

Deep Run High School

CHEMISTRY I: 1(A), 5(A), 7(A)

Unit 10 Test

Instructor: Jennifer Krug

Name: _____

Score: / 100

Question 1

/1

What is the equilibrium constant for the combustion reaction below?



☐
$$K_{eq} = \frac{[\text{C}_4\text{H}_{10}]^2 [\text{O}_2]^{13}}{[\text{CO}_2]^8 [\text{H}_2\text{O}]^{10}}$$

☐
$$K_{eq} = \frac{8 [\text{CO}_2] + 10 [\text{H}_2\text{O}]}{2 [\text{C}_4\text{H}_{10}] + 13 [\text{O}_2]}$$

☐
$$K_{eq} = \frac{[\text{CO}_2]^8 [\text{H}_2\text{O}]^{10}}{[\text{O}_2]^{13}}$$

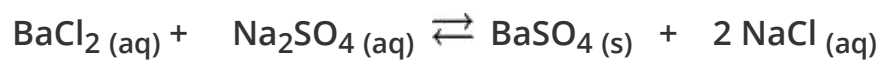
☐
$$K_{eq} = \frac{[\text{C}_4\text{H}_{10}]^2 [\text{CO}_2]^8}{[\text{O}_2]^{13} [\text{H}_2\text{O}]^{10}}$$

Name: _____

Question 2

/1

What is the correct equilibrium expression for the reaction shown below:



☐ $K_{eq} = \frac{[\text{BaCl}_2][\text{Na}_2\text{SO}_4]}{[\text{NaCl}]^2}$

☐ $K_{eq} = \frac{[\text{NaCl}]^2}{[\text{BaCl}_2][\text{Na}_2\text{SO}_4]}$

☐ $K_{eq} = \frac{[\text{BaCl}_2][\text{Na}_2\text{SO}_4]}{[\text{BaSO}_4][\text{NaCl}]^2}$

☐ $K_{eq} = \frac{[\text{BaSO}_4][\text{NaCl}]^2}{[\text{BaCl}_2][\text{Na}_2\text{SO}_4]}$

Name: _____

Question 3

/1

Which of the following salts is the least soluble in water at 25 °C?

Solubility Products @ 25°C	
Substance	K_{sp}
MnCO ₃	1.82×10^{-11}
NiCO ₃	6.61×10^{-9}
PbCl ₂	1.62×10^{-5}
PbI ₂	1.39×10^{-8}

☐ MnCO₃

☐ PbCl₂

☐ PbI₂

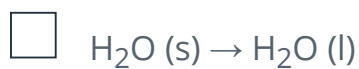
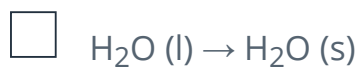
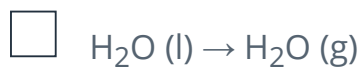
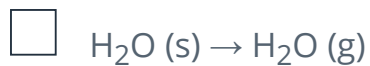
☐ NiCO₃

Name: _____

Question 4

/1

Which of the following exhibits the greatest decrease in entropy?



Question 5

/1

Which of the following will exhibit the fastest rate of reaction?

☐ Adding a whole antacid tablet to a solution of 1.0 M HCl

☐ Adding powdered antacid tablet to a solution of 1.0 M HCl

☐ Adding two antacid tablets to a solution of 1.0 M HCl

☐ Adding broken pieces of an antacid tablet to a solution of 1.0 M HCl

Name: _____

Question 6

/1

All of the following are characteristics of a catalyst *EXCEPT*

- ☐ A catalyst can either be a reactant or a product in a chemical reaction.
- ☐ A catalyst is chemically unchanged at the end of the reaction.
- ☐ A catalyst can be used to increase the rate of a chemical reaction.
- ☐ A catalyst lowers the activation energy by bringing the reactants together.

Question 7

/1

Which of the following will cause an increase in temperature inside the reaction chamber?



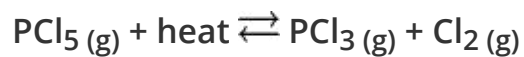
- ☐ Removing the nitrogen gas.
- ☐ Adding oxygen gas.
- ☐ Increasing the pressure.
- ☐ Removing nitrogen monoxide gas.

Name: _____

Question 8

/1

Which of the following will cause a decrease in the equilibrium concentration of Cl_2 gas?

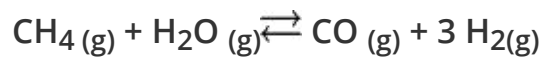


- ☐ The removal of PCl_3 gas
- ☐ A decrease in temperature
- ☐ An increase in temperature
- ☐ The addition of PCl_5 gas

Question 9

/1

Which of the following changes will occur when carbon monoxide gas is added to the reaction chamber?



