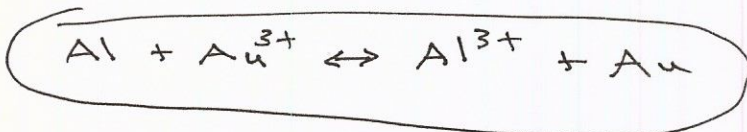
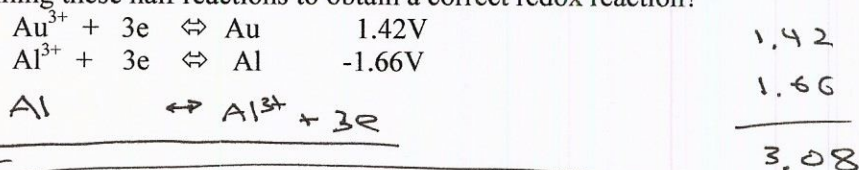


6) You have an idea to make a gold and aluminum battery (galvanic cell) and you decide you need to do some preliminary calculations. First what is the overall balanced spontaneous chemical reaction obtained by combining these half reactions to obtain a correct redox reaction?



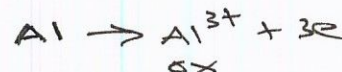
7) Second what is the standard state potential (volts) or electromotive force E° obtained for this reaction?

$$3.08\text{V}$$

8) Third complete the abbreviated cell representation below based on the reaction above

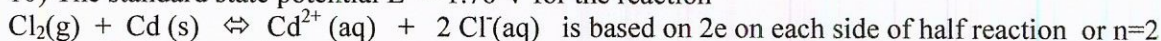


9) And fourth at the Aluminum electrode which of the following is true



oxidation is occurring at the cathode reduction is occurring at the anode
 oxidation is occurring at the anode reduction is occurring at the cathode

10) The standard state potential $E^\circ = 1.76\text{V}$ for the reaction



So therefore what is the voltage potential of E for the same reaction where conditions are not at standard but rather $[\text{Cl}^{-}] = 0.55\text{M}$ and $[\text{Cd}^{2+}] = 0.55\text{M}$ and $P_{\text{Cl}_2} = 2.55\text{atm}$

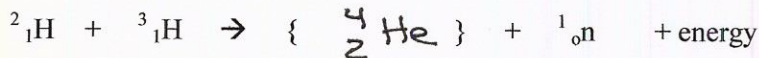
$$\begin{aligned}
 E &= E^\circ - \left(\frac{0.0592}{n} \right) \log Q & Q &= \frac{[\text{Cd}^{2+}][\text{Cl}^{-}]^2}{P_{\text{Cl}_2}} \\
 &= 1.76 - \left(\frac{0.0592}{2} \right) \log \left(\frac{[.55][.55]^2}{2.55} \right) \\
 &= 1.76 - (.0296) \log(.0652) \\
 &= 1.76 - (-0.0351) = 1.795\text{V} \text{ or } 1.80
 \end{aligned}$$

11) What is the value of ΔG° (kJ) for a reaction if $E^\circ = +3.08\text{V}$ and the number of electrons is $n=3\text{mol}$

$$\begin{aligned}
 \Delta G &= -nFE^\circ \\
 &= -(3\text{mol}) \left(\frac{96485\text{C}}{\text{mol}} \right) (+3.08\text{V}) \\
 &= -891521\text{C}\cdot\text{V} \left(\frac{\text{J}}{\text{C}\cdot\text{V}} \right) \left(\frac{\text{kJ}}{1000\text{J}} \right) \\
 \Delta G &= -891\text{kJ}
 \end{aligned}$$

12) bromine is a halogen that exists as a red liquid.
 fluorine chlorine iodine

13) Balance the following fusion nuclear reaction which shows how a heavier element can be created from a lighter ones as it is in the interior of our sun and stars throughout the universe



