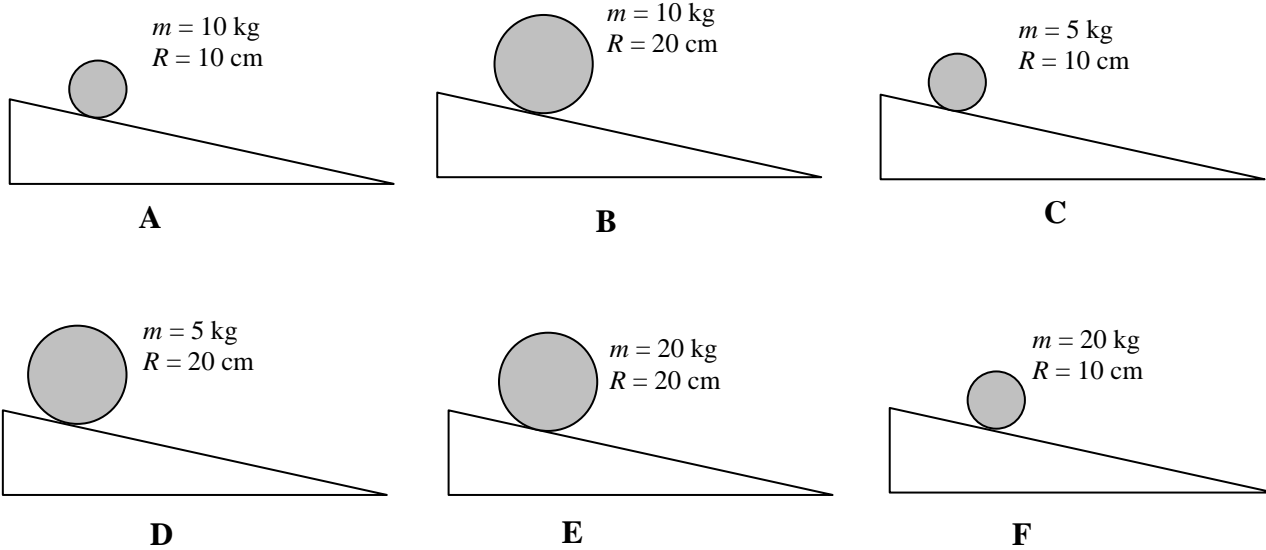


Cylinders Rolling Down Hills

Shown below are six cylinders of different materials that are rolled down the same hill. The diagrams show the masses (m) and radii (R) of the cylinders. The cylinders are all released from rest and roll without slipping the same distance down the incline.

Rank these situations from least to greatest in terms of the time it takes each cylinder to reach the bottom of the hill.



Least 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Greatest

Or, all of the cylinders reach the bottom at the same time. _____

Please carefully explain your reasoning.

How sure are you of your ranking?

Basically Gessed

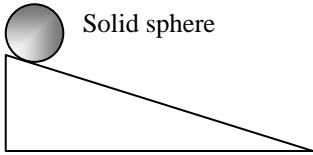
1 2 3 4 5 6 7 8 9 10

Very Sure

Various Objects Rolling Down a Hill: Speed at Bottom

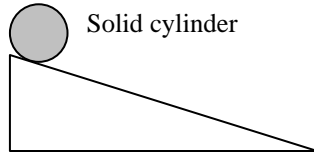
Shown below are five objects of equal mass and radius. All five objects are released from rest and roll the same distance down the same hill without slipping.

Rank the situations shown below from fastest to slowest in terms of their speed when they reach the bottom of the hill.



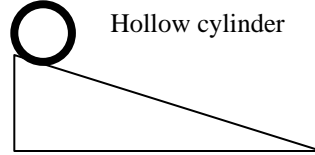
Solid sphere

A



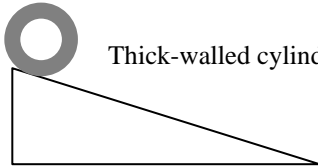
Solid cylinder

B



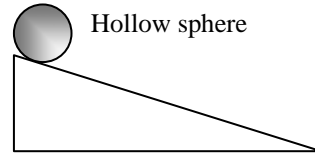
Hollow cylinder

C



Thick-walled cylinder

D



Hollow sphere

E

Fastest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ Slowest

Or, all of the objects are traveling at the same speed. _____

Please carefully explain your reasoning.

How sure are you of your ranking?

