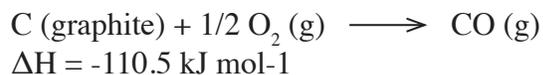
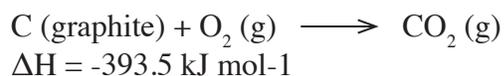


Thermochemistry Practice Items

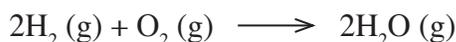
- 500 kJ of heat flow from a system occurs into the environment at the same time the system is expanding, performing 250 kJ of work on the surroundings, what is the change in the internal energy of the system?
 - 750 kJ
 - 250 kJ
 - + 250 kJ
 - + 750 kJ
- The amount of heat required to increase the temperature of 1 g of water by 1°C equals
 - 1 kcal
 - 4.18 cal
 - 4.18 J
 - 1 J
- Dulong and Petit's law states that the molar heat capacity of many solid elements is approximately $25 \text{ J K}^{-1} \text{ mol}^{-1}$. A laboratory scientist working to identify an unknown metal has measured its specific heat, obtaining a value of $0.20 \text{ J K}^{-1} \text{ g}^{-1}$. From other tests, he believes the element to be one among the following list. Which is it?
 - selenium (AW 78.96 u)
 - tellurium (AW 127.60 u)
 - tungsten (AW 183.84 u)
 - bismuth (AW 208.98 u)
- A positive value of ΔH for a reaction carried out at constant pressure means that:
 - Heat is given off to the environment during the reaction.
 - The internal energy of the substance has increased.
 - The reaction is exothermic.
 - Heat is absorbed from the environment during the reaction.
- Within an insulated flask, 20g of an alloy at 80°C is dropped into 100ml of water at 28°C . The final temperature is 30°C . What is the specific heat of the alloy?
 - $0.13 \text{ cal g}^{-1} \text{ }^\circ\text{C}$
 - $0.20 \text{ cal g}^{-1} \text{ }^\circ\text{C}$
 - $0.25 \text{ cal g}^{-1} \text{ }^\circ\text{C}$
 - $0.50 \text{ cal g}^{-1} \text{ }^\circ\text{C}$
- Which of the following standard molar enthalpies of formation is not zero?
 - $\text{O}_2(\text{g})$
 - $\text{Hg}(\text{l})$
 - $\text{C}(\text{graphite})$
 - CH_4
- Carbon and oxygen react to give carbon dioxide. Reacting 8.98 g $\text{C}(\text{s})$ with 18.42 g $\text{O}_2(\text{g})$ at 1 atm pressure and 298K releases -226 kJ of heat to the surroundings. What is the standard enthalpy of formation of $\text{CO}_2(\text{g})$?
 - -226 kJ mol^{-1}
 - -299 kJ mol^{-1}
 - -393 kJ mol^{-1}
 - -452 kJ mol^{-1}

8. Two ways pure carbon may be combusted are as follows:



What is the enthalpy change involved in reacting one mole of carbon monoxide with oxygen to form carbon dioxide?

- A. -172.5 kJ
 - B. -283.0 kJ
 - C. -504.0 kJ
 - D. -566.0 kJ
9. Which of the following statements is true about the following exothermic reaction carried out to completion at 300K and 1kPa pressure?



- A. The decrease in internal energy is greater than the enthalpy change.
- B. The magnitude of the internal energy change is less than the magnitude of the enthalpy change.
- C. The enthalpy change equals the loss of internal energy.
- D. The enthalpy decreased while internal energy increased.

