


Total Number of Pages in Section A (including top page): 7

EXAMINATION SCRIPT

STUDENT NO.			DEPARTMENT:	MME (L-2, T-1)
1711018			BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY	
COURSE NO.	MME 231	DATE	25 September, 2021	
COURSE TITLE	Materials Thermodynamics			

SECTION A

Declaration on the Online Course Conduct by Undergraduate Student of BUET for COVID-19 Situation

Please write the declaration in your own handwriting and sign it.

On my honour, I bearing Student No. 1711018 hereby declare that,

I shall not misuse, in any form or method, the course materials including Lecture notes, Reading materials, Audio and video records of the lectures of this course. I shall not adopt any unfair means during final examination and shall not receive any help or offer/provide help to anyone. I shall preserve hard copy and soft copies of the answer scripts and will not expose the same to any person/party/media. I agree to accept any punitive measure taken by BUET authority if at any time during or after the completion of the course it is revealed/violated otherwise.

Signature: Amin

Date: 25 September 2021

Instructions

1. Clearly enter your Student ID, Course Number, Course Title, and Date in the space provided. Complete the declaration exactly as below with your signature and date. You can also insert the scanned image of your handwritten declaration in this box.
2. Declaration: I shall not misuse, in any form or method, the course materials including Lecture Notes, Reading Materials, Audio and Video Records of the lectures of this course. I shall not adopt any unfair means during the Final Examination and shall not receive any help or offer/ provide help to anyone. I shall preserve hard copy and soft copies of the answer scripts and will not expose the same to any person/party/media. I agree to accept any punitive measure taken by BUET Authority if at any time during or after the completion of the course it is revealed/ violated otherwise.
3. Do not put your name or any other form of identification except the Student No. anywhere in the answer script.
4. Use offset/normal white paper of A4 size for writing the answer. Use only one side of the paper for writing. On each page, clearly write your Student ID and Page numbers.
5. After completing the exam, before scanning, please write the total number of pages in this Section (including the top page) on the top right corner of the top page.

Section-AAns. to Ques. no. 4

(a)

Concept of wettability :

Wettability is defined as the measurement of liquid's ability of interaction with other fluids and/or solid surface.

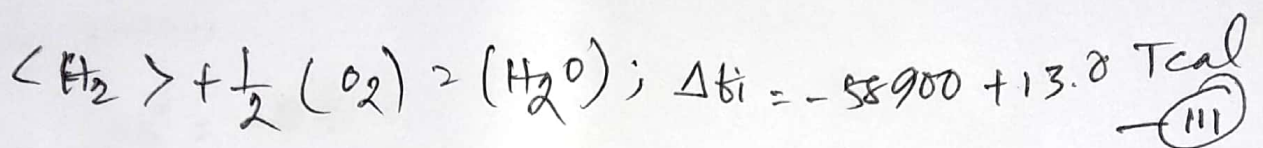
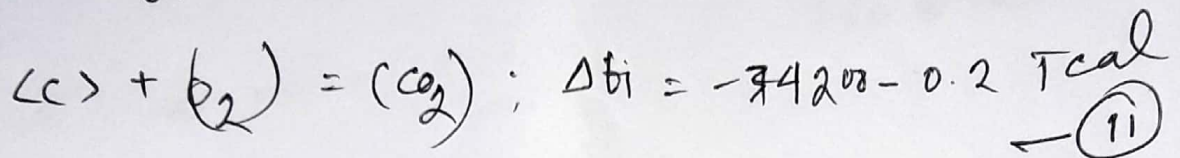
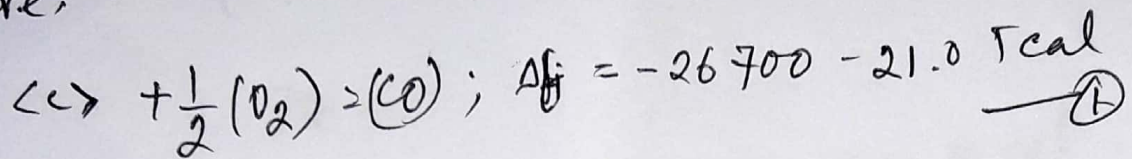
Wettability ~~is~~ measures the level of wetting when solid or liquid phase interact with each other. It measures the surface attribute of polymer and performs many necessary tasks in printing and coating of liquids. Wettability is measured by contact angle.

Lower contact angle ($\leq 90^\circ$) refers to greater wettability and larger/higher contact angle ($\geq 90^\circ$) refers to lower wettability.

