

C151E3Sp07

The people sitting next to you must have a different colored exam. Be Sure to Write Your Name and the Exam Color on Your Green Scantron. You may write on the exam.

1. If the same amount of heat is added to 50.0 g samples of each of the metals below, which metal will experience the largest temperature change?

Metal	Specific Heat (J/g·K)
Al	0.902
Cu	0.385
Fe	0.451
<u>Au</u>	0.128
K	0.753

- a. Al
- b. Cu
- c. Fe
- d. Au
- e. K

2. Which of the following atoms is diamagnetic?

- a. K
- b. C
- c. Ni
- d. Ba
- e. Cl

3. A microwave oven emits radiation at a wavelength of 5.00 millimeters. What is the frequency of this radiation?

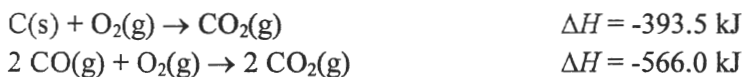
- a.  $1.67 \times 10^{-8} \text{ s}^{-1}$
- b.  $6.00 \times 10^4 \text{ s}^{-1}$
- c.  $1.50 \times 10^6 \text{ s}^{-1}$
- d.  $1.50 \times 10^9 \text{ s}^{-1}$
- e.  $6.00 \times 10^{10} \text{ s}^{-1}$

$$c = \lambda \nu$$

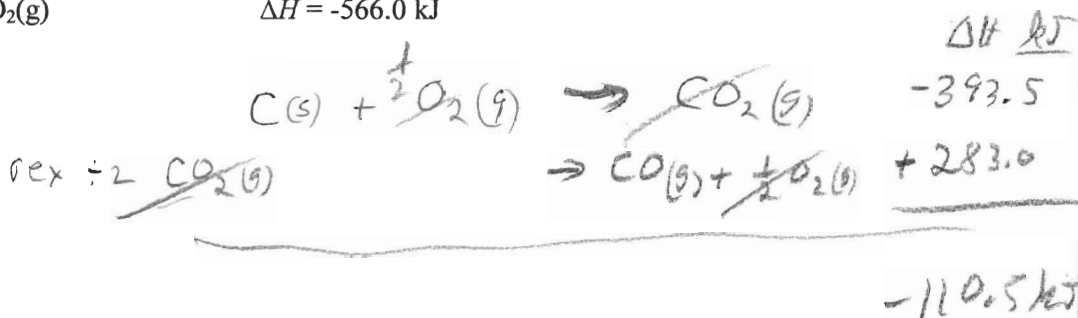
$$\nu = \frac{c}{\lambda} = \frac{3.0 \times 10^8 \text{ m/s}}{5.00 \times 10^{-3} \text{ m}}$$

4. Calculate the standard enthalpy of formation of carbon monoxide,

$\text{C(s)} + 1/2 \text{O}_2(\text{g}) \rightarrow \text{CO(g)}$ , given the enthalpies of the reactions below.



- a. -959.6 kJ
- b. -421.6 kJ°C
- c. -172.5 kJ
- d. -110.5 kJ
- e. 172.5 kJ



5. All of the following statements are true EXCEPT
- In an endothermic process heat is transferred from the surroundings to the system.
  - The greater the specific heat of an object, the more thermal energy it can store.
  - The SI unit of specific heat capacity is joules per gram per kelvin.
  - Heat is transferred from the system to the surroundings in an exothermic process.
  - The temperature of a system is a state function.

6. What is the hybridization of the bromine atom in BrF<sub>5</sub>?

- sp
- sp<sup>2</sup>
- sp<sup>3</sup>
- sp<sup>3</sup>d
- sp<sup>3</sup>d<sup>2</sup>

42 v.e.



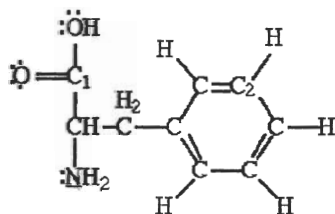
7. What is the energy of a single photon with a wavelength of 633 nm?

- $9.34 \times 10^{-21}$  J
- $7.11 \times 10^{-18}$  J
- $3.14 \times 10^{-19}$  J
- $4.73 \times 10^{14}$  J
- $7.15 \times 10^{14}$  J

$$c = \lambda \nu \quad E = h\nu \rightarrow E = h \frac{c}{\lambda}$$

$$E = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(3.0 \times 10^8 \text{ m/s})}{633 \times 10^{-9} \text{ m}}$$

8. Which of the underlined atoms (N, C<sub>1</sub>, C<sub>2</sub>, and O) are sp<sup>2</sup> hybridized?



- N and O
- N, C<sub>1</sub>, and O
- C<sub>1</sub>, and C<sub>2</sub>
- O and C<sub>1</sub>
- O only

and  $\text{:}\ddot{\text{O}}\text{:}$

9. If 25.0 g H<sub>2</sub>O at 11.2°C is combined with 75.0 g H<sub>2</sub>O at 87.2°C, what is the final temperature of the mixture? The specific heat of water is 4.184 J/g·K.

