

♥♥The second exam for chemistry 101♥♥

2021

(Past paper)



Good luck! <3

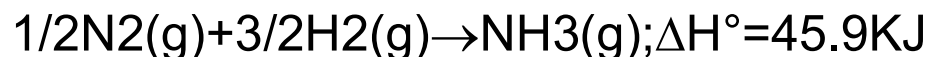
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1. If 636.0mL of nitrogen gas, measured at 488.9mmHg and 22.3°C, reacts with excess iodine according to the following reaction, what mass of nitrogen triiodide is produced?  $\text{N}_2(\text{g}) + 3\text{I}_2(\text{s}) \rightarrow 2\text{NI}_3(\text{s})$

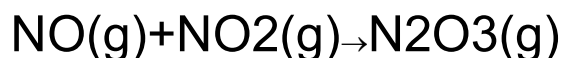
- a. 3.33
- b. 0.472g
- c. 176g
- d. 13.3g
- e. 6.66g

**ANSWER: B**

2. Using two or more of the following,



Determine  $\Delta H^\circ$  for the following reaction.



- a. -207.1kj
- b. 207.1kj
- c. 39.7kj
- d. 24.3kj
- e. -39.7kj

**ANSWER: B**

3. When the valve between the 2.00-L bulb, in which the gas pressure is 2.50 atm, and the 3.00-L bulb, in which the gas pressure is 1.50 atm, is opened, what will be the final pressure in the two bulbs? Assume the temperature remains constant.

- a. 4.00atm
- b. 2.17atm
- c. 1.83atm
- d. 2.10atm
- e. 1.90atm

4. What volume of ammonia gas, measured at 547.9mmHG and 27.6°C is required to produce 8.98g of ammonium sulfate according to the following balanced chemical equation?



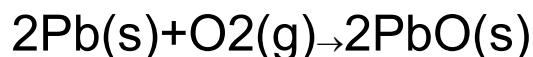
- a. 0.00397 L
- b. 18L
- c. 4.65L
- d. 1.16L
- e. 0.000992L

5. When 50.0, L of 1.27M of HCl(aq) is combined with 50.0mL of 1.32M of NaOH(aq) in a coffee-cup calorimeter, the temperature of the solution increases by 8°C. what is the change in enthalpy for this balanced reaction?  $\text{HCl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$ ; assume

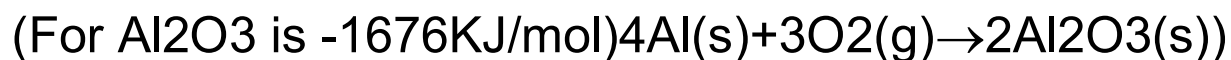
that the solution density is 1.00g/mL and the specific heat capacity of the solution is 4.18J/g. °C

- a. 55.8KL
- b. -51.5KJ
- c. -55.8KJ
- d. 51.5KJ
- e. -26.8KJ

6. When 56.8g of lead reacts with 3.50L of oxygen gas, measured at 1.00atm and 25.0°C, 60.1KJ of heat is released at constant pressure. What is  $\Delta H^\circ$  for this reaction? (R=0.0821L.atm/(K.mol))



7. How much heat is evolved upon the complete oxidation of 6g of aluminum at 25°C and 1atm pressure?



- a. 85.59kJ
- b. 171.1kJ
- c. 342.3kJ
- d. 684.7kJ
- e.  $9.238 \times 10^3$  KJ

**ANSWER: B**

8. 86.9-g sample of chromium (s=0.447J/(g. °C)), initially at 338.33°C, is added to an insulated vessel containing

189.9g of water ( $s=4.18\text{J}/(\text{g}\cdot^{\circ}\text{C})$ ) initially at  $16.17^{\circ}\text{C}$ . At equilibrium, the final temperature of the metal-water mixture is  $28.06^{\circ}\text{C}$ . How much heat was absorbed by the water? The heat capacity of the vessel is  $0.220\text{KJ}/^{\circ}\text{C}$ .

