

EASE 4 CHEMISTRY GRADE 11**Multiple Choice**

Identify the choice that best completes the statement or answers the question.

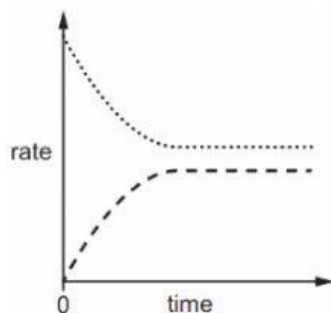
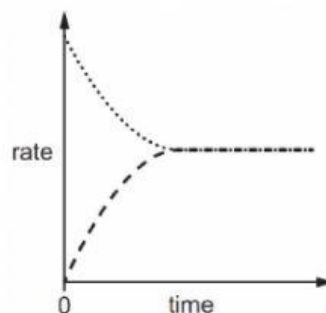
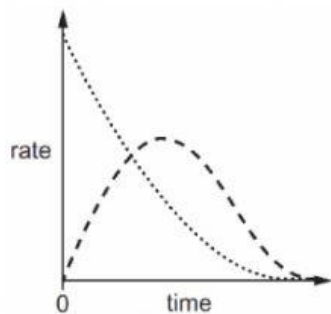
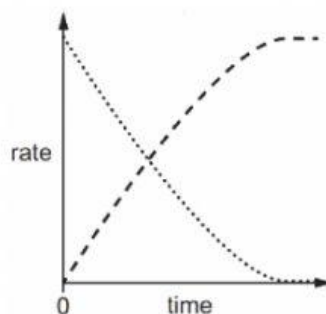
1. Which statements about reversible reactions are correct?

- 1 An increase in concentration of a reactant always increases the concentration of the product.
- 2 An increase in temperature always increases the rate at which the equilibrium is established.
- 3 An increase in temperature always increases the concentration of the product at equilibrium.

A) 1, 2 and 3**C)** 2 and 3**B)** 1 and 2**D)** 1 only**2. Two compounds X and Y react to produce compound Z. The reaction is reversible.**

When X and Y are mixed together in a closed system a dynamic equilibrium is gradually established.

Which graph could represent the change in the rates of the forward and reverse reactions over time?

A)**C)****B)****D)**

6. X and Y react together to form Z in a reversible reaction.

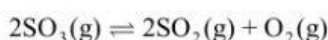
The equilibrium yield of Z is lower at higher temperature.

The equilibrium yield of Z is lower at lower pressure.

Which equation could be represent this reaction?

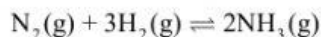
- A) $X(g) + Y(g) \rightleftharpoons Z(g) \quad \Delta H = -100 \text{ kJ mol}^{-1}$ C) $X(s) + Y(g) \rightleftharpoons 2Z(g) \quad \Delta H = -100 \text{ kJ mol}^{-1}$
B) $X(g) + Y(g) \rightleftharpoons Z(g) \quad \Delta H = +100 \text{ kJ mol}^{-1}$ D) $X(s) + Y(g) \rightleftharpoons 2Z(g) \quad \Delta H = +100 \text{ kJ mol}^{-1}$

7. The decomposition of $\text{SO}_3(\text{g})$ is a dynamic equilibrium.



What happens when the pressure of the system is increased?

- A) The rate of reaction will decrease and the position of the equilibrium will move to the left. C) The rate of reaction will increase and the position of the equilibrium will move to the left.
B) The rate of reaction will decrease and the position of the equilibrium will move to the right. D) The rate of reaction will increase and the position of the equilibrium will move to the right.
8. Ammonia is manufactured from nitrogen and hydrogen using the Haber process.



What is the expression for K_c for this equilibrium?

- A) $\frac{2[\text{NH}_3(\text{g})]}{[\text{N}_2(\text{g})] + 3[\text{H}_2(\text{g})]}$ C) $\frac{[\text{NH}_3(\text{g})]^2}{[\text{N}_2(\text{g})] + [\text{H}_2(\text{g})]^3}$
B) $\frac{2[\text{NH}_3(\text{g})]}{[\text{N}_2(\text{g})] \times 3[\text{H}_2(\text{g})]}$ D) $\frac{[\text{NH}_3(\text{g})]^2}{[\text{N}_2(\text{g})] \times [\text{H}_2(\text{g})]^3}$

9. What is the correct expression for K_c for the reaction shown?



- A) $\frac{[2\text{I}^{-}][2\text{Fe}^{3+}]}{[\text{I}_2][2\text{Fe}^{2+}]}$ C) $\frac{[\text{I}_2][2\text{Fe}^{2+}]}{[2\text{I}^{-}][2\text{Fe}^{3+}]}$
B) $\frac{[\text{I}^{-}]^2 [\text{Fe}^{3+}]^2}{[\text{I}_2][\text{Fe}^{2+}]^2}$ D) $\frac{[\text{I}_2][\text{Fe}^{2+}]^2}{[\text{I}^{-}]^2 [\text{Fe}^{3+}]^2}$

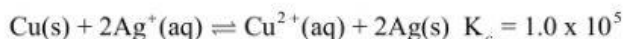
10. The unit of K_c for an equilibrium reaction are $\text{mol}^{-1} \text{dm}^3$.

