| Student Name: | Grade: 09 |
|---|---|
| Test Name: November Chemistry for All: Unit 6 - Equations and Stoichiometry | Version: 1 |

1. Ethene ($C_2H_4$) gas burns in the presence of oxygen to produce carbon dioxide gas, water vapor and heat. Which of the following is a balanced chemical equation that correctly includes "heat" as either a reactant or a product.

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

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

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

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

2. When potassium chlorate is heated it produces potassium chloride and oxygen gas. Which of the following represents a balanced chemical equation that included "heat" as either a reactant or a product?

   (a) $KNO_{3(s)} \rightarrow KNO_{2(s)} + O_{2(g)} + heat$

   (b) $2\,KNO_{3(s)} \rightarrow 2\,KNO_{2(s)} + O_{2(g)} + heat$

   (c) $KNO_{3(s)} + heat \rightarrow KNO_{2(s)} + O_{2(g)}$

   (d) $2\,KNO_{3(s)} + heat \rightarrow 2\,KNO_{2(s)} + O_{2(g)}$

**Instructions for questions 3 through 6.**

For each of the following simple chemical equations, choose the correctly balanced option.

3.  ____ Fe + ____ $Cl_2$ → ____ $FeCl_3$

    (a) $Fe + 3\ Cl_2 \rightarrow FeCl_3$

    (b) $4\ Fe + 6\ Cl_2 \rightarrow 4\ FeCl_3$

    (c) $2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$

    (d) $Fe + Cl_2 \rightarrow FeCl_3$

4.  ____ Zn + ____ HCl → ____ $ZnCl_2$ + ____ $H_2$

    (a) $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$

    (b) $Zn + 2\ HCl \rightarrow ZnCl_2 + 2\ H_2$

    (c) $3\ Zn + 6\ HCl \rightarrow 3\ ZnCl_2 + 3\ H_2$

    (d) $2\ Zn + 2\ HCl \rightarrow 2\ ZnCl_2 + H_2$

5.  ____ Cu + ____ $AgNO_3$ → ____ Ag + ____ $Cu(NO_3)_2$

    (a) $2\ Cu + 4\ AgNO_3 \rightarrow 4\ Ag + 2\ Cu(NO_3)_2$

    (b) $Cu + 3\ AgNO_3 \rightarrow 3\ Ag + Cu(NO_3)_2$

    (c) $3\ Cu + AgNO_3 \rightarrow Ag + 3\ Cu(NO_3)_2$

    (d) $Cu + 2\ AgNO_3 \rightarrow 2\ Ag + Cu(NO_3)_2$

6. ____ $Al +$ ____ $O_2 \rightarrow$ ____ $Al_2O_3$

    (a) $3\ Al + 2\ O_2 \rightarrow Al_2O_3$

    (b) $2\ Al + 3\ O_2 \rightarrow Al_2O_3$

    (c) $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$

    (d) $12\ Al + 9\ O_2 \rightarrow 6\ Al_2O_3$
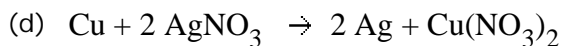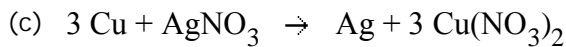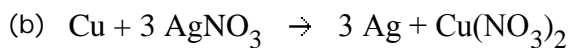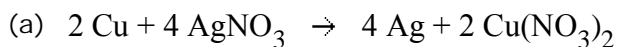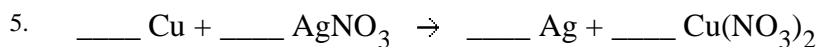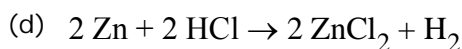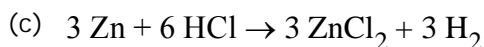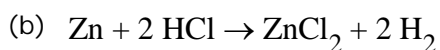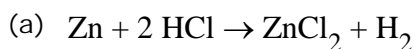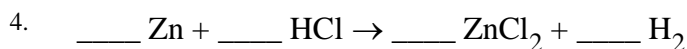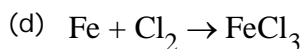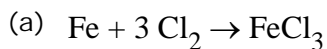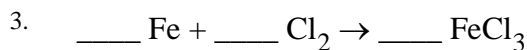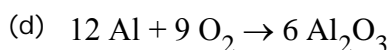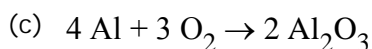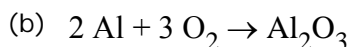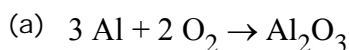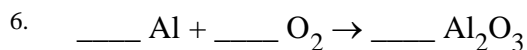
7. Zinc reacts with hydrochloric acid to produce zinc chloride and hydrogen according to the following equation:
$$Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$$
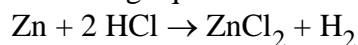
How many moles of HCl are required to produce 7.50 moles of $ZnCl_2$?

