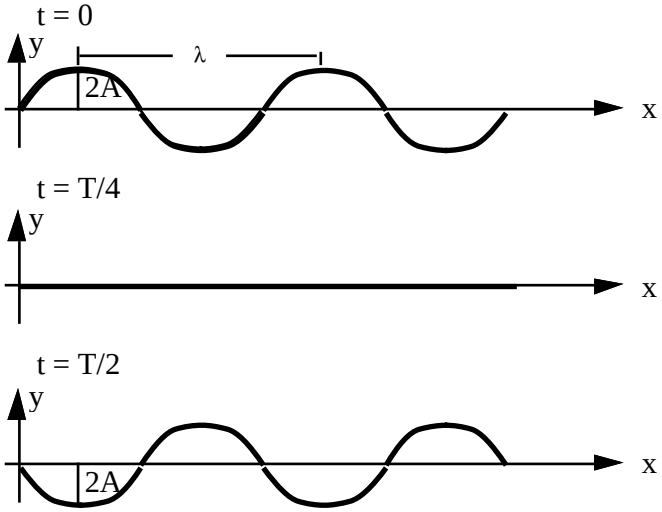
Sketch of solutions and marking scheme for self administered feedback test for PHYS1169

Q1 a) $y_1 = A\sin(kx - \omega t)$ and $y_2 = A\sin(kx + \omega t + \phi)$

(ϕ may have any value including zero) 2

b)



(λ and 2A not required in the question) 4

c) i) For an estimation, treat the cable as an ideal stretched string, fixed at the ends. The possible standing wave resonances have

$\lambda = 2L, L, 2L/3, \ldots\ldots \lambda_n = 2L/n$

$$f_n = \frac{v}{\lambda_n} = \frac{n}{2L}\sqrt{\frac{T}{\mu}} \qquad \mu = \frac{m}{L} = \frac{\pi r^2 L.\rho}{L} = \rho\pi r^2.$$

$$f_n = \frac{n}{2L}\sqrt{\frac{T}{\rho\pi r^2}} = \frac{n}{2*8}\sqrt{\frac{7\ 10^3}{5600\pi\ (.0040)^2}} = n * 9.9\ \text{Hz}$$

Resonant frequencies $\cong$ 10, 20, 30, 40, 50 Hz 6

ii) A resonator can store energy in large vibrations from a continuous supply by a low power source. e.g. the wind exerts a small force on the cable, but over minutes it stores substantial energy. This vibration may be transmitted to other parts of the structure. If they too have resonances at any of these frequencies, potentially dangerous vibrations may be set up.

Q2 i) $I \equiv \frac{P}{A} = \frac{P}{4\pi r^2} = 6.4\ \text{mW.m}^{-2}$ 2

ii) $\beta_I \equiv 10 \log_{10} \frac{I}{I_o} = 98\ \text{dB}$ 2

b) iii) $I \equiv \frac{P}{A} = \frac{P}{2\pi r^2} = 12.8\ \text{mW.m}^{-2}$ 2

ii) $\beta_I' \equiv 10 \log_{10} \frac{I}{I_o} = 101\ \text{dB}$, *OR* $\beta_I' = \beta + 3\ \text{dB} = 101\ \text{dB}$ 2

c) $f = f_o \frac{c + v_o}{c - v_s} \quad \therefore\ 1 - \frac{v_s}{c} = \frac{f_o}{f} \quad \therefore\ v_s = c\left(1 - \frac{f_o}{f}\right) = 31\ \text{ms}^{-1}.$ 3

How did you go? *If you have had difficulty with this test, don't panic, but you should consider whether your study and learning habits are adequate. If you did badly and you do not think that your performance is likely to improve, then you should talk to your programme coordinator or the course authority about whether or not you should withdraw from this course.*