ERSC 2220H 2013 PTBO Exam Prep Question Set

These questions are intended to give you practice at answering multiple choice questions similar to what you can expect on the final exam. It is important to keep in mind that you should not simply find the answer to each question. ***You should focus on understanding the concepts and material related to the questions so that you can do well on the exam itself.*** Answers to all questions will be posted about one week before the exam. **(Please note that you will be provided with a periodic table at the exam)**

1. Choose the correct number of significant digits in the number 7.20850 g.
a). 5
b). 4
c). 6
d). 3

2. Choose the correctly rounded off version of 12.77 to three significant digits.
a). 12.77
b). 12.8
c). 12.7
d). 13.0

3. Choose the correct number of significant figures in the product 3.883 × 7.99.
a). 7
b). 5
c). 4
d). 3

4. Choose the correct representation of 20,733 in scientific notation.
a). 2.0733×10^4
b). 2.0733×10^3
c). 2.073×10^4
d). 2.0700×10^4

5. Choose the correct representation of 0.00730 in scientific notation.
a). 7.3×10^{-3}
b). 7.30×10^{-3}
c). 7.3×10^3
d). 7.300×10^{-3}

6. Choose the correct value for the freezing point of water:
a). 37 ºC
b). 273 K
c). 36 ºF
d). 212 ºF

7. A Celsius degree is larger than a Fahrenheit degree.
a). True
b). False

8. Choose the correct symbol for calcium.
a). Cr
b). Ca
c). C
d). Cb

9. Choose the number of elements that constitute the bulk (~99%) of the earth's crust.
a). 26
b). 114
c). 10
d). 88

10. Choose the molecular structure that violates Dalton's Laws.
a). Al_2O_3
b). Fe_3O_4
c). $Al_{1.3}Cr_{0.7}O_7$
d). $C_7H_{15}OH$

11. Choose the subatomic particle with a negative charge.
a). proton
b). neutron
c). electron
d). alpha particle

12. The nucleons (nuclear particles) are
a). protons and electrons
b). neutrons and electrons
c). neutrinos and neutrons
d). protons and neutrons

13. The atomic mass of carbon is 12.01. Choose the most correct statement below.
a). The bulk of carbon is ^{14}C.
b). Most carbon has very little ^{14}C or ^{13}C.
c). About 50% of C on the planet is either ^{14}C or ^{13}C.
d). 75% of C is ^{12}C

14. Choose the correct number of hydrogen atoms in $Mg(CH_3CO_2)_2$.
a). 2
b). 3
c). 6
d). 12

15. Choose the element that normally occurs as a diatomic molecule.
a). C
b). B
c). O
d). Ar

16. Choose the correct formula for the ionic compound formed between nitrogen and magnesium.
a). Mg_3N_2
b). MgN
c). MgNi
d). Mg_2N_2

17. Choose the correct formula for the ionic compound containing ammonium ion, NH^{4+}, and phosphate ion, PO_4^{3-}.
a). NH_4PO_4
b). NH_3PO_4
c). $(NH_4)_3PO_4$
d). $(NH_4)_3(PO_4)_1$

18. Choose the best answer describing the properties characteristic of a solid
a). lacks a definite shape
b). lacks a definite volume
c). has a definite shape and volume
d). has a definite volume

19. A mixture that can be separated by filtration is a heterogeneous mixture.
a). True
b). False

20. The temperature at which a liquid changes into a gas is the
a). melting point
b). condensation point
c). boiling point
d). freezing point

21. Chemical changes _____
a). convert one substance into one or more other substances
b). convert a liquid into a gas
c). lower the density of a substance
d). convert a solid directly to a gas

22. Choose the correct density conversion factor if you wanted to determine how many mL of ethyl alcohol is displaced by 22.8 g of ethyl alcohol.
a). 0.790 g/mL
b). 1 mL/0.790 g

23. The density of bone is 3.317 g/mL. The volume of a sample of bone was determined by displacement of water. The bone displaced 255 mL of water. Calculate the mass of a bone that has a volume 255 mL.
a). 76.877 mL
b). 77 mL
c). 845.8 g
d). 147 mL

24. A homogeneous mixture is made by mixing 50 mL of water (density = 1.00 g/mL) and 50 mL of ethyl alcohol (density = 0.790 g/mL). The density of the resulting solution lies above 1.00 g/mL.
    a). True
    b). False

25. Bourbon is sold as 40% solutions of ethyl alcohol. In this case, the ethyl alcohol is the solute.
    a). True
    b). False

