

CHEMISTRY DEPARTMENT 2024
S.6 BRAINSTORMING TEST
TOPIC; CHEMICAL EQUILIBRIA

TIME; 1hour 30mins

NAME.....**INDEX number**.....

Signature **Stream**

Instructions; Attempt all questions in this paper.

1. (a) Explain what is meant by the term **equilibrium constant**

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(b) State any three characteristics of an equilibrium reaction

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(c) Differentiate between heterogeneous and homogenous equilibrium reactions. (where necessary give an example)

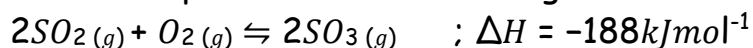
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2. During the manufacture of sulphuric acid by contact process, sulphur dioxide is oxidised to sulphur trioxide according to the following equation.



(a) State two conditions for maximum yield of sulphur trioxide

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(b) Derive an expression for relationship between K_c and K_p for the above reaction

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(c) State the source of

(i) Sulphur dioxide

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(ii) Oxygen
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(d) State and explain the effect on the yield of sulphur trioxide if

(i). Temperature was increased

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(ii). Pressure was decreased

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(iii). Concentration of sulphur dioxide was increased.

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(iv) Excess nitrogen added

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(d). (i) Explain why sulphur trioxide is not directly reacted with water but rather another solvent during manufacture of sulphuric acid.

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(ii) Write equations to show how sulphuric acid can be obtained from that solvent.

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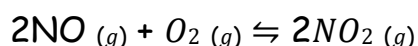
(ii) Write an equation for the reaction to show how calcium single phosphate fertilizer can be obtained from sulphuric acid

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(e) State one use of sulphuric acid

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3. Nitrogen monoxide combines with oxygen according to the following equation



(a). Write an expression for the equilibrium constant K_c

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(b). 3.0 moles of nitrogen monoxide and 1.5 moles of oxygen were put in a 1litre vessel. When equilibrium was attained, the vessel was found to contain 0.5 moles of oxygen.

Calculate the equilibrium constant K_c at this temperature.

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4. (a). The degree of dissociation of 3.4 moles of hydrogen iodide at 460°C was found to be 20%. Calculate the
 (i). Number of moles of hydrogen iodide, hydrogen and iodine formed at equilibrium.

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(ii). Equilibrium constant, K_c , for the dissociation reaction.

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5. Sulphuryl dichloride decomposes when heated according to the following equation.



When 67.5g of sulphur dioxide dichloride was heated in a 1dm³ vessel at 120°C and 3.6 atmospheres, it was found that at equilibrium, 45% of it had decomposed.

(i). Write the expression for the equilibrium constant, K_p .

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(ii). Calculate the number of moles of each component present at equilibrium.

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(iii). Determine the value of the equilibrium constant, K_c .

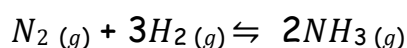
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6. Hydrogen reacts with nitrogen to produce ammonia according to the following equation



(a) State two conditions for maximum yield of ammonia

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(b) State the source of

(i) Nitrogen

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(ii) Hydrogen

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(b). Write the expression for the equilibrium constant, K_c .

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(c). Stoichiometric amounts of nitrogen and hydrogen were reacted at 40 atm and at equilibrium, 0.8 moles of ammonia was formed. Calculate the

(i). Amount of hydrogen at equilibrium

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(ii). Value of the equilibrium constant, K_p

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(d). State giving reasons, what would happen to the value of equilibrium constant when

(i). Pressure is increased.

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(ii). Argon is added to the reaction mixture at constant pressure

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(iii). Argon is added to the reaction mixture at constant volume

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7. (a). Phosphorus(V) chloride decomposes according to the equation.



Deduce that the total pressure, $P_T = 3K_p$ when 50% of phosphorus(V) chloride has dissociated.

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b) At a given temperature, 3.2 moles of phosphorus pentachloride dissociated so that at equilibrium, it was found to contain 20% chlorine. Calculate the value of K_c .

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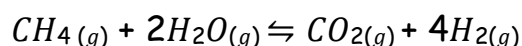
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8. Methane reacts with steam according to the equation



When 0.18 moles of methane and 0.22 moles of steam were heated in a 5dm^3 vessel, 0.1 moles of carbon dioxide was found to be present at equilibrium. Calculate the value of K_c .

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8. Briefly describe an experiment to determine the equilibrium concentration constant for a reaction between ethanol and ethanoic acid

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