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5. A 25.0 g block of iron at 94.3 °C is placed in 125 g of H₂O at 24.8 °C. What is the final temperature of the copper?

$$C_s(\text{Fe}) = 0.449 \text{ J/g}\cdot^\circ\text{C}$$

$$C_s(\text{H}_2\text{O}) = 4.18 \text{ J/g}\cdot^\circ\text{C}$$

- A. 59.6 °C
B. 26.3 °C
C. 68.0 °C
D. 30.1 °C
-
6. A balloon filled with gas expands from a volume of 3.00 L to 5.00 L against a constant external pressure of 1.20 atm. The total energy change of the gas is 600 J. How much heat did the system absorb?

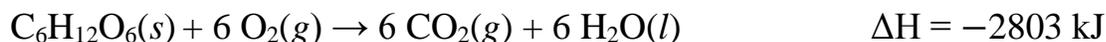
- A. 514 J
B. 843 J
C. 2590 J
D. -654 J
-
7. When heated, CaCO₃(s) decomposes at constant pressure to form CaO(s) and CO₂(g). If 0.00250 mol of CaCO₃ requires of 448 J of heat to convert it to products and the expansion of the CO₂(g) does 6.00 J of work on the surroundings, what are ΔE and ΔH for the system?

- A. $\Delta H = -448 \text{ J}$ and $\Delta E = 6 \text{ J}$
B. $\Delta H = 6 \text{ J}$ and $\Delta E = -442 \text{ J}$
C. $\Delta H = 448 \text{ J}$ and $\Delta E = 442 \text{ J}$
D. $\Delta H = -448 \text{ J}$ and $\Delta E = -454 \text{ J}$
-

8. Which of the following processes has the correct sign of the enthalpy change?

- A. moisture condensing on the outside of a cold soft drink can, $\Delta H > 0$
- B. wood burning, $\Delta H < 0$
- C. ice melting, $\Delta H < 0$
- D. the chemical reaction in a "hot pack" hand warmer, $\Delta H > 0$

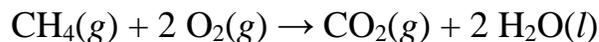
9. The major energy source for the human body is the oxidation of glucose ($C_6H_{12}O_6$) according to the following thermochemical equation:



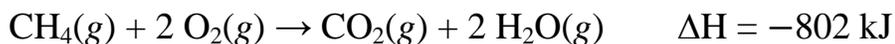
If 40.0 % of the energy released from the oxidation of glucose is converted to work, how much work can the human body do after consuming 19.0 grams of glucose?

- A. 94.5 kJ
- B. 118 kJ
- C. 155 kJ
- D. 289 kJ

10. What is ΔH_{rxn} for



given the following reactions?

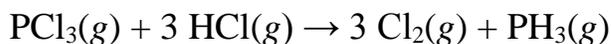


- A. -714 kJ
 - B. -846 kJ
 - C. -890. kJ
 - D. -758 kJ
-

11. Which of the following equations has $\Delta H^\circ_{\text{reaction}}$ equal to $\Delta H^\circ_{\text{formation}}$ of $\text{Fe}(\text{NO}_3)_2$?

- A. $\text{Fe}(s) + 2 \text{N}(g) + 6 \text{O}(g) \rightarrow \text{Fe}(\text{NO}_3)_2(s)$
- B. $\text{Fe}(s) + 2 \text{NO}_3^-(aq) \rightarrow \text{Fe}(\text{NO}_3)_2(s)$
- C. $\text{Fe}(s) + \text{N}_2(g) + 3 \text{O}_2(g) \rightarrow \text{Fe}(\text{NO}_3)_2(s)$
- D. $\text{Fe}(s) + \text{N}_2(g) + 2 \text{O}_3(g) \rightarrow \text{Fe}(\text{NO}_3)_2(s)$

12. Given the data below, calculate DH°_{rxn} for



Compound	DH°_f (kJ/mol)
$\text{PH}_3(g)$	5.4
$\text{PCl}_3(g)$	-287.0
$\text{HCl}(g)$	-92.3

- A. 373.9 kJ
- B. 558.8 kJ
- C. 569.3 kJ
- D. 384.7 kJ

13. How does atmospheric carbon dioxide increase the Earth's surface temperature?

- A. CO_2 , when excited by visible light, reacts with acid rain to form ozone.
 - B. CO_2 absorbs ultraviolet radiation, giving off large amounts of heat in the process.
 - C. CO_2 is transparent to visible light, but absorbs outgoing infrared thermal radiation and re-radiates some of it back to the surface.
 - D. CO_2 trapped in the upper atmosphere reacts exothermically with atmospheric N_2 and O_2 to form highly reactive chemical species, thereby heating the atmosphere.
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14. This graph represents the visible, ultraviolet and infrared regions of the electromagnetic spectrum. Which response assigns the regions correctly?