To remove 'hot shortness' defect in steel:

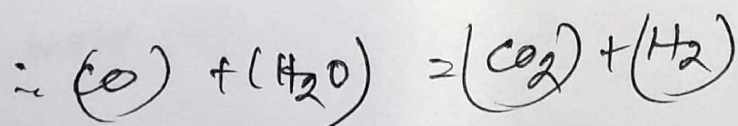
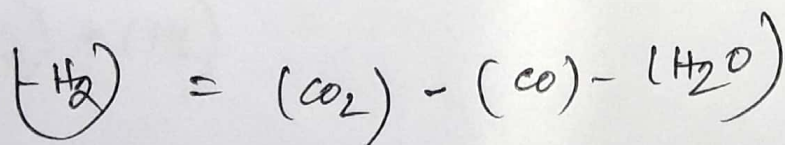
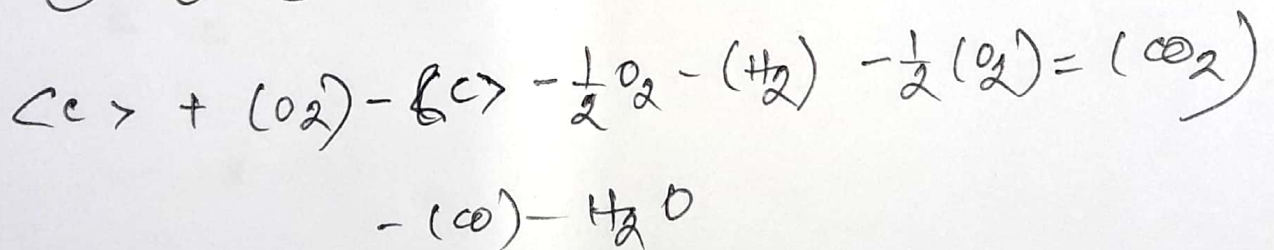
Ans. to Q. 2

here,



the reaction will be,

$$\text{(ii)} - \text{(i)} - \text{(iii)} \Rightarrow$$



$$\Delta H_r^\circ = -34200 - 0.2 T + 26700 - 21.0 T + 58900 + 13.8 T$$

$$= (-8600 + 7.8 T) \text{ cal}$$

At 1200K,

$$\Delta G^\circ = (-3600 + 7.8 \times 1200) \text{ cal}$$

$$= 760 \text{ cal}$$

ΔG° for the main reaction is $= -760 \text{ cal}$.

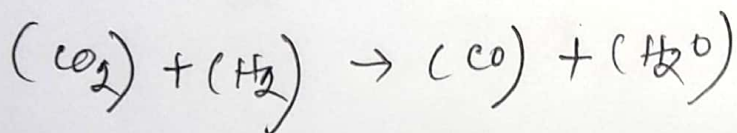
We know,

$$\Delta G^\circ = -RT \ln K$$

$$\therefore \ln K = -\frac{\Delta G^\circ}{RT}$$

$$K = e^{-\frac{\Delta G^\circ}{RT}} = e^{-\frac{760}{1.987 \text{ kcal} \times 1200 \text{ K}}}$$

$$\therefore K = 1.3754$$



$$\begin{aligned} \text{total mole at equilibrium} &= .1 - a + .1 - a + 3 + 4a \\ &= 0.5 \end{aligned}$$

Now,

$$K = \frac{P_{\text{CO}_2} \cdot P_{\text{H}_2\text{O}}}{P_{\text{H}_2} \cdot P_{\text{CO}_2}}$$

1 (b)

Here,

$$\log p(\text{mm}) = 8.83 - \frac{1400}{T} - 0.86 \log T$$

$$2.303 \log p(\text{bar}) = 20.335 - \frac{33163.2}{T} - 0.85 \ln T$$

$$\Rightarrow d \ln p(\text{bar}) = \left(-\frac{33163.2}{T^2} - \frac{0.85}{T} \right) dT$$

$$= \left(\frac{33163.2}{T^2} \right) dT = \frac{\Delta H_v}{RT^2} dT$$

$$\therefore \frac{\Delta H_v}{RT^2} = \frac{33163.2 - 0.85T}{T^2}$$

$$\therefore \Delta H_v = (33163.2 - 0.85T) \times R$$

at 2350 K,

$$\Delta H_v = (33163.2 - 0.85 \times 2350 \text{ K}) \times 8.3147 \text{ mol}^{-1} \text{ K}$$

$$= 25911.628 \text{ J/mol}$$

Now,

we get,

$$K = \frac{a^2 + 0.3a}{a^2 - 0.2a + 0.01} = 1.3754$$

$$\Rightarrow \text{a} = 1.507$$

At equilibrium,

$$x_{CO} = \frac{.3 + a}{0.5} = 3.614$$

$$x_{H_2O} = \frac{a}{0.5} = 3.014$$

$$x_{H_2} = \frac{.1 - a}{0.5}$$

Now,

$$Q = \frac{P_{NH_3}^2}{P_{H_2}^3 \times P_{H_2O}}$$

$$= 6.428 \times 10^{-7} \text{ atm}^{-2}$$

$\therefore \frac{Q}{K} < 1$, it will proceed to equilibrium

$$\Delta G = RT \ln \frac{Q}{K} \quad (\text{by putting values})$$

$$\boxed{= -85143.9024 \text{ J/mol}} \quad (\text{Ans})$$

25911.6298 J/mol heat is required at 2350 K,

$$\underline{\Delta H_f = 129555.817} \quad (\text{Ans})$$

4(b)

$$\Delta G^\circ = RT \ln K$$

$$\therefore K = e^{-\frac{\Delta G^\circ}{RT}}$$

$$= \boxed{539504.03}$$

(putting values)

