# 信物作业参考解答

## 1 作业四

**题 24**

解. (1) 因 $RC$ 串联, 故 $I_C = I_R = I$,

$$\frac{U_R}{U_C} = \frac{I_R Z_R}{I_C Z_C} = \frac{Z_R}{Z_C} = \frac{4}{3}.$$

由 $RC$ 串联电路的矢量图, 总电压为

$$U = \sqrt{U_R^2 + U_C^2} = \sqrt{\frac{16}{9} + 1} U_C = \frac{5}{3} U_C,$$

即

$$U_C = \frac{3}{5} U = \frac{3}{5} \times 100V = 60V,$$
$$U_R = \frac{4}{3} U_C = \frac{4}{3} \times 60V = 80V.$$

(2) 总电压与电流的相位差为

$$\varphi = \arctan \frac{-U_C}{U_R} = \arctan\left(-\frac{3}{4}\right) = 36°52'$$

负号表明总电压的相位比电流落后 $36°52'$. □

**题 25**

解. $RLC$ 串联电路的谐振（角）频率为

$$\omega = \frac{1}{\sqrt{LC}}, \quad f = \frac{1}{2\pi\sqrt{LC}} = 113\,\mathrm{Hz}$$

谐振时, 安培计和各伏特计的读数（有效值）为

$$I = \frac{U}{R} = \frac{220}{300}\,\mathrm{A} = 0.733\,\mathrm{A},$$
$$U_1 = U_R = IR = 220\,\mathrm{V},$$
$$U_2 = U_L = I\omega L = 0.733 \times 2\pi \times 113 \times 250 \times 10^{-3}\,\mathrm{V} = 130\,\mathrm{V},$$
$$U_3 = U_C = \frac{I}{\omega C} = U_L = 130\,\mathrm{V},$$
$$U_4 = U_{LC} = I\left(\omega L - \frac{1}{\omega C}\right) = 0,$$
$$U = U_{RLC} = U_R = 220\,\mathrm{V}.$$

□

**题 26**

解. 由波形曲线可得

$$A = 10\ \text{cm} = 0.1\ \text{m}, \lambda = 40\ \text{cm} = 0.4\ \text{m}$$

并有

$$u = \lambda/T = 0.2\ \text{m/s}, \quad \omega = 2\pi/T = \pi\ \text{rad/s}$$

(1) 设波动表达式为 $y = A\cos\left[\omega\left(t - \frac{x}{u}\right) + \phi_0\right]$ 将波形曲线沿传播方向稍作平移可得: 坐标原点和 $P$ 点的振动状态分别为:

$$y\left(0, \frac{1}{3}\right) = -\frac{A}{2}, \quad v\left(0, \frac{1}{3}\right) < 0 \text{ 和} y\left(P, \frac{1}{3}\right) = 0, \quad v\left(P, \frac{1}{3}\right) > 0$$

由旋转矢量图可知, $t = 1/3$ s 时坐标原点的相位为 $2\pi/3$, 有

$$\omega\left(t - \frac{x_0}{u}\right) + \phi_0 = \pi \times \frac{1}{3} + \phi_0 = \frac{2}{3}\pi$$

得坐标原点的振动初相

$$\phi_0 = \pi/3$$

所以, 坐标原点的振动表达式为 $y_0 = 0.1\cos\left(\pi t + \frac{\pi}{3}\right)$ (SI 单位) $t = 1/3$ s 时, $P$ 点的振动相位为 $-\pi/2$, 有

$$\omega\left(t - \frac{x_p}{u}\right) + \phi_0 = \pi \times \left(\frac{1}{3} - \frac{x_p}{20}\right) + \frac{\pi}{3} = -\frac{\pi}{2}$$

解得

$$x_P = 0.233\ \text{m}$$

将以上数值代人波动表达式, 得 $P$ 点的振动表达式

$$y_P = 0.1\cos\left(\pi t - \frac{5\pi}{6}\right)\text{m}$$

(2) 波动表达式为

$$y = A\cos\left[\omega\left(t - \frac{x}{u}\right) + \phi_0\right] = 0.1\cos\left[\pi(t - 5x) + \frac{\pi}{3}\right]\text{m}.$$

□