NGO & SONS
ACADEMIC COACHING

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CHEMISTRY

Module 3

REACTIVE CHEMISTRY

Homework 1

- ❑ Physical and chemical changes

YEAR 11

Name:

Class:

Foundation

Multiple Choice

1 Which of the following situations describes a physical change?

A. Heating a saltwater solution using a Bunsen burner, causing water to evaporate and salt to crystallise

B. Burning ethanol to heat up a pot of water

C. The inflation of an airbag in a car crash resulting from the decomposition of sodium azide solid to form nitrogen gas and sodium solid

D. Synthesising ammonia from nitrogen and hydrogen gas for use in fertiliser

2 Which of the following situations describes a chemical change?

A. Increasing the temperature of aluminium oxide such that it has a high electrical conductivity

B. Shattering a sodium chloride crystal into smaller pieces

C. Heating up iron until it begins to glow red instead of its original silvery colour

D. The rising of bread while it bakes

3 A solution containing blood-red iron (III) thiocyanate ions and pale yellow iron (III) ions was initially coloured blood-red. A chemist decreased the temperature of the solution, and it turned a deeper blood-red colour. The temperature was then raised higher than it was initially, and the solution turned yellow. **1**

Which of the following best describes the change in the solution, and what observable feature signals this change?

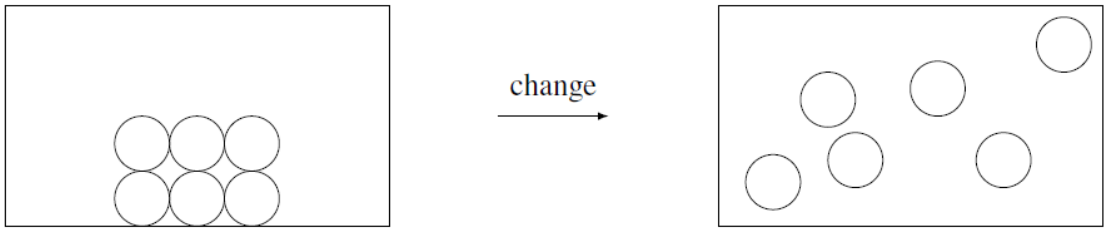
A. Physical, colour change

B. Physical, temperature change

C. Chemical, colour change

D. Chemical, temperature change

4 The diagram below shows a change imposed on a chemical, represented by circles, in a closed container.



What type of change is displayed in the diagram, and what is the change illustrated?

A. Physical, decomposition
B. Physical, temperature
C. Chemical, decomposition
D. Chemical, temperature

5 Which of the following statements is TRUE?

A. The electrolysis of water to form hydrogen and oxygen gas is a chemical change due to the formation of new substances
B. A colour change always indicates a chemical change
C. Some physical changes cannot be reversed
D. Crumpling paper is a physical change due to the change in scattering of light in its new shape

6 Which of the following statements is FALSE?

A. Physical changes never involve the change in the chemical composition of a substance
B. Dissolving sodium chloride in water is a chemical change due to the dissociation of the ionic lattice into individual ions that are surrounded by water molecules
C. All chemical changes are, in theory, reversible
D. The combustion of petrol in a vehicle engine is a chemical change due to the formation of carbon dioxide and water expelled from the vehicle's exhaust

7 Which of the following word equations correctly represents the chemical equation provided below?

$$2\,HBr\,(aq) + Na_2CO_3\,(s) \longrightarrow 2\,NaBr\,(aq) + H_2O\,(l) + CO_2\,(g)$$

A. Monohydrogen monobromide + disodium monocarbonate → monosodium monobromide + dihydrogen monoxide + monocarbon dioxide

B. Hydrogen bromide + sodium carbonate → sodium bromide + water + carbon dioxide

C. Hydrogen monobromide + sodium bicarbonate → sodium monobromide + water + carbon dioxide

D. Hydrogen bromide + sodium carbonate → sodium bromide + water + carbon monoxide

8 In the Haber process, ammonia gas is synthesised from hydrogen and nitrogen gas.

If 9000 ammonia molecules were produced, how many hydrogen molecules had reacted?

A. 9000

B. 18000

C. 4500

D. 13500

9 Liquid pentan-1-ol ($C_5H_{12}O$) was combusted in oxygen gas to produce carbon dioxide gas and liquid water.

Which of the following chemical equations correctly represents this scenario?

A. $2\,C_5H_{12}O\,(l) + 15\,O_2\,(g) \longrightarrow 10\,CO_2\,(g) + 12\,H_2O\,(l)$

B. $C_5H_{12}O\,(l) + O_2\,(g) \longrightarrow CO_2\,(g) + H_2O\,(l)$

C. $2\,C_5H_{12}O\,(aq) + 15\,O_2\,(g) \longrightarrow 10\,CO_2\,(g) + 12\,H_2O\,(l)$

D. $C_5H_{12}O\,(aq) + 5\,O_2\,(g) \longrightarrow 5\,CO\,(g) + 6\,H_2O\,(l)$

Short Answers

10 Distinguish between the terms ‘physical change’ and ‘chemical change’. **2**

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11 Outline THREE characteristics of a physical change. **3**

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12 Outline THREE characteristics of a chemical change. **3**

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13 Describe TWO examples of a physical change. **2**

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14 Identify TWO definitive indicators of a chemical change. **2**

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15 Explain why chemical changes typically require more energy than physical changes. **2**

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16 Classify the following scenarios as physical or chemical changes. Justify your answer.

