Unit 4: Electrolysis

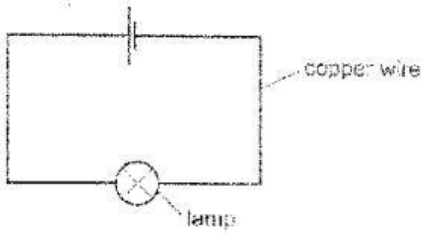
4.1 Electrolysis of binary compounds

1. **M/J 16/P12/Q21**
In which reaction are two of the products salts?
   - A aqueous lead(II) nitrate and aqueous copper(II) sulfate
   - B aqueous sodium hydroxide and solid ammonium sulfate
   - C dilute hydrochloric acid and aqueous sodium carbonate
   - D dilute hydrochloric acid and magnesium

2. **M/J 16/P12/Q13**
Concentrated aqueous sodium chloride is electrolysed using inert electrodes until no more chlorine gas is evolved.
What could be the pH of the resulting solution?
   A 1 B 4 C 7 D 11

3. **M/J 16/P12/Q12**
Copper is purified by electrolysis.
Which statement is not correct?
   - A Both electrodes contain copper.
   - B Copper is both oxidised and reduced in the process.
   - C Pure copper is deposited on the positive electrode.
   - D The electrolyte is aqueous copper(II) sulfate.

4. **M/J 16/P12/Q6, M/J 16/P11/Q9, O/N 07/P1/Q10**
An electrical circuit is set up using copper wire.



Which process takes place in the copper wire?
   - A Electrons move along the wire to the negative terminal, positive ions stay in position
   - B Electrons move along the wire to the positive terminal, positive ions move to the negative terminal.
   - C Electrons move along the wire to the positive terminal, positive ions stay in position.
   - D Negative ions move along the wire to the positive terminal, positive ions move to the negative terminal.

5. **M/J 16/P11/Q16**
Which ion is not present in dilute sulfuric acid?
   A H^+ B OH^- C SO_3^{2-} D SO_4^{2-}

6. **O/N 15/P11/Q19**
Which occurs during the electrolysis of dilute sulfuric acid?
   - A Hydrogen and oxygen are formed in the ratio two volumes of oxygen to one volume of hydrogen.
   - B Hydrogen is formed at the positive electrode.
   - C Oxide ions are oxidised to oxygen.
   - D The dilute sulfuric acid becomes more concentrated.

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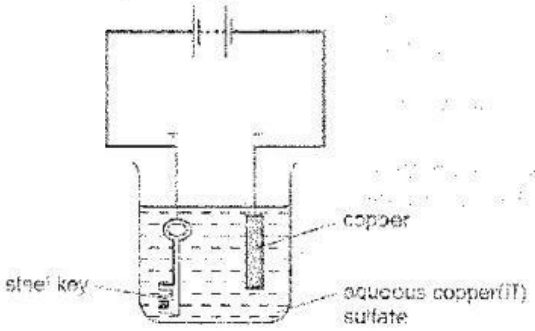
7. M/J 16/P11/Q15
Aqueous copper(II) sulfate is electrolysed using carbon electrodes. Which observations will be made?

	at the positive electrode	electrolyte	at the negative electrode
A	colourless gas forms	blue colour fades	pink solid forms
B	colourless gas forms	no change	colourless gas forms
C	electrode decreases in mass	blue colour fades	colourless gas forms
D	electrode decreases in mass	no change	pink solid forms

8. O/N 15/P12/Q9
The apparatus shown is set up to plate a steel key with copper.



The key does not get coated with copper. Which change needs to be made to plate the key?

A Increase the concentration of the aqueous copper(II) sulfate.
B Increase the voltage.
C Replace the solution with dilute sulfuric acid.
D Reverse the electrical connections.

9. M/J 15/P12/Q14
Caesium is a Group I metal.
Which reaction involving this element would **not** produce hydrogen?

A adding caesium to ethanoic acid
B adding caesium to water
C electrolysing aqueous caesium chloride
D electrolysing molten caesium chloride

10. M/J 15/P11/Q13
What are the correct anode (positive electrode) and cathode (negative electrode) products when aqueous copper(II) sulfate is electrolysed using copper electrodes?

	anode product	cathode product
A	aqueous copper(II) ions	copper metal
B	aqueous copper(II) ions	hydrogen gas
C	oxygen gas	copper metal
D	oxygen gas	hydrogen gas

11. O/N 14/P12/Q19
Which method is used to obtain chlorine from aqueous sodium chloride?

A crystallisation B distillation C electrolysis D filtration

12. O/N 14/P12/Q12
What is the correct equation for the reaction taking place at the negative electrode when molten magnesium chloride is electrolysed using inert electrodes?

