1984 – 2002 selected, released AP Chemistry MCQ's for

UNIT 06ABCDEFGHIJ AND 09ABCDEF

(derived partly form compilations originally made by Dan Reid)

Notes:

The MCQ section of the current AP Chemistry Exam has 4 choices (A-D), no calculator use, and has an equations & constants sheet and a periodic table available. The first year that the current (May 2019) CED was examined was 2020, when there was NO MCQ section in the exam due to COVID-19. Any MCQ question prior to 2021 is a question that was not specifically written to align with the current CED, but all of the questions listed in this document have relevant *chemistry*.

Previous MCQ sections of the AP Chemistry Exam differed from the current format in the following ways;

1984 Periodic table, calculators allowed, no equations & constants, five choices A-E
1989 Periodic table, calculators allowed, no equations & constants, five choices A-E
1994 Periodic table, calculators allowed, no equations & constants, five choices A-E
1999 Periodic table, NO calculators allowed, no equations & constants, five choices A-E
2002 Periodic table, NO calculators allowed, no equations & constants, five choices A-E

1984

47.

$$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)} \quad \Delta H_{rxn} = -889.1 \text{ kJ}$$
$$\Delta H_f^\circ \ H_2O_{(l)} = -285.8 \text{ kJ / mole}$$
$$\Delta H_f^\circ \ CO_{2(g)} = -393.3 \text{ kJ / mole}$$

What is the standard heat of formation of methane, $\Delta H_f^\circ \ CH_{4(g)}$, as calculated from the data above?

(A) −210.0 kJ/mole
(B) −107.5 kJ/mole
(C) −75.8 kJ/mole
(D) 75.8 kJ/mole
(E) 210.0 kJ/mole

56. A cube of ice is added to some hot water in a rigid, insulated container, which is then sealed. There is no heat exchange with the surroundings. What has happened to the total energy and the total entropy when the system reaches equilibrium?

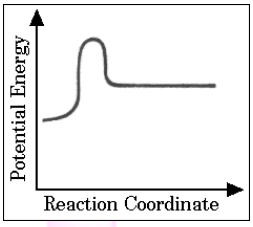
	Energy	Entropy
(A)	Remains constant	Remains constant
(B)	Remains constant	Decreases
(C)	Remains constant	Increases
(D)	Decreases	Increases
(E)	Increases	Decreases

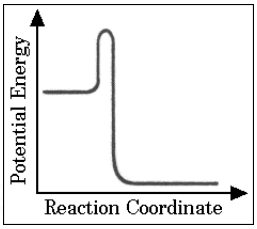
1989

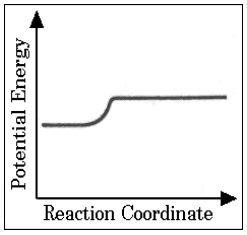
41. Which of the following reactions has the largest positive value of ΔS per mole of Cl_2 ?

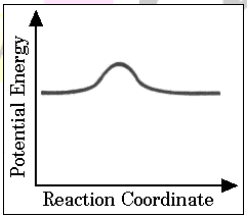
(A) $H_{2(g)} + Cl_{2(g)} \rightarrow HCl_{(g)}$
(B) $Cl_{2(g)} + 1/2O_{2(g)} \rightarrow Cl_2O_{(g)}$
(C) $Mg_{(s)} + Cl_{2(g)} \rightarrow MgCl_{2(s)}$
(D) $2NH_4Cl_{(s)} \rightarrow N_{2(g)} + 4H_{2(g)} + Cl_{2(g)}$
(E) $Cl_{2(g)} \rightarrow 2Cl_{(g)}$

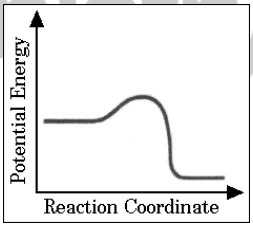
48. Which of the following is a graph that describes the pathway of reaction that is endothermic and has high activation energy?

(A)


(B)


(C)


(D)


(E)


53. Which of the following must be true for a reaction that proceeds spontaneously from initial standard state conditions?

(A) $\Delta G^\circ > 0$ and $K_{eq} > 1$
(B) $\Delta G^\circ > 0$ and $K_{eq} < 1$
(C) $\Delta G^\circ < 0$ and $K_{eq} > 1$
(D) $\Delta G^\circ < 0$ and $K_{eq} < 1$
(E) $\Delta G^\circ = 0$ and $K_{eq} = 1$

70.

$$H_2O_{(s)} \rightarrow H_2O_{(l)}$$

When ice melts at its normal melting point, 273.16 K and 1 atmosphere, which of the following is true for the process shown above?

(A) $\Delta H < 0, \Delta S > 0, \Delta V > 0$
(B) $\Delta H < 0, \Delta S < 0, \Delta V > 0$
(C) $\Delta H > 0, \Delta S < 0, \Delta V < 0$
(D) $\Delta H > 0, \Delta S > 0, \Delta V > 0$
(E) $\Delta H > 0, \Delta S > 0, \Delta V < 0$

1994

25.

