Quiz 13 solutions

1. The difference between electromagnetic radiation and particle radiation is ____. Particle radiation includes ___.
Check two (2) boxes.
electromagnetic radiation is from atoms and particle radiation is from molecules (blank 1)
electromagnetic radiation is not dangerous and particle radiation is very dangerous (blank 1)
electromagnetic radiation is from radioactive isotopes and particle radiation is from nuclear reactions (blank 1)
electromagnetic radiation is from electrons and particle radiation is from the nucleus (blank 1)
alpha particles, beta particles, gamma particles (blank 2)
alpha particles, beta particles, neutrons (blank 2)
alpha particles, beta particles, X-rays (blank 2)
gamma radiation, X-rays (blank 2)

2. Based on ____, alpha particles are ___ dangerous than beta particles because ___.
Check three (3) boxes.
ΔG (blank 1)
REB (blank 1)
RBE (blank 1)
more (blank 2)
less (blank 2)
as (blank 2)
they move very fast (blank 3)
they are smaller than beta particles (blank 3)
they are much bigger than beta particles (blank 3)
they are blocked by concrete (blank 3)

3. Radioactive decay of radioactive isotopes is a first order reaction. The half-life of a radioisotope is 0.693/k.
Americium-241 is used in smoke detectors and is an alpha emitter and has a half-life of 458 years.
Carbon-14 is used to date old objects and is a beta emitter and has a half-life of 5700 years.
The nuclear decay product of Am-241 is ____. You would be exposed to more radiation by the isotope with the ___ k, which would be ____.
Check three (3) boxes.
Pa (blank 1)
U (blank 1)
Np (blank 1)
Pu (blank 1)
large (blank 2)
small (blank 2)
Am-241 (blank 3)
C-14 (blank 3)
Same (blank 3)

4. The half life of radioactive C-14 is 5700 years (which is used to determine the age of old objects). You have a 2.0 g sample of C-14. How many grams of sample remains after 3 half lives?
Give a number with 2 significant figures only. Do not include text.
Answer: 0.25

5. U-235 undergoes induced fission.
$^{235}_{92}U$ + $^{1}_{0}n$ --> $^{236}_{92}U$ --> $^{140}_{54}Xe$ + ____ + ___ $^{1}_{0}n$
The second product has a mass number of 94 and is ____. The number of neutrons produced is ____.
1st blank: Write the mass number, atomic symbol, and atomic number, e.g., 235U92 for U-235. Do not add spaces between numbers or letters. 2nd blank: give a number only. Do not include text. Separate each answer with a comma.
Answer: $^{94}_{38}Sr$, 2

Quiz 12 solutions

1. The positive terminal of a power supply ___ electrons from the ___ in an electrolytic cell. The ___ electrons in this electrode are ___ a substance and causes it to ___.

attract (blank 1)
Repels (blank 1)
Anode (blank 2)
Cathode (blank 2)
Deficiency of (blank 3)
Extra (blank 3)
Accepted from (blank 4)
Donated to (blank 4)
Oxidize (blank 5)
Reduce (blank 5)

2. You don't want to show off your gold ring so you decide to plate it with iron (cover your gold ring with iron). You can use the following materials: Au (s), graphite (s), Fe (s), gold ring, Au^{3+} (aq), Fe^{2+} (aq), H_2O.

a. The gold ring should be the ____ and is connected to the ____ electrode of the battery (power supply).

Anode (blank 1)
Cathode (blank 1)
Either (blank 1)
in my mouth as a I sip tea (blank 1)
Positive (blank 2)
Negative (blank 2)
Either one (blank 2)

b. The electrolyte should contain ___. The reaction that you want to occur at the ring is ____.

Blank 2: Write the balanced chemical equation. Use ^ to show superscript for ions, e.g., Na^+ for sodium ion. Add a space between substances.

