MC_Chem1A_Sp12_LecExam2 Name KEY

Please read the questions very carefully to understand what is being asked. If you do not understand anything, please ask your instructor. Use the reverse side of your question paper as scratch. No outside paper is allowed. You can use the periodic table and constant data provided. Total points = 48 + (20*3=) 60 = 108

SHORT ANSWER. Please write the set-up equation and insert the raw data with units in the equation before doing your calculations. Write the word or phrase that best completes each statement or answers the question.

Given
108.0 J
ΔT = 4.7 °C
C = 0.128 J/g·°C

1) Suppose it took 108.0 joules of energy to raise a bar of gold from 25.0°C to 29.7°C. Given that the specific heat capacity of gold is 0.128 J/g•°C, what is the mass (in grams) of the bar of gold? Show all your calculations with set up equation and units. (8 pts.) 1) 180 g

q, + ΔT, C

$q = c \times m \times \Delta T$

$m = \frac{q}{c \cdot \Delta T} = \frac{(108.0\ J)}{(0.128\ J/g°C)(4.7\ °C)} = 180\ g$

2) How much heat (in joules) is necessary to raise the temperature of 21.0 g of water from 31.0 °C to 95 °C. Given specific heat of water = 4.18 joules/(g. °C) (4 pts.) 2) 5620 J

m, + ΔT, C

Given
21.0 g
64 °C
4.18 J/g·°C

$q = c \times m \times \Delta T$

$= (4.18\ J/g·°C)(21.0\ g)(64.0\ °C)$

$= 5620\ J$

3) Given the following information: 3) 225.8 kJ

$C (s) + O_2 (g) \rightarrow \cancel{CO} \; CO_2 (g)$ $\Delta H^0_{rxn} = -394.1$ kJ

$H_2 (g) + 1/2\, O_2 (g) \rightarrow H_2O (l)$ $\Delta H^0_{rxn} = -286.0$ kJ

$C_2H_2 (g) + 5/2\, O_2 (g) \rightarrow 2\, \cancel{CO} \; CO_2 (g) + H_2O (l)$ $\Delta H^0_{rxn} = -1300.0$ kJ

Calculate the ΔH^0_{rxn} for the reaction (10 pts.):

$2\, C (s) + H_2 (g) \rightarrow C_2H_2 (g)$

$2C(s) + 2O_2(g) \rightarrow 2\,CO_2(g)$ $\Delta H_{rxn} = -788.2$ kJ

$H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l)$ $\Delta H_{rxn} = -286.0$ kJ

$2\,CO_2(g) + H_2O(l) \rightarrow C_2H_2(g) + \frac{5}{2} O_2(g)$ $\Delta H_{rxn} = 1300.0$ kJ

$2C(s) + H_2(g) \rightarrow C_2H_2(g)$ $\Delta H_{rxn} = 225.8$ kJ

4) When 20.0 mL 0.15 M KCl reacts with 20.0 mL 0.15 M $AgNO_3$ in a coffee cup calorimeter, the temperature of the mixture increases from 25.2 °C to 26.8 °C and the combined solution weighs 40.8 g. If no heat is absorbed by the calorimeter, then calculate the $\boxed{\Delta H_{rxn}/(\text{mole of } AgNO_3)}$ for the reaction between $AgNO_3$ and KCl:

$KCl (aq) + AgNO_3 (aq) \rightarrow AgCl (aq) + KNO_3 (aq)$

Given specific heat of water = 4.18 j/(g.K). (8 pts.)

4) 9.1×10^4 J

-9.10×10^4 J/mol

$+\Delta T$

$\Delta H_{rxn} = -q = -(c \times m \times \Delta T)$

$= -[(4.18\ J/g\,°C)(40.8\ g)(1.6\ °C)]$ 2 sig fig

$= -273$ J

$\text{mol } AgNO_3 = 20.0\ mL \times \frac{L}{1000\ mL} \times \frac{0.15\ mol}{L} = 0.003 \text{ mol } AgNO_3$

$\Delta H_{rxn} / \text{mol } AgNO_3 = \frac{-273\ J}{0.003 \text{ mol } AgNO_3} = -9.10 \times 10^4 \text{ J/mol } AgNO_3$

9.1×10^4 J/mol $AgNO_3$ 2 sf

5) Calculate the energy of one mole of blue light with wavelength = 434 nanometer. (λ)
Given, E = hν; N= 6.022 x 10^{23}/mol; h = 6.626x10^{-34} j.s/photon, Vel of light c = 2.89x10^{8}m/s.(8 pts.)

5) 2.66×10^5 J/mol

$$E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34}\ J \cdot s/\text{photon})(2.89 \times 10^{8}\ m/s)}{(434 \times 10^{-9}\ m)}$$

$$= \frac{4.41224424 \times 10^{-19}\ J}{\text{photon}} \times \frac{6.022 \times 10^{23}\ \text{photons}}{1\ \text{mol}}$$

$$= 2.66 \times 10^{5}\ J/\text{mol}$$

6) Bohr's equation for the energy of an electron E in the n-th shell is given by:

$$E_n = -Rhc / n^2 = -2.179 \times 10^{-18}\ J / n^2$$

Use the equation to calculate the wavelength of the electromagnetic radiation that is emitted when an electron moves from n = 4 to n = 2. Rydberg constant, R = 1.0974 x 10^{7} m^{-1}(10 pts.)

