RTD EXAM PREP

Chemistry 30

Unit A

Thermochemical Changes

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Energy

The ability to do work.

Kinetic

Energy of motion.

Temperature Change

Molecules gain or lose energy and move faster or slower.

Heat

Transfer of thermal energy.

Potential

Stored energy.

Intermolecular

Bonds between molecules (Van der Waals).

Intramolecular

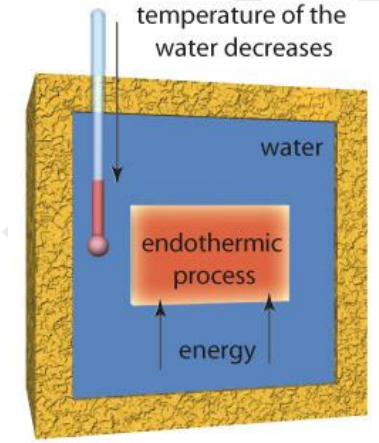
Bonds between atoms within a molecule.

Chemical Change

Bonds within molecues or polyatomic ions are broken an/or formed.

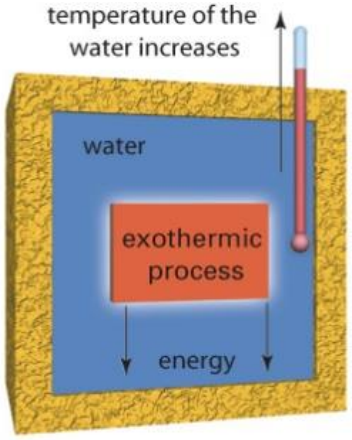
Endothermic

System increaes potential energy.



Exothermic

System decreases potential energy.



Heat Transfer and Calorimetry

- **Thermal energy** – the kinetic energy (E_k) of the entities of a substance. Thermal energy increases with temperature.

$$Q = mc\Delta t$$

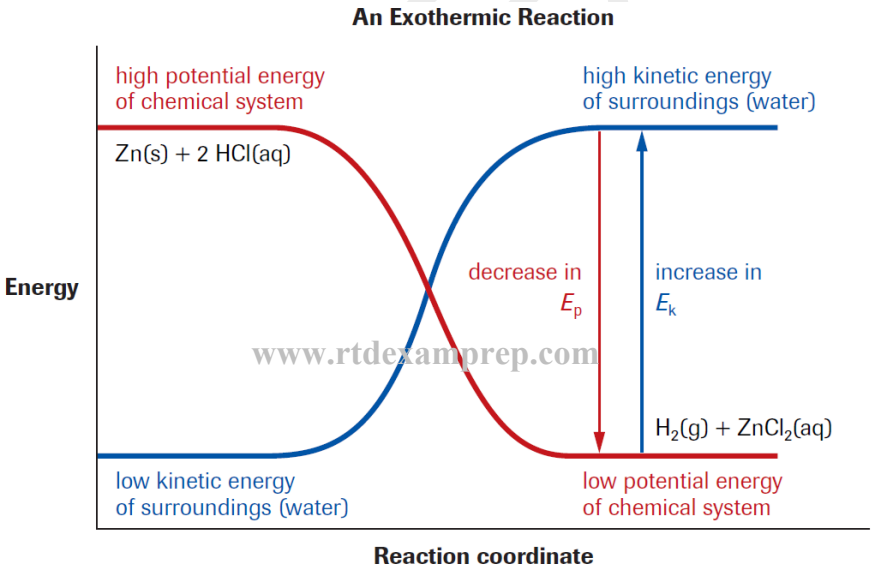
- **Temperature** – a measure of the average kinetic energy of the entities of a substance
- **Heat** – thermal energy transferred between systems. Heat is *not* possessed by a system.
- **Chemical potential energy** (E_p) – energy stored in chemical bonds
- **Enthalpy** (H) – the total kinetic and potential energy in a chemical system
- **Change in enthalpy** ($\Delta_r H$) – difference in enthalpy (assume the difference in chemical potential energy) between the products and reactants. THE TEMPERATURE OF THE SYSTEM DOES NOT CHANGE!

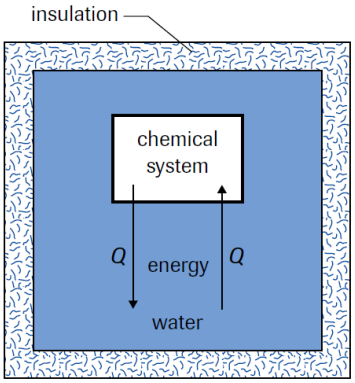
$$\Delta_r H = H_{products} - H_{reactants}$$

Subscript	Meaning
r	any reaction specified
c	complete combustion
f	formation
d	decomposition
sol	solution
dil	dilution

- **Molar change in enthalpy** ($\Delta_r H_m$) – change in energy per mole of a substance undergoing a specific reaction

$$\Delta_r H = n\ \Delta_r H_m$$





Example 1

Methylpropane, $C_4H_{10}(g)$, is used as a lighter fluid. When 1.80 g of methylpropane is burned in a calorimeter, the temperature of 2.60 kg of water changed from 20.0 °C to 29.7 °C.

a) Calculate the amount of thermal energy absorbed by the water.

b) Determine the enthalpy change for the combustion of 1.80 g of methylpropane.

c) Determine the molar enthalpy of combustion for methylpropane.

