Entropy Measure of disorder, randomness

Example: Determine if the ΔS is $\uparrow(+)$ or $\downarrow(-)$

1. air escaping from a tire
2. snow melting
3. salt dissolving in H_2O
4. liquid cooling
5. $2\ KClO_{3\,(s)} \rightarrow 2KCl\ (s) + 3O_2\ (g)$
6. $H_2O\ (l) \rightarrow H_2O\ (s)$
7. $2Al\ (s) + 3I_2\ (s) \rightarrow 2AlI_3\ (s)$
8. $N_2\ (g) + 3H_2\ (g) \rightarrow 2NH_3\ (g)$
9. $KCl\ (s) \rightarrow KCl(l)$
10. $CO_2\ (s) \rightarrow CO_2\ (g)$
11. $Ag^+\ (aq) + Cl^-\ (aq) \rightarrow AgCl(s)$
12. $2N_2O_5\ (g) \rightarrow 4NO_2\ (g) + O_2\ (g)$

SOL Questions:

The table shows the specific heat capacity of four substances.

1.

Substance	Heat Capacity $\frac{J}{g \cdot °C}$
Aluminum	0.900
Glass	0.50
Carbon dioxide	0.843
Water	4.18

For an equal mass of each, which one will require the least amount of heat to raise its temperature from 20°C to 30°C ?

$Q = m C \Delta T$ (m: constant; ΔT: constant)

A. Aluminum

B. Glass smallest C

C. Carbon Dioxide

D. Water

2. **Solid magnesium has a specific heat of 1.01 J/g°C. How much heat is given off by a 20.0 gram sample of magnesium when it cools from 70.0°C to 50.0°C?**

$Q = mC\Delta T$

$20.0g \times \frac{1.01J}{g°C} \times (50.0°C - 70.0°C)$

F 202 J

G 404 J

H 808 J

J 1010 J

3 **When 92.0 g of ethanol (C_2H_5OH) are vaporized at its boiling point of 78.3°C, it requires 78.6 k of energy. What is the approximate molar heat of vaporization of ethanol in kJ/mol?**

$\Delta H_{vap} = ? \frac{kJ}{mole} = \frac{78.6kJ}{2.00mole} = 39.3\frac{k}{mol}$

A 0.854

B 1.17

C 39.3

D 78.3

$92.0g \left| \frac{1mole}{46.08g} \right. = 2.00mole$

4 **If 89.6 joules of heat are needed to heat 20.0 grams of iron from 30.0°C to 40.0°C, what is the specific heat of the iron in $\frac{J}{g \cdot °C}$?**

A 0.448

B 2.23

C 8.96

D 896

$Q = mC\Delta T$

$C = \frac{Q}{m\Delta T} = \frac{89.6\ J}{20.0g \times (40.0°C - 30.0°C)}$

Homework:

1. Given the equation $3CO\ (g) + Fe_2O_3\ (s) \rightarrow 2Fe\ (s) + 3CO_2\ (g) + 24.7\ kJ$, how much heat is released when 7.00 mole of CO react?

$$\frac{7.00\ mole\ CO}{3\ mole\ CO} \left| \frac{24.7\ kJ}{} \right. = \boxed{173\ kJ}$$

2. How many grams of water can be melted if 55.0kJ of heat is added? ($\Delta H_{fusion\ H2O}$=334 kJ/Kg)

$$55.0\ kJ \left| \frac{1\ kg}{334\ kJ} \right| \frac{1000\ g}{1\ kg} = \boxed{165\ g}$$

3. How much heat is required to raise the temperature of 50.90 g of **mercury** from 13.0°C to 85.0°C? (use value on front) $Q = mC\Delta T$ $C = \frac{0.140\ J}{g\ K}$ ∴ convert to kelvin

286K 358K

$$Q = m\ C\ \Delta T$$

$$50.90\ g \times \frac{0.140\ J}{g\ K} \times (358\ K - 286\ K) = \boxed{513\ J}$$

4. A 155g sample of an unknown substance was heated from 25.0°C to 40.0°C. In the process, the substance absorbed 5694J of energy. What is the specific heat of the substance? Identify the substance (use the table on the front) $Q = mC\Delta T$

$$C = \frac{Q}{m\Delta T} = \frac{5694\ J}{155\ g \times (15\ K)} = \boxed{\frac{2.45\ J}{g\ K}}$$ closest is Ethanol

5. A 16.5g sample of an unknown metal is at 88.0°C is added to a calorimeter of 25.2g of water at 14.6°C. The final temperature of the system is 20.5°C. What is the specific heat of the metal? 2 part problem

$-Q_{H_2O} = +Q_{sample}$ $\quad -25.2g \times \frac{4.184\ J}{g\ °C} \times (20.5°C - 14.6°C)$

$Q_{sample} = Q_{H_2O} = -m_{H_2O}\ C_{H_2O}\ \Delta T_{H_2O}$ $\quad Q_{samp} = Q_{H_2O} = \boxed{-622\ J}$

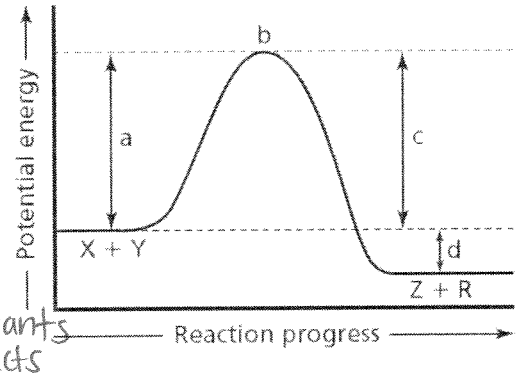
$$C = \frac{Q}{m\Delta T}$$

$$\frac{-622\ J}{16.5g \times (20.5 - 88.0°C)} = \boxed{\frac{0.558\ J}{g\ °C}}$$

6. Determine if there is an increase or decrease in entropy:

a. Melting of ice cubes ↑ ΔS
b. Dissolving sugar in a cup of hot coffee ↑ ΔS
c. A solid sublimes ↑ ΔS
d. Volume of a gas increases ↑ ΔS
e. Condensation of water ↓ ΔS
f. $H_2\ (g) + Br_2\ (l) \rightarrow 2HBr\ (g)$ ↓ ΔS
g. $CuSO_4\ (s) \rightarrow CuSO_4\ (s) + 5H_2O(g)$ ↑ ΔS
h. $2XeO_3\ (s) \rightarrow 2Xe\ (g) + 3O_2\ (g)$ ↑ ΔS

Use the diagram to the right:



7. Is this reaction endothermic or exothermic?
8. What do all the letters represent? (omit c)

a. activation energy
b. activated complex
d. enthalpy (Heat of Rxn) ΔH

X+Y = Reactants
Z+R = products