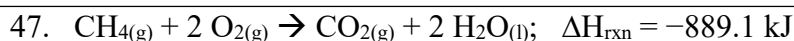


# AP Chemistry: Thermodynamics

## Multiple Choice

(You may use a calculator.)

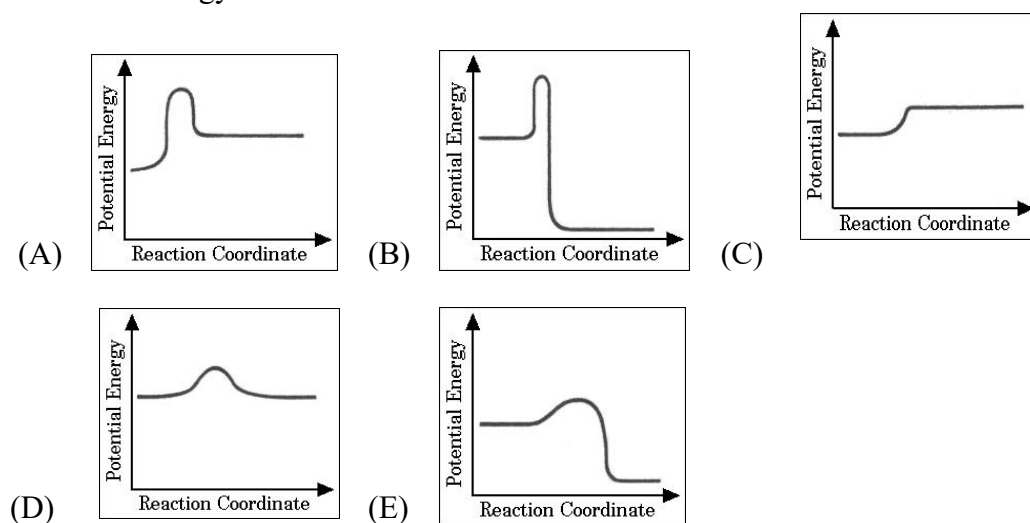


$\Delta H_f^\circ \text{H}_2\text{O}(\text{l}) = -285.8 \text{ kJ / mole} \quad \Delta H_f^\circ \text{CO}_2(\text{g}) = -393.3 \text{ kJ / mole}$

What is the standard heat of formation of methane,  $\Delta H_f^\circ \text{CH}_4(\text{g})$ , as calculated from the data above?

- (A)  $-210.0 \text{ kJ/mole}$  (B)  $-107.5 \text{ kJ/mole}$  (C)  $-75.8 \text{ kJ/mole}$  (D)  $75.8 \text{ kJ/mole}$  (E)  $210.0 \text{ kJ/mole}$

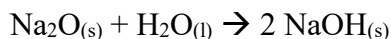
48. Which of the following is a graph that describes the pathway of reaction that is endothermic and has high activation energy?



25.

$\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$	$\Delta H^\circ = x$
$2 \text{Na}(\text{s}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{Na}_2\text{O}(\text{s})$	$\Delta H^\circ = y$
$\text{Na}(\text{s}) + 1/2 \text{O}_2(\text{g}) + 1/2 \text{H}_2(\text{g}) \rightarrow \text{NaOH}(\text{s})$	$\Delta H^\circ = z$

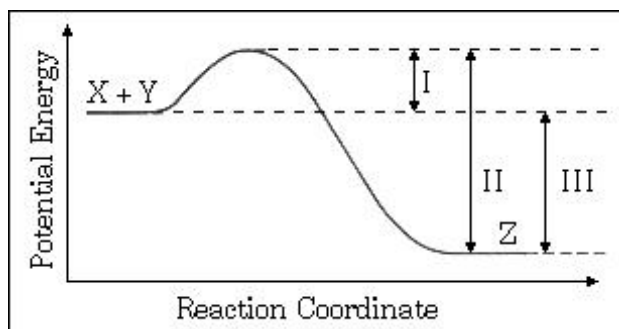
Based on the information above, what is the standard enthalpy change for the following reaction?



- (A)  $x + y + z$  (B)  $x + y - z$  (C)  $x + y - 2z$  (D)  $2z - x - y$  (E)  $z - x - y$

30. The energy diagram for the reaction  $\text{X} + \text{Y} \rightarrow \text{Z}$  is shown. The addition of a catalyst to this reaction would cause a change in which of the indicated energy differences?

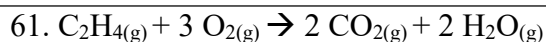
- (A) I only  
(B) II only  
(C) III only  
(D) I and II only



(E) I, II, and III

19. Which of the following best describes the role of the spark from the spark plug in an automobile engine?

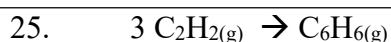
- (A) The spark decreases the energy of activation for the slow step.
- (B) The spark increases the concentration of the volatile reactant.
- (C) The spark supplies some of the energy of activation for the combustion reaction.
- (D) The spark provides a more favorable activated complex for the combustion reaction.
- (E) The spark provides the heat of vaporization for the volatile hydrocarbon.



For the reaction of ethylene represented above,  $\Delta H$  is  $-1,323 \text{ kJ}$ . What is the value of  $\Delta H$  if the combustion produced liquid water  $\text{H}_2\text{O}_{(l)}$ , rather than water vapor  $\text{H}_2\text{O}_{(g)}$ ?

( $\Delta H$  for the phase change  $\text{H}_2\text{O}_{(g)} \rightarrow \text{H}_2\text{O}_{(l)}$  is  $-44 \text{ kJ mol}^{-1}$ .)

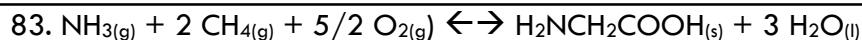
- (A)  $-1,235 \text{ kJ}$     (B)  $-1,279 \text{ kJ}$     (C)  $-1,323 \text{ kJ}$     (D)  $-1,367 \text{ kJ}$     (E)  $-1,411 \text{ kJ}$



What is the standard enthalpy change,  $\Delta H^\circ$ , for the reaction represented above?

( $\Delta H^\circ_f$  of  $\text{C}_2\text{H}_{2(g)}$  is  $230 \text{ kJ mol}^{-1}$ ;  $\Delta H^\circ_f$  of  $\text{C}_6\text{H}_{6(g)}$  is  $83 \text{ kJ mol}^{-1}$ )

- (A)  $-607 \text{ kJ}$     (B)  $-147 \text{ kJ}$     (C)  $-19 \text{ kJ}$     (D)  $+19 \text{ kJ}$     (E)  $+773 \text{ kJ}$



At constant temperature,  $\Delta H$ , the change in enthalpy for the reaction above is approximately equal to...

- (A)  $\Delta E - (11/2)RT$     (B)  $\Delta E - (7/2)RT$     (C)  $\Delta E + RT$     (D)  $\Delta E + (7/2)RT$     (E)  $\Delta E (11/2)RT$