شكراً لتحميلك هذا الملف من موقع المناهج الإماراتية

حل تجميعة أسئلة وفق الهيكل الوزاري

تاريخ نشر الملف على موقع المناهج: 2023-11-29 14:30:49

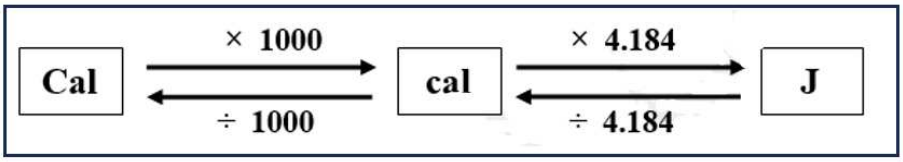
التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم

روابط مواد الصف الثاني عشر المتقدم على تلغرام

التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة كيمياء في الفصل الأول

1	حل تجميعة أسئلة وفق الهيكل الوزاري
2	مراجعة تجميعة أسئلة وفق الهيكل الوزاري
3	نموذج الهيكل الوزاري الجديد بريدج
4	ملخص الدرس الأول الطاقة من الوحدة الأولى
5	حل أسئلة الامتحان النهائي



Q1: The energy content of a single serving of bread is 70.0 Cal.
What is the energy content in calories?

- ○ 70 cal
- ○ 7×10^{2} cal
- ○ 0.07 cal
- ◉ 7×10^{4} cal

Q2: Many nutrition experts say that an average person needs 2,000 Cal per day from his or her diet.
How many joules is this?

- ◉ 8.4×10^{6} J
- ○ 0.478×10^{6} J
- ○ 8.4×10^{3} J
- ○ 2.092×10^{6} J

Q3: Which of the following statements is true about the two figures in the table below?

أي العبارات التالية صحيحة فيما يتعلق بالشكلين في الجدول أدناه؟

- ○ The energy in X is greater than in Y — ○ الطاقة في X أكبر منها في Y
- ○ The energy in Y is greater than in X — ○ الطاقة في Y أكبر منها في X
- ○ The energy in X is 355 Cal — ○ الطاقة في X تُساوي 355 Cal
- ○ The energy in Y is 3.6×10^{5} J — ○ الطاقة في Y تُساوي 3.6×10^{5} J

	
150 Cal	5.0×10^{5} J
Y	X

2	CHM.5.5.01.001.08 Describe the relationship between the specific heat capacity of a substance and the resistance to change in temperature	Textbook+ table 2 + example problem 2 + practice problems	8,9 , 10

Note: The lower the specific heat of a substance, the faster it heats or cools.

Q1: Arrange the following metals in the table according to the increase in their temperature, knowing that their masses are equal and the time of exposure to heat is constant?

Metal	Gold	Aluminum	Iron	Silver
Specific heat	0.897	0.129	0.449	0.235

* Gold < Iron < Silver < Aluminum
* Iron < Gold < Silver < Aluminum
* Aluminum < Silver < Iron < Gold
* Gold < Iron < Aluminum < Silver

Q2: which one of these units not representing the unit of specific heat?

* J/g.^{0}C
* J/g. K
* cal/g.^{0}C
* g / J.^{0}C

$$q = C \times m \times \Delta T$$

Q3: An alloy has a specific heat of 1.25 cal/g·°C at 25 °C. When it is dropped into warm water, the alloy absorbs 750 cal of heat. If the final temperature of the alloy is 75 °C, what is its mass?

- 2.4 g
- 12 g
- 24 g
- 36 g

Q4: A 4.0-gram piece of copper is heated and fashioned into a bracelet. The amount of energy transferred by heat to the copper is 6,000 J.
If the specific heat of copper is 0.40 J/g°C, what is the change in the copper's temperature?

- 24,000°C
- 3,750°C ✓
- 9,600°C
- 37.5°C

Q5: What is the energy required to raise the temperature of 250 grams of oxygen by 40°C?
The specific heat of oxygen is 0.918 (J/g·°C).

- 9,180 J ✓
- 10,000 J
- 192.78 J
- 36.72 J

Q6: Calculate the final temperature of a mixture of 100 g of water at 90°C and 600 g of water at 20°C.
Given: $c = 4.184\ J/g \cdot °C$

- ○ 55°C
- ○ 20°C
- ◉ 30°C ✓
- ○ 10.5°C

Q7: The amount of heat required to raise the temperature of one gram of any substance by one degree Celsius (1°C) is _____.

- ○ calorie
- ○ thermal energy
- ○ temperature
- ◉ specific heat

Q8: A hot 1 kg piece of copper is allowed to cool to 100°C. If the copper gave off 231 kJ of energy, what was the initial temperature of the copper?
Given: The specific heat of copper is 0.385 J/g·°C.

- ◉ 700°C ✓
- ○ 420°C
- ○ 350°C
- ○ 500°C

Q9: How much heat must be removed from 6 kg of water to cool it from 20 to 10°C?
Given: $c_{water} = 4.186 J/g \cdot °C$

- ○ 251.16 J
- ○ 502,320 J
- ◉ 251,160 J ✓
- ○ 502.32 J

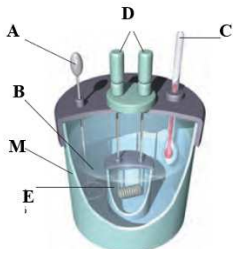
Q10: Two pieces of aluminum and iron were left to sit in the Sun at the same time and for the same length of time. What is the mass of the piece of iron (g) whose temperature increases by the same amount as the piece of aluminum?

تُركت قطعتان من الألمنيوم والحديد في الشمس في نفس الوقت ولنفس المدة الزمنية، ما كتلة قطعة الحديد (g) التي تزداد درجة حرارتها بنفس مقدار زيادة درجة حرارة قطعة الألمنيوم؟

الحديد Iron	الألمنيوم Aluminium	المادة Substance
.....	47.0 g	Mass الكتلة
0.449	0.897	الحرارة النوعية Specific Heat J/(g. °C)
30.0° C	30.0° C	ΔT

* 93.9 * 39.5 * 115.13 * 50.23

3	CHM.5.5.01.002.06 Describe the two types of calorimeter (Bomb calorimeter & Coffee-cup calorimeter)	Textbook+ figure 5&6	12 , 13



Bomb calorimeter

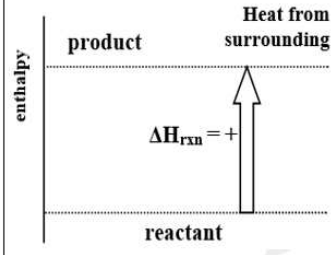
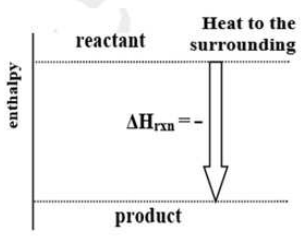
Coffee-cup calorimeter

Both two devices measure * the amount of heat (q) that has been absorbed or evolved
*** And the specific heat (c) of substances.**

The pressure within a **Coffee-cup** calorimeter is constant ,

The pressure within a **bomb** calorimeter often changes during a reaction,

4	CHM.5.5.01.004.04 Compare and contrast potential energy diagrams of exothermic and endothermic reactions in terms of general shape, enthalpy of reactants and products, activation energy of forward and backward reactions, and enthalpy of reaction and its sign	Textbook+ figures 8 ,9

Endothermic reaction	exothermic reaction
	
$A + B + heat \longrightarrow AB$	$A + B \longrightarrow AB + heat$
$A + B \longrightarrow AB \quad \Delta H_{rxn} = +$	$A + B \longrightarrow AB \quad \Delta H_{rxn} = -$
cooling the surrounding	Heating the surrounding

Q1: For an exothermic reaction, _____.

