Anglo-Chinese School
(Barker Road)
A Methodist Institution
Founded in 1886

CHEMISTRY
DEPARTMENT OF SCIENCE

Name: ANSWERS ( ) Class: SEC 4

ELECTROLYSIS – ASSIGNMENT

Multiple-Choice Questions [20 Marks]

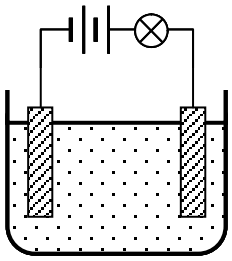
TOTAL SCORE / 30

Write in your selected answer for the multiple-choice questions in the boxes provided.

1	2	3	4	5	6	7	8	9	10
B	D	B	B	D	C	A	C	C	A

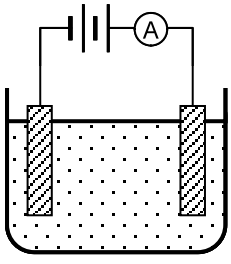
11	12	13	14	15	16	17	18	19	20
A	B	B	D	A	C	D	D	D	C

1. The circuit below was set-up, using an unknown substance **Q**. It was observed that the bulb lit, but there were no decomposition products at the electrodes. What is **Q**?



A aqueous sodium chloride
B mercury
C molten sodium chloride
D sugar solution

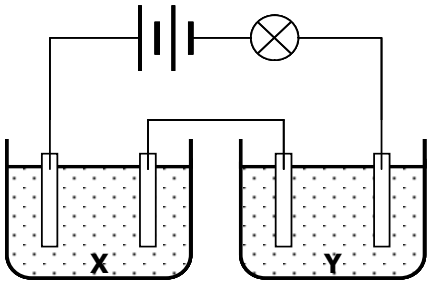
2. When the experiment below was set-up, the ammeter showed that no current was flowing. A few drops of dilute sulfuric acid were dissolved in liquid **Z** and the ammeter then showed that a current was flowing.



What could **Z** be?

A aqueous NaOH
B concentrated NaCl
C ethanol
D water

3. Two cells, containing substances **X** and **Y** respectively, were connected in series with a battery and a light bulb, as shown in the diagram below.



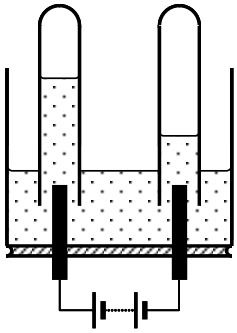
In which of the following pairs of substances did the bulb light up?

	*in **X***	*in **Y***
A	aqueous copper(II) sulfate	solid lead(II) bromide
B	aqueous potassium sulfate	dilute hydrochloric acid
C	concentrated hydrochloric acid	pure ethanoic acid
D	concentrated sodium chloride	concentrated sugar solution

4. Which one of the following does not yield any gaseous products?

	electrolyte	*electrodes*
A	aqueous copper(II) sulfate	platinum
B	aqueous silver nitrate	copper
C	concentrated sodium chloride	copper
D	dilute sulfuric acid	platinum

5. A liquid is to be electrolysed, and two test-tubes full of the liquid are placed over carbon electrodes. The diagram below shows the apparatus after some time.



Which one of the following could be the liquid undergoing electrolysis?

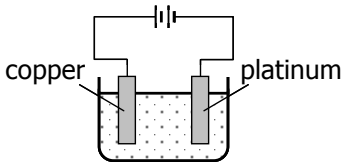
A aqueous $CuSO_4$
B concentrated HCl
C concentrated NaCl
D dilute H_2SO_4

6. Electrolysis of molten lead(II) bromide gives lead at the cathode. Why does lead form?

A Lead(II) bromide decomposes on heating.
B Lead is less reactive than hydrogen.
C Positive lead(II) ions are discharged at the cathode.
D The anode dissolves to form lead(II) ions.

7. Four electrolysis experiments, each using aqueous copper(II) sulfate as the electrolyte, were set-up as shown below. In which of these four experiments did the concentration of the copper(II) sulfate electrolyte remain constant?

