***** ANSWER KEY *****

Student Name: **Grade:** 09

Test Name: November Chemistry for All: Unit 9 - Thermochemistry and Solutions **Version:** 1

1. The heat of formation of sodium chloride is ΔH= –410.9kJ/mol NaCl under standard conditions. If a reaction produces 1.30 moles of sodium chloride, how much heat will be released as a result?

(a) 316 kJ
(b) 534 kJ
✔ (c) -534 kJ
(d) -316 kJ

Standard:

MI_CHEM_HS-0912-C3-1x-d
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic c3.1x Hess's Law
C3.1d Calculate the amount of heat produced for a given mass of reactant from a balanced chemical equation.

2. The heat of formation of sodium chloride is $\Delta H = -410.9$kJ/mol NaCl under standard conditions. If a reaction produces 22.00g of sodium chloride, how much heat will be released as a result?

(a) 133.9 kJ
✔ (b) -154.7 kJ
(c) 1090. kJ
(d) -9043 kJ

Standard:

MI_CHEM_HS-0912-C3-1x-d
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic c3.1x Hess's Law
C3.1d Calculate the amount of heat produced for a given mass of reactant from a balanced chemical equation.

3. In the reaction $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s) + 821.8kJ$, if 5.000 moles of sodium chloride are produced, how much heat is released?

(a) 4109 kJ
(b) -4109 kJ
(c) 2500. kJ
✔ (d) -2500. kJ

Standard:

MI_CHEM_HS-0912-C3-1x-d
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic c3.1x Hess's Law
C3.1d Calculate the amount of heat produced for a given mass of reactant from a balanced chemical equation.

4. The heat of reaction for $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is 93.8kJ/mol $NH_3(g)$. What is ΔH for this reaction if we start with 35.0 g of $N_2(g)$?

(a) 3280 kJ
✔ (b) 235 kJ
(c) 117 kJ
(d) 58.6 kJ

Standard:

MI_CHEM_HS-0912-C3-1x-d
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic c3.1x Hess's Law
C3.1d Calculate the amount of heat produced for a given mass of reactant from a balanced chemical equation.

5. The specific heat of aluminum is 0.900J/gC Al and that of water is 4.184J/gC H_2O. Which requires more heat to raise one gram of the substance one degree Celsius?

✔ (a) water
(b) aluminum

Standard:

MI_CHEM_HS-0912-C5-4-A
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.4 Phase Change/Diagrams
C5.4A Compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees.

6. The specific heat of aluminum is 0.900J/gC Al and that of water is 4.184J/gC H_2O. The temperature of 1.00g of each has to be raised 50.0ºC, how much heat energy will be required for each?

(a) 0.0180 J for aluminum and 0.0837 J for water
✔ (b) 45.0 J for aluminum and 209 J for water
(c) 50.9 J for aluminum and 54.2 J for water
(d) 55.6 J for aluminum and 12.0 J for water

Standard:

MI_CHEM_HS-0912-C5-4-A
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.4 Phase Change/Diagrams
C5.4A Compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees.

7. The specific heat of aluminum is 0.900J/gC Al and that of water is 4.184J/gC H_2O. The temperature of 1.00g of each has to be raised from 22.0ºC to 66.0ºC. How much energy will be required to do this to each?

(a) 79.2 J for aluminum and 368 J for water
(b) 59.4 J for aluminum and 276 J for water
✔ (c) 39.6 J for aluminum and 184 J for water
(d) 19.8 J for aluminum and 92.0 J for water

Standard:

MI_CHEM_HS-0912-C5-4-A
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.4 Phase Change/Diagrams
C5.4A Compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees.

8. Sodium chloride has a melting point of 801ºC, the melting point of water is 0ºC. In terms of the forces between the particles, why does this occur?

(a) Sodium chloride is a polar compound and water is a non-polar compound, so the attraction between solid sodium chloride particles is greater than that between water particles.

(b) Sodium chloride is a non-polar compound and water is a polar compound, so the attraction between solid sodium chloride particles is greater than water particles.

(c) Both sodium chloride and water form a three dimensional network of bonds in their solid form, but the bonds that hold the particles of sodium chloride together are weaker than those that hold the particles of water together.

✔ (d) Both sodium chloride and water form a three dimensional network of bonds in their solid form, but the bonds that hold the particles of sodium chloride together are stronger than those that hold the particles of water together.

