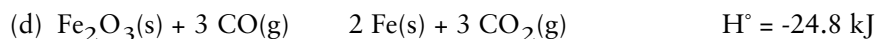
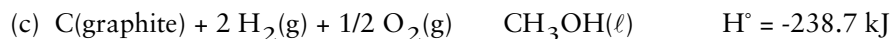


1. (4 points) Which of the following enthalpy changes can be designated as a standard molar enthalpy of formation? (*There may be more than one answer.*)



2. (3 points) Methane, natural gas, burns in air to give carbon monoxide and water.



What is the enthalpy change, $\text{H}^\circ_{\text{rxn}}$, for this reaction? (*All possible answers rounded to one decimal place.*)

(a) +952.0 kJ

(b) +802.3 kJ

(c) -560.5 kJ

(d) -802.3 kJ

(e) -952.0 kJ

(f) None of the above

3. (4 points) Place the following in order of increasing energy:

a) Light with $\lambda = 420 \text{ nm}$

b) The signal from your favorite FM radio station

c) γ -rays (gamma-rays) from a radioactive element

d) Infrared light

e) Light with $\nu = 500 \text{ Hz}$ (or 100 cycles per second)

_____ *lowest energy*

_____ *highest energy*

4. (2 points) Which of the following subshells CANNOT exist? (*Circle all that apply.*)

a) $3p$

b) $4s$

e) $1p$

c) $2f$

5. (5 points) Consider *only* the following energy levels for the H atom. (The diagram below does not attempt to show the correct energy level spacings.)

----- $n = 5$

----- $n = 4$

----- $n = 3$

----- $n = 2$

----- $n = 1$

The emission spectrum of an excited H atom consists of transitions between these levels.

- a) How many emission lines are possible, considering *only* the five quantum levels?

- b) The emission line having the *lowest frequency* corresponds to a transition from the level with $n =$ _____ to the level with $n =$ _____.
- c) The emission line having the *largest energy* corresponds to a transition from the level with $n =$ _____ to the level with $n =$ _____.
6. (4 points) You bombard a piece of cherry pie in a microwave oven with photons having a wavelength of 0.50 m. What is the frequency of these photons?

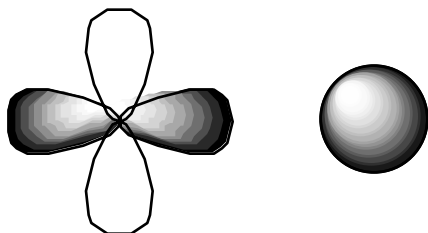
- a) $1.7 \times 10^{-9} \text{ sec}^{-1}$
- b) 2.0 sec^{-1}
- c) $1.5 \times 10^8 \text{ sec}^{-1}$
- c) $6.0 \times 10^8 \text{ sec}^{-1}$
- d) $1.2 \times 10^9 \text{ sec}^{-1}$

What is the energy of 1 mol of photons with a wavelength of 0.50 m?

- a) $4.0 \times 10^{-25} \text{ J}$
- b) 0.060 J
- c) 0.24 J
- d) 4.2 J
- e) $3.6 \times 10^{32} \text{ J}$

7. (8 points) Answer the following questions:

- (a) The quantum number ℓ describes the _____ of an atomic orbital.
- (b) The size of an atomic orbital is described by the quantum number _____
- (c) A photon of green light has _____ (less or more) energy than a photon of orange light.
- (d) The maximum number of orbitals that may be associated with the following set of quantum numbers $n = 4$ and $\ell = 2$ is _____.
- (e) The maximum number of orbitals that may be associated with the quantum number set $n = 2$, $\ell = 1$, and $m_\ell = 0$ is _____.
- (f) Label each of the orbital pictures below with the appropriate letter:



- (g) An orbital with $n = 4$ and $\ell = 1$, is labeled _____ (e.g, 1s)