A $Cl^- \rightarrow Cl + e^-$ B $2Cl^- \rightarrow Cl_2 + 2e^-$ C $Mg^+ + e^- \rightarrow Mg^-$ D $Mg^{2+} + 2e^- \rightarrow Mg$

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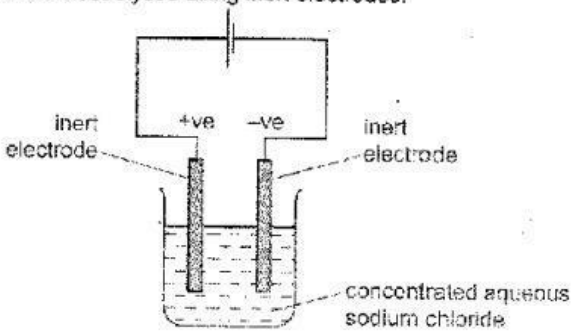
13. M/J 15/P11/Q14

Concentrated aqueous sodium chloride is electrolysed using inert electrodes.



Which statement about this electrolysis is correct?

A Chloride ions travel through the solution to the negative electrode.

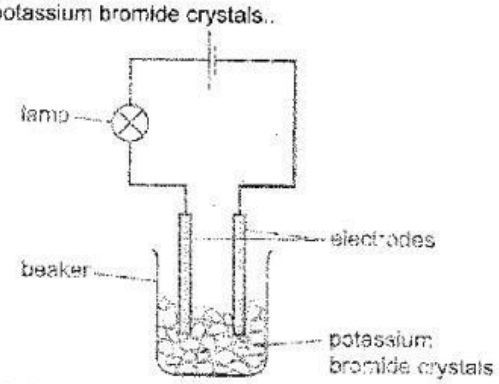
B Electrons travel through the solution to the sodium ions.

C Gases are given off at both electrodes.

D Sodium is formed at the negative electrode.

14. O/N 14/P12/Q8, O/N 14/P11/Q7, O/N 04/P1/Q9

The experiment shown is used to test potassium bromide crystals..



The lamp does not light. Distilled water is then added to the beaker and the lamp lights. Which statement explains these results?

A Electrons are free to move in the solution when potassium bromide dissolves.

B Metal ions are free to move when potassium bromide melts.

C Metal ions are free to move when potassium reacts with water.

D Oppositely charged ions are free to move in the solution when potassium bromide dissolves.

15. O/N 14/P11/Q12

Which changes are observed during the electrolysis of aqueous copper(II) sulfate using copper electrodes?

1 A pink solid is deposited on the negative electrode.
2 Bubbles form on the positive electrode.
3 The colour of the solution does not change.

A 1 and 2 only B 1 and 3 only C 2 and 3 only D 1, 2 and 3

16. M/J 14/P12/Q14

What is observed during the electrolysis of aqueous copper(II) sulfate using carbon electrodes?

A A pink solid is deposited on the anode.

B Bubbles form on the negative electrode.

C The colour of the solution fades.

D The negative electrode becomes smaller.

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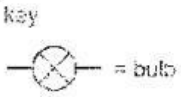
17. M/J 14/P12/Q13

A concentrated aqueous solution of sodium chloride is electrolysed. What are the equations for the reactions taking place at the cathode (negative electrode) and the anode (positive electrode)?

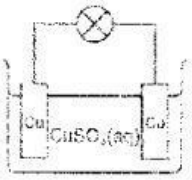
	cathode (–ve)	anode (+ve)
A	$2H^+ + 2e \rightarrow H_2$	$2Cl^- \rightarrow Cl_2 + 2e^-$
B	$2H^+ + 2e^- \rightarrow H_2$	$4OH^- \rightarrow O_2 + 2H_2O + 4e$
C	$Na^+ + e^- \rightarrow Na$	$2Cl^- \rightarrow Cl_2 + 2e^-$
D	$Na^+ + e^- \rightarrow Na$	$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

18. M/J 14/P12/Q18, M/J 14/P11/Q16

In which circuit does the bulb light?