- a. 9.43KJ
- b. 15.2KJ
- c. 12KJ
- d. 6.82KJ
- e. 112KJ

9. A sample of hydrogen was collected by water displacement at  $23.0^{\circ}\text{C}$  and an atmospheric pressure of  $735\text{mmHG}$ . Its volume is  $568\text{mL}$ . After water vapor is (removed), what volume would the hydrogen occupy at the same conditions of pressure and temperature? (The vapor pressure of water at  $23.0^{\circ}\text{C}$  is  $21\text{mmHG}$ ).

- a. 552mL
- b. 509 mL
- c. 568mL
- d. 585mL
- e. 539MI

10. A small amount wet of hydrogen gas ( $\text{H}_2$ ) can be prepared by the reaction of zinc with excess hydrochloric acid and trapping the gas produced in an inverted tube initially filled with water. If the total pressure of the gas in the collection tube is  $757.9\text{mmHG}$  at  $25^{\circ}\text{C}$ , what is the

partial pressure of the hydrogen? The vapor pressure of water is 23.8mmHG.

- a. 781.7mmHG
- b. 734.1mmHG
- c. 47.7mmHG
- d. 32.8mmHG
- e. 757.9mmHG

11. What volume of sulfur trioxide gas, SO<sub>3</sub>, has the same number of atoms 4L of helium gas at the same temperature and pressure?

- a. 4L
- b. 20L
- c. 16L
- d. 1L
- e. 0.8L

12. In a certain experiment, 0.7000 mol of hydrogen gas reacted with 0.7000 mol of solid iodine at a constant 1 atm pressure, producing 1.4000 mol of solid hydrogen iodide and absorbing 36.9KJ of heat in the process, which of the following thermochemical equations correctly describes this experiment?

- a.  $\text{H}_2(\text{g}) + \text{I}_2(\text{s}) \rightarrow 2\text{HI}(\text{s}), \Delta H^\circ = 73.8\text{KJ}$
- b.  $\text{H}_2(\text{g}) + \text{I}_2(\text{s}) \rightarrow 2\text{HI}(\text{s}), \Delta H^\circ = -36.9\text{KJ}$
- c.  $\text{H}_2(\text{g}) + \text{I}_2(\text{s}) \rightarrow 2\text{HI}(\text{s}), \Delta H^\circ = 36.9\text{KJ}$



13. a bomb calorimeter has a heat capacity of  $2.47 \text{KJ/K}$ . When a  $0.106\text{-g}$  sample of certain hydrocarbon was burned in this calorimeter, the temperature increased by  $2.14\text{K}$ . calculate the energy of combustion for  $1\text{g}$  of the hydrocarbon?

a.  $-2.33 \times 10^3 \text{ J/g}$

b.  $-0.560 \text{ J/g}$

c.  $-4.99 \times 10^5 \text{ J/g}$

d.  $-5.29 \text{ J/g}$

e.  $-0.120 \text{ J/g}$

14. What is the partial pressure of carbon dioxide in a container that contains  $3.63 \text{ mol}$  of oxygen,  $1.49 \text{ mol}$  of nitrogen, and  $4.49 \text{ mol}$  of carbon dioxide when the total pressure is  $871 \text{ mmHG}$ ?

a.  $871 \text{ mmHG}$

b.  $135 \text{ mmHG}$

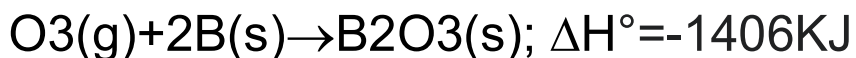
c.  $329 \text{ mmHG}$

d.  $406 \text{ mmHG}$

e.  $763 \text{ mmHG}$

15) Given the following thermochemical data at  $25^\circ\text{C}$  and  $1 \text{ atm}$  pressure,





Determine  $H^\circ$  for the following reaction at  $25^\circ\text{C}$  and 1 atm pressure.  $3\text{O}_2(\text{g}) \rightarrow 2\text{O}_3(\text{g})$

