單選題，每題2.5分，答錯不倒扣

1. What is the molecular geometry of BrF_4^-?

A) tetrahedral

B) square pyramidal

C) square planar

D) seesaw

2. Which of the following elements has the **highest** electronegativity??

A) Br

B) Al

C) Cl

D) F

3. Express the number 0.03300 in scientific notation:

A) 3.300×10^{-2}

B) 3.30×10^{-2}

C) 3.3×10^{-2}

D) 33×10^{-3}

4. An exothermic reaction causes the surroundings to

A) warm up.

B) become acidic.

C) expand.

D) decrease its temperature.

5. The orbital hybridization on the carbon atom in CO_2 is

A) dsp^3

B) sp^3

C) sp

D) sp^2

6. Which statement is **false** for O_2, O_2^{2-}, and O_2^{2+}?

A) There are bond orders of 2 for O_2, 1 for O_2^{2-}, and 3 for O_2^{2+}.

B) The highest occupied molecular orbital of O_2^{2+} is bonding.

C) The highest occupied molecular orbital of O_2 is antibonding.

D) All of them are diamagnetic.

7. How many of the σ bonds are there in H_2SO_4 molecule?

A) 1

B) 3

C) 5

D) 6

8. Which of the following is diamagnetic?

A) B_2

B) C_2

C) O_2

D) O_2^+

9. Which of the following atoms has the largest number of **unpaired** electrons in *p* orbitals in their ground-state electron configurations?

A) Br

B) Xe

C) S

D) P

10. Which of the following statements is **false**?

A) For monoelectron atom, the 4*s* orbital lies lower in energy than the 5*s* orbital.

B) For a potassium atom, a 4*s* orbital, a 4*p* orbital, and a 4*d* orbital all have the same energy.

C) For a hydrogen atom, a 4*s* orbital, a 4*p* orbital, and a 4*d* orbital all have the same energy.

D) The 4*s* orbital lies lower in energy than the 3*d* orbital for atoms K, Ca, Sc, and Ti.

11. Which of the following statements about the node for an orbital is **true**?

A) Node is a surface where there is no chance of finding the electron.

B) Node is a surface where there is a 50% chance of finding the electron.

C) Node is a surface where there is a maximum probability of finding the electron.

D) Node is the midpoint of the orbital.

12. What volume of 18.0 M sulfuric acid must be used to prepare 12.0 L of 0.195 M H_2SO_4?

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A) 90 mL
B) 45 mL
C) 130 mL
D) 65 mL

13. Iron is produced from its ore by the reactions:
$2C(s) + O_2(g) \rightarrow 2CO(g)$
$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$
How many moles of $O_2(g)$ are needed to produce 1 mole of Fe(s)?
A) 0.5 mole O_2
B) 0.75 mole O_2
C) 1 mole O_2
D) 1.5 mole O_2

14. Vitamin C (ascorbic acid) contains 40.92% C, 4.58% H, and 54.50% O by mass.
What is the empirical formula of ascorbic acid?
A) $C_3H_5O_2$
B) C_2H_4O
C) $C_3H_6O_2$
D) $C_3H_4O_3$

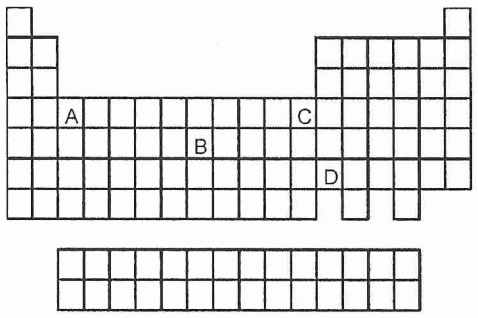
15. What is the volume of the solution that would result by diluting 70.00 mL of 0.0913 M NaOH to a concentration of 0.0150 M?
A) 466 mL
B) 489 mL
C) 426 mL
D) 504 mL

16. What is the electron configuration of Ca^{2+}?
A) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
B) $1s^2 2s^2 2p^6 3s^2 3p^6$
C) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
D) $1s^2 2s^2 2p^6$

17. What kind of information will be provided by the infrared spectrum?
A) Nuclear Vibration
B) Nuclear spin
C) Electron spin

D) Electronic transition

18. Which element, indicated by letter on the periodic table shown below, has a 2+ ion with the electron configuration [Ar]3d^{10}?



