SL worksheet

Match the following definitions with the following terms:

1. System	Has a negative delta H value
2. Surrounds	Chemical bonds and intermolecular forces
3. Internal energy	Is the total internal heat of a system
4. Kinetic	Has a positive delta H value
5. Potential	The small part of the universe undergoing the chemical or physical charge were looking at
6. Endothermic	Energy transferred by changes in temperature
7. Heat	Total kinetic and potential energy of a system
8. Work	Heat flow is always from hotter to colder material with equilibrium when temperatures are equal
9. Spontaneous	A property that depends only on the amount of material and conditions (the state of the system)
10. ~~Enthalpy~~ Endothermic	Everything else
11. State function	Particle motion/vibration
12. Path function	Energy transferred by anything else (usually pushing things)
13. Exothermic	Path function a property that depends on the process by which a state was achieved (q and w)

1) If a system absorbs heat from the surroundings q out of the system is (+)
2) If a system releases heat to surroundings q out of the system is (-)
3) Spontaneous heat flow is always from hotter to colder material until ⇌ when temperatures are equal
   ↓equilibrium
4) If a system is at ⇌, so no further heat is flowing, the two things must have the same Temperature
5) Do state functions depend on anything other then the initial and final states?
6) At a constant pressure $\Delta H = q$
7) For an endothermic reaction the q of the system is (+) and the q of the surroundings is (-)
8) Melting ice absorbs heat, q is (+), and endothermic
9) Temperature measures the average KE of molecules
10) When the temperature decreases q is (-)
11) When the temperature ↑ q is positive
12) q depends on the heat capacity of the material

13) 20 kJ of heat is transferred to each of 2 kg gold (worth $2000) and 2 kg of aluminum (worth $2.60) both initially had a temperature of 30*C which metal has a hotter final temperature C(Au) = 0.13 J/g*C, C(Al) = 0.90 J/g*C?

$q = mc\Delta T$, same q, same m $\therefore \Delta T = q/mc$

TREND

$T \propto \frac{1}{C}$ | ↑T ↓C ↓T ↑C | so C(Au) has lower C ∴ higher T

14) The heat capacity of gold is C(Au) = 0.13 J/g*C; 2 kg of gold was placed in a reaction flask initially at 20*C and once the reaction came to completion it had a temperature of 45*C. Calculate q

$C = 0.13\ J/g{\cdot}°C \quad m = 2kg \frac{1000g}{1kg} = 2000g \quad T_i = 20°C \quad T_f = 45°C$

$q = mc\Delta T$

$= 2000g\ (0.13\ J/g{\cdot}°C)(45°C - 25°C)$

$q =$

15) A 15.0 g piece of cadmium metal absorbs 134 J of heat while rising from 24*C to 62*C calculate the specific heat of cadmium.

$m = 15.0g \quad T_i = 24°C \quad C = ?$

$q = 134J \quad T_f = 62°C$

$q = mc\Delta T$

$C = q/m\Delta T = 134J/15.0g(62-24°C) =$

16) Calculate the specific heat capacity of a new alloy if a 15.4 g sample absorbs 393 J when it is heated from 0.0/C to 37.6 /C.

