POTENTIAL DAY 7: UNIT REVIEW

BIG IDEAS TO REMEMBER

- **$U = kq_1q_2/r$** — signed, one power of r, summed over pairs.
- **$V = kq/r$** — the scalar map; superposition is signed addition. $U = qV$, $W = q\Delta V$.
- **$\Delta V = -\int E\cdot dl$** (uniform: Ed) and **$E = -dV/dx$** — the landscape pair.
- **Equipotentials ⊥ E**, crowded = strong; a conductor is ONE equipotential (hence $q \propto R$ on wired spheres).
- **$V = \int k\, dq/r$** — scalar integrals beat field integrals; ring $kQ/\sqrt{z^2+R^2}$; differentiate V to recover E.
- **$\frac{1}{2}mv^2 = q\Delta V$**; the eV is charge-through-volts by definition.

A V or E? (The Unit's Central Distinction)

At each location, state V and E as zero/nonzero, with one reason: **(a)** midpoint of a ± dipole; **(b)** midpoint between two equal + charges; **(c)** center of a charged ring; **(d)** inside a charged conducting sphere.

MIXED PRACTICE

B Assembly Chain

Three +2.0 μC charges at the corners of an equilateral 1.0 m triangle: total U (three pairs), then the work to bring a fourth +1.0 μC charge to the CENTER (distance 0.577 m from each).

C Landscape Chain

$V(x) = 300 - 75x^2$ volts. Find E(x), then the force on a +2.0 μC charge at x = 1.0 m, then find the equilibrium location and state whether it is stable or unstable for a positive charge (would it settle there?).

D Turning-Point Chain

A +2.0 μC bead (m = 0.004 kg) moving at 15 m/s heads straight for a fixed +8.0 μC charge from far away. Find the closest approach.

AP-STYLE PRACTICE

E Short FRQ: Ring, Both Ways

A ring of radius R carries charge +Q.

a. **Derive** $V(z)$ on the axis by the scalar integral (state why r is constant).

b. **Differentiate** to find $E_z(z)$, and verify $E_z(0) = 0$.

c. **Explain** in one sentence why $V(0) \neq 0$ even though $E(0) = 0$.

F Reflection

Which of these can you least reliably do on your own — pair energies, the V/E distinction, $E = -dV/dx$, or scalar integrals? Name it, and write your plan to fix it before the test:

Test Reminder: V is signed; $E = -dV/dx$ needs a minus; equipotential motion is free; and check every continuous-V result at $z \to \infty$ (must die like kQ/z).