

Reaction Coordinate →



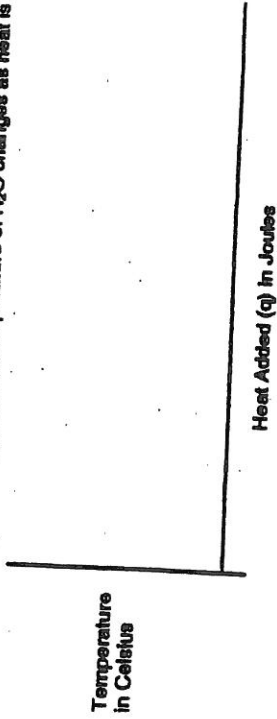
Answer the questions using the graph above.

1. Is the above reaction endothermic or exothermic? _____
2. What letter represents the potential energy of the reactants? _____
3. What letter represents the potential energy of the products? _____
4. What letter represents the heat of reaction (ΔH)? _____
5. What letter represents the activation energy of the forward reaction? _____
6. What letter represents the activation energy of the reverse reaction? _____
7. What letter represents the potential energy of the activated complex? _____
8. Is the reverse reaction endothermic or exothermic? _____
9. If a catalyst were added, what letter(s) would change? _____



Specific Heat and Latent Heats of Water

Draw a graph showing how the temperature of H₂O changes as heat is added.



Graph

1. Label the graph with the appropriate equations for finding heat (q):
 $q = mH$ $q = mH_v$ $q = mC_p\Delta T$ $q = mC_p\Delta T$ $q = mC_p\Delta T$
2. Label the graph indicating the state(s) that water would be observed: solid, liquid, gas, solid/liquid mix, liquid/gas mix
3. Label the Melting Point and Boiling Point of water (in °C) on the y-axis.
4. What happens to temperature during a phase change? _____

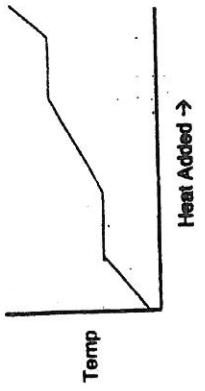
Level One Examples:

1. How much heat is added if 100 grams of liquid water increases in temperature from 30°C to 70°C? ($q = 16,720 \text{ J}$)
2. How much heat is absorbed if 200 g of ice increases in temperature from -15°C to -5°C? ($q = 4100 \text{ J}$)
3. How much heat is released if 80 grams of water vapor is decreases in temperature from 150°C to 125°C? ($-4,040 \text{ J}$)
4. How much heat is absorbed when 30 g of ice is changed into liquid water at 0°C? (16,000 J)
5. How much heat is released when 50 grams of water vapor is changed into liquid water at 100°C? ($-113,000 \text{ J}$)



Level One Practice
Use the graph to help you visualize the change that is being described.

Use the graph to help you visualize the change that is being described.



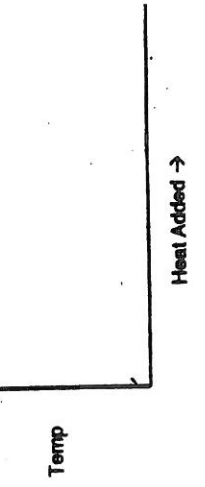
- How much heat is needed to raise the temperature of 36 grams of ice from -18°C to 0°C ? (1,328.4 J)
- How much heat is needed to change 36 grams of ice into water at 0°C ? (12,034 J)
- How much heat is needed to raise the temperature of 36 grams of water from 0°C to 100°C ? (15,048 J)
- How much heat is needed to change 36 grams of water to vapor? (81,360 J)
- How much heat is needed to raise the temperature of 36 grams of vapor from 100°C to 130°C ? (2181.6 J)
- How much heat is needed to increase the temperature of 4 grams of ^{ice} ~~water~~ from -25°C to -15°C ? (82 J)
- How much heat is released when 30 g of water changes from 40°C to 25°C ? (-1,981 J)
- How much heat is released when 30 grams of liquid water changes into ice? (-10,020 J)

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Worksheet You made it to Level 2!