- ○ $H_{reactants} < H_{products}$
- ○ there is no relation between $H_{reactants}$ and $H_{products}$
- ◉ $H_{reactants} > H_{products}$ ✓
- ○ $H_{reactants} = H_{products}$

Q2: **1) Which of the following equations causes you to feel cold and shivering when you get out of a hot bath?**

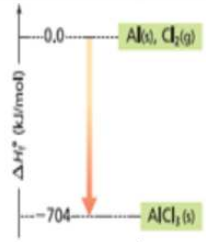
$H_2O_{(l)} + 40.7KJ \longrightarrow H_2O_{(g)}$ (*)

$H_2O_{(g)} \longrightarrow H_2O_{(l)} \quad \Delta H = -40.7KJ$ *

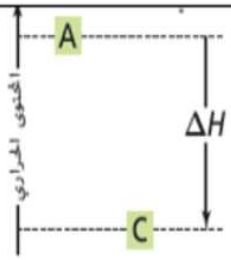
$H_2O_{(l)} \longrightarrow H_2O_{(s)} + 6.01KJ$ *

$H_2O_{(s)} \longrightarrow H_2O_{(l)} \quad \Delta H = 6.01KJ$ *

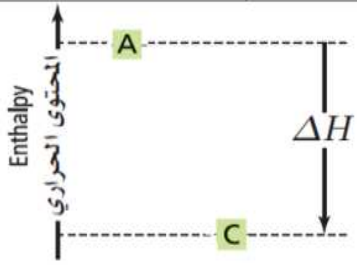
Q3:

Based on the figure below, which of the following statements is true?	بناءً على المخطط التالي، أي العبارات التالية صحيحة؟
	
A. The formation of $AlCl_3$ began at 0.0°C	A. بدأ تشكل $AlCl_3$ عند 0.0 °C
B. The final temperature of the reactants was -704°C.	B. كانت درجة الحرارة النهائية للمتفاعلات هي -704°C
C. The final temperature of the products was -704°C	C. كانت درجة الحرارة النهائية للنواتج هي -704°C
D. The formation of $AlCl_3$ releases energy.	D. يؤدي تكوين $AlCl_3$ إلى إنتاج الطاقة

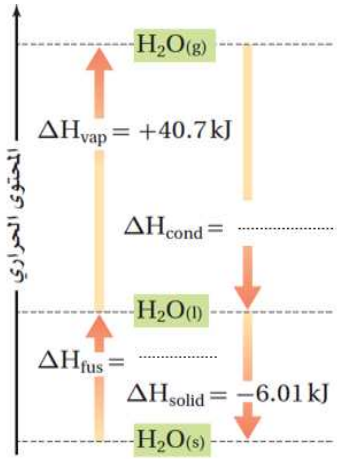
Q4:

In the below figure. Which of the following is true?	في الشكل أدناه. أي العبارات التالية صحيحة؟
	
A. The reaction is endothermic	A. التفاعل ماص للحرارة
B. The sign of ΔH is positive	B. إشارة ΔH موجبة
C. the product (A) has a lower energy than the reactant (C).	C. طاقة المواد A أقل من طاقة المواد C
D. the product (C) has a lower energy than the reactant (A).	D. طاقة المواد C أقل من طاقة المواد A

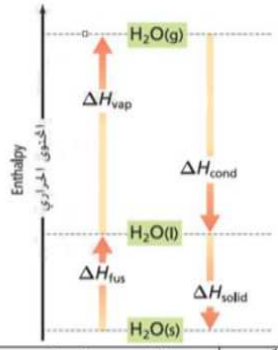
Q5:

Which of the following is correct about the reaction with the equation: $A \rightarrow C$,shown in the diagram below?	أي من التالية صحيحًا حول التفاعل ذو المعادلة: $A \rightarrow C$ الموضّح بالشكل أدناه؟
I. $\Delta H > 0$	I. $\Delta H > 0$
II. $H_{products} < H_{reactants}$	II. $H_{\text{النواتج}} < H_{\text{المتفاعلات}}$
III. Heat flows from the system to the surroundings	III. الحرارة تنتقل من النظام إلى المحيط
	
A. I only	A. I فقط
B. I and II only	B. I و II فقط
C. II and III only	C. II و III فقط
D. I and III only	D. I و III فقط

1) **Molar heat of vaporization ΔH_{vap}:**
   The heat required to vaporize one mole of liquid.
2) **Molar heat of fusion ΔH_{fus}:**
   The heat required for the fusion of one mole of a solid.
3) **Molar heat of freezing ΔH_{solid}:**
   Heat resulting from the conversion of one mole of a substance from the liquid state to the solid state.
4) **Molar heat of condensation ΔH_{cond}:** Heat resulting from the conversion of one mole of a substance from the gaseous state to the liquid state.



Q1:

Which of the following statements is not correct according to the diagram shown below?	أي العبارات التالية غير صحيحة اعتمادًا على الشكل أدناه؟
	
A. The ΔH values of the molar enthalpy of vaporization and the molar enthalpy of fusion are positive	A. تكون قيم ΔH للحرارة المولية للتبخير والحرارة المولية للانصهار موجبة
B. The ΔH values of the molar enthalpy of condensation and molar enthalpy of solidification are negative	B. تكون قيم ΔH للحرارة المولية للتكثيف والحرارة المولية للتجمد سالبة
C. The molar enthalpy of solidification and the molar enthalpy of fusion have the same numerical values but with opposite signs	C. تتساوى القيمة العددية للحرارة المولية للتجمد مع القيمة العددية للحرارة المولية للانصهار ولكن تختلف إشارتهما
D. The molar enthalpy of condensation and the molar enthalpy of vaporization have the same numerical values with same sign	D. تتساوى القيمة العددية للحرارة المولية للتكثف مع القيمة العددية للحرارة المولية للتبخير وتتشابه إشارتهما

Q2: *Select the CORRECT thermochemical equation for the vaporization of ethanol*

- (●) $C_2H_5OH(l) \rightarrow C_2H_5OH(g) \quad \Delta H_{vap} = 38.56\ kJ$
- ( ) $C_2H_5OH \rightarrow C_2H_5OH \quad \Delta H_{vap} = 38.56\ kJ$
- ( ) $C_2H_5OH(g) \rightarrow C_2H_5OH(l) \quad \Delta H_{vap} = 38.56\ kJ$
- ( ) $C_2H_5OH(g) \rightarrow C_2H_5OH(l) \quad \Delta H_{vap} = -38.56\ kJ$

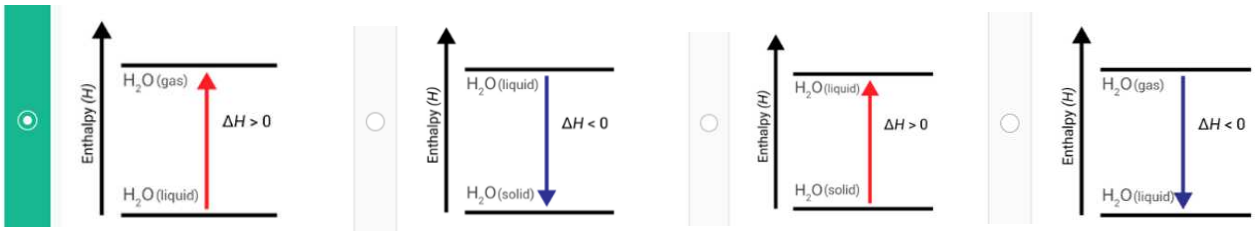
Q3: The heat required to melt one mole of a solid substance is the _____.

