

Chemistry 30: Practice Test #2

1. Numerical response. Left justify your answer in the boxes provided

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Which of the following changes, when applied to the equilibrium system given, would cause an **increase** in the amount **of reactants** produced?

Record all correct answers in numerical order.



1. $\text{Na}_2\text{SO}_4 (\text{aq})$ is added
 2. Volume of the reaction vessel is increased.
 3. CO_3^{2-} is removed
 4. NaHSO_4 is added
 5. $\text{HCO}_3^- (\text{aq})$ is added
2. Given that the equilibrium constant will increase when the temperature of a system is increased, **identify the type of reaction** and if heat would be included as a **product or reactant**.
 - A. Exothermic, reactant
 - B. Endothermic, reactant
 - C. Exothermic, product
 - D. Endothermic, product
3. Numerical response. Left justify your answer in the boxes provided

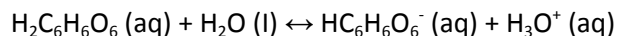
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From the following list, select the statement(s) that apply to a system at equilibrium

1. The rate of the forward reaction equals the rate of the reverse reaction
2. The percent reaction is
3. Pressure of the system must remain constant
4. Concentration of the products is equal to the concentration of the reactants
5. The system may be open or closed

Use the following information to answer the next question.

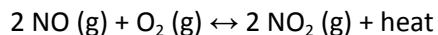
Ascorbic acid $\text{H}_2\text{C}_6\text{H}_6\text{O}_6$ (aq), is commonly taken on a daily basis as the dietary supplement Vitamin C. It has been suggested that this acid helps fight the common cold. The equation below represents the Brønsted-Lowry reaction of ascorbic acid and water.



4. Which of the following rows identifies the Brønsted-Lowry acids and a conjugate acid-base pair from the equation above?

A.	$\text{H}_2\text{C}_6\text{H}_6\text{O}_6$ (aq) and $\text{HC}_6\text{H}_6\text{O}_6^-$ (aq)	H_2O (l) and H_3O^+ (aq)
B.	$\text{H}_2\text{C}_6\text{H}_6\text{O}_6$ (aq) and $\text{HC}_6\text{H}_6\text{O}_6^-$ (aq)	$\text{HC}_6\text{H}_6\text{O}_6^-$ (aq) and H_3O^+ (aq)
C.	$\text{H}_2\text{C}_6\text{H}_6\text{O}_6$ (aq) and H_3O^+ (aq)	H_2O (l) and H_3O^+ (aq)
D.	$\text{H}_2\text{C}_6\text{H}_6\text{O}_6$ (aq) and H_3O^+ (aq)	$\text{HC}_6\text{H}_6\text{O}_6^-$ (aq) and H_3O^+ (aq)

Use the following equilibrium reaction to answer the next question.



- 1) Increase volume
- 2) Decrease volume
- 3) Increase NO (g) concentration
- 4) Decrease NO (g) concentration
- 5) Increase $\text{NO}_2 \text{ (g)}$ concentration
- 6) Decrease $\text{NO}_2 \text{ (g)}$ concentration

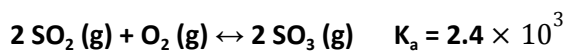
5. Numerical response. Left justify your answer in the boxes provided

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The stresses numbered above that will cause the equilibrium system to shift to the right are _____, _____, _____ and _____.

6. Which of the following substances can act as a Brønsted-Lowry base?
- A. CH_3OH (aq)
 - B. HCOOH (aq)
 - C. NaNO_3 (aq)
 - D. NaHCO_3 (aq)

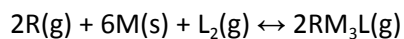
7. Use the following reaction to complete the statement below.



