1.

Consider the following processes used to produce energy. Which does *not* predominantly use potential energy?

Student Response

1. Fossil fuel plant
2. Burning natural gas
3. Hydroelectric power plant
4. Nuclear power plant
5. Windmills on wind farms

2.

How much heat is liberated at constant pressure when 19.9 mL of liquid methanol (CH_3OH) combusts in excess oxygen? The density of methanol is 0.791 g/mL.

$2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(l)$ $\Delta H^o = -1452.8$ kJ/mol

Student Response

1. 7.14×10^2 kJ
2. 2.91×10^3 kJ
3. 1.45×10^3 kJ
4. 7.26×10^2 kJ
5. 3.57×10^2 kJ

3.

For the following *unbalanced* reaction, when the ΔrH^o value is calculated using only ΔfH^o values, which of the following would correctly represent the term used for the ΔfH^o of $N_2O(g)$ which would be substituted into the ΔrH^o summation equation?

$NH_3(g) + N_2O(g) \rightarrow N_2(g) + H_2O(l)$ $\Delta H = ?$ kJ/mol

Student Response

1. $\Delta_f H^\circ_{N_2O}$
2. $-3\,\Delta_f H^\circ_{N_2O}$
3. $^1/_3\,\Delta_f H^\circ_{N_2O}$
4. $-\Delta_f H^\circ_{N_2O}$
5. $3\,\Delta_f H^\circ_{N_2O}$

4.

When 0.0500 mol of HCl is reacted with 0.0500 mol of NaOH in 50.0 mL of water, the

temperature of the water increases by 13.7°C. Calculate the heat of the reaction for the following thermochemical equation:

$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$

Assume that the heat capacity of the system is 209.2 J/°C.

Student Response

1. +57,300 J/mol
2. –57,300 J/mol
3. –2870 J/mol
4. + 2870 J/mol
5. +115,000 J/mol

5.

What is the *molar* heat of combustion of benzene, C_6H_6, if combustion of 1.00 g of benzene causes a temperature rise of 5.18°C in a bomb calorimeter that has a heat capacity of 8.07 kJ/°C? (Molar mass C_6H_6 = 78.1.)

Student Response

1. –3,260 kJ/mol
2. –41,800 kJ/mol
3. –41.8 kJ/mol
4. –4,180 kJ/mol
5. –48,700 kJ/mol

6.

Using the following thermochemical data,

$2Er(s) + 6HF(g) \rightarrow 2ErF_3(s) + 3H_2(g)$ $\quad \triangle H^o = -1795.4$ kJ/mol

$2Er(s) + 6HCl(g) \rightarrow 2ErCl_3(s) + 3H_2(g)$ $\quad \triangle H^o = -1443.6$ kJ/mol

calculate $\triangle H^o$ for the following reaction.

$ErF_3(s) + 3HCl(g) \rightarrow ErCl_3(s) + 3HF(g)$

Student Response

1. 703.6 kJ/mol
2. –1619.5 kJ/mol
3. 351.8 kJ/mol
4. –3239.0 kJ/mol
5. 175.9 kJ/mol

7.

In a calorimetry experiment, 0.0157 g of calcium metal are added to 42.8 mL of 0.706 *M* hydrochloric acid, initially at 22.78°C, in an insulated container. The temperature of the solution rises to 23.97°C. What is $\triangle H^o$ for the following reaction? Assume the density and specific heat of the acid solution are the same as those of water, 1.00 g/mL and 4.184 J g^{-1} $^oC^{-1}$ respectively, and neglect the heat capacity of the container.

$Ca(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2(g)$

Student Response

1. −70.9 kJ/mol
2. −14.1 kJ/mol
3. −6.95 kJ/mol
4. −543 kJ/mol
5. 213 kJ/mol

8.

Which substance has a heat of formation equal to zero at 25°C and 1 atm?

Student Response

1. $Br_2(l)$
2. $Br_2(g)$
3. $C_2H_6(g)$
4. $Br_2(s)$
5. $C_2H_6(l)$

9.

Which of the following equations represents the equation for the $\Delta f H°$ for N, N-diethyl-m-toluamide, $C_{12}H_{17}NO(l)$, the active ingredient in some insect repellents?

