Exam Review Questions - Multiple Choice

The following questions are for review. They are in no particular order.

1. An atom of iron $^{56}_{26}Fe$ has...

a) 26 protons, 26 electrons, 30 neutrons
b) 30 protons, 30 electrons, 26 neutrons
c) 26 protons, 26 electrons, 56 neutrons
d) 30 protons, 26 electrons, 26 neutrons

2. A bromide ion will have a charge of ...

a) -1 b) -2 c) -3 d) +1

3. The atom with an atomic number 13 will tend to ...

a) gain 5 electrons b) gain 3 electrons c) lose 5 electrons d) lose 3 electrons

4. The first four ionization energies of an element X are 740, 1450, 7730, and 10 470 kJ mol^{-1}. The formula for the stable ion of X is most likely to be ...

a) X^{+} b) X^{2+} c) X^{3+} d) X^{4+}

5.Which one of the following best supports the concept that electrons in atoms may have only certain energies (i.e. are quantized)...

a) emission spectrum of mercury b) mass spectrum of the isotopes
c) scattering of alpha particles by gold foil d) make up of the periodic table

6. For the species below, the one that would be expected to require the most energy for the removal of another electron is...

a) Na^{+} b) Mg^{+} c) Al^{2+} d) Cl^{+}

7. _____ discovered the nuclear atom...

a) Thomson b) Bohr c)Rutherford d) Ms. Pall

8. How many electrons are in the outer (highest) energy level of a **$^{39}_{19}K^{+1}$ ion**?

a) 3 b) 5 c) 7 d) 8

9. The following species Cl^{-}, Ar, and K^{+} all have the same...

a) number of protons b) number of electrons
c) number of neutrons d) number of isotopes

10. Which of the following elements would have the **largest** atomic radius...

a) Li b) Cs c) F d) I

11. All of the following ions are isoelectronic with a Noble gas except...

a) Al^{3+} b) H^- c) Ga^{3+} d) Cl^-

12. Of the pairs of elements below, which would have the highest melting point?

a) $MgCl_2$ b) NaCl c) CCl_4 d) NCl_3

13. Which of the following molecule has only Van-der-Walls forces of attraction...

a) HF b) CF_4 c) NaF d) NF_3

14. The formula for a compound of thulium is $TmPO_4$. The formula for the nitrate of thulium would be...

a) $Tm(NO_3)_3$ b) Tm N c) $Tm_2(NO_3)_3$ d) $(NO_3)_3Tm$

15. Which of the following molecule would be polar and pyramidal...

a) $CHCl_3$ b) NI_3 c) OF_2 d) $BeCl_2$

16. Atoms of the different isotopes of the same element are identical in the...

a) number of electrons
b) sum of number of protons and neutrons
c) sum of the number of protons and neutrons
d) mass number

17. All of the following are isoelectronic (have the same number of valence electrons) except...

a) CO_3^{2-} b) NO_3^- c) SO_3^{2-} d) BO_3^{3-}

18. What is the basis of metallic bonding?

a) the attraction of metal ions for delocalized electrons
b) the attraction between neutral metal ions
c) the attraction of oppositely charged ions
d) the sharing of two valence electrons between two atoms

19. When is ionic bonding likely to occur between two atoms?

a) when both atoms have low ionization energy and low electron affinity
b) when both atoms have high ionization energy and low electron affinity
c) when both atoms have high ionization energy and high electron affinity
d) when one atom has high ionization energy and high electron affinity, and the other atom has low ionization energy and low electron affinity.

20. Which of the liquid substances listed below has polar molecules, predominantly covalent bonding between atoms of the molecule and a significant degree of hydrogen bonding between molecules?

a) liquid hydrogen, H_2
b) liquid sodium chloride, NaCl
c) liquid silane, SiH_4
d) liquid hydrogen fluoride, HF

21. Which of the three following molecules will be polar?

H_2O PF_3 CH_4

a) H_2O and CH_4 b) H_2O and PF_3 c) all of them d) none of them

22. Which one of the following elements has the highest **first ionization energy?**

a) Na b) Fe c) Cl d) I

23. In which group of the periodic table are you likely to find a **metalloid**?

a) the alkali metal family b) the alkaline earth family
c) the carbon family d) the halogen family