- ( ) molar enthalpy of solidification
- (●) molar enthalpy of fusion
- ( ) molar enthalpy of condensation
- ( ) molar enthalpy of vaporization

Q4: *Select the CORRECT thermochemical equation for the solidification of methanol.*

- ◉ $CH_3OH(l) \rightarrow CH_3OH(s) \quad \Delta H_{solid} = -3.16\ kJ$
- ○ $CH_3OH(s) \rightarrow CH_3OH(l) \quad \Delta H_{solid} = -3.16\ kJ$
- ○ $CH_3OH(s) \rightarrow CH_3OH(l) \quad \Delta H_{solid} = 3.16\ kJ$
- ○ $CH_3OH(l) \rightarrow CH_3OH(s) \quad \Delta H_{solid} = 3.16\ kJ$

Q5: *Select the CORRECT diagram that represents the enthalpy change in a vaporization process.*



6	CHM.5.5.01.006.07 Define enthalpy (heat) of combustion, ΔHcomb, while determining on what basis it is defined	Textbook+ table 3 + example problem 4 + practice problems

Molar heat of combustion ΔH_{comb}: The change in enthalpy upon complete combustion of one mole of a substance.

The enthalpy of combustion always negative (exothermic)

The reactants should contain one mole of reactant and any amount of oxygen.

$$1A + xO_2 \longrightarrow \text{product(s)}$$

Example : $H_{2(g)} + {}^1/_2O_{2(g)} \longrightarrow H_2O_{(g)}$

$$CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(g)}$$

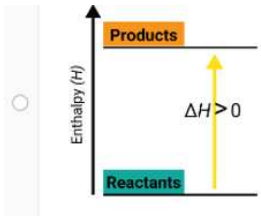
Q1: Identify the thermochemical equation that correctly represents the combustion reaction.

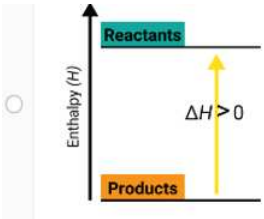
- ○ $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O \quad \Delta H = 1{,}560\ kJ$
- ◉ $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l) \quad \Delta H = -2{,}220\ kJ$
- ○ $Fe(s) + O_2(g) \rightarrow Fe_2O_3(s) \quad \Delta H = 3{,}926\ kJ$
- ○ $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O + 5{,}471\ kJ$

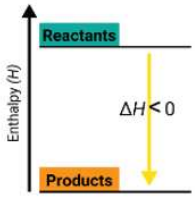
Q2: which one of these equations doesn't represent a combustion equation?

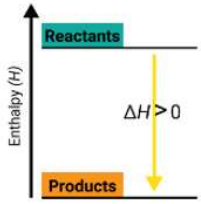
* $2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$
* $SO_{2(g)} + {}^1/_2O_{2(g)} \longrightarrow SO_{3(g)}$
* $C_{(s)} + {}^1/_2O_{2(g)} \longrightarrow CO_{2\ (g)}$
* $S_{8(g)} + 8O_{2(g)} \longrightarrow 8SO_{2(g)}$

Q3: Which of the following represents the correct diagram for a combustion reaction?









7	CHM.5.5.02.002.01 Calculate, using Hess's law, the ΔH of a reaction	Textbook+ example problem 5 + practice problems

Q1: Which of the following statements must be considered when applying Hess's Law?

I: The enthalpy change is proportional to the quantities of reactants and products.

II: If a reaction is reversed, then the sign of the enthalpy change value must also be reversed.

III: Changing the physical state of any reactant or product will involve an enthalpy change.

- II and III
- I and II
- I, II, and III
- only I

Q2:

Using standard enthalpies of formation what is the ΔH°_{rxn} for the combustion of methane?	مستخدمًا حرارة التكوين القياسية ما ΔH°_{rxn} للتفاعل احتراق الميثان؟
$CH4_{(g)} + 2O2_{(g)} \rightarrow CO2_{(g)} + 2H2O_{(l)}$ $\Delta H^\circ f\,(CO2) = -394\ kJ$ $\Delta H^\circ f\,(H2O) = -286\ kJ$ $\Delta H^\circ f\,(CH4) = -75\ kJ$	
A. -605 kJ	
B. -640 kJ	
C. -891 kJ	
D. -1041 kJ	

Q3:

How much is ΔH of the following reaction? $CO_{(g)} + 2H_{2(g)} \rightarrow CH_3OH_{(l)}$ Use the thermochemical equations (a, b and c) shown below	ما قيمة ΔH للتفاعل التالي؟ $CO_{(g)} + 2H_{2(g)} \rightarrow CH_3OH_{(l)}$ استخدم المعادلات الكيميائية الحرارية a، b و c الموضحة أدناه
a. $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H = -284\ kJ$ b. $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$ $\Delta H = -286\ kJ$ c. $CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$ $\Delta H = -727\ kJ$	

+157 kJ

-1297 kJ

-129 kJ

+1051 kJ

Q1: What is meant by the standard heat of formation $\Delta H^0 f$?

The change in enthalpy that accompanies the formation of one mole of a compound from its elements in their standard state.

Q2: what are the Conditions for the heat of formation equation?

1) **The product should be only one substance.**
2) **The product should be one mole.**
3) **The reactants should be elements in the standard state (1atm pressure and 25^0C)**

binary molecule	elements
H_2 , N_2 , O_2 , F_2 , Cl_2 , $Br_{2(l)}$, $I_{2(S)}$	Al , C , Na , Fe ….etc.

The standard heat of formation is calculated experimentally by assuming that the elements in their standard state have a $\Delta H^0 f = 0.0kJ$

Q1:

Which of the following represents the standard enthalpy of formation for the compound formed in the following reaction?	أي مما يلي يُمثل حرارة تكوين قياسية للمركب الناتج من التفاعلات التالية؟

a. $N_{2(g)} + 2O_{2(g)} \rightarrow 2NO_{2(g)}$ $\Delta H = +66.4\ kJ$

b. $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$ $\Delta H = -568\ kJ$

c. $\frac{1}{2}H_{2(g)} + \frac{1}{2}F_{2(g)} \rightarrow HF_{(g)}$ $\Delta H = -273\ kJ$

d. $SO_{3(g)} + H_2O_{(l)} \rightarrow H_2SO_{4(l)}$ $\Delta H = -814\ kJ$

Q2:

Which of the following represents the standard enthalpy of formation for the compound formed in the following reaction?	أي مما يلي يُمثل حرارة تكوين قياسية للمركب الناتج من التفاعلات التالية؟

a. $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$

b. $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$

c. $CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

d. $CO_{(g)} + 2H_{2(g)} \rightarrow CH_3OH_{(l)}$

Q1: **In which of the following changes the sign of the change in ΔS is negative?**

* $C_{10}H_{8\,(s)} \longrightarrow C_{10}H_{8\,(l)}$
* $NaCl_{(s)} \longrightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)}$
* $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2\,(g)}$
* $2NO_2 \longrightarrow N_{2\,(g)} + 2O_{2\,(g)}$

Q2: **Which of these statements increases the entropy of the system?**

I - When the system size increases.
II - When the energy increases.
III - When the number of particles or their freedom of movement increases.
IV - change matter from liquid to solid.

* I and II
* I , II and III
* III and IV
* I , II and IV

Q3: Consider the chemical reaction represented in the equation below:

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

Identify the option that best describes the entropy of the system.

- $S_{products} > S_{reactants}$
- $\Delta S_{system} = 0$
- $S_{reactants} > S_{products}$
- $\Delta S_{system} < 0$

Q4: Identify the statement(s) below that correspond(s) with a negative entropy change.

