Question #: 1

Select the two oxidation-reduction reactions.

A. \(3\text{K}_2\text{S(aq)} + 2\text{Fe(NO}_3\text{)}_3(aq) \rightarrow \text{Fe}_2\text{S}_3(s) + 6\text{KNO}_3(aq)\)
B. \(2\text{NaOH(aq)} + \text{H}_2\text{SO}_4(aq) \rightarrow \text{Na}_2\text{SO}_4(aq) + 2\text{H}_2\text{O(l)}\)
C. \(2\text{CH}_3\text{OH(l)} + 3\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 4\text{H}_2\text{O(l)}\)
D. \(2\text{AgNO}_3(aq) + \text{Cu(s)} \rightarrow \text{Cu(NO}_3\text{)}_2(aq) + 2\text{Ag(s)}\)
E. \(\text{AgNO}_3(aq) + \text{NaCl(aq)} \rightarrow \text{AgCl(s)} + \text{NaNO}_3(aq)\)

Question #: 2

Determine the oxidation number of each element in \(\text{Cr(NO}_2\text{)}_2\).

Enter a number and a sign (+ or –) for each answer.

Oxidation number of \(\text{Cr} = 1\)
Oxidation number of \(\text{N} = 2\)
Oxidation number of \(\text{O} = 3\)

1. __________  
2. __________  
3. __________

Question #: 3

For the reaction
\(\text{Na(s)} + \text{H}_2\text{O(l)} \rightarrow \text{NaOH(aq)} + \text{H}_2(g)\)

A. Na loses an electron and is oxidized.  
B. Na gains an electron and is oxidized.  
C. Na loses an electron and is reduced.  
D. Na gains an electron and is reduced.
**Question #: 4**

Consider the reaction
\[ \text{MnO}_2 + 4 \text{HCl} \rightarrow \text{MnCl}_2 + \text{Cl}_2 + 2 \text{H}_2\text{O} \]
How many moles of HCl are required to react completely with 0.35 moles \( \text{MnO}_2 \)?

\[ 1 \text{ mol HCl} \]

Report your answer with **two** significant figures. Do **NOT** include units in your answer. For numbers in scientific notation, use the format \( 2.2\text{E}2 \) or \( 2.2\text{E}-2 \).

1. 

____________________________________________________________________________

**Question #: 5**

For the reaction \( \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} \)
How many grams \( \text{C}_6\text{H}_12\text{O}_6 \), will produce 3.0 moles of \( \text{CO}_2 \)?

A. 90. g  
B. 180 g  
C. 360 g  
D. 45 g

____________________________________________________________________________

**Question #: 6**

Glucose reacts with oxygen according to the reaction:
\[ \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} \]
If 2.0 moles of \( \text{C}_6\text{H}_12\text{O}_6 \) reacts with 4.0 moles of \( \text{O}_2 \), what is the limiting reactant?  

1 [glucose, oxygen]

How many moles of the excess reactant remains after the reaction is completed?  

\[ 2 \text{ mol} \]

Report your answer with **two** significant figures. Do **NOT** include units in your answer. For numbers in scientific notation, use the format \( 2.2\text{E}2 \) or \( 2.2\text{E}-2 \).

1. 
2. 

____________________________________________________________________________
Question #: 7

For the reaction \( C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O \)
If the percent yield for the reaction is 75%, what is the actual yield of \( CO_2 \), in moles, when 0.50 moles of \( C_6H_{12}O_6 \) reacts with an excess of \( O_2 \)?

A. 4.1 mol  
B. 3.0 mol  
C. 0.12 mol  
D. 2.3 mol

---

Question #: 8

Examine the four problems below. Select the two problems for which \( M_1V_1 = M_2V_2 \) can be used.

A. Calculate the molarity of \( H_2SO_4 \) if 15.0 mL of \( H_2SO_4 \) is titrated with 25.0 mL of 0.100 M \( NaOH \).
B. Calculate the molarity of \( HCl \) if 25.0 mL of water is added to 10.0 mL of the \( HCl \).
C. Calculate the volume of 8.0 M \( KOH \) needed to make 500 mL of 0.25 M \( KOH \).
D. What volume of 0.25 M \( Ba(OH)_2 \) is required to completely react with 15.0 mL of 0.15 M \( HNO_3 \)?

