Name:
Score: 0 / 20 points (0%)

CiF12_chapter 2_rq

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

___ 1. Which of the following reactions will definitely occur spontaneously?

	Change in entropy	Change in enthalpy
a	Positive	Positive
b	Positive	Negative
c	Negative	Negative
d	Negative	Positive

a. a
b. b
c. c
d. d

ANSWER: B
A reaction will favour the movement towards greater randomness. This is indicated by a positive change in entropy (ΔS).
A reaction will be favoured if it releases heat energy. This is indicated by a negative change in enthalpy (ΔH).
Where only one drive is favoured, then it depends which drive has the greater effect on the reaction.
POINTS: 0 / 1
FEEDBACK:
REF: 25

___ 2. Which of the following correctly describes the following chemical system occurring in a beaker:
H_2O (l) → H_2O (g)

	Type of system	Type of change
a	Closed	Chemical
b	Closed	Physical
c	Open	Chemical
d	Open	Physical

a. a
b. b
c. c
d. d

ANSWER: D
The beaker does not have a lid, so it is an open system. The equation indicates a change of state, the boiling of water, which is a physical change.
POINTS: 0 / 1
FEEDBACK:
REF: 28

___ 3. Which of the following chemical systems represents an exothermic chemical change?
a. H_2O (l) → H_2O (g)
b. H_2O (g) → H_2O (l)
c. H_2 (g) + ½O_2 (g) → H_2O (l)

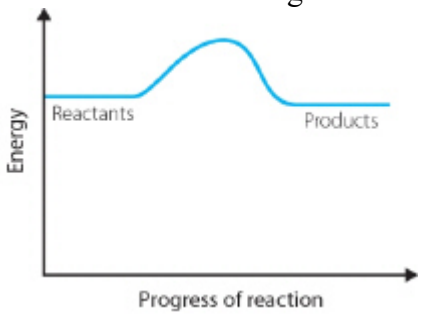
d. $H_2O\ (l) \rightarrow H_2\ (g) + \frac{1}{2}O_2\ (g)$

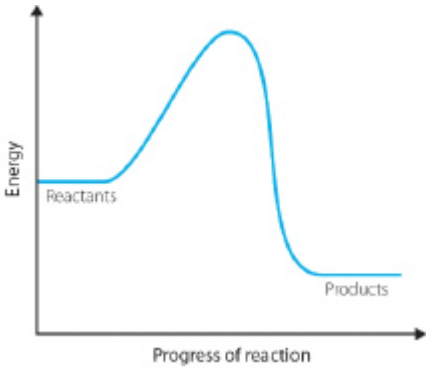
ANSWER: C
Chemical change produces a new substance; hence, the answer must be either C or D. C is a combustion reaction, which releases energy. Hence, C is an exothermic reaction.
POINTS: 0 / 1
FEEDBACK:
REF: 28

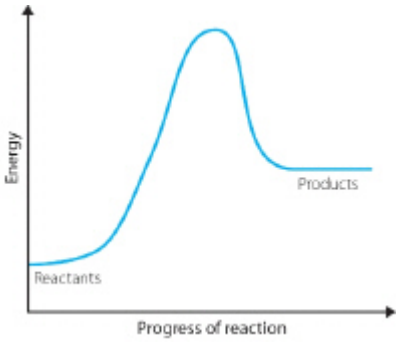
4. Identify the correct statement about reversible reactions.
   a. All physical and chemical changes are reversible reactions.
   b. All physical changes are reversible but only some chemical changes are reversible.
   c. All chemical changes are reversible but only some physical changes are reversible.
   d. Only physical changes are reversible.

ANSWER: B
POINTS: 0 / 1
FEEDBACK:
REF: 29

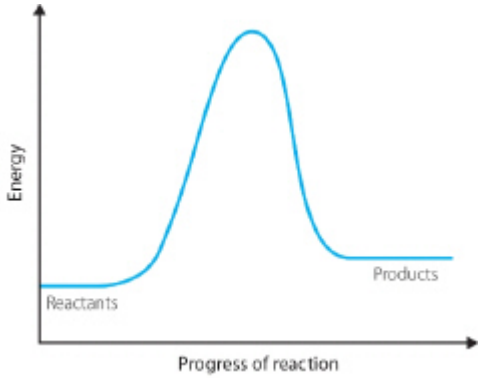
5. Which one of the following indicates the energy profile diagram for a reversible reaction?

a.


b.


c.


d.