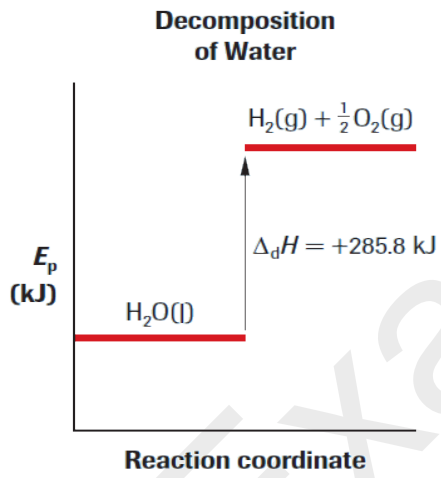
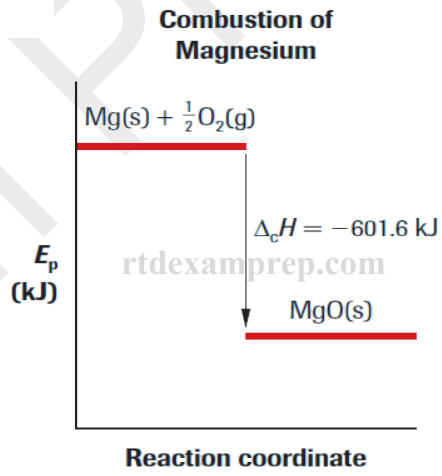
Example 2

A student is asked to prepare a 50.0 mL solution of ammonium nitrate. If the molar enthalpy of solution of ammonium nitrate is +25.0 kJ/mol, determine the mass of ammonium nitrate that should be dissolved to decrease the temperature of the water by 7.55 ˚C?

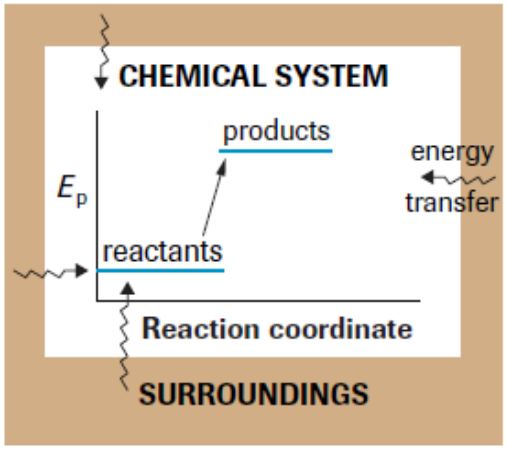
Example 3

150 mL of 0.200 mol/L HCl(aq) is added to 150 mL of 0.200 mol/L NaOH(aq). If the initial temperature of both solutions is 25.0^{o}C and the final temperature of the mixture after the reaction was complete was 27.1^{o}C, determine the molar enthalpy of neutralization for HCl(aq).

Four Ways of Communicating Enthalpy Changes

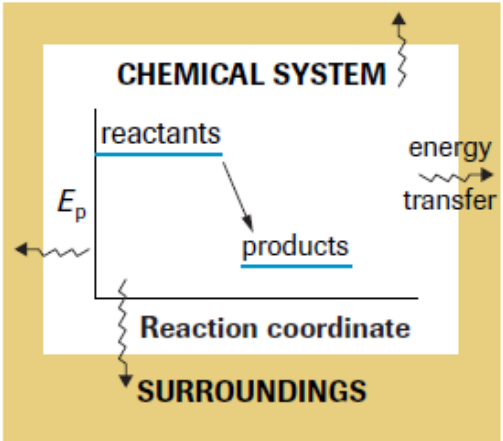
		ENDOTHERMIC Decomposition of Water	EXOTHERMIC Combustion of Magnesium
1)	Molar Enthalpy	$\Delta_d H_m = +285.8$ kJ/mol	$\Delta_c H_m = -601.6$ kJ/mol
2)	Enthalpy Change	$H_2O(l) \rightarrow H_2(g) + \frac{1}{2}O_2(g) \quad \Delta_d H^\circ = +285.8$ kJ	$Mg(s) + \frac{1}{2}O_2(g) \rightarrow MgO(s) \quad \Delta_c H^\circ = -601.6$ kJ
3)	Term in a Balanced Equation	$H_2O(l) + 285.8\text{ kJ} \rightarrow H_2(g) + \frac{1}{2}O_2(g)$	$Mg(s) + \frac{1}{2}O_2(g) \rightarrow MgO(s) + 601.6$ kJ
4)	Chemical Potential Energy Diagram		

Endothermic Reaction



Surroundings are cooled as chemical system absorbs energy.

