Question #: 1

Which statement is **false**?

A. Potential energy is associated with the position or composition of an object.
B. Kinetic energy is associated with the motion of an object.
C. Chemical energy is created during a chemical reaction.
D. Thermal energy is associated with molecular motion.

Question #: 2

What is the total change in internal energy for a system that does 42 kJ of work and absorbs 17 kJ of heat?

A. +59 kJ  
B. +25 kJ  
C. −25 kJ  
D. −59 kJ

Question #: 3

A 23.4 g sample of water, originally at 25 °C, gains 1.2 kJ of heat. What is the final temperature of the water?

\[ C_s (H_2O) = 4.18 \text{ J/g} \cdot \text{°C}. \]

1. ________ °C

Question #: 4

A balloon inflates from 1.68 L to 2.50 L against a constant external pressure of 3.45 atm. How much work is done by the balloon?
A. +2.83 J
B. +283 J
C. +0.820 J
D. −287 J

**Question #**: 5

Is the reaction shown in this figure endothermic or exothermic?  

**Question #**: 6

Given the following reactions:

\[
\text{CH}_2\text{CO}(g) + 2 \text{O}_2(g) \rightarrow 2 \text{CO}_2(g) + \text{H}_2\text{O}(g) \quad \Delta H = -981.1 \text{ kJ}
\]

\[
\text{CH}_4(g) + 2 \text{O}_2(g) \rightarrow \text{CO}_2(g) + 2 \text{H}_2\text{O}(g) \quad \Delta H = -802.3 \text{ kJ}
\]

Find the enthalpy change for:

\[
2 \text{CH}_4(g) + 2 \text{O}_2(g) \rightarrow \text{CH}_2\text{CO}(g) + 3 \text{H}_2\text{O}(g)
\]

A. −623.5 kJ
B. −1783.6 kJ
C. 178.8 kJ
D. 1293.0 kJ
Question #: 7

How much heat is released when 13.2 kg of propane is completely combusted according to the following chemical equation?

\[ C_3H_8(g) + 5 O_2(g) \rightarrow 3 CO_2(g) + 4 H_2O(g) \quad \Delta H^\circ_{\text{rxn}} = -2044 \text{ kJ} \]

Enter scientific notation in this format: 9.99E-9 for 9.99 \times 10^{-9}

1. ______

Question #: 8

For which of the following chemical equations does \( \Delta H^\circ_{\text{rxn}} = \Delta H^\circ_{\text{f}} \)?

A. \( \text{Na}^+ (aq) + \text{Cl}^- (aq) \rightarrow \text{NaCl}(s) \)
B. \( 2 \text{H}(aq) + \text{O}(aq) \rightarrow \text{H}_2\text{O}(l) \)
C. \( \text{Mg}(s) + \text{Cl}_2(g) \rightarrow \text{MgCl}_2(s) \)
D. \( \text{HCl}(aq) + \text{NaOH}(aq) \rightarrow \text{NaCl}(aq) + \text{H}_2\text{O}(l) \)

Question #: 9

Which type of electromagnetic radiation has higher energy: X-rays or microwaves?

![Electromagnetic Spectrum Diagram]
1. 

**Question #**: 10

What is the energy of a photon of orange light ($\lambda = 623$ nm)?

A. $3.19 \times 10^{-19}$ J  
B. $4.82 \times 10^{-14}$ J  
C. 187 J  
D. $3.75 \times 10^{-26}$ J

**Question #**: 11

Three photons, as shown in the figure below, strike a metal surface. Which photon has an energy **lower** than the metal's binding energy?

A. 700 nm  
B. 550 nm  
C. 400 nm  
D. none of the photons shown

**Question #**: 12

In the figure of a Bohr atom shown below, which stationary state has the **highest** energy?
Question #: 13

An electron has a mass of $9.11 \times 10^{-31}$ kg and a velocity of $5.70 \times 10^{3}$ m/s. What is the de Broglie wavelength of this electron?

$\lambda = \frac{h}{p}$

Enter scientific notation in this form: 9.99E–9 for $9.99 \times 10^{-9}$

1. _______

Question #: 14

The concept of complementary properties is central to Heisenberg's uncertainty principle.
Which of the following is a **true** statement?

