Topic 5 Particle model/Balancing Equations/Mass

1. Balance the equations below:

   a) $Al + O_2 \rightarrow Al_2O_3$

   b) $ZnS + O_2 \rightarrow ZnO + SO_2$

   c) $Fe_2O_3 + C \rightarrow Fe + CO_2$

   d) $Cu_2S + Cu_2O \rightarrow Cu + SO_2$

   e) $CO_{2(g)} + H_2O_{(l)} \rightarrow C_6H_{12}O_{6(s)} + O_{2(g)}$

   f) $Fe + H_2SO_4 \rightarrow Fe_2(SO_4)_3 + H_2$

   g) $C_2H_6 + O_2 \rightarrow H_2O + CO_2$

   h) $CH_4 + O_2 \rightarrow CO_2 + H_2O$

   i) $P_4O_{10} + H_2O \rightarrow H_3PO_4$

   k) $Fe_2O_3 + C \rightarrow CO_2 + Fe$

   l) $HCl + Al \rightarrow AlCl_3 + H_2$

   m) $H_2SO_4 + C \rightarrow CO_2 + H_2O + SO_2$

Multiple Choice

2. The reaction caused by the burning of butane in air is represented by the following equation:

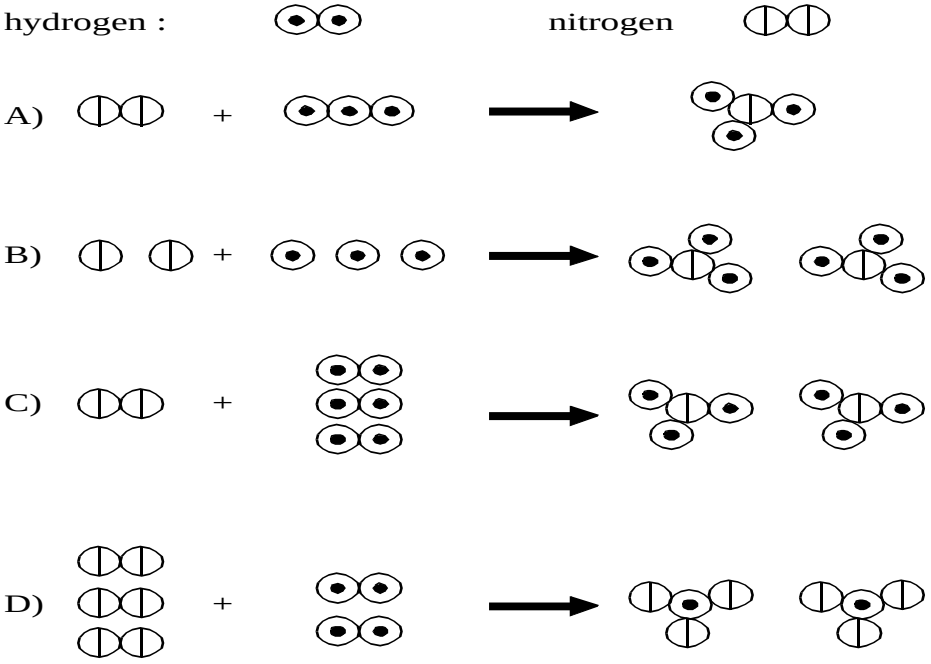
   $$2\,C_4H_{10(g)} + 13\,O_{2(g)} \rightarrow 8\,CO_{2(g)} + 10\,H_2O_{(g)} + \text{Energy}$$

   During a laboratory experiment, you react 29 g of butane (C_4H_{10}) in the presence of oxygen (O_2). You observe that 88 g of carbon dioxide (CO_2) and 45 g of water vapour (H_2O) form.
   What mass of oxygen did you use in this experiment?
   A) 59 g B) 104 g C) 133 g D) 162 g

3. One litre of nitrogen (N_2) reacts with three litres of hydrogen (H_2) to produce two litres of ammonia, according to the following equation :

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

   Which of the following models best describes the chemical change that occurs?