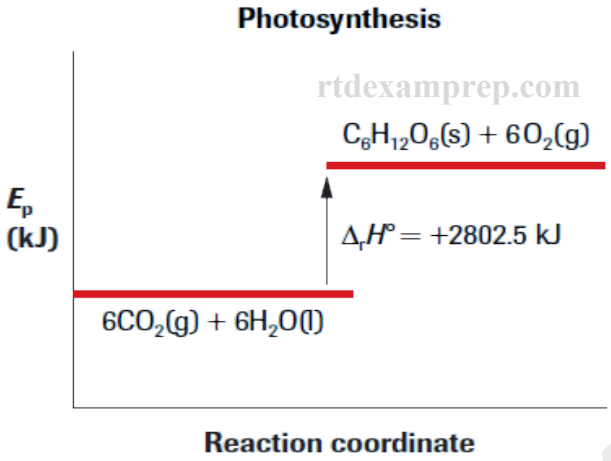
Exothermic Reaction

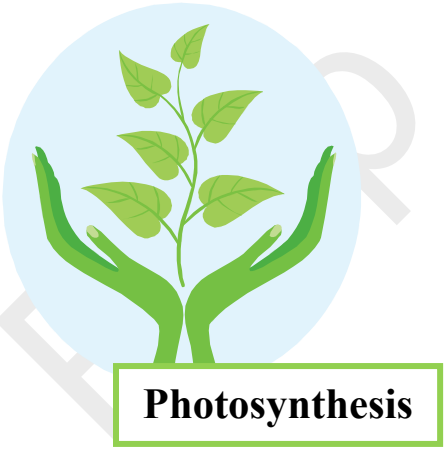


Surroundings are warmed as chemical system releases energy.

The Sun is a Major Source of Stored Chemical Energy on Earth

1. The standard molar enthalpy for photosynthesis of glucose:
   $\Delta_r H^\circ_m = +2802.5$ kJ/mol
   $C_6H_{12}O_6$
2. $6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(s) + 6O_2(g) \quad \Delta_r H^\circ = +2802.5$ kJ
3. $6CO_2(g) + 6H_2O(l) + 2802.5\text{ kJ} \rightarrow C_6H_{12}O_6(s) + 6O_2(g)$
4. Potential energy diagram for photosynthesis:

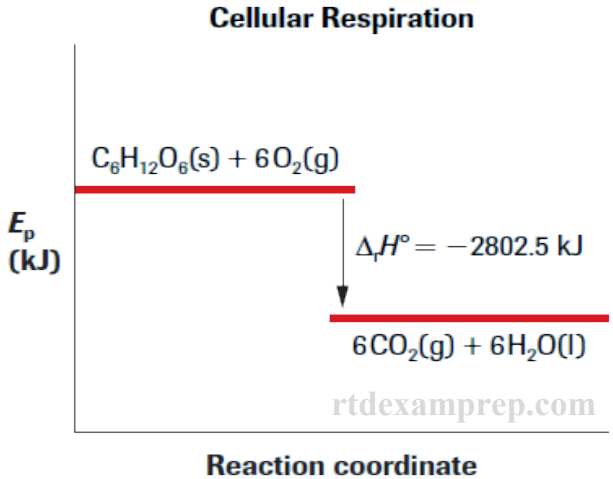




Photosynthesis

1. The standard molar enthalpy for cellular respiration of glucose:
   $\Delta_r H^\circ_m = -2802.5$ kJ/mol
   $C_6H_{12}O_6$
2. $C_6H_{12}O_6(g) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l) \quad \Delta_r H^\circ = -2802.5$ kJ
3. $C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l) + 2802.5$ kJ
4. Potential energy diagram for cellular respiration:

Cellular Respiration



Hess' Law

Hess' law is used to determine the enthalpy (energy) change for a net reaction from a series of reactions.

We manipulate reactions in the following manner:

- reverse the reaction (make sure to reverse the sign of the ΔH)
- multiply / divide by a co-efficient (do the same to the ΔH)

Example 4

Using the following reactions, determine the molar enthalpy of formation for butane.

1) $C_4H_{10}(g) + \frac{13}{2} O_2(g) \rightarrow 4 CO_2(g) + 5 H_2O(g)$ $\quad \Delta H = -2\,657.4$ kJ

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

3) $2 H_2(g) + O_2(g) \rightarrow 2 H_2O(g)$ $\quad \Delta H = -483.6$ kJ

Example 5

Using the following reactions, predict the molar enthalpy of combustion of pentane, assuming that combustion takes place in a calorimeter and produces carbon dioxide gas and liquid water.

1) $5 C(s) + 6 H_2(g) \rightarrow C_5H_{12}(l)$ $\quad \Delta_f H° = -173.5$ kJ

2) $C(s) + O_2(g) \rightarrow CO_2(g)$ $\quad \Delta_f H° = -393.5$ kJ

3) $H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(g)$ $\quad \Delta_f H° = -241.8$ kJ

4) $H_2O(l) \rightarrow H_2O(g)$ $\quad \Delta_{vap} H° = +40.65$ kJ

This concludes the NOTES sample of our Chemistry Unit A Study Guide. Please note that this section represents about half of the Unit A notes.