    (a) 2.00 mol HCl

    (b) 3.25 mol HCl

    (c) 7.50 mol HCl

    (d) 15.0 mol HCl

8. Copper metal reacts with silver nitrate to form silver and copper(II) nitrate as seen in the following equation:
$$Cu + 2\ AgNO_3 \rightarrow 2\ Ag + Cu(NO_3)_2$$

How many moles of silver will be produced from 3.65 moles of silver nitrate?

    (a) 1.83 mol Ag

    (b) 3.65 mol Ag

    (c) 7.30 mol Ag

    (d) 394 mol Ag

9. Use the following equation to answer the next question.
$$2\,Fe + 3\,Cl_2 \rightarrow 2\,FeCl_3$$

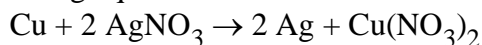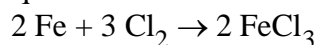How many grams of iron(III) chloride are produced when 15.3 g of iron react with excess chlorine gas?

(a) 22.3 g $FeCl_3$

(b) 35.5 g $FeCl_3$

(c) 44.4 g $FeCl_3$

(d) 89.0 g $FeCl_3$

10. Use the following equation to answer the next question.
$$2\,Fe + 3\,Cl_2 \rightarrow 2\,FeCl_3$$
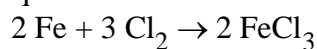
How many grams of iron are needed to react with 98.1 g of chlorine gas to produce iron(III) chloride?

(a) 51.5 g Fe

(b) 77.1 g Fe

(c) 116 g Fe

(d) 224 g Fe

11. When 16.3 g of magnesium and 4.52 g of oxygen gas react, identify the limiting reactant.
$$2\,Mg + O_2 \rightarrow 2\,MgO$$
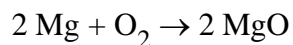
(a) Mg

(b) MgO

(c) $O_2$

12. If 25.3 g of aluminum reacts with 25.3 g of copper(II) sulfate, how many grams of copper are formed?

$$2 \text{ Al} + 3 \text{ CuSO}_4 \rightarrow 3 \text{ Cu} + \text{Al}_2(\text{SO}_4)_3$$
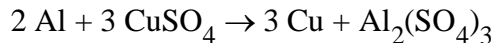
(a)  0.158 g Cu

(b)  0.938 g Cu

(c)  10.0 g Cu

(d)  40.0 g Cu

13. Identify the limiting reactant when 1.00 g of zinc reacts with 12.42 g $Pb(NO_3)_2$.

$$\text{Zn} + \text{Pb(NO}_3)_2 \rightarrow \text{Pb} + \text{Zn(NO}_3)_2$$
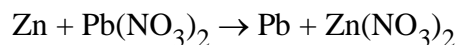
(a)  Zn

(b)  Pb

(c)  $Pb(NO_3)_2$

(d)  $Zn(NO_3)_2$

14. A 2.0 g sample of ammonia is mixed with 4.0 g of oxygen. Which is the limiting reactant?

$$4 \text{ NH}_{3(g)} + 5 \text{ O}_{2(g)} \rightarrow 4 \text{ NO}_{(g)} + 6 \text{ H}_2\text{O}_{(g)}$$
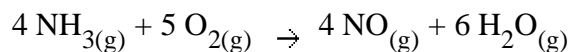
(a)  $NH_3$

