



ALEXANDER ROAD HIGH SCHOOL

JUNE 2016

3 HOUR

PHYSICAL SCIENCES MID-YEAR EXAM – PAPER 2

CO, KB, MH

TOTAL = 150

GRADE 12

Instructions

- The question paper consists of 9 questions
 - Answer all the questions
 - Answer section A on the answer sheet provided
 - Answer section B on the folio sheets and answer each question on a new side of a page.
 - A non-programmable calculator may be used
 - Number the answers correctly according to the numbering system
 - All relevant data can be found at the end of the question paper
 - Round off to two (2) decimal places where necessary
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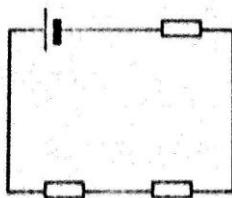
SECTION A

- Answer on the answer sheet -

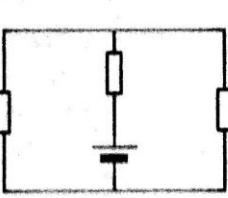
QUESTION 1: Multiple choice

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down the letter (A–D) next to the question number on the attached ANSWER SHEET.

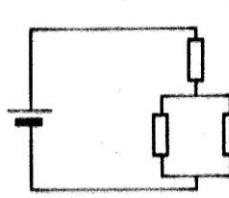
- 1.1 Consider the circuits below, containing identical cells and resistors.



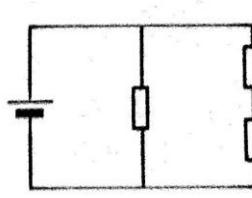
K



L



M



N

Which one of the following pairs has the same effective resistance?

- A K and L
- B M and N
- C K and N
- D L and M

- 1.2 Which would be the most suitable indicator to use in a titration between a strong base and a weak acid?
- A Bromothymol Blue
B Phenolphthalein
C Litmus Paper
D Methyl Orange
- 1.3 Which one of the following is the conjugate acid of NH_3 ?
- A NH_2^-
B NH_4^+
C NH^{2-}
D NH_3
- 1.4 A solution of NaOH has a concentration of $2,4 \times 10^{-4} \text{ mol.dm}^{-3}$. What is the pH of the solution?
- A 11,54
B 13,38
C 12,50
D 10,38
- 1.5 Which one of the following substances has the lowest boiling point?
- A H_2O
B H_2S
C CO
D H_2
- 1.6 The gas with the largest volume at STP is...
- A 48g of oxygen
B 4g of hydrogen
C 12g of helium
D 28g of nitrogen

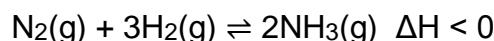
- 1.7 A hypothetical reaction reaches equilibrium at 25°C in a closed container according to the following balanced equation:



The temperature is now decreased to 5°C. Which one of the following is correct as the reaction approaches a new equilibrium?

	Reaction Rate	Yield
A	Decrease	Remains the same
B	Increases	Decrease
C	Decreases	Increase
D	Decreases	Decrease

- 1.8 The following reaction reaches equilibrium in a closed container:

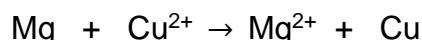


Ammonia gas is removed from the reaction vessel.

Which ONE of the following is correct as the reaction approaches a new equilibrium?

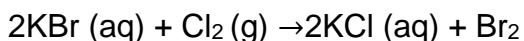
	Yield	Temperature
A	Increase	Decrease
B	Increase	Increase
C	Decrease	Increase
D	Decrease	Decrease

- 1.9 In the following reaction, which substance is the reducing agent?