14) Which of these noble gases has the highest boiling point
 He Ne Ar Kr Xe

15) SiO₂ is made of:

small molecules of SiO₂

positive atoms and free electrons

positive and negative ions

an extended 3-dimensional network of Si and O atoms

16) For a reaction with a potential of $E^0 = +3.08\text{V}$, you can expect that the equilibrium constant, K is

very small

a little more than 1

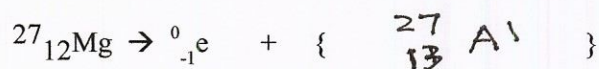
a little less than 1

very large

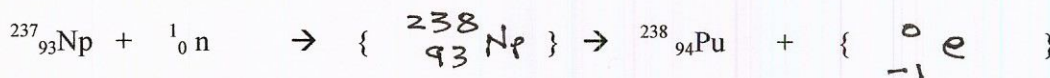
17) A 15.5 ampere (A) current is passed for 888 seconds through a solution containing Al³⁺ ions. How many moles of Aluminum would plate out based on the half reaction $\text{Al}^{3+} + 3\text{e} \rightarrow \text{Al}$?

$$\begin{aligned}
 n_{\text{mol Al}} &= (15.5 \text{ A}) (888 \text{ s}) \left(\frac{\text{C}}{\text{As}} \right) \left(\frac{\text{mole e}}{96485 \text{ C}} \right) \left(\frac{1 \text{ mol Al}}{3 \text{ mole e}} \right) \\
 &= \underline{0.0476 \text{ mol Al}}
 \end{aligned}$$

18) Complete the following equation associated with beta emission.



19) NASA uses plutonium-238 isotope as a source of heat to generate electricity for all its deep space missions. In the past this isotope was made at the Savannah River National Laboratory in Aiken, SC. Neptunium-237 was placed in a reactor and allowed to absorb neutrons. Complete the missing parts below:



20) Plutonium $\frac{{}^{238}_{94}\text{Pu}}{144}$ has how many neutrons 144n and how many electrons 94e or -13

21) The size of atom is due to its
protons neutrons electrons photons

22) Protons and neutrons in close contact in the nucleus are attracted to each other by
gravity strong force electromagnetism vacuum pressure

23) Gold has a density of 19.3 g/mL and Aluminum is 2.70 g/mL. Although there are differences in the size and packing of the gold and aluminum atoms, another critical factor in this density difference is that relative to aluminum,
gold has more protons and neutrons in the nucleus of each Au atom.

24) Which of these metals is very soft and can be cut with a steel knife
Na Ti Fe Cu Ni

25) Metal that was used in a compound added to gasoline (banned about 2 decades ago in US) to make engine burn smoother (acted as antiknock agent)
Mg V Cr Cu Pb

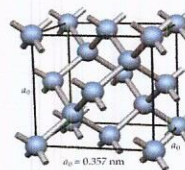
26) Most abundant metal in the earth's crust but more expensive than gold in 1855.
Al Ag Na U

27) If 10.000 grams of ^{234}U are sealed in a container and then opened many years later — exactly how time has passed if the amount of uranium isotope left in the container is 1.8222g given that the half life of this isotope of uranium is $t_{1/2} = 200,000$ year

$$\frac{0.693}{200,000 \text{ yr}} = k \quad \ln(1.8222) = \ln(10.000) - (3.47 \times 10^{-6} \text{ yr}^{-1})t$$
$$k = 3.47 \times 10^{-6} \text{ yr}^{-1} \quad 0.6000 = 2.303 - (3.47 \times 10^{-6} \text{ yr}^{-1})t$$
$$\frac{-1.703}{-3.47 \times 10^{-6} \text{ yr}^{-1}} = 4.9 \times 10^5 \text{ yr}$$

28) Element found in the greatest number of compounds because of its unique ability to form long chains and rings.
Ar B C Si S

29) This diagram illustrates the connections found in



diamond graphite carbon nanotubes buckyballs

30) By mass your body is mostly
H C U O Cl

31) Is stronger than steel and a better conductor of electricity than copper.
sodium chloride carbon nanotube silicon dioxide sodium

32) This element has the lowest density as a gas: C H At Ta No O Ga