A. The position and velocity of an electron are unrelated.
B. The **more** precisely we know the position of an electron, the **less** precisely we know its momentum.
C. The **more** precisely we know the position of an electron, the **more** precisely we know its velocity.
D. We cannot precisely know the mass of an electron.

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**Question #**: 15

Which of the following statements about quantum numbers and probability distributions is **true**?

A. The size of the probability distribution decreases with increasing principal quantum number, \( n \).
B. The shape of the probability distribution is determined by the angular momentum quantum number, \( l \).
C. The probability distribution is independent of the magnetic quantum number, \( m_l \).
D. The direction in which the probability distribution rotates is determined by the spin quantum number, \( m_s \).

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**Question #**: 16

An electron has quantum numbers \( n = 2, l = 1, m_l = -1, m_s = -\frac{1}{2} \)

Which type of orbital (sublevel or subshell) is this electron in? **1**

(Your answer should consist of one number and one letter.)

1. _____

---

**Question #**: 17

What wavelength of light is emitted when an electron drops from the \( n = 4 \) state to the \( n = 3 \) state, using the Bohr model of the hydrogen atom?

**1** nm
1. 

**Question #**: 18

Which of the following sets of quantum numbers, \([n, l, m_l, m_s]\), is/are allowed for an electron in an atom?

Answer **all** allowed sets.

A. \([1, 0, 0, –\frac{1}{2}]\)
B. \([3, 4, –4, \frac{1}{2}]\)
C. \([3, 2, –2, –\frac{1}{2}]\)
D. \([1, 1, 2, \frac{1}{2}]\)

**Question #**: 19

This illustration represents which type of atomic orbital?

![Atomic Orbital Diagram]

A. \(s\)
B. \(p\)
C. \(d\)
D. \(f\)

**Question #**: 20

What is the ground-state electron configuration of arsenic?
1. **Question #21**

Based on the figure below, which subshell will experience the **greatest** amount of shielding?

A. 3s  
B. 3p  
C. 3d  
D. The 3s, 3p and 3d subshells experience the same amount of shielding.

2. **Question #22**

How many **valence** electrons does carbon have? 1

1. _____

3. **Question #23**
What is the noble gas core of zinc?

   A. [Ne]  
   B. [Ar]  
   C. [Kr]  
   D. [Xe]

**Question #: 24**

Which group has an \( ns^2np^5 \) electron configuration?

   A. alkali metals  
   B. transition metals  
   C. halogens  
   D. noble gases

**Question #: 25**

Which element's 4+ ion has a [Kr]4d\(^{10}\) electron configuration?

1. ________
Question #: 1

Which statement is **false**?

A. Potential energy is associated with the position or composition of an object.
B. Kinetic energy is associated with the motion of an object.
✓C. Chemical energy is created during a chemical reaction.
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Question #: 2

What is the total change in internal energy for a system that does 42 kJ of work and absorbs 17 kJ of heat?

A. +59 kJ
B. +25 kJ
✓C. –25 kJ
D. –59 kJ

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Question #: 3

A 23.4 g sample of water, originally at 25 °C, gains 1.2 kJ of heat. What is the final temperature of the water?

\[ C_s (\text{H}_2\text{O}) = 4.18 \text{ J/g} \cdot \text{oC}. \]

\[ 1 \text{ °C} \]

\[ 37|37|37|37|37 |37 °C|37 oC|37.3|370C| \]

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Question #: 4

A balloon inflates from 1.68 L to 2.50 L against a constant external pressure of 3.45 atm. How much work is done by the balloon?
Question #: 5

Is the reaction shown in this figure endothermic or exothermic? 1

1. endothermic|endo|endotherm|

Question #: 6

Given the following reactions:

\[ \text{CH}_2\text{CO}(g) + 2 \text{O}_2(g) \rightarrow 2 \text{CO}_2(g) + \text{H}_2\text{O}(g) \quad \Delta H = -981.1 \text{ kJ} \]

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Find the enthalpy change for:

\[ 2 \text{CH}_4(g) + 2 \text{O}_2(g) \rightarrow \text{CH}_2\text{CO}(g) + 3 \text{H}_2\text{O}(g) \]

✓A. –623.5 kJ
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\]

Enter scientific notation in this format: 9.99E-9 for 9.99 \times 10^{-9}

1. \(6.12 \times 10^5\) kJ

Question #: 8

For which of the following chemical equations does \(\Delta H^\circ_{\text{rxn}} = \Delta H^\circ_{\text{f}}\)?