---

Question #: 9

Determine the molarity of \( Fe^{2+} \) in a solution of \( Fe(NO_3)_2(aq) \), if 10.0 mL of the iron solution is titrated with 15.5 mL of 0.100 M \( MnO_4^- \) to reach the end-point. The reaction equation is provided below.

\( 5Fe^{2+}(aq) + MnO_4^- (aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l) \)

A. 0.500 M  
B. 0.775 M  
C. 0.155 M  
D. 0.215 M
Question #: 10

Energy is the capacity to do __1__.  

1. __________

Question #: 11

What is potential energy?

A. The energy of an object's motion and position.  
B. The energy from moving charged particles.  
C. The energy stored due to an object's position or state.  
D. The energy of an object in motion.

Question #: 12

Identify the principal type of energy exhibited by each of the following. Choose between the words kinetic or potential.
A car parked on a hill. __1__
A falling rock. __2__
Chemical energy. __3__

1. __________
2. __________
3. __________

Question #: 13

Select the true statement

A. Work is a state function because its value is path dependent.  
B. Heat is not a state function because its value is path independent.  
C. Total internal energy is not a state function because its value is not path dependent.  
D. Volume is a state function because its value in not path dependent.
Question #: 14

The change in internal energy is equal to

A. heat plus work.
B. work minus heat.
C. volume times change in pressure.
D. change in enthalpy under all conditions.

Question #: 15

A system does 566 kJ of work and loses 256 kJ of heat to the surroundings.
What is the sign of work? 1 [+ or -]
What is the sign of heat? 2 [+ or -]

1. __________
2. __________

Question #: 16

A gas expands from 1.0 L to 9.0 L against an external pressure of 2.0 atm. Calculate the work of the system (the gas), in kJ, as it expands.

$101.3 \text{ J} = 1 \text{ L/atm}$.

In blank (1), put only the sign [+ or -] of the work, in blank (2), put the numerical value (without the sign). Report your answer with two significant figures. Do NOT include units in your answer. For numbers in scientific notation, use the format 2.2E2 or 2.2E-2.

1. __________
2. __________
**Question #**: 17

Put in the **letter** to match the name, symbol and unit with the definitions provided. You may need to scroll down to see all of the provided information.

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<td>J</td>
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<tr>
<td>Energy required to raise the temperature of one gram by one degree Celsius.</td>
<td>3</td>
<td>Cs</td>
<td>4</td>
</tr>
<tr>
<td>(m \times Cs)</td>
<td>5</td>
<td>C</td>
<td>6</td>
</tr>
</tbody>
</table>

Choose from these terms in the table below. **Remember, put only the letter (A - J). You will not use all letters.**

- **A** heat
- **B** specific heat capacity
- **C** heat capacity
- **D** q
- **E** w
- **F** J/°C
- **G** J/(g°C)
- **H** K
- **I** kJ
- **J** J

\(J/°C\)

1. ______
2. ______
3. ______
4. ______
5. ______
6. ______

**Question #:** 18

A 41.0 g sample of a substance is initially at 27.5 °C. After absorbing 942 J of heat, the temperature of the substance is 72.4 °C. What is the specific heat capacity of the substance?

A. 0.512 J/(g°C)
B. 1.95 g°C/J
C. 21.0 J/°C
D. 0.421 J/(g°C)
E. 0.501 g°C/J
F. 2.21 J/°C
Question #: 19

Consider the energy diagram for the reaction: reactants → products. You may need to scroll down to see the entire question.

The reaction is 1 [endothermic or exothermic].
In blank(2) include the put only the sign [+] or [-]. In blank (3), report the value as a whole number without the sign. Do not include units in your answer.
The energy change is 2 3 kJ/mol.

1. __________
2. __________
3. __________

Question #: 20

Consider the reaction
H₂(g) + Cl₂(g) → 2 HCl(g) \[ \Delta H = -184.6 \text{ kJ} \]
Select the true statement if 0.150 moles of Cl₂ reacts with an excess of H₂.