A



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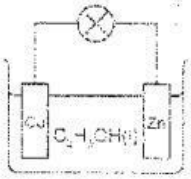

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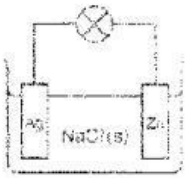

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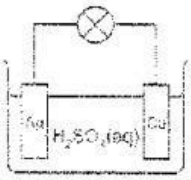

19. M/J 14/P11/Q22

In the extraction of aluminium by electrolysis, its oxide is dissolved in molten cryolite. Cryolite is a sodium salt. Aluminium is deposited at the .....1..... and it can be deduced that aluminium is .....2..... sodium in the reactivity series. Which words correctly complete gaps 1 and 2?

	1	2
A	+ve electrode	above
B	+ve electrode	below
C	–ve electrode	above
D	–ve electrode	below

20. O/N 13/P12/Q24, O/N 13/P11/Q27

Aluminium is manufactured by the electrolysis of molten aluminium oxide.
Which gas is **not** formed during this process?

A carbon dioxide B carbon monoxide C oxygen D sulfur dioxide

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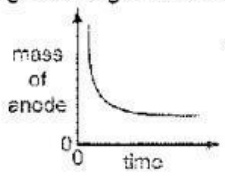
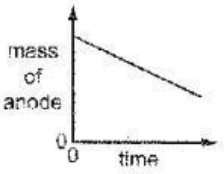
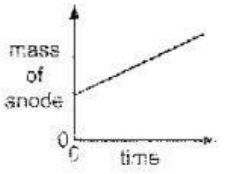
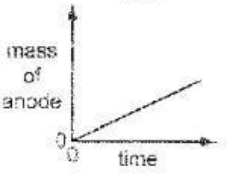
21. M/J 14/P11/Q21

Aqueous copper(II) sulfate is electrolysed using copper electrodes. The current is constant and the anode (positive electrode) is weighed at regular intervals. Which graph is obtained when the mass of the anode is plotted against time?

A 

C 

B 

D 

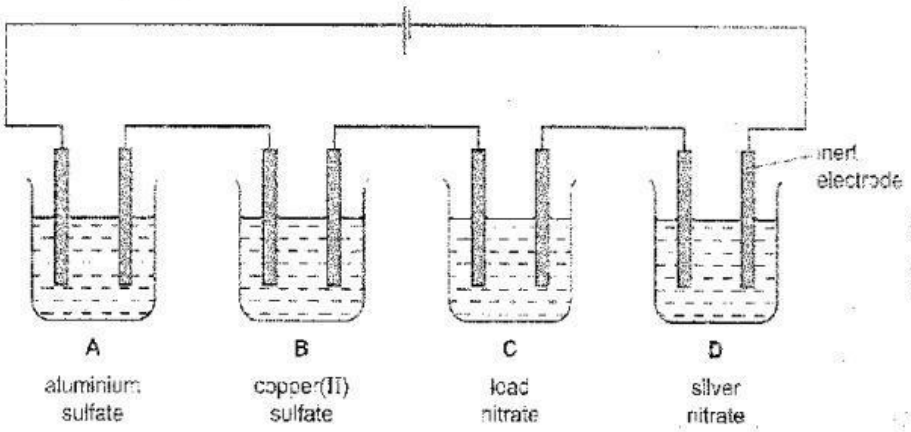
22. O/N 13/P12/Q14

Which arrangement would be used to electroplate copper onto a steel key?

	electrolyte	anode (positive electrode)	cathode (negative electrode)
A	aqueous copper(II) sulfate	piece of pure copper	steel key
B	aqueous copper(II) sulfate	steel key	piece of pure copper
C	aqueous sulfuric acid	piece of pure copper	steel key
D	aqueous sulfuric acid	steel key	piece of pure copper

23. O/N 13/P11/Q15

When electrolysed using inert electrodes, which dilute solution would produce the greatest increase in mass of the cathode?
[A_r: Al, 27; Cu, 64; Pb, 207; Ag, 108]



24. O/N 13/P11/Q14

When dilute sulfuric acid is electrolysed between inert electrodes, which statements are correct?

1 Hydrogen is released at the negative electrode.
2 Oxygen is released at the positive electrode.
3 Sulfur dioxide is released at the positive electrode.
4 The acid becomes more concentrated.

A 1, 2 and 4
B 1 and 2 only
C 2 and 3
D 3 and 4

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25. M/J 13/P12/Q23

Which property is common to calcium, potassium and sodium?