- A Mg
- B Cu²⁺
- C Mg²⁺
- D Cu

1.10 Which of the following statements is true for this reaction?

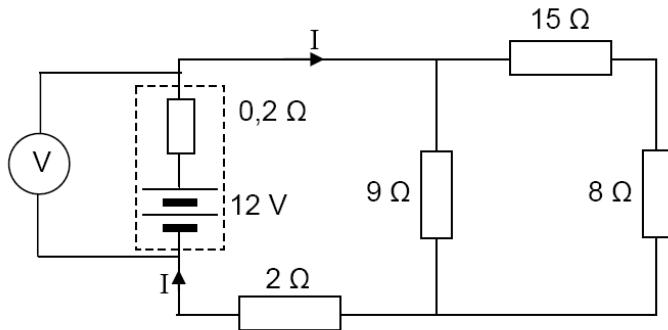


- A bromide ions are oxidized by chlorine
- B bromide ions are reduced by chlorine
- C chlorine is oxidized by bromide ions
- D chlorine is reduced by bromide ions

[$10 \times 2 = 20$]

SECTION B: QUESTION 2

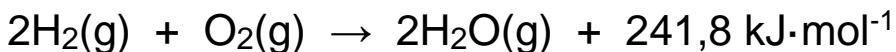
The battery in the circuit below has an emf of 12 V and an internal resistance of $0,2 \Omega$. The resistance of the connecting wires can be ignored.



- 2.1 Calculate the current, I, that flows through the battery. (7)
- 2.2 Calculate the reading on V? (2)
- 2.3 Calculate the current strength through the 8Ω resistor. (2)
- 2.4 How will the current strength be influenced if the 8Ω resistor is removed and a gap is left in the circuit? Just write INCREASE, DECREASE or STAY THE SAME. (2)
- 2.5 How will the reading on the voltmeter be affected if the 9Ω resistor is removed and replaced with a conducting wire of negligible resistance? Explain your answer. (4)

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3. Hydrogen gas and oxygen gas react to form water according to the following balanced equation:



The activation energy (EA) for this reaction is $1\ 370 \text{ kJ}\cdot\text{mol}^{-1}$.

- 3.1 Define the term *activation energy*. (2)

- 3.2 Sketch a potential energy versus reaction coordinate graph for the above reaction. Clearly label the axes and indicate the following on the graph:

- ΔH
 - EA for the forward reaction
 - Reactants (**R**) and products (**P**)
 - Activated complex (**X**)
- (4)

- 3.3 Write down the value of the:

- 3.3.1 Heat of reaction (1)

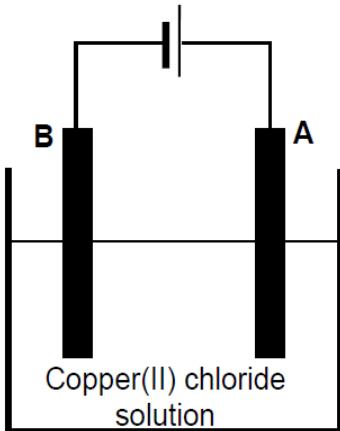
- 3.3.2 Activation energy for the following reaction:



[9]

QUESTION 4

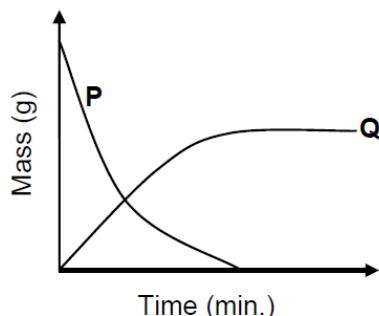
The electrochemical cell below is set up to demonstrate the purification of copper.



- 4.1 Which type of electrochemical cell is illustrated above? (1)

- 4.2 State the energy conversion in this type of cell. (1)

The graphs below show the change in mass of the electrodes whilst the cell is in operation.



4.3 Define an *oxidising agent* in terms of electron transfer. (2)

4.4 Which graph represents the change in the mass of electrode B? (1)

4.5 Write down the half reaction at electrode B. Indicate all phases. (2)

Both electrodes are replaced with graphite electrodes. It is observed that Cl_2 -gas forms at the one electrode.