Au (s) (blank 1)
graphite (s) (blank 1)
Fe (s) (blank 1)
Au^{3+} (aq) (blank 1)
Fe^{2+} (aq) (blank 1)
Other
$Fe^{\wedge 2+}$ + 2 $e^{\wedge -}$ --> Fe

3. You want to split water by electrolysis. You have NaOH solution, Pt cathode and graphite anode. You know the following half reactions:

Reaction 1:	$2 H^+ + 2e^- \rightarrow H_2$	$E_{reduction} = 0$ V
Reaction 2:	$2 H_2O + 2e^- \rightarrow H_2 + 2 OH^-$	$E_{reduction} = -0.83$ V
Reaction 3:	$O_2 + 4 H^+ + 4e^- \rightarrow 2 H_2O$	$E_{reduction} = 1.23$ V
Reaction 4:	$O_2 + 2 H_2O + 4e^- \rightarrow 4 OH^-$	$E_{reduction} = 0.40$ V

a. The half reaction that occurs at the graphite anode is _____. The half reaction that occurs at the Pt cathode is ____.

Reaction 1 (blank 1)
Reverse of Reaction 1 (blank 1)
Reaction 2 (blank 1)
Reverse of Reaction 2 (blank 1)
Reaction 3 (blank 1)
Reverse of Reaction 3 (blank 1)
Reaction 4 (blank 1)
Reverse of Reaction 4 (blank 1)
Reaction 1 (blank 2)
Reverse of Reaction 1 (blank 2)
Reaction 2 (blank 2)

Reverse of Reaction 2 (blank 2)
Reaction 3 (blank 2)
Reverse of Reaction 3 (blank 2)
Reaction 4 (blank 2)
Reverse of Reaction 4 (blank 2)
H^+ means acid conditions: H_2SO_4
OH^- means basic conditions: NaOH

b. Show how you would calculate the minimum applied voltage to split water, e.g., E_{cell} = 0 V – 0.83 V = -0.83 V. Show the numbers you need to add or subtract to calculate E_{cell}.
E_{cell} = -0.83 V + (-0.40 V) = -1.23 V

Quiz 11 solutions
1. Here is a list of oxidizing agents. Acids can behave as oxidizing agents.

I_2 (g) + 2 e^- ---> 2 I^- (aq)	E° = 0.53 V
O_2 (g) + 4 H^+ (aq) + 4 e^- ---> 2 H_2O	E° = 1.23 V
HClO (aq) + H^+ (aq) + 2 e^- ---> Cl^- (aq) + H_2O	E° = 1.49 V
H_2O_2 (aq) + 2 H^+ (aq) + 2 e^- ---> 2 H_2O	E° = 1.77 V
2 H^+ (aq) + 2 e^- ---> H_2 (g)	E° = 0 V
Au^{3+} (aq) + 3 e^- ---> Au	E° = 1.50 V
Ag^+ (aq) + e^- ---> Ag	E° = 0.80 V

____ is a better oxidizing agent than HClO but not as good as H_2O_2 because this substance has a ___ ___ potential than HClO but ___ than H_2O_2.
H_2O_2 (blank 1)
HClO (blank 1)
O_2 (blank 1)
I_2 (blank 1)
H^+ (blank 1)
Au^{3+} (blank 1)
Ag^+ (blank 1)
Higher (blank 2)
Lower (blank 2)
Oxidation (blank 3)
Reduction (blank 3)
Higher (blank 4)
Lower (blank 4)
Substance with highest E° is the best oxidizing agent.

2. a. Silver metal is ___ active than gold metal. This means silver is a ___ ___ agent than gold. It also means the reduction potential of silver ion is ___than the reduction potential of gold ion.
More (blank 1)
Same (blank 1)
Less (blank 1)
better (blank 2)
worse (blank 2)
oxidizing (blank 3)
reducing (blank 3)
higher (blank 4)
same (blank 4)
lower (blank 4)

b. You want to make a silver-gold battery.