Level Two
Use the graph to help you visualize the change that is being described.

Use the graph to help you visualize the change that is being described.



- Examples:**
- How much heat is absorbed if 30 grams of water at -10°C is converted into liquid water? (10,435 J)
 - How much heat is absorbed if 45 grams of water at 80°C is converted into steam at 105°C ? (105,916.5 J)
 - How much heat is released if 500 grams of vapor at 120°C changes to liquid water at 70°C ? (-1,212,900 J)

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1. How much heat is added when 50 g of ice at -10°C is changed to liquid water? (17,725 J)

2. How much heat is added when 0.5 kg liquid water at 20°C is changed into vapor at 100°C ? (1,297,200 J)

3. How much heat is absorbed when 20 g of water at 82°C is raised to 110°C ? (4,7108.8 J)

4. How much heat is released when 45 g of water at 30°C is placed in a freezer at -10°C ? (-21,545.5 J)

5. How much heat is released when 15 grams of liquid water at 30°C freezes into ice? (-6891 J)

6. How much heat is released when 60 grams of liquid water at 100°C is placed in a -20°C freezer? (-39,1650 J)

7. How much heat is absorbed if 10 grams of ice at -3°C is converted into vapor at 108°C ? (30,343.1 J)

Ans. (-88950.4 J)

Calorimetry Practice

1) The burning of methane in oxygen to yield carbon dioxide gas and liquid water causes the surrounding 1.52-kg of water in a calorimeter to change in temperature from 20° to 34°C . How much heat is released by this reaction?

2) The temperature of a sample of water increases from 20.0° to 46.6°C as it absorbs 5650 J of heat. What is the mass of the sample? (50.8 g)

3) A 4.5-g nugget of pure gold absorbed 276 J of heat. What was the final temperature of the gold if the initial temperature was 25.0°C ? (500.5 $^{\circ}\text{C}$)
Hint: Look up specific heat for gold on Reference Tables.

4) If 335 g of water at 65.5°C loses 9750 J of heat, what is the final temperature of the water? (58.5 $^{\circ}\text{C}$)

5) Calculate the amount of heat required to raise the temperature of 22.8 g of copper from 20°C to 875°C . (1505.2 J)

6) What is the temperature change (ΔT) when a 25-g block of aluminum absorbs 10 kJ of heat? (446.9 $^{\circ}$)

7) A 10-gram sample of zinc loses 560 J of heat and has a final temperature of 100°C . What was its initial temperature? (244.3 $^{\circ}\text{C}$)

8) An unknown substance with a mass of 48 grams absorbs 1066 J and its temperature changes by 50°C . What is this substance? (Aluminum)

Congratulations!! You made it!!



(6)

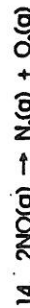
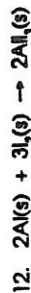
ENTR

Name _____

Entropy is a measure of randomness in a substance. The symbol for change in entropy is ΔS .

Solids are very ordered and have low entropy. Liquids and aqueous ions have more entropy because they move about more freely, and gases have an even larger amount of entropy. According to the Second Law of Thermodynamics, nature is always proceeding to a state of higher entropy.

Determine whether the following reactions show an increase or decrease in entropy.



CHATELIER'S PRINCIPLE

Name _____

Le Chatelier's Principle states that when a system at equilibrium is subjected to a stress, the system will shift its equilibrium point in order to relieve the stress.

Complete the following chart by writing left, right or none for equilibrium shift, and decreases, increases or remains the same for the concentrations of reactants and products, and for the value of K.



Stress	Equilibrium Shift	$[N_2]$	$[H_2]$	$[NH_3]$	K
1. Add N_2	right	—	decreases	increases	remains the same
2. Add H_2					
3. Add NH_3					
Remove N_2					
5. Remove H_2					
6. Remove NH_3					
7. Increase Temperature					
8. Decrease Temperature					
9. Increase Pressure					
10. Decrease Pressure					