The equilibrium law expression for the equation above is __i__, and at equilibrium, the amount of products present is __ii__ the amount of reactants present.

	i	ii
A.	$K_a = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$	Less than
B.	$K_a = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$	Greater than
C.	$K_a = \frac{[\text{SO}_2]^2[\text{O}_2]}{[\text{SO}_3]^2}$	Less than
D.	$K_a = \frac{[\text{SO}_2]^2[\text{O}_2]}{[\text{SO}_3]^2}$	Greater than

8. The equilibrium expression for the following equilibrium equation is _____.



a	$K_c = \frac{[\text{RM}_3\text{L}]^2}{[\text{R}]^2[\text{M}]^6[\text{L}_2]^2}$
b	$K_c = \frac{[\text{RM}_3\text{L}]^2}{[\text{R}]^2[\text{L}_2]}$
c	$K_c = \frac{[\text{R}]^2[\text{M}]^6[\text{L}_2]^2}{[\text{RM}_3\text{L}]^2}$
d	$K_c = \frac{2[\text{RM}_3\text{L}]}{2[\text{R}][\text{L}_2]}$

9. Numerical response. Left justify your answer in the boxes provided

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Consider the table of observations made when some Brønsted-Lowry acids and bases are reacted. For each reaction the students have noted whether the reaction **favours reactants** or **favours products**.

	HR(aq)	HG(aq)	HW(aq)	HM(aq)
R ⁻ (aq)	-----	Reactants	Products	Reactants
G ⁻ (aq)	Products	-----	Products	Products
W ⁻ (aq)	Reactants	Reactants	-----	Reactants
M ⁻ (aq)	Products	Reactants	Products	-----

Using the list of chemical reagents given below, rank the acids from **weakest to strongest**.

1	2	3	4	5	6	7	8
M ⁻ (aq)	G ⁻ (aq)	HW(aq)	HM(aq)	W ⁻ (aq)	HG(aq)	R ⁻ (aq)	HR(aq)

10. **Numerical response**. Left justify your answer in the boxes provided

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Household bleach contains NaOCl(aq), a weak base, The ionization reaction for sodium hypochlorite is given below.



If the pOH of a solution is 5.00, the [NaOCl(aq)] is a.b x 10^{-c} mol/L

11. **Numerical response**. Left justify your answer in the boxes provided

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The K_b for the nitrite ion ($\text{NO}_2^-(\text{aq})$) is expressed as $a.b \times 10^{-cd}$. The values for a, b, c, and d are ____, ____, ____, and ____

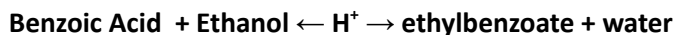
12. A buffer is an equilibrium mixture of a _____ acid or base with its _____ partner.

a	Strong	Amphoteric
b	Strong	Conjugate
c	Weak	Amphoteric
d	Weak	Conjugate

13. A bomb calorimeter is ideally suited for measuring the heat evolved during a combustion reaction. A sample of sucrose ($C_{12}H_{22}O_{11}(s)$) in a bomb calorimeter causes the temperature of 345 mL of water to rise from 24.9 °C to 28.3 °C. The heat capacity of the calorimeter assembly is 4.90 kJ/mol. What is the experimental molar enthalpy of combustion of sucrose in kJ/mol?

