Chapter 10

10-4

解：

对原点出振动表达式做替换$t \to (t - x/u)$得到波动方程：

$$y(x,t) = 6.0 \times 10^{-2} \sin(\frac{\pi}{2}t - \frac{\pi}{4}x) \tag{SI}$$

- (1)

$$y(5,t) = 6.0 \times 10^{-2} \sin(\frac{\pi}{2}t - \frac{5}{4}\pi) \tag{SI}$$

- (2)

$$\Delta\varphi = -\frac{5}{4}\pi$$

10-5

解：

- (1)
  $a\uparrow, b\uparrow, c\downarrow$
- (2)

$$y(x,t) = 1 \times 10^{-3} \cos(0.25\pi t - 5\pi x) \tag{SI}$$

- (3)

$$y(0.3,t) = -1 \times 10^{-3} \sin 0.25\pi t \tag{SI}$$

10-6

解:

- (1)
  做变量替换$t \rightarrow (t - x/u)$, 得:

$$y(x, t) = 3\cos(4\pi t - \frac{\pi}{6}x + \frac{\pi}{2}) \tag{SI}$$

- (2)
  做变量替换$t \rightarrow (t - (x - x_1)/u)$, 得:

$$y(x, t) = 3\cos(4\pi t - \frac{\pi}{6}x - \frac{\pi}{2}) \tag{SI}$$

10-7

解:

依题意有: $\omega = 25\pi, A = 0.30, \lambda = 0.20$ (SI), 故写出波函数:

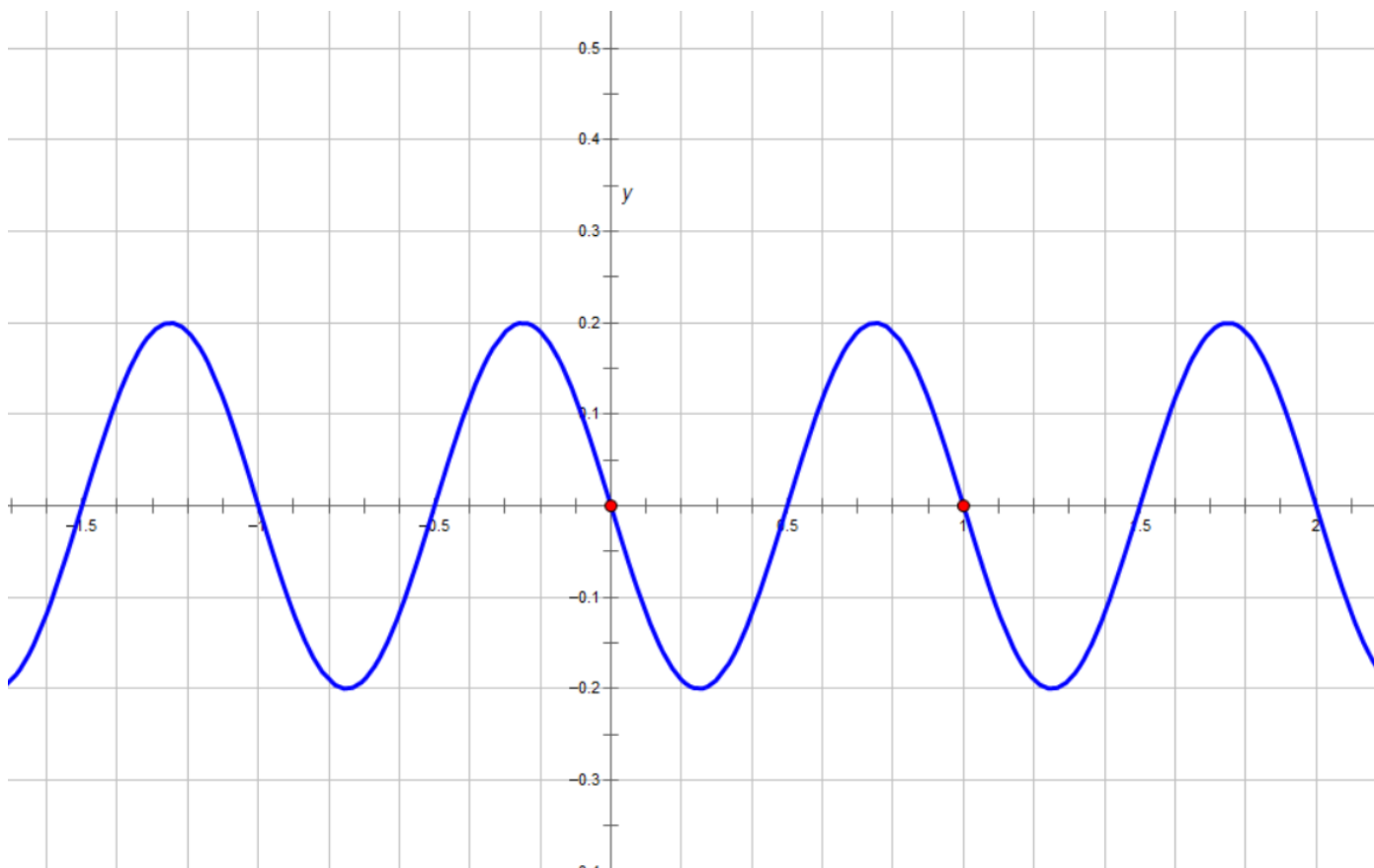$$\xi = 0.30\sin(25\pi t - 10.0\pi x) \tag{SI}$$

10-8

解:

- (1)
  由图可得: $A = 0.2, \lambda = 0.6, u = 0.6$ (SI)。故P点振动表达式:

$$y(0.3, t) = 0.2\sin 2\pi t \tag{SI}$$

- (2)

$$y(x, t) = -0.2\sin(2\pi t - \frac{10\pi}{3}x) \tag{SI}$$

- (3)

10-10

解:

$$\Delta\varphi = \frac{\pi}{2} - 2\pi\frac{v_1}{u_1}r_1 + 2\pi\frac{v_2}{u_2}r_2 = 0$$

故有:

$$A = A_1 + A_2 = 0.02 \text{ m}$$

10-11

解:

有干涉相消, 故满足:

$$x - (d - x) = \frac{1}{2}\lambda + \frac{1}{2}\lambda + k'\lambda \quad (k' \in \mathbb{Z})$$

依题意有:

$$\lambda = \frac{u}{f} = 4 \text{ m}$$

解得:

$$x = (1 + 2k) \text{ m} \quad (k = \{k \in \mathbb{N} \mid 1 \le k \le 14\})$$

10-13

解:

由于在 $x = 0$ 处反射且反射处为自由端，故有原波为:

$$y_0 = 0.15 \cos[100\pi(t + \frac{x}{200}) + \frac{\pi}{2}]$$

合成波:

$$y_{all} = y + y_0 = -0.3 \sin 100\pi t \cos \frac{\pi}{2} x$$

为驻波。