

CHM 2045 Exam 2 Review - Fall 2023 - Academic Resources

1. If 1000. g of boiling water (at 100 °C) was placed in an 1800. g cast iron skillet initially at 25°C, and the final equilibrium temperature of the water and the skillet was 88°C, estimate the specific heat capacity of the skillet. Assume this is a closed system and that the specific heat capacity of water is 4.184 J/°C•g. **= 0.4428 J/g °C**

2. Which statement is incorrect regarding internal energy (U, E) and the first law of thermodynamics?
 - A) The first law of thermodynamics states that energy must be conserved.
 - B) When the system gains heat and performs work, then $\Delta\{U, E\}$ for the system must be positive.**
 - C) The first law of thermodynamics does not imply that heat can't be converted to work.
 - D) When the system loses heat and performs work, then $\Delta\{U, E\}$ for the system must be negative.
 - E) When its $\Delta\{U, E\}$ increases, then the system must gain heat or have work performed on it, or both.

3. Deterioration of buildings, bridges, and other structures through the rusting of iron costs millions of dollars a day. The enthalpy of formation of rust, Fe₂O₃(s), is -826.0 kJ/mol. How much heat is released (in kJ) when 0.500 kg of Fe reacts with 200. g of O₂, forming Fe₂O₃(s)? **=3442 kJ**

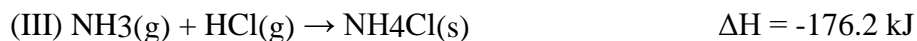
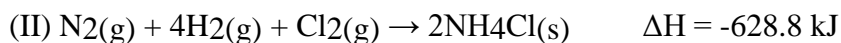
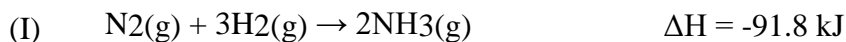
4. When 50.0 ml of 0.200 M AgNO₃ and 50.0 ml of 0.100 M CaCl₂, both at 25.0°C, are reacted in a coffee-cup calorimeter, the temperature of the reacting mixture increases to 26.0°C. Calculate ΔH in kJ per mole of AgCl produced. Assume the density of the solution is 1.05 g/ml and the specific heat capacity of the solution 4.20 J/g°C.

$$\Delta H = -44.1 \text{ kJ/mol}$$

5. A pure gold ring (C = 0.128 J/g°C) and pure silver ring (C = 0.235 J/g°C) have a total mass of 15.3g. The two rings are heated to 62.1°C and dropped into a 13.1mL of water (ρ = 1.00 g/mL and C = 4.184 J/g°C) at 20.9°C. When equilibrium is reached, the temperature of the water is 22.9°C. What was the mass of the gold ring?

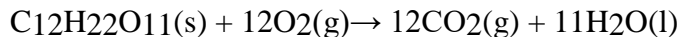
$$= 7.5 \text{ g}$$

6. Find the heat of formation of gaseous HCl



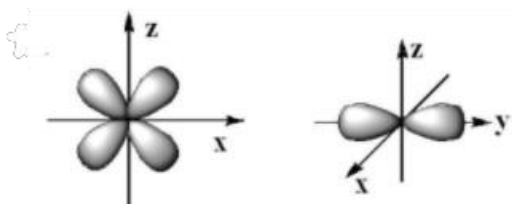
$$\Delta H_f = -92.3 \text{ kJ}$$

7. Consider the reaction



in which 10.0 g of sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$, was burned in a bomb calorimeter with a heat capacity of $7.50 \text{ kJ}/^\circ\text{C}$. The temperature increase inside the calorimeter was found to be 22.0°C . What is the heat of this reaction per mole of sucrose? **-5648 kJ/mol**

8. For each of the following orbital shapes below, give the maximum number of electrons that can be accommodated in the orbitals that share the same principal quantum number, n , and angular quantum number, l .



