Direct conversion of methane to methanol - Answer Sheet

7% of total											
Question	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	6.10	**Total**
Points	2	4	1	2	4	3	3	3	4	6	**32**
Score											

6.1 (2 pt)
Give the number of **S1** sites and the number of **S2** sites required to oxidize one methane molecule to methanol.

6.2 (4 pt)
Compute the percentage of copper that reacted.

_____ %

6.3 (1 pt)
Experimental data is plotted in **Figure 1**. Based on this, **decide** on the (pseudo) order of the oxidation of CH_4. **Tick** the box with the correct statement.

☐ The reaction is of (pseudo) zeroth order.
☐ The reaction is of (pseudo) first order.
☐ The reaction is of (pseudo) second order.

6.4 (2 pt)
Write down the (pseudo) rate law for the oxidation of CH_4 that is consistent with the experimental data under the given conditions. Note that it may depend on the concentrations of CH_4 as well as of sites **S1** and **S2** and on the rate constants.

6.5 (4 pt)
Tick the boxes with correct statements:
☐ At least two types of copper sites react, each with a different rate constant.
☐ The overall methane oxidation by copper-loaded zeolite is faster at higher temperature.
☐ At higher temperature, a larger fraction of the copper sites will have reacted with methane after completion of the reaction.
☐ One of the reactions becomes slower at higher temperature.

6.6 (3 pt)
Derive the equation linear in time that relates $I_2(t)$ to the rate constant for the loss of **S1** sites.

6.7 (3 pt)
Tick the boxes for each measurement that needs to be calibrated with a known Cu(II) standard.

☐ Total number of paramagnetic Cu(II) sites in the sample
☐ Concentration of paramagnetic Cu(II) sites in the sample
☐ Rate constant
☐ Types of different paramagnetic Cu(II) species in the sample

6.8 (3 pt)
Considering **Figure 1** on the question sheet and **based on a calculation**, **decide** if methane reacts faster or slower with **S2** sites than with **S1** sites.

☐ Methane reacts faster with **S1**.
☐ Both reaction rates are the same.
☐ Methane reacts faster with **S2**.

6.9 (4 pt)
Draw the structure of the intermediate product and **assign** protons **a** and **d**.

6.10 (6 pt)
Give a possible structure of **A** and **assign** all protons and carbon **1**.