q lost = q gained

Cooling object

- 7.2 mol of H_2 gas is cooled from 319 K to 299K, how much heat was lost?
- q = nCΔT

Cooling object

- 7.2 mol of H_2 gas is cooled from 319 K to 299K, how much heat was lost? q = nCΔT
- q = 7.2mol (28.8J/molK)(299-319K)
- q = -4147.2 J
- q = -4100 J
- 4.1 kJ was lost
- negative means the energy was lost instead of gained.

Energy is never destroyed!!!

- 1st law of thermodynamics
- In a closed system, if you put 2 objects of different temperatures together...
- the heat will go from the hotter object to the cooler object.
- the q lost by one object will be the q gained by the other object.
- $q_{lost} = q_{gained}$

continuing with the H_2 from the earlier problem

- The hydrogen was put in 9.179 moles of a substance at 274.4 K and it heated to 280.4 K, what was the substance?
- q_{lost}= 4147.2 J
- 4147.2 = 9.179 mol C (6.0K)
- C = 75 J/K mol
- water (liquid)

Another problem

- .778 mol of tungsten at 68° C is dropped in water at 25° C, the system comes to equilibrium (both temperatures are equal) at 35° C. How much water was present?

Another problem

- .778 mol of tungsten at 68° C is dropped in water at 25° C, the system comes to equilibrium (both temperatures are equal) at 35° C. How much water was present?
- q_{lost} = .778 mol(24.2)(-33) = -621...
- = 621.3108 = n (75.3)(10)
- n = .83 mol H_2O

A problem

- You add 14.2 g of a metal at 98.0° C to 126 g of water at 17.2° C. The system comes to equilibrium at 19.1° C. What is the metal?

• q_{lost}		❑q_{gained}	
• m		❑m	
• c		❑c	
• ΔT		❑ΔT	
• T_f		❑T_f	
• T_i		❑T_i	

A problem

- You add 14.2 g of a metal at 98.0° C to 126 g of water at 17.2° C. The system comes to equilibrium at 19.1° C. What is the metal?

• q_{lost}		❑q_{gained}	
• m	14.2 g	❑m	126 g
• c	?	❑c	4.183
• ΔT	-78.9 K	❑ΔT	1.9 K
• T_f	19.1° C	❑T_f	19.1° C
• T_i	98.0° C	❑T_i	17.2° C

Work

- q = m c Δ T
- Water side
- q = 126 g (4.183) 1.9K =
- 1001.4102 J = -1001.4102 J lost
- -1001…= 14.2 g (c) -78.9 K
- c = .89 J/g K
- Most likely aluminum.
- How close your answer is to the actual answer depends on how good your lab technique is.

A different problem

- You add 63 g of a metal at 101.0° C to 132 g of water at 19.0° C. The system comes to equilibrium at 20.2° C. What is the metal?
- q_{lost}
- m
- c
- Δ T
- T_f
- T_i

- ❑q_{gained}
- ❑m
- ❑c
- ❑Δ T
- ❑T_f
- ❑T_i

A different problem

- You add 63 g of a metal at 101.0° C to 132 g of water at 19.0° C. The system comes to equilibrium at 20.2° C. What is the metal?
- q_{lost}
- m 63 g
- c ?
- Δ T -80.8
- T_f 20.2 ° C
- T_i 101.0 ° C

- ❑q_{gained}
- ❑m 132 g
- ❑c 4.183
- ❑Δ T 1.2
- ❑T_f 20.2° C
- ❑T_i 19.0° C

Work

- q = m c Δ T
- Water side
- q = 132 g (4.183) 1.2K =
- 662.5872 J = -662.5872 J lost
- -662…= 63 g (c) -80.8 K
- c = .13 J/g K
- Either lead or gold.
- Check for color to determine which

Another

- 5.25 mol of He at 34° C is mixed with 24.3 mol of H_2 and the system comes to equilibrium at 14° C, what was the initial temperature of the hydrogen?

Another

- 5.25 mol of He at 34° C is mixed with 24.3 mol of H_2 and the system comes to equilibrium at 14° C, what was the initial temperature of the hydrogen?
- $q_{lost\ He}$ = 5.25 mol(25.2)(287-307)
- $q_{lost\ He}$ = -2646 J
- 2646 J = 24.3 mol(28.8) (287- $T_{i\ H2}$)
- $T_{i\ H2}$ = 283 K (10.° C)

More

- 23 g of nickel at 99.8° C is dropped in 121 g of water at 20.3° C. What is the final temperature?

More

- 23 g of nickel at 99.8° C is dropped in 121 g of water at 20.3° C. What is the final temperature?

-23g(.444)(99.9-T_f)
=121g(4.183)(20.3-T_f)

- T_f = 21.8° C

Problems

- 2.28 mol of aluminum at 66.0° C is dropped in water at 28.0° C, the system comes to equilibrium (both temperatures are equal) at 34.0° C, how much water was present?

Problems

- 2.28 mol of aluminum at 66.0° C is dropped in water at 28.0° C, the system comes to equilibrium (both temperatures are equal) at 34.0° C, how much water was present?
- q_{lost} = 2.28 mol(24.2)(-32)
- = -1765.632 = -(n (75.3)(6.0))
- n = 3.9 mol H_2O

Last One

- How many grams of silver at 50° C would be required to heat 21 mol of water from 12° C to 32° C (bring the system at equilibrium at 32° C)?

Last One

- How many grams of silver at 50° C would be required to heat 21 mol of water from 12° C to 32° C (bring the system at equilibrium at 32° C)?
- q = 21 mol(75.3)(20K) = 31626 J
- q = - 31626 J = m (.233) (-18)
- m = 7500 g or 7.5 kg