A) 4, 2 B) 6, 2 C) 5, 3 **D) 10, 6** E) 14, 10

9. Which of the following full sets of quantum numbers is incorrect?

- a) The e^- gained from $\text{Br} \rightarrow \text{Br}^-$; $n=4, l=1, m_l=+1, m_s=-1/2$
- b) The outermost e^- in Rb; $n=5, l=0, m_l=0, m_s=+1/2$
- c) The 6th e^- in O; $n=2, l=0, m_l=0, m_s=+1/2$**
- d) The 3rd e^- in F; $n=2, l=0, m_l=0, m_s=+1/2$
- e) The 8th e^- in O; $n=2, l=1, m_l=-1, m_s=-1/2$

10. Which of the following electron configurations are correct?

I. Hg: [Xe] $6s^2 4f^{14} 5d^{10}$ II. Mo: [Kr] $5s^1 4d^5$ III. Cr: [Ar] $4s^2 3d^4$

IV. Au: [Xe] $6s^2 4f^{14} 5d^9$ V. Cu: [Ar] $4s^1 3d^{10}$

a) I, III, V

b) II, IV

c) I, II, V

d) None

e) All

11. Which of the following electron configurations for these ions are correct?

I. Ca^{2+} : [Ar] $4s^2$ II. V^{3+} : [Ar] $3d^2$ III. S^{2-} : [Ne] $3s^2 3p^6$ IV. Cr^{3+} : [Ar] $3d^3$ V. Br^- : [Ar] $5s^2 4d^{10} 5p^6$

a) All

b) I, V

c) II, IV, V

d) III, V

e) II, III, IV

12. Which of these are in the correct increasing atomic size order?

a) Sr < Ca < Mg

b) Rb < Br < Kr

c) Se < Br < Cl

d) Xe < I < Ba

e) K < P < F

13. Which of these are in the correct order for increasing IE_1 .

a) Cs < Xe < I

b) Kr < Ar < He

c) Rb < Ca < K

d) Sn < Sb < I

e) A and C

f) B and D

14. Which of the following statements on successive IE is true?

- a) Between Rb, Sr, and Y, Rb has the highest IE_2
- b) Between Rb, Sr, and Y, Sr has the highest IE_2
- c) Between Na, Mg, Al, and Si, Al has the highest IE_4
- d) Between Na, Mg, Al, and Si, Si has the highest IE_4
- e) A and C
- f) B and D

15. Label the following ions paramagnetic or diamagnetic.

I. Co^{3+} paramagnetic

II. Hg^{2+} diamagnetic

III. Cr^{3+} paramagnetic

IV. V^{3+} paramagnetic

V. Zn^{2+} diamagnetic

16. Which ions are ranked correctly by decreasing size?

I. $Sr^{2+} > Ca^{2+} > Mg^{2+}$ II. $S^{2-} > Cl^- > K^+$ III. $Mg^{2+} > Na^+ > F^-$ IV. $Ba^{2+} > Cs^+ > I^-$ V. $P^{3-} > S^{2-} > Cl^-$

- a) I, III, V
- b) II, IV
- c) I, II, V
- d) I, IV, V
- e) II, III, IV, V

17. Which of the following is the correct order for increasing bond length?

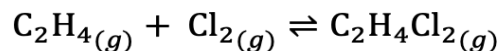
C-C, C=C, $C\equiv C$

- a) $C\equiv C < C=C < C-C$
- b) $C=C < C\equiv C < C-C$
- c) $C-C < C=C < C\equiv C$
- d) $C\equiv C < C-C < C=C$

18. How are bond length and bond strength related?

- a) Inversely related
- b) Directly related
- c) Length = 1/2 Strength
- d) Strength = 1/2 Length

19. Calculate the enthalpy of the reaction:



Given the following bond energies:

C-C 347 kJ/mol
C=C 614 kJ/mol
C≡C 839 kJ/mol

C-H 413 kJ/mol
C-Cl 339 kJ/mol
Cl-Cl 243 kJ/mol

H-H 432 kJ/mol
H-Cl 427 kJ/mol

- a) -1078 kJ
- b) +168 kJ
- c) -168 kJ
- d) +563 kJ
- e) -563 kJ