Ag^+ (aq) + e^- --> Ag (s)	E° = 0.80 V
Au^{3+} (aq) + 3 e^- --> Au (s)	E° = 1.50 V

Gold is the ____ because it is ___ active than silver. The ____ is oxidized and is the ____.
Anode (blank 1)
cathode (blank 1)
Less (blank 2)
Not (blank 2)
More (blank 2)
Same (blank 2)
Ag (blank 3)
Au (blank 3)
Ag^+ (blank 3)
Au^{3+} (blank 3)
Anode (blank 4)
cathode (blank 4)

c. The voltage produced by this battery is ____ V. ΔG for this battery is ____ 0, which I know from the equation ___, because the battery reaction is ___.
Blank 1: Give a number with 2 decimal places only in "Other". Do not include text. Blank 3: Give an equation (not the name of an equation) in "Other". Separate each answer with a comma.
Greater than (blank 2)
less than (blank 2)
equal to (blank 2)
spontaneous (blank 4)
not spontaneous (blank 4)
Other
0.70, ΔG = -nFE
$E_{cell} = E_{cathode} - E_{anode}$ = 1.50 – 0.80 = 0.70 V

d. Starting from $[Ag^+] = [Au^{3+}]$ = 1 M, your Ag/Au battery has discharged 60%. You use the Nernst equation to determine the voltage of the battery: A = B - (RT/nF) ln (Q)
For this 60% discharged battery, n = _____, Q = _____, and A = ___ V.
Blank 1: Give a number with 1 significant figure. Do not include text. Blank 2: Give a number with 3 significant figures. Do not include text. Blank 3: Give a number with 3 significant figures. Do not include text. Separate each answer with a comma.
3, 54.9, 2.23
Reduction half-reaction: Au^{3+} (aq) + 3 e^- --> Au (s)
Oxidation half-reaction: Ag (s) --> Ag^+ (aq) + e^-

Overall reaction: 3 Ag (s) +	Au^{3+} (aq) -->	3 Ag^+ (aq) + Au (s)
Initial:	1	1
Reacts:	0.6	0.6 moles Au^{3+} (aq) (3 moles Ag^{2+} /1 moles Au^{3+}) = 1.8 moles
Left over:	0.4	2.8

Q = Ratio of $[Ag^+]^3/[Au^{3+}] = (2.8)^3$ /0.4 = 54.88
Ecell = 0.70 – (8.31) (298)/(3) (96500) ln (54.88) = 0.67 V

Quiz 10 solutions
Carbonated beverages are acidic because CO_2 reacts with water to form H^+ and HCO_3^-:

CO_2 (g) + H_2O (l) ---> H^+ (aq) + HCO_3^- (aq)

For this reaction, ΔH = -12 kJ/mole and ΔS = -189 J/mole K.
1. At 25ºC, ΔG = _____ kJ/mole. This means this reaction is ___.
Blank 1: Give a number with 3 significant figures only in "Other". Do not include units.
Spontaneous (blank 2)
Not spontaneous (blank 2)
Other
44 to 47
44.7 kJ/mole using Hess' law, 46.7 kJ/mole using ΔG = ΔH – T ΔS

2. This reaction is _____ by enthalpy and _____ by entropy and occurs at ______ temperature(s).
Favored (blank 1)
Not favored (blank 1)
Favored (blank 2)
Not favored (blank 2)
all (blank 3)
some (blank 3)
no (blank 3)
ΔH = -12 kJ/mole → ΔH < 0 so reaction is favored by enthalpy.
ΔS = -189 J/mole K → ΔS < 0 so reaction is not favored by entropy.

3. At 25°C, K_{eq} = ______. The equation I would use to calculate K_{eq} is _____.
Blank 1: Give a number in scientific notation with 3 signficant figures as _._ _E_ in "Other". Do not include text.
q = m s ΔT (blank 2)
ΔH = q (blank 2)
ΔG = ΔH – T ΔS (blank 2)
ΔG = - R T ln Keq (blank 2)
ΔE = q + w (blank 2)
Other
1.45E-8 to 1.8E-8
ΔG = -RT ln Keq or Keq = $e^{-(\Delta G/RT)} = e^{-(44600/((8.31)(298))}$ = 1.5E-8.