The next section is a sample of the PRACTICE QUESTIONS for Unit A, again representing about half of the sample questions.

The video sample matches the notes sample here.

Unit A Practice Questions

Use the following information to answer the next question.

A student designed a calorimetry experiment to determine the mass of water that could be heated by 400 kJ of energy released by burning butane gas, and recorded the following results.

Initial temperature of water	21.6 °C
Final temperature of water	55.6 °C
Energy released	400 kJ

1. The mass of water involved in this calorimetry experiment is _____ kg.

NR

Use the following information to answer the next question.

A thermite reaction is a highly exothermic process that is used in welding massive steel objects such as ship propellers and train rails. The reaction can be represented by the following equation.

$$2\ Al(s) + Fe_2O_3(s) \rightarrow Al_2O_3(s) + 2\ Fe(l) \qquad \Delta H = -851.5\ kJ$$

2. If the heat produced by the reaction of 1.00 mol of iron(III) oxide were absorbed by 7.40 kg of $H_2O(l)$ at room temperature, then the resulting temperature change of the water would be _____ °C.

NR

3. The amount of heat released by a substance when the temperature of 250.0 g of water increases from 20.0 °C to 35.0 °C is

A. 12.4 kJ **B.** 13.7 kJ **C.** 15.7 kJ **D.** 57.6 kJ

4. As dry air is heated from 15.0 °C to 25.0 °C by the combustion of methane in a furnace, the air would primarily undergo

A. a decrease in kinetic energy **B.** an increase in kinetic energy
C. a decrease in potential energy **D.** an increase in potential energy

5. Which of the following reactions would release the **largest** amount of energy?

A. $2\ Na(s) + Cl_2(g) \rightarrow 2\ NaCl(s)$
B. $CaO(s) + 3\ C(s) + 462.3\ kJ \rightarrow CaC_2(s) + CO(g)$
C. $P_4(s) + 10\ Cl_2(g) \rightarrow 4\ PCl_5(g) \qquad \Delta H° = -1\ 772\ kJ$
D. $C_2H_4(g) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 2\ H_2O(g) + 1\ 322.9\ kJ$

6. The energy required to completely decompose 1.50 mol of $PCl_3(l)$ is

A. 480 kJ **B.** 320 kJ **C.** 287 kJ **D.** 213 kJ

Use the following information to answer the next question.

A fire fuelled by burning magnesium metal produces a brilliant white light and intense heat, which makes fighting the fire very difficult. Firefighters extinguish this type of fire by smothering it with sand.

7. Which of the following equations represents the burning of magnesium?

A. $Mg(s) + \frac{1}{2}O_2(g) + 601.6\ kJ \rightarrow MgO(s)$

B. $Mg(s) + \frac{1}{2}O_2(g) \rightarrow MgO(s) + 601.6\ kJ$

C. $Mg(s) + \frac{1}{2}O_2(g) \rightarrow MgO(s) \qquad \Delta H° = +601.6\ kJ$

D. $2\ Mg(s) + O_2(g) + 1\ 203.2\ kJ \rightarrow 2\ MgO(s)$

Use the following information to answer the next question.

$$4\ Q(s) + Z_2(g) + 100.0\ kJ \rightarrow 2\ Q_2Z(g)$$

8. The ΔH value for the reverse reaction would be

A. –100.0 kJ **B.** –50.0 kJ **C.** +50.0 kJ **D.** +100.0 kJ

Use the following information to answer the next question.

Fuel	Molar Enthalpy of Combustion
Methane	–802.5 kJ/mol
Ethane	–1 428.4 kJ/mol
Butane	–2 657.3 kJ/mol
Octane	–5 074.1 kJ/mol

9. An interpretation that applies to the data in the table above is that the greater the number of carbon atoms in a fossil fuel molecule, the

A. lower the amount of energy stored in the molecule
B. greater the amount of energy released during combustion
C. greater the strength of each carbon-carbon covalent bond
D. lower the chemical amount of oxygen required for complete combustion

10. If 44.7 kJ of energy is released when 1.65 g of ethanol, $C_2H_5OH(l)$, is burned in a calorimeter, then the molar enthalpy of combustion of ethanol is

A. –1.67 kJ/mol **B.** –27.1 kJ/mol **C.** –73.8 kJ/mol **D.** -1.25×10^3 kJ/mol

Use the following information to answer the next question.

In an experiment, technicians compared the use of methane and propane as fuels. They burned samples of the two fuels and used a calorimeter to determine the energy transferred. The combustion reactions are represented by the following equations.

$$CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g)$$

$$C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(g)$$

11. Which of the following statements correctly classifies two of the variables in the technicians' experiment?

A. The manipulated variable is the type of fuel, and a controlled variable is the type of calorimeter.

B. The responding variable is the final temperature of the water, and a controlled variable is the type of fuel.

C. The manipulated variable is the type of fuel, and a responding variable is the temperature change of the fuel.

D. The responding variable is the final temperature of the water, and a controlled variable is the temperature change of the fuel.

12. The energy released when 0.500 mol of AgI(s) is formed from its elements is _____ kJ.

NR

13. Which of the following equations represents the balanced chemical equation for the decomposition of water and the energy transfer during the reaction?