10. Elemental phosphorus can exist in several allotropes; the most common of which are white and red solids. The white form is the standard state. White phosphorus exists as molecules made up of four atoms in a tetrahedral structure. White phosphorus reacts with oxygen and water to form phosphoric acid:



At 298K and 1 atm, the enthalpy change of the above reaction equals:

- A. the standard enthalpy of formation of phosphoric acid minus the standard enthalpy of formation of water.
 - B. the sum of the bond dissociation energies of products and reagents.
 - C. four times the standard enthalpy of formation of phosphoric acid minus six times the standard enthalpy of formation of water.
 - D. the bond dissociation energy of phosphoric acid.
11. Which of the following statements does not directly follow from or lead to Hess' Law?
- I. The enthalpy change for a reaction may depend on whether a one step or a five step process is utilized.
 - II. The enthalpy change of a reaction equals the standard enthalpies of the products minus the standard enthalpies of the reagents.
 - III. Enthalpy is a state function.
- A. I
 - B. I and III
 - C. II and III
 - D. I, II and III

12. The table below provides the heat capacities of ice, liquid water, and steam as well as the heats of transformation for melting and boiling water ($P = 1\text{atm}$).

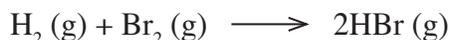
C_{ice} (cal/g·°C)	Latent Heat of Fusion (cal/g)	C_{water} (cal/g·°C)	Latent Heat of Vaporization (cal/g)	C_{steam} (cal/g·°C)
0.5	80	1	540	0.48

For which of the choices below does the enthalpy change have the greatest difference with internal energy change?

- A. heating 1 mole of ice at 1atm pressure from -150°C to -50°C
 B. melting 1 mole of ice at 1atm pressure at 0°C
 C. heating 1 mole of liquid water from 0°C to 100°C
 D. vaporizing 1 mole of water at 100°C
13. Given these bond energies:

H–H	(435 kJ/mol)
Br–Br	(192 kJ/mol)
H–Br	(368 kJ/mol)

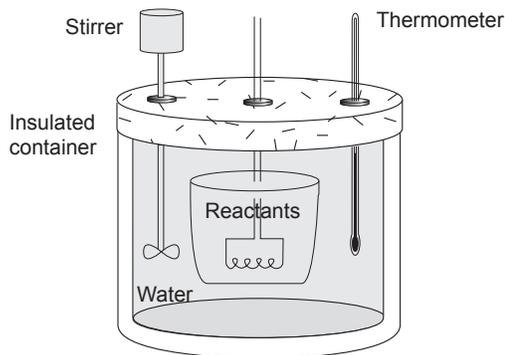
Which of the following would be the best estimate of the enthalpy change of the following reaction?



- A. -26 kJ
 B. -109 kJ
 C. +109 kJ
 D. +259 kJ

The following passage pertains to questions 14 - 16.

A bomb calorimeter consists of a strong steel container, called a bomb, in which reactants are placed and then immersed in an insulated bath holding a known quantity of water. A heater wire in the bomb is often used to set the reaction off.



After the reaction has occurred and thermal equilibrium is reached within the calorimeter, the entire system will be at a higher temperature. By carefully measuring the temperature of the water before and after reaction, the quantity of heat evolved by the chemical reaction can be computed.

In a particular experiment a researcher compressed 0.2 mol of H_2 and 0.1 mol of O_2 into a 0.5 liter bomb. The bomb was then immersed in the water of a calorimeter. The heat capacity of the entire calorimeter apparatus including water was $10850\text{ cal}/^{\circ}\text{C}$. A reaction was set off which proceeded to completion. Before the reaction, the temperature of the water was 25.00°C . After the reaction, the temperature was measured to be 26.25°C .

14. Which of the following is the closest value to the pressure in the bomb if it were measured prior to reaction ignition?
- A. 1.2 atm
 B. 14 atm
 C. 65 atm
 D. 150 atm

15. What is the magnitude of heat flow that occurred into the water bath and calorimeter apparatus in the reaction described in the passage?

- A. 14 kJ
- B. 57 kJ
- C. 109 kJ
- D. 285 kJ

16. Suppose that 2 moles of hydrogen atoms were injected into a bomb calorimeter. The hydrogen atoms react to form 1 mol of H_2 . Heat flow occurs from the system into the surrounding water bath and calorimeter apparatus. This heat flow would be equal in magnitude to

- A. the enthalpy change of the reaction.
 - B. the standard enthalpy of formation of H_2 .
 - C. the internal energy decrease in the system.
 - D. H_2 bond dissociation energy.
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