Instructions:

This exam should have 25 questions. Each question is worth 4 points for a total of 100 points. A periodic table should follow this page.

Information:
Mass % = (mass of solute (g)/mass of solution (g)) x 100%
Volume % = (volume (mL) solute/volume (mL) solution) x 100%
Mass/volume % = (grams of solute/mL of solution) x 100%
M = moles of solute/L of solution
([H₃O⁺])([OH⁻]) = 1 x 10⁻¹⁴ = K_w
pH = −log[H₃O⁺] pOH = −log[OH⁻]
M₁V₁ = M₂V₂
Alkane: CₙH₂ₙ⁺₂
Cyclo: CₙH₂ₙ
# WebElements: the periodic table on the world-wide web

http://www.webelements.com/

<table>
<thead>
<tr>
<th>1</th>
<th>Hydrogen (H)</th>
<th>2</th>
<th>Lithium (Li)</th>
<th>3</th>
<th>Beryllium (Be)</th>
<th>4</th>
<th>Boron (B)</th>
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<tr>
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<td>1.008</td>
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<td>6.941</td>
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<td>9.0122</td>
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<td>10.811</td>
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<td>11</td>
<td>Sodium (Na)</td>
<td>12</td>
<td>Magnesium (Mg)</td>
<td>22</td>
<td>23.055</td>
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<td>22.990</td>
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<td>Potassium (K)</td>
<td>37</td>
<td>Rubidium (Rb)</td>
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<td>Cerium (Ce)</td>
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<td>Francium (Fr)</td>
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<td></td>
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<td>87</td>
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</tr>
</tbody>
</table>

Symbols and names: the symbols and names of the elements, and their spellings are those recommended by the International Union of Pure and Applied Chemistry (IUPAC - http://www.iupac.org). Names have yet to be proposed for the most recently discovered elements 115-117 and 118 so these used here are IUPAC's temporary systematic names. In the USA and some other countries, the spellings aluminium and cesium are normal while in the UK and elsewhere the common spelling is sulphur.

Group labels: the numeric system (1-18) used here is the current IUPAC convention.

Atomic weights (mean relative masses): Apart from the heaviest elements, these are the IUPAC 2001 values and given to 5 significant figures. Elements for which the atomic weight is given within square brackets have no stable nuclides and are represented by the element's longest lived isotope.

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The name given to an aqueous solution of HBr is
   A) bromous acid.
   B) hydrobromic acid.
   C) hydrogen bromide.
   D) hypobromous acid.
   E) bromic acid.

2) Which of the following statements correctly describes the hydronium-hydroxide balance in the given solution?
   A) In neutral solutions, \([H_3O^+] = [H_2O]\).
   B) In acids, \([OH^-]\) is greater than \([H_3O^+]\).
   C) In bases, \([OH^-]\) is less than \([H_3O^+]\).
   D) In bases, \([OH^-] = [H_3O^+]\).
   E) In bases, \([OH^-]\) is greater than \([H_3O^+]\).

3) What is the \([OH^-]\) in a solution that has a \([H_3O^+] = 1 \times 10^{-6}\) M?
   A) \(1 \times 10^{-10}\) M
   B) \(1 \times 10^{-6}\) M
   C) \(1 \times 10^{-12}\) M
   D) \(1 \times 10^{-2}\) M
   E) \(1 \times 10^{-8}\) M

4) What is the pH of a solution with \([OH^-] = 1 \times 10^{-4}\) M?
   A) -10.0
   B) -4.0
   C) \(1.0 \times 10^{-10}\)
   D) 10.0
   E) 4.0

5) Which of the following is the strongest acid?
   A) NaOH
   B) HCl
   C) \(NH_4^+\)
   D) H_2CO_3
   E) H_3PO_4

