單一選擇題，總共四十題，每題 2.5 分；答案錯誤每題倒扣 0.5 分，
若總分爲負分，則以零分計算。

1. An ion is formed
   (a) by either adding or subtracting protons from the atom.
   (b) by either adding or subtracting electrons from the atom.
   (c) by either adding or subtracting neutrons from the atom.
   (d) All of the above are true.
   (e) Two of the above are true.
2. Which is not the correct chemical formula for the compound named?
   (a) potassium phosphate K_3PO_4
   (b) iron(II) oxide FeO
   (c) calcium carbonate $CaCO_3$
   (d) sodium sulfide NaS
   (e) lithium nitrate $LiNO_3$
3. The mass percent of iron in an iron oxide is 77.7%. Find the empirical formula.
   (a) Fe_3O_2; (b) Fe_3O_4; (c) Fe_2O_3; (d) FeO; (e) None of these
4. What volume of 10.00M potassium hydroxide is required to prepare 75.0 mL of 0.500 M KOH?
   (a) 3.75 mL; (b) 4.18 mL; (c) 9.43 mL; (d) 1.50 L; (e) None of these
5. For which gas do the molecules have the smallest average kinetic energy?
   (a) He; (b) Cl_2; (c) CH_4; (d) NH_3; (e) all gases the same.
6. The diffusion rate of N2 gas is 1.73 times as great as a noble gas (both gases are at the same temperature). What is the noble gas?
   (a) He; (b) Ne; (c) Ar; (d) Kr; (e) Xe
7. Consider the reaction $CaCl_2(s) + 2H_2O(g) \rightleftharpoons CaCl_2 \bullet 2H_2O(s)$
   (a) $K = [CaCl_2 \bullet 2H_2O] / [CaCl_2][H_2O]^2$
   (b) $K= 1 / [H_2O]^2$
   (c) $K= 1 / 2[H_2O]^2$
   (d) $K= [H_2O]^2$
   (e) $K= [CaCl_2 \bullet 2H_2O] / [H_2O]^2$
8. A system at a state of chemical equilibrium is
   (a) microscopically dynamic and macroscopically static.
   (b) microscopically dynamic and macroscopically dynamic.
   (c) microscopically static and macroscopically static.

(d) microscopically static and macroscopically dynamic.

(e) None of these.

9. The strong acid HA is added to water. Which of the following is the strongest base in the system?

(a) HA; (b) H_2O; (c) H_3O^+; (d) A^-; (e) H_2A^-

10. Identify the strongest base.

(a) CH_3O^-; (b) CH_3OH; (c) CN^-; (d) H_2O; (e) NO_3^-

11. Calculate the pH of a solution prepared by mixing 50 mL of a 0.1 M solution of HF with 25 mL of a 0.2 M solution of NaF. pK_a of HF is 3.14.

(a) 3.14; (b) 10.80; (c) 5.83; (d) 7.35; (e) 12.00.

12. Which of the following compounds has the lowest solubility in mol/L in water?

(a) $Al(OH)_3$ $K_{sp}=2x10^{-32}$; (b) CdS $K_{sp}=1x10^{-28}$; (c) $PbSO_4$ $K_{sp}=1.3x10^{-8}$;

(d) $Sn(OH)_2$ $K_{sp}=3x10^{-27}$; (e) MgC_2O_4 $K_{sp}=8.6x10^{-5}$

13. Which of the following statements is (are) true?

(a) Enthalpy is a state function.

(b) In exothermic reactions, the reactants are lower in potential energy than the products.

(c) A chemist takes the surroundings point of view when determining the sign for work or heat.

(d) The heat of reaction and change in enthalpy can always be used interchangeably.

(e) At least two of the above statements are true.

14. The standard enthalpy of formation of H_2O (l) at 298 K is -285.6 kJ/mol. Calculate the change in internal energy for the following process at 298 K: H_2 (g) + 1/2 O_2 → H_2O (l)

(a) -278.2 kJ/mol; (b) -281.9 kJ/mol; (c) -285.6 kJ/mol; (d) -289.3 kJ/mol; (e) 3430 kJ/mol.

15. From which process is ΔS negative?

(a) evaporation of 1 mol of CCl_4(l)

(b) mixing 5 mL ethanol with 25 mL water.

(c) compressing 1 mol Ne at constant temperature from 1.5 atm to 0.5 atm.

(d) raising the temperature of 100 g Cu from 275 K to 295 K.

(e) grinding a large crystal of KCl to power.

16. The equilibrium constant K_p (in atm) for the dissociation reaction of Cl_2 was measured as a function of temperature (in K). A graph on ln K_p versus 1/T for this reaction gives a straight line with a slope of $-1.352x10^4$ and an intercept of 14.51.

(a) The reaction is exothermic.

(b) The reaction is endothermic.

(c) The reaction is spontaneous.

(d) The reaction is very fast.

(e) None of these.

17. Two moles of a monatomic ideal gas are cooled from 225oC to 25oC at constant volume.

Calculated ΔS.