- a. +980KJ/mol
- b. +284KJ/mol
- c. -284KJ/mol
- d. -980KJ/mol
- e. -2670KJ/mol

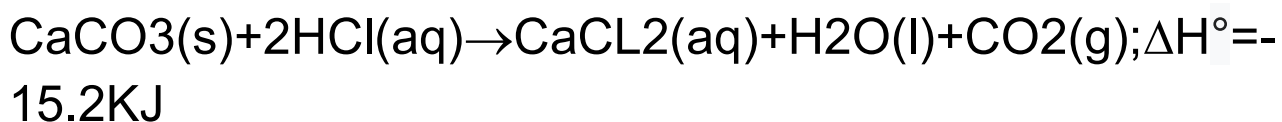
16) At  $25^\circ\text{C}$ , the standard enthalpy of combustion of gaseous propane ( $\text{C}_3\text{H}_8$ ) is  $-2219.0\text{KJ}$  per mole of propane, and the standard enthalpy of combustion of gaseous propylene ( $\text{C}_3\text{H}_6$ ) is  $-2058.3\text{KJ}$  per mole of propylene. What is the standard enthalpy change for the following reaction at  $25^\circ\text{C}$ ?  $\text{C}_3\text{H}_6(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{C}_3\text{H}_8(\text{g})$ ;

Substance	$\Delta H^\circ_f(\text{KJ/mol})$
$\text{CO}_2(\text{g})$	-393.5
$\text{H}_2\text{O}(\text{l})$	-285.8

- a. -20.4KJ
- b. -150.7KJ
- c. +104.7KJ
- d. +160.7KJ
- e. e. -125.1KJ



17. How much heat is liberated at constant pressure  
0.833g of calcium carbonate reacts with 59.7 mL of  
0.251M hydrochloric acid?



- a. 0.113KJ
- b. 0.526KJ
- c. 3.81KJ
- d. 12.6KJ
- e. 0.24 KJ

18. which of the following is/are true of Avogadro's law?

1. Avogadro's law relates the volume of a gas to the moles of the gas at constant temperature and pressure

2. Avogadro's law states that the pressure of a gas decreases if the volume is increased at constant temperature and molar concentration

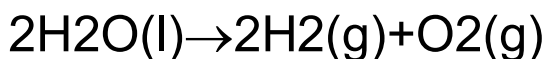
3. Avogadro's law states that the pressure of a gas increases with the increase in its temperature at constant volume and molar concentration

- a. 1 and 3
- b. 3 only
- c. 2 only
- d. 1 only
- e. 2 and 3

19. How many values are there for the magnetic quantum number when the value of the angular momentum quantum number is 3?

- a. 7
- b. 14
- c. 15
- d. 1
- e. 12

20. Which of the following statements is true concerning the decomposition of liquid water to form hydrogen gas and oxygen gas?



- a.  $\Delta H$  is greater than  $\Delta U$  because of the pressure-volume work done by the gaseous products
- b.  $\Delta H$  is less than  $\Delta U$  because the atmosphere does pressure-volume work on the gaseous products
- c.  $\Delta H$  is less than  $\Delta U$  because of the pressure-volume work done by the gaseous products
- d.  $\Delta H$  is greater than  $\Delta U$  because the pressure is constant
- e.  $\Delta H$  equals  $\Delta U$  because both are state functions

21. Absolute zero is the point at which?

- a. a straight-line graph of  $V$  versus  $T(K)$  intersects the origin
- b. a straight-line graph of  $V$  versus  $1/P$  at constant  $T$  intersects the origin
- c. gaseous helium liquefies
- d. a straight-line graph of  $V$  versus  $T(^{\circ}C)$  intersects the origin
- e. a straight-line graph of  $1/V$  versus  $P$  at constant  $T$  intersects the origin

22) calcium nitrate react with ammonium chloride at slightly elevated temperatures, as represented in the equation below.



What is the maximum volume of  $\text{N}_2\text{O}$  at STP that could be produced using a 5.20-mol sample of each reactant?

- a. 233L
- b.  $1.42 \times 10^3$  L
- c. 22.4L
- d. 116L
- e.  $8.58 \times 10^{-3}$  L

23. The reaction of iron hydrochloric acid is represented by the following thermochemical equation.

$\text{Fe(s)} + 2\text{HCl(aq)} \rightarrow \text{FeCl}_2\text{(aq)} + \text{H}_2\text{(g)}$ ;  $\Delta H^\circ = -87.9\text{KJ}$ ; How much heat is liberated at constant pressure if 0.154g of iron reacts with 25.7mL of 0.358M HCl?