A Their atoms all have more neutrons than protons.

B Their ions all have eight electrons in their outer shell.

C They all sink when added to water.

D They are all deposited at the positive electrode when their molten chloride is electrolysed.

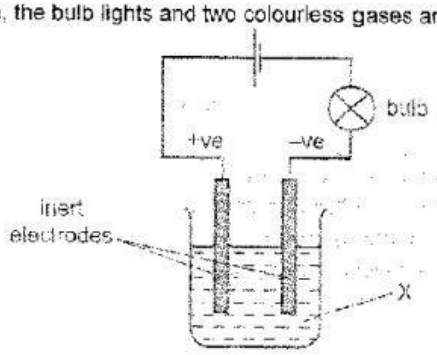
26. M/J 13/P12/Q14

A concentrated aqueous solution of copper(II) chloride is electrolysed using inert electrodes.
What is the product at the positive electrode?

A chlorine B copper C hydrogen D oxygen

27. O/N 12/P12/Q12

In the experiment shown in the diagram, the bulb lights and two colourless gases are formed, one at each electrode.



What is X?

A concentrated aqueous sodium chloride

B dilute sulfuric acid

C methanol

D molten sodium chloride

28. O/N 12/P12/Q6

When concentrated aqueous sodium chloride is electrolysed using carbon electrodes, which row correctly states the products at the electrodes and the solution remaining?

	cathode (–)	anode (+)	solution remaining
A	chlorine	hydrogen	hydrochloric acid
B	hydrogen	chlorine	sodium hydroxide
C	hydrogen	oxygen	sodium chloride
D	sodium	chlorine	water

29. M/J 12/P12/Q15

Which substance will conduct electricity without being chemically changed?

A sodium chloride solution C solid sodium chloride

B solid iron D solid sulfur

30. M/J 12/P12/Q14

Which change **always** takes place when an aqueous solution of 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.

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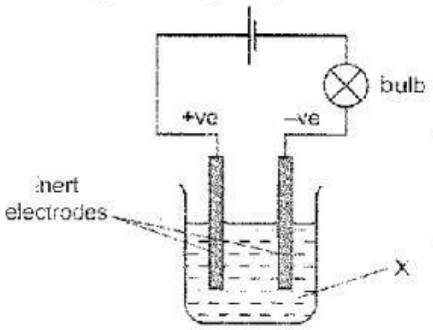
31. **O/N 12/P11/Q13**
In the experiment shown in the diagram, the bulb lights and a gas is produced at each electrode.



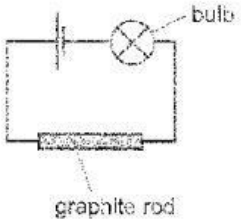
What is X?

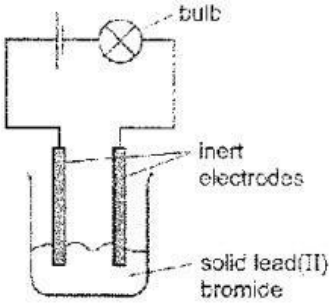
A aqueous copper(II) sulfate
B concentrated aqueous sodium chloride
C ethanol
D molten lead bromide

32. **M/J 12/P12/Q11, M/J 06/P1/Q18, M/J 12/P11/Q13**
Which statement about conduction of electricity is correct?

A Electricity is conducted in aqueous solution by electrons.
B Electricity is conducted in a metal wire by ions.
C Electricity is conducted in a molten electrolyte by electrons
D Electricity is conducted in an acid solution by ions.

33. **M/J 12/P12/Q8**
In which set of apparatus will the bulb be **least** bright?

A


B


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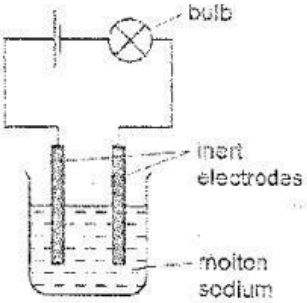

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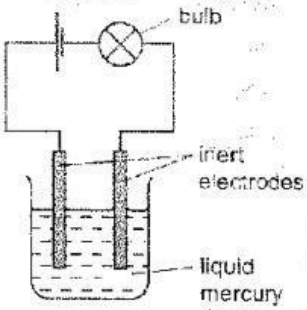

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34. M/J 12/P11/Q15

Aqueous copper(II) sulfate is electrolysed using copper electrodes.
Which equation represents the reaction taking place at the anode (positive electrode) in this electrolysis?