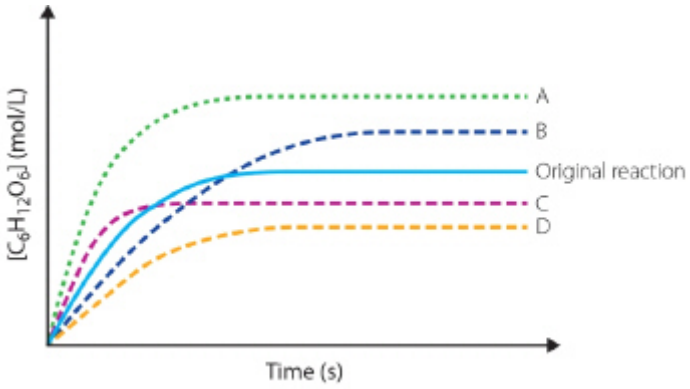
ANSWER: A
For a reaction to be reversible, the activation energies of both the forward and reverse reactions must be low enough that sufficient particles will have enough energy for a successful collision.
POINTS: 0 / 1
FEEDBACK:
REF: 29

6. A closed chemical system commences with only reactants present. The statements below are about a chemical system establishing dynamic equilibrium.
   1 The reverse reaction will start to occur.
   2 Concentration of reactants is high compared to the concentration of the products.
   3 The concentration of products increases.
   4 Products will form at the same rate they are used up.

   Which of the following shows the correct sequence of steps for establishing dynamic equilibrium for this system?
   a. 1, 2, 3, 4
   b. 1, 3, 2, 4
   c. 2, 1, 3, 4
   d. 2, 3, 1, 4

ANSWER: D
Initially, there are no products so the concentration of reactants is high compared to the concentration of products (statement 2). The rate of the forward reaction is high and products begin to form, which increases the concentration of the products (statement 3). Once there are some products present, the reverse reaction starts to occur (statement 1). When equilibrium occurs, the rate of the forward and reverse reactions are the same, so products will form at the same rate they are used up (statement 4).
POINTS: 0 / 1
FEEDBACK:
REF: 34

7. $6CO_2\,(g) + 6H_2O\,(l) \rightleftharpoons C_6H_{12}O_6\,(aq) + 6O_2\,(g)$ ΔH is positive
The reaction is performed at a particular temperature. It is then repeated at a higher temperature.



Which graph shows the results for the reaction at the higher temperature?

a. Graph A
b. Graph B
c. Graph C
d. Graph D

ANSWER: A

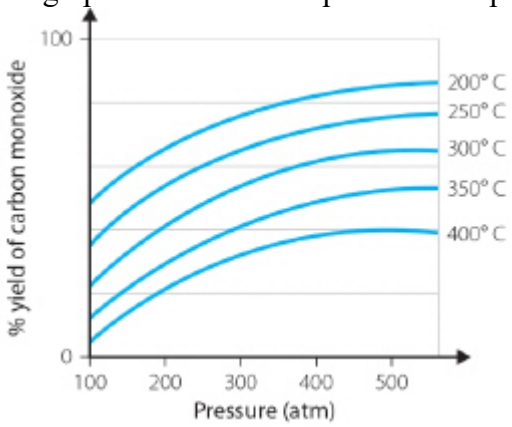
At a higher temperature, the rate of the reaction increases, so the products are formed more quickly, i.e. the initial slope of the graph is steeper. $C_6H_{12}O_6$ is a product. Since the reaction has a positive enthalpy, it is endothermic. Heat is absorbed as the forward reaction occurs. When the temperature of the reaction is increased, heat is added to the system; hence, the system favours the reaction that overcomes this change. Removing heat from the system favours the reaction that absorbs heat – the forward reaction. Therefore, the concentration of $C_6H_{12}O_6$ increases.

POINTS: 0 / 1
FEEDBACK:
REF: 45

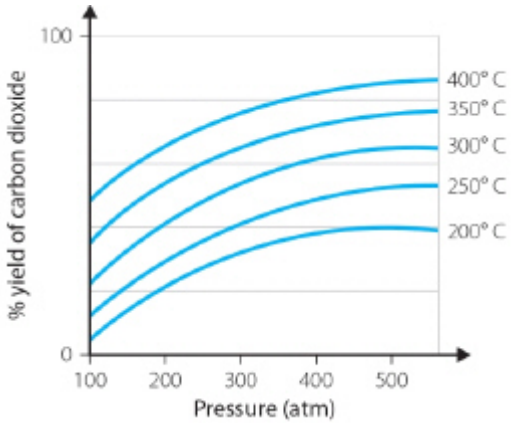
8. $2C\ (s) + O_2\ (g) \rightleftharpoons 2CO\ (g)$ ΔH is negative

Which graph shows how temperature and pressure affect the yield of carbon monoxide?

