

- Under what conditions will the molarity of a solution be almost numerically equal to its molality?
 - high temperature
 - low temperature
 - high concentration
 - low concentration
 - high pressure
- 1.68 moles of $\text{Al}_2(\text{SO}_4)_3$ are mixed with 350. mL of H_2O . What is the molality of $\text{Al}_2(\text{SO}_4)_3$ in this solution?
 - 4.80 m
 - 1.82 m
 - 1.68 m
 - 3.85 m
 - 37.0 m
- If 50.0 mL of a 2.00 M MgBr_2 (aq) solution is diluted to 250.0 mL with water, what will be the concentration of the Br^- ions in the new solution?
 - 0.200M
 - 0.333 M
 - 0.400 M
 - 0.667 M
 - 0.800 M
- Which of the following concentration units is affected by temperature changes?
 - molarity
 - molality
 - mole fraction
 - percent composition
 - all of these are affected by temperature changes
- A 3.50 M MgSO_4 (aq) solution could be prepared by
 - dissolving 3.50 grams of MgSO_4 in 1.00 L of water.
 - dissolving 3.50 moles of MgSO_4 in 1.00 L of water.
 - dissolving 3.50 moles of MgSO_4 in 1.00 kg of water
 - dissolving 3.50 moles of MgSO_4 in enough water to make 1.00 L of solution.
 - dissolving 3.50 moles of MgSO_4 in enough water to make 1.00 kg of solution.

6. A solution is labeled $0.255\text{M Mg}_2(\text{PO}_4)_3 (\text{aq})$. What is the concentration of phosphate ions in this solution?
- A. 0.765 M
 - B. 0.510 M
 - C. 0.128 M
 - D. 0.085 M
 - E. 0.255 M
7. Rubbing alcohol is an aqueous solution that contains 293 grams of isopropanol ($\text{C}_3\text{H}_7\text{OH}$) per 500. mL of solution. Calculate the molarity of isopropanol in rubbing alcohol.
- A. 0.101 M
 - B. 0.293 M
 - C. 4.88 M
 - D. 2.93 M
 - E. 9.77 M
8. Seawater contains 1.94% chlorine by mass. How many grams of chlorine are there in 400 mL of seawater if the density of seawater is 1.03 g/mL ?
- A. 7.53 g
 - B. 7.76 g
 - C. 7.99 g
 - D. 5.86 g
 - E. 4.12 g
9. What is the molality of NaOH in a solution labeled " $28.7\%(\text{w/w})\text{ NaOH} (\text{aq})$?"
- A. 7.18 m
 - B. 10.0 m
 - C. 19.5 m
 - D. 40.3 m
 - E. 2.87 m
10. If 25.0 mL of a $5.00\text{ M HNO}_3(\text{aq})$ solution is diluted to 100.0 mL with water, what will be the new concentration of the $\text{HNO}_3(\text{aq})$?
- A. 3.00 M
 - B. 2.00 M
 - C. 1.50 M
 - D. 1.25 M
 - E. 1.00 M

11. Two metals of equal mass with different heat capacities are exposed to the same amount of heat. Which metal undergoes the smaller change in temperature?
- A. The metal with the higher heat capacity.
 - B. The metal with the lower heat capacity.
 - C. Both undergo the same temperature change.
 - D. You need to know the the initial temperature of the metals.
 - E. You need to know the shape of the metals.
12. If liquid mercury (Hg) has a specific heat capacity of $0.14 \text{ J/g}\cdot^\circ\text{C}$, what is the molar heat capacity of liquid mercury?
- A. $75.3 \text{ J/mol}\cdot^\circ\text{C}$
 - B. $7.00 \text{ J/mol}\cdot^\circ\text{C}$
 - C. $14.3 \text{ J/mol}\cdot^\circ\text{C}$
 - D. $28.1 \text{ J/mol}\cdot^\circ\text{C}$
 - E. $200.1 \text{ J/mol}\cdot^\circ\text{C}$
13. Which of the following is a unit of energy?
- A. kJ
 - B. km
 - C. kPa
 - D. kL
 - E. none of these
14. Which of the following is the symbol for heat capacity?
- A. Cal
 - B. ΔE
 - C. C
 - D. ΔT
 - E. q
15. A Bomb Calorimeter has a “fixed volume” so that no change in volume can occur. Which of the following must also be true according to the First Law of Thermodynamics?
- A. $\Delta E = w$
 - B. $\Delta E = q$
 - C. $q=w$
 - D. $q = 0$
 - E. $q= -w$
16. Which of the following terms refers to a property that is dependent only on final and initial conditions rather than the path a reaction follows?
- A. thermodynamics
 - B. state function
 - C. calorimetry
 - D. exothermic
 - E. spontaneous
17. The term enthalpy refers to:
- A. an energy change measured at constant volume.
 - B. an energy change measured at constant pressure.
 - C. an energy change measured at constant temperature.
 - D. an energy change measured at constant concentration.
 - E. an energy change measured at constant time.