- A. X = infrared, Y = visible, Z = ultraviolet
- B. X = visible, Y = ultraviolet, Z = infrared
- C. X = infrared, Y = ultraviolet, Z = visible
- D. X = ultraviolet, Y = visible, Z = infrared

15. What is the frequency of light with a wavelength of 5.40×10^{-7} m?

- A. 1.62×10^{11} Hz
- B. 5.56×10^{14} Hz
- C. 1.62×10^5 Hz
- D. 6.17×10^{-5} Hz

16. What is the wavelength of a photon with energy of 6.77×10^{-19} J?

- A. 127 nm
- B. 294 nm
- C. 454 nm
- D. 981 nm

17. Which of the following is **false** about the Bohr model of the atom?

- A. It gives correct energy level values for hydrogen and helium.
 - B. Each electron's orbit has a fixed energy.
 - C. An atom's emission spectrum results from electronic transitions between orbits.
 - D. An electron in an orbit maintains a constant distance from the nucleus.
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18. Hydrogen emits light with a wavelength of 2160 nm as it relaxes to the $n = 4$ energy level. In which energy level was the initial excited-state atom?

A. 5

C. 7

B. 6

D. 8

19. An alpha particle (6.64×10^{-27} kg) is accelerated until it has a de Broglie wavelength of 2.78×10^{-11} m. What is the speed of the alpha particle?

A. 7.29×10^{-4} m/s

C. 3.59×10^3 m/s

B. 5.26×10^{12} m/s

D. 9.48×10^5 m/s

20. Three different metal surfaces (**A**, **B** and **C**) are exposed to a 200 nm laser. The kinetic energies of electrons ejected from the surfaces were **A** = 1 J, **B** = 3 J and **C** = 135 J. Which metal has the **highest** binding energy?

A. A

C. C

B. B

D. All three binding energies are equal.

21. How many **electrons** can an $n = 5$ shell hold?

A. 5

C. 25

B. 30

D. 50

22. Which of the following is **true** for the angular momentum quantum number, l ?

- A. $l = 2$ describes the set of p orbitals.
- B. The possible l values for $n = 1$ are 0 and 1 (one).
- C. The value of l determines the orientation in space of an orbital.
- D. l can be 1 (one) when n is 6.

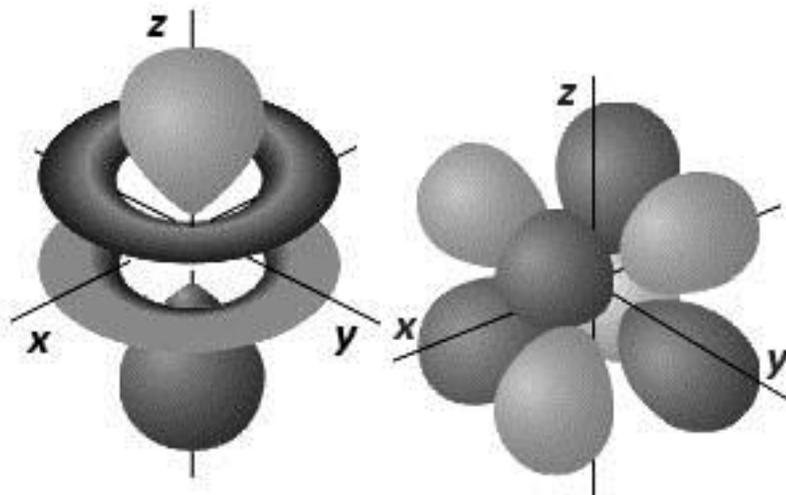
23. How many different values of magnetic quantum levels (m_l) are possible in the $3d$ sublevel?

- A. 2
- B. 3
- C. 1
- D. 5

24. For a hydrogen atom, electronic transition **I** occurs when the atom **absorbs** 95 nm light, while transition **II** results in **emission** of 4050 nm light. What are the quantum level changes corresponding to these electronic transitions?

