
1. Which of the following is **not** a unit of energy?

A. joule

C. kilowatt-hour

B. newton

D. calorie

2. Which of the following statements is **correct** concerning state functions?

A. State functions are independent of the path taken from the initial to the final state.

B. State functions are dependent on the path taken from the initial to the final state.

C. Work is a state function.

D. Internal energy is not a state function.

3. Which of the following signs of q and w represent a system that is **doing work** on the surroundings, as well as **losing heat** to the surroundings?

A. $q = +, w = +$

C. $q = +, w = -$

B. $q = -, w = +$

D. $q = -, w = -$

4. A Kentucky basketball player does 125.1 Calories of work and produces 129.0 Calories of heat during the first half of a game. What is ΔE if the **basketball player is the system**?

A. 125.1 Calories

C. 254.1 Calories

B. -129.0 Calories

D. -254.1 Calories

5. How much heat is required to raise the temperature of 79.0 g of ethanol from 298.0 K to 385.0 K? specific heat capacity of ethanol = $2.42 \text{ J/g}\cdot^\circ\text{C}$.

A. 12.9 kJ

C. 57.0 kJ

B. 16.6 kJ

D. 73.6 kJ

6. A 50.0 g piece of copper at 85°C is placed in 250 mL of ethanol at 62°C . What is the **final temperature** of the mixture at **thermal equilibrium**?

Specific heat capacity of copper = $0.235 \text{ J/g}\cdot^\circ\text{C}$; specific heat capacity of ethanol = $2.42 \text{ J/g}\cdot^\circ\text{C}$; density of ethanol = 0.789 g/mL .

A. 58°C

C. 75°C

B. 63°C

D. 80°C

7. If a balloon is inflated from 0.0100 L to 0.500 L against an external pressure of 10.00 atm, how much work is done? $101.3 \text{ J} = 1 \text{ L}\cdot\text{atm}$

A. -49.6 J

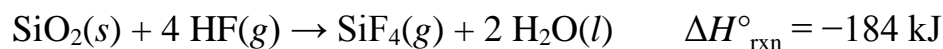
C. 0.49 J

B. 49.6 J

D. -496 J

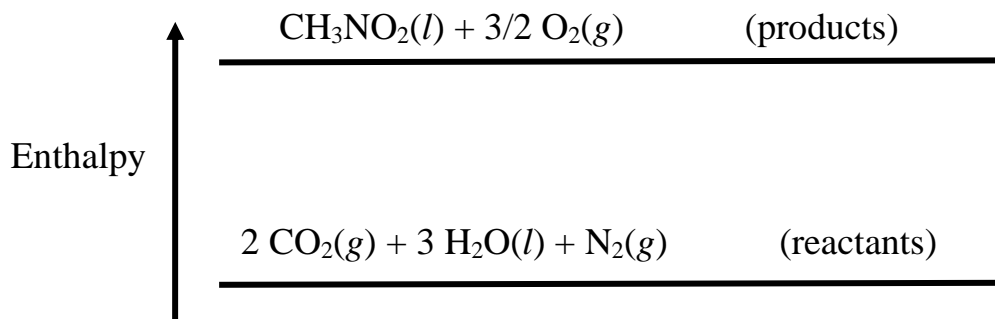
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8. Which of the following statements is **correct** about the relationship between the change in enthalpy and the change in internal energy of a chemical reaction?
- A. The enthalpy change and the change in internal energy are nearly identical under constant volume conditions.
 - B. The enthalpy change and the change in internal energy are always equal.
 - C. The enthalpy change and the change in internal energy have the same values but opposite signs.
 - D. Enthalpy changes are for exothermic reactions while changes in internal energy are for endothermic reactions.

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9. According to the following thermochemical equation, what **mass** of HF must react in order to produce 350. kJ of energy if SiO₂ is present in excess?



- A. 43.7 g
 - B. 107 g
 - C. 152 g
 - D. 177 g
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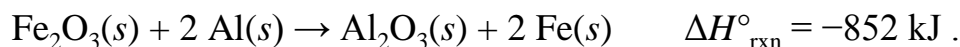
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10. Consider the following chemical reaction, where the change in enthalpy is either 1418 kJ or -1418 kJ.



What is the **sign** of ΔH and what is the **heat change** associated with the production of 55.8 grams of $\text{O}_2(g)$?