- **Statement I:** The disorder decreases during the process.
- **Statement II:** The entropy decreases during the process.
- **Statement III:** During the process:

$$S_{final} > S_{initial}$$

- II and III
- only II
- I and II
- only I

Q5: Consider the chemical reactions below. Identify the process for which:

$$\Delta S_{system} < 0$$

- $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
- $2NO_2(g) \rightarrow N_2O_4(g)$
- $NaCl(s) + H_2O(l) \rightarrow NaCl(aq)$
- $H_2O(s) \rightarrow H_2O(g)$

10	CHM.5.5.02.009.04 Calculate free energy change, ΔG, when ΔH, ΔS , and temperature (in Kelvin or Celsius) are given while determining whether reaction is spontaneous or nonspontaneous	Textbook+ table 6 + example problem 7 + practice problems

$$\Delta G_{System} = \Delta H_{System} - T\Delta S_{System}$$

If (ΔG negative) the reaction <u>is spontaneous</u>
If (ΔG positive) the reaction <u>is not spontaneous</u>

Q1: If you know that ΔS=322J\K and ΔH=145KJ for a reaction, the minimum temperature in Kelvin that makes the reaction spontaneous is?

* 375K * 382K * 415K * 451K

Q2: If you know that the value of ΔS = -22J\K and the value of ΔH = -74.5KJ for a reaction, which of the following is true?

* The reaction Always spontaneous
* The reaction Always not spontaneous
* The reaction spontaneous at high temperature
* The reaction spontaneous at low temperature

Q3: The following reaction $C_5H_{12(g)} + 8O_{2(g)} \longrightarrow 5CO_{2(g)} + 6H_2O_{(g)} + 3535.6\ kJ$ is

* Always spontaneous
* Always not spontaneous
* Spontaneous at high temperature
* Spontaneous at low temperature

Q4:

For a process, the enthalpy change of a system is 1.25×10^5 J and the entropy change is 300.0 J/K. Calculate the free energy change of the system at 290 K.	بالنسبة لعملية ما، يكون تغير المحتوى الحراري للنظام هو 1.25×10^5 J وتغير الإنتروبي هو 300.0 J/K احسب تغير الطاقة الحرة للنظام عند 290K.
A. 8.7×10^4 J	
B. 3.8×10^4 J	
C. 1.2×10^5 J	
D. 1.2×10^4 J	

Q5:

For a process, ΔH_{system} = 145 kJ and ΔS_{system} = 322 J/K. What is the value of ΔG_{system} at 382 K?	لعملية معينة $\Delta H_{النظام}$ = 145 kJ و $\Delta S_{النظام} = 322\ J/K$ ما قيمة $\Delta G_{النظام}$ عند 382K ؟
A. ΔG = +22KJ	
B. ΔG = -22KJ	
C. ΔG = +277kJ	
D. ΔG = -277kJ	

Q6: Copper (II) sulfide reacts with oxygen under standard conditions to form copper (II)sulfate as shown in the equation below. Which of the following is correct?

يتفاعل كبريتيد النحاس (II) مع الأكسجين في ظل ظروف قياسية لتكوين كبريتات النحاس (II) كما في المعادلة أدناه.
أي مما يأتي صحيح؟

$$CuS_{(s)} + 2O_{2(g)} \longrightarrow CuSO_{4(s)}$$

$$\Delta H^{o}_{rxn} = -718.3kJ \quad , \Delta S^{o}_{rxn} = -368.0J/K$$

العملية (تلقائية / غير تلقائية) Process (Spontaneous / Non-Spontaneous)	$\triangle G^0$ (kJ)	
Nonspontaneous غير تلقائية	+727.5	A
Spontaneous تلقائية	−609.0	B
Nonspontaneous غير تلقائية	+571.8	C
Spontaneous تلقائية	−571.8	D

11	CHM.5.4.02.003.02 Explain the effect of changing the concentration (Adding reactants or removing products or adding products) on an equilibrium system CHM.5.4.02.003.04 Explain the effect of changing temperature on an equilibrium system	Textbook+ figure 12 , 14

* **Increasing of reactants concentration** prefer the forward reaction (vice versa)

* **Increasing of products concentration** prefer the reverse reaction (vice versa).

Q1: Which of the following statements is true for the following equilibrium reaction if the concentrations of $NH_{3(g)}$ decrease?

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

a) The concentration of N_2 increases. **c) The reverse reaction preferred over of forward rection.**

b) The concentration of H_2 decreases. **d) The value of the equilibrium constant K_{eq} decreases.**

Q2: Which of the following statements is true for the following equilibrium reaction when some of HCl has been added to the reaction?

$$4HCl_{(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(l)} + 2Cl_{2(g)}$$

a) The concentration of O_2 increases. **c) The forward reaction preferred over of reverse rection.**

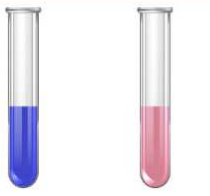
b) The amount of H_2O decreases. **d) The value of the equilibrium constant K_{eq} increases.**

Q3: *Select the CORRECT answers.*

Consider the equilibrium: $Co(H_2O)_6^{2+}(aq) + 4Cl^-(aq) \rightleftharpoons CoCl_4^{2-}(aq) + 6H_2O(l)$

The aqueous solution of $Co(H_2O)_6^{2+}$ is pink, and that of $CoCl_4^{2-}$ is blue.

What changes would occur when more water is added?



$CoCl_4^{2-}(aq)$ $Co(H_2O)_6^{2+}(aq)$

- ☐ The solution turns purple.
- ☐ The equilibrium remains the same.
- ☐ The solution turns blue.
- ☑ The equilibrium shifts to the left. ✓
- ☑ The solution turns pink. ✓
- ☐ The equilibrium shifts to the right.

Q4: What changes would occur to the equilibrium and equilibrium constant (K_{eq}) if we double the concentration of the products?

- ○ The equilibrium shifts left, and K_{eq} doubles.
- ○ The equilibrium shifts right, and K_{eq} doubles.
- ○ The equilibrium shifts right, and K_{eq} halves.
- ◉ The equilibrium shifts left, and K_{eq} remains the same.

* **Increasing temperature,** the reaction shifts away from the heat side .

A + B ⇌ C + D + heat (exothermic reaction)

A + B + heat ⇌ C + D (endothermic reaction)

* **Decreasing temperature,** the reaction shifts toward the heat side .

A + B ⇌ C + D + heat (exothermic reaction)

A + B + heat ⇌ C + D (endothermic reaction)

Q1:

Select the CORRECT answer.

Consider the equilibrium below:

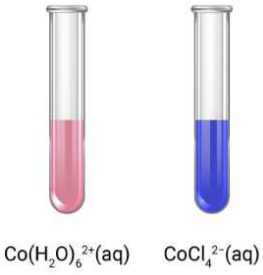
$$Co(H_2O)_6^{2+}(aq) + 4Cl^-(aq) \rightleftharpoons CoCl_4^{2-}(aq) + 6H_2O(l)$$

A $Co(H_2O)_6^{2+}$ solution has a pink color.

A $CoCl_4^{2-}$ solution has a blue color.

When we freeze the equilibrium mixture, the solution's color turns pink.

Which option about the enthalpy of the forward reaction is CORRECT?



- ○ $\Delta H = 0$
- ◉ $\Delta H > 0$ ✓
- ○ $\Delta H < 0$
- ○ We cannot tell the sign of ΔH.

Q2: Consider the exothermic reaction: $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

Which change would shift the equilibrium to produce more SO_3?

- ○ decrease pressure
- ○ remove oxygen gas
- ◉ decrease temperature ✓
- ○ increase temperature

Q3: In this equilibrium: $Cl_{2(g)} + SO_{2(g)} \rightleftharpoons SO_2Cl_{2(g)}$ + heat

Determine the true statement when the reaction heated?

* The value of Keq increases
* The concentration of SO_2 decreases
* The equilibrium will shift to the right.
* The equilibrium will shift to the left.

Q4: In this equilibrium: $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ $\Delta H = -92KJ$

Which of these statements not true when the reaction cold?

