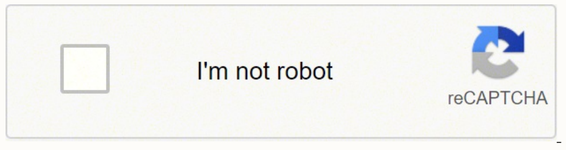

Open

Hess' s law worksheet chemistry 120

Example

$C(s) + H_2O(g) \longrightarrow CO(g) + H_2(g)$	$\Delta H_{rxn} = ?$
$C(s) + O_2(g) \longrightarrow CO_2(g)$	$\Delta H = -393.5$ kJ
$2\,CO(g) + O_2(g) \longrightarrow 2\,CO_2(g)$	$\Delta H = -566.0$ kJ
$2\,H_2(g) + O_2(g) \longrightarrow 2\,H_2O(g)$	$\Delta H = -483.6$ kJ

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

$\frac{1}{2} \times [2\,CO_2(g) \longrightarrow 2\,CO(g) + O_2(g)]$ $\quad \Delta H = \frac{1}{2} \times (+566.0$ kJ$)$

$\frac{1}{2} \times [2\,H_2O(g) \longrightarrow 2\,H_2(g) + O_2(g)]$ $\quad \Delta H = \frac{1}{2} \times (+483.6$ kJ$)$

$C(s) + O_2(g) \longrightarrow CO_2(g)$	$\Delta H = -393.5$ kJ
$CO_2(g) \longrightarrow CO(g) + \frac{1}{2}O_2(g)$	$\Delta H = +283.0$ kJ
$H_2O(g) \longrightarrow H_2(g) + \frac{1}{2}O_2(g)$	$\Delta H = +241.8$ kJ
$C(s) + H_2O(g) \longrightarrow CO(g) + H_2(g)$	$\Delta H_{rxn} = +131.3$ kJ

Chemistry 120
Hess's Law Worksheet

1. Calculate ΔH for the reaction C_2H_4 (g) + H_2 (g) → C_2H_6 (g), from the following data.

C_2H_4 (g) + 3 O_2 (g) → 2 CO_2 (g) + 2 H_2O (l)	ΔH = -1411. kJ/mole
C_2H_6 (g) + 7/2 O_2 (g) → 2 CO_2 (g) + 3 H_2O (l)	ΔH = -1560. kJ/mole
H_2 (g) + 1/2 O_2 (g) → H_2O (l)	ΔH = -285.8 kJ/mole

2. Calculate ΔH for the reaction 4 NH_3 (g) + 5 O_2 (g) → 4 NO (g) + 6 H_2O (g), from the following data.

N_2 (g) + O_2 (g) → 2 NO (g)	ΔH = -180.5 kJ
N_2 (g) + 3 H_2 (g) → 2 NH_3 (g)	ΔH = -91.8 kJ
2 H_2 (g) + O_2 (g) → 2 H_2O (g)	ΔH = -483.6 kJ

3. Find ΔH_f^0 for acetic acid, $HC_2H_3O_2$, using the following thermochemical data.

$HC_2H_3O_2$ (l) + 2 O_2 (g) → 2 CO_2 (g) + 2 H_2O (l)	ΔH = -875. kJ/mole
C (s, graphite) + O_2 (g) → CO_2 (g)	ΔH = -394.51 kJ/mole
H_2 (g) + 1/2 O_2 (g) → H_2O (l)	ΔH = -285.8 kJ/mole

4. Calculate ΔH for the reaction CH_4 (g) + NH_3 (g) → HCN (g) + 3 H_2 (g), from the reactions.

N_2 (g) + 3 H_2 (g) → 2 NH_3 (g)	ΔH = -91.8 kJ
C (s, graphite) + 2 H_2 (g) → CH_4 (g)	ΔH = -74.9 kJ/mole
H_2 (g) + 2 C (s, graphite) + N_2 (g) → 2 HCN (g)	ΔH = +270.3 kJ

5. Calculate ΔH for the reaction 2 Al (s) + 3 Cl_2 (g) → 2 $AlCl_3$ (s) from the following data.

2 Al (s) + 6 HCl (aq) → 2 $AlCl_3$ (aq) + 3 H_2 (g)	ΔH = -1049. kJ
HCl (g) → HCl (aq)	ΔH = -74.8 kJ/mole
H_2 (g) + Cl_2 (g) → 2 HCl (g)	ΔH = -1845. kJ
$AlCl_3$ (s) → $AlCl_3$ (aq)	ΔH = -323. kJ/mole

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12 • The Gas Laws

BOYLE'S LAW

Boyle's Law states that the volume of a gas varies inversely with its pressure if temperature is held constant. (If one goes up, the other goes down.) We use the formula:

$$P_1 \times V_1 = P_2 \times V_2$$

Solve the following problems (assuming constant temperature). Assume all number are 3 significant figures.

