MOMENT OF INERTIA PART 2 LAB

SEE EXAMPLE 10.3 OF TEXTBOOK

TODAY WE WILL VERIFY THE KINEMATIC LAW RELATING THE ANGLE OF ROTATION AND THE TIME. FROM PART 1, WE KNOW from EXAMPLE 10.3:

$h = \frac{1}{2}at^2$, where a is the linear acceleration of and h the vertical distance the hanging mass falls in a time t if it starts from rest. We also know the pulley's angular acceleration is $\alpha=a/r$, where r is the radius of the pulley axle drum. IN ADDITION WE KNOW $\theta = \frac{1}{2}\alpha t^2$ AND ALSO $\theta= h/r$. ***Thus, we can we plot θ vs. t^2 with the expectation of a straight line whose slope is α/2 .***

FOR 3 GIVEN ROTATING SYSTEMS YOU WILL PLOT θ vs. t^2 for 4 values of the time t, picking the values of h that produce equally spaced value of t^2. Here's how you do this. For a given value of maximum drop height h you will reduce the drop height 3 times so t^2 changes in equal increments. Suppose for example the maximum value of the height is H. Thus: $t_1 = t_{max} = \sqrt{\frac{2H}{a}}$, here $H = h_1$. We want the next time to be such that $t_2{}^2 = \frac{3}{4}t_{max}{}^2$, thus $h_2 = \frac{3}{4}H$; $t_3{}^2 = \frac{1}{2}t_{max}{}^2$, thus $h_3 = \frac{1}{2}H$; $t_4{}^2 = \frac{1}{4}t_{max}{}^2$, thus $h_4 = \frac{1}{4}H$.

YOU WILL PLOT THE ANGLE VS THE SQUARE OF TIME AND VERIFY THE LAW OF ROTATION BY OBSERVING A STRAIGHT LINE. YOU WILL MAKE THREE PLOTS OF

θ vs. t^2 : With the spindle underneath, YOU WILL PERFORM THE EXPERIMENT WITH (1)THE **DISK ALONE**, (2) THE **RING ALONE** AND THE (3) **RING PLUS THE DISK** AND COMPARE THE SLOPES OF THE LINES GIVEN BY = θ vs. t^2. You will get time t with a digital timer.

FOR EACH PLOT YOU WILL HAVE 4 DROP HEIGHTS AND FOR EACH OF THE 4 DROP HEIGHTS h , YOU WILL DROP THE HANGING MASS 4 TIMES AND COMPUTE THE AVERAGE TIME. For a particular drop height the angle is the height/r, where r is the radius of the axle drum you will measure.

DATA SHEET:	
r =	
SPINDLE + RING	
h_1 =H = max h	θ_1
TIME t	
a	
b	
c	
d	
Average t	
h_2 =3H/4	θ_2
TIME t	
a	
b	
c	
d	
Average t	
h_3 =H/2	θ_3
TIME t	
a	
b	
c	
d	
Average t	
h_4 =H/4	θ_4
TIME t	
a	
b	
c	
d	
Average t	

SPINDLE + DISK	
h_1 =H = max h	θ_1
TIME t	
a	
b	
c	
d	
Average t	
h_2 =3H/4	θ_2
TIME t	
a	
b	
c	
d	
Average t	
h_3 =H/2	θ_3
TIME t	
a	
b	
c	
d	
Average t	
h_4 =H/4	θ_4
TIME t	
a	
b	
c	
d	
Average t	

SPINDLE + DISK +RING	
h_1 =H = max h	θ_1
TIME t	
a	
b	
c	
d	
Average t	
h_2 =3H/4	θ_2
TIME t	
a	
b	
c	
d	
Average t	
h_3 =H/2	θ_3
TIME t	
a	
b	
c	
d	
Average t	
h_4 =H/4	θ_4
TIME t	
a	
b	
c	
d	
Average t	

FOR EACH SYSTEM, PLOT ***θ vs. t^2 . USE LOGGER PRO (WITH NO DEVICE CONNECTED) OR EXCEL TO***

GRAPH THE LINE AND FIND THE SLOPE OF θ vs. t^2 .

Q1: EXPLAIN THE DIFFERENCES BETWEEN THE SLOPES OF THE 3 GRAPHS. DOES THE ORDERING OF THE SLOPE MAGNITUDES MAKE SENSE? WHICH SLOPE IS THE LARGEST? THE SMALLEST? IINTERMEDIATE? EXPLAIN USING PHYSICAL PRINCIPLES AND EQUATIONS.

Q2: FROM YOUR SLOPE VALUE FOR THE SPINDLE + DISK, COMPUTE $I_{SP} + I_{DISK}$ AND COMPARE WITH THE VALUE OF $I_{SP} + I_{DISK}$ YOU OBTAINED IN PART 1 OF THIS LABORATORY.