- a. 0.404KJ
- b. 13.5KJ
- c. 1.85KJ
- d. 87.9KJ
- e. 0.242KJ

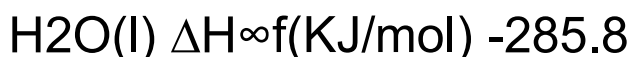
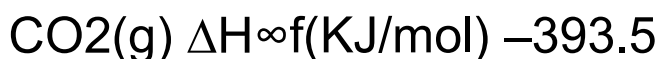
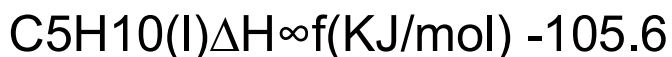
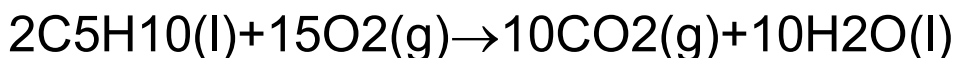
24. A 500-cm<sup>3</sup> sample of 1.0 M NaOH(aq) is added to 500cm<sup>3</sup> of 1.0M HCl(aq) in a Styrofoam cup, and the solution is quickly stirred. The rise in temperature ( $\Delta T_1$ ) is measured. The experiment is repeated using 100cm<sup>3</sup> of each solution, and the rise in temperature ( $\Delta T_2$ ) is measured. What conclusion can you draw about  $\Delta T_1$  and  $\Delta T_2$ ?  $\text{HCl(aq)} + \text{NaOH(aq)} \rightarrow \text{H}_2\text{O(l)} + \text{NaCl(aq)}$ ;  $\Delta H^\circ = -55.8\text{KJ}$

- a.  $\Delta T_1$  is five times as large as  $\Delta T_2$
- b.  $\Delta T_1$  is less than  $\Delta T_2$
- c.  $\Delta T_2$  is greater than  $\Delta T_1$
- d.  $\Delta T_2$  is equal to  $\Delta T_1$
- e.  $\Delta T_2$  is five times as large as  $\Delta T_1$

25. In a mixture of helium and chlorine, occupying a volume of 12.8L at 605.6mmHg and 21.6°C, it is found that the partial pressure of chlorine is 143mmHg. What is the total mass of the sample?

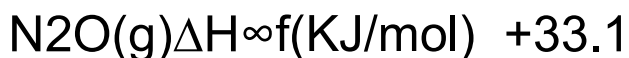
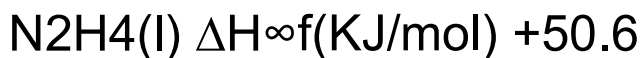
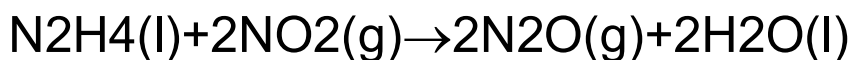
- a. 31.6g
- b. 7.09g
- c. 1.28g
- d. 0.4g
- e. 8.37g

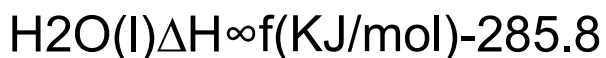
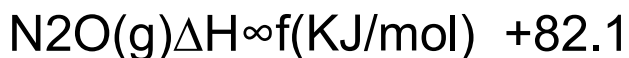
26. What is the standard enthalpy change for the combustion of liquid cyclopentane, C<sub>5</sub>H<sub>10</sub>?



- a. +784.9KJ
- b. +573.7KJ
- c. -784.9KJ
- d. -6581.8KJ
- e. -573.7KJ

27. What does the standard enthalpy change for the following reaction?

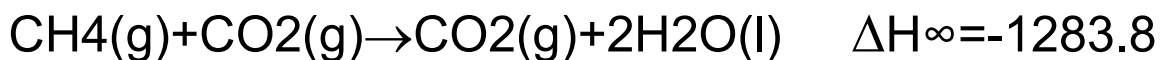




- a. -119.7KJ
- b. +290.6KJ
- c. -524.2KJ
- d. -290.6KJ
- e. +119.7KJ

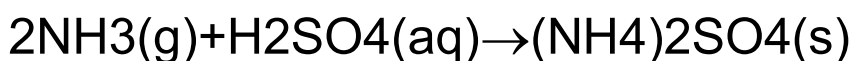
**ANSWER: D**

28. when 9.42g of methane ( $\text{CH}_4$ ) is burned in a bomb calorimeter (heat capacity= $2.677 \times 10^3 \text{ J}/^{\circ}\text{C}$ ), the temperature rises from 24.00 to  $27.08^{\circ}\text{C}$ , How much heat is absorbed by the calorimeter?