- A. (I) $n = 1 \rightarrow n = 5$; (II) $n = 5 \rightarrow n = 4$
 - B. (I) $n = 5 \rightarrow n = 1$; (II) $n = 1 \rightarrow n = 2$
 - C. (I) $n = 4 \rightarrow n = 5$; (II) $n = 5 \rightarrow n = 1$
 - D. (I) $n = 1 \rightarrow n = 2$; (II) $n = 2 \rightarrow n = 5$
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25. Two orbitals from the same subshell are shown. What is the maximum number of **electrons** that this subshell can hold?



A. 6

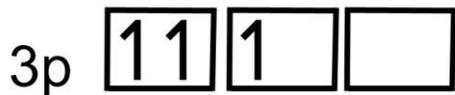
C. 10

B. 8

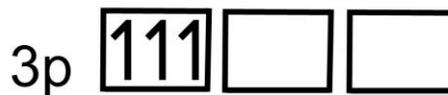
D. 14

26. Which of the following represents an **allowed** orbital arrangement of electrons?

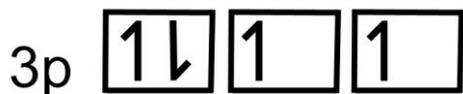
A.



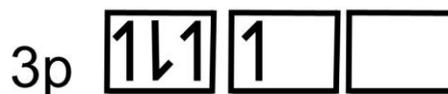
C.



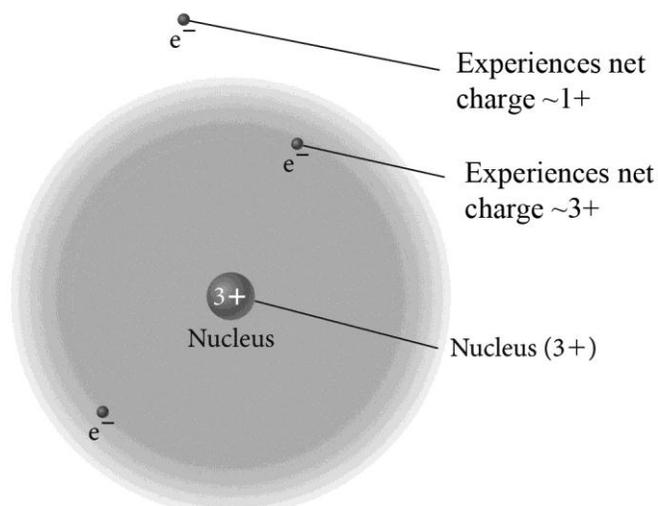
B.



D.

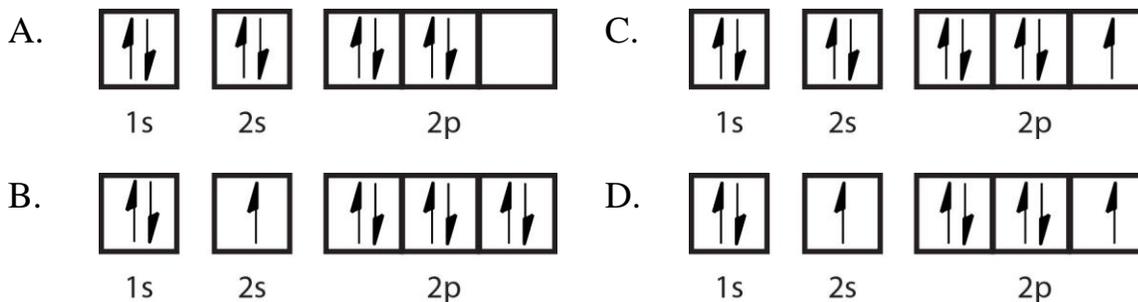


27. This figure illustrates what concept about $1s$ and $2s$ electrons in a lithium atom?



- A. Shielding
B. Electron spin quantum number
C. Electron affinity
D. Pauli exclusion principle

28. Choose the orbital diagram that represents the ground state of fluorine.



29. Elements in the p -block have valence electrons in

- A. p orbitals only
B. s and p orbitals
C. s orbitals only
D. s , p , and d orbitals

30. What is the ground-state electron configuration of molybdenum?

- A. $[\text{Kr}]5s^14d^5$
B. $[\text{Kr}]5s^24d^4$
C. $[\text{Kr}]4s^13d^5$
D. $[\text{Ar}]5s^14d^5$
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Answer Key:

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