A. Exothermic and endothermic reactions

1. How would you know if an exothermic reaction had occurred?

2. How would you know if an endothermic reaction had occurred?

3. Below is a table of results for four reactions, the temperatures before and after the reactions are also given.

Reaction	Temperature at start ^{O}C	Temperature at end ^{O}C
A	22	28
B	20	20
C	21	12
D	25	25

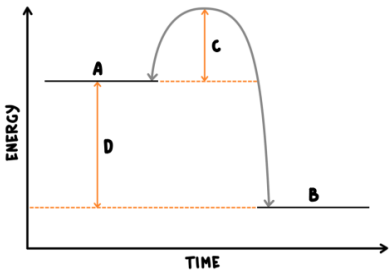
a) Which reaction is endothermic? Explain how you know this.

b) Which reaction is exothermic? Explain how you know this.

B. Activation energies and reaction profiles

1. What is meant by the term activation energy?

2. On the reaction profile below what is shown by the letters?



3. What two things are needed for a chemical reaction to occur?

4. What is an exothermic reaction?

5. What is an endothermic reaction?

C. The Energy Change of Reactions – HIGHER Tier ONLY

1. Which process is exothermic, bond breaking or bond making?

2. Explain your answer to question 1.

3. How do we calculate the overall energy change of a reaction?

4. The bond energy between a hydrogen and a nitrogen atom is 386 Kj/mol, the bond energy between the two hydrogen atoms is 432 Kj/mol and the bond energy between two nitrogen atoms is 942 Kj/mol.

   Using these bond energies, calculate the overall energy change for the following reaction:

   $2NH_3 \longrightarrow N_2 + 3H_2$

5. Is the reaction exothermic or endothermic? Explain your answer.

D. Chemical Cells and Fuel Cells - CHEMISTRY ONLY

1. Give two factors which may affect the voltage given out by a battery.

2. Here is a reactivity series of metals. The most reactive is first, the least reactive is last:

   Magnesium Zinc Tin Copper

   Which two metals would you use to make a battery which had the highest voltage?

3. Why do non-renewable batteries stop producing voltage after a certain time?

4. How are rechargeable batteries recharged?

5. What chemical is the fuel in a fuel cell?

6. What happens to this fuel inside the fuel cell to produce a potential difference?

7. Write the overall balanced symbol equation for the reaction in a fuel cell.

8. Write the half equation for the reaction that happens at the cathode in a fuel cell.

9. Write the half equation for the reaction that happens at the anode in a fuel cell.