- a. -16.7
- b. +16.7
- c. -19.6
- d. +19.6

14. Ethyl benzoate is formed by the following reaction.



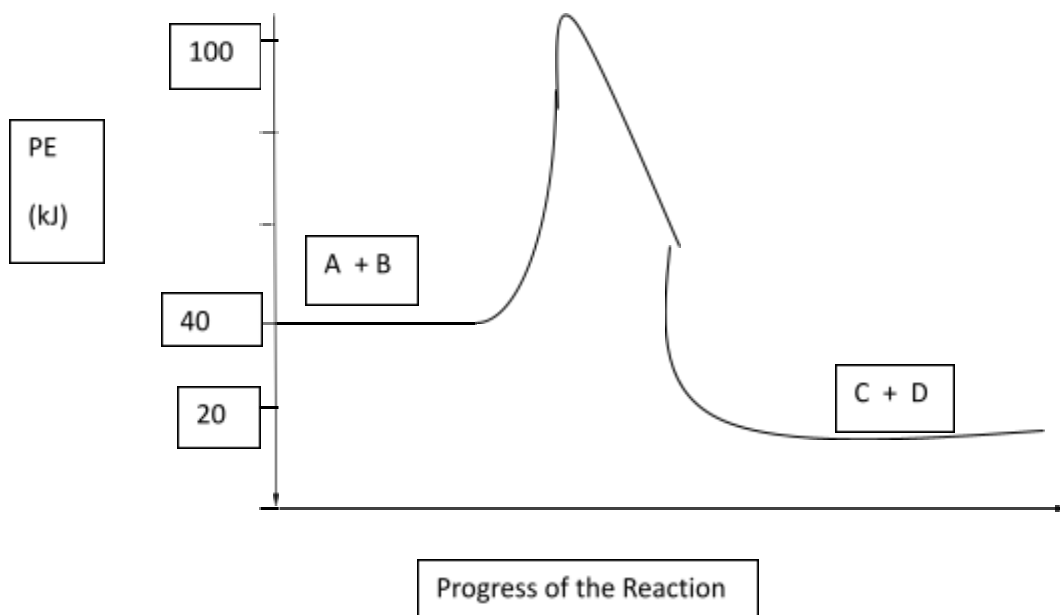
In the above reaction hydrogen ions are used as a catalyst. When a catalyst is used the activation energy of a reaction

- a. Increases
- b. Decreases
- c. Stays the same
- d. Is eliminated

15. Predict the enthalpy change due to the combustion of 11.7 g of propane in a barbeque. The molar enthalpy of combustion of propane is -2043.9 kJ/mol

- a. $+5.42 \times 10^2$ kJ
- b. -5.42×10^2 kJ
- c. $+2.39 \times 10^4$ kJ
- d. -2.39×10^4 kJ

Use the following diagram to answer the next **two questions**



16. The energy barrier that must be overcome for the forward reaction to occur is called the i, and in the diagram above it has a value of ii.

The statement above is completed by the information in row

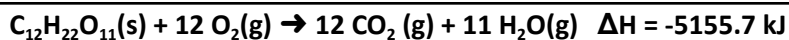
	<i>i</i>	<i>ii</i>
A.	activation energy	80 kJ
B.	activation energy	60 kJ
C.	enthalpy change	80 kJ
D.	enthalpy change	60 kJ

17. The reaction depicted in the diagram above is i and the enthalpy change for the forward reaction is ii

	<i>i</i>	<i>ii</i>
A.	Endothermic	80 kJ
B.	Endothermic	20 kJ
C.	Exothermic	-80 kJ
D.	Exothermic	-20 kJ

Use the following information to answer the following question

The combustion of sucrose can be represented by the following reaction



18. The combustion of sucrose can be carried out in a calorimeter. If 343 mg of sucrose is combusted in a calorimeter containing 1.00 L of water, predict the change in temperature of the Calorimetry assembly (*assume the calorimeter has the same specific heat capacity as water*).
- An increase of 1.35 °C
 - A decrease of 1.35 °C
 - An increase of 1.23 °C
 - A decrease of 1.23 °C
-

19. The combustion of octane is shown in the unbalanced reaction below



What is the enthalpy of reaction for the combustion of 1 mol of octane?

- 385.2 kJ
 - 5225.8 kJ
 - 5074.1 kJ
 - 5470.1 kJ
20. The products of cellular respiration are i, and the products of outdoor complete hydrocarbon combustion are ii

The statement above is completed by the information in row.

