Which one shows the correct dissociation reaction for the given weak acid?

A. HCl $\rightarrow$ $H^+$ + $Cl^-$  
B. HCl $\leftrightarrow$ $H^+$ + $Cl^-$  
C. HF $\rightarrow$ $H^+$ + $F^-$  
D. HF $\leftrightarrow$ $H^+$ + $F^-$

Which pair contains two weak acids?

A. CH$_3$COOH and HCN  
B. HNO$_3$ and HNO$_3$  
C. H$_3$PO$_4$ and H$_2$SO$_4$  
D. HBr and HBrO$_3$

Acid A has $pK_a$ value of 3.68 and Acid B has a $pK_a$ value of 5.31.

What is the $K_a$ of acid A?  

Which acid is weaker?  

Report the numerical answer with two significant figures. Do NOT include units in your answer. Use the format 2.2E-2 or 2.2E2 for numbers in scientific notation.

1. 
2. 

1. 
2. 
Question #: 4

Which two pairs of compounds can form buffers in aqueous solution?

A. H_3PO_4 and K_3PO_4  
B. HCl and KCl  
C. CH_3COOH and CH_3COONa  
D. CH_3NH_2 and HCN  
E. NH_3 and NH_4Cl

Question #: 5

A patient undergoes a procedure in a hospital and their pH is too low. Should bicarbonate (HCO_3^-) be added or removed to raise the patient's pH?

H_2CO_3 ⇌ HCO_3^- + H^+

A. Added  
B. Removed

Question #: 6

A neutral atom of the radioisotope, cobalt-60 (^{60}Co), has _1_ protons, _2_ neutrons, and _3_ electrons.  
Do NOT include units in your answer.

1. __________  
2. __________  
3. __________
Question #: 7

An alpha particle has an atomic mass of \( 1 \) and an atomic number of \( 2 \). Report each answer as a whole number. Do NOT include units in your answer.

1. _________
2. _________

Question #: 8

Molybdenum-97 reaction with deuterium (\(^2\)H) to form an unknown particle and 2 neutrons. Complete the blanks in the nuclear equation for this process. Do NOT include units in your answers. **Confirm that your responses correspond to the correct number for each blank. The attached image also shows the layout if the reaction below appears odd on your display.**

\[
\begin{array}{c}
\text{97} \\
\text{42} \\
\text{Mo} + \text{2 H} \rightarrow \underline{1} \underline{3} + \underline{2} \underline{5} \\
\text{4} \\
\text{n}
\end{array}
\]

1. _________
2. _________
3. _________
4. _________
5. _________

Attachment:

attachment_for_itemid_15664.png
Question #: 9

Is the reaction an example of fission, fusion, both, or neither?

\[ ^{235}_{92}\text{U} + ^{1}_{0}\text{n} \rightarrow ^{96}_{37}\text{Rb} + ^{137}_{55}\text{Cs} + 3^{1}_{0}\text{n} \]

A. fission  
B. fusion  
C. both fission and fusion  
D. neither fission nor fusion

Question #: 10

A radioactive material that decays from 130 g to 8.13 g in 34 hours. The substance has a half-life of _1_ hours.

Report your answer with two significant figures. Do NOT include units in your answer.

1. __________

Question #: 11

A nuclide has a half-life of 45 minutes. After a 96-gram sample undergoes radioactive decay for 4.5 hours, the remaining mass of nuclide is _1_ grams.

Report your answer with two significant figures. Do NOT include units in your answer.

1. __________
Question #: 12

The carbon-14 ratio in a sample decays to $1/16$ of its original value. If the half-life of carbon-14 is 5730 years, what is the age of the sample?

A. 11460 years  
B. 17190 years  
C. 22920 years  
D. 28650 years  
E. 91680 years

Question #: 13

Which **two** are physical changes?

A. A toothpick is broken in half.  
B. A piece of wood is burned.  
C. Water is added to concentrated juice and mixed.  
D. Hydrogen and oxygen combine to make water.

Question #: 14

A patient with a mass of 62 kg is prescribed 0.15 mCi of I-131 per kg of body weight. The solution of I-131 contains 25. mCi per 15. mL. A volume of ___ mL should be administered to the patient. Report your answer with **two** significant figures. Do **NOT** include units in your answer.

1. __________


**Question #: 15**

Balance the following chemical equation with the smallest possible whole numbers by filling in each blank with the proper coefficient. If the coefficient is 1, fill in 1.

\[ \text{1}_\text{C}_3\text{H}_6\text{O}_2(l) + \text{2}_\text{O}_2(g) \rightarrow \text{3}_\text{CO}_2(g) + \text{4}_\text{H}_2\text{O}(l) \]

1. 
2. 
3. 
4. 