4.6 Give two reasons (except that graphite is a solid) why graphite is a good choice for an electrode. (2)

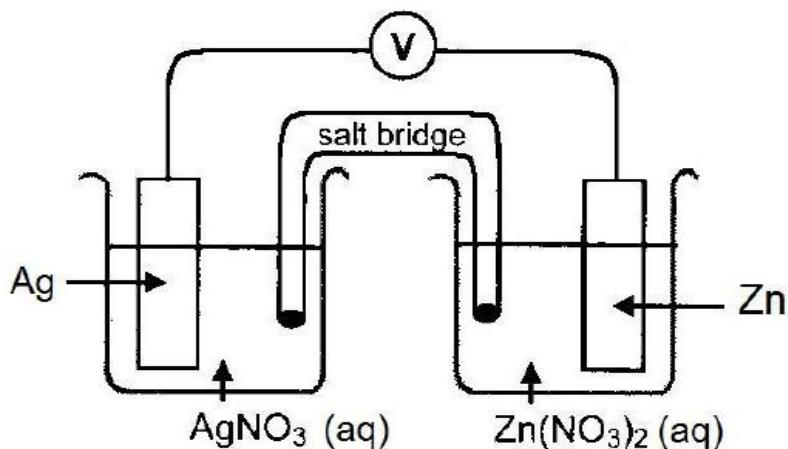
4.7 At which electrode (A or B) is the Cl_2 -gas formed. Explain fully how the gas forms. (3)

4.8 Is electrode A the anode or the cathode? (1)

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QUESTION 5

The following cell is set up in a laboratory by a group of learners:



5.1 State the energy conversion in this type of cell. (1)

5.2 Write the half-reaction that occurs at the cathode. (2)

5.3 Give the cell-notation for the cell under standard conditions. (4)

5.4 Calculate the emf of the cell. (4)

[11]

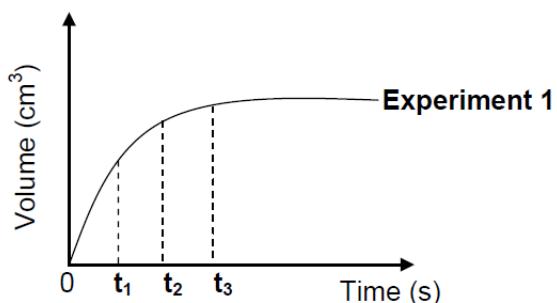
QUESTION 6

The acids in the table below, react with EXCESS magnesium ribbon in each of the three experiments to produce hydrogen gas.

Experiment	Dilute Acid
1	100 cm ³ of 0,1 mol.dm ⁻³ HNO ₃
2	50 cm ³ of 0,2 mol.dm ⁻³ HNO ₃
3	100 cm ³ of 0,1 mol.dm ⁻³ H ₂ SO ₄

The volume of hydrogen gas produced is measured in each experiment.

The graph below was obtained for Experiment 1.



Use this graph to answer the following questions:

6.1 At which time (t_1 , t_2 or t_3) is

6.1.1 the reaction rate the lowest? (1)

6.1.2 the mass of magnesium present in the flask the largest? (1)

6.2 In which time interval, between t_1 and t_2 OR between t_2 and t_3 , does the smallest volume of hydrogen gas form per second? (1)

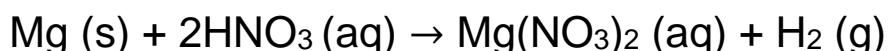
6.3 Redraw the graph for Experiment 1 on your answer sheet.

On the same set of axes, sketch the graphs that will be obtained for Experiment 2 and Experiment 3. Clearly label the three graphs. (4)

6.4.1 How would it effect the reaction rate if the magnesium ribbon is changed to magnesium powder? Only state INCREASE, DECREASE or REMAIN THE SAME. (1)

6.4.2 Explain your answer in 6.4.1 in terms of the collision theory. (3)

6.5 The balanced reaction for experiment 1 is:



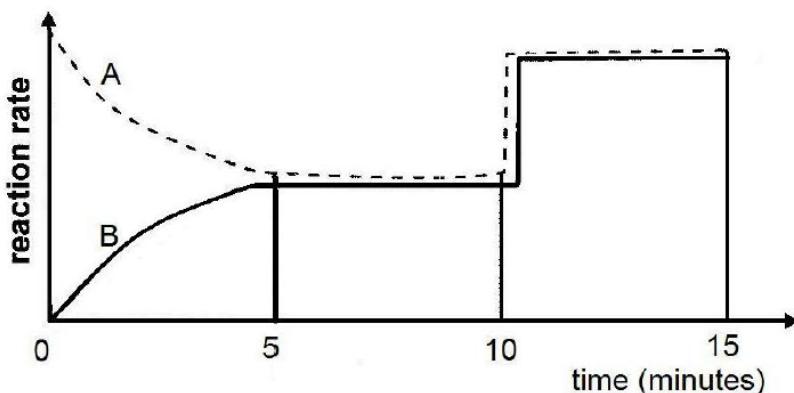
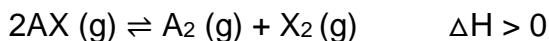
6.5.1 The initial mass of Mg used was 1.6 g. Calculate the mass of the magnesium left in the flask after the completion of experiment 1. (5)

