NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – JULY 2013
REACTOR TECHNOLOGY – SCH 4208 FOR TTE
TIME: THREE (3) HOURS

MATERIAL
Graph papers.

INSTRUCTIONS TO STUDENTS
Answer All questions
Answer each question on a FRESH page.

R = 8.314 $JK^{-1}mol^{-1}$ = 0.08205 dm^3 atm $K^{-1}mol^{-1}$.

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1. (a) In the contact process for the manufacture of sulphuric acid, molten sulphur is burnt with air in a sulphur burner to produce $SO_2(g)$ which is then oxidized in a catalytic reactor to $SO_3(g)$. If the sulphur is burnt at the rate of 20 kg/min, how much $SO_3(g)$ is produced, and what is the minimum air requirement? Air can be taken to contain 21 mole % O_2 and 79 mole % N_2 and its relative molecular mass is 29. [8 marks]

   (b) The natural abundance of ^{235}U in uranium is 0.79 atom %. If a sample of uranium is enriched to 3 at. % and then is stored in salt mines under the ground, how long will it take the sample to reach the natural abundance level of ^{235}U (assuming no other processes form ^{235}U). The half-life of ^{235}U is 7.13 X 10^8 years. [12 marks]

2. (a) Discuss the models used to describe gas solid non-catalytic reactions. [10 marks]

   (b) The pyrolysis of ethane proceeds with an activation energy of about 300 kJ/mol. How much faster is the decomposition at 650°C than at 500^{o}C? [10 marks]

3. a) For any two types of reactors, discuss the advantages, limitations, and applications of each type of reactor. [16 marks]

   b) Which type of reactor is preferred if the rate of heat evolution is high. [4 marks]

4. a) Describe methods which can be used to control the temperature in a batch reactor whose reaction is exothermic. [8 marks]

   b) Determine the time taken to effect an 80% conversion on a 1^{st} order reaction in a batch reactor whose rate constant is 0.00678 min^{-1}. [12 marks]

5. Fixed-bed and fluidized-bed reactors are some of the most important industrial reactors. With the aid of sketch diagrams explain their mode of operation and where they are applied. [20 marks]

END OF QUESTION PAPER!!!