A. 1230 kJ of heat is released.
B. 1230 kJ of heat is absorbed.
C. 27.7 kJ of heat is released.
D. 27.7 kJ of heat is absorbed.
Question #: 21

Consider the reaction
\[ \text{H}_2(g) + \text{Cl}_2(g) \rightarrow 2 \text{HCl}(g) \quad \Delta H = -184.6 \text{ kJ} \]
In a certain experiment, it is determined that the surroundings absorbed 595 kJ. How many grams of HCl were formed? The molar mass of HCl = 36.46 g/mol.

1. \[ \text{g HCl} \]

Report your answer with **three** significant figures. Do **NOT** include units in your answer. For numbers in scientific notation, use the format 2.22E2 or 2.22E-2.

Question #: 22

Consider the reaction: \[ \text{H}_2(g) + \text{Cl}_2(g) \rightarrow 2 \text{HCl}(g) \quad \Delta H = -184.6 \text{ kJ} \]
Determine \( \Delta H \) for the reaction
\[ \text{HCl}(g) \rightarrow \frac{1}{2} \text{H}_2(g) + \frac{1}{2} \text{Cl}_2(g) \]

A. 184.6 kJ
B. \(-184.6 \text{ kJ}\)
C. \(-92.3 \text{ kJ}\)
D. 92.3 kJ
E. \(-369.2 \text{ kJ}\)
F. 369.2 kJ
Consider the diagram below

The image is an example of a constant \( \text{1} \) [pressure, volume] calorimeter. A salt MX is dissolved in water and the temperature of the solution increases. Therefore, the heat of the reaction:

\[
\text{MX(s)} \rightarrow \text{M}^{+}(aq) + \text{X}^{-}(aq)
\]

is \( \text{2} \) [endothermic, exothermic]

The \( q_{\text{rxn}} \text{3} \) [is, is not] equal to \( \Delta H_{\text{rxn}} \).

1. __________
2. __________
3. __________
Question #: 24

Consider the image below and select the **two true** statements.

A. The device is used to determine heat transferred in a combustion reaction.
B. Heat is absorbed by the system (the reaction) from the water.
C. The reaction takes place under constant volume conditions.
D. All heat given off by the reaction is absorbed by only the water.

____________________________________________________________________________

Question #: 25

A 0.473 mol sample of ethanol (C₂H₅OH) is burned in a bomb calorimeter, according to the following reaction equation. If the temperature of the calorimeter rises from 13.0 °C to 79.3 °C, what is the heat capacity of the calorimeter?

\[ \text{C}_2\text{H}_5\text{OH}(l) + 3\text{ O}_2(g) \rightarrow 2\text{ CO}_2(g) + 3\text{ H}_2\text{O}(g) \quad \Delta H^{\circ}_{\text{rxn}} = -1235 \text{ kJ} \]

A. 6.63 kJ/°C
B. 32.7 kJ/°C
C. 8.81 kJ/°C
D. 18.2 kJ/°C
Select the **two** oxidation-reduction reactions.

A. \(3K_2S(aq) + 2Fe(NO_3)_3(aq) \rightarrow Fe_2S_3(s) + 6KNO_3(aq)\)
B. \(2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)\)
C. \(2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(l)\)
D. \(2AgNO_3(aq) + Cu(s) \rightarrow Cu(NO_3)_2(aq) + 2Ag(s)\)
E. \(AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)\)

**Question #2:**

Determine the oxidation number of each element in \(Cr(NO_2)_2\).

Enter a number **and** a sign (+ or −) for each answer.

Oxidation number of Cr = ___
Oxidation number of N = \[\boxed{2}\]
Oxidation number of O = \[\boxed{3}\]

1. +2
2. +3
3. -2

Question #: 3

For the reaction
\[\text{Na}(s) + \text{H}_2\text{O}(l) \rightarrow \text{NaOH}(aq) + \text{H}_2(g)\]

\[\checkmark\] A. Na loses an electron and is oxidized.
B. Na gains an electron and is oxidized.
C. Na loses an electron and is reduced.
D. Na gains an electron and is reduced.