Standard:

MI_CHEM_HS-0912-C2-1x-c

MI HSCEs Science - Chemistry

- 09-12
  - STANDARD C2: FORMS OF ENERGY
    - Topic C2.1x Chemical Potential Energy
      - C2.1c Compare qualitatively the energy changes associated with melting various types of solids in terms of the types of forces between the particles in the solid.

9. The melting point of methane (CH_4) is –182ºC, the melting point of water is 0ºC. Comparing the forces between the particles, why does this occur?

✔ (a) Methane is a non-polar compound, so there is comparatively weak attraction between the particles that make up its solid, and water is a polar compound so there is a much stronger attraction between the particles that make up its solid.

(b) Methane is a polar compound, so there is comparatively weak attraction between the particles that make up its solid, and water is a non-polar compound so there is a much stronger attraction between the particles that make up its solid.

(c) Methane is an ionic compound, so there is comparatively weak attraction between the particles that make up its solid, and water is a polar compound so there is a much stronger attraction between the particles that make up its solid.

(d) Methane is an ionic compound, so there is comparatively weak attraction between the particles that make up its solid, and water is a non-polar compound so there is a much stronger attraction between the particles that make up its solid.

Standard:

MI_CHEM_HS-0912-C2-1x-c

MI HSCEs Science - Chemistry

- 09-12
  - STANDARD C2: FORMS OF ENERGY
    - Topic C2.1x Chemical Potential Energy
      - C2.1c Compare qualitatively the energy changes associated with melting various types of solids in terms of the types of forces between the particles in the solid.

10. The melting point of methane (CH_4) is –182ºC, that of decane ($C_{10}H_{22}$) is –30ºC. Based on the forces between the particles, why does methane have a lower melting point?

(a) Methane is non-polar so the attraction between the particles of solid methane is small, and decane is polar so the attraction between solid particles of decane is greater.

(b) Methane is polar so the attraction between particles of solid methane is small, and decane is non–polar so the attraction between solid particles of decane is greater.

(c) Both methane and decane are polar, but decane is made of much larger molecules, so the attraction between each particle of decane is greater than that between particles of methane.

✔ (d) Both methane and decane are non polar, but decane is made of much larger molecules, so the attraction between each particle of decane is greater than that between particles of methane.

Standard:

MI_CHEM_HS-0912-C2-1x-c

MI HSCEs Science - Chemistry

- 09-12
  - STANDARD C2: FORMS OF ENERGY
    - Topic C2.1x Chemical Potential Energy
      - C2.1c Compare qualitatively the energy changes associated with melting various types of solids in terms of the types of forces between the particles in the solid.

11. One of the characteristics that distinguish ionic compounds from covalent compounds is that ionic compounds have a high melting point and covalent compounds do not. Explain this difference in terms of the attraction between the particles that make them up.

Rubric:

Ans: Ionic compounds form crystalline networks and covalent compounds form individual molecules. The ionic compounds are also held together by electrostatic forces (or ionic bonds) which are stronger than the intermolecualr forces in the covalent molecules.

4- All terms and get 1 comparison

3- 4 terms or 2 terms and a comparison

2- 2 terms or just the comparison

1- Any terms

0- Nothing correct

Standard:

MI_CHEM_HS-0912-C2-1x-c

MI HSCEs Science - Chemistry

- 09-12
  - STANDARD C2: FORMS OF ENERGY
    - Topic C2.1x Chemical Potential Energy
      - C2.1c Compare qualitatively the energy changes associated with melting various types of solids in terms of the types of forces between the particles in the solid.

12. When heated metal is placed in a calorimeter with water, in what direction does the heat travel, and does the temperature of the water increase or decrease?

(a) Heat travels from the water into the metal causing the temperature of the water to decrease.

(b) Heat travels from the metal into the water causing the temperature of the water to decrease.

(c) Heat travels from the water into the metal causing the temperature of the water to increase.

✔ (d) Heat travels from the metal into the water causing the temperature of the water to increase.

Standard:

MI_CHEM_HS-0912-C3-1x-c
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic c3.1x Hess's Law
C3.1c Calculate the 'delta H' (change in H) for a chemical reaction using simple coffee cup calorimetry.

13. When sodium hydroxide is added to water the temperature of the water increases. What does this indicate about the enthalpy and the type of reaction?

✔ (a) ΔH is negative and this is an exothermic reaction.

(b) ΔH is negative and this is an endothermic reaction.

