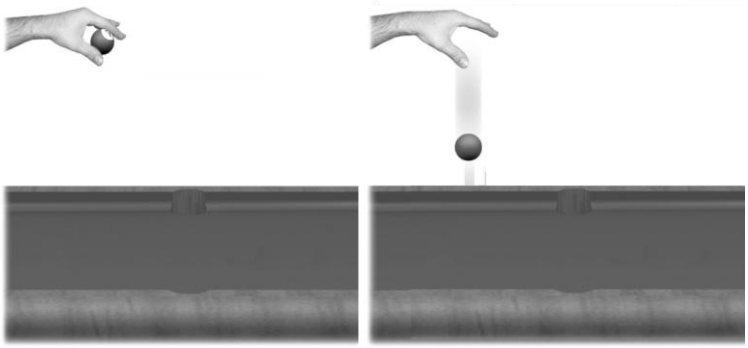
1. There are 140 Calories in the average 12-ounce soft drink. If an individual uses 4.2×10^2 kJ of energy to run one mile, how far does the athlete need to run to "burn" 140 Calories? (1 Calorie = 4184 J)

A. 1.1 miles
C. 1.4 miles
B. 2.8 miles
D. 27 miles

2. The laws of conservation of energy state that energy can be neither created nor destroyed, but energy changes its form. Which of the following statements is **<u>correct</u>** concerning this figure?



A. The billiard ball gains potential energy once it is dropped.
B. The kinetic energy of the billiard ball is converted to potential energy.
C. The billiard table loses energy once the billiard ball strikes it.
D. The billiard ball loses potential energy once it is dropped.

3. A gas sample is **<u>compressed</u>** from an initial volume of 5.55 L to a final volume of 1.22 L by an external pressure of 1.00 atm. During the compression, the gas **<u>releases</u>** 125 J of heat. What is the change in internal energy (ΔE) of the gas? (1 L·atm = 101.3 J)

A. –425 J
C. –301 J
B. 314 J
D. 425 J

4. A 2.7 kg Pyrex glass casserole dish is placed in an oven and heated from 25° C to 260° C. How much energy did the casserole dish absorb? The specific heat of Pyrex glass is 0.75 J/g·°C.

A. 2.7×10^4 J

B. 4.8×10^5 J

C. 8.8×10^5 J

D. 6.3×10^7 J

5. A 376-gram gold nugget at 55 °C is dropped into 190. mL of water at 25 °C. What is the final temperature when the gold and water reach thermal equilibrium?

specific heat of gold = 0.128 J/g·°C
specific heat of water = 4.18 J/g·°C
density of water = 1.00 g/mL

A. 60. °C

B. 55 °C

C. 27 °C

D. 23 °C

6. Heat (q) is absorbed by the **system** in which of the following processes?

I. sweat (the system) evaporating from skin
II. a swollen ankle (the system) wrapped in an ice pack
III. an ice cube tray filled with liquid water (the system) then placed in the freezer

A. I only
B. II only
C. I and III
D. I, II, and III

7. Determine ΔH for the reaction

$$C_2H_4(g) + 6\ F_2\ (g) \rightarrow 2\ CF_4(g) + 4\ HF(g)$$

given the following data:

$H_2(g) + F_2(g) \rightarrow 2\ HF(g)$ $\quad \Delta H_{rxn} = -537$ kJ

$2\ C(s) + 2\ H_2(g) \rightarrow C_2H_4(g)$ $\quad \Delta H_{rxn} = +52$ kJ

$CF_4(g) \rightarrow C(s) + 2\ F_2(g)$ $\quad \Delta H_{rxn} = +680$ kJ

A. –2486 kJ
B. –1066 kJ
C. 222 kJ
D. 486 kJ

8. The enthalpy change of which reaction is a standard enthalpy of formation, $\Delta H°_f$?

A. $Mg(s) + C(s) + 3/2\ O_2(g) \rightarrow MgCO_3(s)$

B. $Mg^{2+}(aq) + CO_3^{2-}(aq) \rightarrow MgCO_3(s)$

C. $Na(s) + 2\ H(g) + 3\ O(g) \rightarrow NaHCO_3(s)$

D. $C(s) + H_4(g) \rightarrow CH_4(g)$

9. Using the following information, what is the enthalpy, $\Delta H°_{rxn}$, of the following reaction?

$$C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$$

Substance	**$\Delta H_f°$ (kJ/mol)**
$H_2O(g)$	–241.8
$H_2O(l)$	–285.8
$CO(g)$	–110.5

