Tro Chapter 6

1. Which one of the following is a unit of energy?
   A) pascal
   B) newton
   C) joule
   D) watt
   E) ampere

2. Chemical energy is
   A) the kinetic energy resulting from violent decomposition of energetic chemicals
   B) the heat energy associated with combustion reactions
   C) the electrical energy produced by fuel cells
   D) the potential energy which resides in chemical bonds
   E) the energy living plants receive from solar radiation

3. How much kinetic energy (KE) does an object with a mass of 900 g traveling in a straight line with a speed of 40 m s^{-1} possess?
   A) 0.72 kJ
   B) 1.44 kJ
   C) 2.88 kJ
   D) 16.2 kJ
   E) 18 kJ

4. A chemical reaction has just occurred in an insulated isolated system which caused an overall increase in the potential energy of the system. Which statement below is true?
   A) Heat was taken in from the surroundings by the system.
   B) Heat was given off to the surroundings by the system.
   C) The temperature of the system increased.
   D) The temperature of the system decreased.
   E) The total energy of the system increased.

5. A 350.0 gram sample of copper is initially at 25.0 °C. It absorbs 12.50 kJ of heat from its surroundings. What is its final temperature, to the nearest tenth of a degree?
   (specific heat = 0.3874 J g^{-1} $°C^{-1}$ for copper)
   A) 38.8 °C
   B) 67.2 °C
   C) 92.2 °C
   D) 117.2 °C
   E) 156.7 °C

6. A calorimeter consists of metal parts with a heat capacity of 925.0 J $°C^{-1}$ and 1100 grams of oil with a specific heat of 2.814 J g^{-1} $°C^{-1}$. What is the heat capacity, in joules per degree, of the ***entire*** assembly?
   A) 1321 J $°C^{-1}$
   B) 2028 J $°C^{-1}$
   C) 3703 J $°C^{-1}$
   D) 4020 J $°C^{-1}$
   E) 5698 J $°C^{-1}$

7. A coffee cup calorimeter contains 480.0 grams of water at 25.00 °C. To it are added:
   380.0 grams of water at 53.5 °C
   525.0 grams of water at 65.5 °C
   Assuming the heat absorbed by the styrofoam is negligible, calculate the expected final temperature. The specific heat of water is 4.184 J g^{-1} $°C^{-1}$.
   A) 38.2 °C
   B) 48.2 °C
   C) 67.6 °C
   D) 88.7 °C
   E) 94.4 °C

8. A calorimeter has metal parts (heat capacity of 925.0 J $°C^{-1}$) and 1100 grams of oil (specific heat = 2.824 J g^{-1} $°C^{-1}$), both at 25.40 °C. Adding a 550 g slug, at 220.0 °C caused the temperature to rise to 35.2 °C. Find the specific heat of the metal!
   A) 0.365 J g^{-1} $°C^{-1}$
   B) 0.389 J g^{-1} $°C^{-1}$
   C) 0.395 J g^{-1} $°C^{-1}$
   D) 0.551 J g^{-1} $°C^{-1}$
   E) 1.20 J g^{-1} $°C^{-1}$

9. An exothermic chemical reaction has just occurred in an insulated isolated system. Which statement below is true?
   A) Heat was taken in from the surroundings by the system.
   B) Heat was given off to the surroundings by the system.
   C) The potential energy of the system increased.
   D) The potential energy of the system decreased.
   E) The total energy of the system increased.

10. Given the reaction, $4B + 3A \rightarrow 4C + 7D$, and some standard enthalpies of formation, ΔH_f^o :

A: +15.7 kJ mol^{-1} B: −86.4 kJ mol^{-1} C: −52.7 kJ mol^{-1} D: −71.6 kJ mol^{-1}

What is the standard enthalpy of reaction, in kJ for the reaction shown?

A) −53.6 kJ
B) −413.5 kJ
C) −515.6 kJ
D) −853.6 kJ
E) −908.4 kJ

11. The thermochemical equation which is associated with ΔH_f^o , the standard enthalpy of formation, for glucose, $C_6H_{12}O_6(s)$, is

A) $6\ C(s) + 6\ H_2O(l) \rightarrow C_6H_{12}O_6(s)$
B) $6\ C(s) + 12\ H(g) + 6\ O(g) \rightarrow C_6H_{12}O_6(s)$
C) $6\ C(s) + 6\ H_2(g) + 3\ O_2(g) \rightarrow C_6H_{12}O_6(s)$
D) $2\ C_2H_5OH(l) + 2\ CO_2(g) \rightarrow C_6H_{12}O_6(s)$
E) $6\ C(g) + 6\ H_2(g) + 3\ O_2(g) \rightarrow C_6H_{12}O_6(s)$

12. The standard enthalpy of combustion for xylene, $C_8H_{10}(l)$, is −3908 kJ mol^{-1}. Using this data and the standard enthalpies of formation, ΔH_f^o : $H_2O(l)$ = −285.9 kJ mol^{-1}; $CO_2(g)$ = −393.5 kJ mol^{-1}, calculate the standard enthalpy of formation of $C_8H_{10}(l)$, in kJ mol^{-1}.