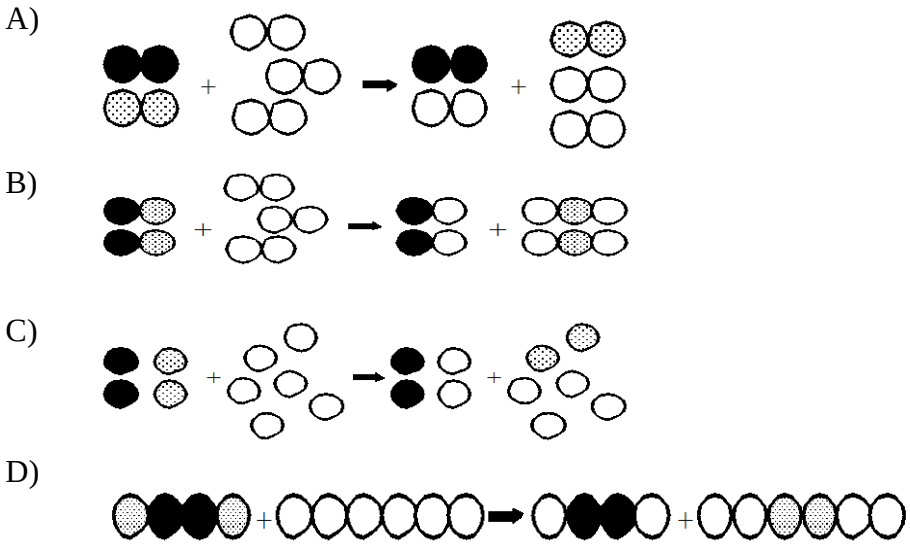


4. Galena is an ore that contains lead sulfide (PbS). To extract lead from galena, the ore is first heated in the presence of dioxygen (O_2). The balanced equation of this reaction is :

   $2\ PbS + 3\ O_2 \rightarrow 2\ PbO + 2\ SO_2$

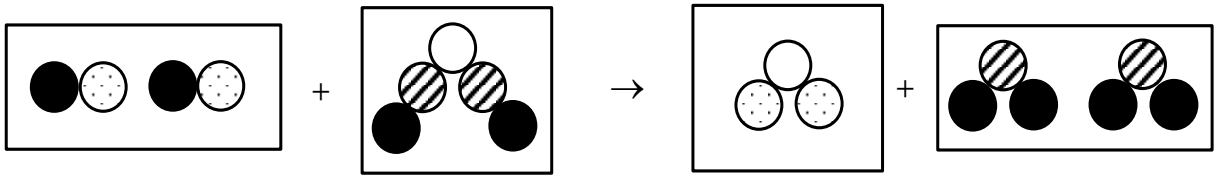
   Which of the models below represents this reaction?

   lead : ● sulfur : ◌ oxygen : ○



5. The following model represents a balanced neutralization reaction involving an acid and a base.

O = ⊘ H = ● Cl = ⊙ Ca = ○



Which of the following correctly represents this neutralization reaction?

A) $2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$
B) $H_2Cl_2 + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$
C) $H_2Cl_2 + CaO_2H_2 \rightarrow CaCl_2 + H_4O_2$
D) $2HCl + CaO_2H_2 \rightarrow CaCl_2 + H_4O_2$

6. Which of the following chemical equations are correctly balanced?

1. $4\ Bi_{(s)} + 3\ O_{2(g)} \rightarrow 2\ Bi_2O_{3(s)}$
2. $2\ Bi_{(s)} + Cl_{2(g)} \rightarrow 2\ BiCl_{3(s)}$
3. $2\ Bi_2S_{3(s)} + 9\ O_{2(g)} \rightarrow 2\ BiO_{3(s)} + 6\ SO_{2(g)}$
4. $Bi_2O_{3(s)} + 3\ C_{(s)} \rightarrow 2\ Bi_{(s)} + 3\ CO_{(g)}$
5. $As_2O_{3(s)} + 6\ H_{2(g)} \rightarrow 2\ AsH_{3(s)} + 3\ H_2O_{(g)}$

A) 1, 3 and 4 B) 3, 4 and 5 C) 1, 4 and 5 D) 2 and 3

7. A reaction involving 168 g of sodium bicarbonate and 120 g of vinegar produces 88 g of carbon dioxide, 36 g of water and a certain amount of salt. How much salt is produced?

A) 80 g B) 164 g C) 340 g D) 412 g

8. Which of the following chemical equations is balanced correctly?

A) $CH_3COOH + 2\ NaOH \rightarrow CH_3COONa + 2\ H_2O$
B) $CH_3COOH + NaOH \rightarrow 2\ CH_3COONa + H_2O$
C) $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$
D) $2\ CH_3COOH + NaOH \rightarrow CH_3COONa + 2\ H_2O$

9. Which of the following newspaper items contradicts the law of conservation of matter?

A) Three tonnes of a miracle fuel combines with eight tonnes of oxygen to form one tonne of greenhouse gas and ten tonnes of water vapour."
B) "Scientists have finally compressed four kilograms of lead into three kilograms of gold."
C) "Yesterday, two water molecules were converted into two hydrogen molecules and one oxygen molecule."
D) "Local high school students discovered that adding 25 kJ of energy to 10 g of ice produces 10 g of water vapour."

