1. (Rotational motion – kinematics/dynamics, 5/ea.) A force of 50 N exerts on 10-kg uniform disk with a radius R = 0.2 m for 1 second time period to initiate \((t = 0)\) spinning of the disk. Assumption: frictionless.

(a) What is the torque applied to the disk? \textbf{Ans.} _____10 N.m.
(b) What is the angular acceleration during the first 1-second period? \textbf{Ans.} \(\frac{50}{\text{rad./s}^2}\)
(c) What is the angular velocity when \(t = 1\) s? \textbf{Ans.} _____50 rad./s
(d) What is the total rotated angle during the first 1-second? \textbf{Ans.} _____25 rad.
(e) What is the total rotated angle during the second 1-second time period? \textbf{Ans.} _____50 rad.

2. (Rotational motion – dynamics/energetics, 5/ea.) Refer to the problem #1 (double-check your results in the first problem), find:

Refer to the diagram in 1.

(a) the work done by the torque. \textbf{Ans.} _____250 J
(b) the rotational kinetic energy at the end of the first 1 s. \textbf{Ans.} _____250 J
(c) the angular momentum at the end of the first 1 s. \textbf{Ans.} _____10 kg.m^2/s

If a point-mass with mass of 5 kg is adhered to the disk at \(r = R/2\) as shown at the end of first 1 s, find:

(d) the rotational inertia for the disk with the point-mass? \textbf{Ans.} _____0.25 kg.m^2 , and
(e) the new angular velocity assuming the angular momentum is conserved? \textbf{Ans.} _____40 rad./s

3. (Oscillatory motion: spring with a point-mass, 5/ea.) A 1-kg point-mass with zero initial velocity connected with a spring is being displaced by \(X_0 = 0.15\) m. Assume (1) the force constant of the spring \((K)\) is 9 N/m, and (2) the motion of spring/object is frictionless and \(t = 0\) when the point-mass is at \(x = 0\) m.

(a) What is the oscillation period of the point-mass, \(T\)? \textbf{Ans.} _____2.1 s
(b) What is the oscillation frequency of the point-mass? \textbf{Ans.} _____0.5 Hz
(c) What is value of \(x(t)\) for \(t = 2T\)? \textbf{Ans.} _____0
(d) What is the maximum kinetic energy of the point-mass? \textbf{Ans.} _____0.1 J
(e) What is the work done by the spring-force when the point-mass is being displaced from \(X\) to the origin \(x = 0\)? \textbf{Ans.} _____0.1 J

4. (Oscillatory motion: pendulum, 5/ea.) A pendulum system with \(L = 1\) m and \(m = 2\) kg is initially energized by giving a potential energy of 0.2 J to the system. Assumption: frictionless, \(g = 9.8\) m/s^2

(a) What is the maximum kinetic energy of the point-mass? \textbf{Ans.} _____0.2 J
(b) What is the maximum velocity of the point-mass (magnitude only)? \textbf{Ans.} _____0.45 m/s
(c) What is the maximum displacement of the point-mass, \(S_m\)? \textbf{Ans.} _____0.14 m
(d) What is the maximum force exerts on the point-mass? \textbf{Ans.} _____2.7 N
(e) What is the net force exerts on the point-mass when it has the maximum velocity? \textbf{Ans.} _____0

<Equations given below are for your reference only>

Rotational motion

- \(I = (1/2)mr^2\) for uniform disk
- \(I = mr^2\) for a point mass
- \(\theta = \theta_0 + \alpha \Delta t + (1/2) \alpha^2 \Delta t^2\)
- \(\omega = \omega_0 + \alpha \Delta t\)
- \(\tau = Fr; L = I \omega\)
- \(\tau = I \alpha; W = \tau \Delta \theta\)
- \(KE_{rot} = (1/2) I \omega^2\)

Oscillatory motion – spring with a point-mass

- \(F = -Kx; F = ma\)
- \(\omega = (K/m)^{1/2}\)
- \(x(t) = X_0 \sin(\omega t); v(t) = X_0 \omega \cos(\omega t); a(t) = -X_0 \omega^2 \sin(\omega t)\)
- \(PE_m = (1/2)KX_0^2; KE_m = (1/2)m v_0^2\)

Oscillatory motion – pendulum

- \(\omega = (g/L)^{1/2}\)
- \(s(t) = S_m \sin(\omega t); v(t) = S_m \omega \cos(\omega t); a(t) = -S_m \omega^2 \sin(\omega t)\)