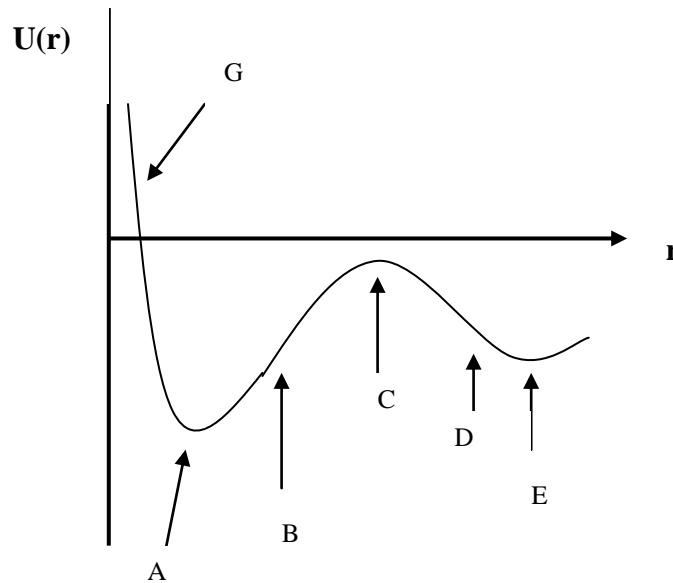
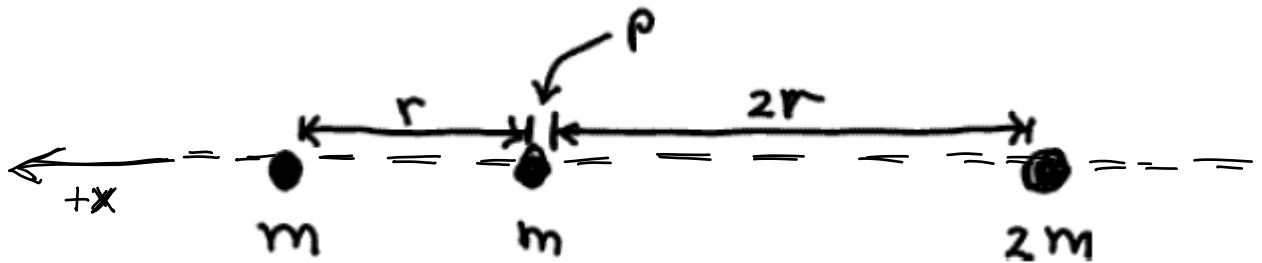


## Physics 113 - Fall 2012 – Problems for workshop 6

1. Consider a mass sandwiched between two collinear springs that are arranged along the  $x$ -axis such that there is no force on the mass when it is centered at  $x=0$ . Assume the mass slides on a frictionless surface and that both springs have a spring constant  $k$ . (a) What is the force on the mass as a function of  $x$  and  $k$  (for reasonable  $x$  that is smaller than the spring length)? (b) Qualitatively graph the potential energy function of the system as a function of  $x$ .
2. Two atoms in a molecule are separated by a distance  $r$ . The potential energy between these two particular atoms depends on the separation of the atoms and is shown below as a function of the distance between the atoms (on some arbitrary scale). *Note: a realistic potential function would have only one well.*
  - a) At what distance(s) is there no force of one atom on the other?
  - b) Suppose the atoms are separated by the distance shown in point A on the graph, what happens if they are moved apart slightly? What about if they are moved together slightly?
  - c) How does your answer change if they start at position B? Or C?
  - d) What is the meaning of the word "equilibrium"? Think about what you've concluded in parts a-c and determine the positions of "stable" and "unstable" equilibrium.
  - e) Why is a chemical bond similar to a spring?



3. Two objects, each of mass  $M$ , lie on the  $y$ -axis a distance  $R$  away from the  $x$ -axis. One mass is at  $y = +R$  and the other mass is at  $y = -R$  (both at  $x = 0$ ). A mass  $m$  is centered on the  $x$ -axis at a distance  $+x$ . Find an expression that describes the net force on the mass  $m$  (in terms of  $x$ ,  $R$ ,  $M$ ,  $m$ ,  $G$ ). Once you have found this expression, convince yourself that it simplifies to what you would expect if  $x$  is much larger than  $R$ .
4. Three masses lie in a line far away from all other masses, as shown in the sketch below. The middle mass lies at point  $P$ .
  - a) What is the net gravitational force on the mass located at point  $P$  due to the other masses?
  - b) What is the net gravitational field at point  $P$ ? (For simplicity, assume the mass at point  $P$  is not present for this part.)



5. A satellite orbits the Earth in a circular geosynchronous orbit. How far is that object from the center of the Earth? How fast is the object moving as it circles the Earth? (Geosynchronous means the satellite appears to be stationary with respect to a point on the Earth's surface.)