	<i>i</i>	<i>ii</i>
A.	CO ₂ (g) and H ₂ O(l)	CO ₂ (g) and H ₂ O(g)
B.	CO ₂ (g) and H ₂ O(l)	CO ₂ (g) and H ₂ O(l)
C.	C ₆ H ₁₂ O ₆ (s) and O ₂ (g)	CO ₂ (g) and H ₂ O(g)
D.	C ₆ H ₁₂ O ₆ (s) and O ₂ (g)	CO ₂ (g) and H ₂ O(l)

21. **Numerical Response**

Left justify your answer in the boxes provided

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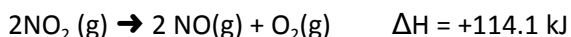
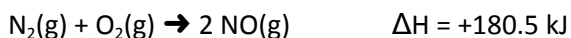
The energy released when 0.250 mol of mercury (II) oxide (red) is formed from its elements is _____ kJ.

22. **Numerical Response**

Left justify your answer in the boxes provided

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Use the given reactions to solve this question.



Find the molar enthalpy of formation of Nitrogen dioxide,



23. **Numerical Response**

Left justify your answer in the boxes provided

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Type of Reaction

1. Endothermic
2. Exothermic

Match the type of reaction numbered above with the reactions given below.

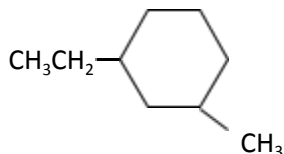
Photosynthesis _____ (Record in Column 1)

Cellular Respiration _____ (Record in Column 2)

Formation of $\text{CO}_2(\text{g})$ _____ (Record in Column 3)

Decomposition of $\text{H}_2\text{O}(\text{l})$ _____ (Record in Column 4)

24. A student drew the following structural diagram:



The IUPAC name for the molecule is 1-____i____-3-____ii____.

	i	ii
A	ethyl	methylcyclohexane
B	ethyl	methylhexane
C	methyl	ethylcyclohexane
D	methyl	ethylhexane

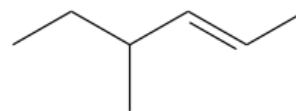
Use the names of organic compounds to answer the following question.

- | | |
|----------------------|--------------------------------|
| 1. heptane | 5. methylcyclohexane |
| 2. cycloheptane | 6. ethylcyclopentane |
| 3. hept-3-ene | 7. 1-ethyl-2-methylcyclobutene |
| 4. 2-methylhex-3-yne | 8. 2,2-dimethylbutane |

25. **Numerical Response**

Left justify your answer in the boxes provided

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The four compounds which are structural isomers of the left compound are _____, _____, _____, and _____.

26. Difference in boiling points will separate chemicals in a process called _____

- a. catalytic cracking
- b. solvent extraction
- c. catalytic reforming
- d. fractional distillation

27. The change in boiling point of alkanes with increasing molar mass is primarily due to increasing

- a. London dispersion forces
- b. dipole–dipole forces
- c. covalent bonds
- d. hydrogen bonds

Use the diagrams of organic compounds to answer the **next TWO questions**.

1		2	
3		4	
5		6	
7		8	

28. **Numerical Response**

Left justify your answer in the boxes provided

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Identify the following types of compounds, in order:

alcohol

ester

carboxylic acid

Cyclo alkene

29. **Numerical Response**

Left justify your answer in the boxes provided

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Identify the following types of compounds, in order:

Aliphatic alkene

halogenated alkane

cyclo alkane

aliphatic alkane

30. **Numerical Response**

Left justify your answer in the boxes provided

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Crude oil is a mixture of many different hydrocarbons, with a wide range of molar masses. To be useful, it must be further refined into specific products. Chemical PROCESSES which are important at a refinery include:

1. catalytic cracking
2. combustion
3. elimination
4. esterification
5. fractional distillation
6. polymerization
7. reforming
8. substitution

Match the process with the description:

Use a catalyst to break large hydrocarbons into smaller molecules

Use heat, pressure, and a catalyst to convert straight-chain alkanes into branched alkanes, cyclic alkanes, and aromatics.