(c) ΔH is positive and this is an exothermic reaction.

(d) ΔH is positive and this is an endothermic reaction.

Standard:

MI_CHEM_HS-0912-C3-1x-c
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic c3.1x Hess's Law
C3.1c Calculate the 'delta H' (change in H) for a chemical reaction using simple coffee cup calorimetry.

14. When ammonium nitrate is added to water the temperature of the water decreases. What does this tell you about the enthalpy and type of reaction?

(a) ΔH is negative and this is an exothermic reaction.
(b) ΔH is negative and this is an endothermic reaction.
(c) ΔH is positive and this is an exothermic reaction.
✔ (d) ΔH is positive and this is an endothermic reaction.

Standard:

MI_CHEM_HS-0912-C3-1x-c
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic c3.1x Hess's Law
C3.1c Calculate the 'delta H' (change in H) for a chemical reaction using simple coffee cup calorimetry.

15. In a calorimeter sodium is reacted with chlorine, producing 5.84g of NaCl. In the process it is recorded that the quantity of heat released to the calorimeter and water in it is 41,100J. What is the molar heat of reaction for sodium chloride?

(a) 7.04 kJ
✔ (b) 411 kJ
(c) 7040 kJ
(d) 411,000 kJ

Standard:

MI_CHEM_HS-0912-C3-1x-c
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic c3.1x Hess's Law
C3.1c Calculate the 'delta H' (change in H) for a chemical reaction using simple coffee cup calorimetry.

16. How will the boiling point of a solution of salt water compare to the boiling point of the same volume of pure water, and why?

(a) lower temperature, because there is less water to heat up

(b) higher temperature, because the salt has a higher boiling point than water

(c) lower temperature, because the salt lowers the partial pressure of the water

✔ (d) higher temperature, because the salt lowers the partial pressure of the water

Standard:

MI_CHEM_HS-0912-C4-7x-a

MI HSCEs Science - Chemistry

09-12

STANDARD C4: PROPERTIES OF MATTER

Topic C4.7x Solutions

C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution.

17. How will the freezing point of a solution of salt water compare to the boiling point of the same volume of pure water, and why?

✔ (a) lower temperature, because the salt particles disrupt the ordered pattern that must exist amongst the water molecules for freezing to take place

(b) higher temperature, because the salt particles disrupt the ordered pattern that must exist amongst the water molecules for freezing to take place

(c) lower temperature, because the salt particles increase the ordered pattern that must exist amongst the water molecules for freezing to take place

(d) higher temperature, because the salt particles increase the ordered pattern that must exist amongst the water molecules for freezing to take place

Standard:

MI_CHEM_HS-0912-C4-7x-a

MI HSCEs Science - Chemistry

09-12

STANDARD C4: PROPERTIES OF MATTER

Topic C4.7x Solutions

C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution.

18. When calculating the effect of a solute on freezing point or boiling point of a specific solvent, how does the effect differ when the identity of solute particles changes, assuming concentration is the same?

(a) The effect depends on the nature of the solute.

✔ (b) The same changes will be observed no matter what the solutes are.

(c) The change in freezing point will be different for different solutes, but the change in boiling point will be the same.

(d) The change in boiling point will be different for different solutes, but the change in freezing point will be the same.

Standard:

MI_CHEM_HS-0912-C4-7x-a
MI HSCEs Science - Chemistry
09-12
STANDARD C4: PROPERTIES OF MATTER
Topic C4.7x Solutions
C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution.

19. A solution is prepared using 3.00 moles of $CaCl_2$ in 1.5kg of water. How many particles are produced by the dissociation of this compound?

(a) one particle per formula unit of $CaCl_2$

(b) two particles per formula unit of $CaCl_2$

✔ (c) three particles per formula unit of $CaCl_2$

(d) five particles per formula unit of $CaCl_2$

Standard:

MI_CHEM_HS-0912-C4-7x-a
MI HSCEs Science - Chemistry
09-12
STANDARD C4: PROPERTIES OF MATTER
Topic C4.7x Solutions
C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution.

20. Given the freezing point depression constant for water is -1.86°C/*m*, at what temperature will this solution freeze?

(a) -3.72°C
(b) -7.44°C
✔ (c) -11.2°C
(d) -18.6°C

Standard:

MI_CHEM_HS-0912-C4-7x-a
MI HSCEs Science - Chemistry
09-12
STANDARD C4: PROPERTIES OF MATTER
Topic C4.7x Solutions
C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution.