- A. positive, 3.26×10^3 kJ C. positive, 1.65×10^3 kJ
B. negative, 2.26×10^3 kJ D. negative, 3.26×10^3 kJ

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11. Consider the thermochemical reaction

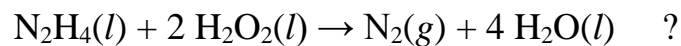


What can we conclude about the reaction

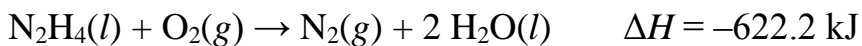


- A. The second reaction is endothermic and requires 852 kJ of heat to occur.
B. The second reaction is exothermic and gives off 852 kJ of heat.
C. The second reaction is endothermic and requires 2.56×10^3 kJ of heat to occur.
D. The second reaction is exothermic and gives off 2.56×10^3 kJ of heat.
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12. What is ΔH_{rxn} for the reaction:

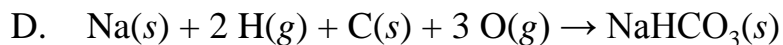
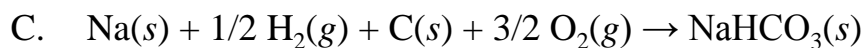
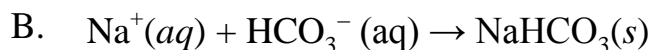
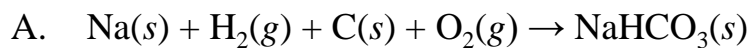


Use the following thermochemical reactions.

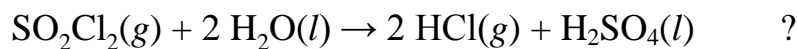


- A. -818.2 kJ C. -954.6 kJ
B. 1011.1 kJ D. 454.6 kJ

13. Which reaction illustrates ΔH_f° for NaHCO_3 ?



14. Using the information provided in the table, what is the enthalpy of reaction ($\Delta H_{\text{rxn}}^{\circ}$) for:



| Substance | ΔH_f° (kJ/mol) |
|-----------------------------|-------------------------------|
| $\text{SO}_2\text{Cl}_2(g)$ | -364 |
| $\text{H}_2\text{O}(l)$ | -286 |
| $\text{HCl}(g)$ | -92 |
| $\text{H}_2\text{SO}_4(l)$ | -814 |

- A. -62 kJ
B. -389 kJ
C. 99 kJ
D. -1038 kJ

15. Which energy source is **not renewable**?

- A. solar
B. wind
C. hydroelectric
D. petroleum

16. Which of the following lists the types of electromagnetic radiation in order of **increasing** frequency?

- A. radio < microwave < ultraviolet < visible < infrared < X-ray < gamma
B. gamma < microwave < ultraviolet < visible < infrared < X-ray < radio
C. radio < microwave < infrared < visible < ultraviolet < X-ray < gamma
D. radio < microwave < ultraviolet < visible < X-ray < infrared < gamma
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17. A wave of electromagnetic radiation travels at a speed of 42 m/s and has a frequency of 3.5 Hz. What is the **wavelength** of the wave?
- A. 0.083 m C. 8.6×10^7 m
B. 12 m D. The wavelength cannot be determined from the information given.

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18. A laser pointer emits violet light at a wavelength of 421 nm. What is the **energy** of a photon emitted by the laser?
- A. 3.61×10^{-19} J C. 5.23×10^{-19} J
B. 4.72×10^{-19} J D. 1.21×10^{19} J

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19. Which of the following statements is **not** correct?
- A. The emission spectrum of a particular element is always the same and can be used to identify the element.
B. In the Bohr model, electrons in the hydrogen atom are located in "stationary states" or particular orbits around the nucleus.
C. An orbital is the volume in which an electron is most likely to be found.
D. The uncertainty principle does not apply to electrons in atoms.
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20. The photoelectric effect is the observation that certain metals emit electrons when light shines on them. Which of the following statements is **correct** concerning the properties of light that eject electrons from metals?
- A. Light of all frequencies will eject electrons from metals given enough time.
 - B. Electrons are emitted from metals only when a certain threshold frequency of the light is met.
 - C. Increasing the intensity (amplitude) of light reduces the number of electrons emitted by metals.
 - D. The intensity (amplitude) of light has no effect on electrons ejected from metals.

