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 repelling each other?

1. Attracting
2. Repelling
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 \( E = 0 \).

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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

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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

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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

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Coulomb Potential Energy

\[
U_{\text{elec}} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r}
\]

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