---

**Question #: 16**

Balance the following chemical equation with the smallest possible whole numbers by filling in each blank with the proper coefficient. If the coefficient is 1, fill in 1.

\[ \text{1}_\text{P} + \text{2}_\text{Cl}_2 \rightarrow \text{3}_\text{PCl}_3 \]

1. 
2. 
3. 

---

**Question #: 17**

Determine the oxidation number for the **underlined** element in each species. You must include a number and a sign (+ or −) for each answer unless the value is 0.

- \( \text{HClO}_4 \) __1__
- \( \text{N}_2 \) __2__
- \( \text{H}_2\text{PO}_4^{2−} \) __3__

1. 
2. 
3. 

---
**Question #**: 18

Complete the table using either **gain** or **loss** for each answer.

<table>
<thead>
<tr>
<th></th>
<th>Oxidation</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>electrons</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>hydrogen</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

1. __________
2. __________
3. __________
4. __________

**Question #**: 19

Identify each substance. Enter **one** letter for each answer.

<table>
<thead>
<tr>
<th>Fe₂O₃</th>
<th>+</th>
<th>3CO</th>
<th>→</th>
<th>2Fe</th>
<th>+</th>
<th>3CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. __________
2. __________
3. __________
4. __________
Question #: 20

Identify each reaction as combination, decomposition, single replacement, double replacement, combustion.

\begin{align*}
Cu + 2 \text{AgNO}_3 &\rightarrow 2\text{Ag} + \text{Cu(NO}_3\text{)}_2 \quad &{\text{1}} \\
2\text{C}_8\text{H}_{18} + 25\text{O}_2 &\rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O} \quad &{\text{2}} \\
\text{CaCO}_3 &\rightarrow \text{CaO} + \text{CO}_2 \quad &{\text{3}}
\end{align*}

1. __________ \\
2. __________ \\
3. __________

---

Question #: 21

Which one is a redox reaction?

A. \(\text{NaCl (aq)} + \text{AgNO}_3(aq) \rightarrow \text{AgCl(s)} + \text{NaNO}_3(aq)\)
B. \(2\text{AgNO}_3(aq) + \text{Cu(s)} \rightarrow \text{Cu(NO}_3\text{)}_2(aq) + 2\text{Ag(s)}\)
C. \(\text{HCl(aq)} + \text{NaOH(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}\)
D. \(\text{TiCl}_4(s) + \text{H}_2\text{O(g)} \rightarrow \text{TiO}_2(s) + 4\text{HCl(g)}\)

---

Question #: 22

Which **two** will have an increase in entropy?

A. \(\text{H}_2\text{O(l)} \text{ at 85 °C} \rightarrow \text{H}_2\text{O(l)} \text{ at 75 °C}\)
B. \(\text{Na}_2\text{SO}_4(s) \rightarrow \text{Na}_2\text{SO}_4(aq)\)
C. \(\text{CaCO}_3(s) \rightarrow \text{CaO(s)} + \text{CO}_2(g)\)
D. \(\text{CO}_2(g) \rightarrow \text{CO}_2(s)\)
Question #: 23

A reaction is spontaneous at low temperatures only if the

A. enthalpy change ($\Delta H$) is negative and the entropy change ($\Delta S$) is negative.
B. enthalpy change ($\Delta H$) is negative and the entropy change ($\Delta S$) is positive.
C. enthalpy change ($\Delta H$) is positive and the entropy change ($\Delta S$) is negative.
D. enthalpy change ($\Delta H$) is positive and the entropy change ($\Delta S$) is positive.

Question #: 24

What three factors will increase the rate of this reaction? Check all that apply.

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

A. increasing the concentration of $N_2$
B. increasing the temperature
C. decreasing the concentration of $N_2$
D. decreasing the temperature
E. adding a catalyst

Question #: 25

For the reaction, $N_2O_5 \rightarrow NO_2 + NO_3$, the concentration of NO$_2$ increases from 0.38 M to 0.95 M in 15 seconds.

What is the rate of appearance of NO$_2$? __1__ M/s

During this reaction, the amount of $N_2O_5$ is __2__ [increasing, decreasing]

Report your answer with two significant figures. Do NOT include units in your answer.

1. __________
2. __________
What is the enthalpy of the reaction? __1__ kJ
The reaction is __2__ [endothermic, exothermic].
Report your answer with two significant figures. Do NOT include units in your answer.

1. __________
2. __________
What is the activation energy of the **forward** reaction? \(1\) kJ
What is the activation energy of the **reverse** reaction? \(2\) kJ
Report your answers with **two** significant figures. Do **NOT** include units in your answers.

