

Ministry-type Questions
(equilibrium, acids and bases, electrochemistry)

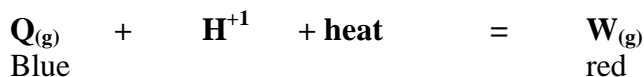
1. Consider the following reactions and reaction types:

Reaction	Type
1. a reaction between zinc and an acid in an open beaker_____	a. irreversible b. reversible c. steady state
2. a reaction in which the rate at which Cu^{+2} forms from Cu is equal to the rate at which Cu^{+2} precipitates into Cu _____	
3. the amount of water in a pool that loses some H_2O to evaporation but gains the same amount from a hose.	
4. $2 \text{NO}_{2(g)} = \text{N}_2\text{O}_{4(g)}$ _____	

Which of the following correctly matches the reactions with the reaction-type?

- A) 1a, 2b, 3c, 4a
- B) 1b, 2c, 3a, 4b
- C) 1a, 2c, 3a, 4a
- D) 1a, 2b, 3c, 4b

2. You are given the equilibrium mixture, which is *light purple in colour*:



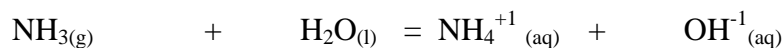
You would like to produce as much **blue gas** as possible.

(4 marks)

Which of the following strategies would *fail*?

- A) Removing acid with a source of hydroxide ion.
- B) Lowering the temperature of the reaction.
- C) Adding a substance that would lower the activation energy
- D) Keep removing Q as it forms.

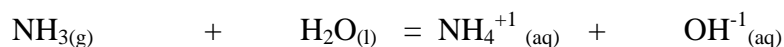
3. If a drying agent was added to the following equilibrium:



which of the following substances would we find *more of* after equilibrium is disturbed?

- A) ammonia (NH₃)
- B) water
- C) ammonium (NH₄⁺¹(aq))
- D) hydroxide

4. If we increased pressure of the vessel containing the following at equilibrium:



which of the following would apply?

- A) There would be no effect on the equilibrium concentrations of the reactants.
- B) The forward reaction would be favoured, resulting in more hydroxide produced.
- C) The system's temperature would decrease and favour whichever reaction is exothermic.
- D) The reverse reaction would be favoured, resulting in less ammonium ion.

5. What chemical equation is associated with the following equilibrium expression:

Watch the subscripts!!

$$K = \frac{[\text{Mn}^{+5}][\text{Cu}^{+2}]}{[\text{Mn}^{+6}][\text{Cu}^{+1}]}$$

- A) $\text{Mn}^{+5}(\text{aq}) + \text{Cu}^{+2}(\text{aq}) = \text{Mn}^{+6}(\text{aq}) + \text{Cu}^{+1}(\text{aq})$
- B) $\text{Mn}^{+5}(\text{l}) + \text{Cu}^{+2}(\text{l}) = \text{Mn}^{+6}(\text{l}) + \text{Cu}^{+1}(\text{l})$
- C) $\text{Mn}^{+6}(\text{aq}) + \text{Cu}^{+1}(\text{aq}) = \text{Mn}^{+5}(\text{aq}) + \text{Cu}^{+2}(\text{aq})$
- D) $\text{Mn}^{+6}(\text{l}) + \text{Cu}^{+1}(\text{l}) = \text{Mn}^{+5}(\text{l}) + \text{Cu}^{+2}(\text{l})$

6. An aqueous solution is found to have 2.0×10^5 times as much $[\text{OH}^-]$ as $[\text{H}^+]$ ion. What is the pOH of the solution?
- A) 4.3
 B) 5.3
 C) 8.7
 D) 9.7
7. When chlorogenic acid in potatoes is exposed to air, oxygen reacts with it, resulting in the formation of a black compound. According to this information, chlorogenic acid is a.....
- A) a reducing agent
 B) an oxidizing agent
 C) a substance that loses electrons
 D) a substance that gains electrons
 E) both A and C
 F) both B and C
 G) both B and D
 H) both A and D
8. A student attaches a zinc electrode into each of two potatoes; a copper electrode is also inserted into each potato. Wires connect the electrochemical cell to a clock. A week later there is no additional Cu formed on the copper electrodes, but the potatoes originally had a pH of about 4. Based on this, which of the following are most likely to be the half reactions powering the clock?
- A) $\text{Zn} \rightarrow \text{Zn}^{+2} + 2\text{e}^-$ $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
 B) $\text{Zn}^{+2} + 2\text{e}^- \rightarrow \text{Zn}$ $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$
 C) $\text{Cu}^{+2} + 2\text{e}^- \rightarrow \text{Cu}$ $\text{Zn} \rightarrow \text{Zn}^{+2} + 2\text{e}^-$
 D) $\text{Cu} \rightarrow \text{Cu}^{+2} + 2\text{e}^-$ $\text{Zn}^{+2} + 2\text{e}^- \rightarrow \text{Zn}$

Show work

9. Given the following at 750°C :

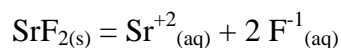
$$K = 0.371$$



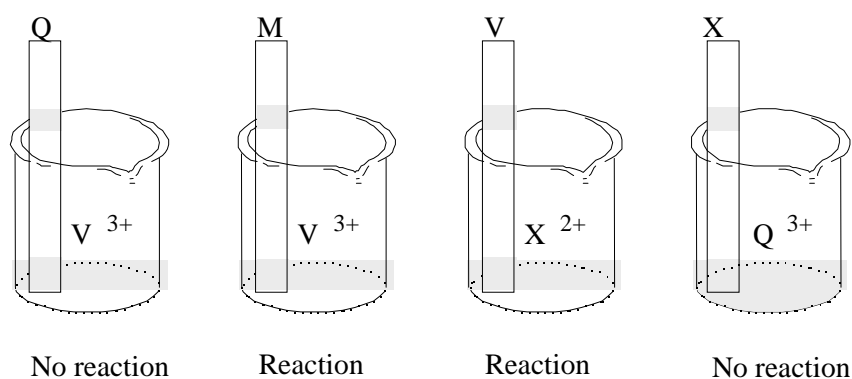
If 0.0100 moles of A and 0.0200 moles of B are mixed in a 2.00 L container, find the equilibrium concentrations for all substances.

(4 marks)

10. How many grams of $\text{SrF}_{2(s)}$ will dissolve in 1.0 L of water if the K for the following reaction is 7.8×10^{-10} ?



11. In the laboratory, you are given different metallic strips and different solutions containing metal ions. You place the strips in the solutions and you observe the following.



- Write an equation showing the strongest oxidizing agent at work. Explain what it's doing to the substance that it's reacting with.
12. When could the overall voltage for an electrochemical cell be the same as the standard reduction potential of a half reaction? Give an example.
13. A student assembled a zinc-silver battery and obtained a voltage that was lower than the expected value. The teacher told him that the battery had been assembled properly. Wiring had nothing to do with the lower voltage. What could have been responsible for the unexpected voltage?