- ☐ No change will occur.
- ☐ Hydrogen gas will increase.
- ☐ Methane gas will increase.
- ☐ Water vapor will decrease.

Name: _____

Question 10

/1

For which set of values of ΔH and ΔS will a reaction be spontaneous (thermodynamically favorable) at all temperatures?

☐

$\Delta H = +10 \text{ kJ/mol}$; $\Delta S = +5 \text{ J/K mol}$

☐

$\Delta H = -10 \text{ kJ/mol}$; $\Delta S = -5 \text{ J/K mol}$

☐

$\Delta H = +10 \text{ kJ/mol}$; $\Delta S = -5 \text{ J/K mol}$

☐

$\Delta H = -10 \text{ kJ/mol}$; $\Delta S = +5 \text{ J/K mol}$

Question 11

/1

For an exothermic reaction,

☐

ΔG is always positive.

☐

ΔH is always negative.

☐

ΔS is always positive.

☐

All the above.

Question 12

/1

How many calories are in 100.0 Joules? (*Show your answer using the proper number of significant figures.*) _____

Name: _____

Question 13

/1

According to the Law of Energy Conservation, if the heat energy absorbed equals +250 calories, then the heat energy transferred will equal _____ calories.

Question 14

/1

Which equation shows the correct way to calculate the enthalpy?

☐ $\Delta H = \text{Products} + \text{Reactants}$

☐ $\Delta H = \text{Products} \div \text{Reactants}$

☐ $\Delta H = \text{Products} - \text{Reactants}$

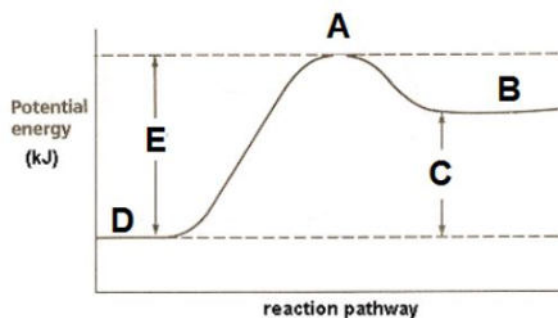
☐ $\Delta H = \text{Products} \times \text{Reactants}$

Name: _____

Question 15

/1

Which letter represents the forward activation energy?



Question 16

/1

Which of the following is considered an endothermic reaction?

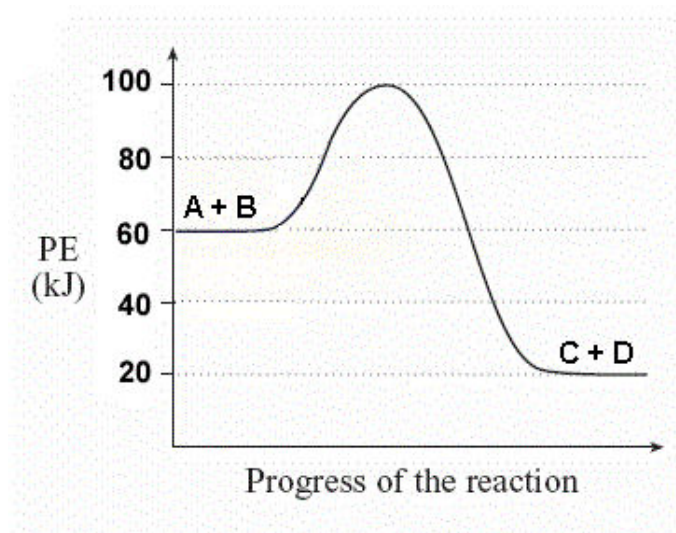
- ☐ $\text{P}_4(\text{s}) + 6 \text{Cl}_2(\text{g}) \rightarrow 4 \text{PCl}_3(\text{g}) + 1224 \text{ kJ}$
- ☐ $2 \text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2 \text{CO}(\text{g}) + 221 \text{ kJ}$
- ☐ $2 \text{H}_2\text{O}(\text{l}) + 572 \text{ kJ} \rightarrow 2 \text{H}_2(\text{g}) + 1 \text{O}_2(\text{g})$
- ☐ $1 \text{H}_2(\text{g}) + 1 \text{Br}_2(\text{l}) \rightarrow 2 \text{HBr}(\text{g}) + 72.8 \text{ kJ}$

