

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)

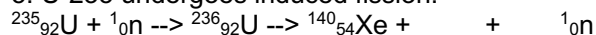
Same (blank 3)

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.



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: ${}^{94}_{38}\text{Sr}$, 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, Au³⁺ (aq), Fe²⁺ (aq), H₂O.

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)

Au³⁺ (aq) (blank 1)

Fe²⁺ (aq) (blank 1)

Other

Fe²⁺ + 2 e⁻ --> 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: $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

$E_{\text{reduction}} = 0\text{ V}$

Reaction 2: $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$

$E_{\text{reduction}} = -0.83\text{ V}$

Reaction 3: $\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$

$E_{\text{reduction}} = 1.23\text{ V}$

Reaction 4: $\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^- \rightarrow 4\text{OH}^-$

$E_{\text{reduction}} = 0.40\text{ V}$

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)

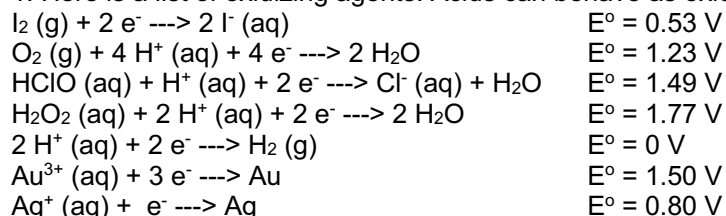
Reaction 2 (blank 2)

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: H₂SO₄
OH⁻ means basic conditions: NaOH

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

Quiz 11 solutions

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



_____ is a better oxidizing agent than HClO but not as good as H₂O₂ because this substance has a _____ potential than HClO but _____ than H₂O₂.

H₂O₂ (blank 1)

HClO (blank 1)

O₂ (blank 1)

I₂ (blank 1)

H⁺ (blank 1)

Au³⁺ (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^o 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)

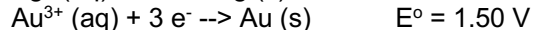
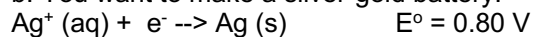
reducing (blank 3)

higher (blank 4)

same (blank 4)

lower (blank 4)

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



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)

Au³⁺ (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, $\Delta G = -nFE$

$E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}} = 1.50 - 0.80 = 0.70 \text{ V}$

d. Starting from $[\text{Ag}^+] = [\text{Au}^{3+}] = 1 \text{ M}$, 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, $n = \underline{\hspace{2cm}}$, $Q = \underline{\hspace{2cm}}$, and $A = \underline{\hspace{2cm}} \text{ V}$.

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: $\text{Au}^{3+} (\text{aq}) + 3 \text{e}^- \rightarrow \text{Au} (\text{s})$

Oxidation half-reaction: $\text{Ag} (\text{s}) \rightarrow \text{Ag}^+ (\text{aq}) + \text{e}^-$

Overall reaction: $3 \text{Ag} (\text{s}) + \text{Au}^{3+} (\text{aq}) \rightarrow 3 \text{Ag}^+ (\text{aq}) + \text{Au} (\text{s})$

Initial:

1	1
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Reacts:

0.6	0.6 moles Au ³⁺ (aq) (3 moles Ag ²⁺ / 1 moles Au ³⁺) = 1.8
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 moles

Left over:

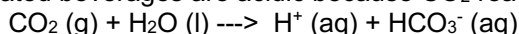
0.4	2.8
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$Q = \text{Ratio of } [\text{Ag}^+]^3 / [\text{Au}^{3+}] = (2.8)^3 / 0.4 = 54.88$

$E_{\text{cell}} = 0.70 - (8.31) / (3) (96500) \ln(54.88) = 0.67 \text{ V}$

Quiz 10 solutions

Carbonated beverages are acidic because CO₂ reacts with water to form H⁺ and HCO₃⁻:



For this reaction, $\Delta H = -12 \text{ kJ/mole}$ and $\Delta S = -189 \text{ J/mole K}$.

1. At 25°C, $\Delta G = \underline{\hspace{2cm}} \text{ kJ/mole}$. 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 $\Delta G = \Delta H - T \Delta S$

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)

$\Delta H = -12 \text{ kJ/mole} \rightarrow \Delta H < 0$ so reaction is favored by enthalpy.

$\Delta S = -189 \text{ J/mole K} \rightarrow \Delta S < 0$ 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 significant figures as ._.E_ in "Other". Do not include text.

$q = m s \Delta T$ (blank 2)

$\Delta H = q$ (blank 2)

$\Delta G = \Delta H - T \Delta S$ (blank 2)

$\Delta G = -R T \ln K_{eq}$ (blank 2)

$\Delta E = q + w$ (blank 2)

Other

1.45E-8 to 1.8E-8

$\Delta G = -RT \ln K_{eq}$ or $K_{eq} = e^{-(\Delta G/RT)} = e^{-(44600/((8.31)(298)))} = 1.5E-8$.

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.

$\Delta G = \Delta H - T \Delta S$

Set $\Delta G = 0$ and solve for $T = (\Delta G - \Delta H) / (-\Delta S) = (0 - (-12000)) / (-189) = 63.48 \text{ K} = 63 \text{ K}$

Quiz 9 solutions

1. 100 g of water ($s = 4.18 \text{ J/g } ^\circ\text{C}$) at 5.0°C is added to 100 g of liquid ethanol ($s = 2.5 \text{ J/g } ^\circ\text{C}$) 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

$m_w s_w \Delta T_w = -m_e s_e \Delta T_e$

$(100 \text{ g}) (4.18 \text{ J/g } ^\circ\text{C}) (T_f - 5.0^\circ\text{C}) = -(100 \text{ g}) (2.5 \text{ J/g } ^\circ\text{C}) (T_f - 25^\circ\text{C})$

Solve for $T_f = 12.5^\circ\text{C}$.

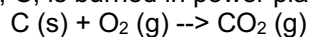
ΔT for water = $12.5^\circ\text{C} - 5^\circ\text{C} = 7.5^\circ\text{C}$

ΔT for ethanol = $12.5^\circ\text{C} - 25^\circ\text{C} = 12.5^\circ\text{C}$

heat gained by water = $(100 \text{ g}) (4.18 \text{ J/g } ^\circ\text{C}) (12.5^\circ\text{C} - 5.0^\circ\text{C}) = 3130 \text{ J}$

- heat lost by ethanol = $-(100 \text{ g}) (2.5 \text{ J/g } ^\circ\text{C}) (12.5^\circ\text{C} - 25^\circ\text{C}) = 3130 \text{ J}$

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



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: $[\Delta H_f \text{ of } \text{CO}_2 \text{ (g)}] - [\Delta H_f \text{ of coal} + \Delta H_f \text{ of } \text{O}_2 \text{ (g)}] = -393 \text{ kJ/mole} - [0 + 0] = -393 \text{ kJ/mole}$

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 \rightarrow high pressure gas

Step B: high pressure gas \rightarrow high pressure liquid

Step C: high pressure liquid \rightarrow low pressure liquid

Step D: low pressure liquid \rightarrow 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