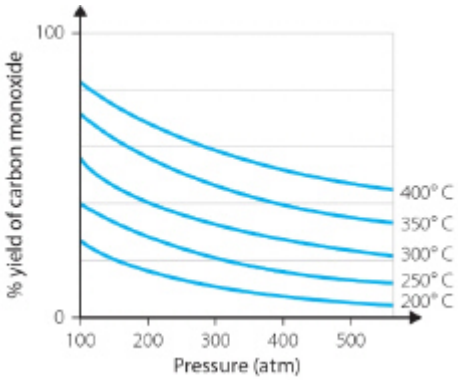
a.

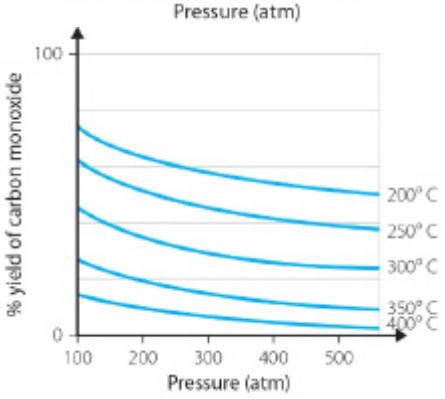


b.



c.





d.

ANSWER: D
CO (g) is a product, so its yield is increased when the forward reaction is favoured.
Solids do not affect heterogeneous systems, so only gases impact this equilibrium.
POINTS: 0 / 1
FEEDBACK:
REF: 46

___ 9. N_2O_4 (g) $\rightleftharpoons$ $2NO_2$ (g) ΔH is positive
Which condition favours the production of nitrogen dioxide?
a. Increasing the pressure
b. Increasing the volume
c. Decreasing the temperature
d. Adding argon gas to the system

ANSWER: B
Le Chatelier's Principle states that the system will adjust to minimise the effect of the change made to system. When volume is increased, less molecules of gas are present in a given volume. The system will favour the reaction that increases the number of molecules of gas in a given volume. Since there is 1 mol of gaseous reactant molecules and 2 moles of gaseous product molecules, the forward reaction is favoured to increase the number of molecules of gas present.
POINTS: 0 / 1
FEEDBACK:
REF: 39

___ 10. Ammonia gas is produced by reacting nitrogen gas with hydrogen gas. The production of ammonia is an exothermic reaction.
Which condition favours the production of ammonia?
a. Increasing the pressure
b. Increasing the volume
c. Increasing the temperature
d. Adding argon gas to the system

ANSWER: A

$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$ ΔH is negative

Le Chatelier's Principle states that the system will adjust to minimise the effect of the change made to system. When pressure is increased, more molecules of gas are present in a given volume. The system will favour the reaction that decreases the number of molecules of gas in a given volume. Since there are 4 moles of gaseous reactant molecules and only 2 moles of gaseous product molecules, the forward reaction is favoured to decrease the number of molecules of gas present.

POINTS: 0 / 1

FEEDBACK:

REF: 41

___ 11. $4HCl\,(g) + O_2\,(g) \rightleftharpoons 2H_2O\,(g) + 2Cl_2\,(g)$ exothermic reaction

Identify the conditions required to favour the forward reaction.

	Pressure	Temperature
a.	High	High
b.	High	Low
c.	Low	High
d.	Low	Low

ANSWER: B

Le Chatelier's Principle states that the system will adjust to minimise the effect of the change made to system. When pressure is increased, more molecules of gas are present in a given volume. The system will favour the reaction that decreases the number of molecules of gas in a given volume. Since there are 5 moles of gaseous reactant molecules and only 4 moles of gaseous product molecules, the forward reaction is favoured to decrease the number of molecules of gas present.

When temperature is decreased, less heat is present in the system. The system favours the reaction that increases the heat released by the system, hence favouring the forward reaction.

POINTS: 0 / 1

FEEDBACK:

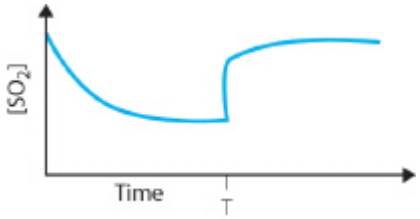
REF: 45–6

___ 12. The equation shows an equilibrium established when sulfur trioxide is produced by reacting sulfur dioxide with oxygen.