A. $H_2(g) + \frac{1}{2}\ O_2(g) \rightarrow H_2O(l) + 285.8\ kJ$

B. $H_2O(l) \rightarrow H_2(g) + \frac{1}{2}\ O_2(g) + 285.8\ kJ$

C. $2\ H_2O(l) + 285.8\ kJ \rightarrow 2\ H_2(g) + O_2(g)$

D. $H_2O(l) + 285.8\ kJ \rightarrow H_2(g) + \frac{1}{2}\ O_2(g)$

14. When used as a fuel in automobiles, ethanol burns more efficiently than fossil fuels. The balanced equation, including the appropriate enthalpy change for the combustion of ethanol, is

A. $C_2H_5OH(l) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) \quad \Delta H° = -1\ 234.8\ kJ$

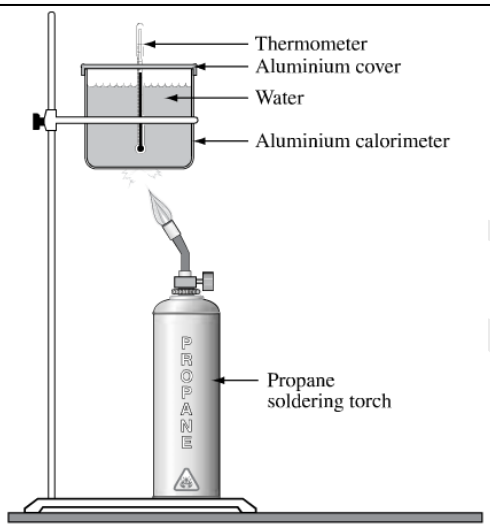
B. $C_2H_5OH(l) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) \quad \Delta H° = +1\ 234.8\ kJ$

C. $C_2H_5OH(l) \rightarrow 2\ C(s) + 3\ H_2(g) + \frac{1}{2}\ O_2(g) \quad \Delta H° = +277.6\ kJ$

D. $C_2H_5OH(l) \rightarrow 2\ C(s) + 3\ H_2(g) + \frac{1}{2}\ O_2(g) \quad \Delta H° = -277.6\ kJ$

Use the following information to answer the next question.

A technician performed an experiment to determine the molar enthalpy of combustion of propane in a soldering torch, as represented by the diagram below.



15. If the experimental value of the molar enthalpy of combustion of propane in the technician's calorimetry experiment is significantly different from the theoretical value, then the technician could reduce the discrepancy in the data by

A. using a glass beaker to hold the water
B. creating an enclosing shield around the apparatus
C. raising the aluminium calorimeter higher above the flame
D. decreasing the mass of water in the aluminium calorimeter

*Use the following information to answer the next **two** questions.*

Sucrose, $C_{12}H_{22}O_{11}(s)$, is commonly used to sweeten food. In order to determine the molar enthalpy of combustion for sucrose, a technician burns a 0.0150 mol sample of sucrose using a copper calorimeter that contains 250.0 g of water. The combustion of sucrose is represented by the following equation.

$$C_{12}H_{22}O_{11}(s) + 12\ O_2(g) \rightarrow 12\ CO_2(g) + 11\ H_2O(g)$$

16. If the temperature change of the water in the calorimeter is +55.5 °C, then the experimental molar enthalpy of combustion for sucrose is approximately

A. -8.72×10^{-1} kJ/mol **B.** -1.40×10^{1} kJ/mol **C.** -5.81×10^{1} kJ/mol **D.** -3.88×10^{3} kJ/mol

17. *If included as a term in the equation above, energy is a __i__ , and the water in the calorimeter undergoes a change primarily in __ii__ energy. This statement is completed by row:*

Row	*i*	*ii*
A.	reactant	kinetic
B.	reactant	potential
C.	product	kinetic
D.	product	potential

Use the following information to answer the next question.

Disposable lighters contain butane gas which undergoes combustion, as represented by the following equation: $2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$

18. According to the equation above, the molar enthalpy change for the combustion of butane gas is

A. –2 657.3 kJ/mol **B.** –2 877.3 kJ/mol **C.** –5 314.6 kJ/mol **D.** –5 754.6 kJ/mol

Use the following information to answer the next question.

A student uses a calorimeter to determine the molar enthalpy of solution for solid ammonium nitrate. The student assumes that the calorimeter neither gains nor loses heat during the experiment and that the density and specific heat capacity for the final solution are the same as those of water. The data was collected and recorded in the following table.

Mass of calorimeter	25.45 g
Mass of calorimeter and water	175.45 g
Mass of ammonium nitrate	1.68 g
Initial temperature of water	22.30 °C
Final temperature of water	20.98 °C

19. The experimental molar enthalpy of solution of ammonium nitrate is +/– _____ kJ/mol.

NR

Use the following information to answer the next question.

A student experimentally determined the molar enthalpy of formation for carbon dioxide gas by burning 1.04 g of C(s) in a calorimeter. The student found that burning the carbon released enough heat to increase the temperature of 1.00 kg of water from 12.00 °C to 19.36 °C.