24. Which atom has the **smallest** radius?

a) K b) Ga c) Br d) Rb

25. A certain element is listed as having atomic mass of 72.6 u. It is probably true that it contains...

a) a mixture of isomers b) a mixture of allotropes
c) a mixture of isotopes d) an impurity

26. In which of the following solids are **all** the atoms held together by covalent bonds?

a) silicon dioxide b) sodium chloride c) iodine d) potassium nitrate

27. The number of valence electrons in sulphur trioxide, SO_3 , is ...

a) 18 b) 24 c) 32 d) 40

28. Which elements are characterized by the filling of d orbitals?

a) Halogens b) Rare earths c) Actinides d) 1st Transition series

29. The chemical family that readily forms anions is the...

a) alkali metals b) alkaline earths c) transition elements d) halogens

30. When an electron in an atom moves from an excited state to a ground state...

a) it produces a continuous spectrum
b) it produces a discontinuous spectrum
c) it produces an absorption spectrum
d) it produces a magnetic resonance spectrum

31. Which one of the following will be observed as the atomic number of the elements in a single group of elements on the periodic table increases?

a) an increase in the atomic radii
b) an increase in the ionisation energies
c) an increase in the electronegativities
d) a decrease in the ionic radii

32. Hydrogen, HF, has a boiling point of 20 ^{0}C, while hydrogen chloride, HCl , has a boiling point of - 84 ^{0}C
This is explained by...

a) the Van der Waals' forces
b) the hydrogen bonds
c) the orbital structure
d) the molecular structure

33. Given a list of the following substances:

CH_4 , Ne , C_2H_5OH , CO_2

Which of these is molecular and bonded by hydrogen bonds?

a) CH_4 b) Ne c) C_2H_5OH d) CO_2

34. Given the following substances :

CaF_2 , HF, F_2 , CH_3Cl

Which substance would you expect to have the highest melting point?

a) CaF_2 b) HF c) F_2 d) CH_3Cl

35. The elements X and Y have 6 and7 electrons respectively, in the highest energy levels of their atoms. What is the formula and type of bonding used in a compound formed by these elements?

a) XY_2 , ionic b) X_2Y, ionic c) X_2Y, covalent d) XY_2 , covalent

36. An element, J, has three isotopes with the relative abundances of ...

Atomic Number	Atomic Mass	Relative Abundance
22	45.00	10 %
22	46.00	75 %
22	47.00	15 %

Given this information, what is the atomic mass of element J ?

a) 22.00 u b) 46.00 u c) 46.05 u d) 47.90 u

37. Which statement is true about ionization energies?

a) The first ionization energies in a period increase smoothly from left to right across the periodic table.
b) The first ionization energies of the elements in a family increase smoothly down the family.
c) Successive ionization energies increase smoothly with the charge on the species.
d) Successive ionization energies increase with the charge on the species in an irregular manner.

38. In which one of the species below would the F - X - F bond angle be expected to be the smallest?

a) CF_4 b) NF_3 c) BF_3 d) OF_2

39. The increase in boiling points observed for F_2 , Cl_2 , Br_2 , I_2 is best attributed to...

a) an increase in Van der Waals' forces with increasing atomic number.
b) a decrease in the electronegativity with increasing atomic number.
c) an increase in the X - X bond energy with increasing atomic number.
d) a decrease in the ionization energy with increasing atomic number.

40. Which of the following substances would be expected to exhibit hydrogen bonding?

I. CH_3F II. CH_3OH III. CH_3NH_2

a) I only b) II only c) II and III only d) I, II and III

41. Which one of the following species would be expected to have the largest radius?

a) Sr b) Sr^{2+} c) Te d) I

42. Magnesium is found in the second column of the periodic table. What ionic state and charged particles will it have after reacting with another atom in an ionic bond?

a) Mg^{2+} , 10 protons, 12 electrons
b) Mg^{2+} , 12 protons, 10 electrons
c) Mg^{+} , 12 protons, 10 electrons
d) Mg^{2-} , 12 protons, 14 electrons

43. Which of the following particles is isoelectronic with an atom of argon?

a) K^- b) Cl^+ c) Na^+ d) S^{2-}

44. Which one of the following electronic configurations is correct for a halogen atom?

a) [Ne] $3s^2\,3d^5$
b) [Ar] $4s^2\,4p^5$
c) [Ar] $4s^2\,3d^5$
d) [Kr] $5s^2\,4d^{10}\,5p^5$