6) Which of the following is the correctly balanced equation for the complete neutralization of \(H_3PO_4\) with Ca(OH)_2?
   A) \(H_3PO_4 + Ca(OH)_2 \rightarrow Ca(HPO_4) + 2H_2O\)
   B) \(2H_3PO_4 + 3Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + 6H_2O\)
   C) \(3H_3PO_4 + Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + 5H_2O\)
   D) \(4H_3PO_4 + 6Ca(OH)_2 \rightarrow 2Ca_3(PO_4)_2 + 12H_2O\)
   E) \(H_3PO_4 + Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + H_2O\)
7) In a buffer system of HF and its salt, NaF,
   A) the F⁻ neutralizes added base.
   B) the HF neutralizes added acid.
   C) the HF is not necessary.
   D) the F⁻ neutralizes added H₂O.
   E) the HF neutralizes added base.

8) What is the molarity of a KCl solution made by diluting 75.0 mL of a 0.200 M solution to a final volume of 100. mL?
   A) 0.100 M    B) 0.150 M    C) 0.200 M    D) 6.67 M    E) 0.267 M

9) How many milliliters of 0.200 M NaOH are required to completely neutralize 5.00 mL of 0.100 M H₃PO₄?
   A) 0.833 mL    B) 2.50 mL    C) 7.50 mL    D) 15.0 mL    E) 5.00 mL

10) The functional group contained in the compound CH₃CH₂OH is a(n)

11) A molecule containing a carbon atom bonded to four chlorine atoms has the shape of a
    A) tetrahedron.
    B) cube.
    C) rhombus.
    D) square.
    E) triangle.

12) As carbon bonds with atoms of increasingly higher electronegativities, the polarity of the bond
    A) reverses.
    B) decreases.
    C) increases.
    D) stays the same.
    E) becomes inverted.

13) Which of the following is NOT typical of most organic compounds?
    A) poor solubility in water
    B) high flammability
    C) low boiling point
    D) covalent bonding
    E) high melting point

14) An alkyne is always a carbon compound that contains a ____ bond.
    A) triple    B) single    C) hydrogen    D) aromatic    E) double

15) The functional group contained in the compound (CH₃CH₂)₂O is a(n)
16) The functional group contained in the compound CH₃CH₂CONH₂ is a(n)
   A) ester.
   B) carboxylic acid.
   C) thiol.
   D) amide.
   E) amine.

17) Carbon atoms always have how many covalent bonds?
   A) four    B) one    C) three    D) five    E) two

18) Which of the following is NOT a representation for a carboxylic acid functional group?
   A) O
   B) CHO
   C) COOH
   D) C(=O)OH
   E) CO₂H

19) What is the name of the unbranched alkane with six carbon atoms?
   A) heptane
   B) pentane
   C) octane
   D) butane
   E) hexane

20) The reaction of butane with oxygen is called
    A) addition.
    B) neutralization.
    C) substitution.
    D) titration.
    E) combustion.

21) What is the IUPAC name of this alkane?

   CH₃       CH₂ - CH₂ - CH₃
   |         |
   CH₃ - CH - CH₂ - CH
   |         |
   CH₂ - CH₂ - CH₃

   A) 6-methyl-4-propylheptane
   B) 2-methyl-4-ethylheptane
   C) 3-methyl-1,1-dipropylbutane
   D) methylpropylheptane
   E) 2-methyl-4-propylheptane

22) Which of the following compounds could have the molecular formula C₇H₁₆?
    A) pentane
    B) hexane
    C) 2-methylheptane
    D) 3-ethylhexane
    E) 2,3-dimethylpentane
23) How many structural isomers can be drawn for butane (C₄H₁₀)?
   A) one            B) two           C) three           D) four         E) five

24) What is the name for a one-carbon alkyl substituent?
   A) ethyl          B) propyl        C) pentyl          D) methyl       E) butyl

25) The boiling point of a branched alkane is generally _____ that of the straight chain hydrocarbon with the same number of atoms.
   A) lower than     B) higher than   C) about the same as