**Year 11 Chemistry Test 2**

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47

**The Mole, Energy & Rates Answers**

**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Section A: Multiple Choice (10 marks)**

This section has 10 questions. Answer all questions by circling the correct option. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 10 minutes

1. Select the option where the formulas for the three named ions are given correctly.

**nitrite cyanide phosphate**

1. NO3- CN- P3-

b) NO2- Cy- PO43-

c) N3- Cy- PO32-

d) NO2- CN- PO43-

2. Which one of the following ionic formulae is correct?

* 1. Aℓ(PO4)3
  2. Na2HCO3
  3. Mg(NO3)3
  4. CaS

3. One mole of \_\_\_\_\_\_\_\_ contains the largest number of atoms

1. S8
2. C10H8
3. Aℓ2(SO4)3
4. Na3PO4

4. What is the formula for an ionic compound formed between an element, X, from group 2

and an element, Y, from group 15?

(a) XY

(b) X3Y2

(c) XY2

(d) X2Y3

5. Propane is commonly used as a fuel for portable stoves. It combusts with oxygen to

produce carbon dioxide and water. The reaction is commonly represented as:

C3H8 (g) + 5O2 (g) 🡪 3CO2 (g) + 4H2O (g)

Which of the following alternatives does not accurately represent a correct mole

relationship for the above reaction?

a) n(CO2) = 3/5 x n(O2)

b) n(H2O) = 4/5 x n(O2)

c) n(CO2) = 5/3 x n(O2)

d) n(H2O) = 4/3 x n(CO2)

6. The combustion of ammonia gas, NH3 to produce nitrogen dioxide, NO2 is

shown in the balanced equation below:

4NH3 (g) + 7O2 (g) → 4NO2 (g) + 6H2O (g)

If 5.0 mol of NH3 reacts with excess of O2, calculate the number of moles of

nitrogen dioxide produced:

a) 4.0

b) 5.0

c) 7.5

d) 10

7. The reaction of hydrogen gas and oxygen gas to produce water releases 286 kJ of heat. Which of the following equations correctly represents this?

a) 2H2(g) + O2(g) → 2H2O(ℓ) ΔH = 286 kJ

b) 2H2(g) + O2(g) → 2H2O(ℓ) ΔH = -286 kJ

c) 2H2(g) + O2(g) → 2H2O(ℓ) - 286 kJ

d) 2H2(g) + O2(g) + 286 kJ → 2H2O(ℓ)

8. Which of these chemical equations represents an exothermic reaction?

(i) CO + H2O → H2 + CO2 + 41 kJ

(ii) CH4 + H2O → CO + 3 H2 ΔH = +206 kJ

(iii) N2O3 + 40 kJ → NO + NO2

1. (i) only
2. (ii) only
3. (iii) only
4. (ii) and (iii) only

9. The following graph shows the distribution of kinetic energy for reacting particles at two different temperatures T1 and T2. The dotted line represents the activation energy

(Ea) for a chemical reaction between the particles.

Chart, diagram

Description automatically generated with medium confidence

Which of the following statements concerning this information is correct?

a) Temperature T1 is lower than temperature T2.

b) The reaction rate at T2 is greater than at T1 because a greater area of the curve is to the left of the dotted line.

c) Adding a catalyst would move the dotted line to the right.

d) At temperature T1, the number of particles with energy greater than the activation

energy is given by area A plus area B.

10. Which of the following statements correctly explains why a reaction is endothermic?

a) More energy is released when breaking reactant bonds than is absorbed when

making product bonds.

b) More energy is absorbed when breaking reactant bonds than is released when

making product bonds.

c) Less energy is absorbed when breaking reactant bonds than is released when making product bonds.

d) Less energy is released when breaking reactant bonds than is absorbed when making product bonds

**Section Two: Short answer (37 Marks)**

This section has **six (6)** questions. Answer all questions. Write your answers in the spaces provided.

Suggested working time: 40 minutes.