A) A
B) B
C) C
D) D

19. In a recent accident, some drums of uranium hexafluoride were lost in the English Channel. The melting point of uranium hexafluoride is 64.5°C. What is the melting point of uranium hexafluoride on the Fahrenheit scale?
A) 148 °F
B) 83.3 °F
C) 116 °F
D) 122 °F

20. In which of the following is electromagnetic radiation listed correctly in increasing order of wavelength (lowest wavelength first)?
A) X-rays < infrared < ultraviolet
B) Microwave < visible < infrared
C) Visible < microwave < infrared
D) Ultraviolet < visible < infrared

21. Which of the following statements about buffer solution is **NOT** true?
A) It resists changes in pH by dilution
B) It resists changes in pH by small addition of acids or bases
C) The most effective buffer solution contains approximately equal concentration of conjugate acid-base pair
D) A concentrate sulfuric acid is a good buffer solution

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22. Which atom has the lowest ionization energy?

A) N

B) O

C) F

D) Ne

23. Which wavelength listed below is in the visible light region?

A) 60000 nm

B) 6000 nm

C) 600 nm

D) 60 nm

24. Which of the following compounds has the highest melting point?

A) 1,4-dichlorobenzene (1,4 二氯苯)

B) 1,3-dichlorobenzene (1,3 二氯苯)

C) 1,2-dichlorobenzene (1,2 二氯苯)

D) Toluene (甲苯)

25. Absorption of what type of electromagnetic radiation results in transitions among allowed **nuclear spin** states?

A) Microwave

B) Radio wave

C) Ultraviolet light

D) Infrared light

26. What is the important precaution observed in the storage of metallic sodium?

A) Leave the container uncoverd

B) Store the sodium in kerosene

C) Store the sodium in water

D) Use an opaque container

27. Solutions which distill without change in composition or temperature are called

A) Saturated solution

B) Ideal solution

C) aqueous solution

D) Azeotropic mixtures

28. Which of the following reactions would have a negative ΔS^{o}?

A) $H_2(g) \rightarrow 2H(g)$

B) $H_2(l) \rightarrow H_2(g)$

C) $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

D) $2H_2(g) + CO(g) \rightarrow CH_3OH(g)$

29. Which of the following species could be a Lewis base?

A) A negative ion

B) A positive ion

C) Organic molecules with sigma bonds

D) A molecule with an empty orbital

30. A solution with pH = 2 is more acidic than one with a pH = 6 by a factor of

A) 4

B) 16

C) 10000

D) 1000

31. Cathode-ray tubes experiments conducted by J. J. Thomson evidenced the presence of

A) Protons

B) Electrons

C) X-ray

D) Photons

32. Which halogen molecule has a yellow color at room temperature?

A) F_2

B) Cl_2

C) Br_2

D) I_2

33. For Cr, which of the following oxidation numbers does **NOT** exist?

A) 4

B) 3

C) 2

D) 6

34. Which of the following species is the strongest reducing agent?

A) Cu

B) Al
C) H_2
D) Zn

35. Which of the following ions would be useful in the removal of Fe^{3+} from water?
A) OH^-
B) Cl^-
C) $[SO_4]^{2-}$
D) $[NO_3]^-$

36. Which of the following electron configurations is inconsistent with Hund's rule of maximum multiplicity?
A) $1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$
B) $1s^2 2s^2 2p_x^2 2p_y^2 2p_z^2$
C) $1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$
D) $1s^2 2s^2 2p_x^2 2p_y^1 2p_z^0$

37. The NO2- ion forms linkage isomers in which either the nitrogen or the oxygen is bound to a transition metal. Which of the following ligands can also form linkage isomers?
A) CO_2
B) SCN^-
C) OH^-
D) CO_3^{2-}

38. Which one is **NOT** colligative property (which depends on concentration rather than the identity of the molecules)?
A) Freezing point depression
B) Boiling point elevation
C) Osmotic pressure
D) Capillary rise

39. Chlorine exists naturally as a mixture of chlorine-35 and chlorine-37 isotopes. An atom of chlorine-35 contains
A) 17 protons, 18 neutrons, 17 electrons.
B) 16 protons and 17 electrons, only.
C) 18 protons, 18 electrons, and 17 neutrons.
D) 17 protons, 35 neutrons, and 17 electrons.

40. Which of the following combinations of quantum numbers is **NOT** allowed?

A) $(n,l,m_l,m_s)=(4,3,-2,\frac{1}{2})$

B) $(n,l,m_l,m_s)=(3,1,0,-\frac{1}{2})$

C) $(n,l,m_l,m_s)=(1,1,0,\frac{1}{2})$

D) $(n,l,m_l,m_s)=(5,2,0,-\frac{1}{2})$