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21. A McDonald's "Quarter Pounder with Cheese" sandwich weighs 198 grams and contains 510 Calories, including 234 Calories from fat. What is the de Broglie wavelength of a Quarter Pounder with Cheese as it moves at a speed of 0.500 m/s toward the mouth of a hungry McDonald's customer?

- A. 6.69×10^{-33} m
- B. 1.26×10^{-34} m
- C. 8.92×10^{-34} m
- D. 3.46×10^{-33} m

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22. The wave and particle nature of the electron are complementary properties. How does the Heisenberg uncertainty principle describe the complementary properties of electrons?
- A. If the position of an electron is known, then the velocity of the electron is also known.
 - B. The position and velocity of an electron can be determined simultaneously in monatomic elements only.
 - C. The position and velocity of an electron cannot be measured simultaneously.
 - D. If the velocity of an electron is known, then the velocity of the nucleus is also known.
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23. Which of the following transitions (in a hydrogen atom) represents **absorption** of the **smallest** frequency photon?

A. $n = 5$ to $n = 6$

C. $n = 4$ to $n = 1$

B. $n = 5$ to $n = 4$

D. $n = 1$ to $n = 2$

24. What is the **maximum** number of electrons that a $n = 3$ shell can hold?

A. 9

C. 10

B. 12

D. 18

25. Each of the following sets of quantum numbers is supposed to specify an orbital. Which of the following sets of quantum numbers **contains an error**?

A. $n = 2, l = 1, m_l = -1$

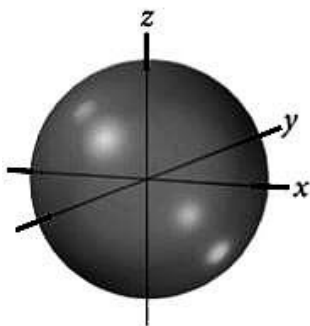
C. $n = 3, l = 3, m_l = -2$

B. $n = 4, l = 2, m_l = 0$

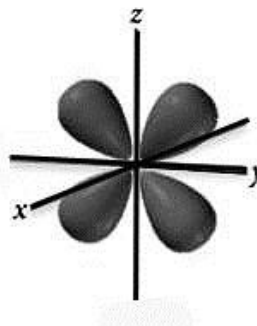
D. $n = 3, l = 0, m_l = 0$

26. Which one of the following orbitals could have the quantum numbers $n = 5, l = 3$?

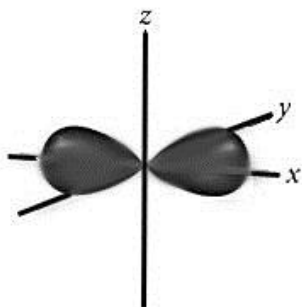
A.



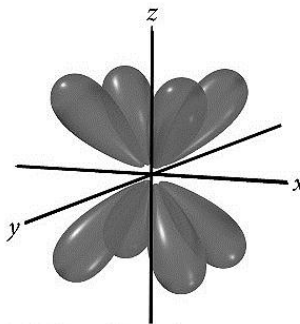
C.



B.



D.



27. What is the end (final) value of n in a hydrogen atom transition, if the electron starts at $n = 2$ and the atom **absorbs** a photon of light with a frequency of 4.57×10^{14} Hz?

A. 1

C. 4

B. 3

D. 6

28. What are the **possible** values of n and m_l for an electron in a $2p$ orbital?

- A. $n = 0$ or 1 and $m_l = -1, 0, \text{ or } +1$ C. $n = 1$ and $m_l = -1, 0, \text{ or } +1$
B. $n = 0, 1, \text{ or } 2$ and $m_l = 0$ D. $n = 2$ and $m_l = -1, 0, \text{ or } +1$

29. Which quantum number describes the **orientation** of an electronic orbital?

- A. m_l C. l
B. n D. m_s

30. Ultraviolet radiation possesses enough energy to damage biological molecules. If the typical energy of **one mole** of carbon-carbon bonds is 348 kJ , what is the longest wavelength of radiation with enough energy to break a carbon-carbon bond?

- A. 344 nm C. 267 nm
B. 727 nm D. 454 nm
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Answer Key:

1. B
2. A
3. D
4. D
5. B
6. B
7. D
8. A
9. C
10. C
11. C
12. A
13. C
14. A
15. D
16. C
17. B
18. B
19. D
20. B
21. A
22. C
23. A
24. D
25. C
26. D
27. B
28. D
29. A
30. A