Physics 121 - Test 2 Practice

July 20, 2009

Use this test to help review for our upcoming test. It might be helpful to work through the problems carefully and then try doing them again without using your book. Remember, the best way to solve physics problems is to develop a method and follow it every time. For the actual test you can bring a notecard, your calculator and I will provide a copy of table 10.2.

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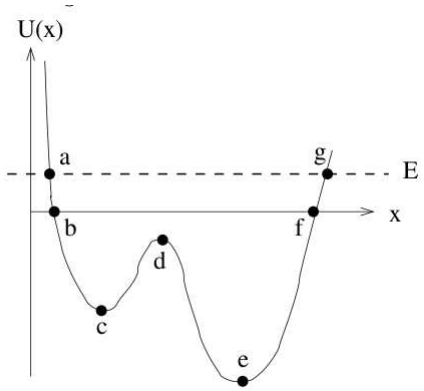
1. Equation 1 describes the potential energy as a function of position for a particle.

$$U(x) = 3.2x^2 - 1.6x \tag{1}$$

a) What is the force as a function of position?
b) What is the force on the particle when it's at x=1.6m?

2. A particle moves along the x-axis while acted on by a single conservative force. the potential that corresponds to the force is shown below. The total energy of the particle is given by the dotted line in the figure.



a) At which point(s) is the particle in stable equilibrium?
b) At which point(s) is the particle in unstable equilibrium?
c) Which points are the turning points for the particle?

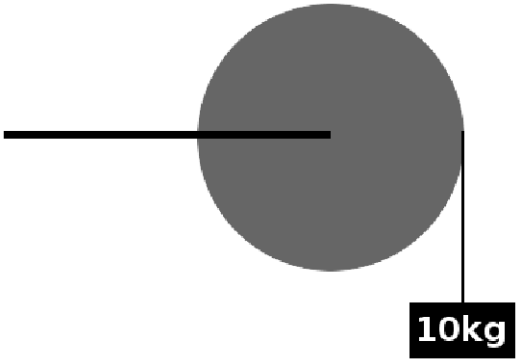
3. Halley's Comet has a mass of about 3×10^{14}kg. At perihelion it is 8.76×10^{10}m from the Sun, at aphelion, it is 5.25×10^{12}m from the Sun. What is the change in gravitational potential energy as the comet moves from aphelion to perihelion? The Suns mass is 1.99×10^{30}kg, $G = 6.67 \times 10^{-11} Nm^2/kg^2$

4. A spaceship with mass 10,000kg starts out at rest on the Earths surface at the equator and ends up in a geostationary orbit 4.21×10^7m from the center of the Earth, traveling at 3.07km/s. What is the energy required to reach this orbit? You can ignore mass lost from the rocket fuel burning. The radius of the Earth is 6.37×10^6m, the mass of the Earth is 5.97×10^{24}kg.

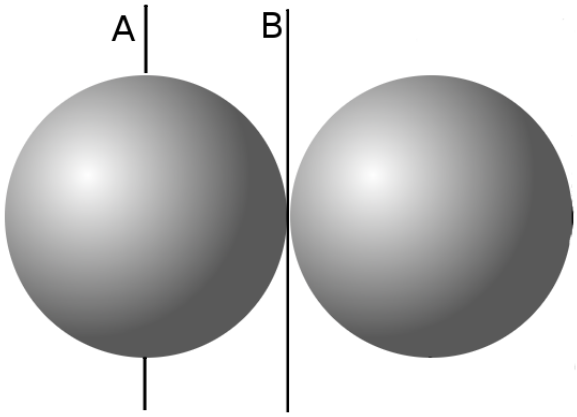
5. Find the center of mass of the following system: A 3kg mass located at $(2.5\hat{i} + 5\hat{j})$ m, a 4kg mass located at $(-3\hat{i} + 3\hat{j})$ m and a 2kg mass located at $(0\hat{i} + -4\hat{j})$ m.

6. Two children stand facing each other and throw pieces of play-dough at one another. The child on the left throws a 0.1kg piece with a velocity of 1.3m/s to the right. The child on the right throws a 0.15kg piece with a velocity of 0.9m/s to the left. The pieces meet in the middle and stick together. What is the final velocity of the new chunk of play-dough?

7. In the picture below, there is a massless lever (1m from end to end) attached to a solid cylinder (mass 25kg, radius 0.3m) with a massless rope wound around it. On the end of the rope is a 10kg mass. What downward force must you apply at the end of the lever to accelerate the hanging mass up at $0.5m/s^2$?



8. The figure below shows two identical hollow spherical shells. Both of radius R and mass M. What is the moment of inertia, I, of the whole system around axis B?



9. A baseball of mass 0.15kg and radius 0.037m is rolling without slipping on level ground at 1.3m/s when it encounters a 4m long ramp at a 25° angle with the horizontal.
a) How far up the ramp does the ball roll?
b) How fast should you roll the ball to make it to the top of the ramp?

10. A thin disk with a mass of 1.2kg and radius of 0.2m is spinning freely at 33rpm with its surface parallel to a table top. You drop a lump of clay that has a mass of 0.47kg at the very edge of the turntable. What is the new spin rate of the disk in rpm?