

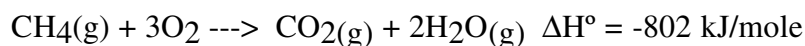
US 110 Exam 3

Name _____

By submitting this exam, I affirm that I have neither given nor received unauthorized aid.

Useful Information: $q = m \times S \times \Delta T$, $\Delta E = q + w$, $w = -P\Delta V$, 1 Latm = 101 J, Bond Order = $\frac{\#bonding - \#antibonding}{2}$, $U = \frac{k|Z_1Z_2|}{d}$, $\Delta E = \Delta H + w$, $C_f = E_{valence} - (\#bonds + E_{nonbonding})$

(1)(4points) Many power plants burn methane (natural gas) to generate electricity. The reaction for the combustion of methane is shown below. A small house needs 2.8×10^5 kJ of electricity a day. How much methane (in moles) must be burned to generate 2.8×10^5 kJ?



(2)(6 points) To 100.0 mL of water was added 0.250 moles (20.0 g) of NH_4NO_3 . The initial temperature of the water was 20.0°C . The final temperature of the water was 7.2°C . Assume that the specific heat for the final solution is $4.18 \frac{\text{J}}{\text{g}^\circ\text{C}}$ and the density of water is 1.00 g/mL.



What is the ΔH for the reaction and is the reaction endothermic or exothermic?

(3)(2 points) Place the following in the order of increasing ionization energy:
Cs, As, Ca, S, He

(4)(2 points) Place the following in the order of increasing size:
P, Cl, As^{3-} , Se^{2-}

(5)(2 points) Which third row element should have the highest 4th ionization energy?

(6)(2 points) Place the following in the order of increasing electronegativity:
B, Ga, N, Ba, Cs

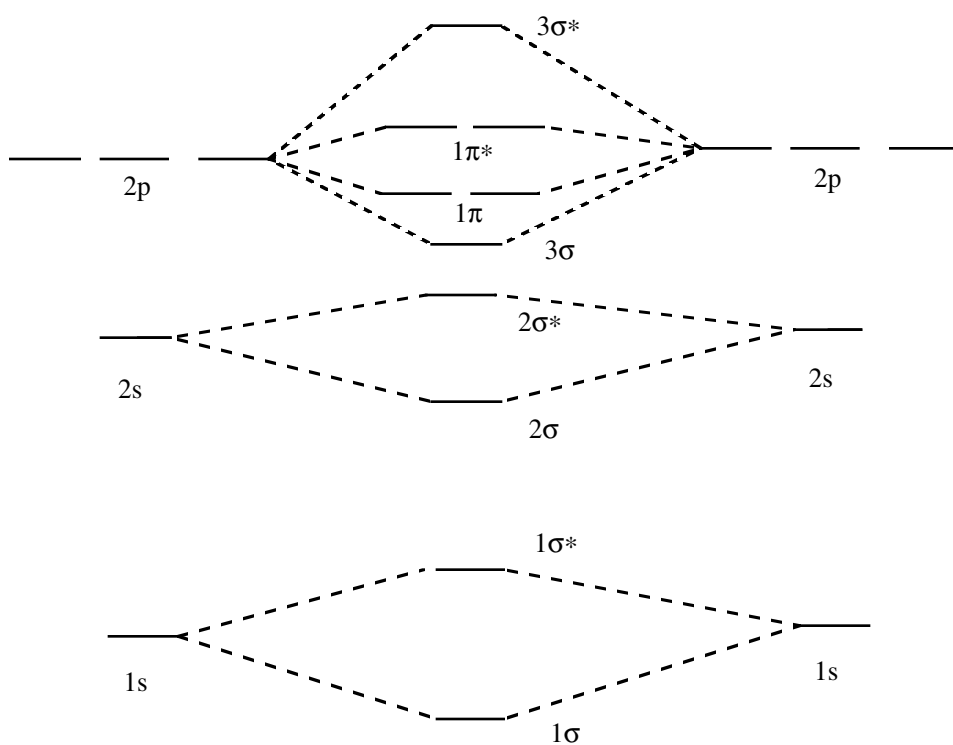
(7)(4 points) Draw the best Lewis dot structure(s) for PO_4^{3-} . Remember formal charge considerations.

(8)(8 points) Draw the Lewis dot structures for the following species. Draw the 3D structure (VSPER) and give the name of the geometry. Then, list the hybridization of the central atom.

(a) BF_3

(b) SF_4

(9)(6 points)



- (a) What is the ground state electron configuration of CN?
- (b) What is the bond order of CN?
- (c) What should have a shortest bond distance, CN^+ , CN or CN^- ?

(10)(8 points) Create a Born-Haber cycle to find the U for the following reaction using the information below.



F₂ bond dissociation energy = 155 kJ/mole

Mg $\Delta H_{\text{sublimation}}$ = 146 kJ/mole

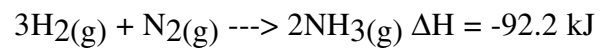
Mg (g): E_{i1} = 738 kJ/mole, E_{i2} = 1451 kJ/mole

F(g) Electron Affinity = -328 kJ/mole

(11)(4 points) Arrange the following in order of increasing ionic bond strength.

ZnCl₂, Ca₃P₂, MgO, BaS, CsI

(12)(4 points) Find ΔE for the following reaction assuming that when one mole of N₂ reacts with 3 moles of H₂ at 1.00 atmosphere of constant pressure, that the change in volume is -1.12 L.



Extra Credit:(4 points): In *Science and Modern Thought*, J. Arthur Thomson lists several limitations of science. What is one of them?