POTENTIAL DAY 6: ENERGY DYNAMICS & THE EV

WARMUP Day 3 Bridge

A +2.0 μC charge falls through a 120 V drop. **(a)** Energy gained = $q\Delta V$ = ________. **(b)** Where did that energy come from?

CHARGES IN FLIGHT: QΔV = ΔK

Energy conservation with the map: a charge released through a potential difference converts **$q\Delta V$** into kinetic energy — no force diagrams, no kinematics, any field shape.

$$\frac{1}{2}mv^2 = q\Delta V$$

For particles, the friendly currency is the **electron volt**: 1 eV = the energy of one elementary charge through one volt = 1.6×10^{-19} J. An electron across a 500 V gap gains 500 eV, by definition — no arithmetic.

WE DO Exercise 1: The Two Currencies

A proton accelerates from rest through 200 V. **(a)** KE in eV: ________ (no computation!). **(b)** KE in joules: ________. **(c)** Speed: $v = \sqrt{2K/m}$, $m_p = 1.67\times10^{-27}$ kg — order of magnitude?

TRAJECTORIES AND TURNING POINTS

WE DO **Exercise 2: Uphill Roll**

A +4.0 μC bead (m = 0.002 kg) is fired at 30 m/s toward a fixed +6.0 μC charge from very far away. **(a)** Its initial KE. **(b)** The bead stops where $qV(r) = KE_0$: solve $kq\_src \cdot q/r = KE_0$ for the closest-approach distance r.

YOU DO **Exercise 3: Back Down the Hill**

The same bead rolls back out from its turning point. What speed does it have when it returns to "very far away" — and which conservation law makes this a no-computation question?

CALC **Exercise 4: The Map as a Landscape**

For a positive charge, qV(x) is literally a potential-energy landscape U(x). Sketch U(r) = kQq/r for the bead above, mark its total energy line $E = KE_0$, and mark the turning point where the line meets the curve. (Unit 3, Day 7 — same picture, new well.)

PAPER PRACTICE

PRACTICE PROBLEMS

P1 eV Fluency

An electron accelerates through 750 V. KE in eV? In joules?

P2 Speed From Volts

A +2.0 μC bead (m = 0.001 kg) falls from rest through 90 V. Find its final speed.

P3 Closest Approach

A +1.0 μC bead with 0.054 J of KE flies straight at a fixed +6.0 μC charge from far away. Find its closest-approach distance.

P4 Two-Plate Racetrack

An electron starts at rest at the negative plate of a 400 V gap. Find its exit KE (eV and J) and exit speed ($m_e = 9.11\times10^{-31}$ kg). Then: a proton in the reversed gap gains the same KE — but exits far slower. Why?