* The value of Keq decreases.
* The equilibrium will shift to the right.
* The concentration of NH_3 increases.
* The concentration of H_2 decreases.

12	CHM.5.4.02.003.03 Explain the effect of changing the volume and pressure on an equilibrium system	Textbook+ figure 13

1) Only the gaseous state(g) is affected by pressure or volume changes.

2) Remember that increasing the volume means decreasing the pressure (and vice versa).

3) Increasing pressure (increases concentration) (decreasing volume):

The equilibrium is likely from the side of the most gaseous moles to the side of the least gaseous moles. (And vice versa).

Q1: Which equilibrium reaction would NOT be affected by changes in pressure?

- $2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$
- $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$
- $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
- $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ ✓

Q2: Which of the following equilibrium reactions shift to the left when the volume of reaction container increase?

a) only 1
c) 2 , 3
b) 1 , 2 , 3
d) only 3

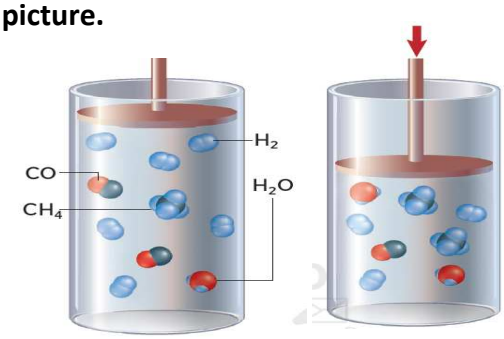
1. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$
2. $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
3. $CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + 2H_2O_{(g)}$

Q3: depending on the following equilibrium reaction and the picture.

$$CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g)$$

If the piston is lowered What of these is happened?

* The concentration of CH_4 increases
* The reaction shifted to reactant
* The concentration of H_2 increases
* The value of Keq decreases



13	CHM.5.4.02.006.01 Calculate the value of equilibrium constant given the concentration data at a specific equilibrium position	Textbook+ example problem 4 + practice problems

Q1: Consider the equilibrium concentrations: $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$

$[CO]_{eq} = 0.012M$

$[Cl_2]_{eq} = 0.054M$

$[COCl_2]_{eq} = 0.14M$

The value of the equilibrium constant (K_{eq}) is equal to

* **216** * **323** * **16.4** * **0.56**

Q2: *Select the CORRECT answer.*

Consider the equilibrium constant:

$$K_{eq} = \frac{[B_2][C_2]}{[A]^2}$$

To which equation does this equilibrium expression apply?

- ○ $A_2 \rightleftharpoons 2B + 2C$
- ○ $B_2 + C_2 \rightleftharpoons 2A$
- ○ $2B + 2C \rightleftharpoons A_2$
- ◉ $2A \rightleftharpoons B_2 + C_2$

Q3: If you know that the K_{eq} for the reaction $2NO_{(g)} \rightleftharpoons N_{2(g)} + O_{2(g)}$ at a temperature of 2000 ^{0}C is 100, it is found at equilibrium that the concentration of N_2 and O_2 Respectively was 4mol/L of and 0.3mol/L of .Calculate the [NO] in the vessel at equilibrium?

* **0.11** * **0.12** * **14.5** * **0.86**

Q4:

The reaction $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ reaches equilibrium. If the equilibrium concentrations are:

$[SO_2] = 0.0170$ mol / L

$[O_2] = 0.0230$ mol / L

Keq is 4.32

What is the equilibrium concentration of SO_3 in mol / L

التفاعل $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ يصل إلى حالة الاتزان، فإذا كانت التراكيز عند الاتزان هي:

$[SO_2] = 0.0170$ mol / L و $[O_2] = 0.0230$ mol / L

وثابت الاتزان K_{eq} لهذا التفاعل هو 4.32

فما تركيز الاتزان لـ SO_3 بوحدة mol / L ؟

* **0.00536** * **0.0342** * **0.124** * **0.016**

14	CHM.5.4.02.008.01 Calculate the molar solubility (concentration) of a sparingly soluble ionic compound using the solubility product constant, Ksp	Textbook+ examples problem 5,6 + practice problems

Q1: The compound lead(II) iodate ($Pb(IO_3)_2$) is slightly soluble in water at 298 K.

The dissolution reaction of lead(II) iodate is:

$$Pb(IO_3)_2 \rightleftharpoons Pb^{2+} + 2IO_3^- \quad K_{sp} = 2.6 \times 10^{-13}$$

Calculate the ion concentrations present in the saturated solution at 298 K.

- ○ $[Pb^{2+}] = 2.6 \times 10^{-13}$ mol/L, $[IO_3^-] = 5.2 \times 10^{-13}$ mol/L
- ○ $[Pb^{2+}] = 8.04 \times 10^{-5}$ mol/L, $[IO_3^-] = 4.02 \times 10^{-5}$ mol/L
- ◉ $[Pb^{2+}] = 4.02 \times 10^{-5}$ mol/L, $[IO_3^-] = 8.04 \times 10^{-5}$ mol/L ✓
- ○ $[Pb^{2+}] = 6.38 \times 10^{-5}$ mol/L, $[IO_3^-] = 1.28 \times 10^{-5}$ mol/L

Q2: The dissolution equilibrium of barium bromate ($Ba(BrO_3)_2$) at 298 K is:

$$Ba(BrO_3)_2(s) \rightleftharpoons Ba^{2+}(aq) + 2BrO_3^-(aq) \qquad K_{sp} = 2.43 \times 10^{-4}$$

Calculate the solubility of barium bromate at 298 K.

- ○ $s = 2.43 \times 10^{-4}$ mol/L
- ○ $s = 6.08 \times 10^{-5}$ mol/L
- ○ $s = 2.02 \times 10^{-5}$ mol/L
- ◉ $s = 3.93 \times 10^{-2}$ mol/L

Q3: Consider the following dissolution reaction:

$$Ca_5(PO_4)_3(OH)(s) \rightleftharpoons 5Ca^{2+}(aq) + 3PO_4^{3-}(aq) + OH^-(aq) \quad K_{sp} = 6.8 \times 10^{-37}$$

The concentration of hydroxide ions (OH^-) is $2.72 \times 10^{-5} M$.

In this case, the calcium ion (Ca^{2+}) concentration will be [$1.36 \times 10^{-4} M$ ✓ ▾].

Q4: Consider the following equilibrium at 298 K: $PbF_2(s) \rightleftharpoons Pb^{2+}(aq) + 2F^-(aq)$

At equilibrium, the concentrations of the ions are:

$[Pb^{2+}] = 2.17 \times 10^{-3}$ mol/L

$[F^-] = 4.35 \times 10^{-3}$ mol/L

The solubility product constant is: [$K_{sp} = 4.11 \times 10^{-8}$ ✓ ▾]

15	CHM.5.4.02.008.04 Identify whether a precipitate will form or not (by calculation and using relation between Ksp and Qsp)	Textbook+ example problem 7 + practice problems

Q1: Which statement is NOT TRUE when $Q_{sp} < K_{sp}$?

- ○ More of the ionic compound can dissolve.
- ◉ The solution is saturated and at equilibrium. ✓
- ○ A solid precipitate doesn't form in the solution.
- ○ The reaction favors the forward process.

Q2: Will a precipitate of $Mg(OH)_2$ form when 250ml of 0.20M $MgCl_2$ are mixed with 750ml 0.0025M NaOH?

