LESSON MAKER PRO

Energy Balance Lab

Model energy changes with a system equation.

HIGH SCHOOL · HS-PS3-1

HS-PS3-1 "Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known..."

NAME _____ DATE _____

TRACK THE TOTAL

Add the energy changes of all components in the system. Their sum equals energy entering minus energy leaving: ΔE1 + ΔE2 (+ ΔE3) = Ein - Eout. Use a positive sign for an increase and a negative sign for a decrease.

WORKED EXAMPLE

Two components are in a system. Component 1 changes by -4 J. Energy entering is 17 J, and energy leaving is 9 J. Find ΔE2.

1. 17 J - 9 J = 8 J
2. -4 J + ΔE2 = 8 J
3. ΔE2 = 12 J

Answer: ΔE2 = +12 J

PRACTICE 5 problems

1 A two-component system has 14 J entering and 6 J leaving. Component A changes by +3 J. Find ΔEB.

ANSWER _____

2 A two-component system has 16 J entering and 3 J leaving. Component B changes by -2 J. Find ΔEA.

ANSWER _____

3 No energy crosses the boundary of a two-component system. Component A changes by -21 J. Find ΔEB.

ANSWER _____

4 A three-component system has 24 J entering and 7 J leaving. ΔEA = +5 J and ΔEB = -1 J. Find ΔEC.

ANSWER _____

5 A two-component system has 25 J leaving and no energy entering. Component A changes by -10 J. Find ΔEB.

ANSWER _____

APPLY IT Show your work

1 At robotics club, a small robot is lifted. Its kinetic energy and gravitational energy are components of the system. The motor transfers 36 J into the system, and 11 J leaves as heat. The robot's kinetic energy increases by 7 J. Find the change in gravitational energy.

WORK SPACE

ANSWER _____

2 During a basketball shot, treat the ball's kinetic and gravitational energies as the system components. Air resistance transfers 6 J out of the system. The ball's gravitational energy changes by -28 J. Find the change in kinetic energy.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A drone system has kinetic, gravitational, and thermal energy. Energy entering is 40 J, and energy leaving is 13 J. Its kinetic energy changes by +16 J and its gravitational energy changes by -5 J. Find the thermal-energy change. Write the equation and one sentence explaining what its sign means.

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ANSWER KEY

Energy Balance Lab

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A two-component system has 14 J entering and 6 J leaving. Component A changes by +3 J. Find ΔEB.	**ΔEB = +5 J**
2	A two-component system has 16 J entering and 3 J leaving. Component B changes by -2 J. Find ΔEA.	**ΔEA = +15 J**
3	No energy crosses the boundary of a two-component system. Component A changes by -21 J. Find ΔEB.	**ΔEB = +21 J**
4	A three-component system has 24 J entering and 7 J leaving. ΔEA = +5 J and ΔEB = -1 J. Find ΔEC.	**ΔEC = +13 J**
5	A two-component system has 25 J leaving and no energy entering. Component A changes by -10 J. Find ΔEB.	**ΔEB = -15 J**

PART 2 · APPLY IT

1. **ΔEgravitational = +18 J** The system change is 36 J - 11 J = 25 J. Subtract the +7 J kinetic-energy change, so gravitational energy changes by +18 J.
2. **ΔEkinetic = +22 J** The total system change is -6 J. Since -28 J + ΔEkinetic = -6 J, the kinetic-energy change is +22 J.

CHALLENGE

ΔEk + ΔEg + ΔEth = 40 J - 13 J; 16 J + (-5 J) + ΔEth = 27 J; ΔEth = +16 J. The positive sign means the drone's thermal energy increased by 16 J.

Accept equivalent equations and correct use of positive or negative signs. Accept answers that name the component energy and include the correct value in joules.