1. __________
2. __________

---

**Question #: 28**

Select the **two** true statements.

A. Catalysts change the identity of the reactants or products.
B. Catalysts lower the activation energy.
C. Catalysts change the enthalpy of a reaction.
D. Catalysts change the entropy of a reaction.
E. Catalysts decrease the reaction rate.
F. Catalysts are present at the beginning and end of a reaction.
Question #1

Which one shows the correct dissociation reaction for the given weak acid?

A. HCl $\rightarrow$ H$^+$ + Cl$^-$
B. HCl $\leftrightarrow$ H$^+$ + Cl$^-$
C. HF $\rightarrow$ H$^+$ + F$^-$
D. HF $\leftrightarrow$ H$^+$ + F$^-$

C. HF $\rightarrow$ H$^+$ + F$^-$

Question #2

Which pair contains two weak acids?

A. CH$_3$COOH and HCN
B. HNO$_3$ and HNO$_3$

✓ A. CH$_3$COOH and HCN
C. H₃PO₄ and H₂SO₄
D. HBr and HBrO₃

Question #: 3

Acid A has pKₐ value of 3.68 and Acid B has a pKₐ value of 5.31.
What is the Kₐ of acid A? 
Which acid is weaker? [A, B]

Report the numerical answer with two significant figures. Do NOT include units in your answer. Use the format 2.2E-2 or 2.2E2 for numbers in scientific notation.

1. 2.1E-4
2. B

Question #: 4

Which two pairs of compounds can form buffers in aqueous solution?

A. H₃PO₄ and K₃PO₄
B. HCl and KCl
✓ C. CH₃COOH and CH₃COONa
D. CH₃NH₂ and HCN
✓ E. NH₃ and NH₄Cl

Question #: 5

A patient undergoes a procedure in a hospital and their pH is too low. Should bicarbonate (HCO₃⁻) be added or removed to raise the patient's pH?

H₂CO₃ ⇌ HCO₃⁻ + H⁺

✓ A. Added
    B. Removed
Question #: 6

A neutral atom of the radioisotope, cobalt-60 (\(^{60}\)Co), has \(1\) protons, \(2\) neutrons, and \(3\) electrons.
Do **NOT** include units in your answer.

1. 27
2. 33
3. 27

Question #: 7

An alpha particle has an atomic mass of \(1\) and an atomic number of \(2\).
Report each answer as a **whole** number. Do **NOT** include units in your answer.

1. 4
2. 2

Question #: 8

Molybdenum-97 reaction with deuterium (\(^2\)H) to form an unknown particle and 2 neutrons.
Complete the blanks in the nuclear equation for this process.
Do **NOT** include units in your answers.
**Confirm that your responses correspond to the correct number for each blank.** The attached image also shows the layout if the reaction below appears odd on your display.

\[
\begin{array}{ccccc}
97 & 2 & 1 & 2 & \\
\text{Mo} & + & \text{H} & 3 & + 2n \\
42 & 1 & 4 & 5 & \\
\end{array}
\]
Question #: 9

Is the reaction an example of fission, fusion, both, or neither?

\[
\frac{235}{92} U + \frac{1}{0} n \rightarrow \frac{96}{37} Rb + \frac{137}{55} Cs + 3 \frac{1}{0} n
\]

✓ A. fission  
B. fusion  
C. both fission and fusion  
D. neither fission nor fusion

Question #: 10

A radioactive material that decays from 130 g to 8.13 g in 34 hours. The substance has a half-life of \( \underline{1} \) hours.

Report your answer with two significant figures. Do NOT include units in your answer.

1. 8.5

Question #: 11

A nuclide has a half-life of 45 minutes. After a 96-gram sample undergoes radioactive decay for 4.5 hours, the remaining mass of nuclide is \( \underline{1} \) grams.

Report your answer with two significant figures. Do NOT include units in your answer.

1. 1.5
Question #: 12

The carbon-14 ratio in a sample decays to 1/16 of its original value. If the half-life of carbon-14 is 5730 years, what is the age of the sample?

A. 11460 years
B. 17190 years
C. 22920 years
D. 28650 years
E. 91680 years

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Which two are physical changes?

A. A toothpick is broken in half.
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D. Hydrogen and oxygen combine to make water.

Question #: 14

A patient with a mass of 62 kg is prescribed 0.15 mCi of I-131 per kg of body weight. The solution of I-131 contains 25. mCi per 15. mL. A volume of ___ mL should be administered to the patient.

Report your answer with two significant figures. Do NOT include units in your answer.