An exothermic process that consumes hydrocarbons, but produces thermal energy to fuel other processes in the refinery

Separates crude oil into components based upon their boiling properties

Record your **four digit** answer in the boxes above.

31. When 2-methylbut-2-ene reacts with hydrochloric acid, the product(s) will be:

- a. 2-methyl-2-chlorobutane and 2-methyl-3-chlorobutane
- b. 2-chloro-2-methylbutane and 3-chloro-2-methylbutane
- c. 2-chlorobut-2-ene and methane
- d. 2-chloro-2-methylbutane and 1-chloro-2-methylbutane

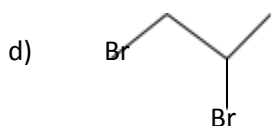
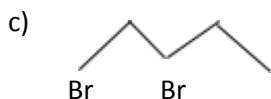
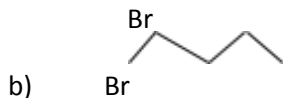
32. Which one of the following statements best describes an elimination reaction?

- a. Carbon atoms in the organic product are bonded to fewer atoms than the carbon atoms in the organic reactant.
- b. A hydrogen atom or functional group is replaced with a different atom or functional group.
- c. Atoms are added to a double or triple carbon–carbon bond.
- d. Two molecules are combined and a small molecule, such as water, is produced as a second product.

33. Which of the following equations best shows the complete combustion of propane?

- a. $2\text{C}_2\text{H}_6(\text{g}) + 7\text{O}_2(\text{g}) \rightleftharpoons 4\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$
- b. $2\text{C}_2\text{H}_6(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons \text{C}(\text{s}) + 2\text{CO}(\text{g}) + \text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$
- c. $2\text{C}_3\text{H}_8(\text{g}) + 9\text{O}_2(\text{g}) \rightleftharpoons 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$
- d. $\text{C}_3\text{H}_8(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons 3\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{g})$

34. Which of the following compounds could be formed in the addition reaction of pent-1-ene and bromine?



35. Which of the following equations represent a **disproportion reaction**?

- A. $\text{Sn}(\text{s}) + \text{Br}_2(\text{l}) \rightarrow \text{SnBr}_2(\text{s})$
- B. $2\text{Na}(\text{s}) + \text{I}_2(\text{s}) \rightarrow 2\text{NaI}(\text{s})$
- C. $2\text{NH}_3(\text{aq}) + \text{NaOCl}(\text{aq}) \rightarrow \text{N}_2\text{H}_4(\text{aq}) + \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- D. $\text{Cl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{HOCl}(\text{aq}) + \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$

36. Which of the following equations represents a spontaneous redox reaction?

- A. $3 \text{Cr}^{2+}(\text{aq}) \rightarrow \text{Cr}(\text{s}) + 2\text{Cr}^{3+}(\text{aq})$
- B. $2 \text{H}^{+}(\text{aq}) + \text{Cu}(\text{s}) \rightarrow \text{H}_2(\text{g}) + \text{Cu}^{2+}(\text{aq})$
- C. $\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4 \text{Br}^{-}(\text{aq}) \rightarrow 2\text{Br}_2(\text{l}) + 4 \text{OH}^{-}(\text{aq})$
- D. $\text{MnO}_4^{-}(\text{aq}) + 8 \text{H}^{+}(\text{aq}) + 5 \text{Fe}^{2+}(\text{aq}) \rightarrow 5 \text{Fe}^{3+}(\text{aq}) + \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$

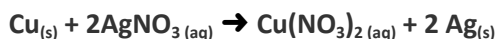
37. A 1964 Chevy is parked in the backyard waiting to be restored. Snow and rain have corroded the car for many years. Which of the following would be **the least effective** at preventing this corrosion?