- 43.1°C
- 68.2°C
- 73.2°C
- 74.4°C
- 87.0°C

$$\text{Heat gained} = \text{Heat lost}$$

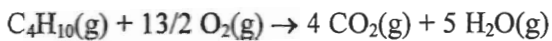
$$\frac{4.184 \text{ J}}{\text{g}\cdot\text{K}} | 25.0 \text{ g} | (T_F - 11.2) = \frac{4.184 \text{ J}}{\text{g}\cdot\text{K}} | 75.0 \text{ g} | (87.2 - T_F)$$

$$104.6 T_F - 1171.52 = 27,363.36 - 313.8 T_F$$

$$418.4 T_F = 28,534.88$$

$$T_F = 68.2^\circ\text{C}$$

10. The standard molar enthalpy of combustion of butane is -2877 kJ.



1 mol C<sub>4</sub>H<sub>10</sub>

What is the enthalpy change for the combustion of 15.00 g C<sub>4</sub>H<sub>10</sub>?

- a. -4315 kJ
- b. -2219 kJ
- c. -1114 kJ
- d. -742.5 kJ
- e. -491.2 kJ

$$\frac{15.00 \text{ g C}_4\text{H}_{10}}{58.12 \text{ g/mol}} \times \frac{-2877 \text{ kJ}}{1 \text{ mol C}_4\text{H}_{10}} = -742.5 \text{ kJ}$$

11. Calculate the wavelength of the line in the Lyman series that results from the transition  $n = 5$  to  $n = 1$ . The Rydberg constant equals  $-2.18 \times 10^{-18} \text{ J}$ .

- a. 54.2 nm
- b. 95.0 nm
- c. 114 nm
- d. 126 nm
- e. 209 nm

$$\Delta E = E_{\text{final}} - E_{\text{initial}}$$

$$E_F = -2.18 \times 10^{-18} \text{ J} \left( \frac{1}{5^2} \right) = -8.72 \times 10^{-20}$$

$$E_I = -2.18 \times 10^{-18} \text{ J} \left( \frac{1}{1^2} \right) = -2.18 \times 10^{-18}$$

$$\Delta E = 2.093 \times 10^{-18}$$

$$\Delta E = h\nu = h \frac{c}{\lambda}$$

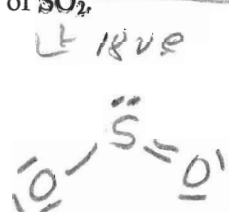
$$\lambda = \frac{hc}{\Delta E} = 9.5 \times 10^{-8} \text{ m} = 95 \text{ nm}$$

12. Which element has the electron configuration  $1s^2 2s^2 2p^6 3s^2 3p^2$ ?

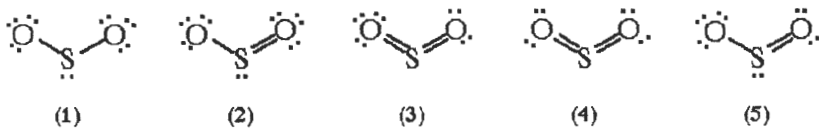
- a. Mg
- b. Ga
- c. Si
- d. Ge
- e. S

13. Use VSEPR theory to predict the electron pair geometry and the molecular geometry of SO<sub>2</sub>.

- a. e<sup>-</sup> pair geometry = trigonal planar, molecular geometry = bent
- b. e<sup>-</sup> pair geometry = trigonal planar, molecular geometry = linear
- c. e<sup>-</sup> pair geometry = tetrahedral, molecular geometry = bent
- d. e<sup>-</sup> pair geometry = tetrahedral, molecular geometry = trigonal planar
- e. e<sup>-</sup> pair geometry = tetrahedral, molecular geometry = linear



14. Which of the following is a correct Lewis structure for SO<sub>2</sub>?



- a. 1
- b. 2
- c. 3
- d. 4
- e. 5

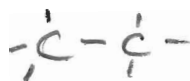
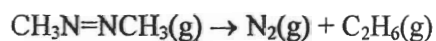
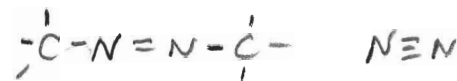
15. In general, atomic radii

- a. increase down a group and increase across a period.
- b. decrease down a group and remain constant across a period.
- c. increase down a group and decrease across a period.
- d. increase down a group and remain constant across a period.
- e. remain constant down a group and increase across a period.

