Name:
Student Number:

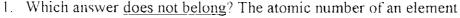## INSTRUCTIONS:
1. This exam contains 9 pages
2. No scratch, loose paper, pencil, red pen
3. Calculators allowed
4. Multiple choice problems: only one answer is correct

Constants:
$R = 8.314$ J K^{-1} mol^{-1} = 0.0821 L atm K^{-1} mol^{-1}

$h = 6.63 \times 10^{-34}$ J s

$c = 3 \times 10^8$ m s^{-1}

$R_H = 109678$ cm^{-1} = 2.18×10^{-18} J
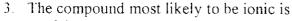
$m_e = 9.11 \times 10^{-31}$ kg

$e = 1.60 \times 10^{-19}$ C

First Bohr radius for H: $r = n^2h^2/Z4\pi^2m_ee^2 = a_0 = 0.529$ Å

Energy of a Bohr orbit: $E = -2\pi^2m_ee^4Z^2/h^2n^2$

1 atm = 1.01325×10^5 Pa = 760 mmHg

1. Which answer <u>does not belong</u>? The atomic number of an element
    a.   corresponds to the number of protons in the element
    b.   corresponds to the number of electrons in the element
    c.   identifies the order in which the element was discovered
    d.   is always an integer

2. For the Na$^+$ ion,
    a.   the number of protons equals the number of electrons
    b.   the atomic number is the number of electrons
    c.   the number of protons is greater than the number of electrons
    d.   the number of electrons is greater than the number of protons

3. The compound most likely to be ionic is
    a. SO_2
    b. PCl_3
    c. NaI
    d. N_2O_4

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4. Which of the following is true for the element with atomic number 12?
   a. the element is in period 2
   b. the element is an alkali metal
   c. the atom forms an ion with a charge of 2+
   d. the element is in group IVA

5. The formula for the hypochlorite ion is
   a. ClO^-
   b. ClO_2^-
   c. ClO_3^-
   d. ClO_4^-

6. The best name of the compound $FeCl_2$ is
   a. iron chloride
   b. iron(II) chloride
   c. iron(II) dichloride
   d. iron dichloride

7. The name of the compound N_2O_4 is
   a. dinitrogen oxide
   b. nitrogen(IV) oxide
   c. dinitrogen tetroxide
   d. nitrogen(II) oxide

8. The number of atoms in 3.00 mol of ammonia, NH_3, is
   a. 3.00
   b. 12.0
   c. 1.81×10^{24}
   d. 7.22×10^{24}

9. In the reaction $Fe_2O_3(s) + 3\ CO(g) \rightarrow 2\ Fe(s) + 3\ CO_2(g)$, when 45.3 g of CO reacts quantitatively with 79.8 g of Fe_2O_3, the limiting reagent is
   a. Fe_2O_3
   b. CO
   c. Fe
   d. CO_2

10. The reaction $2\ KClO_3(s) \rightarrow 2\ KCl(s) + 3\ O_2(g)$ produces 0.834 g of O_2 from 5.32 g of $KClO_3$; the theoretical yield is
    a. 15.7 %
    b. 0.834 g
    c. 2.08 g
    d. 60.0 %

35. According to the kinetic molecular theory, the pressure exerted by a gas increases when the number of molecules in the sample is increased because
   a. more molecules strike the walls
   b. molecules hit the walls harder
   c. molecules collide with each other more often
   d. molecules move farther between collisions with the walls

36. Real gases deviate from the ideal gas equation at very high pressures because
   a. real molecules occupy space, which is then no longer available for molecular motion
   b. at high pressures the molecules are in such close proximity that small attractive forces become important
   c. both of the preceding answers (a. and b.) are correct
   d. None of the preceding answers is correct

37. A 250 mL sample of a volatile organic compound weighed 0.474 g at 1.00 atm and 100°C. Calculate the molar mass of the compound.
   a. 58.1 g/mol
   b. 21.2 g/mol
   c. 72.0 g/mol
   d. 122 g/mol

38. The relationship that states that the total pressure of a mixture of gases is equal to the sum of the partial pressures of the individual gases is
   a. Boyle's Law
   b. Charles' Law
   c. Avogadro's Law
   d. Dalton's Law

39. The blue line with a wavelength of 434 nm in the spectrum of the hydrogen atom results from the electron dropping from the $n = 5$ level to the $n = 2$ level. It is also true that
   a. light at 434 nm is emitted when the electron moves from $n = 2$ to $n = 5$
   b. the energy of the $n = 5$ level is 4.56×10^{-19} J
   c. the energy of the $n = 5$ level is lower than that of the $n = 2$ level
   d. the energy difference between the $n = 5$ and $n = 2$ levels is 4.56×10^{-19} J

40. The minimum energy needed to force an electron from the surface of magnesium metal is 5.86×10^{-19} J. When light of 461 nm falls on magnesium,
   a. no electrons are knocked off
   b. electrons with a kinetic energy of 1.55×10^{-19} J are emitted
   c. electrons with a kinetic energy of 1.02×10^{-19} J are emitted
   d. insufficient information is given to tell what happens

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41. VSEPR
    a. stands for Valence Shell Electron Paramagnetic Resonance
    b. states that the shapes of molecules can be predicted simply by locating the pairs of electrons that are in the valence shell as far apart from each other as possible
    c. states that the shapes of molecules can be predicted simply by locating the pairs of electrons that are in the valence shell as close together as possible
    d. all of the above describe VSEPR

42. A polar molecule
    a. may but need not have a dipole moment
    b. has a dipole moment
    c. is composed of two atoms of the same element
    d. has no dipole moment

43. A dipole moment
    a. measures the direction and magnitude of the separation of charges in a polar molecule
    b. is the sum of Pauling electronegativities of bonded atoms in a polar molecule
    c. is inversely proportional to the difference of the Pauling electronegativities of bonded atoms in a polar molecule
    d. measures the magnetic moment caused by unpaired electron