श्रद्धावान् लभते ज्ञानम्

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19PHY104-
Computational Engineering Mechanics

19AIE105-
Object Oriented programming

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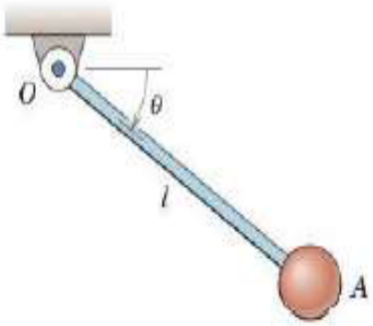
Problem 18

If all frictional effects are neglected, the expression for the angular acceleration of the simple pendulum is $\ddot{\theta} = \frac{g}{l}\cos\theta$, where g is the acceleration due to gravity and l is the length of the rod OA.

if the pendulum has a clockwise angular velocity $\dot{\theta} = \omega$, when θ =0 at t=0; determine the time t' at which the pendulum passes the vertical position θ = 90^0. The pendulum length l can vary from 0.5 m to 2.0 m and ω can vary from 2 rad/s to 10 rad/s. Find the variation of θ with t.



AIM:

To determine the time 't' at which the pendulum passes the vertical position

And to find the variation of θ with 't'

SOLVING METHODOLOGY

$$\alpha = \frac{g\cos(\theta)}{l}$$

$$a = \frac{dv}{dt} = \frac{dv}{ds} \times \frac{ds}{dt}$$

$$a = \frac{vdv}{ds}$$

$$\alpha = \frac{d\omega}{d\theta} \times \frac{d\theta}{dt}$$

$$\alpha = \frac{\omega d\omega}{d\theta}$$

$$\alpha.d\theta = \omega d\omega$$

$$\int \frac{g\cos(\theta)}{l} d\theta = \int_{\omega_0}^{\omega} \omega.d\omega$$

$$\frac{g\sin(\theta)}{l} = \left[\frac{\omega^2}{2}\right]_{\omega_0}^{\omega}$$

$$\frac{\omega^2}{2} - \frac{{\omega_0}^2}{2} = \frac{g\sin(\theta)}{l}$$

$$\omega^2 = \omega_0^{\,2} + \frac{2g\sin(\theta)}{l}$$

$$\omega = \sqrt{\omega_0^{\,2} + \frac{2g\sin(\theta)}{l}}$$

$$\frac{d\theta}{dt} = \sqrt{\omega_0^{\,2} + \frac{2g\sin(\theta)}{l}}$$

$$\int dt = \int \frac{d\theta}{\sqrt{\omega_0^{\,2} + \frac{2g\sin(\theta)}{l}}}$$

$$t = \int \frac{d\theta}{\sqrt{\omega_0^{\,2} + \frac{2g\sin(\theta)}{l}}}$$

Implementation using OOPS:

```
package Projects;
import java.util.*;
public class mech_and_oops {
public static void main(String[] args) {
Scanner sc=new Scanner(System.in);
System.out.println("Enter the length");
double l=sc.nextDouble();
System.out.println("Enter the angular velocity");
double w=sc.nextDouble();
```

```
sc.close();
if(w>=2 && w<=10 && l>=0.5 && l<=2) {
Question s1= new alphadtet(w,l);
Question s2= new time(w,(Math.PI)/2,l);
System.out.println("w: "+s1.cal());
System.out.println("time: "+s2.cal());
}
else {
System.out.println("Error!");
}
} }



interface Question{
public double cal();
}
class alphadtet implements Question{
double angv;
public alphadtet(double w,double l) {
double dx =0.00001;
double g=9.81;
for(double i=2-dx;i<=w;i+=dx) {
w=Math.sqrt(w*w+2*g*Math.cos(i)/l);
```

```
}
angv=w;
}
public double cal() {
double dx =0.00001;
return angv*dx;
}
        }

class time implements Question{
double tim;
public  time(double w,double tet,double l){
double dx=0.000001;
double t=0;
double g=9.81;
for(double i=0;i<=tet;i+=dx) {
t=t+(1/Math.sqrt((w*w)+(2*g*Math.sin(i)/l)));
}
}
tim=t;
}
public double cal() {
double dx=0.000001;
return tim*dx;
}
```

```
}
```