

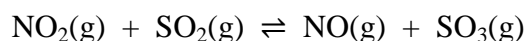
1. When carbon is burnt in excess oxygen, the only product is carbon dioxide. Calculate the volume of $\text{CO}_2(\text{g})$ at $120\text{ }^\circ\text{C}$ and 1.20 atm produced from 2.8 g of carbon.

- a) 1.9 L b) 6.3 L c) 13 L d) 190 L e) 635 L

2. An ideal gas receives 245 J of heat and expands by 1.30 L against an external pressure of 60.0 kPa . What is the change in internal energy of the system?

- a) $+167\text{ J}$
 b) $+323\text{ J}$
 c) -323 J
 d) -167 J
 e) 0 J as there are no forces between ideal gas molecules

3. $K_p = 85$ at $460\text{ }^\circ\text{C}$ and $K_p = 21$ at $800\text{ }^\circ\text{C}$ for the following reaction:



Which one of the following statements is true?

- a) $\Delta_r H^\circ > 0$ and $K_c < K_p$
 b) $\Delta_r H^\circ < 0$ and $K_c > K_p$
 c) $\Delta_r H^\circ = 0$ and $K_c = K_p$
 d) $\Delta_r H^\circ < 0$ and $K_c = K_p$
 e) $\Delta_r H^\circ > 0$ and $K_c = K_p$

4. Consider the following reaction: $2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$ $K_p = 7.1$ at $25\text{ }^\circ\text{C}$

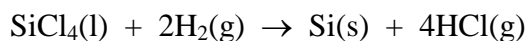
What is the value of K_p for the following reaction at $25\text{ }^\circ\text{C}$?

- a) -7.1 $\frac{1}{2}\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons \text{NO}_2(\text{g})$
 b) -3.6
 c) 0.14
 d) 0.37
 e) 0.020

5. Given the following thermochemical data, what is the enthalpy of formation $\Delta_f H^\circ_{298}$ for $\text{C}_2\text{H}_5\text{OH}(\text{l})$ at 298 K and 100 kPa ?

- a) $+277\text{ kJ mol}^{-1}$ $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$ $\Delta H^\circ = -393\text{ kJ mol}^{-1}$
 b) -277 kJ mol^{-1} $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$ $\Delta H^\circ = -286\text{ kJ mol}^{-1}$
 c) -688 kJ mol^{-1} $\text{C}_2\text{H}_5\text{OH}(\text{l}) + 3\text{O}_2(\text{g}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + 2\text{CO}_2(\text{g})$ $\Delta H^\circ = -1367\text{ kJ mol}^{-1}$
 d) $+688\text{ kJ mol}^{-1}$
 e) $+542\text{ kJ mol}^{-1}$

6. What is the enthalpy change for the following reaction?



Data:

Compound	$\Delta_f H^\circ / \text{kJ mol}^{-1}$
$\text{SiCl}_4(\text{l})$	-687
$\text{HCl}(\text{g})$	-92

- a) -319 kJ mol^{-1}
- b) $+319 \text{ kJ mol}^{-1}$
- c) $+1055 \text{ kJ mol}^{-1}$
- d) -895 kJ mol^{-1}
- e) $-1055 \text{ kJ mol}^{-1}$

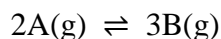
7. Which one of the following compounds has an unpaired electron?

- a) NO_2
- b) N_2H_4
- c) N_2O_4
- d) N_2O
- e) N_2

8. What is the oxidation number of nitrogen in NCl_3 ?

- a) -III
- b) -I
- c) 0
- d) +I
- e) +III

9. Samples of A (2.0 mol) and B (3.0 mol) are placed in a 10.0 L container and the following reaction takes place



At equilibrium, the concentration of A is 0.14 M. What is the value of K_c ?

- a) 3.0
- b) 0.33
- c) 2.4
- d) 0.42
- e) 6.8

10. For the reaction in question 9, what is the effect of increasing the volume of the container at constant temperature?

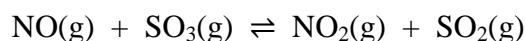
- a) K_c increases because all the reactant and product concentrations increase.
- b) The reaction proceeds towards the reactants.
- c) No change because the reaction does not alter the total number of moles present.
- d) The reaction proceeds towards the products.
- e) There is insufficient information provided to make a prediction.

