

- 1) Give 3 good reasons for using biomass as an energy source
- 2) Give 3 disadvantages of using biomass as an energy source
- 3) What is agreed upon in the Kyoto protocol?
 - a) Mitigation of greenhouse gases
 - b) Decrease of CO₂ emissions
 - c) Establishing CO₂ equivalents for general greenhouse gases
 - d) Limitations on economic growth
- 4) What is meant by the expression "CO₂ neutral"?
- 5) Which 3 chemical elements are the major constituents of biomass?
- 6) How is the analysis denoted for determination of the elemental composition of biomass?
- 7) Which main molecules is biomass made of?
- 8) What is a typical composition of biogas, i.e. gasified biomass?
- 9) Can biogas be burned with any burner? Why?
- 10) What conservation equations are relevant to describe thermal biomass conversion?
- 11) With what type of reactors can biomass be converted?
- 12) Which kind of models are available for thermal conversion of biomass particles?
- 13) What dimensionless number is a measure for the heat transfer at the gas side of a particle compared to the heat transfer inside a particle?
- 14) What physical quantities are important for the combustion of biogas?
- 15) Name a primary measure to reduce emissions.

- 1) a) CO₂ neutral b) oil independence c) sustainable source d)
- 2) a) Emissions, gas-cleaning b) competition with food production c) competition in relation to water resources d)
- 3) a
- 4) It means that the production of CO₂ and fixation of CO₂ by conversion of biomass and growing of biomass, respectively, can occur in a short time frame.
- 5) C,H,O
- 6) Ultimate analysis
- 7) Cellulose, lignin and hemicellulose (evt. water)
- 8) CO, H₂, CH₄, H₂O, CO₂, tars
- 9) The heat of condensation of the water formed.
- 10) Conservation of mass, momentum, energy and chemical species.
- 11) Fixed bed, grate furnace, fluidized bed (bubbling, circulating), entrained flow reactor.
- 12) Shrinking density, shrinking sphere, shrinking core.
- 13) Biot number
- 14) Laminar burning velocity, Wobbe index, ignition delay time, evt. turbulent burning velocity
- 15) Enhanced mixing, staging, high dilution (recirculating flue gases), low equivalence ratio, low temperature (NO_x), secondary air (CO).