$H_{2(g)} + 1/2O_{2(g)} \rightarrow H_2O_{(l)}$ $\Delta H° = x$
$2Na_{(s)} + 1/2O_{2(g)} \rightarrow Na_2O_{(s)}$ $\Delta H° = y$
$Na_{(s)} + 1/2O_{2(g)} + 1/2H_{2(g)} \rightarrow NaOH_{(s)}$ $\Delta H° = z$

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

$$Na_2O_{(s)} + H_2O_{(l)} \rightarrow 2\ NaOH_{(s)}$$

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

35. For which of the following processes would ΔS have a negative value?

I. $2Fe_2O_{3(s)} \rightarrow 4Fe_{(s)} + 3O_{2(g)}$
II. $Mg^{2+} + 2OH^- \rightarrow Mg(OH)_{2(s)}$
III. $H_{2(g)} + C_2H_{4(g)} \rightarrow 3C_2H_{6(g)}$

(A) I only
(B) I and II only
(C) I and III only
(D) II only
(E) I, II, and III

58.

$$N_2(g) + 3\ H_{2(g)} \rightarrow 2\ NH_{3(g)}$$

The reaction indicated above is thermodynamically spontaneous at 298 K, but becomes nonspontaneous at higher temperatures. Which of the following is true at 298 K?

(A) ΔG, ΔH, and ΔS are all positive
(B) ΔG, ΔH, and ΔS are all negative
(C) ΔG and ΔH are negative, but ΔS is positive
(D) ΔG and ΔS are negative, but ΔH is positive
(E) ΔG and ΔH are positive, but ΔS is negative

1999

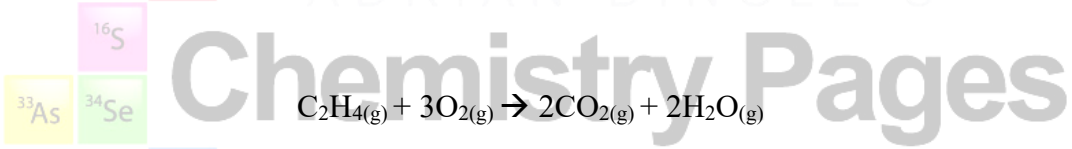
19. Which of the following best describes the role of the spark from the spark plug in an automobile engine?

(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

22. Of the following reaction, which involves the largest decrease in entropy?

(A) $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$
(B) $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$
(C) $Pb(NO_3)_{3(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$
(D) $C_3H_{8(g)} + O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$
(E) $4La_{(s)} + 3O_{2(g)} \rightarrow 2La_2O_{3(s)}$

61.



$$C_2H_{4(g)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(g)}$$

For the reaction of ethylene represented above, ΔH is −1,323 kJ. What is the value of ΔH if the combustion produced liquid water $H_2O_{(l)}$, rather than water vapor $H_2O_{(g)}$?

(ΔH for the phase change $H_2O_{(g)} \rightarrow H_2O_{(l)}$ is −44 kJ mol^{-1})

(A) −1,235 kJ
(B) −1,279 kJ
(C) −1,323 kJ
(D) −1,367 kJ
(E) −1,411 kJ

66. When solid ammonium chloride, $NH_4Cl_{(s)}$ is added to water at 25 °C, it dissolves and the temperature of the solution decreases. Which of the following is true for the values of ΔH and ΔS for the dissolving process?

	ΔH	**ΔS**
(A)	Positive	Positive
(B)	Positive	Negative
(C)	Positive	0
(D)	Negative	Positive
(E)	Negative	Negative

2002

25.

$$3C_2H_{2(g)} \rightarrow C_6H_{6(g)}$$

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

($\Delta H°_f$ of $C_2H_{2(g)}$ is 230 kJ mol^{-1}; $\Delta H°_f$ of $C_6H_{6(g)}$ is 83 kJ mol^{-1})

(A) −607 kJ
(B) −147 kJ
(C) −19 kJ
(D) +19 kJ
(E) +773 kJ

41. When solid NH_4SCN is mixed with solid $Ba(OH)_2$ in a closed container, the temperature drops and a gas is produced. Which of the following indicates the correct signs for ΔG, ΔH, and ΔS for the process?

	ΔG	ΔH	ΔS
(A)	−	−	−
(B)	−	+	−
(C)	−	+	+
(D)	+	−	+
(E)	+	−	−

73.

$$X_{(s)} \rightleftarrows X_{(l)}$$

Which of the following is true for any substance undergoing the process represented above at its normal melting point?

(A) $\Delta S < 0$
(B) $\Delta H = 0$
(C) $\Delta H = T\Delta G$
(D) $T\Delta S = 0$
(E) $\Delta H = T\Delta S$

ANSWERS

1984

47. C
56. C

1989

41. D
48. A
53. C
70. E (don't forget, ice floats in water, meaning it is LESS dense as a solid than a liquid – very unusual. Since the mass of H_2O has not changed, in order to be less dense as a solid its volume must be greater).

1994

25. D
30. D
35. D
58. B

1999

19. C
22. E
61. E
66. A

2002

25. A
41. C
73. E (at a phase change, an equilibrium is set up between the two phases, and K = 1, and $\Delta G^\circ = 0$)