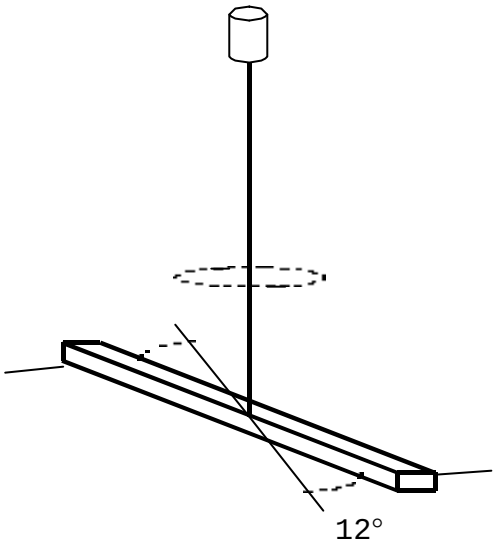
**PHYS1231 Higher Physics 1B Test 1R S2 2000**

**Question 1 (Marks 16 )**

(a) A vibrating system is described by the equation $y = 1.60\,(cm)\sin(1.30\,t - 0.75)$ where t is in seconds and angles are in radians. Find the displacement, velocity and acceleration for t=0 s and t=0.60 s

(b) A uniform bar is suspended at its mid-point from a vertical torsion wire, as shown in the figure below



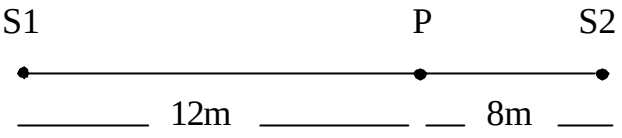

A torque of 5 Nm applied to the bar produces a deflection of the bar in the horizontal plane of 12°; when the bar is released it oscillates with SHM with a period T of 0.5 s. Use this information to determine the moment of inertia of the bar about the axis of rotation.

**Question 2 (Marks 18)**

(a)Two sources, $S_1$ and $S_2$, separated by 20m along a straight string send out transverse waves given by

$$y_{s1} = 0.06\sin pt \text{ and } y_{s2} = 0.02\sin pt$$

respectively, where y is in metres and t is in seconds. The arrangement is shown in the figure below.




The waves' speed is $3ms^{-1}$. Find the equation of motion of an element of the wire that is located 12m from source 1, in the direction of $S_2$.

(b) A one-dimensional travelling sound wave is described in terms of pressure amplitude by the equation

$$p = 1.5\sin\{[\frac{2p}{l}](x - 330\,t)\}$$

where $p$ is in pascals, $x$ and λ are in metres, and $t$ is in seconds.

(i) What is the velocity of this wave?
(ii) If the wavelength of the sound wave is 2 m, what is the frequency?
(iii) What is the maximum pressure amplitude?
(iv) What is the pressure at $x$=1/6m and $t$=0?

**Question 3 (Marks 13)**

In a Young's two-slit experiment, two wavelengths $l_1 = 750nm$ and $l_2 = 900nm$ respectively, illuminate a pair of slits spaced by $2x10^{-3}m$ producing an interference pattern on a screen 2m from the slits. Find the minimum non-zero distance, measured from the common central bright fringe position, at which a bright fringe from one interference pattern will coincide with a bright fringe from the other.

**Question 4 (Marks 19)**

Due to the cost overrun of preparations, it is necessary to fabricate Olympic medals from aluminium. The aluminium is anodised by depositing a thin layer of aluminium oxide on the medals to colour them. This means that gold and silver are not available, but other attractive

colours are. If the anodising film is 250nm thick, what colour will the medals be when viewed in white light striking the surface at normal incidence? Begin your answer by providing a fully labelled sketch showing incident and reflected rays and all relevant phase changes. [The index of refraction of aluminium oxide is 1.80]

**Question 5 (Marks 14)**

(a) A polariser and an analyser are positioned with an angle of 30° between their polarisation axes.

(i) If unpolarised light of intensity $I_0$ is incident upon the two sheets what is the transmitted intensity?

(ii) If polarised light of intensity $I_0$ is incident upon the polariser-analyser pair, such that the polarisation direction in $I_0$ makes an angle of 30° with the polariser, find the transmitted intensity.

(b) A quarter wave plate is made from a transparent mineral with indices of refraction $n_{\perp}$=1.732 and $n_{||}$=1.456 for light of free-space wavelength $l = 589\,nm$. Calculate the minimum thickness required for the plate at this wavelength.