Assignment 12

Due on 2021-04-14, 23:59 IST.

The due date for submitting this assignment has passed.

As per our records you have not submitted this assignment.

1) The reaction at carbon surface, \( C + CO_2 \rightarrow 2CO \), is an
   - exothermic surface reaction
   - endothermic surface reaction
   - exothermic condensation reaction
   - exothermic recombination reaction
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - exothermic surface reaction

2) In one-film model,
   - \( CO_2 \) is produced at carbon particle surface
   - \( CO \) is produced at carbon particle surface
   - \( CO \) penetrates towards the surface
   - reduction reaction occurs at the surface
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - \( CO_2 \) is produced at carbon particle surface

3) In one-film model, total mass flux of carbon is
   - mass flux of \( O \) minus mass flux of \( CO_2 \)
   - mass flux of \( CO_2 \) plus mass flux of \( O \)
   - mass flux of \( CO_2 \) minus mass flux of \( O \)
   - none of the above
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - mass flux of \( CO_2 \) minus mass flux of \( O \)

4) Resistance to diffusion of oxygen to carbon surface is directly proportional to
   - diffusion coefficient, \( D \)
   - \( D \)
   - \( D^2 \)
   - none of the above
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - \( D \)

5) Carbon particle combustion is kinetically controlled when
   - particle radius is large
   - particle radius is small
   - temperature is large
   - none of the above
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - particle radius is small

6) In two-film model, carbon is produced at carbon surface due to its gas-phase reaction with \( O \).
   CO is produced at carbon surface due to its surface reaction with \( CO_2 \).
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - CO is produced at carbon surface due to its surface reaction with \( CO_2 \).

7) Consider a 250-micron-diameter carbon particle burning in still air (ambient oxygen mass fraction = 0.233) at 1 atm. The kinetic rate constant, \( k_k \), in m³ is calculated as a function of particle surface temperature \( T_p \) as \( 3 \times 10^{-10} \div \text{exp}(-17995/T_p) \). Assume the mean molecular weight of the gases at the surface is 28 g/mol. View diffusivity at 450 K, \( D_m = 1.25 \times 10^{-5} \text{ m}^2 \text{s}^{-1} \) and it varies with temperature as \( D_m = 1.7 \times 4.25^{1.5} \). Assuming the oxygen mass fraction at the particle surface is 0.01, the surface temperature \( T_p \), at which the resistance diffusion and resistance to kinetics of surface reaction are the same, is _____.
   Corresponding mass burning rate of carbon (mg/s) is _____.
   Score: 0
   Accepted Answers:
   - 1.24, 0.001596
   - 1.234, 0.001141
   - 1.245, 0.001489
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - 0.001596

8) In problem 7, if the surface temperature is 1650 K, all other quantities being the same, the mass burning rate of carbon in mg/s is
   - 0.002375
   - 0.002392
   - 0.002029
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - 0.002375

9) A carbon particle of diameter of 100 microns is burning in air \( \text{F}_{\text{O}_2} = 0.233 \). Surface temperature in 1800 K, and the pressure is 1 atm. Assume the molecular weight of the gases mixture at the particle surface is 30 g/mol, the value of diffusion coefficient of 1.87 \( \times \) \( 10^{-5} \text{ m}^2 \text{s}^{-1} \) and surface mass fraction of \( CO_2 \) is 0.0285. Value of transport number is ____. Burning rate of the carbon particle in mg/s is ____.}
   Score: 0
   Accepted Answers:
   - 0.14812, 0.00277
   - 0.12093, 0.00005
   - 0.1203, 0.00049
   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - 0.14812, 0.00277

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