R= 8.31 J/mol K = 0.0821 L atm/mol K = 62.4 L torr/mol K PV = nRT

RH = 2.18 x 10–18 Joule Energy of a Bohr orbit = –RH h = 6.63x10–34 J•s

n2

E = hν = hc c = 3.0000x108 m/ s

λ where ν = frequency in sec-1

.

|  |  |
| --- | --- |
| Substance | ΔH*f̊ (kJ/mol)* |
| CO2(g) | –393.5 |
| CO(g) | –110.5 |
| C2H6(g) | – 84.68 |
| HBr(g) | –36.43 |
| HCl(g) | –92.30 |
| H2O (*l*) | –285.8 |
| HI(g) | +25.9 |
| I2 (g) | +62.25 |
|  |  |

Specific heat of water = 4.18 joule/g K

Choices for questions 1-6 are A) positive, (+) B) negative, (-) or C) zero ( 0 ) (

1. The sign of ΔHo for an exothermic reaction.

2. The sign of the work, *w*, when a gas, contracts due to a pressure applied upon it.

3. ΔHo for the process indicated by the equation 2 HBr(g) → H2(g) + Br2(g)

4. ΔH*f̊* of Cl(g)

5. The heat of formation of Fe (s)

6. The sign of ΔV, the change in volume, when the pressure on a gas is halved at

constant temperature.

7. The expression **hc** = is smallest for A) red light B) infra red radiation

λ

C) ultra violet radiation

10. How many unpaired electrons are there on an atom of Cobalt in the ground state?

A) 7 B) 2 C) 3 D) none

11. How many completely filled sublevels are there on an atom of Sn in the ground state?

A) 4 B) 8 C) 10 D) 11

12. Both calcium atoms and Titanium 2+ ions have 20 electrons. In terms of *unpaired* electrons,

A) both calcium and Ti2+ have none B) Ca has 2 while Ti2+has none.

C) Ca has none, while Ti2+ has 2 D) both calcium and Ti2+ have two

13. How many electrons occupy the 2p sublevel on a Silicon atom in the ground state?

A) 1 B) 2 C) 4 D) 6

22. How much heat is required to raise the temperature of 50.0 g of liquid water from 25o to 45o C. ? A) 1.0 kJ B) 4.18 kJ C) 9.40 kJ D) 12.8 kJ

23. What is the frequency of a photon of light with a wave length of 484 nanometers? (in sec-1)

A) 1.6 x 10−15 B) 4.1 x 10−19 C) 6.2 x 1014 C) 6.2 x 105

Consider the combustion reaction of benzene, (*l*)

2 C6H6(l) + 15 O2(g) →12 CO2(g) + 6 H2O(l) ΔHo = –6535 kJ

24. What is the enthalpy change for the reverse reaction if it produces exactly three moles of benzene? A) + 19600 kJ B) + 9803kJ C) - 9803 kJ D) - 19600 kJ

I. Based on the equation 2 C6H6(l) + 15 O2(g) →12 CO2(g) + 6 H2O(g) ΔHo = –6271 kJ

the heats of formation given on the accompanying sheet, and the heat of formation of C6H6(ℓ), which is + 49.0 kJ/ mol

A. What is the heat of formation, ΔHo*f*, of H2O(g) in kJ per mole ? ( 3 pts)

B. If the reaction began with C6H6 (g) instead of C6H6(l), would the amount of heat released

be greater, equal to, or less than 6535 kilojoules? Explain your answer. ( 2 pts)

III. Find ΔH for each of the following reaction: ( 2 pts)

2 HBr(g) + Cl2(g) → 2 HCl (g) + Br2 (*l*)

V. Use Bohr theory to calculate the following for a hydrogen atom. ( 2 pts each part = 8 pts)

A. The energy and wave length of a line in the hydrogen spectrum that has a frequency of

3.08 x 1015 s-1

VIII. In an experiment to determine the specific heat of copper, 25.00 grams of copper are heated to 100.0°C. The copper is quickly poured into a styrofoam coffee cup that contains 50.00 grams of water at an initial temperature of 24.0°C. The final temperature of the mixture is found to be 27.3° .

Assuming that there was no heat loss to the environment... ( 6 pts)

A. How much heat was gained by the water?

B. How much heat was lost by the copper?

C. What is the specific heat of copper found in this experiment

IX. In an experiment to determine the heat of neutralization, 50.00 mL of 1.00 molar HCl and 50.00 mL of 1.00 molar NaOH are allowed to come to room temperature, 24.0°C.

The two solutions are mixed, and the temperature increases to 29.0°C.

A. Assuming that the density of the mixture is 1.00 g/mL, and the specific heat is 4.18 J/g°

how much heat, in joules, was produced by the reaction? ( 2 pts)

B. How many moles of water were produced by the reaction? ( 1 pt)

C. What is the heat of neutralization, from this experiment, in kilojoules/mol water ?

( 2 pts)