21. Explain why gases are less soluble in warm water than in cold water.

Rubric:

3: whole answer (or equivalent wording) 2: relationship between temperature & order , plus relationship between dissolution & order in gases 1: either of the relationships in 2-pt answer 0: none of the above

Standard:

MI_CHEM_HS-0912-C3-4x-g
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic C3.4x Enthalpy and Entropy
C3.4g Explain why gases are less soluble in warm water than cold water.

22. The solubility of oxygen in water will be greatest at which of the following temperatures?

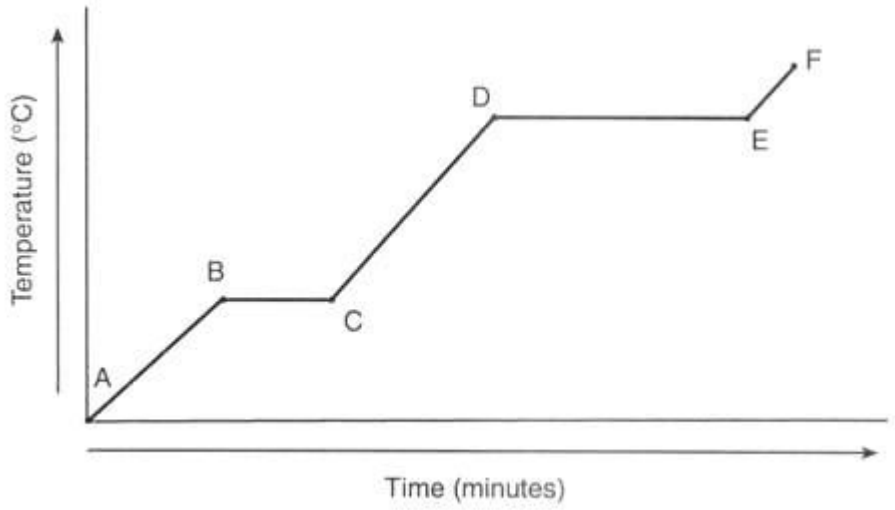
✔ (a) 275 K
(b) 290. K
(c) 315 K
(d) 330. K

Standard:

MI_CHEM_HS-0912-C3-4x-g
MI HSCEs Science - Chemistry
09-12
STANDARD C3: ENERGY TRANSFER AND CONSERVATION
Topic C3.4x Enthalpy and Entropy
C3.4g Explain why gases are less soluble in warm water than cold water.

Instructions for questions 23 through 27.

For the questions below, refer to the graph of the heating curve for water:



23. Which region of the graph represents the process of melting ice?

(a) from point A to point B
✔ (b) from point B to point C
(c) from point C to point D
(d) from point D to point E
(e) from point E to point F

Standard:

MI_CHEM_HS-0912-C5-4-B
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.4 Phase Change/Diagrams
C5.4B Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling.

24. What region of the graph represents boiling of water?

(a) from point A to point B
(b) from point B to point C
(c) from point C to point D
✔ (d) from point D to point E
(e) from point E to point F

Standard:

MI_CHEM_HS-0912-C5-4-B
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.4 Phase Change/Diagrams
C5.4B Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling.

25. What portion of the graph represents solid water?

- ✔ (a) from point A to point B
- (b) from point B to point C
- (c) from point C to point D
- (d) from point D to point E
- (e) from point E to point F

Standard:

MI_CHEM_HS-0912-C5-4-B
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.4 Phase Change/Diagrams
C5.4B Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling.

26. Which region of the graph represents water as a vapor?

- (a) from point A to point B
- (b) from point B to point C
- (c) from point C to point D
- (d) from point D to point E
- ✔ (e) from point E to point F

Standard:

MI_CHEM_HS-0912-C5-4-B
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.4 Phase Change/Diagrams
C5.4B Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling.

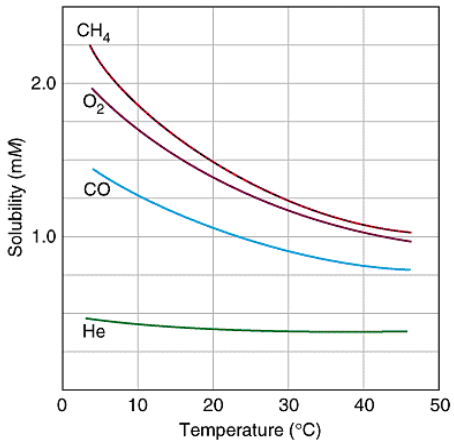
27. Which portion of the graph represents water in the liquid state?