Question #: 4

Consider the reaction
\[\text{MnO}_2 + 4 \text{HCl} \rightarrow \text{MnCl}_2 + \text{Cl}_2 + 2 \text{H}_2\text{O}\]

How many moles of HCl are required to react completely with 0.35 moles MnO\(_2\)?

\[\boxed{1.4}\]

Question #: 5

For the reaction
\[\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}\]

How many grams \(\text{C}_6\text{H}_{12}\text{O}_6\), will produce 3.0 moles of CO\(_2\)?
Glucose reacts with oxygen according to the reaction:

\[ \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} \]

If 2.0 moles of \( \text{C}_6\text{H}_{12}\text{O}_6 \) reacts with 4.0 moles of \( \text{O}_2 \), what is the limiting reactant? 1 [glucose, oxygen]

How many moles of the excess reactant remains after the reaction is completed? 2 mol

Report your answer with two significant figures. Do NOT include units in your answer. For numbers in scientific notation, use the format \( 2.2\text{E}2 \) or \( 2.2\text{E}-2 \).

1. oxygen|O2|
2. 1.3

For the reaction \( \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} \)

If the percent yield for the reaction is 75%, what is the actual yield of \( \text{CO}_2 \), in moles, when 0.50 moles of \( \text{C}_6\text{H}_{12}\text{O}_6 \) reacts with an excess of \( \text{O}_2 \)?

A. 4.1 mol
B. 3.0 mol
C. 0.12 mol
D. 2.3 mol

Examine the four problems below. Select the two problems for which \( M_1V_1 = M_2V_2 \) can be used.
A. Calculate the molarity of H$_2$SO$_4$ if 15.0 mL of H$_2$SO$_4$ is titrated with 25.0 mL of 0.100 M NaOH.
✓B. Calculate the molarity of HCl if 25.0 mL of water is added to 10.0 mL of the HCl.
✓C. Calculate the volume of 8.0 M KOH needed to make 500 mL of 0.25 M KOH.
D. What volume of 0.25 M Ba(OH)$_2$ is required to completely react with 15.0 mL of 0.15 M HNO$_3$?

Question #: 9

Determine the molarity of Fe$^{2+}$ in a solution of Fe(NO$_3$)$_2$ (aq), if 10.0 mL of the iron solution is titrated with 15.5 mL of 0.100 M MnO$_4^-$ to reach the end-point. The reaction equation is provided below.

$$5\text{Fe}^{2+}(aq) + \text{MnO}_4^-(aq) + 8\text{H}^+(aq) \rightarrow 5\text{Fe}^{3+}(aq) + \text{Mn}^{2+}(aq) + 4\text{H}_2\text{O}(l)$$

A. 0.500 M
✓B. 0.775 M
C. 0.155 M
D. 0.215 M

Question #: 10

Energy is the capacity to do 1.

1. work

Question #: 11

What is potential energy?

A. The energy of an object's motion and position.
B. The energy from moving charged particles.
✓C. The energy stored due to an object's position or state.
D. The energy of an object in motion.
Question #: 12

Identify the principal type of energy exhibited by each of the following. Choose between the words kinetic or potential.
A car parked on a hill.  1
A falling rock.  2
Chemical energy.  3

1. potential|potential energy|
2. kinetic|kinetic energy|
3. potential|potential energy|

Question #: 13

Select the true statement

A. Work is a state function because its value is path dependent.
B. Heat is not a state function because its value is path independent.
C. Total internal energy is not a state function because its value is not path dependent.
✓D. Volume is a state function because its value is not path dependent.

Question #: 14

The change in internal energy is equal to

✓A. heat plus work.
B. work minus heat.
C. volume times change in pressure.
D. change in enthalpy under all conditions.

Question #: 15

A system does 566 kJ of work and loses 256 kJ of heat to the surroundings.
What is the sign of work?  1 [+ or -]
What is the sign of heat?  

1. -
2. -

**Question #1: 16**

A gas expands from 1.0 L to 9.0 L against an external pressure of 2.0 atm. Calculate the work of the system (the gas), in kJ, as it expands.

101.3 J = 1 L/atm.

In blank (1), put **only the sign** [+ or -] of the work, in blank (2), put the **numerical** value (without the sign). Report your answer with **two** significant figures. Do **NOT** include units in your answer. For numbers in scientific notation, use the format 2.2E2 or 2.2E-2.

1. -
2. 1.6 kJ

**Question #17**

Put in the **letter** to match the name, symbol and unit with the definitions provided. You may need to scroll down to see all of the provided information.

