(Hint: ln 2 = 0.6931... ~= 0.7)

1. Balance the following half reaction in an acid. How many hydrogen ions are needed?
$Cr(OH)_3 \rightarrow CrO_4^{2-}$

a. 5
b. 4
c. 3
d. 2
e. 1

2. The reaction below occurs in a(an) _____ cell and the sign of the anode is _____.
$Cu_{(s)} + 2Ag^+ \rightarrow CU^{2+} + 2Ag_{(s)}$

a. Electrochemical, Positive
b. Voltaic, Positive
c. Electrochemical, Negative
d. Galvanic, Negative

3. Which statements are true in regards to a table of standard half cell reduction potentials?

I. The reactants of the reaction are oxidizing agents
II. The more positive the potential the better the reducing agent
III. The reactions shown are reductions
IV. The oxidizing number of the products is smaller than the reactants

a. I, III, IV
b. I, II, III, IV
c. II, III
d. II, IV

4. If a dead battery has a ratio of 2 for $[Fe^{2+}]/[Cd^{2+}]$, what is the standard cell potential? (Hint: log(2) = 0.301)

a. 0.36 V
b. 0.33 V
c. -0.33 V
d. -0.36 V

5. Rank the following from weakest to strongest oxidizing agent: Li^+, K^+, Mg^{+2} , Zn^{+2}

$Li^+ + e^- \rightarrow Li$ -3.1 V
$K^+ + e^- \rightarrow K$ -2.9 V
$Mg^{+2} + 2e^- \rightarrow Mg$ -2.4 V
$Zn^{+2} + 2e^- \rightarrow Zn$ -0.76 V

a. $Li^+ < K^+ \leq Mg^{2+} < Zn^{2+}$
b. $Li^+ \leq Mg^{+2} \leq K^+ < Zn^{2+}$
c. $Zn^{+2} < Mg^{+2} < K^+ < Li^+$
d. $Zn^{+2} < Mg^{+2} < K^+ < Li^+$

6. How many moles of Al^{3+} were needed to produce 4 moles of Al when 0.5 faraday of charge passes through a cell?

a. 0.2 mol Al^{3+}
a. 4 mol mol Al^{3+}
b. 1 mol^{3+}
c. 0.1 moles Al^{3+}

7. What current is needed to produce 98.5 g of solid gold from Au+ in 2 hours?
   a. 6.7 A
   b. 24.1 kA
   c. 804.0 A
   d. 7.0 kA

8. The following reaction is at equilibrium. If $[Ag^+] = 1x10^{-6}$ M, what is $[Cu^{2+}]$?
$Cu^{2+} + 2Ag(s) \rightarrow Cu_{(s)} + 2Ag^+$
   a. $5x10^{-9}$ M
   b. $5x10^{-15}$ M
   c. $2x10^{8}$ M
   d. 5x10-7 M

9. Which of the following is not true about nickel-metal hydride batteries?
   a. They are not rechargeable
   b. Nickel is the cathode
   c. They have 2-3 times more capacity than a NiCd battery of equivalent size.
   d. A hydrogen absorbing alloy is the anode

10. Consider the reaction below:
$2A + B \rightarrow ½C$
If [C] increases from 0 M to 0.5 M in the course of 1 minute, what [B] remains after 30 seconds if it is initially 1 M?
   a. 0.5 M
   b. 0 M
   c. 1 M
   d. 1.5 M

11. Consider the data below:

Experiment	[A] (M)	[B] (M)	[C] (M)	initial rate ($M \cdot s^{-1}$)
1	1	0.5	2	0.4
2	2	3	2	0.8
3	1	0.5	1	0.8
4	2	0.5	4	0.4

If only these species are pertinent, what is the overall order of the reaction?
   a. 1st
   b. 3rd
   c. 0
   d. 2nd

12. Consider the following elementary reaction:
$O(g) + O(g) \rightarrow O_2(g)$
If $[O]_o$ is 4 atm and after 3 seconds [O] has decreased to 1 atm, what is the value of k, the rate constant, for this reaction?
   a. 0.250 $M^{-1} \cdot s^{-1}$
   b. 0.375 $M^{-1} \cdot s^{-1}$
   c. 0.500 $M^{-1} \cdot s^{-1}$
   d. 0.125 $M^{-1} \cdot s^{-1}$

13. integrated rate law calculation (half life)
Consider the following reaction:
$H_2O_2(aq) \rightarrow H_2O(l) + \frac{1}{2}O_2(aq)$
If, at a certain temperature and in the presence of a catalyst, the rate constant for this decomposition is 0.00726 s^{-1}, what is the apporximate half life of hydrogen peroxide? (Note: the actual catalyzed rate of decomposition of hydrogen peroxide is not first order and is in fact rather complicated, but assume it is first order here to make the calculations doable.)

a. 50 seconds
b. 100 seconds
c. 200 seconds
d. 500 seconds
e. 1000 seconds

14. In a straight-line plot for a 2nd order reaction, the x-axis has units of _____ and the y-intercept is the _____ of an initial concentration.