26. Several grams of sodium sulfate are dissolved in a beaker containing 225 mL of water. The outside of the beaker beads up with water, indicating that the temperature of the mixture is substantially below room temperature. The dissolution of sodium sulfate in water is therefore:
    a). Exothermic
    b). Endothermic

27. A piece of iron at 75 ºC is placed in a beaker containing 300 mL of water at 22.5 ºC. The final temperature of the water is:
    a). between 75 ºC and 22.5 ºC
    b). above 75 ºC
    c). below 22.5 º

Chapter 4

28. Choose the element that is classified as a nonmetal.
a). Mg
b). Ge
c). K
d). P

29. Choose the element that is classified as a metal.
a). C(s)
b). Hg(l)
c). Br_2(l)
d). N_2(g)

30. Choose the element in the 4th period.
a). F_2(g)
b). O_2
c). NH_3
d). Ag
e). Cr

31. Choose the element classified as an alkaline earth.
a). Mg
b). O_2
c). Zn
d). P_4(s)

32. Choose the binary compound.
a). SO_2
b). N_2
c). C_2H_6O
d). P_4

33. Choose the metal that is found in only one oxidation state.
a). Zn
b). Cu
c). Fe
d). Ti

34. Choose the correct formula for dinitrogen tetroxide.
a). $Pb(NO_3)_2$
b). NO_4
c). N_2O_4
d). CH_4(g)

35. Choose the correct formula for hydroiodic acid.
a). HI
b). HIO_4
c). H_2OI
d). HIO_3

36. Choose the correct formula for sulfurous acid.
a). H_2S
b). H_2SO_2
c). H_2SO_3
d). H_2SO_4

CHAPTER 5

37. Choose the correct statement defining a mole.
a). The number of atoms in exactly 12 g of ^{12}C
b). Avogadro's number of atoms
c). The number of atoms in one atomic mass of any element in grams
d). All of the above

38. Choose the correct number of carbon atoms in $Co(C_2O_4)_3$.
a). 2
b). 3
c). 4
d). 6

39. Choose the correct definition of a hydrate.
a). Compounds of carbon and water
b). Solutions where the solvent is water
c). Ionic compounds with water molecules attached to the structure
d). Molecular compounds crystallized from water

40. Choose the correct formula for copper(II) sulfate pentahydrate.
a). $Cu_2SO_4(H_2O)_5$
b). $CuCO_4 \bullet 5H_2O$
c). $CuSO_4 \bullet 5H_2O$
d). $CuSO_3 \bullet 4H_2O$

41. Choose the number of moles of sulfur present in one mole of $Fe_2(SO_4)_3$.
a). 1
b). 12
c). 3
d). 8

CHAPTER 6
42. Choose the chemical substance with the incorrect phase.
a). Mg(s)
b). Hg(l)
c). Br_2(l)
d). N_2(l)

43. Choose the balanced equation.
a). $C_3H_6(g) + O_2(g) \rightarrow 3\ CO_2(g) + 3\ H_2O(g)$
b). $4\ Al(s) + 3\ O_2(g) \rightarrow 2\ Al_2O_3(s)$
c). $P_4(s) + O_2(g) \rightarrow P_2O_5(s)$
d). $S_6(s) + N_2(g) \rightarrow S_3N_2(s)$

44. Choose the correctly balanced equation.
a). $C(g) + O_2(g) \rightarrow CO(g)$
b). $P_4(s) + 5\ O_2(g) \rightarrow 2\ P_2N_5(l)$
c). $C_6H_{12}O_6(l) + 6\ O_2(g) \rightarrow 6\ CO_2(g) + 6\ H_2O(l)$
d). $2\ H_2(g) + O_2(g) \rightarrow H_2O(g)$

45. Choose the combustion reaction.
a). $CO_2(g) + H_2O(g) \rightarrow C_6H_{12}O_6(l) + O_2(g)$
b). $CH_3O_2H(l) + NaOH(aq) \rightarrow CH_3CO_2Na(aq) + H_2O(l)$
c). $NH_3(aq) + HCl(aq) \rightarrow NH_4^+(aq) + Cl^-(aq)$
d). $2Ag(NO_3)(aq) + CoCl_2(aq) \rightarrow 2\ AgCl(s) + Co(NO_3)_2(aq)$
e). $2\ C_8H_{18}(l) + 25\ O_2(g) \rightarrow 16\ CO_2(g) + 18\ H_2O(l)$