What could be the equation for the equilibrium?

- 1 $\text{A}(\text{aq}) + \text{B}(\text{aq}) \rightleftharpoons \text{C}(\text{s}) + \text{D}(\text{aq})$
2 $\text{P}(\text{aq}) + \text{Q}(\text{aq}) \rightleftharpoons \text{R}(\text{aq})$
3 $\text{W}(\text{aq}) + 2\text{X}(\text{aq}) \rightleftharpoons \text{Y}(\text{aq}) + \text{Z}(\text{aq})$

- A) 1, 2 and 3 C) 2 and 3
B) 1 and 2 D) 1 only

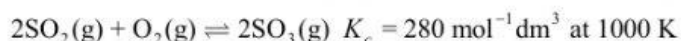
11. When copper is added to a solution of silver ions, the following equilibrium is established.



What is the concentration of silver ions at equilibrium when $[\text{Cu}^{2+}] = 0.10 \text{ mol dm}^{-3}$?

- A) $5.0 \times 10^{-7} \text{ mol dm}^{-3}$ C) $1.0 \times 10^{-3} \text{ mol dm}^{-3}$
B) $5.0 \times 10^{-4} \text{ mol dm}^{-3}$ D) $1.0 \times 10^2 \text{ mol dm}^{-3}$

12. The reaction between sulfur dioxide and oxygen is reversible.



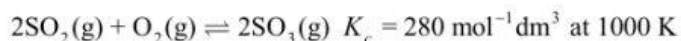
In an equilibrium mixture at 1000 K the sulfur trioxide concentration is 6.00 mol dm^{-3} .

The sulfur dioxide concentration is twice the oxygen concentration.

What is the sulfur dioxide concentration?

- A) $0.175 \text{ mol dm}^{-3}$ C) $0.318 \text{ mol dm}^{-3}$
B) $0.254 \text{ mol dm}^{-3}$ D) $0.636 \text{ mol dm}^{-3}$

13. The reaction between sulfur dioxide and oxygen is reversible.

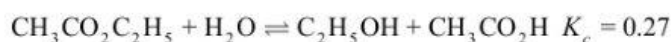


In an equilibrium mixture at 1000 K the sulfur dioxide concentration is $0.200 \text{ mol dm}^{-3}$ and the oxygen concentration is $0.100 \text{ mol dm}^{-3}$.

What is the sulfur trioxide concentration?

- A) $1.058 \text{ mol dm}^{-3}$ C) $2.366 \text{ mol dm}^{-3}$
B) $1.120 \text{ mol dm}^{-3}$ D) $5.600 \text{ mol dm}^{-3}$

14. Ethyl ethanoate undergoes the following reaction.



Equal amounts of ethanoic acid and ethanol were mixed together and allowed to reach equilibrium.

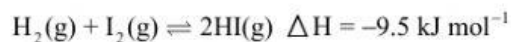
At equilibrium, the concentrations of both ethanoic acid and ethanol were 0.42 mol dm^{-3} .

What is the concentration of ethyl ethanoate at equilibrium?

- A) 0.22 mol dm^{-3} C) 0.81 mol dm^{-3}
B) 0.65 mol dm^{-3} D) 1.54 mol dm^{-3}

15. In this question you should assume that all gases behave ideally.

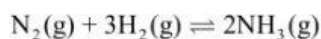
Hydrogen and iodine react reversibly in the following reaction. The system reaches dynamic equilibrium.



Which statement must be true for the K_p of this equilibrium to be constant?

- A) The partial pressure of H_2 , I_2 and HI are equal. C) The forward and reverse reactions have stopped.
B) The external pressure is constant. D) The temperature is constant.

16. The table gives the partial pressure of the gases when the following equilibrium is reached.



	N_2	H_2	NH_3
partial pressure	1	9	1

What is the numerical value of the equilibrium constant, K_p ?

A) $\frac{1}{729}$

C) $\frac{1}{9}$

B) $\frac{1}{27}$

D) 9

17. The manufacture of ammonia from nitrogen and hydrogen is an important industrial process.

Which of the following would leave the equilibrium constant, K_p , for the formation of ammonia unchanged?