1. A sample of oxygen gas occupies a volume of 250 mL at 740 torr pressure. What volume will it occupy at 800 torr pressure? $P_1V_1 = P_2V_2$

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(740\ \text{torr})(250\ \text{mL})}{(800\ \text{torr})} = 231\ \text{mL}$$

2. A sample of carbon dioxide occupies a volume of 3.50 Liters at 125 kPa pressure. What pressure would the gas exert if the volume was decreased to 2.00 liters?

$$P_2 = \frac{P_1V_1}{V_2} = \frac{(125\ \text{kPa})(3.50\ \text{L})}{(2.00\ \text{L})} = 219\ \text{kPa}$$

3. A 2.00-Liter container of nitrogen had a pressure of 3.20 atm. What volume would be necessary to decrease the pressure to 1.00 atm?

$P_1 = 3.20$ atm $V_1 = 2.00$ L $P_2 = 1.00$ atm

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(3.20\ \text{atm})(2.00\ \text{L})}{(1.00\ \text{atm})} = 6.40\ \text{L}$$

4. Ammonia gas occupies a volume of 450 mL as a pressure of 720 mmHg. What volume will it occupy at standard pressure (760 mmHg)?

$P_1 = 720$ mmHg $V_1 = 450$ mL $P_2 = 760$ mmHg

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(720\ \text{mmHg})(450\ \text{mL})}{(760\ \text{mmHg})} = 426\ \text{mL}$$

5. A 175 mL sample of neon had its pressure changed from 75.0 kPa to 150 kPa. What is its new volume?

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(75.0\ \text{kPa})(175\ \text{mL})}{(150\ \text{kPa})} = 87.5\ \text{mL}$$

6. A sample of hydrogen at 1.50 atm had its pressure decreased to 0.50 atm producing a new volume of 750 mL. What was the sample's original volume?

$$V_1 = \frac{P_2V_2}{P_1} = \frac{(.50\ \text{atm})(750\ \text{mL})}{(1.50\ \text{atm})} = 250.\ \text{mL}$$

7. Chlorine gas occupies a volume of 1.20 liters at 720 torr pressure. What volume will it occupy at 1 atm pressure?

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(720\ \text{torr})(1.20\ \text{L})}{(1\ \text{atm} \times \frac{760\ \text{torr}}{1\ \text{atm}})} = 1.14\ \text{L}$$

8. Fluorine gas exerts a pressure of 900 torr. When the pressure is changed to 1.50 atm, its volume is 250 mL. What was the original volume?

$$V_1 = \frac{P_2V_2}{P_1} = \frac{(1.50\ \text{atm})(250\ \text{mL})}{(900\ \text{torr} \times \frac{1\ \text{atm}}{760\ \text{torr}})} = 317\ \text{mL}$$

Section 11 = Solutions and their Properties.

↳ most substances we encounter are mixtures - wood, gas, milk, champagne, air, steel, etc...

↳ when the components are uniformly intermingled or mixed, the homogeneous mixture is a solution.

⊛ Solution Composition.

↳ solutions can be dilute or concentrated, but we need to define "solution composition" more precisely to do calculations.

↳ there are several methods for determining a solution's concentration.

① Molarity → $M = \frac{\text{moles solute}}{\text{L solution}}$ ⇒ 1M = 1 mol/L

↳ "molar"

② Molality → $m = \frac{\text{moles solute}}{\text{kg solvent}}$ ⇒ 1m = 1 mol/kg

↳ "molal"

③ Mass Percent → $\frac{\text{mass solute}}{\text{mass solution}}(100\%)$

④ Mole Fraction → $\chi_{\text{solute}} = \frac{\text{moles solute}}{\text{moles of solution}}$

⑤ Normality → $\frac{\text{\# of equivalents}}{\text{L solution}} = N$

↳ "normal"

Name: _____ Date: _____

Hess's Law Worksheet

1. Calculate ΔH for the reaction $C_2H_2(g) + H_2(g) \rightarrow C_2H_4(g)$ from the following data:

$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l)$ ΔH = -1411 kJ

$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ ΔH = -1560 kJ

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ ΔH = -286 kJ

2. Calculate ΔH for the reaction $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$ from the following data:

$N_2(g) + O_2(g) \rightarrow 2NO(g)$ ΔH = +180.5 kJ

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ ΔH = -91.8 kJ

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ ΔH = -483.6 kJ

3. Find ΔH for acetic acid, $HC_2H_3O_2$, using the following thermochemical data: $HC_2H_3O_2$ is formed from its elements: C, H_2, O_2