Basically Guessed

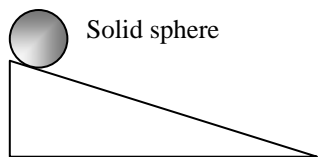
1 2 3 4 5 6 7 8 9 10

Very Sure

Various Objects Rolling Down a Hill: Total Energy

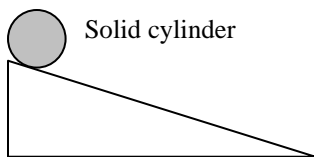
Shown below are five objects of equal mass and radius. All five objects are released from rest and roll the same distance down the same hill without slipping.

Rank the situations shown below from greatest to least in terms of their total mechanical energy when they reach the bottom of the hill.



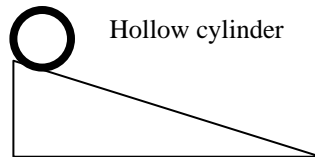
Solid sphere

A



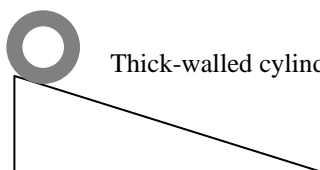
Solid cylinder

B



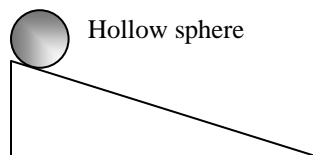
Hollow cylinder

C



Thick-walled cylinder

D



Hollow sphere

E

Greatest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ Least

Or, all of the objects have the same total energy. _____

Please carefully explain your reasoning.

How sure are you of your ranking?

Basically Guessed

1

2

3

4

5

6

7

8

9

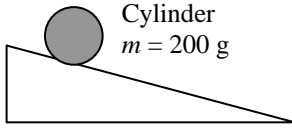
10

Very Sure

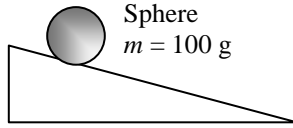
Cylinders and Spheres Rolling Down Hills I

Shown below are six objects. Some of them are cylinders, and some of them are spheres. They all have the same radius but different masses, as shown in the diagram. They are all released from rest from the same height on the hill and allowed to roll without slipping to the bottom of the hill.

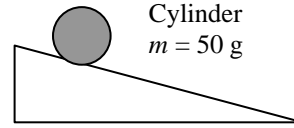
Rank these six situations from least to greatest in terms of the time it takes the object to roll to the bottom of the hill.



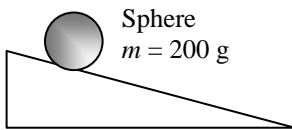
A



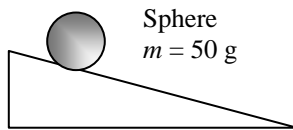
B



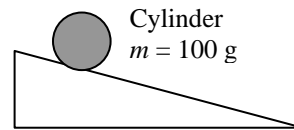
C



D



E



F

Least 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Greatest

Or, all of the objects reach the bottom at the same time. _____

Please carefully explain your reasoning.

How sure are you of your ranking?

