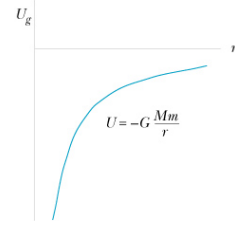




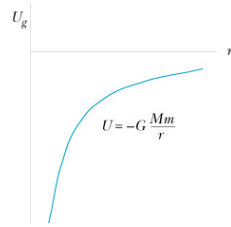
### Chapter 05-3 Energy Diagrams



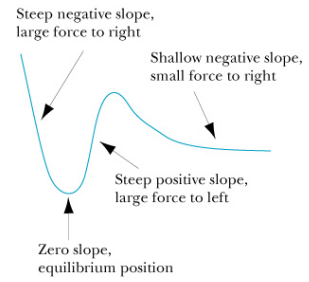
### Potential Energy Graph



### Force and Potential Energy



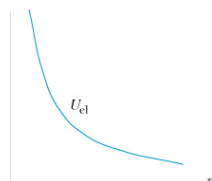
### Example



### Poll

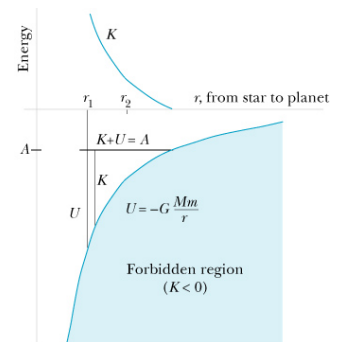
Here is a graph of potential energy for two charged particles as a function of  $r$ . Are the charged particles attracting or repeling each other?

1. Attracting
2. Repeling
3. Neither, because at some distances they attract and other distances they repel.



### Energy Diagram

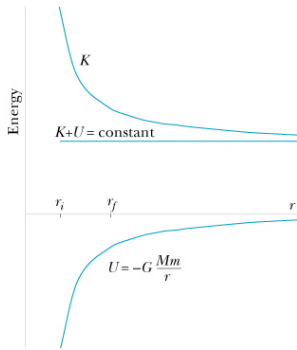
System = star + planet





### Unbound "orbit"

If the total energy is positive, then when the potential energy goes to zero, the kinetic energy is positive. The system is unbound.



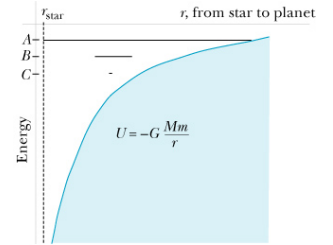
Escape happens when  $E=0$ .



### Poll

A, B, and C are three different possible orbits (depending on the initial conditions) for a star and planet. Which orbit is unbound?

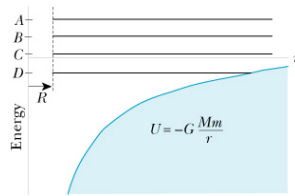
1. A
2. B
3. C
4. Both A and B
5. Both B and C
6. All of the above
7. None of the above



### Poll

Four objects are launched from a planet with energies A, B, C, and D. Which objects will have a closed orbit?

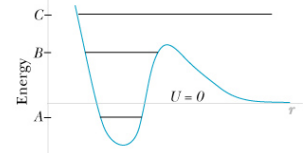
1. A
2. B
3. C
4. D
5. All of the above.
6. None of the above
7. A, B, and C



### Poll

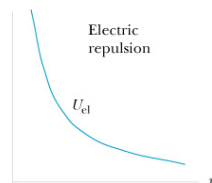
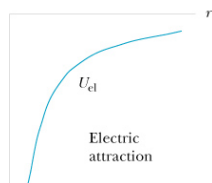
A system has a certain potential energy function. (Note: from the potential energy curve, it's obvious that it's not a gravitational or electrical interaction.) A, B, and C are different total energies depending on the initial conditions. For which total energy is the system bound?

1. A
2. B
3. C
4. All of the above
5. Both A and B
6. Both B and C



### Coulomb Potential Energy

$$U_{elec} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r}$$



### Example

A 2-mm-diameter plastic bead is charged to -1 nC. An alpha particle (He nucleus) is fired at the bead from far away with a speed of  $1 \times 10^6$  m/s, and it collides head-on. What is its speed at impact?



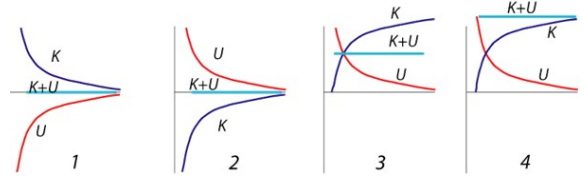
## Example

Suppose an electron is fired at the bead from far away and it "reflects" at a distance of 0.1 mm from the surface. What was the electron's initial speed?



## Poll

Two electrons, initially far apart, head toward each other. They have the same initial speed  $v$ . Which is the correct energy diagram?



5. None of the above