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? Ans. ________10 N.m.

(b) What is the angular acceleration during the first 1-second period? Ans. ________50 rad./s^2

(c) What is the angular velocity when $t = 1$ s? Ans. ________50 rad./s

(d) What is the total rotated angle during the first 1-second? Ans. ________25 rad.

(e) What is the total rotated angle during the second 1-second time period? 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. Ans. ________250 J

(b) the rotational kinetic energy at the end of the first 1 s. Ans. ________250 J

(c) the angular momentum at the end of the first 1 s. 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? Ans. ________0.25 kg.m^2, and

(e) the new angular velocity assuming the angular momentum is conserved? 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 $X_m = 0.15$ 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, $T$? Ans. ________2.1 s

(b) What is the oscillation frequency of the point-mass? Ans. ________0.5 Hz

(c) What is value of $x$ (t) for $t = 2T$? Ans. ________0

(d) What is the maximum kinetic energy of the point-mass? 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 $x = 0$? 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? Ans. ________0.2 J

(b) What is the maximum velocity of the point-mass (magnitude only)? Ans. ________0.45 m/s

(c) What is the maximum displacement of the point-mass, $S_m$? Ans. ________0.14 m

(d) What is the maximum force exerts on the point-mass? Ans. ________2.7 N

(e) What is the net force exerts on the point-mass when it has the maximum velocity? Ans. ________0

<Equations given below are for your reference only>

<table>
<thead>
<tr>
<th>Rotational motion</th>
<th>Oscillatory motion – spring with a point-mass</th>
<th>Oscillatory motion – pendulum</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I = (1/2)mr^2$ for uniform disk</td>
<td>$F = -Kx; F = ma$</td>
<td>$\omega = (g/L)^{1/2}$</td>
</tr>
<tr>
<td>$\theta = \theta_0 + \omega_0 t + (1/2)\alpha t^2$</td>
<td>$\omega = (K/m)^{1/2}$</td>
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<tr>
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<td>$t = 1\alpha; W = \tau \Delta \theta$</td>
</tr>
<tr>
<td>$\tau = Fr; L = I\omega$</td>
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<tr>
<td>$\tau = I\alpha; W = \tau \Delta \theta$</td>
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