(b)  $O_2$

(c)  NO

(d)  $H_2O$

15. What volume is occupied by 5.00 moles of any gas at STP?

(a)  0.223 L

(b)  2.08 L

(c)  12.0 L

(d)  112 L

16. What volume is occupied by 0.750 moles of chlorine gas at STP?

   (a)  16.8 L
   (b)  1.80 L
   (c)  0.313 L
   (d)  0.033 L

17. Methane burns according to the following equation;
$$CH_4 + 2\,O_2 \rightarrow CO_2 + 2\,H_2O$$
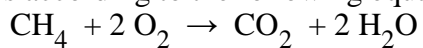   Assume all reactants and products in this reaction are at gases and are reacting at STP.  If 7.50 L of methane react, how much oxygen is required?

   (a)  7.50 L
   (b)  15.0 L
   (c)  22.4 L
   (d)  30.0 L

18. The following reaction occurs at STP assume all reactants and products are gases at STP.

$$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$$
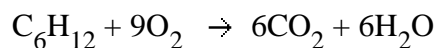
   If 1.9 L of oxygen is used, how may liters of water vapor will form?

   (a)  0.63 L
   (b)  1.3 L
   (c)  2.9 L
   (d)  43 L

**Instructions for questions 19 through 21.**

For each of the following reactions, choose the correctly balanced equation that shows the correct products:
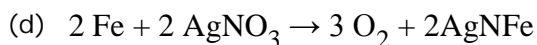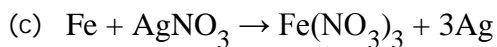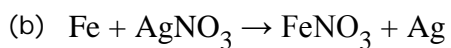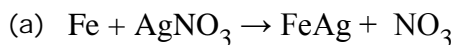
19.  $Li + H_2O \rightarrow$

   (a)  $2\,Li + 2\,H_2O \rightarrow 2\,LiOH + H_2$

   (b)  $Li + H_2O \rightarrow LiO + H_2$

   (c)  $Li + H_2O \rightarrow LiOH + H_2$

   (d)  $Li + 2\,H_2O \rightarrow LiO_2 + 2\,H_2$

20.  $Al + Pb(NO_3)_2 \rightarrow$

   (a)  $Al + 3\,Pb(NO_3)_2 \rightarrow Al(NO_3)_3 + 3\,Pb$

   (b)  $2\,Al + 3\,Pb(NO_3)_2 \rightarrow 2\,Al(NO_3)_3 + 3\,Pb$

   (c)  $2\,Al + Pb(NO_3)_2 \rightarrow 2\,AlNO_3 + Pb$

   (d)  $Al + Pb(NO_3)_2 \rightarrow Al(NO_3)_2 + Pb$

21.  $Fe(s) + AgNO_3(aq) \rightarrow$

   (a)  $Fe + AgNO_3 \rightarrow FeAg + NO_3$

   (b)  $Fe + AgNO_3 \rightarrow FeNO_3 + Ag$

   (c)  $Fe + AgNO_3 \rightarrow Fe(NO_3)_3 + 3Ag$

   (d)  $2\,Fe + 2\,AgNO_3 \rightarrow 3\,O_2 + 2AgNFe$
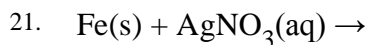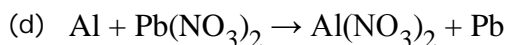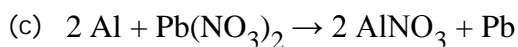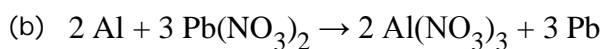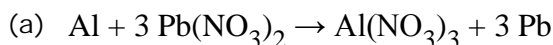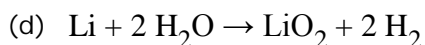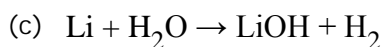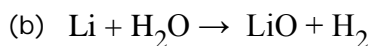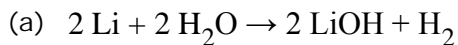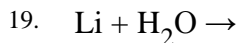
22. Fluorine gas added to aqueous potassium chloride produces aqueous potassium fluoride and chlorine gas. Write a balanced chemical equation for this reaction.