20. In this experiment, the student determined that the molar enthalpy of formation for carbon dioxide was

A. -1.30×10^3 kJ/mol
B. -3.56×10^2 kJ/mol
C. –30.8 kJ/mol
D. –2.67kJ/mol

Use the following information to answer the next question.

$4\ HNO_3(aq) + 5\ N_2H_4(l) \rightarrow 7\ N_2(g) + H_2O(g) \qquad \Delta H = -2\ 462.0\ kJ$

21. Which statement is correct for the indicated reaction?

A. 205.2 kJ are absorbed per mole of $H_2O(g)$ produced
B. 351.7 kJ are absorbed per mole of $N_2(g)$ produced
C. 615.5 kJ are released per mole of $HNO_3(aq)$ consumed
D. 492.4 kJ are released per mole of $N_2H_4(g)$ produced

*Use the following information to answer the next **two** questions.*

Sour gas is a mixture of predominantly methane gas and hydrogen sulfide gas. The Claus process can be used to remove hydrogen sulfide gas from sour as represented by the following equation.

$$8\ H_2S(g)\ +\ 4\ O_2(g)\ \rightarrow\ S_8(s)\ +\ 8\ H_2O(g) \qquad \Delta H° = -\ 1\ 769.6\ kJ$$

22. NR The enthalpy change for 1.00 mol of $H_2S(g)$ during the Claus process, expressed in scientific notation, is $\pm\ \boldsymbol{a}.\boldsymbol{bc} \times 10^{\boldsymbol{d}}$ kJ/mol. The values of ***a***, ***b***, ***c***, and ***d*** are ____, ____, ____, and ____.

23. *During the Claus process, energy is __i__ the surroundings, and energy is included as a __ii__ in the balanced chemical equation. This statement is completed by row:*

Row	*i*	*ii*
A.	absorbed from	reactant
B.	absorbed from	product
C.	released to	reactant
D.	released to	product

Use the following information to answer the next question.

$$2\ CH_3OH(l) + 3\ O_2(g)\ \rightarrow\ 2\ CO_2(g) + 4\ H_2O(l)$$

24. The amount of thermal energy released for the complete combustion of one mole of methanol is

A. 725.9 kJ/mol **B.** 563.4 kJ/mol **C.** 277.6 kJ/mol **D.** 223.6 kJ/mol

*Use the following information to answer the next **two** questions.*

$$2\ CH_3OH(l) + 3\ O_2(g)\ \rightarrow\ 2\ CO_2(g) + 4\ H_2O(g) \qquad \Delta H° = -1\ 275.8\ kJ$$

25. NR The mass of methanol that burns to produce an enthalpy change of -9.00×10^4 kJ is _____ kg.

26. The amount of methanol that must be burned to raise the temperature of 250.0 g of water from 20.0 °C to 35.0 °C is

A. 6.16×10^{-3} mol
B. 1.23×10^{-2} mol
C. 2.46×10^{-2} mol
D. 2.46×10^{1} mol

27. The energy released during the combustion of the wood in the match originally came from the

A. Sun **B.** atmosphere
C. formation of cellulose in the wood **D.** decomposition of carbon dioxide and water

Use the following information to answer the next question.

Xenon tetrafluoride is a binary compound made from a noble gas. The formation of xenon tetrafluoride can be represented by the following equation.

$$Xe(g) + 2\ F_2(g) \rightarrow XeF_4(s) \qquad \Delta H° = -251\ kJ$$

28. The energy that is transferred when 69.1 g of $XeF_4(s)$ is produced is _____ kJ.

NR

*Use the following information to answer the next **two** questions.*

Some matches consist of a wooden stick and a head that contains tetraphosphorous trisulfide, $P_4S_3(s)$, and that can be ignited on any rough surface. When the match is drawn across a rough surface, enough heat is generated to start the reaction represented by the following equation.

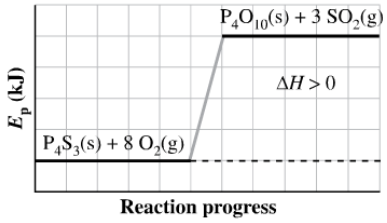
$$P_4S_3(s) + 8\ O_2(g) \rightarrow P_4O_{10}(s) + 3\ SO_2(g)$$

$$\Delta_f H°_{P_4S_3(s)} = -155.0\ kJ/mol$$

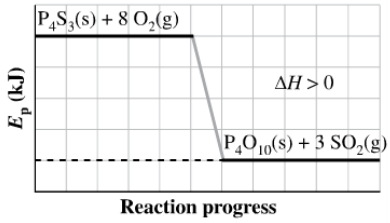
$$\Delta_f H°_{P_4O_{10}(s)} = -2\ 984.0\ kJ/mol$$

29. Which of the following potential energy diagrams represents the reaction that occurs at the head of the match?

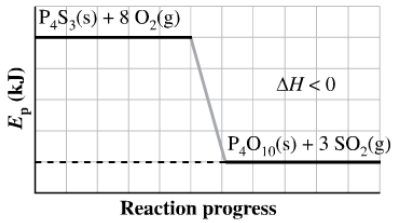
A.