- A. Cover with paint
- B. Cover with a tarp
- C. Store in a dry environment
- D. Run a mild electric current through

Use the following information to answer the next question.

A simple demonstration of a redox reaction involves placing a solid piece of copper wire in a silver nitrate solution. Within minutes the wire begins to look fuzzy or furry, as small silver crystals begin to form on the wire. Meanwhile, the originally clear silver nitrate solution begins to take on a pale bluish tint. Furthermore, if the crystals are shaken off of the wire we see that the wire partially disintegrated.

The overall equation for our demonstration is:



38. What is the net ionic equation for the above equation?

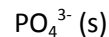
- a. $\text{Cu}_{(\text{s})} + 2\text{Ag}^{+}_{(\text{aq})} \rightarrow \text{Cu}^{2+}_{(\text{aq})} + 2\text{Ag}_{(\text{s})}$
- b. $\text{Cu}_{(\text{s})} + 2\text{AgNO}_{3(\text{aq})} \rightarrow \text{Cu}(\text{NO}_3)_{2(\text{aq})} + 2 \text{Ag}_{(\text{s})}$
- c. $\text{CuO}(\text{s}) + 2\text{H}^{+}(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- d. $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Cu}(\text{s})$

39. **Numerical Response**

Left justify your answer in the boxes provided

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Determine the oxidation numbers of phosphorus in the various compounds given. Charge is not included.



Record in the
1st box

Record in the
2nd box

Record in the
3rd box

Record in the
4th box

40 . Select the statement that applies **only** to electrolytic cells.

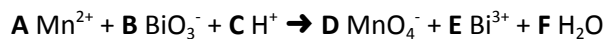
- A. Oxidation occurs at the anode
- B. Cations travel to the anode
- C. The standard cell potential is negative
- D. Electrons travel in the external circuit from the anode to the cathode

41. **Numerical Response**

Left justify your answer in the boxes provided

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Balance the following reaction by oxidation numbers.



Record the values of A, B, E and F in the four boxes above.

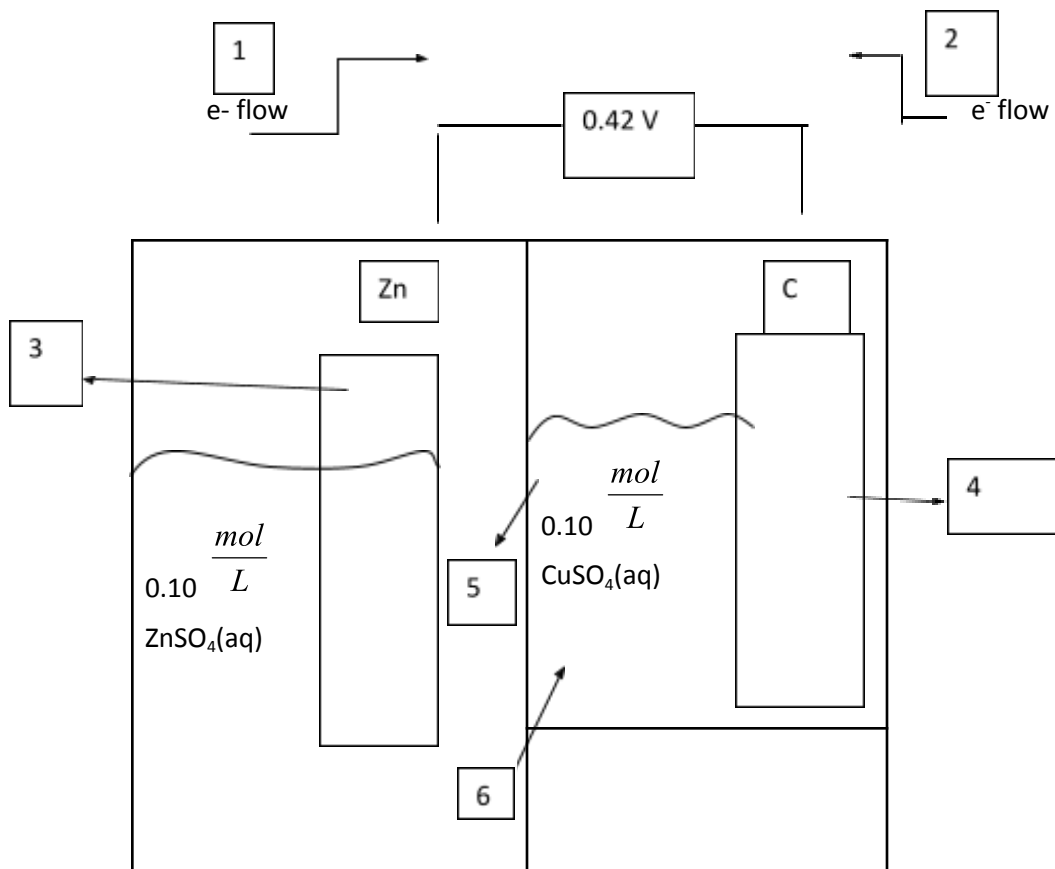
42. Some electrochemical cells require a salt bridge or porous cup to separate the two reactants.
Other electrochemical cells do not require a salt bridge or porous cup.