4. ΔH for this reaction is ____. Lowering the temperature shifts the reaction to the _____ side so ____ CO_2 (g) escapes from the soda.
Hot (blank 1)
Exergonic (blank 1)
Endothermic (blank 1)
Exothermic (blank 1)
Reactant (blank 2)
Product (blank 2)
South (blank 2)
More (blank 3)
Less (blank 3)
Polar (blank 3)

5. The temperature at which this reaction occurs/does not occur is _____ K. I would not be able to get this reaction to occur or not occur at this temperature because _____.
1st blank: answer "any temperature" or "no temperature" or give the minimum temperature in K at which this reaction occurs or does not occur with 2 significant figures only; do not include units. 2nd blank: fill in the blank. Separate each answer with a comma.
63, water is not a liquid at 63 K.
ΔG = ΔH – T ΔS
Set ΔG = 0 and solve for T = (ΔG – ΔH) / (- ΔS) = (0 – (-12000))/(-189) = 63.48 K = 63 K

Quiz 9 solutions
1. 100 g of water (s = 4.18 J/g °C) at 5.0°C is added to 100 g of liquid ethanol (s = 2.5 J/g °C) at 25°C. The ____ gains heat. ΔT for the water is ____ ΔT for the ethanol because of the difference in ____. The final temperature is ____ degrees C.
Blank 4: Give a number with 3 significant figures in "Other".
water (blank 1)
ethanol (blank 1)
is greater than (blank 2)
equals (blank 2)

is less than (blank 2)
mass (blank 3)
specific heat (blank 3)
temperature (blank 3)
Other
12.5
$q = m\ s\ \Delta T$
heat gained by water = - heat lost by ethanol
$m_w\ s_w\ \Delta T_w = -m_e\ s_e\ \Delta T_e$
(100 g) (4.18 J/g °C) (T_f – 5.0°C) = -(100 g) (2.5 J/g °C) (T_f – 25°C)
Solve for T_f = 12.5°C.
ΔT for water = 12.5°C - 5°C = 7.5°C
ΔT for ethanol = 12.5°C - 25°C = 12.5°C
heat gained by water = (100 g) (4.18 J/g °C) (12.5°C – 5.0°C) = 3130 J
- heat lost by ethanol = -(100 g) (2.5 J/g °C) (12.5°C – 25°C) = 3130 J

2. Coal, C, is burned in power plants to make electricity:

$$C\ (s) + O_2\ (g) \dashrightarrow CO_2\ (g)$$

ΔH_f of coal = 0 kJ/mole.
a. For every 1 mole of coal that reacts, __ moles of CO_2 are produced. ΔH of this reaction = ___ kJ/mole.
Blank 1: give a number with 2 significant figures only. Do not include text. Blank 2: give a number with 3 significant figures only. Do not include text. Separate each answer with a comma.
1, -393
Apply Hess' law: [ΔH_f of CO_2 (g)] – [ΔH_f of coal + ΔH_f of O_2 (g)] = -393 kJ/mole – [0 + 0] = -393 kJ/mole

b. This reaction is ___ because the energy required to break bonds in the reactants is ___ the energy released when bonds form to make products.
Exothermic (blank 1)
Endothermic (blank 1)
is greater than (blank 2)
equals (blank 2)
is less than (blank 2)

c. The coal combustion reaction ___ work because there are __ moles of gas reactants compared to __ moles of gas products. This causes a ___ of gas.
Blanks 2 and 3: Give a number with 1 significant figure in "Other". Do not include text. Separate each answer with a comma.
Produces (blank 1)
Absorbs (blank 1)
Does not involve (blank 1)
Expansion (blank 4)
Compression (blank 4)
Neither expansion nor compression (blank 4)
Other
1, 1

3. A refrigerator keeps your food cold.
Step A: low pressure gas → high pressure gas
Step B: high pressure gas → high pressure liquid
Step C: high pressure liquid → low pressure liquid
Step D: low pressure liquid → low pressure gas
Step A ___ work. Step __ cools the air inside your refrigerator because the refrigerant ___ heat when it ___.
requires (blank 1)
produces (blank 1)
A (blank 2)

B (blank 2)
C (blank 2)
D (blank 2)
Gains (blank 3)
Loses (blank 3)
Neither gains nor loses (blank 3)
compresses (blank 4)
Condenses (blank 4)
Expands (blank 4)
vaporizes (blank 4)
Step A: low pressure gas → high pressure gas compresses a gas and requires work.
Step D: liquid → gas phase change is endothermic