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NPTEL

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Courses » Fundamentals Of Combustion (Part 1)

Announcements Course Ask a Question Progress Mentor

## Unit 4 - Week 3 : Thermochemistry

### Course outline

How to access the portal?

Week 1 :  
Introduction to Combustion

Week 2 :  
Thermodynamics of combustion

Week 3 :  
Thermochemistry

● Lecture 11  
Thermochemistry

● Lecture 12 Heat of reaction and bond energy

● Lecture 13 Adiabatic flame temperature

● Lecture 14 Adiabatic flame temperature and its effect on various parameters

● Lecture 15 Introduction to chemical equilibrium

○ Quiz : Week 3 Assessment 3

● Week 3 Assessment 3 Solutions

○ Week 3 Feedback

Week 4 :  
Chemical Equilibrium and Kinetics

### Week 3 Assessment 3

The due date for submitting this assignment has passed. **Due on 2018-02-28, 23:59 IST.**

#### Submitted assignment

1) Calculate the heat of reaction of ethane in  $\text{kJ mol}^{-1}$ , as described in the equation **1 point**  
 $\text{C}_2\text{H}_6(\text{g}) + 3.5\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l})$ , given the heats of formation of ethane gas, carbon dioxide gas and water liquid are  $-84.7 \text{ kJ mol}^{-1}$ ,  $-393.5 \text{ kJ mol}^{-1}$  and  $-285.8 \text{ kJ mol}^{-1}$  respectively

- 1260  
 -1360  
 -1460  
 -1560

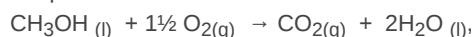
**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

**-1560**

2) Determine the heat of formation of liquid methanol for which the heat of reaction of **2 points**  
 methanol, as described in the equation



is  $-715 \text{ kJ mol}^{-1}$  and the heats of formation of carbon dioxide gas and water liquid are  $-393.5 \text{ kJ mol}^{-1}$  and  $-285.8 \text{ kJ mol}^{-1}$  respectively.

- 250.1  
 -275.1  
 -300.1  
 -325.1

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

**-250.1**

3) Determine heat of reaction for combustion reaction  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}$ , **2 points**  
 Given bond energy of C-H, O = O, C = O and O-H are 338, 498, 745 and 460 kJ respectively

- 922  
 -942  
 -962  
 -982

Week 5 :  
Chemical  
Kinetics

Week 6 : Types  
of reaction and  
Introduction to  
Physics of  
combustion

Week 7 :  
Transport  
Phenomena

Week 8 :  
Conservation  
Equations

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

-982

4) Hess's law states that a chemical reaction is independent of its path by which reactions **1 point** takes place while keeping invariant,

- Initial conditions  
 Final conditions  
 Both (a) and (b)  
 None of the above

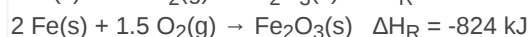
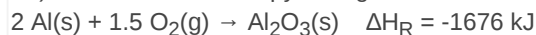
**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

Both (a) and (b)

5) The standard enthalpy changes for the formation of aluminium oxide and iron oxide are **1 point**



Calculate heat of reaction for the reaction,



- 852 kJ  
 2500 kJ  
 852 kJ  
 Insufficient data

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

-852 kJ

6) Calculate adiabatic flame temperature at constant volume for a combustor working **6 points** with stoichiometric n-butane-air mixture. Assuming complete combustion with no dissociation. Assume the specific heat capacity of the combustion products is constant evaluated at 2000 K. The combustor operates at 1 atm with initial mixture entering at 298K.

**Given:**

$$h_{f,C_4H_{10}}^0(298K) = -124733 \text{ kJ/kmol}$$

$$h_{f,CO_2}^0(298K) = -393546 \text{ kJ/kmol}$$

$$h_{f,H_2O}^0(298K) = -241845 \text{ kJ/kmol}$$

$$c_{p,H_2O}(2000K) = 51.143 \text{ kJ/kmol} \cdot K$$

$$c_{p,CO_2}(2000K) = 60.433 \text{ kJ/kmol} \cdot K$$

$$c_{p,N_2}(2000K) = 35.988 \text{ kJ/kmol} \cdot K$$

- 2620K  
 2720K  
 2815K  
 2850K

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

2720K

7) Determine the lower heating value of liquid ethanol in kJ/kg of  $C_2H_5OH$  for which the heat of **1 point** formation of ethanol is -278000 J/mol

Given:

$$h_{f,g}(\text{H}_2\text{O}) = 44010 \text{ kJ/kmol}$$

$$h_{f,\text{H}_2\text{O}(g)}^0(298\text{K}) = -241845 \text{ kJ/kmol}$$

$$h_{f,\text{CO}_2}^0(298\text{K}) = -393546 \text{ kJ/kmol}$$

- 65.32  
 35.36  
 45.20  
 26.84

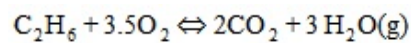
No, the answer is incorrect.

Score: 0

Accepted Answers:

26.84

8) Evaluate heat of reaction per kJ/kg of  $\text{C}_2\text{H}_6$  at STP for the following reaction. Use **1 point** standard enthalpy of formation of  $\text{C}_2\text{H}_6$  as  $-84667 \text{ kJ/kmol}$  and  $\text{H}_2\text{O}$  in gaseous phase as  $-241845 \text{ kJ/kmol}$  and  $\text{CO}_2$  as  $-393546 \text{ kJ/kmol}$ .



- 35.5  
 -47.5  
 -58.5  
 -63.8

No, the answer is incorrect.

Score: 0

Accepted Answers:

-47.5

9) Calculate adiabatic flame temperature at constant pressure for a combustor working **5 points** with stoichiometric n-butane-air mixture. Assuming complete combustion with no dissociation. Assume the specific heat capacity of the combustion products is constant evaluated at  $2000 \text{ K}$ . The combustor operates at  $1 \text{ atm}$  with initial mixture entering at  $298\text{K}$ .

Given:

$$h_{f,\text{C}_4\text{H}_{10}}^0(298\text{K}) = -124733 \text{ kJ/kmol}$$

$$h_{f,\text{CO}_2}^0(298\text{K}) = -393546 \text{ kJ/kmol}$$

$$h_{f,\text{H}_2\text{O}}^0(298\text{K}) = -241845 \text{ kJ/kmol}$$

$$c_{p,\text{H}_2\text{O}}(2000 \text{ K}) = 51.143 \text{ kJ/kmol} \cdot \text{K}$$

$$c_{p,\text{CO}_2}(2000 \text{ K}) = 60.433 \text{ kJ/kmol} \cdot \text{K}$$

$$c_{p,\text{N}_2}(2000 \text{ K}) = 35.988 \text{ kJ/kmol} \cdot \text{K}$$

- 2520  
 2229  
 2360  
 2230

No, the answer is incorrect.

Score: 0

Accepted Answers:

2229

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