46. Choose the combination reaction.
a). $Mg(OH)_2(s) + 2\ HCl(aq) \rightarrow MgCl_2(aq) + 2\ H_2O(l)$
b). $CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$
c). $Zn(s) + CuCl_2(aq) \rightarrow ZnCl_2(aq) + Cu(s)$
d). $P_4(s) + 5\ O_2(g) \rightarrow 2\ P_2O_5(s)$

47. Choose the strong acid.
a). CH_3COOH
b). H_2S
c). HNO_2
d). HCl

CHAPTER 7

48. The value of Avogadro's number is needed to convert moles of product to grams of product.
    a). True
    b). False

49. A stoichiometric mixture is when the reactants are combined in the same mole ratios as appear in the balanced chemical equation.
    a). True
    b). False

50. For the reaction

$$H_3PO_4(aq) + 3\ NaOH(aq) \rightarrow Na_3PO_4(aq) + 3\ H_2O(l)$$

    if equimolar amounts of H_3PO_4 and NaOH are in solution, choose the limiting reagent.
    a). Na_3PO_4
    b). H_3PO_4
    c). NaOH
    d). H_2O

51. The limiting reactant is_____
    a). the reactant that controls the amount of product produced.
    b). the reactant that provides the bulk of the heat evolved in an exothermic reaction.
    c). the reactant that is in excess.
    d). the reactant that remains after the reaction is complete

52. Choose the key item that must be determined experimentally in order to calculate the percent yield.
    a). theoretical yield
    b). mol of product
    c). g of reactant used
    d). heat evolved

53. Dissolution of a white granular material in water causes the solution to decrease in temperature. Choose the correct statement that accounts for this phenomena.
    a). The reaction is exothermic.
    b). The reaction produces heat.
    c). Heat is a reactant.
    d). Heat is a product.

54. Select the true statement about exothermic reactions.
    a). They are product favored.
    b). Heat is a reactant.
    c). Heat is a product.
    d). They are reactant favored.

55. If 572 kJ of heat is produced for every mole of O_2 in the following reaction:

$$2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(l)$$

    how many kJ are produced when 3 mol of O_2 are reacted?
    a). 572 kJ
    b). 1.144 kJ
    c). 1144 kJ
    d). 1716 kJ

56. A thermochemical equation must include:
    a). the number of moles of product.
    b). the enthalpy of reaction.
    c). the heat evolved.
    d). the number of grams of reactants used.

CHAPTER 8

57. Choose the **most chemically relevant** feature of valence electrons.
    a).Valence electrons are often unpaired
    b). Valence electrons are energetically available for bonding.
    c). Valence electrons lie in orbitals that are furthest from the nucleus
    d). Valence electrons are displaced by visible or ultraviolet light.

58. Choose the correct ordering, in increasing energy, of the sublevels.
    a). f>d>s>s
    b). p>s>f>d
    c).d>f>p>s
    d). s>p>d>f

59. Choose the sublevel that has three orbitals
    a). s
    b). p
    c). d
    d). f

60. Choose the maximum number of electrons the d sublevel can contain.
    a). 2
    b). 6
    c). 10
    d). 14

61. Choose the correct electron configuration for nitrogen.
    a). $1s^2 2s^2 2p^1$
    b). $1s^2 2s^2 2p^3$
    c). $1s^2 2s^2 2p^9$
    d). $1s^2 2s^2 2p^1 3s^2$

62. Choose the element that has the electron configuration [Ne]$3s^2 3p^3$:
    a). S
    b). O
    c). P
    d). Si

63. Choose the most chemically relevant feature of valence electrons.
    a).Valence electrons are often unpaired
    b). Valence electrons are energetically available for bonding.
    c). Valence electrons lie in orbitals that are furthest from the nucleus
    d). Valence electrons are displaced by visible or ultraviolet light.

64. Choose the correct electron configuration for N^{3-}.
    a). [He]$2s^2 2p^3$
    b). [He]$2s^2 2p^4$
    c). [He]$2s^2 2p^5$
    d). [He]$2s^2 2p^6$

65. Choose the species that is larger than its parent atom.
    a). Li^+
    b). N^{3-}

CHAPTER 9

66. Which element disobeys the octet rule?
    a). O
    b). C
    c). Be
    d). N

67. Choose the number of electrons N must acquire to achieve an octet.
    a). 1
    b). 2
    c). 3
    d). 4

68. Choose the best definition for a chemical bond.
    a). the attraction between two oppositely charged ions
    b). the forces that hold two atoms together
    c). the transfer of one electron from one atom to another
    d). a pair of electrons between two atoms

69. Choose the number of electrons Mg must lose to achieve an octet.
    a). 1
    b). 2
    c). 3
    d). 4

70. Choose the statement that best characterizes covalent bonds
    a). Bonding is primarily based on electron sharing.
    b). Bonding is primarily based on electron transfer.
    c). Bonding is primarily based on electrostatic attraction.
    d). Bonding is primarily based on electron repulsion.