6) ~~4.818×10^{9}~~ nm
481.8 nm

$$E_{n=4} = -2.179 \times 10^{-8}\ J / 16 = -1.362 \times 10^{-09}\ J$$

$$E_{n=2} = -2.179 \times 10^{-8}\ J / 4 = -5.448 \times 10^{-09}\ J$$

$$\Delta E = E_{n=2} - E_{n=4} = -4.122 \times 10^{-09}\ J$$

$$E = h\nu = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E} = \frac{(6.626 \times 10^{-34}\ J \cdot s)(2.997 \times 10^{8}\ m/s)}{4.122 \times 10^{-09}\ J}$$

$$= 4.818 \times 10^{-17}\ m \times \frac{10^{9}\ nm}{m} = 4.818 \times 10^{8}\ nm$$

$$= 4.818 \times 10^{2}\ nm$$

$$= 481.8\ nm$$

MULTIPLE CHOICE. On scantron, answer by filling the bubbles of the same number as the question number. Choose the one alternative that best completes the statement or answers the question. (3 poins each)

7) Which one of the following conditions would always result in an increase in the internal energy of a system? 7) C

A) The system loses heat and does work on the surroundings.
B) The system gains heat and does work on the surroundings.
C) The system gains heat and has work done on it by the surroundings.
D) The system loses heat and has work done on it by the surroundings.
E) None of the above is correct.

8) Which one of the following is an endothermic process? 8) Cancelled

A) water freezing
B) ice melting
C) Hydrochloric acid and barium hydroxide are mixed at 25°C: the temperature increases.
D) boiling soup
E) Both A and C

9) Which one of the following statements is true? 9) C

A) The enthalpy change of a reaction is the reciprocal of the ΔH of the reverse reaction.
B) Enthalpy is an intensive property.
C) Enthalpy is a state function.
D) The enthalpy change for a reaction is ~~independent~~ of the state of the reactants and products.
E) H is the value of q measured under conditions of constant ~~volume~~.

10) The reaction 10) B

$$4Al\ (s) + 3O_2\ (g) \rightarrow 2Al_2O_3\ (s) \qquad \Delta H° = -3351\ kJ$$

is _____, and therefore heat is _____ by the reaction.

A) endothermic, absorbed
B) exothermic, released
C) exothermic, absorbed
D) endothermic, released
E) thermoneutral, neither released nor absorbed

11) For which one of the following reactions is the value of $\Delta H°_{rxn}$ equal to $\Delta H°_f$ for the product? 11) A

A) $2\ C\ (s, graphite) + 2\ H_2\ (g) \rightarrow C_2H_4\ (g)$
B) $H_2O\ (l) + 1/2\ O_2\ (g) \rightarrow H_2O_2\ (l)$
C) $N_2\ (g) + O_2\ (g) \rightarrow 2\ NO\ (g)$
D) $2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$
E) $2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (l)$

12) Which one of the following is not a valid value for the magnetic quantum number of an electron in a 5d subshell? 12) D

A) 0 B) 1 C) -1 D) 3 E) 2

0 s
1 p
2 d

13) An electron cannot have the quantum numbers n = _____, l = _____, m_l = _____. 13) C

A) 2, 1, -1 B) 3, 2, 1 C) 1, 1, 1 D) 2, 0, 0 E) 3, 1, -1

2p 3p 1p 2s 3p

14) Which one of the following is an incorrect subshell notation? 14) C

A) 2p B) 3s C) 2d D) 4f E) 3d

3,2

15) Which set of three quantum numbers (n, l, m_l) corresponds to a 3d orbital? 15) B

A) 2, 1, 0 B) 3, 2, 2 C) 3, 3, 2 D) 3, 2, 3 E) 2, 3, 3

16) The ground state electron configuration of Fe is _____. 16) C

A) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

B) $1s^2 2s^2 3s^2 3p^6 3d^6$

C) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$

D) $1s^2 2s^2 3s^2 3p^{10}$

E) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^6$

17) The lowest orbital energy is reached when the number of electrons with the same spin is maximized. This statement describes _____. 17) E

A) Planck's constant

B) Pauli Exclusion Principle

C) Heisenberg Uncertainty Principle

D) deBroglie hypothesis

E) Hund's rule

18) Of the following, which gives the correct order for atomic radius for Mg, Na, P, Si and Ar? 18) B

A) Ar > Si > P > Na > Mg

B) Na > Mg > Si > P > Ar

C) Mg > Na > P > Si > Ar

D) Ar > P > Si > Mg > Na

E) Si > P > Ar > Na > Mg

Na Mg Si P Ar

19) The effective nuclear charge of an atom is primarily affected by _____. 19) D

A) nuclear charge

B) electrondistribution

C) outer electrons

D) inner electrons

E) orbital radial probability

20) Which one of the following atoms has the largest radius? 20) E

A) Sr B) I C) Ca D) Co E) Ba

21) Of the following elements, _____ has the most negative electron affinity. 21) A

A) Cl B) I C) Br D) Se E) S

Consider the following electron configurations to answer the questions that follow:

(i) $1s^2\ 2s^2\ 2p^6\ 3s^1$ Na
(ii) $1s^2\ 2s^2\ 2p^6\ 3s^2$ Mg
(iii) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$ Al
(iv) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ S
(v) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ Cl

22) The electron configuration that belongs to the atom with the lowest second ionization energy is _____. 22) B

A) (i) B) (ii) C) (iii) D) (iv) E) (v)

TRUE/FALSE. On scantron, choose "A" for a true answer and "B" for wrong answer.

23) Work equals force times distance. 23) T

W = F x d

24) If a hydrogen atom electron jumps from the n=6 orbit to the n=2 orbit, energy is released. 24) T

25) The larger the principal quantum number of an orbital, the lower is the energy of the electrons in that orbital. 25) F

26) The effective nuclear charge acting on an electron is larger than the actual nuclear charge. 26) F