A) −669.5 kJ
B) +3228.6 kJ
C) −3228.6 kJ
D) +4587.4 kJ
E) +8485.5 kJ

13. Complete combustion of hydrocarbons, or compounds with C,H, and O as the only elements, gives CO_2 and H_2O as the only products. If carried out under standard conditions, the CO_2 is a gas while the H_2O is a liquid. Given these standard enthalpies of ***combustion***:
$C_2H_4(g) = -1411.08$ kJ mol^{-1} $C_2H_2(g) = -1299.65$ kJ mol^{-1}
$H_2(g) = -285.90$ kJ mol^{-1} $C(s) = -393.50$ kJ mol^{-1}
Calculate the standard enthalpy of reaction for the process, $C_2H_2(g) + H_2(g) \rightarrow C_2H_4(g)$
A) −174.47 kJ
B) +397.33 kJ
C) −961.47 kJ
D) −2424.83 kJ
E) −2996.63 kJ

14. Given the thermochemical equation, $2\ M_2O_5(s) \rightarrow 4\ MO_2(s) + O_2(g)$ with a standard enthalpy of reaction = +74.2 kJ, calculate a value for the standard enthalpy of reaction in the thermochemical reaction, $2\ MO_2(s) + ½\ O_2(g) \rightarrow M_2O_5(s)$ _____

15. Use these reactions and standard enthalpies, ΔH°
$2\ ZbO(s) + ½\ O_2(g) \rightarrow Zb_2O_3(s)$ −128.0 kJ
$ZbO(s) + ½\ O_2(g) \rightarrow ZbO_2(s)$ −380.0 kJ
$2\ ZbO(s) + 3/2\ O_2(g) \rightarrow Zb_2O_5(s)$ −344.5 kJ
find the value for
$Zb_2O_3(s) + O_2(g) \rightarrow Zb_2O_5(s)$ _____

16. Using the standard enthalpies of formation, ΔH_f^o :
$H_2O(l) = -285.9$ kJ mol^{-1}; $C_2H_4(g) = 52.284$ kJ mol^{-1}; $C_2H_5OH(l) = -277.63$ kJ mol^{-1}
calculate the standard enthalpy of reaction for
$C_2H_4(g) + H_2O(l) \rightarrow C_2H_5OH(l)$ _____

17. Using the standard enthalpies of formation, ΔH_f^o :
$CO(g) = -110.5$ kJ mol^{-1} $CO(NH_2)_2(s) = -333.19$ kJ mol^{-1} $NH_3(g) = -46.19$ kJ mol^{-1}
calculate the standard enthalpy of reaction for
$CO(NH_2)_2(s) + H_2(g) \rightarrow 2NH_3(g) + CO(g)$ _____

18. 600.0 ml of 0.240 molar perchloric acid, $HClO_4(aq)$ was added to a high quality insulated calorimeter containing 400.0 ml of 0.300 molar KOH(*aq*). Both solutions have a density of 1.000 g ml^{-1} and a specific heat of 4.184 J g^{-1} $°C^{-1}$. The calorimeter had a heat capacity of 950.0 J $°C^{-1}$. The temperature of the ***entire*** system rose from 25.30 °C to 26.59 °C. Calculate the heat of reaction, in kJ, per mole of NaOH(*aq*).

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19. The standard enthalpy of combustion for oxalic acid, $H_2C_2O_4(s)$, is −251.9 kJ mol^{-1}. Using this data and the standard enthalpies of formation, ΔH_f^o :

$H_2O(l)$ = −285.9 kJ mol^{-1} $CO_2(g)$ = −393.5 kJ mol^{-1}

calculate the standard enthalpy of formation of $H_2C_2O_4(s)$, in kJ mol^{-1}. _____

20. Using the standard enthalpies of formation, ΔH_f^o :

$NO(g)$ = 90.37 kJ mol^{-1} $NO_2(g)$ = 33.8 kJ mol^{-1}

$SO_2(g)$ = −296.9 kJ mol^{-1} $SO_3(g)$ = −395.2 kJ mol^{-1}

calculate the standard enthalpy of reaction for

$SO_2(g) + NO_2(g) \rightarrow SO_3(g) + NO(g)$ _____

Answer Key

1. C
2. D
3. A
4. D
5. D
6. D
7. B
8. B
9. D
10. B
11. C
12. A
13. A
14. −37.1 kJ
15. −216.5 kJ
16. −44.0 kJ
17. 130.3 kJ
18. 55.2 kJ
19. −821.0 kJ
20. −41.7 kJ