

Physics 1A, Section 6

November 13, 2008

Section Business

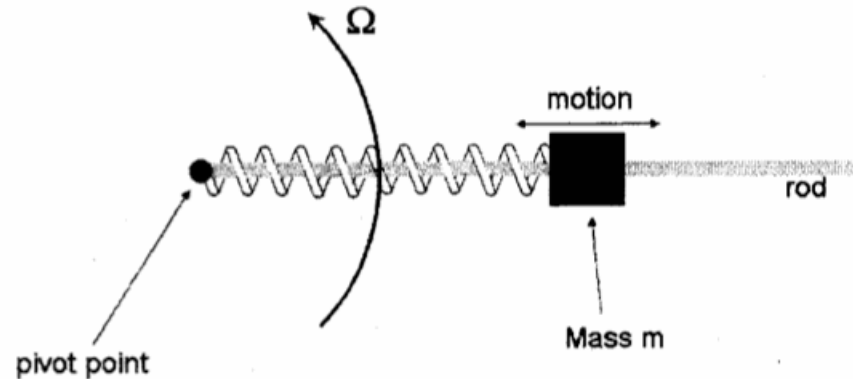
- Homework due Nov. 19: FP5,FP8,QP15,QP16
 - Web site has been updated
- Quiz 3 was due 3 hours ago.

Quiz Problem 53

A long massless rod is attached at one end to a motor which rotates the rod at constant angular speed Ω . A massless spring of force constant k and equilibrium length r_0 is wound around the rod. One end of the spring is attached to the pivot point. At the other end of the spring a mass m is attached. This mass slides along the rod as the spring expands and contracts. There is no friction and no gravity and the motor is powerful enough to keep the angular speed Ω constant. (In case you are worrying about the Coriolis force: don't. It is not relevant here.)

The natural oscillation frequency of the spring and mass combination would be $\omega_0 = (k/m)^{1/2}$ were it not for the rotation of the rod.

Let the radial position of the mass be r , measured from the pivot point.



- (e) Sketch the potential energy $U(r)$ of the mass/spring system for Ω less than the critical value and for Ω greater than the critical value.
- (f) Is angular momentum conserved in this problem? Explain your answer.

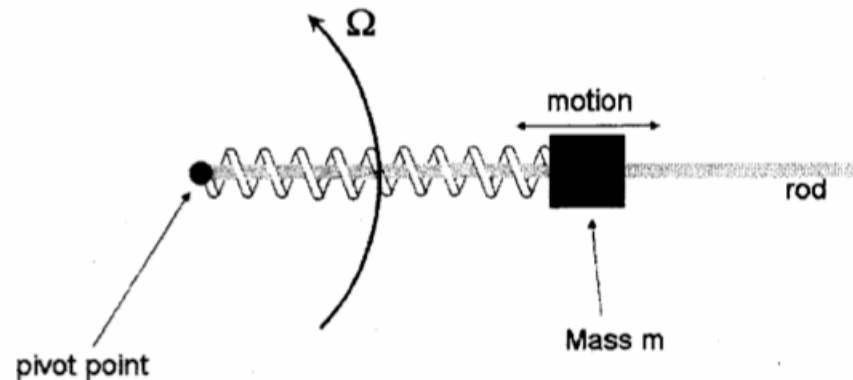
Quiz Problem 53

- Answer:
- e)
- f) no. $L = m\Omega^2 r$, m and Ω constant, but r is not.

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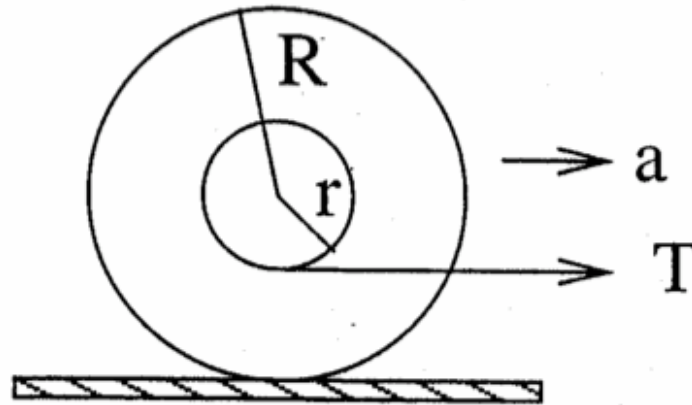


- (e) Sketch the potential energy $U(r)$ of the mass/spring system for Ω less than the critical value and for Ω greater than the critical value.
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Quiz

Problem 25

A yo-yo has mass m , inner radius r , and outer radius R . Its moment of inertia is I about its center. The yo-yo rolls without slipping on a horizontal table, and is pulled along by a horizontal string wound around its inner radius. The pulling by the string gives rise to an acceleration a .

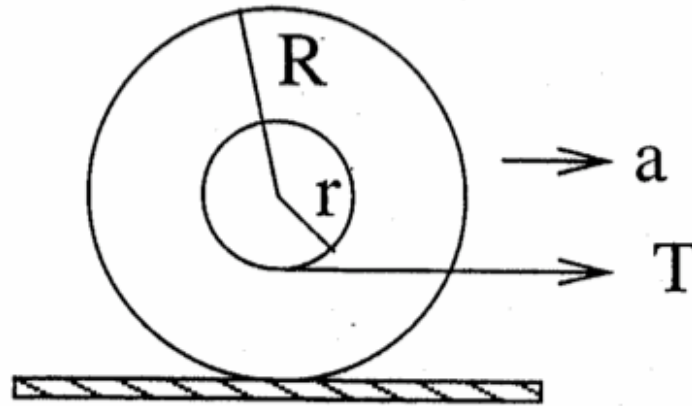


- (a) (3 points) Find the tension T in the string, and the force of friction f .
- (b) (1 point) Find the minimum coefficient of friction μ_{min} so that the yo-yo rolls without slipping. If $I = kmR^2$, find μ_{min} in terms of k , a , and g .
- (c) (1 point) In the picture, in what direction does the yo-yo roll? Explain.

Quiz

Problem 25

A yo-yo has mass m , inner radius r , and outer radius R . Its moment of inertia is I about its center. The yo-yo rolls without slipping on a horizontal table, and is pulled along by a horizontal string wound around its inner radius. The pulling by the string gives rise to an acceleration a .



• Answer:

a) $T = a(mR^2 + I)/[R(R-r)]$

$f = a(I + mrR)/[R(R-r)]$

b) $\mu_{\min} = a(kR + r)/[g(R-r)]$

c) rolls to the right

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(b) (1 point) Find the minimum coefficient of friction $\mu_{\min}$ so that the yo-yo rolls without slipping. If $I = kmR^2$, find $\mu_{\min}$ in terms of k , a , and g .

(c) (1 point) In the picture, in what direction does the yo-yo roll? Explain.

Monday, November 13:

- Quiz Problem 41 (moment of inertia)
- Quiz Problem 32 (collision with rotation)
- *Optional, but helpful, to look at these in advance.*