45. What is the systematic, IUPAC, name for the compound Cr_2O_3?

a) Chromium (III) oxide b) Chromium (II) oxide (III)
c) Chromium trioxide d) Trichromium dioxide

46. In the periodic table, the elements are arranged in order of increasing . . .

a) Number of neutrons b) Number of protons
c) Ionization energy d) Electronegativity

47. Which molecule shows covalent bonding, with the least ionic character?

a) F-Be-F b) F-Li c) F-Br d) F-F

48. Which pair of characteristics applies to typical ionic solids?

a) Good electrical conductivity and high ionization energy
b) High melting point and malleability
c) High melting point and crystalline structure
d) Low melting point and low aqueous solubility

49. The following electronic configuration applies to a neutral atom or a cation:

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

The element or ion could be:

a) An argon ion
b) A neutral potassium atom
c) A chloride ion
d) A neutral calcium atom

50. Sulfur has three natural isotopes of relative masses 32.0, 33.0, 34.0. If the relative atomic mass of sulfur is 32.07, which one of the following statements must be correct?

a) ^{32}S is less abundant than ^{34}S
b) ^{34}S is more abundant than ^{33}S
c) ^{32}S is more abundant than either ^{33}S or ^{34}S
d) Another natural isotope of lesser mass must exist

51. Which of the following compounds possesses at least one σ bond:

A. CH_4 B. C_2H_2 C. C_2H_4 D. All of the above

52. In a double-bonded carbon atom:

A. hybridization between the s orbital and one p orbital occurs.
B. hybridization between the s orbital and two p orbital occurs.
C. hybridization between the s orbital and three p orbital occurs.
D. no hybridization occurs between the s and p orbitals.

53. Which of the following hybridizations does the Be atom in BeH_2 assume?

A. sp B. sp^2 C. sp^3 D. None of the above

54. π bonds are formed by which of the following orbitals?

A. two s orbitals
B. two p orbitals
C. one s and one p orbital
D. All of the above

55. Which of the following decrease(s) as the number of bonds between two atoms increases?

I. Bond length **II. Bond strength**

A. I only B. II only C. Both I and II D. Neither I nor II

56. What type of hybrid orbitals are used for bonding by Xe in the XeF_4 molecule?

A. sp^2 B. sp^3 C. dsp^3 D. d^2sp^3

57. The hybridization of the carbon atom in the carbonate ion, CO_3^{2-}, is best described as :

A. sp B. sp^2 C. sp^3 D. sp^3d^2

58. The following equations represent processes in which solid calcium fluoride is formed. Which one of these has an enthalpy change which is known as the **lattice energy** of calcium fluoride?

A. $Ca_{(s)} + F_{2(g)} \longrightarrow CaF_{2(s)}$

B. $Ca_{(g)} + 2F_{(g)} \longrightarrow CaF_{2(s)}$

C. $Ca^{2+}_{(g)} + 2F^{-}_{(g)} \longrightarrow CaF_{2(s)}$

D. $Ca^{2+}_{(s)} + 2F^{-}_{(g)} \longrightarrow CaF_{2(s)}$

59. Which one of the following compounds would be expected to have the highest crystal lattice energy?

A. MgS B. MgO C. $CaSO_4$ D. $BaSO_4$

60. Which one of the following species would be deflected by an electric field?

I-electron II-proton III-neutron

A. I only B. III only C. I and II only D. I, II, and III

Answers : Exam Review: Multiple Choice

1	2	3	4	5	6	7	8	9	10
A	A	D	B	A	A	C	D	B	B
11	12	13	14	15	16	17	18	19	20
C	A	B	A	B	A	C	A	D	D
21	22	23	24	25	26	27	28	29	30
B	C	C	C	C	C	B	D	D	B

31	32	33	34	35	36	37	38	39	40
A	B	C	A	D	C	D	D	A	C
41	42	43	44	45	46	47	48	49	50
A	B	D	D	A	B	D	C	B	C
51	52	53	54	55	56	57	58	59	60
D	B	A	B	A	D	B	C	B	C

Exam Review — II

1. What amount of oxygen, O_2, (in moles) contains 1.8×10^{22} molecules?

   A. 0.0030 B. 0.030 C. 0.30 D. 3.0

2. A hydrocarbon contains 90% by mass of carbon. What is its empirical formula?

   A. CH_2 B. C_3H_4 C. C_7H_{10} D. C_9H_{10}

3. 6.0 moles of $Fe_2O_3(s)$ reacts with 9.0 moles of carbon in a blast furnace according to the equation below.

$$Fe_2O_3(s) + 3C(s) \longrightarrow 2Fe(s) + 3CO(g)$$

   What is the limiting reagent and hence the theoretical yield of iron?