A. –125.4 kJ

B. –133.4 kJ

C. 131.3 kJ

D. 170.3 kJ

10. An orange laser emits light at a frequency of 4.62×10^{14} Hz. What is the wavelength of the emitted light?

A. 649 nm

B. 677 nm

C. 550 nm

D. 498 nm

11. What is the energy of **<u>one mole</u>** of photons with a wavelength of 400. nm?

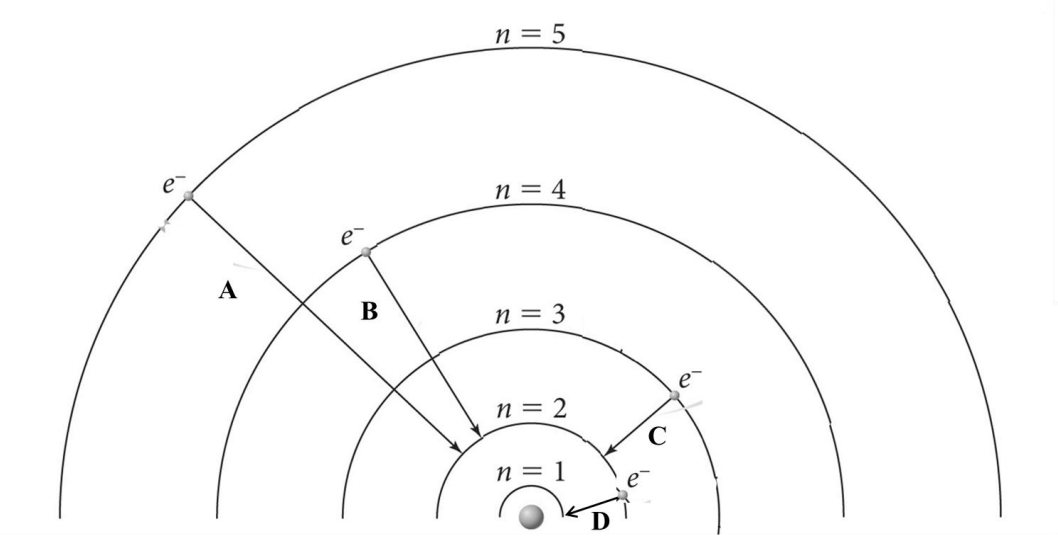
A. 5.69×10^5 J

B. 3.08×10^5 J

C. 3.77×10^5 J

D. 2.99×10^5 J

12. Consider this figure of the Bohr model of the atom. Which electronic transition will emit a photon with the **<u>shortest</u>** wavelength?



A. A

B. B

C. C

D. D

13. What is the de Broglie wavelength of an electron traveling at 1.35×10^5 m/s? The mass of an electron is 9.11×10^{-31} kg.

A. 3.08×10^{-6} m

B. 8.88×10^{-6} m

C. 5.39×10^{-9} m

D. 7.62×10^{-6} m

14. When an electron has the principal quantum number $n = 3$, which of the following statements is correct?

A. The electron can only occupy an *f* orbital.

B. The electron can only occupy a *d* orbital.

C. The electron is lower in energy than an electron that has the principal quantum number $n = 2$.

D. The electron is located in an *s*, *p*, *d*, or *f* orbital.

15. What is the maximum number of **electrons** that an $n = 2$ shell can hold?

A. 2

B. 4

C. 8

D. 16

16. What are the **allowed** values of n and m_l for an electron in a 4*d* orbital?

A. $n = 3$; $m_l = -3, -2, -1, 0, +1, +2,$ or $+3$

B. $n = 4$; $m_l = -2, -1, 0, +1,$ or $+2$

C. $n = 3, 2, 1,$ or 0; $m_l = -3, -2, -1, 0, +1, +2,$ or $+3$

D. $n = 4$; $m_l = -4, -3, -2, -1, 0, +1, +2, +3,$ or $+4$

17. What wavelength of light is emitted when an electron in a hydrogen atom makes a transition from an $n = 5$ to an $n = 3$ shell?

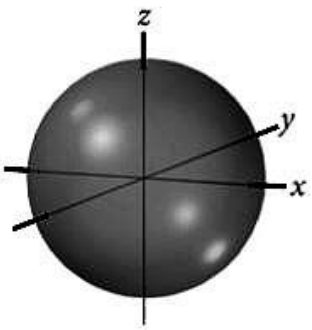
A. 1282 nm

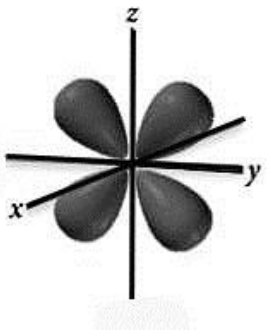
B. 1555 nm

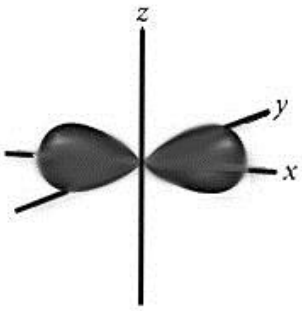
C. 2288 nm

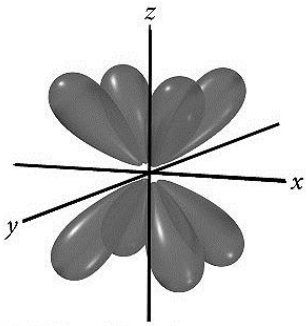
D. 6044 nm

18. Which one of the following orbitals could have the quantum numbers $n = 4$, $l = 1$?

A. 

C. 

B. 

D. 

19. What is the electronic configuration of carbon?

A. $1s^2 2s^2 2p^4$

C. $1s^2 2s^2 2p^6$

B. $1s^2 2s^2 2p^2$

D. $1s^2 2p^4$

20. Which set of four quantum numbers best represents the **highest energy electron in** a tin atom?

A. $n = 4, l = 3, m_l = -1, m_s = +½$

C. $n = 3, l = 2, m_l = 2, m_s = +½$

B. $n = 4, l = 1, m_l = -1, m_s = +½$

D. $n = 5, l = 1, m_l = 0, m_s = +½$

21. How many **valence electrons** are in a neutral sulfur atom?

A. 2
C. 6
B. 4
D. 8

22. What is the electronic configuration of chromium?

A. $[Ar]4s^2 3d^4$
C. $[Ar]4s^2 4d^4$
B. $[Kr]4s^2 3d^4$
D. $[Ar]4s^1 3d^5$

23. Which pair of elements has the element with the **smaller** atomic radius listed **first**?

A. In, Al
C. Si, N
B. Sn, Se
D. F, C

24. Which of the following cations is diamagnetic in the ground state?

A. Fe^{2+}
C. Fe^{3+}
B. Cr^{6+}
D. Cr^{3+}

25. Which pair of elements has the element with the **higher** first ionization energy listed **first**?

A. Br, Bi
C. Rb, Na
B. Sn, P
D. Si, Cl

Answer Key:

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