(a)  $F_{(g)} + KCl_{(aq)} \rightarrow KF_{(aq)} + Cl_{(g)}$

(b)  $F_{2(g)} + KCl_{2(aq)} \rightarrow KF_{2(aq)} + Cl_{2(g)}$

(c)  $2\ F_{(g)} + KCl_{2(aq)} \rightarrow KF_{2(aq)} + 2\ Cl_{(g)}$

(d)  $F_{2(g)} + 2\ KCl_{(aq)} \rightarrow 2\ KF_{(aq)} + Cl_{2(g)}$
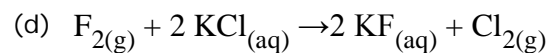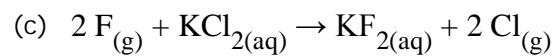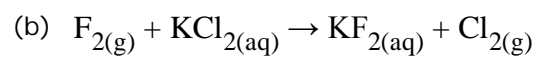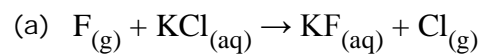
**Instructions for questions 23 through 27.**

Read the following descriptions of chemical reactions and identify the reaction as either exothermic or endothermic.

23. A piece of magnesium metal is burned in the presence of oxygen producing a bright light, heat, and magnesium oxide.

    (a) endothermic
    (b) exothermic

24. A small amount of ammonium nitrate, a white solid, is placed in a baggie and 10 mL of water is added. As the solid dissolves, the baggie begind to feel cold to the touch.

    (a) endothermic
    (b) exothermic

25. A small amount of vinegar is poured into a beaker and the temperature is recorded at 22.0 $^o$C. A spoonful of baking soda is added to the beaker causing the solution to bubble and fizz. The temperature is found to decrease to 20.5 $^o$C.

    (a) endothermic
    (b) exothermic

26. A small piece of magnesium metal is place in a test tube containing hydrochloric acid. The solution bubbles and fizzes until all of the metal has reacted. The tet tube feels warm to the touch.

    (a) endothermic
    (b) exothermic

27. Lighting the Bunsen burner in the lab requires methane gas to burn in the presence of oxygen producing heat and light as well as carbon dioxide gas and water vapor.

   (a) endothermic
   (b) exothermic

**Instructions for questions 28 through 29.**

Identify the following reactions as having a positive change in enthalpy ($+\Delta H$) or a negative change in enthalpy ($-\Delta H$).
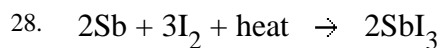
28.   $2Sb + 3I_2 + heat \rightarrow 2SbI_3$

    (a)   positive change in enthalpy

    (b)   negative change in enthalpy

29.   $CaO + H_2O \rightarrow Ca(OH)_2 + heat$
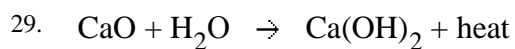
    (a)   positive change in enthalpy

    (b)   negative change in enthalpy

**Instructions for questions 30 through 33.**

For each of the following word equations, choose the correct balanced formula equation.