Name: _____

Question 17

/1

Based on the diagram below, this reaction would be classified as



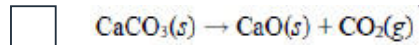
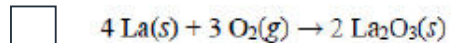
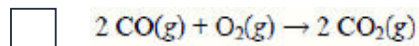
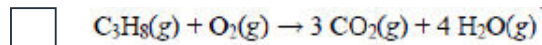
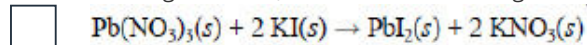
- ☐ an endothermic reaction
- ☐ a precipitation reaction
- ☐ a synthesis reaction
- ☐ an exothermic reaction

Name: _____

Question 18

/1

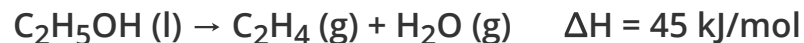
Of the following reactions, which involves the largest decrease in entropy?



Question 19

/1

Calculate the entropy for the following reaction at 25 °C.



(Notice: $\Delta S = \Delta H/T$ but has units of J/mol·K so make sure units match.)

☐ 1800 J/mol·K

☐ 151 J/mol·K

☐ 165 J/mol·K

☐ 1.8 J/mol·K

Name: _____

Question 20

/1

Ch. 5e

Molar Heat of Vaporization

H ₂ O	40.7 kJ/mole
NH ₃	23.4 kJ/mole

Water and ammonia have different molar heats of vaporization. The best interpretation, at the molecular level, is that water molecules —

- ☐ have stronger intermolecular attractions
- ☐ set up stronger repulsive nuclear forces
- ☐ collide more frequently with each other
- ☐ occupy larger molecular volumes

Question 21

/1

Molar Heat of Fusion and Melting Point for Selected Substances

Substance	Melting Point (°C)	ΔH_{fus} (kJ/mol)
Argon	-190	1.18
Benzene	5.5	9.87
Mercury	-39	2.29
Water	0	6.01

Which substance in the table above will release the greatest amount of heat when 1.00 mol is frozen?

- ☐ argon
- ☐ water
- ☐ mercury
- ☐ benzene

Name: _____

Question 22

/1

The compounds ethyne, ethene and ethane contain, respectively, $\text{C}\equiv\text{C}$, $\text{C}=\text{C}$ and $\text{C}-\text{C}$ bonds. What is the expected sequence of carbon-carbon bond lengths and bond enthalpies?

☐

Bond lengths: $\text{C}\equiv\text{C} > \text{C}=\text{C} > \text{C}-\text{C}$; bond enthalpies: $\text{C}\equiv\text{C} < \text{C}=\text{C} < \text{C}-\text{C}$.

☐

Bond lengths: $\text{C}\equiv\text{C} < \text{C}=\text{C} < \text{C}-\text{C}$; bond enthalpies: $\text{C}\equiv\text{C} > \text{C}=\text{C} > \text{C}-\text{C}$.

☐

Bond lengths: $\text{C}\equiv\text{C} < \text{C}=\text{C} < \text{C}-\text{C}$; bond enthalpies: $\text{C}\equiv\text{C} < \text{C}=\text{C} < \text{C}-\text{C}$.

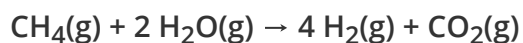
☐

Bond lengths: $\text{C}\equiv\text{C} > \text{C}=\text{C} > \text{C}-\text{C}$; bond enthalpies: $\text{C}\equiv\text{C} > \text{C}=\text{C} > \text{C}-\text{C}$.

Question 23

/1

Calculate the ΔH_{rxn} using the given bond energies:



Average Bond Energies

H - H 436 kJ/mol

O - H 464 kJ/mol

H - C 414 kJ/mol

C = O 799 kJ/mol

☐

-357 kJ/mol

☐

-170 kJ/mol

☐

-2110 kJ/mol

☐

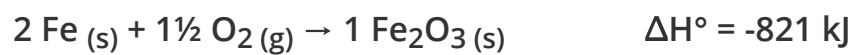
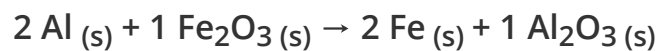
+170 kJ/mol

Name: _____

Question 24

/1

Calculate the value of ΔH° for the reaction below:



☐ -2422 kJ

☐ -780 kJ

☐ +1625 kJ

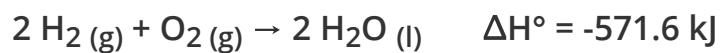
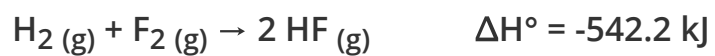
☐ -1211 kJ

Name: _____

Question 25

/1

Calculate the value of ΔH° for the reaction: $2 \text{F}_2 (\text{g}) + 2 \text{H}_2\text{O} (\text{l}) \rightarrow 4 \text{HF} (\text{g}) + \text{O}_2 (\text{g})$.