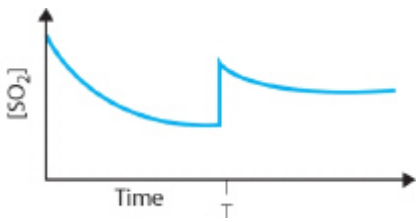
$2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g)$

The volume of the system is halved at time T. Which of the following graphs shows the change in sulfur dioxide over time?

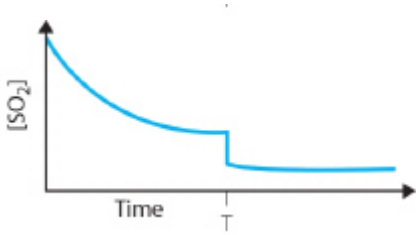
a.



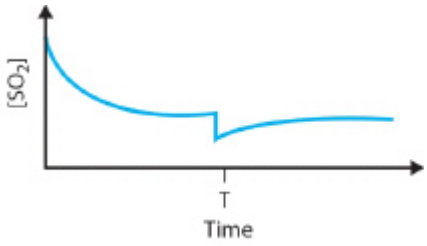
b.



c.

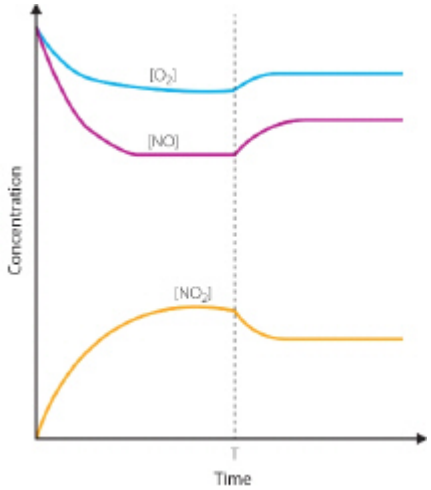


d.



ANSWER: B
When the volume of the container is halved, the molecules of gas are in a smaller volume. This increases the concentration of all gases. Hence, the concentration of sulfur dioxide increases at time T. According to Le Chatelier's Principle, the system then adjusts to minimise the impact of this change; therefore, it favours the reaction that produces less molecules of gas. In this reaction, it favours the forward reaction, thus the concentration of sulfur dioxide decreases as equilibrium is re-established.
POINTS: 0 / 1
FEEDBACK:
REF: 43

13. $2NO\ (g) + O_2\ (g) \rightleftharpoons 2NO_2\ (g)$ ΔH is negative



Which of the following occurred at time T?
a. increase in volume
b. decrease in volume
c. increase in temperature
d. decrease in temperature

ANSWER: C
If the volume changed, there would be a sudden change in concentration for all gases before equilibrium is re-established. This has not occurred, so no change in volume occurred. Reaction is exothermic, so heat is produced of the forward reaction is favoured. When temperature is increased, the system adjusts to minimise this increase in heat by favouring the reaction that absorbs heat. This favours the reverse reaction, which leads to an increase in the concentration of both oxygen and nitrogen oxide and a decrease in the concentration of nitrogen dioxide.

POINTS: 0 / 1
FEEDBACK:
REF: 43

___ 14. Which of the following statements is true for a reaction that has reached equilibrium?
a. The concentration of reactants is zero.
b. The amount of products is equal to the amount of reactants.
c. Both the forward and reverse reactions have stopped.
d. The rate of the forward and reverse reactions is equal.

ANSWER: D
Equilibrium is established when the rate of the forward reaction equals the rate of the reverse reaction
POINTS: 0 / 1
FEEDBACK:
REF: 34

___ 15. In this reaction, initially only ammonia is present in the reaction vessel. Which effect is shown as equilibrium is approached?