	Limiting reagent	Theoretical yield of iron
A.	Fe_2O_3	6.0 mol
B.	Fe_2O_3	12.0 mol
C.	carbon	9.0 mol
D.	carbon	6.0 mol

4. Calcium carbonate decomposes on heating as shown below.

$$CaCO_3 \longrightarrow CaO + CO_2$$

   When 50 g of calcium carbonate are decomposed, 7 g of calcium oxide are formed. What is the percentage yield of calcium oxide?

   A. 7% B. 25% C. 50% D. 75%

5. What amount of NaCl (in moles) is required to prepare 250 cm^3 of a 0.200 mol dm^{-3} solution?

   A. 50.0 B. 1.25 C. 0.800 D. 0.0500

6. What volume, in cm^3, of 0.200 mol dm^{-3} HCl (aq) is required to neutralize 25.0 cm^3 of 0.200 mol dm^{-3} $Ba(OH)_2$(aq) ?

   A. 12.5 B. 25.0 C. 50.0 D. 75.0

7. Which change in conditions would increase the volume of a fixed mass of gas?

	Pressure /kPa	Temperature /K
A.	Doubled	Doubled
B.	Halved	Halved
C.	Doubled	Halved
D.	Halved	Doubled

8. The temperature in Kelvin of 2.0 dm^3 of an ideal gas is doubled and its pressure is increased by a factor of four. What is the final volume of the gas?

A. 1.0 dm^3 B. 2.0 dm^3 C. 3.0 dm^3 D. 4.0 dm^3

9. Consider the following reaction: $N_2(g) + 3H_2(g) \rightleftharpoons 2\,NH_3(g)$

If the reaction is made to go to completion, what volume of ammonia (in dm^3) can be prepared from 25 dm^3 of nitrogen and 60 dm^3 of hydrogen? All volumes are measured at the same temperature and pressure.

A. 40 B. 50 C. 85 D. 120

10. Ethyne, C_2H_2, reacts with oxygen according to the equation below. What volume of oxygen (in dm^3) reacts with 0.40 dm^3 of C_2H_2?

$$2C_2H_2(g) + 5O_2(g) \longrightarrow 4CO_2(g) + 2H_2O(g)$$

A. 0.40 B. 0.80 C. 1.0 D. 2.0

11. Which one of the following species can act as both a Brønsted-Lowry acid and base in aqueous solution?

A. CH_3COOH B. NO_3^- C. $H_2PO_4^-$ D. OH^-

12. Which is a conjugate acid-base pair in the following reaction?

$$HNO_3 + H_2SO_4 \rightleftharpoons H_2NO_3^+ + HSO_4^-$$

A. HNO_3 and H_2SO_4 B. HNO_3 and $H_2NO_3^+$

C. HNO_3 and HSO_4^- D. $H_2NO_3^+$ and HSO_4^-

13. Which equation represents an acid-base reaction according to the Lewis theory but not according to the Brønsted-Lowry theory?

A. $CO_3^{2-}(aq) + 2H^+(aq) \rightarrow H_2O(l) + CO_2(g)$

B. $Cu^{2+}(aq) + 4NH_3(aq) \rightarrow CU(NH_3)_4^{2+}(aq)$

C. $BaO(s) + H_2O(l) \rightarrow Ba^{2+}(aq) + 2OH^-(aq)$

D. $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

14. Which methods can distinguish between solutions of a strong monoprotic acid and a weak monoprotic acid of the same concentration?

I. Add magnesium to each solution and measure the rate of the formation of gas bubbles.
II. Add aqueous sodium hydroxide to each solution and measure the temperature change.
III. Use each solution in a circuit with a battery and lamp and see how bright the lamp glows.

A. I and II only B. I and III only C. II and III only D. I, II and III

15. Solutions of hydrochloric acid (HCl(aq)) and ethanoic acid ($CH_3COOH(aq)$) of the same concentration reacted completely with 5.0 g of calcium carbonate in separate containers. Which statement is correct?