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<td>6</td>
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Choose from these terms in the table below. **Remember, put only the letter (A - J).** You will not use all letters.

- A heat
- B specific heat capacity
- C heat capacity
Question #: 18

A 41.0 g sample of a substance is initially at 27.5 °C. After absorbing 942 J of heat, the temperature of the substance is 72.4 °C. What is the specific heat capacity of the substance?

✓ A. 0.512 J/(g°C)
B. 1.95 g°C/J
C. 21.0 J/°C
D. 0.421 J/(g°C)
E. 0.501 g°C/J
F. 2.21 J/°C

Question #: 19

Consider the energy diagram for the reaction: reactants → products. You may need to scroll down to see the entire question.
The reaction is [endothermic or exothermic].

In blank(2) include the put only the sign [± or -]. In blank (3), report the value as a whole number without the sign. Do not include units in your answer.

The energy change is 2 3 kJ/mol.

1. endothermic
2. +
3. 75

Question #: 20

Consider the reaction

\[ \text{H}_2(g) + \text{Cl}_2(g) \rightarrow 2 \text{HCl}(g) \quad \Delta H = -184.6 \text{ kJ} \]

Select the true statement if 0.150 moles of Cl$_2$ reacts with an excess of H$_2$.

A. 1230 kJ of heat is released.
B. 1230 kJ of heat is absorbed.
C. 27.7 kJ of heat is released.  
✓C. 27.7 kJ of heat is released.
D. 27.7 kJ of heat is absorbed.

Question #: 21
Consider the reaction

\[ \text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2 \text{HCl}(\text{g}) \quad \Delta H = -184.6 \text{ kJ} \]

In a certain experiment, it is determined that the surroundings absorbed 595 kJ. How many grams of HCl were formed? The molar mass of HCl = 36.46 g/mol.

\[ 1 \text{ g HCl} \]

Report your answer with **three** significant figures. Do **NOT** include units in your answer. For numbers in scientific notation, use the format 2.22E2 or 2.22E-2.

1. 235

---

**Question #: 22**

Consider the reaction: \( \text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2 \text{HCl}(\text{g}) \quad \Delta H = -184.6 \text{ kJ} \)

Determine \( \Delta H \) for the reaction

\( \text{HCl}(\text{g}) \rightarrow \frac{1}{2}\text{H}_2(\text{g}) + \frac{1}{2}\text{Cl}_2(\text{g}) \)

A. 184.6 kJ
B. \(-184.6 \text{ kJ}\)
C. \(-92.3 \text{ kJ}\)
D. \(92.3 \text{ kJ}\)

✓D. 92.3 kJ
E. \(-369.2 \text{ kJ}\)
F. 369.2 kJ

---

**Question #: 23**

Consider the diagram below
The image is an example of a constant pressure calorimeter. A salt MX is dissolved in water and the temperature of the solution increases. Therefore, the heat of the reaction:

\[ \text{MX}(s) \rightarrow \text{M}^+(aq) + \text{X}^-(aq) \]

is [endothermic, exothermic]

The \( q_{\text{rxn}} \) [is, is not] equal to \( \Delta H_{\text{rxn}} \).

1. pressure
2. exothermic
3. is

---

**Question #: 24**

Consider the image below and select the **two true** statements.
A. The device is used to determine heat transferred in a combustion reaction.
B. Heat is absorbed by the system (the reaction) from the water.
✓C. The reaction takes place under constant volume conditions.
D. All heat given off by the reaction is absorbed by only the water.

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A 0.473 mol sample of ethanol (C₂H₅OH) is burned in a bomb calorimeter, according to the following reaction equation. If the temperature of the calorimeter rises from 13.0 °C to 79.3 °C, what is the heat capacity of the calorimeter?

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\text{C}_2\text{H}_5\text{OH}(l) + 3 \text{O}_2(g) \rightarrow 2 \text{CO}_2(g) + 3 \text{H}_2\text{O}(g) \quad \Delta H_{\text{rxn}}^\circ = -1235 \text{ kJ}
\]

A. 6.63 kJ/°C
B. 32.7 kJ/°C
✓C. 8.81 kJ/°C
D. 18.2 kJ/°C