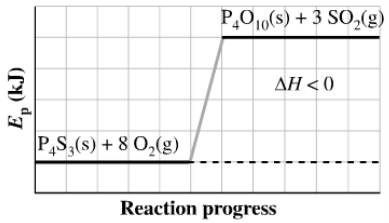
B.



C.



D.



Use the following information to answer the next question.

A hand-warmer packet contains a mixture of powdered iron, carbon, sodium chloride, sawdust, and zeolite, all moistened by a little water. The packet is activated by removing the plastic cover, which exposes the materials in the packet to air. The reaction that occurs is represented by the following equation.

$$4\ Fe(s) + 3\ O_2(g) \rightarrow 2\ Fe_2O_3(s) + 1\ 648.4\ kJ$$

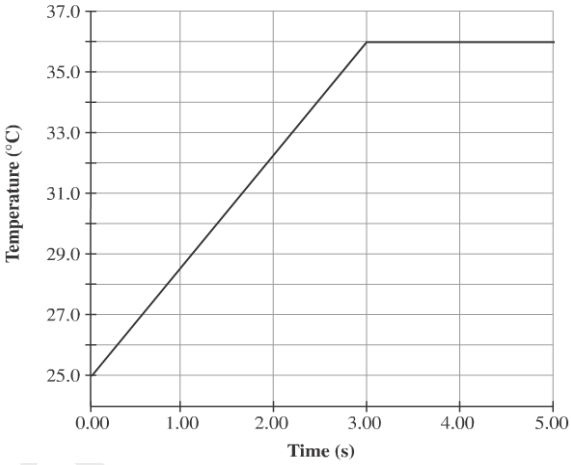
30. When 2.50 g of Fe2O3(s) is produced in the hand-warmer packet, the energy transferred is ___ kJ.

NR

A student mixed 50.0 mL of 1.00 mol/L HCl(aq) with 50.0 mL of 1.00 mol/L NaOH(aq) in a calorimeter. The final mass of the resulting solution was 100.0 g, and the change in temperature of the resulting solution was recorded over time, as shown in the graph.

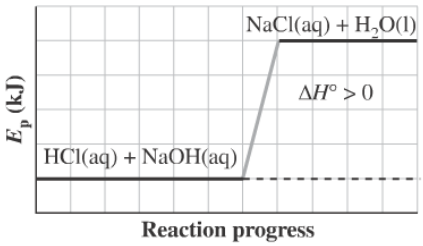
The student assumed that the specific heat capacity of the final solution was the same as that of water, and that the calorimeter neither gained or lost heat.

Calorimetry Data

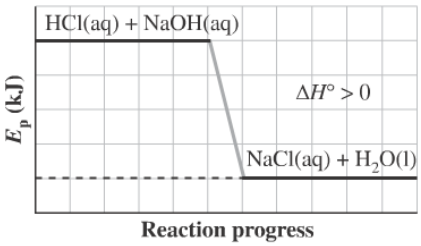


31. Which of the following potential energy diagrams represents the reaction that occurs during the student's experiment?

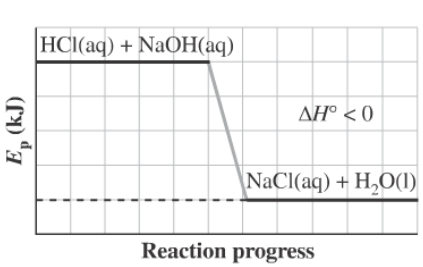
A.



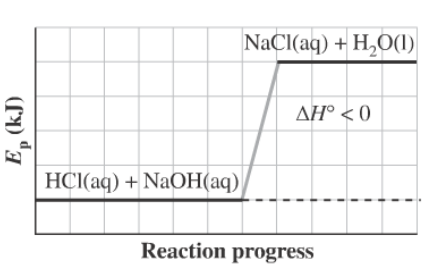
B.



C.



D.



Use the following information to answer the next question.

Airbags in vehicles contain the chemicals sodium azide, $NaN_3(s)$, and iron(III) oxide. When activated by an electrical spark, the sodium azide decomposes rapidly and the gas produced causes the airbag to expand. The reactions that occur in the airbag represented below.

Equation I $2\ NaN_3(s) \rightarrow 2\ Na(s) + 3\ N_2(g)$

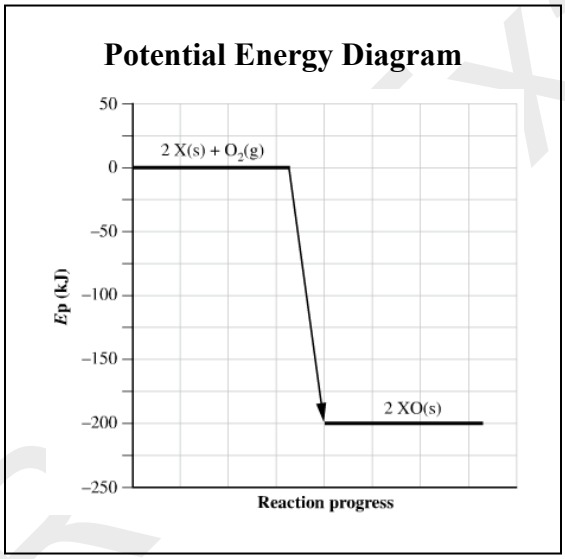
Equation II $Na(s) \rightarrow Na(l)$ $\Delta H = 2.61$ kJ