$m = 15.4g \quad q = 393J$

$T_i = 0°C \quad T_f = 37.6°C$

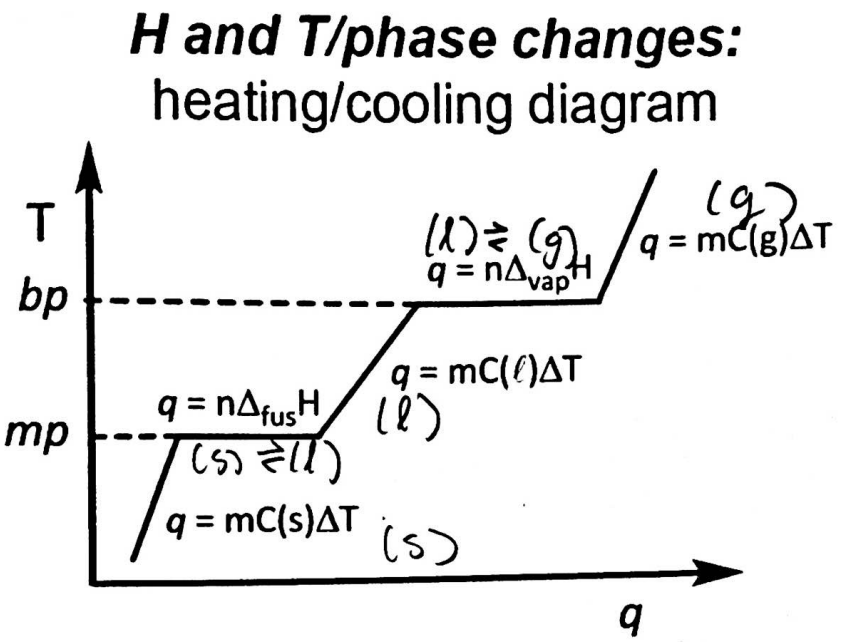
$q = mc\Delta T$

$393\ J = 15.4g\ °C\ (37.6°C - 0°C)$

$C = 393J / 15.9g \cdot (37.6°C)$

$C =$

17) Consider the following heating cooling diagram



a) Show the phases at each stage on the diagram

b) Define enthalpy of fusion

enthalpy needed to melt one mole of a substance at its melting point

c) Define enthalpy of vaporization

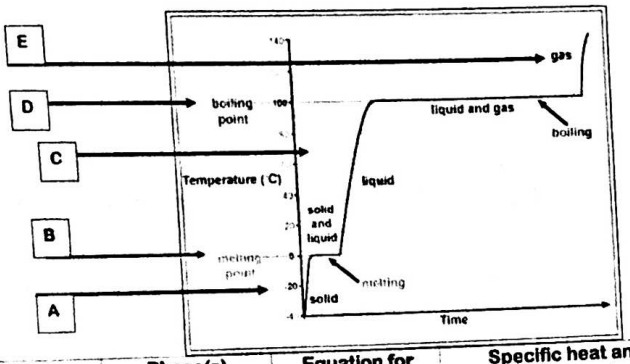
enthalpy needed to vaporize one mole of a substance at its boiling point.

d) In general as intermolecular forces become stronger, enthalpy of vaporization ↑ because it measures the energy required to overcome those forces

↓

overcome

18) Consider the following heating/cooling diagram



start (g)

go to (s)

Point on Graph	Phase(s)	Equation for heat (q)	Specific heat and enthalpy values (water)
A	Solid	$m \times C_p \times \Delta T$	2.11 J/g*C
B	Solid & Liquid	$m \times H_{fus}$	335.5 J/g
C	Liquid	$m \times C_p \times \Delta T$	4.18 J/g*C
D	Liquid & Gas	$m \times H_{vap}$	2260 J/g
E	Gas	$m \times C_p \times \Delta T$	2.00 J/g*C

a. How much heat is released when 111 g of water vapor is cooled from 110*C to water at 100*C

E - 110°C water vapor (g)

D = 100°C → liquid water

need $\Delta H_E = m C_p \Delta T$

$\Delta H_D = m \times H_{vap}$

$\Delta H_E = (111g)(2.00 \frac{J}{g \cdot C})(100°C - 110°C) = -2220J$

$\Delta H_D = (111g)(-2260 \frac{J}{g}) = -250860 J$

$\Delta H_{Total} = \Delta H_E + \Delta H_D = -2260 J + (-250860 J)$

$= -253080 J$ or $\times \frac{1kJ}{1000J}$

$= -253.08 kJ$

19)Calculate the enthalpy for this reaction:

$2C(s) + H_2(g) \longrightarrow C_2H_2(g)$ $\Delta H° = ???$ kJ

Given the following thermochemical equations:

① $C_2H_2(g) + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(\ell)$ $\Delta H° = -1299.5$ kJ

② $C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H° = -393.5$ kJ

③ $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(\ell)$ $\Delta H° = -285.8$ kJ

$2C_{(s)} + H_{2(g)} \rightarrow C_2H_{2(g)}$

① Flip eq ① $(-(\Delta H))$

② multiply eq ② × 2 to get 2C in product
∴ multiply $(2 \times \Delta H)$

③ Dont Δ third eq

w changes

① $\Delta H = 1299.5kJ$

② $\Delta H = -787kJ$

③ $\Delta H = -285.8kJ$

$\Delta H_{Total} = (1299.5kJ) + (-787kJ) + (-285.8kJ)$

20)Calculate the enthalpy of the following chemical reaction:

$CS_2(\ell) + 3O_2(g) \text{ ---> } CO_2(g) + 2SO_2(g)$

Given:

$C(s) + O_2(g) \text{ ---> } CO_2(g)\ \Delta H = -393.5 \text{ kJ/mol}$ → don't Δ
$S(s) + O_2(g) \text{ ---> } SO_2(g)\ \Delta H = -296.8 \text{ kJ/mol}$ → ×2
$C(s) + 2S(s) \text{ ---> } CS_2(\ell)\ \Delta H = +87.9 \text{ kJ/mol}$ → flip

$\Delta H_{Total} = (-393.5 \text{ kJ/mol}) + (-593.6 \text{ kJ/mol}) + (-87.9 \text{ kJ/mol})$

= add them together

21)Given the following data:

$SrO(s) + CO_2(g) \text{ ---> } SrCO_3(s)$ $\Delta H = -234$ kJ → flip it = 234

$2SrO(s) \text{ ---> } 2Sr(s) + O_2(g)$ $\Delta H = +1184$ kJ → ÷2 = 592

$2SrCO_3(s) \text{ ---> } 2Sr(s) + 2C(s, gr) + 3O_2(g)$ $\Delta H = +2440$ kJ → flip it = -1220

? ÷2

Find the ΔH of the following reaction:

$C(s, gr) + O_2(g) \text{ ---> } CO_2(g)$

$\Delta H_{Total} = (234) + (592) + (-1220)$

$= -394 kJ$