A $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

B $SO_4^{2-}(aq) \rightarrow SO_2(g) + O_2(g) + 2e^-$

C $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

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

35. M/J 12/P12/Q9, M/J 12/P11/Q5, O/N 05/P1/Q10

Four substances have the following electrical properties

substance	property
W	does not conduct under any conditions
X	conducts only in aqueous solution
Y	conducts in both the molten and solid states
Z	conducts in both the molten and aqueous states

What are these four substances?

	W	X	Y	Z
A	HCl	S	NaCl	Pb
B	Pb	HCl	NaCl	S
C	S	HCl	Pb	NaCl
D	S	NaCl	HCl	Pb

36. O/N 11/P12/Q15, O/N 11/P11/Q14

Which statement about the electrolysis of an aqueous solution of copper(II) sulfate with platinum electrodes is correct?

A Oxygen is given off at the positive electrode.
B The mass of the negative electrode remains constant.
C The mass of the positive electrode decreases.
D There is no change in the colour of the solution.

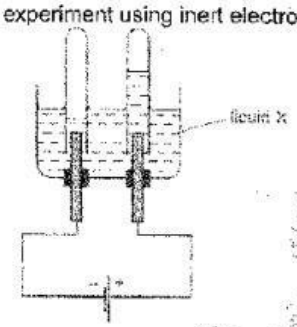
37. O/N 11/P12/Q13, O/N 11/P11/Q13

How can sodium be manufactured?

A by electrolysing aqueous sodium chloride
B by electrolysing aqueous sodium hydroxide
C by electrolysing molten sodium chloride
D by heating sodium oxide with carbon

38. O/N 10/P12/Q13, O/N 10/P11/Q12

The diagram shows the results of an electrolysis experiment using inert electrodes.



Which could be liquid X?

A aqueous copper(II) sulfate
B concentrated aqueous sodium chloride
C dilute sulfuric acid
D ethanol

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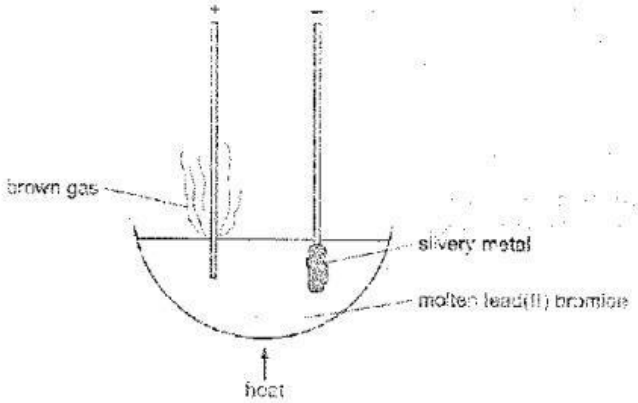
39. M/J 11/P12/Q13, M/J 11/P11/Q13

The diagram shows the electrolysis of molten lead(II) bromide using inert electrodes.

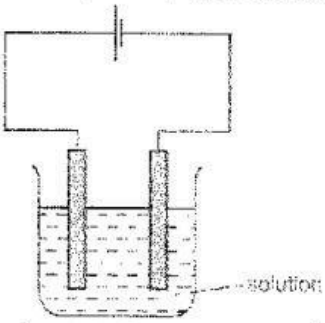


What happens during this electrolysis?

A Atoms change to ions.
B Covalent bonds are broken.
C Ions change to atoms.
D New compounds are formed.

40. M/J 10/P12/Q11, O/N 05/P1/Q12, M/J 10/P11/Q11

The diagram shows the electrolysis of a concentrated aqueous solution containing both copper(II) ions and sodium ions.



Which metal is deposited at the negative electrode and why?

	metal deposited	reason
A	copper	copper is less reactive than sodium
B	copper	copper is more reactive than hydrogen
C	sodium	copper is less reactive than hydrogen
D	sodium	copper is more reactive than sodium

41. O/N 09/P1/Q17

Which row in the table describes the processes occurring at the electrodes when molten sodium chloride is electrolysed?

	anode (positive)	cathode (negative)
A	oxidation	reduction
B	reduction	oxidation
C	oxidation	oxidation
D	reduction	reduction

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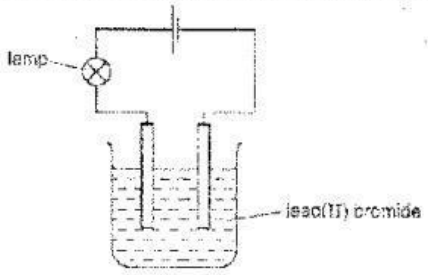
42. M/J 10/P12/Q12, M/J 10/P11/Q12

The diagram shows the apparatus used to electrolyse lead(II) bromide using inert electrodes.