Correct answers: 1B, 2A, 3D, 4D, 5B, 6B, 7A, 8E, 9A, 10D

1. Lead(II) sulfide dissolves in excess nitric acid according to the equation below. Calculate the volume of NO(g) at 27 °C and 1.10 atm produced from 4.7 g of PbS(s).



- a) 0.29 L b) 0.44 L c) 0.66 L d) 30. L e) 45 L
2. An ideal gas receives 245 J of heat and contracts by 1.30 L against an external pressure of 60.0 kPa. What is the change in internal energy of the system?
- a) +167 J
b) +323 J
c) -323 J
d) -167 J
e) 0 kJ as there are no forces between ideal gas molecules
3. $K_p = 0.012$ at 460 °C and $K_p = 0.048$ at 800 °C for the following reaction:



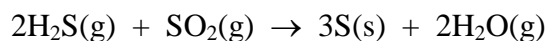
Which one of the following statements is true?

- a) $\Delta_r H^\circ > 0$ and $K_c < K_p$
b) $\Delta_r H^\circ < 0$ and $K_c > K_p$
c) $\Delta_r H^\circ = 0$ and $K_c = K_p$
d) $\Delta_r H^\circ < 0$ and $K_c = K_p$
e) $\Delta_r H^\circ > 0$ and $K_c = K_p$
4. Consider the following reaction: $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ $K_p = 0.14$ at 25 °C
What is the value of K_p for the following reaction at 25 °C?
- a) 7.1 $4\text{NO}_2(\text{g}) \rightleftharpoons 2\text{N}_2\text{O}_4(\text{g})$
b) -3.6
c) 51
d) 0.14
e) 0.37

5. Given the following thermochemical data, what is the enthalpy of formation $\Delta_f H^\circ_{298}$ for PF₅(g) at 298 K and 100 kPa?

- a) +582 kJ mol⁻¹ $2\text{P(s)} + 3\text{F}_2(\text{g}) \rightarrow 2\text{PF}_3(\text{g})$ $\Delta H^\circ = -1838 \text{ kJ mol}^{-1}$
b) -1163 kJ mol⁻¹ $\text{PF}_3(\text{g}) + \text{F}_2(\text{g}) \rightarrow \text{PF}_5(\text{g})$ $\Delta H^\circ = -675 \text{ kJ mol}^{-1}$
c) -1257 kJ mol⁻¹
d) -1594 kJ mol⁻¹
e) -2513 kJ mol⁻¹

6. What is the enthalpy change for the following reaction?



Data:

Compound	$\Delta_f H^\circ / \text{kJ mol}^{-1}$
$\text{H}_2\text{S}(\text{g})$	-21
$\text{SO}_2(\text{g})$	-297
$\text{H}_2\text{O}(\text{g})$	-242

- a) -145 kJ mol^{-1}
- b) $+145 \text{ kJ mol}^{-1}$
- c) $+76 \text{ kJ mol}^{-1}$
- d) -76 kJ mol^{-1}
- e) -823 kJ mol^{-1}

7. Which one of the following compounds has an unpaired electron?

- a) NH_3
- b) N_2O_4
- c) N_2O
- d) NO
- e) N_2

8. What is the oxidation number of nitrogen in NH_2^- ?

- a) +III
- b) +I
- c) 0
- d) -I
- e) -III

9. Samples of A (4.0 mol) and B (2.0 mol) are placed in a 5.0 L container and the following reaction takes place $3\text{A}(\text{g}) \rightleftharpoons 2\text{B}(\text{g})$

At equilibrium, the concentration of A is 0.82 M. What is the value of K_c ?

- a) 0.27
- b) 0.31
- c) 2.4
- d) 4.0
- e) 30.

10. For the reaction in question 9, what is the effect of decreasing the volume of the container at constant temperature?

- a) K_c increases because the product concentration increases.
- b) K_c decreases because the reactant concentration increases.
- c) No change because the reaction does not alter the total number of moles present.
- d) The reaction proceeds towards the products.
- e) The reaction proceeds towards the reactants.

Correct answers: 1A, 2B, 3E, 4C, 5D, 6A, 7D, 8E, 9A, 10D