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VCE Chemistry  $\frac{3}{4}$   
Equilibrium [2.7]  
Test

20 Marks. 1 Minute Reading. 16 Minutes Writing.

Results:

Test Questions	_____ / 15
Extension	_____ / 5



## Section A: Test Questions (15 Marks)

### Question 1 (4 marks)

Tick whether the following statements are **true** or **false**.

Statement	True	False
a. If a reaction is reversible, this means that both the forward and backward reactions occur at the same time.		
b. In VCE chemistry, we study equilibria occurring in open systems.		
c. A dynamic equilibrium is established when the forward and backward reactions occur at the same rate and subsequently stop reacting.		
d. The $K_c$ value gives you the ratio of the concentration of reactants to the concentration of products.		
e. Equilibria in which solids and liquids are present are assigned a 'concentration' value of 1, and consequently ignored in $K_c$ and $Q_c$ expressions.		
f. If a particular reaction has a large extent of reaction, its $Q_c$ value will be high.		
g. If the $Q_c$ value is less than the $K_c$ value, the rate of the forward reaction will be greater than the rate of the reverse reaction until equilibrium is established.		
h. RICE tables are used to find the <b>moles</b> of each reactant and product at equilibrium, and then these values are directly plugged into the $K_c$ expression to obtain the equilibrium constant.		

Space for Personal Notes

**Question 2** (6 marks)

Henry is investigating the reaction between nitrogen and oxygen to produce nitrogen monoxide:



- a.** Explain what can be said about the extent of the reaction above at  $25^\circ\text{C}$ . Justify your answer with reference to the position of equilibrium. (2 marks)

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**b.**

- i.** Calculate the  $K_c$  value for the reaction,  $\text{NO}(\text{g}) \rightleftharpoons \frac{1}{2}\text{N}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g})$  at  $25^\circ\text{C}$ . (1 mark)

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- ii.** For the reaction provided in **part b. i.** if the reaction takes place in a  $2.00\text{ L}$  vessel and  $[\text{NO}] = 2.30 \times 10^2\text{ M}$  and  $[\text{O}_2] = 1.80 \times 10^3\text{ M}$  at equilibrium, calculate the amount, in  $\text{M mol}$ , of  $\text{N}_2$  which must be present in the vessel when the rates of the forward and reverse reactions are equal. (3 marks)

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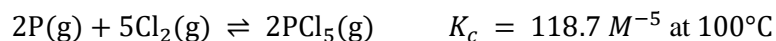
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**Question 3** (5 marks)

The following reversible reaction is being investigated in a laboratory:



The reaction was initiated by mixing 2.32 *mol* of phosphorus with 5.27 *mol* of chlorine in a sealed, 5.00 *L* evacuated vessel at 100°C. 10 minutes into the reaction, it is observed that the concentration of  $\text{PCl}_5$  is 0.333 *M*.

- a.** Calculate the reaction quotient for this reaction once 10 minutes have elapsed. (3 marks)

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- b.** State whether the system is at equilibrium 10 minutes into the reaction or not. If not, explain how the reactions will progress towards equilibrium. (1 mark)

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- c.** Had this reaction occurred in a compressed, 1.00 *L* vessel (still at 100°C), predict the effect this would have had on the equilibrium constant. (1 mark)

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- b. Anika decides to conduct the same experiment at a slightly cooler temperature to ensure her safety and calculates the system's reaction quotient ( $Q_c$ ) after 5 minutes, obtaining a value of 26.9. Explain what Anika may conclude about the position of equilibrium in this instance. (1 mark)

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VCE Chemistry  $\frac{3}{4}$

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