The cells that do **not** require a salt bridge are _____ i _____ cells, because the reaction in these cells is _____ ii _____.

Row	i	ii
A	electrolytic	spontaneous
B	electrolytic	non-spontaneous
C	voltaic	spontaneous
D	voltaic	non-spontaneous

Use the following Voltaic Cell to answer the next **THREE** questions.

43. **Numerical response**



Match the numbers in the diagram above with their appropriate labels given below.

Anode	_____	(Record in the first column)
Cathode	_____	(Record in the second column)
Anion Movement	_____	(Record in the third column)
Cation Movement	_____	(Record in the fourth column)

44. As the cell operates, the observations at the cathode will be the _____
- Plating of a silver coloured metal to the electrode
 - Appearance of a blue colour in the solution
 - Plating of a reddish brown coloured metal at the electrode
 - Appearance of bubbles

45. In this Voltaic cell, the anode is _____ and will take a _____ charge. The cathode is _____ and will take a _____ charge.

a	Zinc	Positive	Carbon	negative
b	Carbon	Positive	Zinc	negative
c	Zinc	Negative	Carbon	positive
d	carbon	Negative	Zinc	positive

Use the following information to answer the next **two questions**.

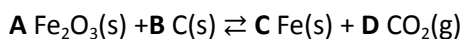
Samples of iron ore ($\text{Fe}_2\text{O}_3(\text{s})$) can be smelted into iron metal by reacting it with coke ($\text{C}(\text{s})$) at high temperatures. Carbon dioxide gas is a waste product.

46. **Numerical Response**

Left justify your answer in the boxes provided

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The unbalanced chemical equation is:



Record the values of the coefficients A, B, C and D in the boxes provided above.

47. In this reaction _____ undergoes oxidation making it the _____ agent. The oxidation number of this chemical entity goes from _____ to _____

a	Iron ore	Reducing	3	0
b	Iron ore	Oxidizing	0	3
c	Carbon	Oxidizing	4	0
d	Carbon	Reducing	0	4

Answers:

1. (135)	2. b	3. (13)	4. c	5. (236)	6. d	7. b	8. b	9. (6483)	10. (414)
11. (1811)	12. d	13. a	14. b	15. b	16. b	17. d	18. a	19. c	20. a
21. (22.7)	22. (66.4)	23. (1221)	24. a	25. (2356)	26.d	27. a	28. (3521)	29. (4786)	30. (1725)
31. b	32. a	33. d	34. b	35. d	36. d	37. b	38. a	39. (5035)	40. c
41. (2557)	42.b	43. (3456)	44. c	45. c	46. (2343)	47. d			