Why does the lamp light up only when the lead(II) bromide is melted?

A Bromine atoms in the lead(II) bromide are converted to ions when it is melted.

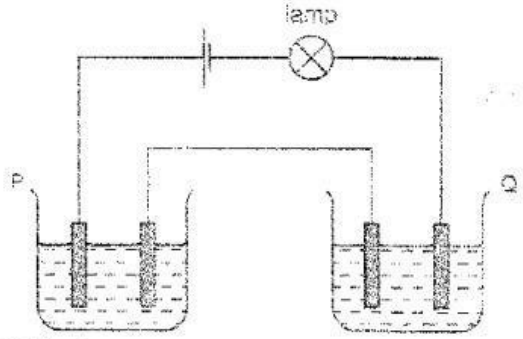
B Electrons flow through the lead(II) bromide when it is melted.

C The ions in lead(II) bromide are free to move only when the solid is melted.

D There are no ions in solid lead(II) bromide.

43. O/N 09/P1/Q13

Two cells, P and Q, containing different liquids, were connected in series with a battery, a suitable lamp and inert electrodes, as shown in the diagram.



For which pair of liquids did the lamp light up?

	in P	in Q
A	concentrated sodium chloride solution	concentrated sugar solution
B	copper(II) sulfate solution	propanol
C	ethanol	molten lead(II) bromide
D	mercury	dilute hydrochloric acid

44. O/N 09/P1/Q11

What products are formed when concentrated aqueous potassium chloride is electrolysed?

	at the anode (positive)	at the cathode (negative)
A	chlorine	hydrogen
B	chlorine	potassium
C	oxygen	hydrogen
D	oxygen	potassium

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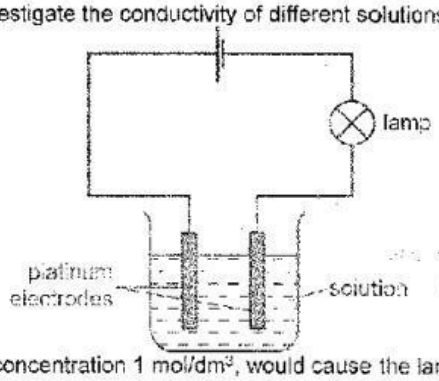
45. O/N 09/P1/Q8

All of the following substances can conduct electricity.
Which substance's conductivity is **not** due to the movement of electrons?

A aluminium **B** graphite **C** lithium chloride **D** mercury

46. M/J 09/P1/Q14

The diagram shows apparatus used to investigate the conductivity of different solutions.



Which substance, in aqueous solution of concentration 1 mol/dm^3, would cause the lamp to give the brightest light?

A ammonia **B** ethanoic acid **C** ethanol **D** sulfuric acid

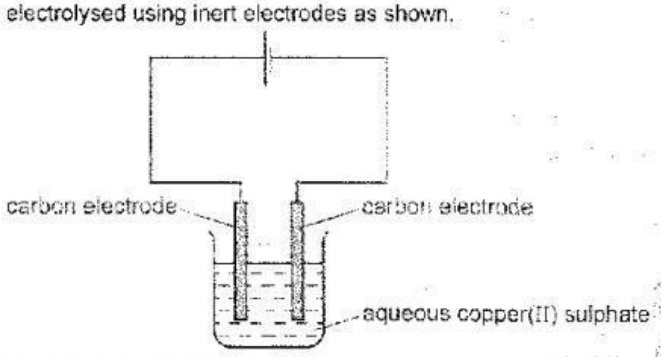
47. M/J 09/P1/Q13, M/J 05/P1/Q10

Which reactions take place during the electrolysis of aqueous copper(II) sulphate with copper electrodes?

	reaction at positive electrode	reaction at negative electrode
A	$Cu^{2+} + 2e^- \rightarrow Cu$	$Cu \rightarrow Cu^{2+} + 2e^-$
B	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$Cu^{2+} + 2e^- \rightarrow Cu$
C	$Cu \rightarrow Cu^{2+} + 2e^-$	$2H^+ + 2e^- \rightarrow H_2$
D	$Cu \rightarrow Cu^{2+} + 2e^-$	$Cu^{2+} + 2e^- \rightarrow Cu$

48. O/N 08/P1/Q30

Aqueous copper(II) sulphate is electrolysed using inert electrodes as shown.



