Name: DISC: Score: / 20

Instructions:

|  |  |  |  |
| --- | --- | --- | --- |
| Q1 | Q2 | Q3 | Q4 |
|  |  |  |  |
| 10 | 10 | 5 | 5 |

* Do your own work.
* Answer the questions below in the space provided.
* Make sure you show all your work and any equations that you use.
* Please place a box around your answers.
* Remember to give the correct units with all numerical answers

Table : Properties of the Disk

|  |  |  |
| --- | --- | --- |
| **MASS** | **RADIUS** | **I** |
| 0.5 kg | 0.75 m |  |

1. A solid, horizontal disk is free to rotate about its center. A force of acts tangentially at the edge of the disk.
   1. What is the torque on the disk ()? (Lecture 14, p. 4)

Torque (3 pts):

From the diagram we notice that and are at to each other. Therefore, we know that We can use this to find the torque: Now we need to check the sign: Remember that counter clockwise is positive (+). Observing the direction of the force (right) the disk will rotate clockwise, thus in the negative direction.

* 1. The disk starts rotating from rest. Using , what is the angular acceleration of the disk?

Angular Acceleration (2 pts):

Letting we can solve as follows: (Homework—Disk with Weight)

* 1. Recall: . Calculate the angular speed of the disk at . (Lecture 8, p. 14)

Angular speed (2 pts):

Apply the kinematic formula:

* 1. What is the kinetic energy of the disk at ()? (Lecture 13, p. 8)

Kinetic Energy (3 pts):

1. A solid cylinder rolls without slipping down an inclined plane. The cylinder starts from rest at the top of the incline. The following are true about the cylinder-inclined plane system:

|  |  |  |  |
| --- | --- | --- | --- |
| **ANGLE OF INCLINE** | **LENGTH OF INCLINE** | **CYLINDER MASS** | **CYLINDER RADIUS** |
|  | 2 m | 3 kg | 0.2 m |

* 1. Draw a figure which describes the cylinder and inclined plane *before* the cylinder starts to roll. Remember to label all parts of the diagram. (Lecture 13, pp. 13-14; Homework—Sphere on Incline)

Figure (2 pts):

Selections (2 pts):

Potential Energy (2 pts):

* 1. As the cylinder rolls down the incline which of the following occur (select all correct responses):
     1. Momentum is conserved.
     2. Potential energy is converted into kinetic energy.
     3. The cylinder will have both rotational and translational kinetic energy.
  2. What is the potential energy of the cylinder at the top of the incline ()? (Lecture 10, p. 6)
  3. What is the total kinetic energy (at the bottom of the incline (hint: total energy is conserved). (Lecture 10, p. 7)

Total Kinetic Energy (2 pts):

Since total energy is conserved,

* 1. Using , find the rotational speed of the cylinder at the bottom of the ramp. For a solid cylinder (Synthesis)

Rotational Speed (2 pts):

First use conservation of energy to find the speed of the center of the cylinder:

Now we find the rotational speed: