1. Calculate the work done (in kJ) against atmospheric pressure of 1.0 atm when 500.0 g of zinc dissolves in excess HCl at 30.0°C according to:
\[ \text{Zn(s) + 2HCl(aq) → ZnCl}_2(\text{aq}) + \text{H}_2(\text{g}) \]
   A) -22.4 B) -19.3 C) -17.6 D) -15.2

2. A gas is compressed in a cylinder by a constant pressure of 10 atm from a volume of 10.0 L to 2.0 L. If the gas absorbs 250 J of heat from the surroundings. What are the values of q, w and \( \Delta E \) (in J)?

<table>
<thead>
<tr>
<th></th>
<th>q</th>
<th>w</th>
<th>( \Delta E )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>+250</td>
<td>+20265</td>
<td>+20515</td>
</tr>
<tr>
<td>B</td>
<td>+250</td>
<td>-18238</td>
<td>-17988</td>
</tr>
<tr>
<td>C</td>
<td>-250</td>
<td>+20265</td>
<td>+20015</td>
</tr>
<tr>
<td>D</td>
<td>+250</td>
<td>+18238</td>
<td>+18488</td>
</tr>
</tbody>
</table>

3. The solubility of nitrogen gas at 25°C and 522 mmHg is 4.7×10⁻⁴ mol/L. What is the value of Henry's law constant at 25°C in mol/L??
   A) 6.8×10⁻⁴ B) 7.5×10⁻⁴ C) 8.2×10⁻⁴ D) 3.8×10⁻⁴

4. Heptane (C₇H₁₆) has a vapor pressure of 792 torr at 100°C. At this same temperature, octane (C₈H₁₈) has a vapor pressure of 352 torr. What will be the vapor pressure in torr of an ideal solution prepared from 25.0 g of heptane and 85.5 g of octane at 100°C?
   A) 653 B) 564 C) 462 D) 418

5. The vapor pressure of water at 20°C is 17.5 mmHg. What is the vapor pressure over a solution prepared from 200.0 g of table sugar (C₁₂H₂₂O₁₁) and 350.0 g water (in mmHg) at 20°C?
   A) 17.0 B) 16.5 C) 16.0 D) 15.5

6. What is the freezing point (in °C) of an aqueous solution of Glucose (C₆H₁₂O₆) that has a boiling point of 102.5°C (at 1.0 atm)? For water, \( K_b = 1.86°C/m \) and \( K_b = 0.52°C/m \).
   A) -0.7 B) -8.9 C) -6.3 D) -5.8

7. 0.102 g of a nonelectrolyte dissolved in 100.0 mL water has an osmotic pressure of 28.1 mmHg at 20°C. Calculate the molar mass of this compound (in g/mol).
   A) 297 B) 396 C) 548 D) 663

8. For the hypothetical reaction:
   \[ \text{A + 3B → 2C} \]
   The rate appearance of C given by \( \Delta [C]/\Delta t \) may also be expressed as:
   A) ??? B) ??? C) ??? D) ???
9. For the reaction.

\[ \text{F}_2(\text{g}) + 2\text{Cl}_2\text{O}(\text{g}) \rightarrow 2\text{FCl}_2\text{O}(\text{g}) + \text{Cl}_2(\text{g}) \]

The following initial rates of reaction have been measured for the given reagent concentrations:

<table>
<thead>
<tr>
<th>Experiment</th>
<th>F(_2) (M)</th>
<th>Cl(_2)O (M)</th>
<th>Rate (M/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.05</td>
<td>0.010</td>
<td>5.0×10(^{-4})</td>
</tr>
<tr>
<td>2</td>
<td>0.05</td>
<td>0.040</td>
<td>2.0×10(^{-3})</td>
</tr>
<tr>
<td>3</td>
<td>0.10</td>
<td>0.010</td>
<td>1.0×10(^{-3})</td>
</tr>
</tbody>
</table>

What of the following is the rate law for this reaction?

A) \( \text{rate} = k [\text{F}_2] [\text{Cl}_2\text{O}]^2 \)
B) \( \text{rate} = k [\text{F}_2] [\text{Cl}_2\text{O}] \)
C) \( \text{rate} = k [\text{F}_2]^2 [\text{Cl}_2\text{O}]^2 \)
D) \( \text{rate} = k [\text{F}_2]^2 [\text{Cl}_2\text{O}] \)

10. A certain first order reaction A \rightarrow B is 25% complete in 42 min at 25\(^\circ\)C. What is the half life of the reaction (in min)?

A) 84
B) 92
C) 101
D) 120

11. The activation energy (E\(_a\)) for the following first-order reaction is 102 kJ/mol.

\[ \text{N}_2\text{O}_5(\text{g}) \rightarrow 2\text{NO}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \]

The value of the rate constant (k) is 1.35×10\(^{-4}\) s\(^{-1}\) at 35\(^\circ\)C. What is the value of k at 0\(^\circ\)C in s\(^{-1}\) unit?

A) 8.17×10\(^{-7}\)
B) 6.27×10\(^{-6}\)
C) 7.48×10\(^{-5}\)
D) 4.2×10\(^{-4}\)

12. Consider the two gaseous equilibria:

\[ \text{SO}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightleftharpoons \text{SO}_3(\text{g}) \]

\[ 2\text{SO}_3(\text{g}) \rightleftharpoons 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \]

The values of the equilibrium constants K\(_1\) and K\(_2\) are related by:

A) \( K_2 = (K_1)^2 \)
B) \( (K_2)^2 = K_1 \)
C) \( K_2 = (K_1)^{-2} \)
D) \( K_2 = (K_1)^{-1} \)

13. What are the values of K\(_p\) and K\(_c\) for the reaction:

\[ \text{H}_2\text{O}(l) = \text{H}_2\text{O}(g) \] at 25\(^\circ\)C?

Given the vapor pressure of water at 25\(^\circ\)C is 23.8 torr.

A) 2.38×10\(^{-2}\) atm, 5.82×10\(^{-1}\) mol/L
B) 2.38×10\(^{-2}\) atm, 9.73×10\(^{-5}\) mol/L
C) 3.13×10\(^{-2}\) atm, 7.66×10\(^{-1}\) mol/L
D) 3.13×10\(^{-2}\) atm, 1.28×10\(^{-3}\) mol/L

14. Hydrogen iodide decomposes according to:

\[ 2\text{HI}(\text{g}) = \text{H}_2(\text{g}) + \text{I}_2(\text{g}) \]

K\(_c\) = 0.0156 at 400\(^\circ\)C
A 0.550 mol sample of HI was injected in a 2.0 L reaction vessel held at 400°C. Calculate (in mol/L) the concentration of H₂ at equilibrium?

A) 0.055  B) 0.0275  C) 0.275  D) 0.22

15. For the reaction at equilibrium, which one of the changes below would cause the equilibrium to shift to the left:

\[ 2\text{NOBr}(g) \rightleftharpoons 2\text{NO}(g) + \text{Br}_2(g) \]  \hspace{1cm} \Delta H^\circ = 30 \text{ kJ}

A) Remove some NO  
B) Add more NOBr  
C) Compress the gas mixture to a smaller volume  
D) Increase the temperature