Ksp $Mg(OH)_2 = 5.6x10^{-12}$

(a precipitate will form and Qsp = 1.76×10^{-7})

Q3: When mixing 100ml of 0.020M $Pb(NO_3)_2$ with 100ml of 0.01M NaCl, a precipitate of $PbCl_2$ is predicted. Which of these statement is true ? (given that K_{SP} for $PbCl_2$ 1.7×10^{-5})

(a precipitate will form and Qsp = 2.5×10^{-7})

Q4:

If an equal volumes of the solutions 0.0322 M $CaCl_2$ and 0.0145 M NaOH are mixed, a precipitate of $Ca(OH)_2$ is predicted. Which of the following is true?	إذا تم خلط حجوم متساوية من محلول $CaCl_2$ تركيزه 0.0322 M ومحلول NaOH تركيزه 0.0145 M يُتوقع أن يتكون راسب من $Ca(OH)_2$. أي مما يأتي صحيح؟
Solubility Product Constants at 298 K for the compound $Ca(OH)_2$ ($Ksp = 5.0 \times 10^{-6}$)	**ثابت حاصل الإذابة عند 298 K للمركب $Ca(OH)_2$ هو ($Ksp = 5.0 \times 10^{-6}$)**
Q sp = 8.5×10^{-7} and a precipitate will not form	Q sp = 8.5×10^{-7}، لا يتكون راسب
Q sp = 2.6×10^{-5} and a precipitate will form	Q sp = 2.6×10^{-5} ويتكون راسب
Q sp = 4.9×10^{-10} and a precipitate will form	Q sp = 4.9×10^{-10} ويتكون راسب
Q sp = 2.5×10^{-4} and a precipitate will not form	Q sp = 2.5×10^{-4} ولا يتكون راسب

$$\text{Average reaction rate} = -\frac{\Delta[\text{reactant}]}{\Delta t}$$

Q1: Nitrogen dioxide forms from dinitrogen tetroxide. The concentration of nitrogen dioxide increased to 0.06*M* in 30 seconds.
What is the average reaction rate of nitrogen dioxide formation?

* **0.002 M/s** * **- 0.002 M/s** * **- 500 M/s** * **- 500 M/s**

Q2: It takes 25 seconds for half of a reactant (called A) to be consumed.
- $[A]_1$ is the concentration of reactant A at the start of the reaction.
- $[A]_2$ is the concentration of reactant A after 25 seconds.

The expression for the reaction rate will be:

$\frac{[A]_1}{50}$ $-\frac{[A]_1}{50}$ $\frac{[A]_2}{50}$ $-\frac{[A]_2}{50}$

Q3: Consider the reaction: A ⟶ B
The concentration of A at 20 seconds is 0.54*M* and at 40 seconds is 0.30*M*.
What is the average rate of reaction over this time interval?

- ○ −0.012*M*/s
- ◉ 0.012*M*/s
- ○ 0.006*M*/s
- ○ −0.006*M*/s

Q4: The concentration of a reactant dropped from 1*M* to 0.6*M* in 15 seconds.
What is the reaction rate of this reaction in *M*/min?

- ○ −0.00044*M*/min
- ◉ 1.6*M*/min
- ○ 0.00044*M*/min
- ○ −1.6*M*/min

Q1: *Select the CORRECT answers from the drop-down menus.*

The rate law of the one-step chemical reaction A → B is expressed as: rate = $k[A]^m$

For a first-order reaction, the exponent *m* is equal to [1 ✓] and the unit of the specific rate constant is [s^{-1} ✓].

Doubling the concentration of the reactant A [doubles ✓] the reaction rate.

Q2: The reaction 3X + B ⟶ D occurs at a temperature of 30 ^{0}C and its rate law is R=k[X]^3 ,
When the concentration of X is doubled, the rate will .....

* **Increase 2 times** * **Increases 8 times** * **Increases 4 times** * **stay as it was**

Q3: The following reaction occurs in one step: 2X + 3Y ⟶ X_2Y_3.
Which of these equations represent the reaction rate law?

* **$R=k[X]^2[Y]^3$** * **$R=k[X]^2[Y]$** * **$R=k[X_2Y_3]$** * **$R=k[X]^2$**

Q4: consider the multi-step reaction between nitrogen monoxide (NO) and hydrogen (H_2)

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

If [NO] doubles, the rate quadruples; if [H_2] doubles, the rate doubles.
. The reaction is described as

* Second order in NO , first order in H_2 * fourth order in NO , Second order in H_2
* Second order in NO , Second order in H_2 * first order in NO , first order in H_2

Q4: In the following reaction: 2X + 3Y ⟶ X_2Y_3 it was found that doubling the concentration of X the rate of Reaction quadruple, doubling the concentration of Y the rate of reaction doesn't change.
Which of these equations represent the reaction rate law?

* **R=k[X]** * **R=k[Y]** * **$R=k[X]^2[Y]$** * **$R=k[X]^2$**

Q5: Determine the overall reaction order for the following reactions?

Reaction	Rate Law Equation	Overall Reaction Order
reaction 1	rate = $k[A][B]$	second ✓
reaction 2	rate = $k[A]^2[B]$	third ✓
reaction 3	rate = $k[A]^2[B]^2$	fourth ✓

Q1: *Select the CORRECT answer.*

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$.

Experiment	[NO] (mol/L)	[O_2] (mol/L)	Initial Rate (mol/(L·s))
Trial 1	0.15	0.15	1.03
Trial 2	0.15	0.3	2.06
Trial 3	0.3	0.3	8.24

- ☑ The rate law: rate = $k[NO]^2[O_2]$. ✓
- ☐ The rate law: rate = $k[NO][O_2]^2$.
- ☐ The rate law: rate = $k[NO]_2[O_2]$.
- ☐ The reaction is zero order in O_2.

Q2: Consider the chemical reaction: A + B → C + D

Quadrupling the concentration of the reactant A increased the rate by a factor of 16.

What is the order of the reaction for reactant A?

- ○ 8
- ○ 4
- ◉ 2 ✓
- ○ 6

Q3: Consider the following second order reaction: $CH_3CHO(g) \rightarrow CH_4(g) + CO(g)$

Which of the following is the ***CORRECT*** rate law equation for the above reaction?

- ○ rate = $2k[CH_3CHO]$
- ◉ rate = $k[CH_3CHO]^2$
- ○ rate = k
- ○ rate = $k[CH_3CHO]$

Q4: The following table expresses the experimental results to measure the rate of the following reaction: X + B ⟶ C

Reaction Rate (M/s)	[B] M	[X] M	experiment
0.03	0.2	0.2	1
0.12	0.2	0.4	2
0.12	0.4	0.4	3

The reaction rate law is :

* **$R=k[X]^2$**
* **$R=k[X]^2[B]$**
* **$R=k[B]^2$**
* **$R=k[X]^2[B]^2$**

Derivation of the unit of specific rate constant (k)

$$k = (L/mol)^{T-1} \cdot s^{-1}$$ where T = total order (n+m)

Q1: Consider the following zero-order reaction:

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

What is the unit of the specific rate constant?

- ○ s^{-1}
- ◉ mol/(L·s)
- ○ s
- ○ L/(mol·s)

Q2: The unit of specific rate constant (k) for a reaction is $M^3.L^{-3}.S^{-1}$, the total order of the reaction is:

* 3 * 2 * 4 * 1

Q3: The reaction 3X + B ⟶ D occurs at a temperature of 30 ^{0}C , and its rate law is $R=k[X]^3$,
The unit for the specific rate constant k is :

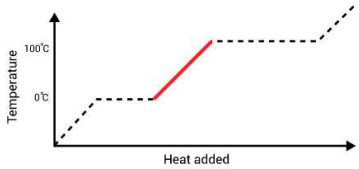
* L/mol.s * mol/L.s * $L^2/mol^2.s$ * $mol^2/L^2.s$

Q4: A reaction with first order ,the unit of the specific rate constant is:

* L/mol.s * mol/L.s * S^{-1} * $mol^2/L^2.s$

Select the CORRECT answer.

Identify the state of the substance when it is at the stage marked in red on the heating curve graph.



- ◉ liquid state ✓
- ○ gaseous state
- ○ solid state
- ○ both liquid and gas

The energy that is stored in a substance because of its composition is called _____.