(a) -27.4 J/K; (b) -54.8 J/K; (c) -6.4 J/K; (d) -12.8 J/K; (e) None of these

18. How many electrons are transferred in the following reaction?

$2Cr_2O_7^{-2} + 14H^+ + 6Cl^- \rightarrow 2Cr^{+3} + 3Cl_2 + 7H_2O$

(a) 2; (b) 4; (c) 6; (d) 8; (e) None of these

19. Consider an electrochemical cell with a copper electrode immersed in 1.0M Cu^{+2} and a silver electrode immersed in 1.0M Ag+.

$Cu^{+2} + 2e^- \rightarrow Cu$ $\quad E^o = 0.34$ V

$Ag^+ + e^- \rightarrow Ag$ $\quad E^o = 0.80$ V

Calculate E^o for this cell (a) 1.48V; (b) 1.26V; (c) 1.14V; (d) 0.46V; (e) None of these

20. Which form of electromagnetic radiation has the shortest wavelengths?

(a) gamma rays; (b) microwaves; (c) radio waves; (d) infrared radiation; (e) X-ray.

21. How many electrons in an atom can have the quantum numbers n=3, l=2?

(a) 2; (b) 5; (c) 10; (d) 18; (e) 6

22. Which of the following atoms or ions has 3 unpaired electrons?

(a) N; (b) O; (c) Al; (d) S^{-2}; (e) Zn^{+2}

23. The electron configuration of Cr^{+3} is

(a) $[Ar]4s^23d^1$; (b) $[Ar]4s^23d^2$; (c) [Ar] $3d^3$; (d) $[Ar]4s^23d^4$; (e) None of these.

24. Which is the highest energy orbital for a silicon atom?

(a) 1s; (b) 2s; (c) 3s; (d) 3p; (e) 3d.

25. Atoms having greatly differing electronegativities are expected to form:

(a) no bonds; (b) polar covalent bonds; (c) nonpolar covalent bonds; (d) ionic bonds; (e) covalent bonds.

26. Choose the compound with the most ionic bond

(a) LiCl; (b) KF; (c) NaCl; (d) LiF; (e) KCl.

27. How many Lewis structures does CO_3^{-2} have?

(a) 1; (b) 2; (c) 3; (d) 4; (e) 5

28. What is the hybridization of Cl in the molecule ClF_3?

(a) sp; (b) sp^2; (c) sp^3; (d) dsp^3; (e) d^2sp^3

29. Which of the following is paramagnetic?

(a) B_2; (b) C_2; (c) H_2; (d) N_2; (e) at least two of the above are paramegnetic.

30. The reaction A $\rightarrow$ B + C is known to be zero order in A with a rate constant of 5.0×10^{-2} mol/Ls at 25°C. An experiment was run at 25°C where $[A]_0 = 1.0 \times 10^{-3}$M. The integrated rate law is

(a) $[A] = kt$; (b) $[A] - [A]_0 = kt$; (c) $[A]/[A]_0 = kt$; (d) $\ln([A]/[A]_0) = kt$; (e) $[A]_0 - [A] = kt$.

31. The resistance of a liquid to an increase in its surface area is called

(a) capillary action; (b) surface tension; (c) vapor pressure; (d) viscosity; (e) None of these.

32. Which statement regarding water is true?

(a) Energy must be given off in order to break down the crystal lattice of ice to a liquid.

(b) Hydrogen bonds are stronger than covalent bonds.

(c) Liquid water is less dense than solid water.

(d) Only covalent bonds are broken when ice melts.

(e) All of the statements (a-d) are false.

33. Identify the major attractive force in H_2S.

(a) London dispersion; (b) dipole-dipole; (c) hydrogen bonding; (d) ionic; (e) None of these.

34. Liquid A has vapor pressure x. Liquid B has vapor pressure y and $x > y$. What is the mole percent of the liquid mixture if the vapor above the solution is 50% A?

(a) $y/(2x + 2y)$; (b) $x/(2x + 2y)$; (c) $x/(x + y)$; (d) $y/(x + y)$; (e) None of these.

35. Which of the following exhibits the greatest metallic character?

(a) Cs; (b) Rd; (c) K; (d) Na; (e) All are equally metallic.

36. Choose the element with the smallest ionization energy.

(a) Li; (b) Na; (c) K; (d) Rd; (e) Cs.

37. Which of the following is true about coordination complexes?

(a) The metal is a Lewis base and the ligands are Lewis acids.

(b) Only complexes with coordination number six are found in nature.

(c) When the ligands approach a transition metal ion in an octahedral field, the d_{xz}, d_{yx}, and d_{xy} atomic orbitals are affected the least by the ligands.

(d) None of above is true.

(e) All of above are true.

38. Which has the greatest number of unpaired electrons?

(a) The square planar complex $Ni(CN)_4^{-2}$.

(b) The tetrahedral complex $FeCl_4^{-}$.

(c) Neither of the above have any unpaired electrons.

(d) Both have the same number (non-zero) of unpaired electrons.

(e) More information is needed.

39. The color of a transition metal complex results from:

(a) bending vibrations; (b) stretching vibrations; (c) transition of an electron between d orbitals; (d) transition of an electron between an s and a p orbital; (e) nuclear magnetic resonance.

40. Which of the following yields a primary alcohol upon reduction?

(a) a ketone; (b) an alkene; (c) an amine; (d) an aldehyde; (e) an ether.