Equation III $6\ Na(l) + Fe_2O_3(s) \rightleftarrows 3\ Na_2O(s) + 2\ Fe(s)$ $\Delta H = -439.9$ kJ

32. If the molar enthalpy of formation for solid sodium azide is +21.7 kJ/mol, then the enthalpy change for the reaction represented by Equation I is

A. –43.4 kJ
B. –10.9 kJ
C. +10.9 kJ
D. +43.4 kJ

Use the following information to answer the next question.



33. *The reaction represented by the graph above is __i__ and the energy term would be included as a __ii__ in the balanced chemical equation.*

The statement above is completed by the information in row

Row	*i*	*ii*
A.	exothermic	product
B.	exothermic	reactant
C.	endothermic	product
D.	endothermic	reactant

Use the following information to answer the next question.

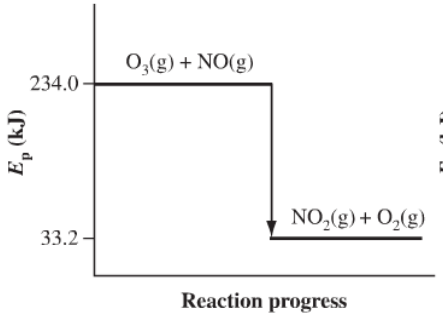
The ozone layer reduces the amount of ultraviolet radiation that reaches the surface of the Earth. In the upper atmosphere, ozone can be depleted by two-step reaction, as represented by the following equations.

Equation I $O_3(g) + NO(g) \rightarrow NO_2(g) + O_2(g)$

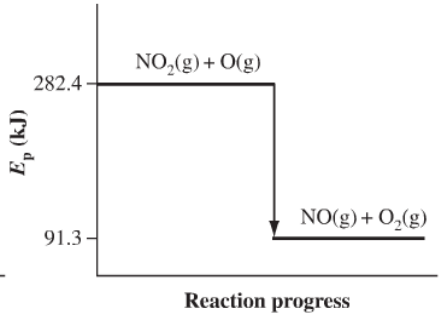
Equation II $NO_2(g) + O(g) \rightarrow NO(g) + O_2(g)$

Overall Equation $O_3(g) + O(g) \rightarrow 2\,O_2(g)$

Equation I



Equation II



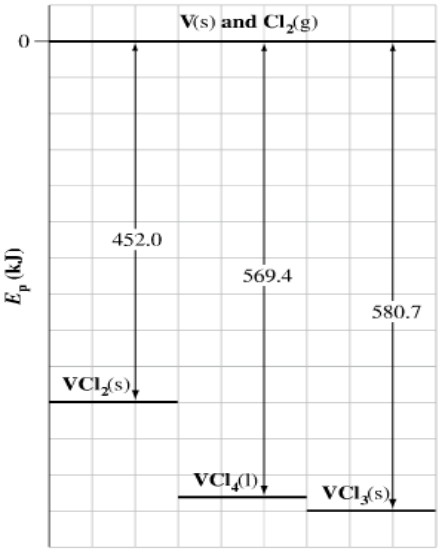
34. The energy transferred during the reaction represented by the overall equation is

A. 9.7 kJ **B.** 142.7 kJ **C.** 249.2 kJ **D.** 391.9 kJ

Use the following information to answer the next question.

The following diagram illustrates the formation enthalpies of V(s), $Cl_2(g)$, and a selection of their

Formation Enthalpies of Vanadium Chlorides ➔



35. The amount of energy absorbed when 0.350 mol of $VCl_4(l)$ decomposes to form $VCl_2(s)$ and $Cl_2(g)$ is _____ kJ.

Use the following information to answer the next question.

Unit A: Thermochemical Changes – Answers

1. 2.81
2. 27.5
3. C
4. B
5. C
6. A
7. B
8. A
9. B
10. D
11. A
12. 30.9
13. D
14. A
15. B
16. D
17. C
18. A
19. 39.5
20. B
21. C
22. 2212
23. D
24. A
25. 4.52
26. C
27. A
28. 83.7
29. C
30. 12.9
31. C
32. A
33. A
34. D
35. 41.1
36. C
37. B
38. B
39. C
40. C
41. B
42. C
43. C
44. A
45. D
46. C
47. C
48. D
49. 2467
50. 3435
51. A
52. A
53. 3124
54. B
55. D
56. B
57. D
58. 78.7
59. 77.6
60. 2356
61. C
62. A
63. 40.2
64. B
65. A
66. C
67. D
68. B
69. D
70. A
71. A
72. C
73. C
74. C
75. 2111
76. A

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