☐ -1084 kJ

☐ -1656 kJ

☐ -512 kJ

☐ -1114 kJ

Instructions for grading: Grade each question and tally the score to obtain the total test points. If the factor does not equal 1, multiply the total points by the factor to obtain the student's final score.

Question 1

What is the equilibrium constant for the combustion reaction below?

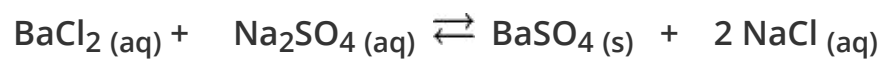


$$K_{eq} = \frac{[\text{CO}_2]^8 [\text{H}_2\text{O}]^{10}}{[\text{O}_2]^{13}}$$

1 possible pts.

Question 2

What is the correct equilibrium expression for the reaction shown below:



$$K_{eq} = \frac{[\text{NaCl}]^2}{[\text{BaCl}_2][\text{Na}_2\text{SO}_4]}$$

1 possible pts.

Question 3

Which of the following salts is the least soluble in water at 25 °C?

Solubility Products @ 25°C	
Substance	K_{sp}
$MnCO_3$	1.82×10^{-11}
$NiCO_3$	6.61×10^{-9}
$PbCl_2$	1.62×10^{-5}
PbI_2	1.39×10^{-8}

☐ $MnCO_3$

1 possible pts.

Question 4

Which of the following exhibits the greatest decrease in entropy?

☐ $H_2O(l) \rightarrow H_2O(s)$

1 possible pts.

Question 5

Which of the following will exhibit the fastest rate of reaction?

☐

Adding powdered antacid tablet to a solution of 1.0 M HCl

1 possible pts.

Question 6

All of the following are characteristics of a catalyst *EXCEPT*

☐

A catalyst can either be a reactant or a product in a chemical reaction.

1 possible pts.

Question 7

Which of the following will cause an increase in temperature inside the reaction chamber?

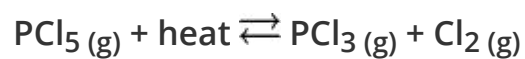
☐

Removing the nitrogen gas.

1 possible pts.

Question 8

Which of the following will cause a decrease in the equilibrium concentration of Cl_2 gas?

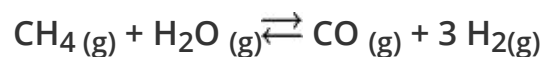


☐ A decrease in temperature

1 possible pts.

Question 9

Which of the following changes will occur when carbon monoxide gas is added to the reaction chamber?



☐ Methane gas will increase.

1 possible pts.

Question 10

For which set of values of ΔH and ΔS will a reaction be spontaneous (thermodynamically favorable) at all temperatures?

☐

$\Delta H = -10 \text{ kJ/mol}$; $\Delta S = +5 \text{ J/K mol}$

1 possible pts.

Question 11

For an exothermic reaction,

☐

ΔH is always negative.

1 possible pts.

Question 12

How many calories are in 100.0 Joules? (*Show your answer using the proper number of significant figures.*) 23.92, 23.92cal, 23.92 cal, 23.92calories, 23.92 calories

1 possible pts.

Question 13

According to the Law of Energy Conservation, if the heat energy absorbed equals +250 calories, then the heat energy transferred will equal -250, - 250, -250calories, -250 calories, -250cal, -250 cal calories.

1 possible pts.

Question 14

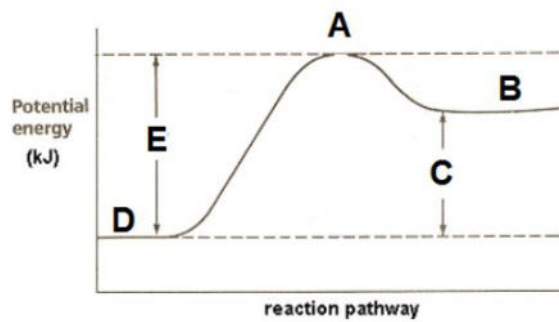
Which equation shows the correct way to calculate the enthalpy?

☐ $\Delta H = \text{Products} - \text{Reactants}$

1 possible pts.

Question 15

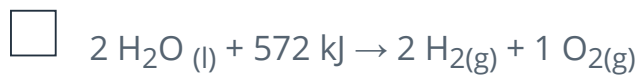
Which letter represents the forward activation energy? e, E



1 possible pts.