- a. 753KJ
- b. 8.24KJ
- c.  $1.28 \times 10^3 \text{ KJ}$
- d.  $4.84 \times 10^3 \text{ KJ}$
- e. 745KJ

29. What volume of ammonia gas, measured at 547.9 mmHg and  $27.6^{\circ}\text{C}$ , is required to produce 8.98g of ammonium sulfate according to the following balanced chemical equation?



- a. 0.000992L
- b. 1.16L
- c. 4.65L
- d. 0.00397L
- e. 18L

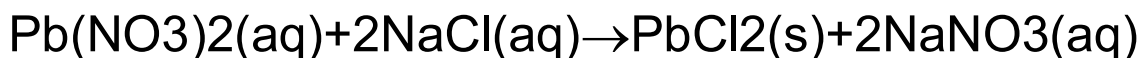
**ANSWER: C**

30. At 530.4 mmHg and 55.3°C, a 3.14-L sample of a hydrocarbon gas has a mass of 2.28g. What is the formula of the gas?

- a. C<sub>2</sub>H<sub>6</sub>
- b. C<sub>2</sub>H<sub>2</sub>
- c. C<sub>2</sub>H<sub>4</sub>
- d. C<sub>3</sub>H<sub>6</sub>
- e. C<sub>3</sub>H<sub>8</sub>

**ANSWER: C**

31. When 13.8 mL of 0.870M lead (2) nitrate reacts with 90.0mL of 0.777M sodium chloride, 0.279KJ of heat is released at constant pressure. What is  $\Delta H^\circ$  for this reaction?



- a. 23.3KJ
- b. 4KJ
- c. 1.84KJ
- d. 8KJ
- e. 3.41KJ

**ANSWER: C**

32. If 250 ml of methane, CH<sub>4</sub>, effuses through a small hole in 20 s, the time required for the same volume of helium to pass through the hole under the same conditions will be

- a. 10 s
- b. 1.3s
- c. 40 s
- d. 5 s
- e. 80 s

33. Under conditions of constant pressure, for which of the following reactions is the magnitude of a pressure-volume work going to be the greatest?

- a.  $2\text{H}_2\text{O}_2(\text{l}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$
- b.  $\text{BaO}(\text{s}) + \text{SO}_3(\text{g}) \rightarrow \text{BaSO}_4(\text{s})$
- c.  $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
- d.  $2\text{KClO}_3(\text{s}) \rightarrow 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g})$
- e.  $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$

**ANSWER: D**

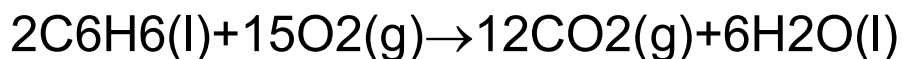
34. Which of the following processes will result in the lowest final temperature of the metal-water mixture at equilibrium? The specific heat of cobalt is 0.421 J/g(°C)



- a. the addition of 100 g of cobalt at 95°C to 40mL of water at 25°C in an insulated container
- b. the addition of 100 g of cobalt at 95°C to 80mL of water at 25°C in an insulated container
- c. the addition of 100 g of cobalt at 95°C to 100mL of water at 25°C in an insulated container
- d. the addition of 100 g of cobalt at 95°C to 60mL of water at 25°C in an insulated container
- e. the addition of 100 g of cobalt at 95°C to 20mL of water at 25°C in an insulated container

