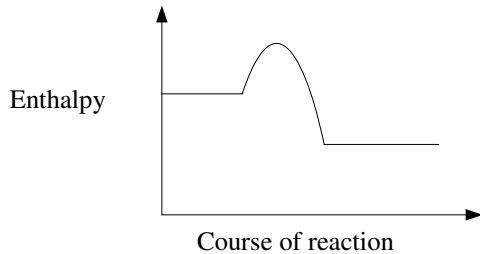


## Year 11 Chemistry Test

### Rate and Equilibrium

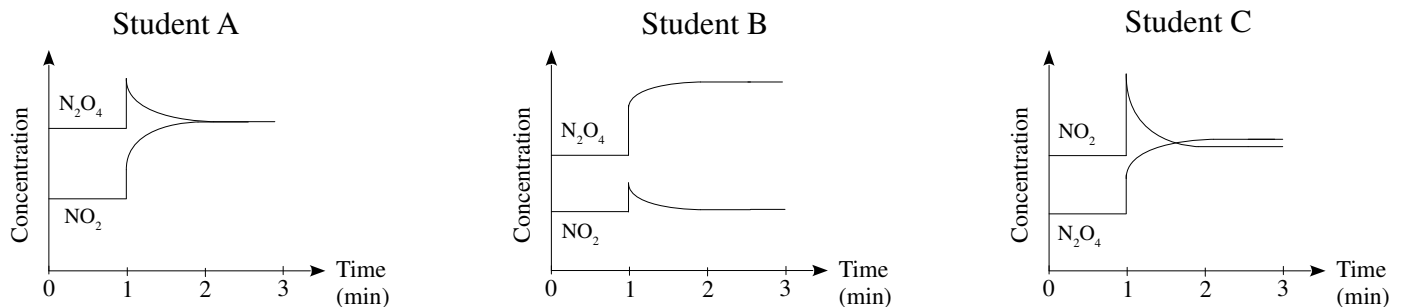
1. Consider the energy profile diagram below:



- (a) Explain, with reference to  $\Delta H$ , whether this reaction is endothermic or exothermic. /2
- (b) "An exothermic reaction will be faster than an endothermic reaction."  
Explain whether you agree and/or disagree with this statement. /2
- (c) Draw on the energy profile diagram to show the effect of adding a catalyst. /1
- (d) Describe what this shows the catalyst does. /2
- (e) State why an appropriate enzyme could have this effect. /1
- (f) Describe an example of the use of enzymes. /2

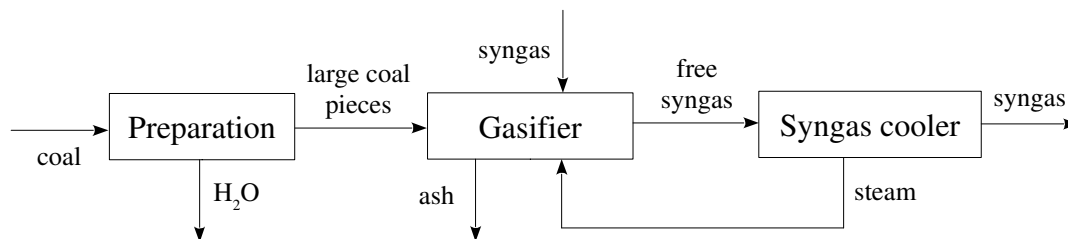
2. Consider an equilibrium system for  $2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$

Three students have drawn answers for question "The pressure is increased. Draw a concentration-time graph to show the reaction that occurs."



- (a) State the two conditions required for a reversible reaction to reach equilibrium. /2
- (b) State the time at which the slope of the graphs is greatest. /1
- (c) State what the slope of the graph represents. /1
- (d) "When the slope of the graph is horizontal, the reaction has stopped."  
Explain whether you agree and/or disagree with this statement. /2
- (e) State which student has given the most correct answer. Explain why it is the most correct. /3
- (f) Write the  $K_C$  expression for this reaction. /1
- (g) For this reaction at  $25^\circ\text{C}$ ,  $K_C = 0.0061$ .  
If the concentrations are  $[\text{NO}_2] = 18 \text{ mol L}^{-1}$  and  $[\text{N}_2\text{O}_4] = 0.11 \text{ mol L}^{-1}$  at  $25^\circ\text{C}$ , determine whether the system is at equilibrium. /2

3. The flow chart below shows the main steps in gasification of coal.



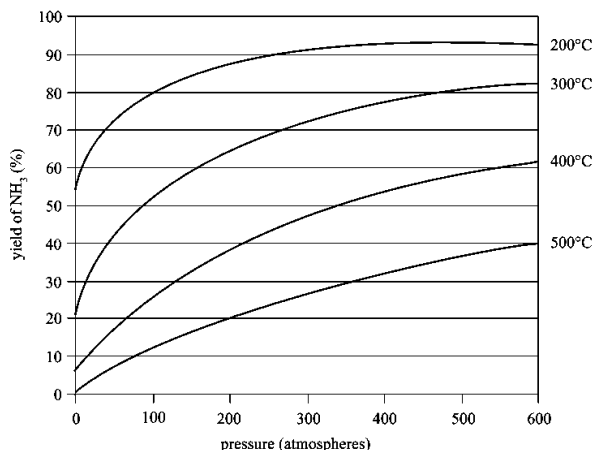
- (a) State one raw material shown on the flowchart above. /1
- (b) State one by-product shown on the flowchart above. /1
- (c) Suggest one improvement that could be made to this process above. /1
- (d) The manufacturer uses a catalyst to increase the rate of reaction of the Gasifier step.
- (i) Suggest two ways (other than a catalyst) the manufacturer could increase the rate of reaction. /2
- (ii) State one advantage for the manufacturer of using a catalyst rather than the suggested ways. /1
- (e) The reaction that takes place in the Gasifier step is exothermic.  
Explain whether high or low temperature conditions would maximise yield. /3

TOTAL MARKS /31

### BONUS QUESTIONS

*Explain-y bonus question:*

The yield of  $\text{NH}_3$  produced in an industrial process is affected by different reaction conditions, as shown below:



Explain whether the reaction to produce  $\text{NH}_3$  is exothermic or endothermic.

*Analogy bonus question:*

Write and explain an analogy for either Collision Theory or Le Chatelier's Principle.

*Maths-y bonus question:*

Consider an equilibrium system for  $2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$  with  $K_C = 0.5$

If the initial concentrations are  $[\text{NO}_2] = 2 \text{ mol L}^{-1}$  and  $[\text{N}_2\text{O}_4] = 0 \text{ mol L}^{-1}$ , use the  $K_C$  expression to determine the final concentration of  $\text{NO}_2$ .