This print-out should have 14 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering. The due time is Central time.

Flywheel

10:09, trigonometry, multiple choice, > 1 min, normal.

001

A flywheel of radius 0.63 m and moment of inertia of 17.2 $\mathrm{kg \cdot m^2}$ rotates initially at a rate of 3.7 revolutions/sec.

If a force of 3.1 N is applied tangentially to the flywheel to slow it down, how much work will be done by this force in bringing the flywheel to a stop?

1. 1.953 J

2. 117.734 J

3. 4647.95 J

4. 399.862 J

5. 63.64 J

6. 235.468 J

7. 9295.9 J

Ferris Wheel Motor 01

10:09, trigonometry, numeric, > 1 min, normal.

002

An electric motor can accelerate a Ferris wheel of moment of inertia $I = 20000\ \mathrm{kg\,m^2}$ from rest to 10 rev/min in 12 s. When the motor is turned off, friction causes the wheel to slow down from 10 rev/min to 8 rev/min in 10 s.

Determine the torque generated by the motor to bring the wheel to 10 rev/min. Answer in units of N m.

003

Determine the power needed to maintain the rotational speed at 10 rev/min. Answer in units of W.

Flywheel and a Motor

10:09, trigonometry, numeric, > 1 min, normal.

004

A flywheel in the form of a heavy circular disk of diameter 0.6 m and mass 200 kg is mounted on a frictionless bearing. A motor connected to the flywheel accelerates it from rest to 1000 rev/min.

What is the moment of inertia of the flywheel? Answer in units of $\mathrm{kg\,m^2}$.

005

How much work is done on it during this acceleration? Answer in units of J.

006

After 1000 rev/min is achieved, the motor is disengaged. A friction brake is used to slow the rotational rate to 500 rev/min.

What is the magnitude of the energy dissipated as heat from the friction brake? Answer in units of J.

Car Engine Horsepower

10:09, trigonometry, numeric, > 1 min, normal.

007

An automobile engine develops a torque of 400 N m and is rotating at a speed of 2000 rev/min.

What horsepower does the engine generate? 1 hp = 746 W Answer in units of hp.

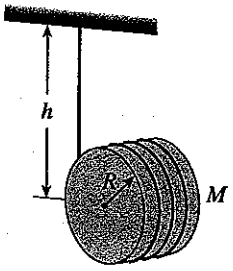
Disc as a Top 02 v1

11:02, trigonometry, numeric, > 1 min, normal.

008

A string is wound around a uniform disc of radius $R = 0.5$ m and mass $M = 2$ kg. The disc is released from rest with the string vertical and its top end tied to a fixed support.

The acceleration of gravity is 9.8 $\mathrm{m/s^2}$.



Calculate the speed of the center of mass when, after starting from rest, the center of mass has fallen $h = 2$ m. Answer in units of m/s.

Dropped Coin

11:01, trigonometry, numeric, > 1 min, normal.

009

A coin with a diameter of 2.4 cm is dropped onto a horizontal surface. The coin starts out with an initial angular speed of 18 rad/s and rolls in a straight line without slipping. If the rotation slows with an angular deceleration of magnitude 1.9 rad/s^2, how far does the coin roll before coming to rest? Answer in units of m.

Rolling Up a Plane

11:02, trigonometry, numeric, > 1 min, normal.

010

Hint: Consider the wheel's energy.

Consider a wheel of radius 1 m, mass 10 kg and moment of inertia $I = \frac{1}{2} M R^2$ (it's a solid disk). The wheel rolls without slipping in a straight line in an uphill direction 30° above the horizontal. The wheel starts at angular speed 30 rad/s but the rotation slows down as the wheel rolls uphill, and eventually the wheel comes to a stop and rolls back downhill.

The acceleration of gravity is 9.8 m/s^2.

How far does the wheel roll in the uphill direction before it stops? Answer in units of m.

Disk and Hoop Race 02

11:02, trigonometry, multiple choice, > 1 min, fixed.

011

A uniform solid disk and a uniform hoop are placed side by side at the top of an incline of height h.

If they are released from rest and roll without slipping, determine their speeds when they reach the bottom. (d = disk, h = hoop)

1. $v_d = \sqrt{h\,g}\,, \quad v_h = \sqrt{2\,h\,g}$
2. $v_d = \sqrt{\frac{1}{2}\,h\,g}\,, \quad v_h = \sqrt{\frac{1}{3}\,h\,g}$
3. $v_d = \sqrt{\frac{2}{3}\,h\,g}\,, \quad v_h = \sqrt{3\,h\,g}$
4. $v_d = \sqrt{2\,h\,g}\,, \quad v_h = \sqrt{h\,g}$
5. $v_d = \sqrt{\frac{4}{3}\,h\,g}\,, \quad v_h = \sqrt{h\,g}$
6. $v_d = \sqrt{\frac{1}{3}\,h\,g}\,, \quad v_h = \sqrt{h\,g}$
7. $v_d = \sqrt{3\,h\,g}\,, \quad v_h = \sqrt{h\,g}$
8. $v_d = \sqrt{3\,h\,g}\,, \quad v_h = \sqrt{2\,h\,g}$
9. $v_d = \sqrt{3\,h\,g}\,, \quad v_h = \sqrt{\frac{1}{3}\,h\,g}$
10. $v_d = \sqrt{2\,h\,g}\,, \quad v_h = \sqrt{\frac{1}{2}\,h\,g}$

012

What is the ratio of their accelerations as they roll down the incline, $\frac{a_{disk}}{a_{hoop}}$?

1. $\frac{a_{disk}}{a_{hoop}} = 3$
2. $\frac{a_{disk}}{a_{hoop}} = 2$
3. $\frac{a_{disk}}{a_{hoop}} = \frac{4}{3}$
4. $\frac{a_{disk}}{a_{hoop}} = \frac{3}{2}$
5. $\frac{a_{disk}}{a_{hoop}} = \sqrt{\frac{4}{3}}$
6. $\frac{a_{disk}}{a_{hoop}} = \sqrt{\frac{3}{2}}$

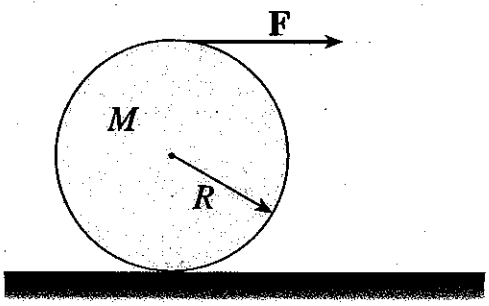
7. $\frac{a_{disk}}{a_{hoop}} = \frac{1}{3}$
8. $\frac{a_{disk}}{a_{hoop}} = \frac{1}{2}$
9. $\frac{a_{disk}}{a_{hoop}} = \sqrt{3}$
10. $\frac{a_{disk}}{a_{hoop}} = \sqrt{2}$

Unwind a Spool of Wire

11:01, trigonometry, numeric, > 1 min, normal.

013

A spool of wire of mass $M = 10$ kg and radius $R = 0.5$ m is unwound under a constant wire tension $F = 10$ N. Assume the spool is a uniform solid cylinder that rolls without slipping.



Calculate the friction force f on the bottom of the spool. Take the rightward direction to be positive. Answer in units of N.

014

Calculate the acceleration of the spool's center of mass. Answer in units of m/s^2.