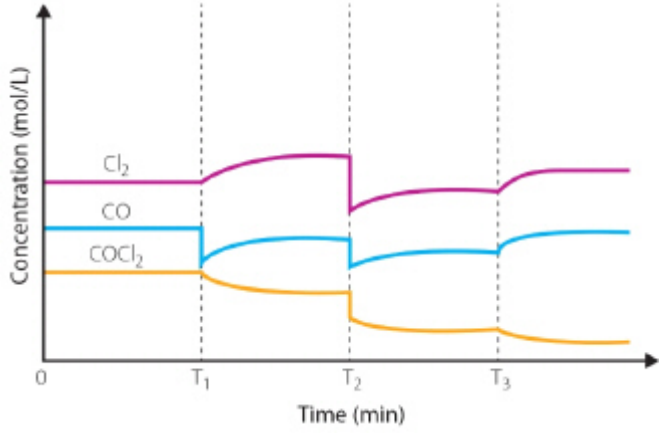
$2NH_3\,(g) \rightleftharpoons N_2\,(g) + 3H_2\,(g)$

	Rate of reverse reaction	$[H_2]$
a	Decreases	Decreases
b	Decreases	Increases
c	Increases	Decreases
d	Increases	Increases

a. a
b. b
c. c
d. d

ANSWER: D
Since there is only ammonia present initially, then there is only a forward reaction initially. Hence, the rate of the reverse reaction increases as the equilibrium is approached. Initially, there is no hydrogen present, so its concentration increases as equilibrium is established.
POINTS: 0 / 1
FEEDBACK:
REF: 39

___ 16. $COCl_2\,(g) \rightleftharpoons CO\,(g) + Cl_2\,(g)$ $\Delta H = +108$ kJ
The graph below shows the changes in concentration for each of the reactants and products over time.



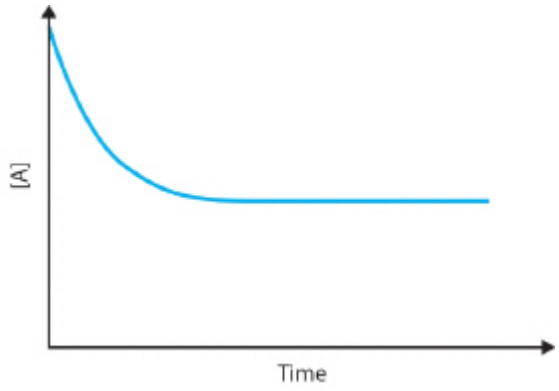
Identify the changes that occur at T_1, T_2 and T_3.

	T_1	T_2	T_3
a	Decrease in [CO]	Increase in volume	Increase in temperature
b	Decrease in [$COCl_2$]	Increase in pressure	Decrease in temperature
c	Decrease in [$COCl_2$]	Increase in temperature	Increase in volume
d	Decrease in [CO]	Decrease in temperature	Increase in pressure

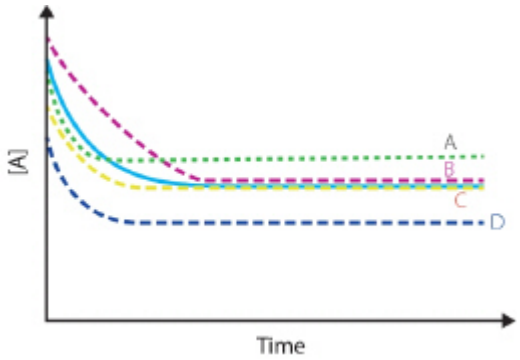
a. a
b. b
c. c
d. d

ANSWER: A
At T_1, only the concentration of CO suddenly decreases. At T_2, the concentration of all reactants and products decreases; hence, the volume of the reaction vessel has increased. At T3, there is no sudden change in concentration of any reactant or product, so the change is due to a change in temperature. Since the reaction is endothermic, the increase in temperature favours the forward reaction, which increases the concentration of CO and Cl_2.
POINTS: 0 / 1
FEEDBACK:
REF: 37

17. $2A(g) + B(g) \rightleftharpoons 2C(g)$ ΔH is positive
The graph shows the change in concentration of *A*, as the reaction approaches equilibrium.



A catalyst was added when the experiment was repeated. Which of the graphs represents this?



a. Graph A
b. Graph B
c. Graph C
d. Graph D

ANSWER: C

A catalyst increases the rate of both the forward and reverse reactions. Therefore, equilibrium is reached in a shorter period of time, but the position of the equilibrium is unchanged.

POINTS: 0 / 1
FEEDBACK:
REF: 49

___ 18. N_2 (g) + $3H_2$ (g) $\leftrightharpoons$ $2NH_3$ (g) ΔH is negative

A magnetite catalyst is used for the Haber process. The catalyst:

a. increases the rate of both the forward and reverse reactions and shifts the equilibrium to the right.
b. increases the rate of both the forward and reverse reactions and shifts the equilibrium to the left.
c. increases the time for the reaction but does not change the position of the equilibrium.
d. decreases the time for the reaction but does not change the position of the equilibrium.