1. 5.6

Question #: 15

Balance the following chemical equation with the smallest possible whole numbers by filling in each blank with the proper coefficient. If the coefficient is 1, fill in 1.

\[ \text{1} \ \text{C}_3\text{H}_6\text{O}_2(\ell) + \text{2} \ \text{O}_2(g) \rightarrow \text{3} \ \text{CO}_2(g) + \text{4} \ \text{H}_2\text{O}(l) \]
Question #: 16

Balance the following chemical equation with the smallest possible whole numbers by filling in each blank with the proper coefficient. If the coefficient is 1, fill in 1.

\[ \boxed{1} \text{P} + \boxed{2} \text{Cl}_2 \rightarrow \boxed{3} \text{PCl}_3 \]

1. 2
2. 3
3. 2

Question #: 17

Determine the oxidation number for the underlined element in each species.
You must include a number and a sign (+ or –) for each answer unless the value is 0.

\[
\begin{array}{ccc}
\text{HClO}_4 & 4 & 1 \\
\text{N}_2 & 2 \\
\text{HPO}_4^{2–} & 4 & 3 \\
\end{array}
\]

1. +7|7+
2. 0
3. +5|5+

Question #: 18

Complete the table using either gain or loss for each answer.

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Identify each substance. Enter one letter for each answer.

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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td>C</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

1. is oxidized.
2. is reduced.
3. is the oxidizing agent.
4. is the reducing agent.

1. B
2. A
3. A
4. B

Question #: 20

Identify each reaction as combination, decomposition, single replacement, double replacement, combustion.

1. Cu + 2AgNO₃ → 2Ag + Cu(NO₃)₂
2. 2C₈H₁₈ + 25O₂ → 16CO₂ + 18H₂O
3. CaCO₃ → CaO + CO₂

1. single displacement[single replacement]
2. combustion
3. decomposition
Question #: 21

Which one is a redox reaction?

A. NaCl (aq) + AgNO₃(aq) → AgCl(s) + NaNO₃(aq)
✓ B. 2 AgNO₃(aq) + Cu(s) → Cu(NO₃)₂(aq) + 2 Ag(s)
C. HCl(aq) + NaOH(aq) → NaCl(aq) + H₂O(l)
D. TiCl₄(s) + H₂O(g) → TiO₂(s) + 4 HCl(g)

Question #: 22

Which two will have an increase in entropy?

A. H₂O(l) at 85 °C → H₂O(l) at 75 °C
✓ B. Na₂SO₄(s) → Na₂SO₄(aq)
✓ C. CaCO₃(s) → CaO(s) + CO₂(g)
D. CO₂(g) → CO₂(s)

Question #: 23

A reaction is spontaneous at low temperatures only if the

✓ A. enthalpy change (ΔH) is negative and the entropy change (ΔS) is negative.
B. enthalpy change (ΔH) is negative and the entropy change (ΔS) is positive.
C. enthalpy change (ΔH) is positive and the entropy change (ΔS) is negative.
D. enthalpy change (ΔH) is positive and the entropy change (ΔS) is positive.

Question #: 24

What three factors will increase the rate of this reaction? Check all that apply.

N₂(g) + 3 H₂(g) → 2 NH₃(g)

✓ A. increasing the concentration of N₂
✓ B. increasing the temperature
C. decreasing the concentration of N₂
D. decreasing the temperature
 ✓ E. adding a catalyst

Question #: 25

For the reaction, N₂O₅ → NO₂ + NO₃, the concentration of NO₂ increases from 0.38 M to 0.95 M in 15 seconds.

What is the rate of appearance of NO₂? 1 M/s

During this reaction, the amount of N₂O₅ is 2 [increasing, decreasing]

Report your answer with two significant figures. Do NOT include units in your answer.

1. 0.038
2. decreasing

Question #: 26

What is the enthalpy of the reaction? 1 kJ

The reaction is 2 [endothermic, exothermic].

Report your answer with two significant figures. Do NOT include units in your answer.

1. 15
2. endothermic
Question #: 27

What is the activation energy of the **forward** reaction? 1 kJ

What is the activation energy of the **reverse** reaction? 2 kJ

Report your answers with **two** significant figures. Do **NOT** include units in your answers.

1. 40|40.|
2. 25|25.|

---

Question #: 28

Select the **two** true statements.

A. Catalysts change the identity of the reactants or products.
   ✓
B. Catalysts lower the activation energy.
C. Catalysts change the enthalpy of a reaction.
D. Catalysts change the entropy of a reaction.
E. Catalysts decrease the reaction rate.
   ✓
F. Catalysts are present at the beginning and end of a reaction.