ENERGY – REVIEW (DAY 12)

BIG IDEAS TO REMEMBER

- **Work** is energy transferred by a force through a displacement.
- **Energy** lets you skip force-by-force tracking and jump straight to before/after.
- **Power** = how fast energy is transferred. Units: watts (J/s).
- **Graphs:** slope of E–t = power; area under F–x = work.
- **The work integral:** $W = \int F(x)\,dx$ handles ANY force — the spring's $\frac{1}{2}kx^2$ is its triangle special case.
- **Force from energy:** $F = -\dfrac{dU}{dx}$ — force points downhill on the U(x) landscape; equilibria sit where the slope is zero.

A Method Choice

For each situation, decide whether you would use **Forces + Kinematics** or **Energy**. Explain briefly.

a. A block slides down a frictionless curved ramp. Find speed at bottom.

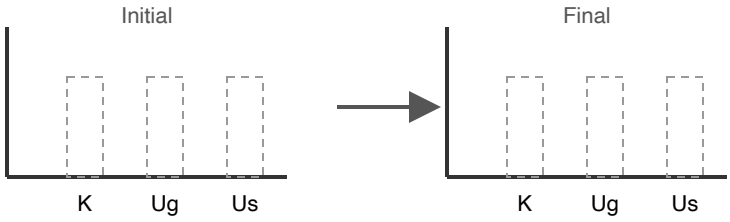
b. A car slows to a stop due to braking friction. Find distance.

c. A spring launches a cart across a table. Find the time it takes.

B Energy Bar Chart → Equation

A block starts from rest and slides down a frictionless incline.

System: Earth–Block (frictionless) → **no external work** (so $W_{ext} = 0$).



2. Write the conservation equation and solve for final speed.

MIXED PRACTICE

C Ramp with Friction

A 2.0 kg block slides down a rough incline. The vertical drop is 1.5 m and the friction force does 6.0 J of negative work. (g = 9.8 m/s².)

a. Change in gravitational PE:

b. Kinetic energy at bottom:

c. Final speed:

D Spring Compression

A 0.50 kg cart moving at 4.0 m/s compresses a spring with constant 800 N/m.

a. Initial kinetic energy:

b. Spring PE at max compression:

c. How far is the spring compressed (x)?

POWER & GRAPHS

E Power Comparison

Motor A lifts a 20 kg box 4.0 m in 2.0 s. Motor B lifts the same box the same height in 4.0 s. (g = 9.8 m/s².)

1. Which motor does more work?

[ ] A > B [ ] B > A [ ] Equal

Reason:

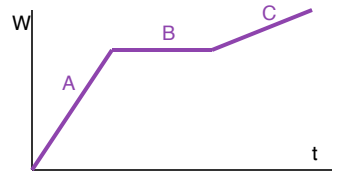
2. Which motor has more power?

[ ] A > B [ ] B > A [ ] Equal

Reason:

F Graph Interpretation

The graph shows **Work vs Time** for a machine.



a. What does the slope represent?

b. Order intervals by power (high to low):

c. What is happening in section B?

G Calculus Connections

1. A force $F(x) = 12x^2$ N (x in meters) pushes a cart along a track from $x = 0$ to $x = 2.0$ m. Find the work done by this force.

2. A particle's potential energy is $U(x) = 2.0x^2 - 4.0x$ (joules, x in meters). Find the equilibrium position and state whether it is stable or unstable.

Exam Tip: Always label your system before using conservation of energy. If friction is present, use $E_i + W_{ext} = E_f$.

AP-STYLE PRACTICE

H Short FRQ: Symbolic Reasoning

A sled of mass m slides down a rough hill from height h and reaches the bottom with speed v.

a. **Define your system:** (e.g., Sled? Sled+Earth? Sled+Earth+Hill?)

b. **Write the energy equation** corresponding to your system. Include work by friction if needed.

c. **Argumentation:** If the hill were the same height but *longer* (less steep), would the final speed v be greater, smaller, or the same? Justify using your equation.

I Reflection

Which idea from this unit (work, energy, power, graphs) is still least clear to you? What is your plan to fix it before the test?

Test Reminder: Draw diagrams, define your system, and explain your reasoning. Don't just plug into formulas.