- ○ kinetic energy
- ◉ chemical potential energy ✓
- ○ elastic potential energy
- ○ gravitational potential energy

A 15 g piece of cadmium metal (Cd) absorbs 134 J of heat, raising its temperature from 24°C to 62.7°C.

What is the specific heat (c) of cadmium?

- ◉ 0.231 J/g·°C ✓
- ○ 0.142 J/g·°C
- ○ 0.103 J/g·°C
- ○ 0.372 J/g·°C

Which of the process below is spontaneous?

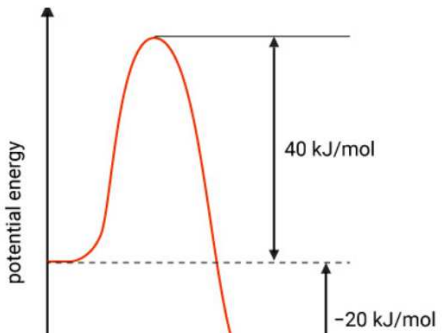
- ○ ice melting at a temperature below 0°C
- ○ water freezing at a temperature above 0°C
- ice melting at room temperature
- ○ water freezing at room temperature

Study the graph below. Which statement is TRUE about the chemical reaction that it represents?

What does the second law of thermodynamics state?

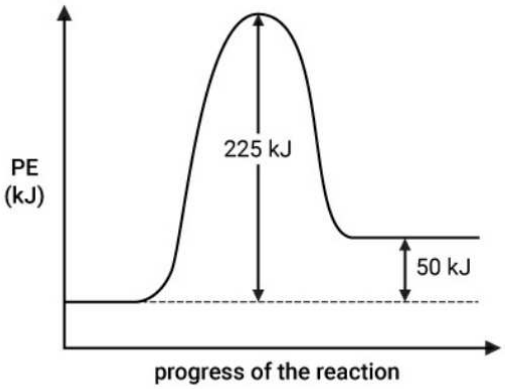
- The amount of energy in the universe does not change.
- Entropy in the universe decreases with time.
- Energy in the universe is neither created, nor destroyed.
- Entropy in the universe increases with time.

The activation energy of the reverse reaction is



Drag and drop the correct option to complete the sentence.

Study the energy diagram.



The forward reaction is

endothermic and ΔH= +50 kJ ✓ .

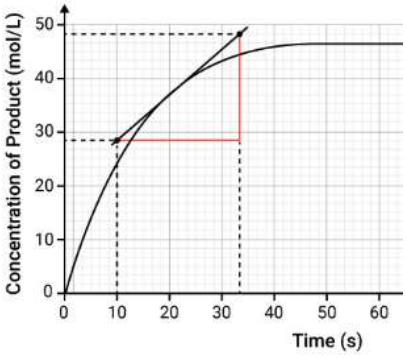
endothermic and ΔH = +225 kJ

exothermic and ΔH = — 50 kJ

exothermic and ΔH = —

Select the CORRECT answer from the drop-down menu.

The graph represents the change in the product's concentration over time.



The instantaneous rate at 20 seconds = 0.83 mol/(L·s) ✓

Which option describes the instantaneous rate?

- ○ changes in the [reactant] over time
- ◉ changes in the [product] at a specific time
- ○ increase in the [product] over time
- ○ decrease in the [reactant] over time

Which reaction will not reach a dynamic equilibrium state?

- ○ $N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g)$
- ○ $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$
- ○ $H_2O(g) + C(s) \rightleftharpoons H_2(g) + CO(g)$
- ◉ $2CH_3OH(g) + 3O_2(g) \rightarrow 4H_2O(l) + 2CO_2(g)$

Select the CORRECT answer.

Which of the following statements apply to reversible reactions?

I: The reaction does not go to completion.
II: The reaction is indicated with a double equilibrium arrow (⇌).
III: The reaction occurs in both the forward and reverse directions.
IV: The reaction stops when one or all reactants are used up.

- ○ statements I and IV
- ◉ statements I, II, and III
- ○ statements II and III
- ○ statements II, III, and IV

Which equilibrium constant refers to a reaction mixture containing almost equal amounts of products and reactants at equilibrium?

- ○ $K_{eq} = 1.5 \times 10^{-1}$
- ◉ $K_{eq} = 9.9 \times 10^{-1}$ ✓
- ○ $K_{eq} = 8.6 \times 10^{6}$
- ○ $K_{eq} = 1 \times 10^{-3}$

The decomposition reaction of 0.3 *M* sulfuryl chloride gas (SO_2Cl_2) was performed at 100 °C:

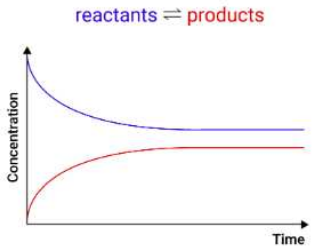
$$SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g) \quad (K_{eq} = 0.078)$$

The experiment was repeated, starting with 0.9 *M* of SO_2Cl_2 gas.

The value of the equilibrium constant in the second equilibrium will be $K_{eq} = 0.078$ ✓ ⌄.

Select the CORRECT answer.

The graph shows the variation of the concentrations in a reaction mixture with time.



Which statement about the equilibrium represented in the graph is TRUE?

- ○ At equilibrium, [products] > [reactants].
- ○ At equilibrium, the constant $K_{eq} = 1$.
- ◉ At equilibrium, the constant $K_{eq} < 1$. ✓
- ○ At equilibrium, [reactants] = [products].

Consider the equilibrium: $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g) \quad K_{eq} = 2.25 \times 10^{12}$

Which statement about the equilibrium is TRUE?

- ○ The equilibrium constant is very low.
- ○ The equilibrium favors the reactants.
- ○ The reaction mixture contains more reactants.
- ◉ The equilibrium favors the products. ✓

Which physical states would exclude a substance from the equilibrium constant expression?
- gaseous state (g)
- liquid state (l)
- solid state (s)
- aqueous solution (aq)

- ○ gaseous state (g) and aqueous solution (aq)
- ○ liquid state (l) and aqueous solution (aq)
- ◉ solid state (s) and liquid state (l) ✓
- ○ gaseous state (g) and liquid state (l)

When you heat solid sodium bicarbonate in closed vessels, the following equilibrium will be established:

$$2NaHCO_3(s) \rightleftharpoons Na_2CO_3(s) + CO_2(g) + H_2O(g)$$

Which equilibrium constant expression for this reaction is CORRECT?

- ○ $K_{eq} = \frac{[NaHCO_3]^2}{[CO_2][H_2O][Na_2CO_3]}$
- ○ $K_{eq} = \frac{[Na_2CO_3]}{[NaHCO_3]^2}$
- ○ $K_{eq} = \frac{[CO_2][H_2O][Na_2CO_3]}{[NaHCO_3]^2}$
- ◉ $K_{eq} = [CO_2][H_2O]$

Bromine (Br_2) is a liquid at room temperature. Bromine evaporates at high temperatures until it reaches equilibrium.

$$Br_2(l) \rightleftharpoons Br_2(g)$$

Which statement about the reaction is TRUE?

- ○ The equilibrium constant K is equal to $[Br_2]_{liquid}$.
- ○ The equilibrium constant omits $[Br_2]_{gas}$.
- ◉ The equilibrium constant K is equal to $[Br_2]_{gas}$. ✓
- ○ The equilibrium is a homogeneous equilibrium.

Which equation is an example of a heterogeneous equilibrium?

- ◉ $C(s) + 2S(g) \rightleftharpoons CS_2(g)$ ✓
- ○ $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
- ○ $3O_2(g) \rightleftharpoons 2O_3(g)$
- ○ $2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$

Which equation is an example of a homogeneous equilibrium?