Question 16

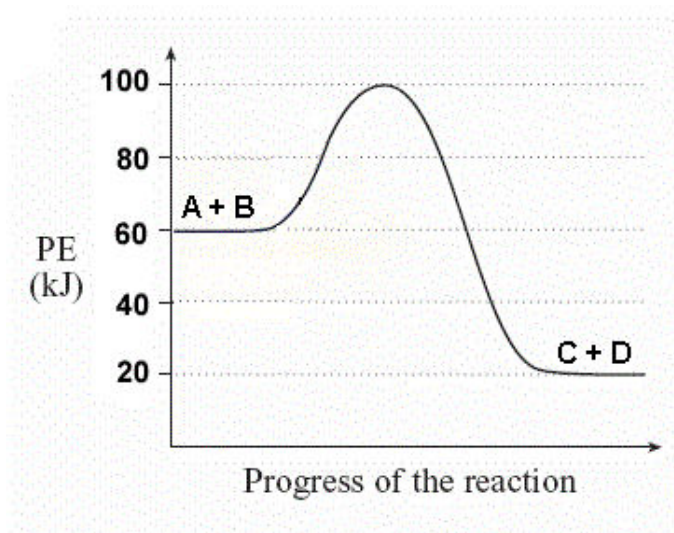
Which of the following is considered an endothermic reaction?



1 possible pts.

Question 17

Based on the diagram below, this reaction would be classified as



☐ an exothermic reaction

1 possible pts.

Question 18

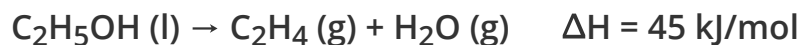
Of the following reactions, which involves the largest decrease in entropy?

☐ $4 \text{La}(s) + 3 \text{O}_2(g) \rightarrow 2 \text{La}_2\text{O}_3(s)$

1 possible pts.

Question 19

Calculate the entropy for the following reaction at 25 °C.



(Notice: $\Delta S = \Delta H/T$ but has units of J/mol·K so make sure units match.)

151 J/mol·K

1 possible pts.

Question 20

Ch. 5e

Molar Heat of Vaporization

H ₂ O	40.7 kJ/mole
NH ₃	23.4 kJ/mole

Water and ammonia have different molar heats of vaporization. The best interpretation, at the molecular level, is that water molecules —

have stronger intermolecular attractions

1 possible pts.

Question 21

**Molar Heat of Fusion and
Melting Point for Selected Substances**

Substance	Melting Point (°C)	ΔH_{fus} (kJ/mol)
Argon	-190	1.18
Benzene	5.5	9.87
Mercury	-39	2.29
Water	0	6.01

Which substance in the table above will release the greatest amount of heat when 1.00 mol is frozen?

benzene

1 possible pts.

Question 22

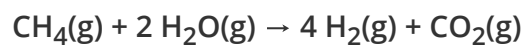
The compounds ethyne, ethene and ethane contain, respectively, $\text{C}\equiv\text{C}$, $\text{C}=\text{C}$ and $\text{C}-\text{C}$ bonds. What is the expected sequence of carbon-carbon bond lengths and bond enthalpies?

Bond lengths: $\text{C}\equiv\text{C} < \text{C}=\text{C} < \text{C}-\text{C}$; bond enthalpies: $\text{C}\equiv\text{C} > \text{C}=\text{C} > \text{C}-\text{C}$.

1 possible pts.

Question 23

Calculate the ΔH_{rxn} using the given bond energies:



Average Bond Energies

H - H 436 kJ/mol

O - H 464 kJ/mol

H - C 414 kJ/mol

C = O 799 kJ/mol

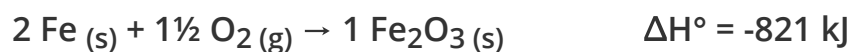
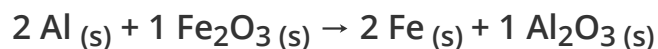


+170 kJ/mol

1 possible pts.

Question 24

Calculate the value of ΔH° for the reaction below:

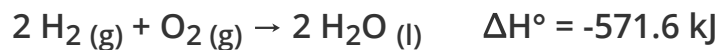
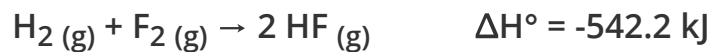


-780 kJ

1 possible pts.

Question 25

Calculate the value of ΔH° for the reaction: $2 \text{F}_2(g) + 2 \text{H}_2\text{O}(l) \rightarrow 4 \text{HF}(g) + \text{O}_2(g)$.



-512 kJ

1 possible pts.