$
$$\begin{cases} I(t+\Delta t) = I(t) + I'(t)\Delta t \\ I'(t+\Delta t) = I'(t) + \Delta t \left(\frac{1}{L} \right) \left(\frac{dV_s(t)}{dt} - R I'(t) - \frac{1}{C} I(t) \right) \end{cases}$$
$$V_s(0) = L \frac{dI(0)}{dt} + \frac{I(0)R}{0} + \frac{V_C(0)}{0}$$
$$I(0) = 0, \quad \frac{dI(0)}{dt} = \frac{V_s(0)}{L} = \frac{1}{L}.$$

(c)(d)

同上。

Problem5:

(a)

(5). (a).

$$a = \frac{GM_s}{r_0^2}$$
$$a_x = -\frac{d^2 x_p}{dt^2} = \frac{-GM_s}{r_0^2} \times \frac{x_p}{r_0} \quad (r_0: \text{Distance}, M_s: \text{mass of sun})$$
$$a_y = -\frac{d^2 y_p}{dt^2} = \frac{-GM_s}{r_0^2} \times \frac{y_p}{r_0} \quad (r_0 = \sqrt{(x_p^2 + y_p^2)})$$

(b).

(b)

$$a_y = -\frac{d^2 y_p}{dt^2} = -\frac{GM_s}{r_0^2} \times \frac{y_p}{r_0} \quad (r_0 = \sqrt{x_p^2 + y_p^2}) \quad \#$$

(b).

$$\frac{V_c^2}{r_0} = a = \frac{GM_s}{r_0^2} \quad (G : 6.67 \times 10^{-11} \text{ (N} \cdot \text{m}^2 / \text{kg}^2))$$

$$V_c = \sqrt{\frac{GM_s}{r_0}}$$

(c).

$$x(t+\Delta t) = x(t) + x'(t) \Delta t$$

(c)

(5). (c).

$$x(t+\Delta t) = x(t) + x'(t) \Delta t$$

$$x'(t+\Delta t) = x'(t) + \frac{x''(t) \Delta t}{1} \\ = x'(t) + \frac{-GM_s}{r_0^2} \times \frac{x(t)}{r_0}$$

$$x(0) = r, \quad x'(0) = 0.$$

$$y(t+\Delta t) = y(t) + y'(t) \Delta t$$

$$y'(t+\Delta t) = y'(t) + \frac{y''(t) \Delta t}{1} \\ = y'(t) + \frac{-GM_s}{r_0^2} \times \frac{y(t)}{r_0}$$

$$y(0) = 0, \quad y'(0) = \sqrt{\frac{GM_s}{r_0}}$$

(5). (a).

$$a = \frac{GM_s}{r_0^2}$$

(d)

橢圓：

任意一點到兩焦點的距離要接近半長軸。

我計算出來的差距約為 $10^{(10)}$ 。

半長軸：

先算半圈的長度，再除以 2。

週期：

先算半圈的時間，再乘以 2。

(e)

我用雙迴圈，x 軸是 R^3 ，y 軸是 T^2 ，每次不一樣的 k 值就算一次 R 和

T， R^3 和 T^2 成一直線，所以 R^3 和 T^2 正比。