- 1 addition of an iron catalyst
- 2 addition of ammonia
- 3 an increase in pressure

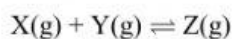
A) 1, 2 and 3

C) 2 and 3

B) 1 and 2

D) 1 only

18. The gases X and Y react to form Z.



An equilibrium mixture of these three gases is compressed at constant temperature.

What will be the changes in the mole fraction of Z and in K_p ?

	mole fraction of Z	K_p
A	increase	increase
B	increase	no change
C	no change	increase
D	no change	no change

A) A

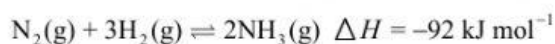
C) C

B) B

D) D

19. Ammonia is manufactured on a large scale by the Haber process.

In a particular plant, conditions of 400 °C and 250 atm in the presence of an iron catalyst are used.



What could contribute most to increasing the equilibrium yield of ammonia?

- A) adding more catalyst
B) increasing the pressure to 400 atm
C) increasing the temperature to 1000 °C
D) using air rather than nitrogen
20. Nitrogen and hydrogen can react together to form ammonia.

The formation of ammonia is exothermic.

The rate and yield of the reaction can be altered by changing the conditions under which the reaction is carried out.

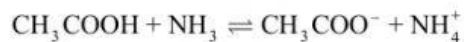
Which row shows the effects of adding iron to the mixture and increasing the temperature?

	adding iron	increasing the temperature
A	has no effect on the equilibrium yield	reduces the equilibrium yield
B	increases the equilibrium yield	increases the equilibrium yield
C	increases the equilibrium yield	increases the rate
D	increases the rate	has no effect on the equilibrium yield

- A) A
B) B

- C) C
D) D

21. The following shows the reaction in aqueous solution.



Which of the following give the correct acid reactant and its conjugate base product?

	acid reactant	conjugate base
1	CH_3COOH	CH_3COO^-
2	CH_3COOH	NH_4^+
3	NH_3	CH_3COO^-
4	NH_3	NH_4^+

- A) 1
B) 2

- C) 3
D) 4

22. Which statements are correct in terms of the Brønsted-Lowry theory of acids and bases?

- 1 Water can act as either an acid or a base.
- 2 Sulfuric acid does not behave as an acid when dissolved in ethanol.
- 3 The ammonium ion acts as a base when dissolved in liquid ammonia.

- A) 1, 2 and 3
B) 1 and 2

- C) 2 and 3
D) 1 only

23. Which statement about the ammonium ion is correct?

- A) It can act as a Brønsted-Lowry base. C) It is pyramidal with bond angles of 107° .
B) It can react with OH^- to give ammonia. D) The nitrogen atom is sp^2 hybridised.

24. Hydrated aluminium ions undergo the following reaction.



Which statement about this reaction is correct?

- A) $\text{H}_2\text{O}(\text{l})$ and $[\text{Al}(\text{H}_2\text{O})_5\text{OH}]^{2+}(\text{aq})$ are a conjugate acid-base pair. C) if $\text{OH}^-(\text{aq})$ is added, the equilibrium will move to the right.
B) $\text{H}_2\text{O}(\text{l})$ is acting as an acid as it is donating H^+ ions. D) K_c varies as the pH is varied.

25. The ionic product of water, K_w , varies with temperature as shown in the following table.

temperature/ $^{\circ}\text{C}$	$K_w/\text{mol}^2 \text{ dm}^{-6}$
25	1.0×10^{-14}
62	1.0×10^{-13}

What conclusion can be drawn from this information?

- A) Water is not a neutral liquid at 62°C .
B) The ionic dissociation of water is an endothermic process.
C) The ionic dissociation of water increases by factor of 5 between 25°C and 62°C .
D) The association of water molecules by hydrogen bonding increases as temperature rises.
26. Water dissociates as follows:



The ionic product of water, K_w , is defines as:

$$[\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6} \text{ at } 298 \text{ K}$$

What deductions be made from these information?

- 1 When water is heated, the concentration of $\text{H}^+(\text{aq})$ increases.
 - 2 When water is heated, the concentration of $\text{OH}^-(\text{aq})$ increases.
 - 3 The pH of pure water at temperature greater than 25°C is greater than 7.
- A) 1, 2 and 3
B) 1 and 2
C) 2 and 3
D) 1 only
27. Which of the following is the pH of a solution of magnesium hydroxide containing $4.0 \times 10^{-5} \text{ mol dm}^{-3}$ of hydroxide ions at 298K?

$$K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$$

- A) 9.6
B) 9.5
C) 8.6
D) 8.3