Student Response

1. $12C(g) + 17H(g) + N(g) + O(g) \longrightarrow C_{12}H_{17}NO(l)$
2. $12C(g) + 17H(g) + N(g) + O(g) \longrightarrow C_{12}H_{17}NO(g)$
3. $12C(s) + \frac{17}{2}H_2(g) + \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \longrightarrow C_{12}H_{17}NO(l)$
4. $12C(l) + 17H(l) + N(l) + O(l) \longrightarrow C_{12}H_{17}NO(l)$
5. $12C(s) + 17H(g) + N(g) + O(g) \longrightarrow C_{12}H_{17}NO(l)$

10.

To determine if an enthalpy value can be designated as $\Delta H°$, which of the following parameters need *not* be set at a standard value?

Student Response

1. Temperature
2. Physical states
3. Concentration of solutions
4. Pressure
5. All of the above have set values.

11.

All of the following have a standard enthalpy of formation value of zero at 25°C and 1.00 atm *except*

Student Response

1. C(s).
2. CO(g).
3. Ne(g).
4. F_2(g).
5. Fe(s).

12.

What would be the kinetic energy of a 1.75-ton car moving at exactly 70 mph?

Student Response

1. 8.75×10^3 J
2. 5.46×10^1 J
3. 4.97×10^4 J
4. 7.77×10^6 J
5. 1.56×10^6 J

13.

The following two reactions are known:

$Fe_2O_3(s) + 3CO(g) \longrightarrow 2Fe(s) + 3CO_2(g) \qquad \Delta H = -26.8$ kJ

$FeO(s) + CO(g) \longrightarrow Fe(s) + CO_2(g) \qquad \Delta H = -16.5$ kJ

Determine the ΔH value for the reaction below.

$Fe_2O_3(s) + CO(g) \longrightarrow 2FeO(s) + CO_2(g)$

Student Response

1. 6.2 kJ
2. 10.3 kJ
3. −10.3 kJ
4. −43.3 kJ
5. 22.7 kJ

14.

How much heat is gained by nickel when 500 g of nickel is warmed from 22.4 to 58.4°C? [The specific heat of nickel is 0.444 J/(g · °C).]

Student Response

1. 8000 J
2. 10,000 J
3. 4000 J
4. 2000 J
5. 6000 J

15.

Which answer lists all of the following responses that are endothermic and none that are exothermic?

1. boiling water
2. freezing water
3. condensation of steam
4. melting ice

Student Response

A. 1 and 4 only
B. 1 and 2 only
C. 2 and 3 only
D. 1, 2, and 3 only
E. 2 and 4 only

16.

The kinetic energy of a 2.50 kg ball rolling down a hill at 0.500 m/s would be

Student Response

1. 5.00 J.
2. 0.625 J.
3. 1.25 J.
4. 0.313 J.
5. 0.200 J.

17.

Consider the reaction given below:

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

Which of the following is *true* for this reaction?

Student Response

1. The reactants have lower energy than the product.
2. The temperature of the system would decrease as the reaction proceeds.
3. The reaction is classified as endothermic.
4. ΔH would be negative.
5. The reaction absorbs energy.

18.

What is the enthalpy change when 7.54 g of TiO(*s*) reacts with excess liquid bromine?
$2TiO(s) + 2Br_2(l) \rightarrow 2TiBr_2(s) + O_2(g)$ $\Delta H^o = 235.4$ kJ/mol

Student Response

1. 471 kJ
2. 27.8 kJ
3. 13.9 kJ
4. 1770 kJ

5. 887 kJ

19.

What is the enthalpy change when 83.1 g of sodium metal reacts with excess water?

$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g) \quad \Delta H^o = -366.8$ kJ/mol

Student Response

1. −1330 kJ
2. −183 kJ
3. 183 kJ
4. −663 kJ
5. 663 kJ

20.

The specific heat of iron is 0.449 J g^{-1} $^oC^{-1}$. What is its molar heat capacity?

Student Response

1. 25.1 J mol^{-1} $^oC^{-1}$
2. 4.18 J mol^{-1} $^oC^{-1}$
3. 0.00804 J mol^{-1} $^oC^{-1}$
4. 124 J mol^{-1} $^oC^{-1}$
5. 0.0399 J mol^{-1} $^oC^{-1}$