(a) from point A to point B
(b) from point B to point C
✔ (c) from point C to point D
(d) from point D to point E
(e) from point E to point F

Standard:

MI_CHEM_HS-0912-C5-4-B
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.4 Phase Change/Diagrams
C5.4B Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling.

28. Looking at the gas solublity chart below, what is the general trend in solubilty for gases as temperature decreases?



(a) There is no relationship.

✔ (b) As temperature decreases, solubility increases.

(c) As temperature decreases, solubility decreases.

Standard:

MI_CHEM_HS-0912-C3-4x-g

MI HSCEs Science - Chemistry

- 09-12
  - STANDARD C3: ENERGY TRANSFER AND CONSERVATION
    - Topic C3.4x Enthalpy and Entropy
      - C3.4g Explain why gases are less soluble in warm water than cold water.

29. Explain the relationship between a substance's structure and its melting point. Give specific examples to illustrate your answer.

Rubric:

4: correct ranking of all 3 relationships; correct forces and examples

3: correct ranking of all 3 relationships; correct forces or examples

2: correct ranking of all 3 relationships

1: correct ranking of any 2 relationships

0: clueless

Standard:

MI_CHEM_HS-0912-C5-5x-e

MI HSCEs Science - Chemistry

- 09-12
  - STANDARD C5: CHANGES IN MATTER
    - Topic C5.5x Chemical Bonds
      - C5.5e Relate the melting point, hardness, and electrical and thermal conductivity of a substance to its structure.

30. Which of the following types of solids would have the highest conductivity?

(a) metallic
(b) covalent molecular
(c) ionic
✔ (d) covalent network

Standard:

MI_CHEM_HS-0912-C5-5x-e
MI HSCEs Science - Chemistry
09-12
STANDARD C5: CHANGES IN MATTER
Topic C5.5x Chemical Bonds
C5.5e Relate the melting point, hardness, and electrical and thermal conductivity of a substance to its structure.

31. Two beakers with the same volume of water, one at room temperature and one near boiling, each have a drop of food coloring added. How will the appearance of the water differ, if at all, after 1 minute and why?

(a) There will be no difference, since the beakers have the same volume of water.

(b) The room-temperature water will have the food coloring spread more, since the molecules are closer together.

(c) The hot water will have the food coloring spread more, since the molecules are farther apart.

✔ (d) The hot water will have the food coloring spread more, since the molecules are moving faster.

(e) The room-temperature water will have the food coloring spread more, since the molecules are moving slower.

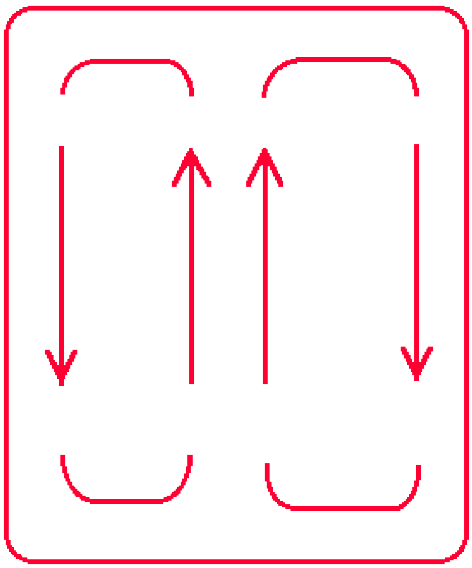
Standard:

MI_CHEM_HS-0912-C2-2x-d

MI HSCEs Science - Chemistry

- 09-12
  - STANDARD C2: FORMS OF ENERGY
    - Topic C2.2x Molecular Entropy
      - C2.2d Explain convection and the difference in transfer of thermal energy for solids, liquids, and gases using evidence that molecules are in constant motion.

32. Looking at the diagram below, would you expect the transfer of heat to be faster in a solid, liquid, or gas?



(a) solid
(b) liquid
✔ (c) gas
(d) there is no difference

Standard:

MI_CHEM_HS-0912-C2-2x-d
MI HSCEs Science - Chemistry
09-12
STANDARD C2: FORMS OF ENERGY
Topic C2.2x Molecular Entropy
C2.2d Explain convection and the difference in transfer of thermal energy for solids, liquids, and gases using evidence that molecules are in constant motion.