$HC_2H_3O_2(l) + 2O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ ΔH = -875 kJ

$C(s, \text{graphite}) + O_2(g) \rightarrow CO_2(g)$ ΔH = -394.1 kJ

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ ΔH = -285.8 kJ

4. Calculate ΔH for the reaction $CH_4(g) + NH_3(g) \rightarrow HCN(g) + 3H_2(g)$ from the reactions:

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ ΔH = -91.8 kJ

$C(s, \text{graphite}) + 2H_2(g) \rightarrow CH_4(g)$ ΔH = -74.9 kJ

$N_2(g) + 2C(s, \text{graphite}) + H_2(g) \rightarrow 2HCN(g)$ ΔH = +270.3 kJ

5. Calculate ΔH for the reaction $2Al(s) + 3I_2(g) \rightarrow 2AlI_3(s)$ from the following data:

$2Al(s) + 6HI(aq) \rightarrow 2AlI_3(aq) + 3H_2(g)$ ΔH = -1014 kJ

$HI(g) \rightarrow HI(aq)$ ΔH = -73.2 kJ

$H_2(g) + I_2(g) \rightarrow 2HI(g)$ ΔH = -104.8 kJ

$AlI_3(s) \rightarrow AlI_3(aq)$ ΔH = -323 kJ

Hess's law worksheet chemistry 120. Chemistry 120 hess's law worksheet answers.

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Problem: Graphite does not react with the hydrogen gas to form methane C (graphite) + 2H2 (g) CH4 (g) Soluction finds the reactions that are produced that bind the graphite to methane through a series of steps.The of the reaction by formation enthalpy formation elements you should need the same amounts of each substance as if you formed the reagents from its elements.Thealpiece tends to be an exotic process of reaction of enthalpiece of bonding the change of Entalpy for the hydrogenation of bonding enthalpit reaction etenalpy the enthalpy change for the hydrogenation of enthalpy for the hydrogenation of eThenodh21 x c = c Link 4 x Links CH 1 x Link HH @ 611 @ 413 @ 436 = 611 KJ = 1652 KJ = 436 KJ = 2699 Total Kjenergia to break reacting reaction reaction links to the enthalpy change for the hydrogenation of eThenodH21 x c = Link C 4 x Links ch 1 x Link HH @ 611 @ 413 @ 436 = 611 kj = 1652 kj = 436 kj = 2699 kj = 346 kj = 2478 kj = 2824 kj = (2699 2824) = 125 kJ Total energy to break links of DH3 reagents 1 x link cc 6 x C- Links H @ 346 @ 413Energy Total to break product bonds Applying the Law of Hessdh1 = DH2 DH3ALPA of reaction formation enthalpath of the sample calculate the standard exchange of enthalpy For the next reaction, since the standard enthalpies of water formation, nitrogen dioxide and nitric acid are -286, +33 and nitric acid are -286, +33 and -286 and -286 and - 33 and â € "173 kJ Mol-1 respectively; The value for oxygen is zero, since it is an element2h2o (L) + 4NO2 (G) + O2 (G)> 4HNO3 (L) DH = DHF of the DHF products of the reagents applying the law of Hesss ... Products [4 x DHF of HNO3] less DHR = 4 x (-173) Reactants [(2 x DHF of H2O) + (4 x DHF of NO2) + (1 x DHF of O2)] 2 (-286) Answer = â € "252 KJ + 4 X (+33) + 0-Entalpy enthalpy enthalpy Entalpy If you burned all products you must obtain the same amounts of oxidation products such as CO2 and H2O H2O. .4)Jk .4)Jk 8,582-(x 2 = HD)l(O2H 2)g(2O +)g(2H 2)Jk 15,493-(x 2 = HD)g(2OC 2)g(2O 2 +)otifarg ,s(C 2Jk . 1-lom Jk 098- y 682- ,493- nos onatem y oneg³Ârdih ,onobrac ed n³Ãitsubmoc ed radn¡Átse saÃplatne sal ;onatem ed n³Ãicamrof al ed radn¡Átse aÃplatne al aluclaC artseum al ed oluc¡ÁCn³Ãitsubmoc al ed saÃplatne sal ed n³Ãiccaer al ed aÃplahtnEocimr©Átoxe osecorp nu se n³Ãitsubmoc al ed aÃplatne aL.sovitcaer sol ³Ãmeuq is

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