18. For a particular process $q = -17 \text{ kJ}$ and $w = +21 \text{ kJ}$. Which of the following statements is false for this process?
- A. Heat flows from the system to the surroundings.
 - B. The system does work on the surroundings.
 - C. $\Delta E = +4 \text{ kJ}$
 - D. The process is exothermic.
19. A 125 gram sample of $\text{H}_2\text{O} (\text{l})$, which has a temperature of $25.0 \text{ }^\circ\text{C}$, gains 2.10 kJ of heat. What will its final temperature be?
- A. 25.0 (less than $0.1 \text{ }^\circ\text{C}$ change)
 - B. $26.0 \text{ }^\circ\text{C}$
 - C. $29.0 \text{ }^\circ\text{C}$
 - D. $24.0 \text{ }^\circ\text{C}$
 - E. $21.0 \text{ }^\circ\text{C}$
20. Calculate the ΔH for the reaction below:
- $$\text{C}_2\text{H}_4 (\text{g}) + 3 \text{O}_2 (\text{g}) \rightarrow 2 \text{CO}_2 (\text{g}) + 2 \text{H}_2\text{O} (\text{l})$$
- A. -1412 kJ
 - B. $+52 \text{ kJ}$
 - C. -1324 kJ
 - D. -1308 kJ
 - E. -628 kJ
21. What is ΔH for the reaction when one mole of $\text{CH}_4 (\text{g})$ is formed from its elements in their standard state?
- A. 0 kJ
 - B. $+16 \text{ kJ}$
 - C. -16 kJ
 - D. $+75 \text{ kJ}$
 - E. -75 kJ

Use the following reactions for the questions 22 – 26:

I.	$\text{B}_2\text{O}_3 (\text{s}) + 3 \text{H}_2\text{O} (\text{g}) \rightarrow \text{B}_2\text{H}_6 (\text{g}) + 3\text{O}_2 (\text{g})$	$\Delta H_{\text{I}} = + 2035 \text{ kJ}$
II.	$2 \text{H}_2\text{O} (\text{l}) \rightarrow 2 \text{H}_2\text{O} (\text{g})$	$\Delta H_{\text{II}} = + 88 \text{ kJ}$
III.	$\text{H}_2 (\text{g}) + \frac{1}{2} \text{O}_2 (\text{g}) \rightarrow \text{H}_2\text{O} (\text{l})$	$\Delta H_{\text{III}} = -286 \text{ kJ}$
IV.	$2 \text{B}(\text{s}) + 3 \text{H}_2 (\text{g}) \rightarrow \text{B}_2\text{H}_6 (\text{g})$	$\Delta H_{\text{IV}} = +36 \text{ kJ}$

22. How many of the reactions above would be considered endothermic?
- A. 0 B. 1 C. 2 D. 3 E. 4
23. Which of the reactions above represents an enthalpy of formation reaction?
- A. I B. II C. II, III D. III, IV E. II, III, IV
24. How much energy would be required in **Reaction IV**. to completely convert 0.345 moles of $\text{H}_2 (\text{g})$ to $\text{B}_2\text{H}_6 (\text{g})$ (assuming excess B (s) is present)?
- A. 104 kJ
 B. 12 kJ
 C. 37 kJ
 D. 313 kJ
 E. 4.1 kJ
25. Given the information above, what would be the value of ΔH for the reaction:
 $\text{H}_2\text{O} (\text{g}) \rightarrow \text{H}_2\text{O} (\text{l})$
- A. +44 kJ
 B. -44 kJ
 C. +88 kJ
 D. -88 kJ
 E. +176 kJ
26. Given the information above, what would be the value of ΔH for the reaction:
- $$2 \text{B} (\text{s}) + 3 \text{H}_2\text{O} (\text{l}) \rightarrow \text{B}_2\text{O}_3 (\text{s}) + \frac{3}{2} \text{O}_2 (\text{g})$$
- A. - 162 kJ
 B. - 250 kJ
 C. - 822 kJ
 D. + 822 kJ
 E. + 894 kJ

27. How much heat energy is liberated when 1.285 moles of CaCl_2 (s) are dissolved in water?

- A. 81 kJ
- B. 104 kJ
- C. 462 kJ
- D. 594 kJ
- E. 1023 kJ

Selected Enthalpies of Formation at 298 K

Substance	ΔH_f° (kJ/mole)
B (s)	0
Ca (s)	0
Ca^{2+} (aq)	-543
CaCl_2 (s)	-796
Cl^- (aq)	-167
C(s)	0
CH_4 (g)	-75
C_2H_4 (g)	+52
CO_2 (g)	-394
H_2 (g)	0
H_2O (g)	-242
H_2O (l)	-286
Na (s)	0
Na^+ (aq)	-240
NaCl (s)	-411
O_2 (g)	0