Name: Key

ID: A

16. When heated, azomethane decomposes into nitrogen gas and methane gas.



Bond	Bond Enthalpy (kJ/mol)
C-H	413
C-N	305
C-C	346

Bond	Bond Enthalpy (kJ/mol)
N-N	163
N=N	418
N≡N	945

BREAKING		MAKING	
C-H	6 x	N≡N	1
N=N	1 x	C-C	1
N-C	2 x	C-H	6

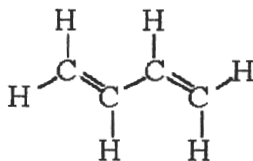
Using average bond enthalpies, calculate the enthalpy of reaction.

- a. -609 kJ/mol
- b. -583 kJ/mol
- c. -462 kJ/mol
- d. -263 kJ/mol
- e. -197 kJ/mol

17. The \_\_\_\_\_ of a photon of light is \_\_\_\_\_ proportional to its energy and \_\_\_\_\_ proportional to its wavelength.

- a. frequency, directly, directly
- b. frequency, directly, inversely
- c. velocity, inversely, directly
- d. amplitude, inversely, inversely
- e. velocity, inversely, inversely

18. How many sigma ( $\sigma$ ) bonds and pi ( $\pi$ ) bonds are in the following molecule?



- a. seven  $\sigma$  and two  $\pi$
- b. six  $\sigma$  and two  $\pi$
- c. eleven  $\sigma$  and zero  $\pi$
- d. nine  $\sigma$  and two  $\pi$
- e. two  $\sigma$  and nine  $\pi$

19. How much energy is required to change the temperature of 15.0 g Fe from 18.5°C to 56.8°C? The specific heat of iron is 0.451 J/g·K.

- a. 57.5 J
- b. 127 J
- c. 259 J
- d. 385 J
- e. 452 J

$$\frac{0.451 \text{ J}}{\text{g} \cdot \text{K}} \times 15.0 \text{ g} \times (56.8 - 18.5) = 259 \text{ J}$$

20. Which of the following elements would have the greatest difference between the first and the second ionization energies?

- a. Na
- b. Sr
- c. Cu
- d. Cl
- e. Sc

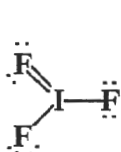
21. What is the total number of valence electrons in a dinitrogen tetroxide molecule?

- a. 18
- b. 24
- c. 26
- d. 32
- e. 34

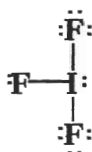
$$N_2O_4$$

$$\begin{array}{l} \text{L} \quad \text{L} \\ \text{L} \quad \text{L} \end{array} \begin{array}{l} 4 \times 6 \\ 2 \times 5 \end{array}$$

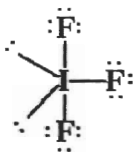
22. What is the correct Lewis structure for IF<sub>3</sub>?



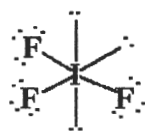
(1)



(2)

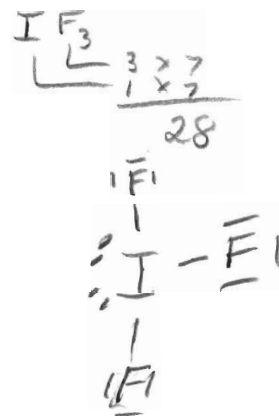


(3)



(4)

- a. 1
- b. 2
- c. 3
- d. 4
- e. 2 and 4



23. If 34.8 J is required to change the temperature of 10.0 g of mercury by 25 K, what is the specific heat of mercury?

- a. 0.139 J/g-K
- b. 0.338 J/g-K
- c. 0.718 J/g-K
- d. 0.870 J/g-K
- e. 1.93 J/g-K

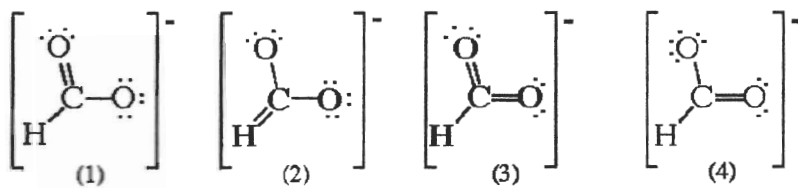
$$\frac{34.8 \text{ J}}{10.0 \text{ g} \cdot 25 \text{ K}} = 0.139$$

24. Which of the following combinations is most likely to produce ionic bonds?

- a. O and H
- b. Al and S
- c. C and N
- d. N and O
- e. S and Cl

Metal + nonmetal

25. Which of the following are resonance structures for formate ion,  $\text{HCO}_2^-$ ?



- a. 1 and 2
- b. 2 and 3
- c. 1 and 3
- d. 1 and 4
- e. 1, 2 and 4