ANSWER: D
Catalysts decrease the activation energy of both the forward and reverse reactions; hence, the rate of both reactions increases and the time for the reaction decreases. A catalyst does not affect the equilibrium position.
POINTS: 0 / 1
FEEDBACK:
REF: 49

___ 19. An equilibrium will exist between $[Co(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$ when they are in a solution. The equation representing this is:

$[Co(H_2O)_6]^{2+}$ (aq) + $4Cl_2$ (aq) $\rightleftharpoons$ $[CoCl_4]^{2-}$ (aq) + $6H_2O$ (l)

The $[Co(H_2O)_6]^{2+}$ ion is a pink colour while the $[CoCl_4]^{2-}$ ion is a deep blue colour.

The reaction mixture is heated until it is almost boiling. The reaction mixture turns blue.

This reaction is:

a. endothermic and favours the production of $[Co(H_2O)_6]^{2+}$.
b. endothermic and favours the production of $[CoCl_4]^{2-}$.
c. exothermic and favours the production of $[Co(H_2O)_6]^{2+}$.
d. exothermic and favours the production of $[CoCl_4]^{2-}$.

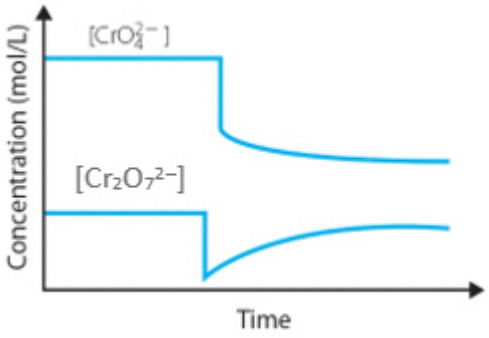
ANSWER: B
The reaction mixture turned blue, which indicates the production of $[CoCl_4]^{2-}$. This shows that the forward reaction was favoured when the temperature was increased; therefore, the reaction is endothermic.
POINTS: 0 / 1
FEEDBACK:
REF: 46

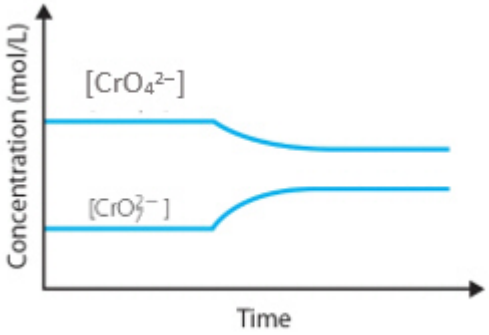
___ 20. Consider the equilibrium between chromate and dichromate:

$2CrO_4^{2-}$ (aq) + $2H^+$ (aq) $\rightleftharpoons$ $Cr_2O_7^{2-}$ (aq) + H_2O (l)

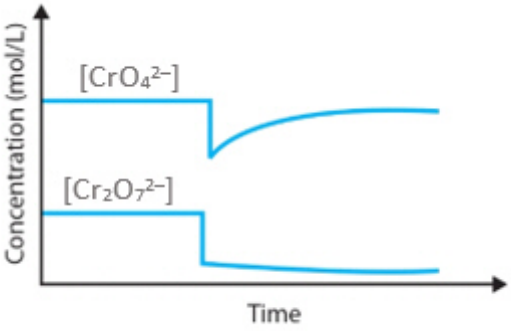
Water is added to the solution. Which graph indicates the effect on the concentration of the chromate and the dichromate ions?

a.

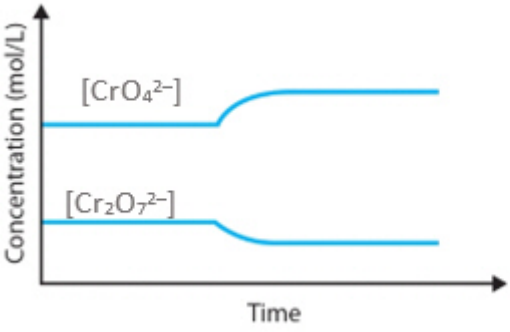




b.



c.



d.

ANSWER: C

Water is added, which decreases the concentration of the each of the aqueous reactants and aqueous products. The system then adjusts to minimise this change by favouring the reaction that increases the number of moles. There are 4 moles of aqueous reactants but only 1 mole of aqueous products, so the reverse reaction is favoured. Therefore, the [CrO_4^{2-}] increases and the [$Cr_2O_7^{2-}$] decreases.

POINTS: 0 / 1

FEEDBACK:

REF: 40

Retake