a. concentration, natural log
b. concentration, inverse
c. time, natural log
d. time, inverse

15. All of the the factors below can increase the rate of a reaction. However, one of them is not considered in collision theory. Which is it?

a. increased reactant concentration
b. addition of a catalyst
c. increased temperature
d. all are considered in collision theory

16 According to transition state theory, a set of chemical species that are involved in an equilbrium will be predcited to spend the least amount of time as _____.

a. reactants
b. products
c. transition states
d. transition state theory doesn't allow for such predictions

17. combined Arrhenius calculation
Consider the combined Arrhenius equation. If, hypothetically, a reaction had an activation energy of zero, what would be the result?

a. Nothing. The reaction would still get faster as temperature was increased.
b. The reaction would infinitely fast, $k = \infty$, at all temperatures.
c. The rate constant, k, would asymptotically approach zero as T approached infinity.
d. The reaction would have the same rate at all temperatures.

18. reaction mechanisms
A reaction mechanism _____

a. is only determined by looking at a balanced net reaction.
b. can be predicted using transition state theory.
c. must be determined experimentally.
d. can be determined using any of these methods.

19. The energy profile (a.k.a. reaction coordinate diagram) of a 3-step mechanism describing a non-spontaneous process, will have 3 peaks and at least _____ of the reverse

steps must have a _____ activation energy than its corresponding forward step.
a. 1, higher
b. 1, lower
c. 2, higher
d. 2, lower

20. A lot of the famous catalyst discussed in your course notes and lectures are or contain which of the following?
a. alkali metals
b. halogens
c. oxygen
d. transition metals
e. phosphorous

21. Which of the following statements could explain why alkali metals explode in water?
a. Alkali metals have low boiling points.
b. Alkali metals have an s^2 configuration that makes them highly reactive.
c. Alkali metals have a low ionization energy.
d. Alkali metals do not explode in water because they are relatively stable metals.

22. What statement about Calcium is false?
a. It is an alkali earth metal.
b. It is found in hard materials like concrete.
c. It is more likely to be reduced.
d. It reacts in hot water to form hydrogen gas.

23. Which statement about the B family is true?
a. They have an electronegativity around 1.5 or lower
b. They form three covalent bonds.
c. They never exist in an octet configuration.
d. They have strictly non-metallic character.

24. Why is the N group important?
a. They are used to make strong structural materials.
b. They are used in fertilizers.
c. They frequently appear in gems.
d. They are useful in batteries.

25. Which of the following is an allotrope of Carbon?
a. Carbonate
b. Oxygen
c. Carbon dioxide
d. Buckministerfullerene (A "Bucky Ball")

26. What happens in reactions with oxygen?
a. They primarily form salts.
b. They drive everything to a lower oxidation state.
c. They drive everything to a higher oxidation state.
d. Nothing. Oxygen is unreactive.

27. Which element would you rather have in a balloon at a birthday party?
a. Neon
b. Oxygen
c. Hydrogen

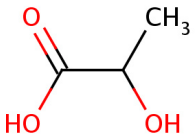
d. Potassium

28. Which of the following statements is false?
a. Hydrochloric acid is produced using the Ostwald process.
b. The Hall process produces aluminum.
c. Alumina is formed in the Bayer process.
d. The Haber process involves nitrogen fixation.

29. Which of the following sets is incorrectly matched?
a. Emerald - beryllium oxide and chromium ions
b. Diamond - silicon
c. Ruby - aluminum oxide and chromium ions
d. Sapphire - aluminum oxide, iron ions, and titanium ions
e. Topaz - aluminum oxide and iron ions

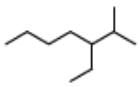
30. how many isomers does C_5H_{12} have?
a. 1
b. 2
c. 3
d. 4

31. What is the IUPAC name for the following structure?

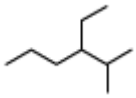


a. 1-carboxylic acid 2-propanol
b. 2-propanol carboxylic acid
c. 2-hydroxyl 3-carboxyl propane
d. 2-hydroxypropanoic acid

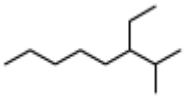
32. which of the following is the correct structure for 3-ethyl-2-methyloctane?
a.



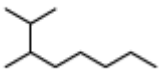
b.



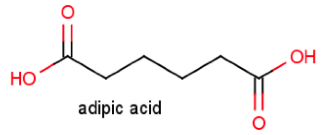
c.



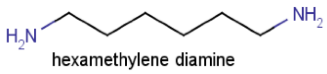
d.



33. Nylon is formed by condensation between the molecules shown below:



adipic acid



hexamethylene diamine

which functional groups react? what type of bond is formed in the condensation reaction?

a. alcohol, amide; ester
b. alcohol, nitro; carboxyl
c. carboxylic acid, nitryl; ether
d. carboxylic acid, amine; amide

34. All of the following molecules contains a carboxyl functional group except:
a. fatty acid
b. nucleic acid
c. amino acid
d. all of the above contains a carboxylic acid group

35. which of the following biomolecules contains an ether bond?
a. sugar
b. protein
c. fatty acid
d. glycerol