71. Choose the best definition for electronegativity.
    a). The ability of an atom to draw electrons in a bond to itself.
    b). The energy required to remove one electron from an atom.
    c). The energy required to add an electron to an atom to form an anion.
    d). The tendency for an atom to acquire lone pairs.

72. An essential requirement of a polar bond is that the two atoms participating in the bond must differ in electronegativity.
    a). True
    b). False

73. Carbon dioxide, CO2, is a nonpolar molecule.
    a). True
    b). False

CHAPTER 12

74. Choose the only intermolecular force favoring the formation of a solution.
    a). solute-solute
    b). solvent-solvent
    c). solute-solvent

75. Choose the type of solution one has if one adds sugar to a glass of ice tea until crystals of sugar are visible at the bottom of the glass.
    a). Saturated
    b). Dilute
    c). Supersaturated

76. Choose the solution from which crystals of solute are expected to form.
    a). dilute
    b). concentrated
    c). saturated
    d). supersaturated

77. Polar compounds dissolve in water because they have positive and negative sites that can interact with the dipoles of water.
    a). True
    b). False

78. Calculate the percent by mass that results if one dissolves twenty grams of sodium chloride in eighty grams of water.
    a). 20%
    b). 80%
    c). 25%
    d). 100%

79. The product of M × V is
    a). concentration
    b). molarity
    c). number of moles
    d). volume of solution

CHAPTER 13

80. Choose the compound that acts as an Arrhenius base.
    a). Na_2CO_3
    b). NH_3
    c). HCl
    d). NaOH

81. Choose the most correct representation of the product of a strong acid in water.
    a). H_3O^+
    b). $H^+(aq)$
    c). $H_5O_2^+$, $H_7O_3^+$
    d). all of the above.

82. Choose the neutralization reaction.
    a). $Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
    b). $CaCO_3(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$
    c). $Mg(OH)_2(s) + 2\ HCl(aq) \rightarrow MgCl_2(aq) + 2\ H_2O(l)$

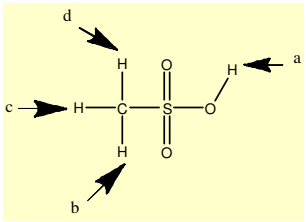
83. Choose the correct definition of a Brønsted-Lowry base.
    a). a proton donor
    b). a hydroxide donor
    c). a proton acceptor
    d). an electron pair donor

84. Choose the conjugate acid-base pair.
    a). H_2SO_4/HSO_3^-
    b). H_2SO_4/H_2SO_3
    c). HBr/Br^-
    d). H_2S/S^{2-}

85. Complete the following sentence. For strong acids, the equilibrium favors_____.
    a). the products.
    b). the reactants.

86. Choose the ionizable proton

a). a
b). b
c). c
d). d



87. Calculate the pH of a 0.01M solution of HI.

a). 7.00
b). 2.00
c). 1.00
d). 0.00

88. Choose the correct statement regarding acidic solutions.

a). $[H_3O^+] > [OH^-]$
b). $[H_3O^+] = [OH^-]$
c). $[H_3O^+] < [OH^-]$

CHAPTER 17

89. Choose the incorrect statement as to why carbon can form long chains and large complex molecules.

a). C-C bonds are strong.
b). Carbon is a large atom.
c). Carbon and hydrogen have similar electronegativities.
d). C-H bonds are relatively unreactive.

90. Choose the maximum number of bonds carbon can form.

a). 1
b). 2
c). 3
d). 4

91. Molecules with the same formula but different structures are known as

a). homologs
b). isomers
c). allotropes
d). isotopes

92. Choose the correct name for C_7H_{16}.

a). pentane
b). hexane
c). heptane
d). octane

93. The longest chain of carbon in 2-methyl hexane is:

a). 5
b). 6
c). 7
d). 8

94. Choose the general formula for a cyclic alkane.

a). C_nH_{2n+1}
b). C_nH_{2n}
c). C_nH_n

95. Choose the structure of 3-hexene.

a). CH_2=CH-CH_2-CH_2-CH_2-CH_3

b). CH_2=CH-CH=CH-CH=CH_2

c). CH_3-CH_2-CH=CH-CH_2-CH_3

d). CH_3-CH=CH-CH_2-CH_2-CH_3

96. Choose the alkyne.

a). CH_3-C≡CH

b). CH_3-CH=CH_2

c). CH_3-CH_2-CH_3

97. Benzene is best described as a(n)

a). alkane.

b). cyclic alkene.

c). aromatic compound.

d). alkynes.