A



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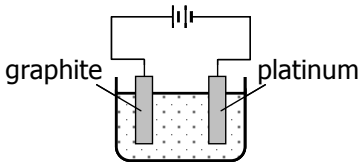

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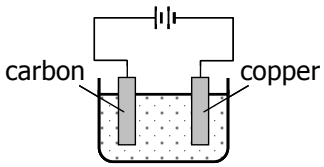

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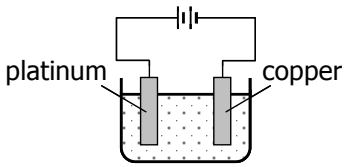
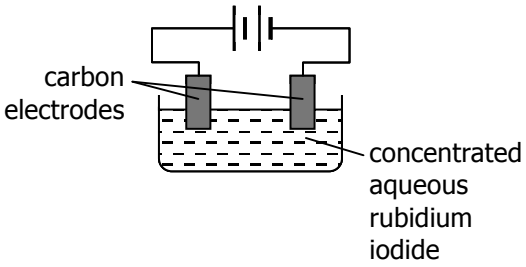


8. In which one of the following instances is there no change in the pH of the solution during electrolysis?

A concentrated sodium chloride solution between platinum electrodes
B copper(II) chloride solution between platinum electrodes
C copper(II) sulfate solution between copper electrodes
D dilute sulfuric acid between copper electrodes

9. The electrolysis shown in the diagram is set up.



What is observed?

	at positive electrode	*at negative electrode*
A	bubbles of colourless gas	bubbles of colourless gas
B	bubbles of colourless gas	solution turns brown
C	solution turns brown	bubbles of colourless gas
D	solution turns brown	silvery droplets

10. An aqueous sample of zinc chloride is electrolyzed using iron electrodes.

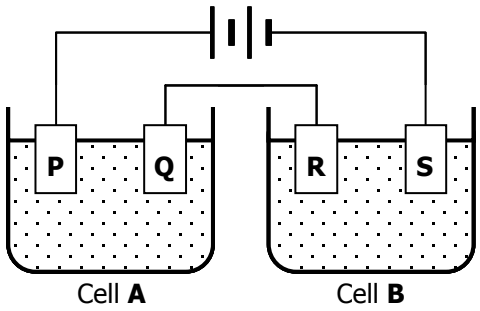
Which of the following statements, pertaining to the above experiment, is false?

A Bubbles of colourless gas are formed at the positive electrode.
B The pH of the solution gradually increases.
C The solution gradually turns green.
D Zinc ions are attracted to the negative electrode.

11. What change **always** takes place when aqueous copper(II) sulfate is electrolysed?

A Copper is deposited at the negative electrode.
B Oxygen is evolved at the positive electrode.
C Sulfate ions move towards the negative electrode.
D The colour of the solution fades.

12. In the diagram below each cell contains an aqueous solution of a single salt and all four electrodes are platinum. Electrodes **Q** and **S** increase in mass during the electrolysis but no gas is given off at **Q** or **S**.



If an increase in mass of **Q** is greater than the increase of mass of **S** in the same time, which of the following statements is *necessarily true*?

A The anions of the solutions in Cells **A** and **B** are different.
B The cations of the solutions in Cells **A** and **B** are different.
C The current flowing in Cell **A** is greater than the current flowing in Cell **B**.
D The solution in Cell **A** is more concentrated than the solution in Cell **B**.

13. Which one of the following involves the largest number of electrons for complete discharge during electrolysis?

A 3 mol of P^{3-} ions
B 4 mol of Al^{3+} ions
C 5 mol of O^{2-} ions
D 8 mol of Na^{+} ions

14. In an electrolysis experiment, the same quantity of electricity deposited 16 g of copper and 6 g of titanium.

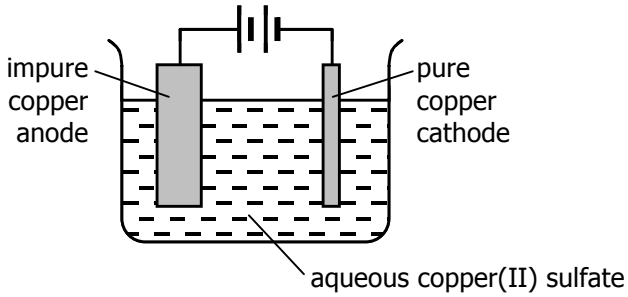
What was the charge on the titanium ion?

A 1+
B 2+
C 3+
D 4+

15. Dilute sulfuric acid was electrolysed using inert electrodes. What volumes (at r.t.p.) of hydrogen and oxygen were formed by the passage of one mole of electrons?

	volume of H_2 / dm^3	**volume of O_2 / dm^3**
A	12	6
B	12	24
C	24	12
D	24	24

16. A sample of copper contained, as an impurity, a metal below it in the reactivity series. The diagram shows the apparatus used for refining the sample.

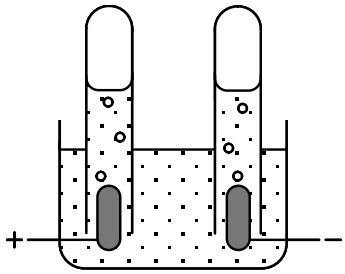


The loss in mass of the positive electrode was 50 g and the gain in mass of the negative electrode was 45 g.

What was the percentage purity of this sample of copper?

A 10.0%
B 11.1%
C 90.0%
D 95.0%

17. The diagram below shows the electrolysis of an unknown electrolyte.



Which of the following could be the electrolyte?