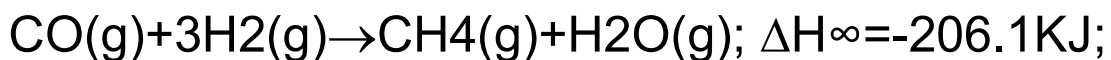
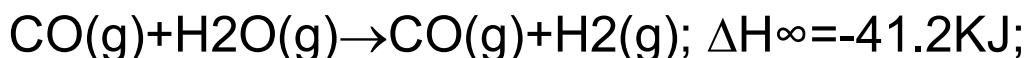
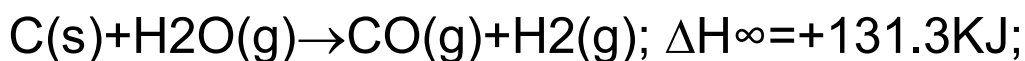
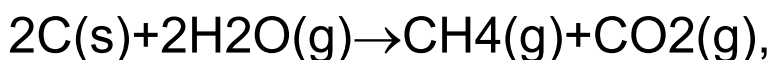
35. When 22.0 mL of liquid benzene (C<sub>6</sub>H<sub>6</sub>, d=0.879 g/mL) reacts with 34.2L of oxygen gas, measured at 1.00 atm pressure and 25C,  $6.09 \times 10^2$  KJ of heat is released at constant pressure.

What is H for the following reaction? (R=0.0821 L.atm/(K.mol))



- a.  $-4.92 \times 10^3$  KJ
- b.  $-2.84 \times 10^1$  KJ
- c.  $-4.36 \times 10^2$  KJ
- d.  $-6.53 \times 10^3$  KJ
- e.  $-3.7 \times 10^2$  KJ

36. Using the following data, calculate the standard enthalpy of reaction for the coal gasification process



- a. +15.3KJ
- b. -378.6KJ
- c. -157.26KJ
- d. +378.6KJ
- e. -116.0KJ

37. The reaction of iron hydrochloric acid is represented by the following thermochemical equation.

$\text{Fe}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{FeCl}_2(\text{aq}) + \text{H}_2(\text{g}); \Delta H^\circ = -87.9 \text{KJ};$  In which of the following experiments would the temperature rise the most?

- a. 1.1 g of Fe added to 1.0 L of 0.02 M HCl
- b. 1.1 g of Fe added to 1.0 L of 0.02 M HCl
- c. 0.56 g of Fe added to 1.0 L of 0.02 M HCl
- d. 2.2 g of Fe added to 1.0 L of 0.03 M HCl
- e. 4.5 g of Fe added to 1.0 L of 0.03 M HCl

38. What is the number of subshells found in the  $n=6$  shell?

- a. 7
- b. 36
- c. 5
- d. 6
- e. 8

**ANSWER: D**

39. A 8.22-g sample of solid calcium reacted in excess fluorine gas to give a 16-g sample of pure solid  $\text{CaF}_2$ . The heat given off in this reaction was 251KJ at constant pressure. Given this information, what is the enthalpy of formation of  $\text{CaF}_2(\text{s})$ ?

- a. 251 KJ/mol
- b.  $-1.23 \times 10^3$  KJ/mol
- c. -613KJ/mol
- d.  $1.23 \times 10^3$  KJ/mol
- e. -251KJ/mol

40. When 0.0500 mol of  $\text{HCl}(\text{aq})$  is reacted with 0.0500 mol of  $\text{NaOH}(\text{aq})$  in 50.0 mL of water, the temperature of the solution increases by  $5.99^\circ\text{C}$ . What is the enthalpy for the following thermochemical equation?

$\text{HCl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$ ; Assume that the heat capacity of the solution and calorimeter is  $465.4\text{J}/^\circ\text{C}$ .

- a. 2.79KJ
- b. -55.8KJ
- c. -0.139KJ
- d. 55.8KJ

e. -2.79KJ

41. The volume of a sample of gas measured at  $35.0^{\circ}\text{C}$  and 1.00 atm pressure is 2.00L. What must the final temperature be in order for the gas to have a final volume of 3.00 L at 1.00 atm pressure?

a.  $52.5^{\circ}\text{C}$

b.  $189.0^{\circ}\text{C}$

c.  $-220.5^{\circ}\text{C}$

d.  $23.3^{\circ}\text{C}$

e.  $-67.8^{\circ}\text{C}$

**ANSWER: B**

42. The partial pressure of  $\text{CH}_4$ ,  $\text{N}_2$ , in a sample of gas were found to be 183 mmHg, 443mmHg, and 693 mmHg, respectively. What is the mole fraction of nitrogen?

a. 0.525

b. 0.336

c. 0.410

d. 21.7

e. 0.912

**ANSWER: B**