98. Choose the functional group found in alcohols.

a). -OH

b). -COOH

c). -CHO

d). -$CONH_2$

99. Choose the functional group found in the following structure:

a). aldehyde

b). ketone

c). ester

d). ether

Some Additional Random Questions

100. Choose the mass of substance that has the same number of atoms as 12.0 g of carbon.

a). 32.0 g oxygen

b). 4.00 g helium

c). 64.0 g sulfur

d). 2.016 g hydrogen

101. Choose the quantity that is not one mole.

a). 6.022×102^3 things

b). 32.0 g of O_2

c). 32.0 g of S_4

d). 4.00 g of He

102. Choose the correct molar mass for iron(III) sulfate

a). 103.909 g/mol

b). 247.970 g/mol

c). 399.8778 g/mol

d). 151.9076 g/mol

103. Choose the correct molar mass for $P(C_6 H5)_3$.

a). 232.3 g/mol

b). 108.1 g/mol

c). 277.42 g/mol

d). 239.28 g/mol

104. Choose the correct molecular formula for the compound with the empirical formula CH_2O and the molar mass of 180 g/mol.

a). CH_2O
b). $C_3H_6O_3$
c). $C_6H_{12}O_6$
d). $C_2H_4O_2$

105. Choose the decomposition reaction.

a). $2\ KClO_3(s) \rightarrow 2\ KCl(s) + 3\ O_2(g)$
b). $2\ KBr(s) + Cl_2(g) \rightarrow 2\ KCl(s) + Br_2(l)$
c). $2\ Fe_2O_3(s) + 3\ C(s) \rightarrow 4\ Fe(s) + 3\ CO_2(g)$
d). $NaOH(aq) + H_2SO_4(aq) \rightarrow NaHSO_2(aq) + H_2O(l)$

106. Choose the correct equation for the complete dissolution of sodium bicarbonate.

a). $NaHCO_3(aq) \rightarrow Na^+(aq) + HCO_3^-(aq)$
b). $NaHCO_3(aq) \rightarrow NaHCO_3(aq)$
c). $NaHCO_3(aq) \rightarrow Na^+(aq) + H^+(aq) + CO_3^-(aq)$
d). $NaHCO_3(aq) \rightarrow Na^+(aq) + H^+(aq) + C(s) + O_2(aq)$

107. Choose the total ionic equation.

a). $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$
b). $Pb(NO_3)_2(aq) + 2\ KI(aq) \rightarrow PbI_2(s) + 2\ KNO_3(aq)$
c). $3\ Mg^{2+}(aq) + 3\ SO_4^{2-}(aq) + 6\ K^+(aq) + 2\ PO_4^{3-} \rightarrow\ Mg_3(PO_4)_2(s) + 6\ K^+(aq) + SO_4^{2-}(aq)$
d). $S_4(s) + 6\ O_2(g) \rightarrow 4\ SO_3(g)$

108. Choose the spectator ion(s) in the equation below.

$$Pb(NO_3)_2(aq) + 2\ KI(aq) \rightarrow PbI_2(s) + 2\ KNO_3(aq)$$

a). Pb^{2+},K
b). I^-, NO_3^-
c). K^+, NO_3^-
d). NO_3^-

109. Choose the single replacement reaction.

a). $Pb(NO_3)_2(aq) + 2\ KI(aq) \rightarrow PbI_2(s) + 2\ KNO_3(aq)$
b). $Zn(s) + CuCl_2(aq) \rightarrow ZnCl_2(aq) + Cu(s)$
c). $2\ C(s) + O_2(g) \rightarrow CO(g)$
d). $C(s) + 2H_2(g) \rightarrow CH_4(g)$

110. Choose the double replacement-precipitation reaction.

a). $Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
b). $3\ NaOH(aq) + H_3PO_4(aq) \rightarrow Na_3PO_4(aq) + 3\ H_2O(l)$
c). $Pb(NO_3)_2(aq) + 2\ KI(aq) \rightarrow PbI_2(s) + 2\ KNO_3(aq)$
d). $C(s) + O_2(g) \rightarrow CO(g)$

111. Choose the neutralization reaction.

a). $Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
b). $CaCO_3(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$
c). $Mg(OH)_2(s) + 2\ HCl(aq) \rightarrow MgCl_2(aq) + 2\ H_2O(l)$