Which ionic equations show the reactions at the electrodes?

1 $Cu^{2+} + 2e^- \rightarrow Cu$
2 $Cu \rightarrow Cu^{2+} + 2e^-$
3 $2H^+ + 2e^- \rightarrow H_2$
4 $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

A 1 and 2 only **B** 1 and 4 only **C** 2 and 3 only **D** 3 and 4 only

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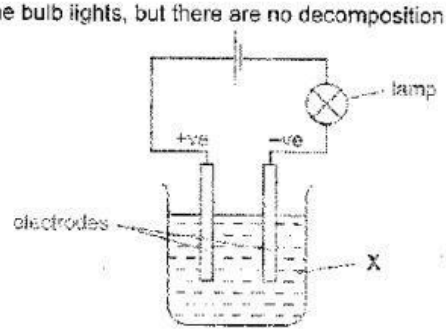
49. O/N 08/P1/Q16

What are the products formed at the electrodes during the electrolysis of molten magnesium chloride between carbon electrodes?

	positive electrode	negative electrode
A	oxygen	magnesium
B	magnesium	chlorine
C	chlorine	magnesium
D	chlorine	hydrogen

50. O/N 08/P1/Q15, M/J 04/P1/Q17

When the experiment shown is set up, the bulb lights, but there are no decomposition products at the electrodes.



What is X?

A aqueous sodium chloride
B bromine
C molten sodium chloride
D mercury

51. M/J 08/P1/Q15

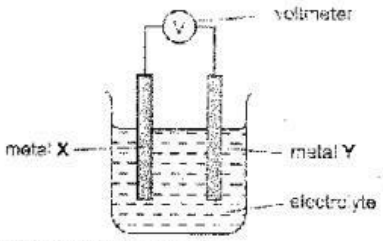
When dilute sulphuric acid is electrolysed between platinum electrodes, which statements are correct?

1 Hydrogen is released at the cathode.
2 Oxygen is released at the anode.
3 Sulphur is released at the anode.
4 The acid becomes more dilute.

A 1 and 2 B 1 and 3 C 2 and 4 D 4 only

52. O/N 07/P1/Q15

The diagram shows a simple cell



Which two metals produce the highest reading on the voltmeter?

	X	Y
A	magnesium	copper
B	magnesium	iron
C	zinc	copper
D	zinc	iron

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53. O/N 07/P1/Q14

Which statement is correct about the electrolysis of an aqueous solution of copper(II) sulphate with platinum electrodes?

A Oxygen is given off at the positive electrode.

B The mass of the negative electrode remains constant.

C The mass of the positive electrode decreases.

D There is no change in the colour of the solution.

54. O/N 06/P1/Q12

Aqueous copper(II) sulphate is electrolysed using copper electrodes.
Which observations will be made?

	at anode (+ve)	at cathode (–ve)	electrolyte
A	anode dissolves	pink solid forms	blue colour fades
B	anode dissolves	pink solid forms	no change
C	colourless gas forms	colourless gas forms	no change
D	colourless gas forms	pink solid forms	blue colour fades

55. O/N 05/P1/Q17

In which line in the table is **all** the information correct?

	reaction at electrode	electrode	product
A	$2X^- \rightarrow X_2 + 2e^-$	cathode	metal
B	$X^+ + e^- \rightarrow X$	anode	metal
C	$2X^- \rightarrow X_2 + 2e^-$	anode	non-metal
D	$X^+ + e^- \rightarrow X$	cathode	non-metal

56. O/N 04/P1/Q14

Dilute sulphuric acid is electrolysed using inert electrodes.
Which equation represents the reaction at the anode (+ve)?

A $O_2^{2-} \rightarrow O_2 + 2e^-$

B $2H^+ + 2e^- \rightarrow H_2$

C $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

D $SO_4^{2-} \rightarrow O_2 + SO_2 + 2e$

57. O/N 04/P1/Q16

A solid deposit of element **R** is formed at the cathode(–ve) when an aqueous solution containing ions of **R** is electrolysed.
Which statement about element **R** must be correct?