30.  Solid potassium nitrate yields solid potassium nitrite and oxygen gas.

(a)  $2KNO_{3(s)} \rightarrow 2KN_{(s)} + 3O_{2(g)}$

(b)  $KNO_{3(s)} \rightarrow KNO_{2(s)} + O_{(g)}$

(c)  $2KNO_{3(s)} \rightarrow 2KNO_{2(s)} + O_{2(g)}$

(d)  $3K_2NO_{3(s)} \rightarrow 2K_3N_{2\ (s)} + 9O_{(g)}$

31.  Aqueous solutions of ammonium chloride and lead(II) nitrate produce lead(II) chloride precipitate and aqueous ammonium nitrate.
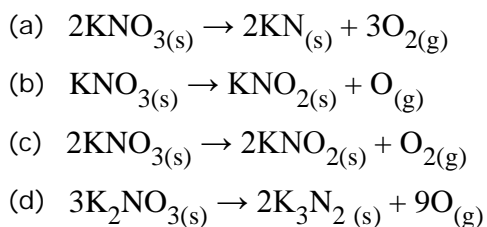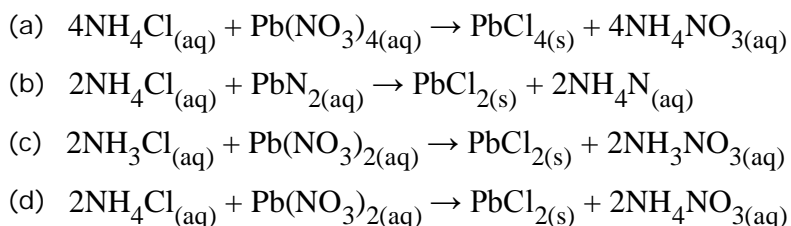
(a)  $4NH_4Cl_{(aq)} + Pb(NO_3)_{4(aq)} \rightarrow PbCl_{4(s)} + 4NH_4NO_{3(aq)}$

(b)  $2NH_4Cl_{(aq)} + PbN_{2(aq)} \rightarrow PbCl_{2(s)} + 2NH_4N_{(aq)}$

(c)  $2NH_3Cl_{(aq)} + Pb(NO_3)_{2(aq)} \rightarrow PbCl_{2(s)} + 2NH_3NO_{3(aq)}$

(d)  $2NH_4Cl_{(aq)} + Pb(NO_3)_{2(aq)} \rightarrow PbCl_{2(s)} + 2NH_4NO_{3(aq)}$

32.  Solid carbon disulfide burns in oxygen to yield carbon dioxide and sulfur dioxide gases.

(a)  $CS_{2(s)} + 3O_{2(g)} \rightarrow CO_{2(g)} + 2SO_{2(g)}$

(b)  $CS_{2(s)} + 6O_{(g)} \rightarrow CO_{2(g)} + 2SO_{2(g)}$

(c)  $CS_{(s)} + 2O_{(g)} \rightarrow CO_{(g)} + SO_{(g)}$

(d)  $2C_2S_{(s)} + 9O_{(g)} \rightarrow 4CO_{2(g)} + S_2O_{(g)}$
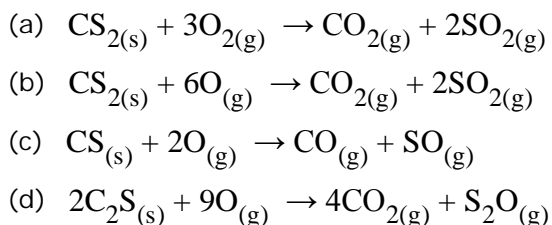
33.  Iron metal reacts with aqueous silver nitrate to produce aqueous iron(III) nitrate and silver metal.

(a)  $Fe_{(s)} + 3AgNO_{2(aq)} \rightarrow Fe(NO_2)_{3(aq)} + 3Ag_{(s)}$

(b)  $Fe_{(s)} + 3AgNO_{3(aq)} \rightarrow Fe(NO_3)_{3(aq)} + 3Ag_{(s)}$

(c)  $Fe_{(s)} + 2AgNO_{3(aq)} \rightarrow Fe(NO_3)_{2(aq)} + 2Ag_{(s)}$

(d)  $Fe_{(s)} + 3AgNO_{2(aq)} \rightarrow Fe(NO_2)_{2(aq)} + 3Ag_{(s)}$
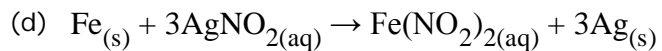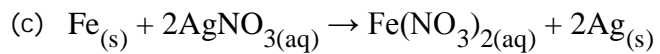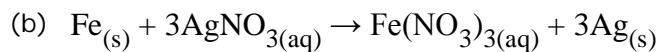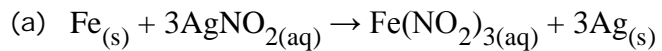
**Instructions for questions 34 through 38.**

For each of the following processes, distinguish between chemical or physical change.

34. a tree undergoing photosynthesis to grow

    (a) chemical
    (b) physical

35. a car rusting

    (a) chemical
    (b) physical

36. NaCl being crushed

    (a) chemical
    (b) physical
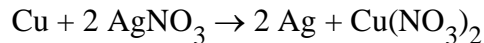
37. NaCl dissolving in water

    (a) chemical
    (b) physical

38. propane gas burning
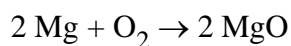
    (a) chemical
    (b) physical

39.   Copper metal reacts with silver nitrate to form silver and copper(II) nitrate as
      seen in the following equation:

$$Cu + 2\ AgNO_3 \rightarrow 2\ Ag + Cu(NO_3)_2$$

How many grams of copper are required to form 250. g of silver?