6.5.2 How will the mass of magnesium present in the flask after the completion of experiment 3 compare to your answer in 6.5.1? Only state LARGER THAN, SMALLER THAN or EQUAL TO. (1)

[17]

QUESTION 7

Consider the graph of reaction rate against time for the following hypothetical reaction:



A: forward reaction

B: reverse reaction

7.1.1 What is represented by the graph between 5 and 10 minutes? (1)

7.1.2 At 10 minutes a change happened in the system. What was the change that happened? (1)

7.1.3 Does the change in 7.1.2 favour the forward reaction, the reverse reaction or neither of the two? Explain your answer by using Le Chatelier's Principle. (3)

7.1.4 Use Le Chatelier's Principle to explain what effect an increase in temperature will have on the equilibrium of the system. (3)

7.1.5 How will adding a suitable catalyst influence the yield of the reaction?

State whether it will INCREASE, DECREASE or STAY THE SAME.

(1)

7.1.6 Give a reason for your answer in 7.1.5.

(1)

7.2 Initially, 7g of pure $\text{N}_2(\text{g})$ is sealed in an empty 10dm^3 container at a fixed temperature.

7.2.1 What is the concentration of the $\text{N}_2(\text{g})$ in the sealed container?

(4)

NaN_3 is added to the container and the system is allowed to reach equilibrium at a fixed temperature according to the following equation.



The equilibrium constant for the reaction at this temperature is 0,216.

7.2.2 Calculate the minimum mass of NaN_3 that must be added to the container in order to achieve equilibrium.

(8)

7.2.3 How would each of the following influence the amount of N_2 -gas? Only write INCREASE, DECREASE or REMAIN THE SAME.

7.2.3.1 An increase in pressure.

(1)

7.2.3.2 More NaN_3 is added at the same temperature.

(1)

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QUESTION 8

2,5 g of sulphuric acid (H_2SO_4) is dissolved in just enough water to make a 250cm^3 of a standard solution. In a titration that followed, 25cm^3 of potassium hydroxide (KOH) solution of unknown concentration, is placed in a conical flask and is neutralised by 20cm^3 of the hydrochloric acid solution. The equation for the reaction is shown below.



8.1.1 Calculate the concentration of the standard solution.

(4)

8.1.2 Calculate the concentration of the unknown KOH solution.

(5)

8.1.3 Determine the pH of the H_2SO_4 solution.

(3)

A solution of an unknown monoprotic acid has a concentration of $0,001\text{mol}\cdot\text{dm}^{-3}$ but a pH of 4.

8.2.1 Define the term *monoprotic*.

(1)

8.2.2 How does a strong acid differ from a weak acid?

(3)

8.2.3 From the pH determine the hydronium ion concentration of the unknown acid.

(2)

8.2.4 Is the unknown monoprotic acid a strong acid or weak acid? Give a reason for your answer.

(2)

8.3 NH₄Cl is an example of a salt that can undergo hydrolysis.

8.3.1 Define the underlined term . (2)

8.3.2 Write an equation to show the hydrolysis of NH₄Cl. (3)

8.3.3 What colour would methyl orange be in the ammonium chloride solution? (1)

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QUESTION 9

9.1 From the list below, state which intermolecular forces exist in each of the following substances:

Dipole-dipole, ion-dipole, London forces, hydrogen bond

a) Ne

b) HBr

c) HF

(3)

9.2 During an experiment a learner uses Chloroform as a solvent to dissolve certain solutes.

The learner finds that I₂ dissolves in the solvent, but NaCl does not. Explain why this is the case. (5)

9.3 Which substance, BF₃ or NH₃, will have a higher boiling point? Explain. (5)

[13]