A **R** forms negative ions.

B **R** ions gain electrons at the cathode.

C **R** ions lose electrons at the cathode.

D **R** is above hydrogen in the reactivity series.

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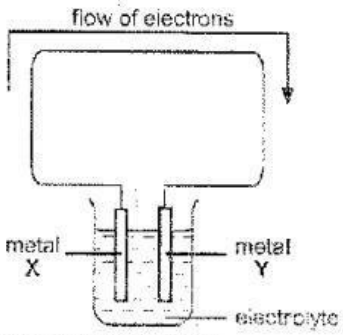
58. O/N 04/P1/Q17

Apparatus was set up as shown.

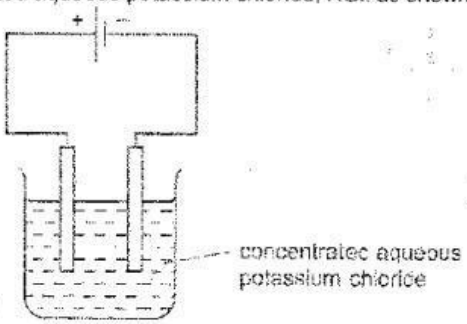


For which pair of metals would electrons flow in the direction shown?

	metal X	metal Y
A	copper	zinc
B	iron	aluminium
C	iron	magnesium
D	zinc	silver

59. M/J 04/P1/Q16

A current was passed through concentrated aqueous potassium chloride, KCl, as shown.



Which entry in the table is correct?

	ions moving towards	
	the cathode (-ve)	the anode (+ve)
A	K^+ only	Cl^- and OH^-
B	K^+ only	Cl^- only
C	K^+ and H^+	Cl^- only
D	K^+ and H^+	Cl^- and OH^-

60. O/N 03/P1/Q31

Aqueous copper(II) sulphate is electrolysed using carbon electrodes. What happens to the electrolyte?

A It becomes more acidic. **B** It becomes more alkaline. **C** It turns deeper blue. **D** It remains unchanged.

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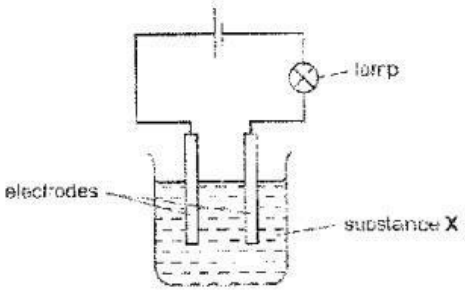
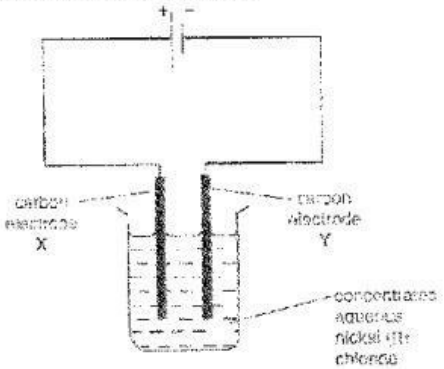
61. M/J 04/P1/Q11
In the circuit below, the lamp lights up.



What could **X** be?

A a solution of ethanol in water
B a solution of sodium chloride in water
C liquid ethanol
D solid sodium chloride

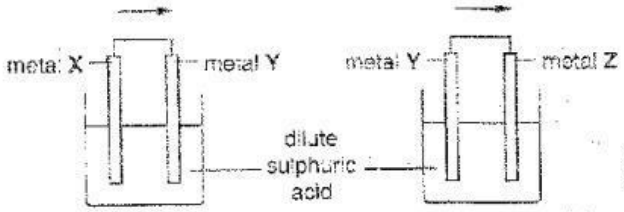
62. O/N 03/P1/Q13
Apparatus is set up as shown in the diagram.



What occurs at electrode **X**?

A Chloride ions are oxidised.
B Chloride ions are reduced.
C Nickel ions are oxidised.
D Nickel is deposited.

63. M/J 03/P1/Q17
Two cells were set up as shown in the diagram. The arrow shows the direction of electron flow in the external circuit.



Which set of metals would give the electron flows in the direction shown?

	metal **X**	metal **Y**	metal **Z**
A	Ag	Cu	Zn
B	Ag	Zn	Cu
C	Cu	Zn	Ag
D	Zn	Cu	Ag

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