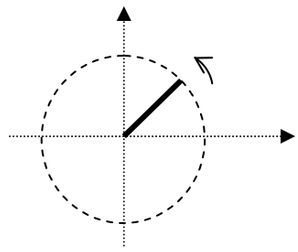
The Open University of Sri Lanka
B.Sc Degree Programme -Level 04
Open Book Test- 2010/2011
Waves and Vibration/Geometrical Optics-PHU 2141/PHE 4141
Duration: One and half (1 ½) hours

Date : 16 th September 2010 **Time: 4.00 p.m to 5.30 p.m**

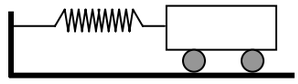
Answer all questions

(1) (a) The following figure shows a rotating rod (length *l*) on a vertical plane at an uniform angular velocity ω .If the motion starts from the horizontal axis ,



(a) Find the length of the projection of the rod on the vertical axis *(y)*at any time *t*.
(b) What are the velocity and acceleration of the motion?
(c) What are the maximum values of them
(d) At what phase angles do they reach to their maximums ?
(e) If a particle on the horizontal axis of the above figure oscillates according to the equation of $x=l \cos \omega t$, write down the equation or draw the path for the superposition of *x* and *y*.
(f) Write down *x* and *y* using the real part of complex numbers..

(2) A mass $m = 0.2\ kg$ is attached to a uniform spring of spring constant $k = 20\ N/m$ and oscillates on a vertical frictionless plane as shown in the figure.



(a) Derive the frequency of the oscillation of mass.
(b) If an external force $-0.1\ v$ acts on the mass (where *v* is the velocity)of the above system, obtain the differential equation with numerical constants for the motion.
(c) If the above motion (b) initiates with the phase angle of $\pi/2$ and the amplitude of the oscillation is $0.12\ m$, write down the displacement of the motion.
(d) Briefly describe the amplitude variation of the motion and sketch it with time.

(3) When a simple harmonic wave is propagated through the air, the displacement (*y)* of an air particle at any position (*x m)* of the propagating direction at any instant (*t s)* is given by

$$y = 2.5 \sin 2\pi(x/0.03 - 11 \times 10^3 t)\ cm$$

(a) Find the amplitude , wave number, wavelength , oscillating frequency of air particles and the velocity of wave propagation.
(b) Find the displacement of the air particle at the moment $x= 0.3\ m$ and $t =0.01\ s$
(c) Find the maximum transverse velocity of any particle in the air.
(d) Prove that the above wave equation satisfies the condition

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{C^2}\frac{\partial^2 y}{\partial t^2}$$

Where C is the wave propagating velocity in the air

(e) If this wave is propagating along the axis of one side closed tube, write down the equation of the reflected wave.

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