FINAL NATIONAL STANDARD EXAMINATION - 2019

(Held On Sunday 24th November, 2019)

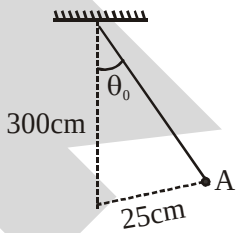
PHYSICS — TEST PAPER WITH SOLUTION

1. A pendulum is made by using a thread of length 300 cm and a small spherical bob of mass 100 g. It is suspended from a point S. The bob is pulled from its position of rest at O to the point A so that the linear amplitude is 25 cm. The angular amplitude in radian and the potential energy of the bob in joule at A are respectively

(a) 0.10 and 0.10 (b) 0.083 and 0.01 (c) 0.251 and 2.94 (d) 0.083 and 0.24

Ans. (b)

Sol. Angular amplitude , $\theta_0 = \frac{25}{300}$



$\theta_0 = .083$ rad

potential energy, $U = mg\ell(1 - \cos\theta)$

$U = 2mg\ell \sin^2(\theta/2)$

$\Rightarrow U \simeq mg\ell\frac{\theta^2}{2}$

$= 0.1 \times 10 \times 3 \times \left(\frac{1}{12}\right)^2 \times \frac{1}{2}$

$= 0.01$ J

2. Consider the following physical expressions

(I) ρv^2 (ρ : density, v : velocity)

(II) $\frac{Y\Delta L}{L}$ (Y : Young's modulus, L : length)

(III) $\frac{\sigma^2}{\varepsilon_0}$ (σ : surface density of charge)

(IV) $h\rho rg$ (h : rise of a liquid in a capillary tube of radius r)

(a) I and II only (b) II and III only (c) II, III and IV only (d) I, II and III only

Ans. (d)

Sol. $[\rho v^2] = [ML^{-3}][L^2T^{-2}]$

$= ML^{-1}T^{-2}$

$\left[Y\frac{\Delta L}{L}\right] = \frac{[F]}{[A]} = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$

$\left[\frac{\sigma^2}{\epsilon_0}\right] = [\text{Pressure}] = ML^{-1}T^{-2}$

$[h\rho rg] = [ML^{-1}T^{-2}][L] = MT^{-2}$

3. Two simple pendulums of lengths 1.44 m and 1.0 m start swinging together in the same phase. The two will be in phase again after a time of

(a) 6 second (b) 9 second (c) 12 second (d) 25 second

Ans. (c)

Sol. $T_1 = 2\pi\sqrt{\frac{1.44}{10}}$ $T_2 = 2\pi\sqrt{\frac{1}{10}}$

$T_1 = 1.2\ T_0$, $T_2 = T_0$

Let after minimum time t, both will again be in phase,

$n_1T_1 = n_2T_2 = t$

$\Rightarrow n_1 \times 1.2 = n_2 \Rightarrow \frac{n_2}{n_1} = \frac{6}{5}$

minimum value of $n_1 = 5$ & $n_2 = 6$

$\therefore t = 6 \times \frac{2\pi}{10} \simeq 12$ second

4. A home aquarium partly filled with water slides down an inclined plane of inclination angle θ with respect to the horizontal. The surface of water in the aquarium

(a) remains horizontal

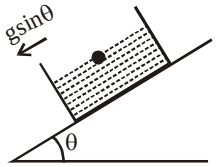
(b) remains parallel to the plane of the incline

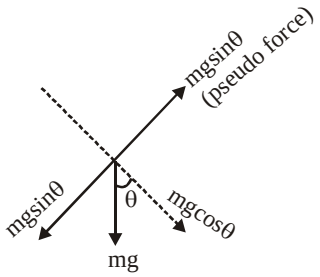
(c) forms an angle α with the horizon where $0 < \alpha < \theta$

(d) forms an angle α with the horizon, where $\theta < \alpha < 90$

Ans. (b or c)

Sol. Considering friction is absent





F.B.D. of a particle in frame of aquarium.

From FBD it can be said that net force (including pseudo force)

act perpendicular to inclined plane therefore liquid surface will be parallel to incline plane

If friction is present then pseudo force will be less than mgsinθ, therefore $0 < \alpha < \theta$.