11-26

1)

$\lambda = \frac{2\pi}{\pi} = \frac{2\times 3}{3} = 2m$

$f = \frac{1}{T} = \frac{100}{2} = 50Hz$

2)

$k = \frac{2\pi}{\lambda} = \frac{2\pi}{2} = \pi \ rad/m$

$\omega = 2\pi f = 2\pi \times 50 = 100\pi \ rad/s$

则向右传播的波：$y_1(x,t) = 0.01\sin(\pi x - 100\pi t)$

向左传播的波：$y_2(x,t) = 0.01\sin(\pi x + 100\pi t)$

11-27

1)

$\cos(5\pi x) = 0$

$5\pi x = (n+\frac{1}{2})\pi$

$x = \frac{2n+1}{10}$ $(n = 0, \pm 1, \pm 2, \cdots)$

$n=0$时，有 $x = 0.1m$，$n=1$时，有 $x = 0.3m$

则波节的坐标为 $x = 0.1m$，和 $x = 0.3m$。

2)

$\omega = 40 rad/s$，则 $T = \frac{2\pi}{\omega} = \frac{1}{20} = 0.05s$

3)

$k = 5\pi \ rad/m$，则 $\lambda = \frac{2\pi}{k} = \frac{2}{5} = 0.4m$

$f = \frac{1}{T} = 20Hz$

$v=\lambda f=20\times0.4=8\,m/s$

由 $y(x,t)=0.045\cos5\pi x\cos40\pi t$

则 $A=0.045$

4)

$v(x,t)=0.045\times5\pi\times(-40\pi)\sin(40\pi t)$

$=-0.045\times40\pi^2\cos(5\pi x)\sin(40\pi t)$

由要使 $v(x,t)=0$，有 $\sin(40\pi t)=0$

则有 $40\pi t=n\pi$，$t=\frac{n}{40}$ $(n=0,1,2,\cdots)$

即 $t=0$、$t=0.025$、$t=0.05$ 时，弦上所有点速度为0，

11-28

1)

$f_{近}=f_s\frac{v}{v-v_s}=500\times\frac{340}{340-25}\approx539.7\,Hz$

$f_{远}=f_s\frac{v}{v+v_s}=500\times\frac{340}{340+25}\approx465.7\,Hz$

则 $\Delta f=539.7-465.7=74\,Hz$

2)

$f'=f_s\frac{v+v_L}{v+v_s}=500\times\frac{340+5}{340-25}\approx553.5\,Hz$

11-30

$f'=400\times\frac{330+2022}{330-33.33}\approx474.8\,Hz$

11-32

1)

$\lambda = \frac{V - V_s}{f_s} = \frac{331-30}{1080} = \frac{301}{1080} \approx 0.2787m$

2)

$f' = f_{s0} \frac{V+v_m}{V-V_s} = 1080 \times \frac{331+(-65)}{331-30} = 1080 \times \frac{266}{301} \approx 954.4Hz$

3)

$V = 331 - 65 = 266 m/s$

4)

$\lambda' = \frac{V'}{f_1} = \frac{266}{954.4} m \approx 0.2787m$

1)

~~$f = \frac{331+(-65)}{331-30} \times 1080$~~

$f = 1080 \times \frac{331}{331-30} \approx 1188Hz$

$\lambda = \frac{331-30}{1080} = \frac{301}{1080} \approx 0.28m$

$f' = \frac{331}{331+30} \times 1080 = 990Hz$

$\lambda' = \frac{331+30}{1080} = 0.33m$

2)

$f_R = \frac{331+65}{331-30} \times 1080 = 1421Hz$

3)

反射波的波速为仍时波在空气中的速度，即331m/s

4)

$\lambda_p = \frac{331-60}{1421} = 0.18\,m$

11-34

对于发射波探测器的波，潜艇先以速度 V 接收，则有

$f' = f(1+\frac{v}{v_s})$ 波

潜艇近视作一个移动波源，将超声波以 f' 发射回波探测器则有

$f'' = f'(1+\frac{v}{v_s})$

则拍为 f'

$f_{拍} = |f''-f| = 241\,Hz$

即 $\left(1+\frac{v}{v_s}\right)^2 - 1 = \frac{241}{30000}$

$\left(1+2\frac{v}{v_s}+\left(\frac{v}{v_s}\right)^2\right) - 1 = \frac{241}{30000}$

$2\frac{v}{v_s}+\left(\frac{v}{v_s}\right)^2 = \frac{241}{30000}$

~~电子~~ ~~$v = 1500 \times \frac{241}{30000}$~~

$v \approx 6.025\,m/s$