Basically Guessed

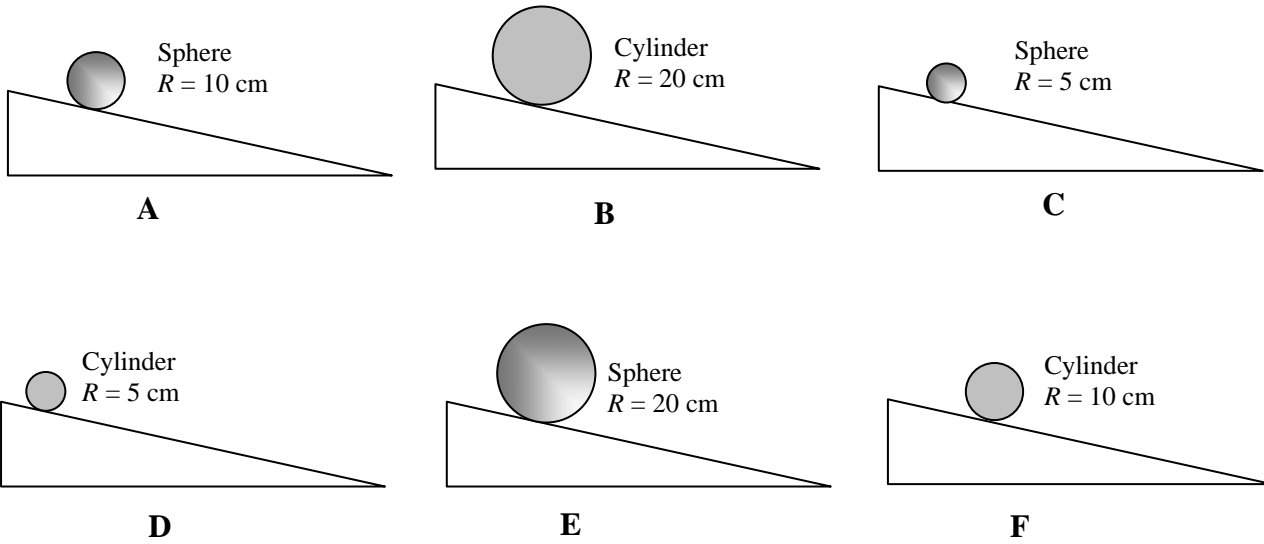
1 2 3 4 5 6 7 8 9 10

Very Sure

Cylinders and Spheres Rolling Down Hills: Energy

Shown in the diagram below are six objects, either cylinders or spheres, all of the same mass but different radii. They are all released from rest from the same height on the hill and allowed to roll without slipping to the bottom of the hill.

Rank these six situations from greatest to least in terms of their total kinetic energy at the bottom of the hill.



Greatest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Least

Or, all of the objects reach the bottom at the same time. _____

Please carefully explain your reasoning.

How sure are you of your ranking?

Basically Guessed

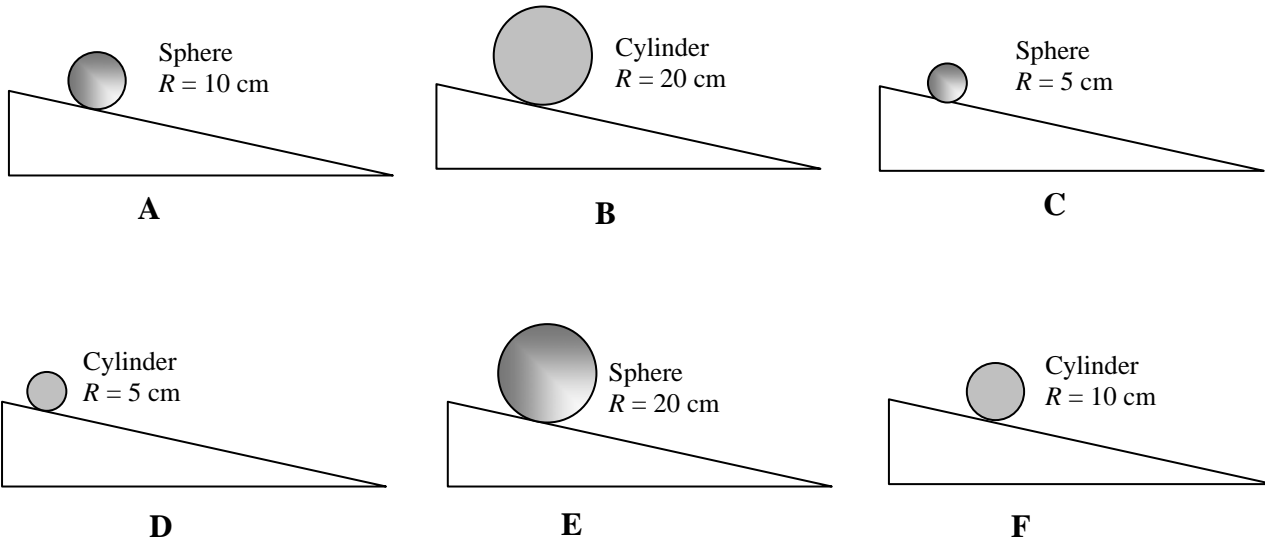
1 2 3 4 5 6 7 8 9 10

Very Sure

Cylinders and Spheres Rolling Down Hills II

Shown in the diagram below are six objects, either cylinders or spheres, all of the same mass but different radii. They are all released from rest from the same height on the hill and allowed to roll without slipping to the bottom of the hill.

Rank these six situations from least to greatest in terms of the time it takes the object to get to the bottom of the hill.



Least 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Greatest

Or, all of the objects reach the bottom at the same time. _____

Please carefully explain your reasoning.

How sure are you of your ranking?

Basically Guessed

1 2 3 4 5 6 7 8 9 10

Very Sure