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**Question 11 (5 marks)**

Complete the following table by writing either the name or formula for each substance.

|  |  |
| --- | --- |
| **Name** | **Formula** |
| barium sulfate | BaSO4 |
| dinitrogen tetrafluoride | N­2F4 |
| sodium sulfide | Na2S |
| tin(II) oxide / tin oxide | SnO |
| magnesium hydroxide | Mg(OH)2 |

**Question 12 (5 marks)**

a) Balance the following equations. (2 marks)

(i) \_\_2\_\_Aℓ (s) + \_\_3\_\_Cℓ2 (g) → ­­­\_\_2\_\_AℓCℓ3 (s)

(ii) \_\_\_\_Ca(OH)2­ (aq) + \_\_2\_\_HBr (aq) → \_\_\_\_CaBr2 (aq) + \_\_2\_\_H2O (ℓ)

b) Write a balanced chemical equation for phosphine PH3 (g) burning in oxygen gas to

form water vapour and solid phosphorus pentoxide. (3 marks)

4PH3 (g) + 13O2 (g) → 6H2O (g) + 4PO5 (s)

(1) – formula for phosphorus pentoxide correct

(1) – formula of water and oxygen gas correct

(1) – balanced

**Question 13 (7 marks)**

a) Determine the number of moles of each element present in 3.00 moles of CH3COOH.

(3 marks)

n(C) = 2 x 3.00 = 6.00 mol (1)

n(H) = 4 x 3.00 = 12.00 mol (1)

n(O) = 2 x 3.00 = 6.00 mol (1)

b) (i) Calculate the molar mass of CuCO3. (1 mark)

M(CuCO3) = 63.55 + 12.01 + 3 x 16.00 =123.56 g mol-1

(ii) Calculate the number of moles of CuCO3 in 60.55 grams. (1 mark)

n(CuCO3) = m / M = 60.55 / 123.56 = 0.4900 mol

(iii) Determine the mass of oxygen in 60.55 grams of CuCO3. (2 marks)

n(O) = 3 x n(CuCO3) = 1.470 mol (1)

m(O) = n x M = 1.470 x 16.00 = 23.52 g (1)

**Question 14 (5 marks)**

Carbon dioxide was prepared by a student in the laboratory by reacting sulfuric acid with a sample of potassium hydrogencarbonate. The equation for the reaction is:

2KHCO3 (s) + H2SO4 (aq) → 2CO2 (g) + 2H2O (ℓ) + K2SO4 (aq)

If 24.70 grams of potassium hydrogencarbonate is reacted with excess sulfuric acid, determine the mass of K2SO4 formed.

M(KHCO3) = 39.10 + 1.008 + 12.01 + 3 x 16.00 = 100.118 g mol-1 (1)

n(KHCO3) = m / M = 24.70 / 100.118 = 0.2467 mol (1)

n(K2SO4) = ½ x n(KHCO3) = ½ x 0.2467 = 0.1234 mol (1)

M(K2SO4) = 2 x 39.10 + 32.06 + 4 x 16.00 = 174.26 g mol-1 (1)

m((K2SO4) = n x M = 0.1234 x 174.26 = 21.496 g (1)

**Question 15 (6 marks)**

In the lab, zinc granules react fairly slowly with dilute hydrochloric acid according to the following balanced equation:

Zn (s) + 2HCℓ (aq) → ZnCℓ2 (aq) + H2 (g)

State two ways that the rate of this reaction could be increased and explain how these changes increase the rate.

Any two of the following:

* Increase temperature of the reaction mixture (1)

Increases the average kinetic energy of the reactant particles (1) thus reactant particles are colliding with more energy/more often (1) resulting in a faster rate of reaction.

* Increase the concentration of hydrochloric acid (1)

More hydrochloric acid in same volume/reactant particles more crowded (1) thus resulting in more collisions between the reactant particles (1) which increases the rate of reation.

* Use powdered zinc/ smaller pieces of zinc (1)

Increases the surface area of the zinc (1) therefore more zinc exposed to the acid resulting in more collisions between the reactant particles (1) thus increasing the rate of reation.

* Add a suitable catalyst (1)

Adding a catalyst lowers the activation energy required for a successful collision (1) thus more reactant particles have sufficient energy when they collide (1) (with the correct orientation) thus increasing the rate of reaction.

**Question 16 (9 marks)**

Nitrogen reacts with oxygen to form nitrogen monoxide according to the following equation.

N2(g) + O2(g) → 2NO(g) ΔH = +56 kJ/mol Ea = 140kJ

1. This reaction is an exothermic / endothermic. (Circle one). (1 mark)
2. Draw a correctly scaled energy profile diagram for this reaction. Indicate reactants,

products, change in enthalpy and activation energy on the diagram. (6 marks)

Axis labelled (1)

Endothermic shape (1)

Reactants and products (1)

ΔH (1)

Ea  (1)

Ratio ΔH : Ea (1)

Diagram

Description automatically generated



c) Indicate using a dotted line on the energy profile diagram above how the diagram would change if a catalyst was used and explain why this changes the diagram.

(2 marks)

Dotted line correctly drawn on diagram (1)

Using a catalyst lowers the activation energy required (1)

**End of Test**