   (a)  1.16 g Cu
   (b)  2.32 g Cu
   (c)  74.0 g Cu
   (d)  500. g Cu

40.   When 16.3 g of magnesium and 4.52 g of oxygen gas react, how many grams
      of magnesium oxide will be formed?

$$2\ Mg + O_2 \rightarrow 2\ MgO$$
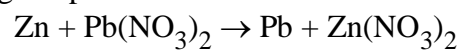
   (a)  0.28 g MgO
   (b)  0.67 g MgO
   (c)  11.4 g MgO
   (d)  27.0 g MgO

41.    If 25.3 g of aluminum reacts with 25.3 g of copper(II) sulfate, identify the
      limiting reactant in this single replacement reaction.

$$2\ Al + 3\ CuSO_4 \rightarrow 3\ Cu + Al_2(SO_4)_3$$
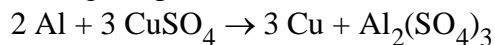
   (a)  Al
   (b)  Cu
   (c)  $Al_2(SO_4)_3$
   (d)  $CuSO_4$
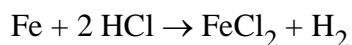
42.  When 1.00 g of zinc reacts with 12.42 g $Pb(NO_3)_2$, how many grams of lead
     are formed in this single replacement reaction?

$$Zn + Pb(NO_3)_2 \rightarrow Pb + Zn(NO_3)_2$$
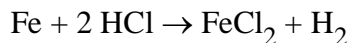
(a)  0.0153 g Pb

(b)  0.0394 g Pb

(c)  3.17 g Pb

(d)  8.16 g Pb

**Instructions for questions 43 through 46.**

A reaction occurs when 24.5 g of iron are placed in 9.11 g of HCl, according to the reaction below:

$$Fe + 2\ HCl \rightarrow FeCl_2 + H_2$$

43. If 24.5 g of iron are placed in 9.11 g HCl, how many grams of $FeCl_2$ are obtained? Identify the limiting and excess reactants in this single replacement reaction.

$$Fe + 2\ HCl \rightarrow FeCl_2 + H_2$$

  (a)  15.9 g $FeCl_2$

  (b)  31.7 g $FeCl_2$

  (c)  40.1 g $FeCl_2$

  (d)  55.6 g $FeCl_2$

44. What is the limiting reactant?

  (a)  Fe

  (b)  $H_2$

  (c)  HCl

  (d)  $FeCl_2$

45. How many grams of iron would be needed to exactly react with the given mass of HCl?

  (a)  6.97 g Fe

  (b)  11.4 g Fe

  (c)  13.9 g Fe

  (d)  16.0 g Fe

46. How many grams of HCl would be needed to exactly react with the given mass of iron?

   (a) 8.00 g HCl
   (b) 16.0 g HCl
   (c) 32.0 g HCl
   (d) 75.0 g HCl

47. A 2.0 g sample of ammonia is mixed with 4.0 g of oxygen. How much nitrogen monoxide is produced after the reaction has stopped?

$$4\,NH_{3(g)} + 5\,O_{2(g)} \rightarrow 4\,NO_{(g)} + 6\,H_2O_{(g)}$$
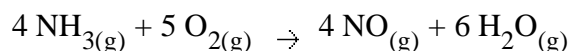
   (a) 0.12 g NO
   (b) 0.50 g NO
   (c) 3.0 g NO
   (d) 3.5 g NO

48. The following reaction occurs at STP assume all reactants and products are gases at STP.

$$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$$
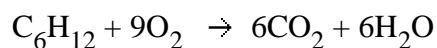
If 1.29 moles of hexene ($C_6H_{12}$) are used, what is the volume of carbon dioxide formed at STP?

   (a) 4.82 L
   (b) 7.74 L
   (c) 173 L
   (d) 1730 L