A. \(\text{Na}^+(aq) + \text{Cl}^-(aq) \rightarrow \text{NaCl}(s)\)
B. \(2 \text{ H}(aq) + \text{O}(aq) \rightarrow \text{H}_2\text{O}(l)\)
C. \(\text{Mg}(s) + \text{Cl}_2(g) \rightarrow \text{MgCl}_2(s)\)
D. \(\text{HCl}(aq) + \text{NaOH}(aq) \rightarrow \text{NaCl}(aq) + \text{H}_2\text{O}(l)\)

\(\text{✓}\)

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Which type of electromagnetic radiation has **higher** energy: X-rays or microwaves?
Question #: 10

What is the energy of a photon of orange light (\( \lambda = 623 \text{ nm} \))?

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A. 700 nm
B. 550 nm
C. 400 nm
D. none of the photons shown

Question #: 12

In the figure of a Bohr atom shown below, which stationary state has the **highest** energy?
A. 1
B. 2
✓C. 3
D. All stationary states are degenerate.

Question #: 13

An electron has a mass of $9.11 \times 10^{-31}$ kg and a velocity of $5.70 \times 10^3$ m/s. What is the de Broglie wavelength of this electron?

$\underline{1.28 \times 10^{-7}}$ m

Enter scientific notation in this form: $9.99E-9$ for $9.99 \times 10^{-9}$

Question #: 14

The concept of complementary properties is central to Heisenberg's uncertainty principle.
Which of the following is a **true** statement?

A. The position and velocity of an electron are unrelated.
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C. The **more** precisely we know the position of an electron, the **more** precisely we know its velocity.
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**Question #: 16**

An electron has quantum numbers \( n = 2, l = 1, m_l = -1, m_s = -\frac{1}{2} \)
Which type of orbital (sublevel or subshell) is this electron in? 1

(Your answer should consist of one number and one letter.)

1. 2p| 2P| 2P| 2P|

**Question #: 17**

What wavelength of light is emitted when an electron drops from the \( n = 4 \) state to the \( n = 3 \) state, using the Bohr model of the hydrogen atom?

1 nm
Question #: 18

Which of the following sets of quantum numbers, \( [n, l, m_l, m_s] \), is/are allowed for an electron in an atom?

Answer \textbf{all} allowed sets.

✓ A. \([1, 0, 0, -\frac{1}{2}]\]
B. \([3, 4, -4, \frac{1}{2}]\]
✓ C. \([3, 2, -2, -\frac{1}{2}]\]
D. \([1, 1, 2, \frac{1}{2}]\]

Question #: 19

This illustration represents which type of atomic orbital?

![Atomic Orbital Diagram]

A. \(s\)
B. \(p\)
✓ C. \(d\)
✓ D. \(f\)

Question #: 20

What is the ground-state electron configuration of arsenic?
A. $1s^2 2s^2 2p^3$
B. [Ar]$4s^2 3d^{10} 4p^3$
C. [Ar]$4s^2 4p^3$
D. [Ar]$4s^3 3d^{10} 4p^5$

**Question #:** 21

Based on the figure below, which subshell will experience the **greatest** amount of shielding?

A. $3s$
B. $3p$
C. $3d$
D. The $3s$, $3p$ and $3d$ subshells experience the same amount of shielding.

**Question #:** 22

How many **valence** electrons does carbon have? 1

1. 4

**Question #:** 23
What is the noble gas core of zinc?

A. [Ne]  
✓B. [Ar]  
C. [Kr]  
D. [Xe]

**Question #: 24**

Which group has an \( ns^2np^5 \) electron configuration?

A. alkali metals  
B. transition metals  
✓C. halogens  
D. noble gases

**Question #: 25**

Which element's 4+ ion has a [Kr]4d\(^{10}\) electron configuration?

1. Sn|tin|Tin|