10. The following is the unbalanced equation for a chemical reaction involving iron (Fe) and water (H_2O):

$$Fe + H_2O \rightarrow Fe_2O_3 + H_2$$

In its reduced form, what is the coefficient of hydrogen in the balanced equation form?

A) 1 B) 2 C) 3 D) 6

11. The balanced equation for the combustion of propane is as follows:

$$C_3H_{8(g)} + 5\ O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$$

When a barbeque is used and 14.7 g of propane (C_3H_8) reacts with 53.3 g of oxygen gas (O_2), this produces a certain amount of carbon dioxide (CO_2) and 24.0 g of water vapour (H_2O). What mass of carbon dioxide is released in this situation?

A) 14.7 g B) 44.0 g C) 61.7 g D) 68.0 g

12. During the combustion of gasoline in cars, nitrogen monoxide, NO, is released into the atmosphere. It reacts with oxygen gas, O_2, to form nitrogen dioxide, NO_2:

$$2\ NO + O_2 \rightarrow 2\ NO_2$$

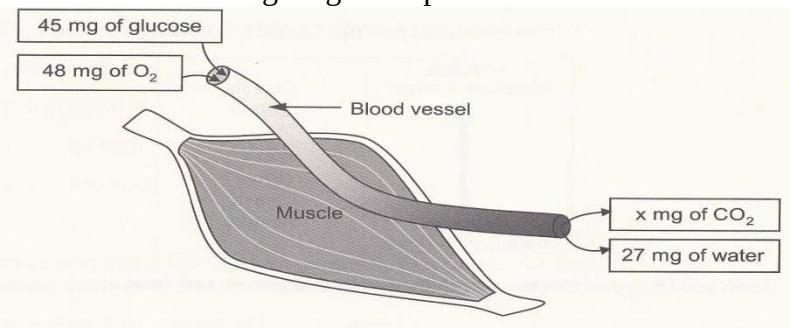
In areas of high automobile traffic, the amount of nitrogen dioxide, NO_2, in the atmosphere can combine with water, H_2O, to produce acid rain, HNO_3:

$$3\ NO_2 + H_2O \rightarrow 2\ HNO_3 + NO$$

When 150 g of NO is released into the atmosphere and is combined with 80 g of O_2 gas, NO_2 is produced. The resulting NO_2 is then mixed with 30 g of water and produces 50 g of NO and a certain amount of HNO_3. How many grams of nitric acid, HNO_3, are produced?

A) 210 g B) 230 g C) 260 g D) 1 120 g

13. The following diagram represents the reaction related to cellular respiration in a muscle.



What mass of carbon dioxide (CO_2) will be produced during this reaction?

A) 24 mg B) 30 mg C) 66 mg D) 120 mg

Short Answer

14. Reaction 1 is the balanced equation for a neutralization reaction.

Reaction 1: $HCl + NaOH \rightarrow NaCl + H_2O$

If 3.65 kg of HCl reacts with 4.00 kg of NaOH, this produces 1.80 kg of H_2O and a certain amount of NaCl.

Reaction 2 is the balanced equation for the electrolysis of sodium chloride.

Reaction 2: $2\ NaCl \rightarrow 2\ Na + Cl_2$

Then all the NaCl from reaction 1 is used in reaction 2 to produce 2.30 kg of Na and a certain amount of Cl_2.

What is the mass of Cl_2 obtained after reaction 2?

15. The Iron and Steel Company uses a chemical reaction to transform ferric oxide (rust) into iron. The balanced equation for this reaction is as follows:

$$2\ Fe_2O_{3(s)} + 3\ C_{(s)} + \text{energy} \rightarrow 4\ Fe_{(s)} + 3\ CO_{2(g)}$$

To determine how much CO_2 it emits, the company took a sample and obtained the data presented in the table below.

Masses of the four Substances before and after the reaction

Substance	Initial Mass (g)	Final Mass (g)
Fe_2O_3	80	0
C	9	0
Fe	0	55
CO_2	0	?

Using the law of conservation of matter, calculate the mass of CO_2 emitted during this reaction.