(a) The mixing of colourless sodium hydroxide and silver nitrate solutions which turned the resultant solution brown. **1**

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(b) The heating of aluminium metal to form a silver-coloured, electrically conductive liquid. **1**

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(c) The synthesis of calcium carbonate solid from calcium oxide solid and calcium dioxide gas. **1**

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17 Write down word AND balanced chemical equations representing the scenarios in Question 16.

(a) **2**

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(b) **2**

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(c) **2**

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18 A step in the Contact process used to produce sulfuric acid is the reversible synthesis of sulfur trioxide gas from sulfur dioxide and oxygen gas.

(a) Write down the balanced chemical equation representing this scenario. **1**

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(b) If 8 molecules of sulfur trioxide was produced, how many molecules of oxygen had reacted? Justify your answer. **2**

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19 Limewater consists of a saturated calcium hydroxide solution. When carbon dioxide gas is bubbled through limewater, a milky white colour is observed.

What type of change had occurred, and what observable feature indicates this change?

A. Physical, colour change

B. Physical, formation of a precipitate

C. Chemical, colour change

D. Chemical, formation of a precipitate

20 Iodate (IO_3^-), hydrogen, and thiosulfate ($S_2O_3^{2-}$) ions react to produce iodide and tetrathionate ($S_4O_6^{2-}$) ions and liquid water.

Which of the following chemical equations best describes the reaction occurring?

A. $IO_3^-(aq) + H^+(aq) + S_2O_3^{2-}(aq) \longrightarrow I^-(aq) + S_4O_6^{2-}(aq) + H_2O(l)$

B. $IO_3^-(aq) + 6H^+(aq) + 6S_2O_3^{2-}(aq) \longrightarrow I^-(aq) + 3S_4O_6^{2-}(aq) + 3H_2O(l)$

C. $I^-(aq) + 3S_4O_6^{2-}(aq) + 3H_2O(l) \longrightarrow IO_3^-(aq) + 6H^+(aq) + 6S_2O_3^{2-}(aq)$

D. $I^-(aq) + S_4O_6^{2-}(aq) + H_2O(l) \longrightarrow IO_3^-(aq) + H^+(aq) + S_2O_3^{2-}(aq)$

21 When carbon dioxide gas is bubbled through water, it reacts with water to form carbonic acid (dihydrogen carbonate) which ionises to form hydrogen and hydrogen carbonate ions. Conversely, hydrogen carbonate and hydrogen ions can synthesise to produce carbonic acid which can decompose to form water and carbon dioxide gas.

Which of the following series of chemical equations best represents this scenario?

A. $CO_2(g) + H_2O(l) \longrightarrow H_2CO_3(aq) \longrightarrow H^+(aq) + HCO_3^-(aq)$

B. $CO_2(g) + H_2O(l) \longrightarrow H_2CO_3(l) \longrightarrow H^+(aq) + HCO_3^-(aq)$

C. $CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$

D. $CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(l) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$

22 When a glucose solution and yeast are placed in a conical flask, the mass of the flask decreased gradually, and the flask was warmer. **2**

Explain whether a physical or chemical change had occurred.

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23 A chemist conducted two experiments involving calcium. In the first experiment, they held a small strip of calcium metal over a Bunsen burner and observed an orange-red-coloured flame. In the second experiment, they placed a separate strip of calcium metal in a solution containing copper hydroxide precipitate and observed that the solution had turned to a deeper blue colour. **3**

Classify these observations as physical and chemical changes and write a balanced chemical equation representing the chemical change. Justify your answers.

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24 A temperature or colour change does not always indicate a chemical change. **2**

Using specific examples, justify this statement.

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25 Write the balanced chemical equations of the scenarios below given their description.

(a) In the Solvay process, solutions of ammonium chloride and calcium hydroxide are mixed to form aqueous ammonia, calcium chloride, and liquid water. **2**

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(b) Solid sulfur is added to a hot, concentrated nitric acid solution to form a sulfuric acid solution, liquid water, and nitrogen dioxide that effervesces. **2**

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(c) Solid sulfur is added to a hot, concentrated nitric acid solution to form a sulfuric acid solution, liquid water, and nitrogen dioxide that effervesces. **2**

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(d) Aqueous chloroplatinic acid (H_2PtC_6), nitrogen dioxide gas, and liquid water is produced from the chemical reaction between platinum solid, and concentrated solutions of hydrochloric acid and nitric acid. **2**

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(e) Solid sodium bromide and sodium bromate ($NaBrO_3$) are added to a concentrated sulfuric acid solution to produce aqueous bromine, sodium sulfate, and liquid water. **3**

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(f) Solutions of potassium nitrate and sucrose ($C_{12}H_{22}O_{11}$) are mixed to form a potassium carbonate solution, liquid water, nitrogen and carbon dioxide gas. **4**

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