A. $CH_3COOH(aq)$ reacted slower because it has a lower pH than HCl(aq).

B. A smaller volume of $CO_2(g)$ was produced with $CH_3COOH(aq)$ than with HCl(aq).

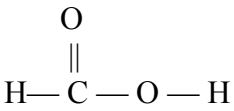
C. A greater volume of $CO_2(g)$ was produced with $CH_3COOH(aq)$ than with HCl(aq).

D. The same volume of $CO_2(g)$ was produced with both $CH_3COOH(aq)$ and HCl(aq).

16. What is the conjugate base of the $HSO_4^-(aq)$ ion?

A. $H_2SO_4(aq)$ B. $SO_4^{2-}(aq)$ C. $H_2O(l)$ D. $H_3O^+(aq)$

17. What is the number of sigma (σ) and pi (π) bonds and the hybridization of the carbon atom in :



	Sigma	Pi	Hybridization
A.	4	1	sp^2
B.	4	1	sp^3
C.	3	2	sp^3
D.	3	1	sp^2

18. Which of the following increase(s) for the bonding between carbon atoms in the sequence of molecules C_2H_6, C_2H_4 and C_2H_2 ?

I. Number of bonds II. Length of bonds III. Strength of bonding

A. I only B. I and III only C. III only D. I, II and III

19. Which allotropes contain carbon atoms with sp^2 hybridization?

I. Diamond II. Graphite III. C_{60} fullerene

A. I and II only B. I and III only C. II and III only D. I, II and II

20. What is the molecular shape and the hybridization of the nitrogen atom in NH_3?

	Molecular shape	Hybridization
A.	tetrahedral	sp^3
B.	trigonal planar	sp^2
C.	trigonal pyramidal	sp^2
D.	trigonal pyramidal	sp^3

21. Which substance has the lowest electrical conductivity?

A. Cu(s) B. Hg(l) C. $H_2(g)$ D. LiOH(aq)

22. Which statement is correct about multiple bonding between carbon atoms?

A. Double bonds are formed by two π bonds.

B. Double bonds are weaker than single bonds.

C. π bonds are formed by overlap between s orbitals.

D. π bonds are weaker than sigma bonds.

23. Which particles can act as ligands in complex ion formation?

I. $C1^-$ II. NH_3 III. H_2O

A. I and II only B. I and III only C. II and III only D. I, II and III

24. Which statements correctly describe the NO_2^- ion?

I. It can be represented by resonance structures.

II. It has two lone pairs of electrons on the N atom.

III. The N atom is sp^2 hybridized.

A. I and II only B. I and III only C. II and III only D. I, II and III

25. In which substance is hydrogen bonding present?

A. CH_4 B. CH_2F_2 C. CH_3CHO D. CH_3OH

26. Which types of hybridization are shown by the carbon atoms in the compound $CH_2 = CH – CH_3$?

I. sp II. sp^2 III. sp^3

A. I and II only B. I and III only C. II and III only D. I, II and III

27. Identify the types of hybridization shown by the carbon atoms in the molecule

$CH_3CH_2CH_2COOH$

I. sp II. sp^2 III. sp^3

A. I and II only B. I and III only C. II and III only D. I, II and III

28. When C_2H_4, C_2H_2 and C_2H_6 are arranged in order of increasing C–C bond length, what is the correct order?

A. C_2H_6, C_2H_2, C_2H_4 B. C_2H_4, C_2H_2, C_2H_6

C. C_2H_2, C_2H_4, C_2H_6 D. C_2H_4, C_2H_6, C_2H_2

29. What is the molecular geometry and the Cl – I – Cl bond angle in the ICl_4^- ion ?

A. Square planar 90° B. Square pyramidal 90°

C. Tetrahedral 109° D. Trigonal pyramidal 107°

30. How many sigma (σ) and pi (π) bonds are present in the structure of HCN?

	σ	π
A.	1	3
B.	2	3
C.	2	2
D.	3	1

Answers: Exam Review — II

1	2	3	4	5	6	7	8	9	10
B	**B**	**D**	**B**	**D**	**C**	**D**	**A**	**A**	**C**
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	**B**	**B**	**D**	**D**	**B**	**A**	**B**	**C**	**D**
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	**D**	**D**	**B**	**D**	**C**	**C**	**C**	**A**	**C**