- (selected) $HSC_2H_4OH(aq) \rightleftharpoons H^+(aq) + SC_2H_4OH^-(aq)$ ✓
- $C_2H_5OH(l) \rightleftharpoons C_2H_5OH(g)$
- $H_2O(l) + SO_3(g) \rightleftharpoons H_2SO_4(aq)$
- $H_2O(g) \rightleftharpoons H_2O(l)$

In which of the following cases would the equilibrium be disturbed?

case I: reactant is added
case II: reactant is removed
case III: product is added
case IV: product is removed

- (selected) cases I, II, III, and IV ✓
- cases III and IV
- cases I and II
- cases I and III

How would the equilibrium constant (K_{eq}) change when we remove some of the products?

- (selected) stays the same ✓
- drops to zero
- decreases
- increases

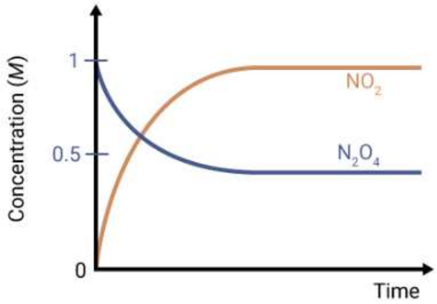
Consider the reversible reaction: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

When would this reaction reach equilibrium?

- when the concentration of NH_3 increases
- when the concentrations of N_2, H_2, and NH_3 are equal
- when the concentrations of N_2 and H_2 decrease
- (selected) when the concentrations of N_2, H_2, and NH_3 remain constant ✓

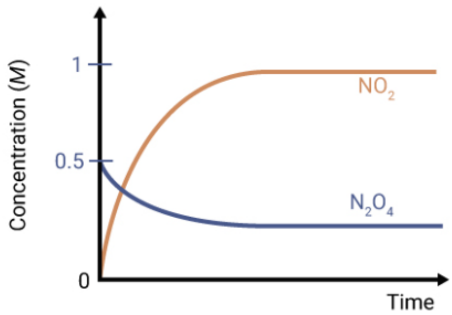
Select the CORRECT answer.

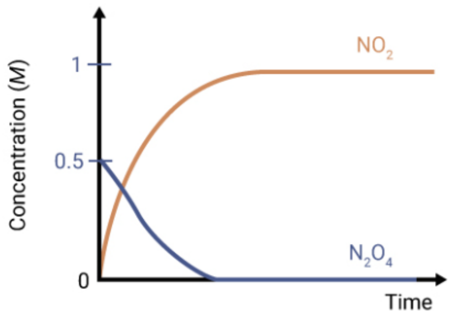
Consider the following equilibrium: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

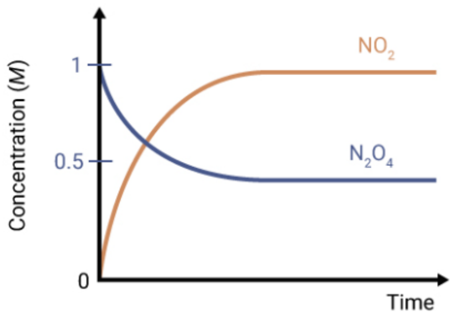


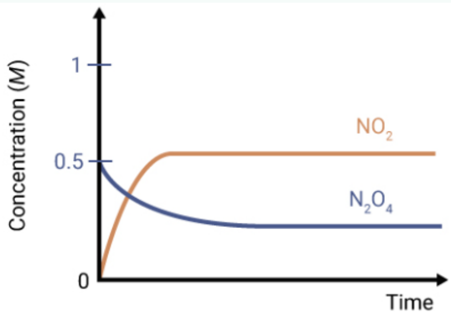
The graph shows reactant and product concentrations until chemical equilibrium is reached.

How would the graph look at the new equilibrium if we remove half of the reactants?









Which of the following statements apply to the removal of reactants?

I: The equilibrium shifts in the direction that forms more reactants.

II: The rate of the reverse reaction increases.

III: The equilibrium shifts to the left to restore balance.

IV: The rate of the forward reaction increases.

- statements I, III, and IV
- statements I and II
- statements I, II, and III ✓
- statements I and IV

Consider the following equilibrium:

$$Ag_2CrO_4(s) \rightleftharpoons 2Ag^+(aq) + CrO_4^{2-}(aq)$$

Which solubility product constant expression is CORRECT for this reaction?

- $K_{sp} = 2[Ag^+][CrO_4^{2-}]$
- $K_{sp} = \frac{[Ag^+]^2[CrO_4^{2-}]}{[Ag_2CrO_4]}$
- **$K_{sp} = [Ag^+]^2[CrO_4^{2-}]$** ✓
- $K_{sp} = [Ag^+][CrO_4^{2-}]$

Consider the solubility product constant expression: $K_{sp} = [V^{3+}]^2[CO_3^{2-}]^3$

Which balanced dissolution equation is represented by the K_{sp} expression above?

- **$V_2(CO_3)_3(s) \rightarrow 2V^{3+}(aq) + 3CO_3^{2-}(aq)$** ✓
- $V_2(CO_3)_3(s) \rightarrow V^{3+}(aq) + CO_3^{2-}(aq)$
- $V_2(CO_3)_3(s) \rightarrow 2V^{2+}(aq) + 3CO_3^{3-}(aq)$
- $V_3(CO_3)_2(s) \rightarrow 3V^{3+}(aq) + 2CO_3^{2-}(aq)$

Select the CORRECT answer.

Consider a slightly soluble ionic compound with the general formula A_2B_3.

Which option represents the K_{sp} in terms of the solubility "s"?

- $K_{sp} = 24s^5$
- $K_{sp} = 108s^6$
- $K_{sp} = 27s^2$
- **$K_{sp} = 108s^5$** ✓

Study the table below:

Ionic Compound	K_{sp}
barium sulfate ($BaSO_4$)	1.1×10^{-10}
lead(II) sulfide (PbS)	2.5×10^{-27}
barium fluoride (BaF_2)	1.0×10^{-6}
mercury(II) sulfide (HgS)	1.6×10^{-52}

Which option ranks the salts from the LEAST soluble to the MOST soluble in water?

- ○ PbS - HgS - $BaSO_4$ - BaF_2
- ○ BaF_2 - $BaSO_4$ - HgS - PbS
- ◉ HgS - PbS - $BaSO_4$ - BaF_2 ✓
- ○ BaF_2 - $BaSO_4$ - PbS - HgS

Consider the following solubility equilibrium:

$$Ag_2CrO_4(s) \rightleftharpoons 2Ag^+(aq) + CrO_4^{2-}(aq) \quad K_{sp} = 1.1 \times 10^{-12}$$

Which option describes what happens when K_2CrO_4 is added to a solution containing Ag_2CrO_4?

- ○ decreases the solubility of K_2CrO_4
- ○ favors the dissolution of Ag_2CrO_4 precipitate
- ○ shifts the equilibrium to the right
- ◉ decreases the solubility of Ag_2CrO_4 ✓

Which statement about the ion product of a slightly soluble compound is TRUE?

- ◉ Q_{sp} uses ion concentration that can vary in solution. ✓
- ○ Q_{sp} is calculated at equilibrium.
- ○ Q_{sp} is a constant value.
- ○ Q_{sp} is always equal to K_{sp}.

Consider the following equilibrium:

$$CaSO_4(s) \rightleftharpoons Ca^{2+}(aq) + SO_4^{2-}(aq)$$

Which substances can decrease the solubility of $CaSO_4$?

- ○ either $Ca(NO_3)_2$ or $CaSO_4$
- ○ either $CaSO_4$ or Na_2SO_4
- ○ either $Ca(NO_3)_2$ or H_2SO_3
- ◉ either $Ca(NO_3)_2$ or Na_2SO_4 ✓