A aqueous potassium iodide
B concentrated copper(II) chloride
C concentrated copper(II) sulfate
D concentrated hydrochloric acid

18. A metal spoon is to be electroplated with silver using aqueous silver nitrate as the electrolyte. Which of the following should be used as the cathode?

A copper block
B platinum block
C silver block
D spoon

19. The heat-reflecting shields of some space rockets are gold-plated, using electrolysis.

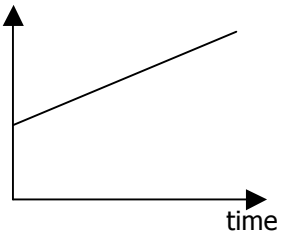
Which electrodes and electrolyte would be used to gold-plate the heat shield?

	negative electrode	*positive electrode*	*electrolyte*
A	carbon	heat shield	gold compound
B	gold	heat shield	copper compound
C	heat shield	carbon	copper compound
D	heat shield	gold	gold compound

20. Aqueous sodium sulfate is electrolysed using copper electrodes. The current is constant and the cathode is weighed at regular intervals over a long period of time.

Which graph is obtained when the mass of the cathode is plotted against time?

A



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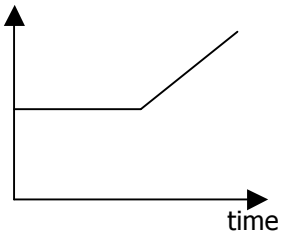
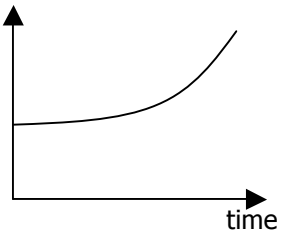


B



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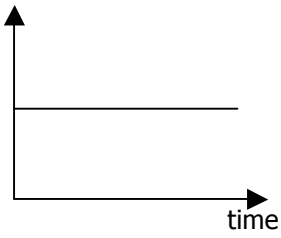
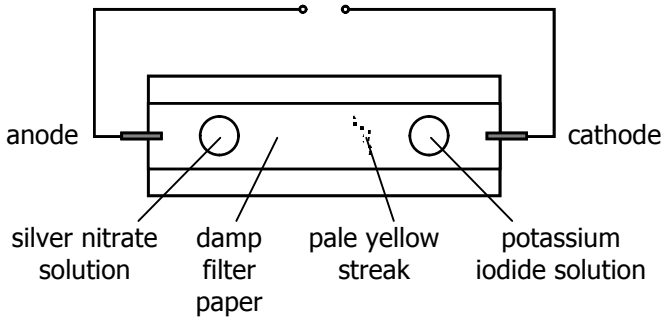


Structured Questions [10 Marks]

21. A strip of moistened filter paper is laid on a microscope slide. A drop of silver nitrate solution is placed near one end of the paper and a drop of potassium iodide solution is placed near the other end. Using inert electrodes, the apparatus is connected to a suitable d.c. supply. After some time, a pale yellow streak appears as shown below.



(a) Briefly explain why a pale yellow streak is formed. [2]

The positive silver ions migrate towards the cathode, while the negative iodide ions migrate towards the anode. When the two ions collide, an insoluble salt of silver iodide is precipitated, causing a solid yellow streak.

(b) Suggest why the streak appears nearer the cathode than the anode. [1]

Silver ions have a lower mass than the iodide ions, and hence are able to migrate further towards the opposite side than the iodide ions in the same time.

22. An aqueous solution of calcium hydroxide is electrolyzed between graphite electrodes.

(a) State the formula of the product would you expect to obtain at the cathode. [1]

H_2

(b) It is observed that, during the electrolysis, the mass of the anode decreases and a white precipitate appears. Explain why this occurs. [3]

The hydroxide ions in the solution are discharged as oxygen gas. The oxygen gas subsequently reacts with the graphite to produce carbon dioxide. The carbon dioxide then reacts with the calcium hydroxide to produce insoluble calcium carbonate, which is the white precipitate observed.

(c) Construct the half-equation for the discharge of hydroxide ions in solution. [1]

$4\ OH^-\ (aq) \longrightarrow 2\ H_2O\ (l) + O_2\ (g) + 4\ e^-$

23. A molten mixture of calcium sulfate, silver iodide and magnesium chloride were placed in the same electrolytic cell, using inert electrodes. A steady current was allowed to pass through the mixture, which was maintained in a molten state by a heat source.

Construct the half-equation for

(a) the reaction at the cathode, and [1]

$Ag^+\ (l) + e^- \longrightarrow Ag\ (l)$

(b) the reaction at the anode. [1]

$2\ I^-\ (l) \longrightarrow I_2\ (g) + 2\ e^-$

END