POTENTIAL DAY 3: POTENTIAL FROM FIELDS

WARMUP **The Landscape Returns**

Unit 3, Day 7: F = –dU/dx — force is minus the slope of the energy landscape. Divide both sides by charge q. What relationship appears, and between which two of THIS unit's quantities?

V AND E: TWO VIEWS, ONE PHYSICS

$$\Delta V = -\int E \cdot dl \quad \text{and, run backward,} \quad E = -dV/dx$$

The field accumulates into potential differences (each E·dx strip carries (V/m)(m) = V); the potential's slope hands back the field. For a UNIFORM field both collapse to:

$$\Delta V = Ed$$ (moving distance d along the field; V DROPS along E)

Field lines point from high V to low V — downhill on the voltage landscape.

WE DO **Exercise 1: Between the Plates**

Two parallel plates 0.30 m apart hold a uniform field of 400 V/m. **(a)** ΔV across the gap = _____. **(b)** Which plate sits at higher V — the one the field points FROM or TO? **(c)** If the gap doubles at the same field, ΔV → _____.

READING SLOPES, BOTH DIRECTIONS

WE DO Exercise 2: E From a V-Graph

A potential falls linearly from 120 V at x = 0 to 0 V at x = 0.60 m. **(a)** Slope dV/dx = _____. **(b)** E = –dV/dx = _____ (magnitude and direction). **(c)** Where would E be zero on a V-graph — what feature?

YOU DO Exercise 3: Nonuniform V

Along an axis, $V(x) = 200 - 50x^2$ volts (x in meters). **(a)** Find E(x) = –dV/dx. **(b)** Evaluate E at x = 1.0 m. **(c)** At x = 0 the potential PEAKS — what is E there, and what mechanics landscape fact is this?

CALC Exercise 4: Accumulate a Nonuniform Field

E(x) = 300x V/m points +x. Find the potential DROP from x = 0 to x = 2.0 m: $\Delta V = \int_0^2 300x\,dx$ = _____. (The strips grow — the second meter costs more volts than the first.)

PAPER PRACTICE

PRACTICE PROBLEMS

P1 Plate Gap

A 600 V/m uniform field spans a 0.20 m gap. Find ΔV.

P2 Field From the Drop

A capacitor's plates sit 0.050 m apart at a 150 V difference. Find the (uniform) field between them.

P3 Slope Reading

$V(x) = 80 - 20x$ volts. Find E, including direction — and explain why it is the same at every x.

P4 Integrate the Field

$E(x) = 60x^2$ V/m points +x. Find the potential drop from x = 0 to x = 2.0 m by integration — units of one strip first.