Chemistry: Chapter 13 Corrosion of metals and their protection
Combined Science (Chemistry Part): Chapter 13 Corrosion of metals and their protection

Section 13.1

|!|EMA031313001O|!|

Consider the information given in the following table.

Metal	Appearance (after cleaning)	Density	Resistance to corrosion
P	Dull	Low	High
Q	Dull	High	Low
R	Silvery	Low	High
S	Slivery	Low	Low

Which of the following metals is most likely to be sodium?

A. Metal *P*
B. Metal *Q*
C. Metal *R*
D. Metal *S*

##D Sodium is silvery after cleaning or when freshly cut, and has low density. Its resistance to corrosion is low as it is very reactive.##

|!|EMB031313002O|!|

Which of the following metals is the most corrosion resistant?

A. Titanium
B. Aluminium
C. Gold
D. Zinc

##C Gold is the most unreactive one.##

|!|EMA031313003O|!|

Which of the following metals is the most corrosion resistant?

A. Silver
B. Gold
C. Titanium
D. Aluminium

##B##

Section 13.2

|!|EMA031313004O|!|

Which of the following are essential factors for rusting to occur?

(1) Oxygen
(2) Water
(3) High temperature

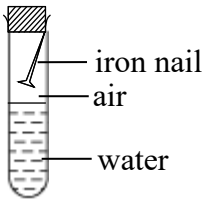
A. (1) and (2) only

B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

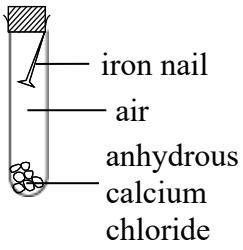
##A High temperature is a factor that can speed up rusting, but not the essential factor for rusting.##

|!|EMA031313005O|!|
In which of the following tube(s) will the iron nail rust after a few days?

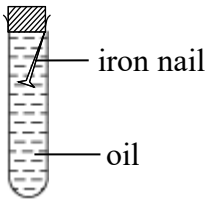
(1)



(2)



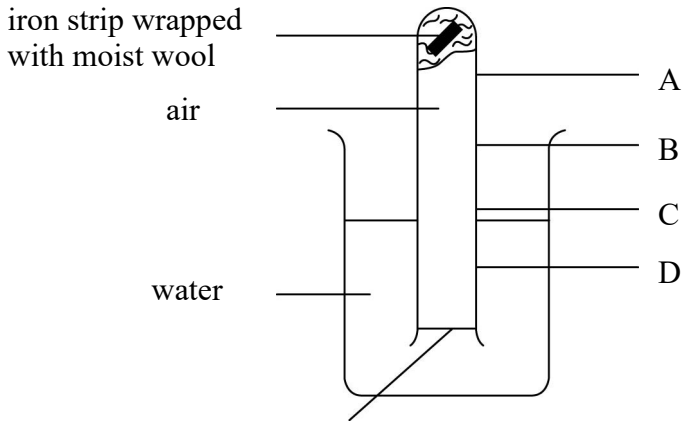
(3)



A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

##A Rusting requires water and oxygen. The nail in tube (2) will not rust because the anhydrous calcium chloride absorbs the moisture in the tube; the nail in tube (3) will not rust as oil protects the nail from water and oxygen.##

|!|EMB031313006O|!|
A setup is shown below. A piece of iron strip wrapped by moist wool is place inside a test tube. The test tube is inverted in water, trapping air in the tube.



water level at the beginning of the experiment

What will be the water level after a few days?

##D The iron strip reacted with all the oxygen in the tube. As air contains about 20% of oxygen, the water level should rise up by $\frac{1}{5}$ of the air column.##

|!|EMA031313007O|!|
Which of the following is the chemical formula of rust?

A. Fe
B. FeO
C. Fe_2O_3
D. $Fe_2O_3 \cdot nH_2O$

□

##D Rust is in fact hydrated iron(III) oxide, where n is a variable number.##

Section 13.3

|!|EMA031313008O|!|
Under which situation would a piece of iron rust faster?

A. Placed in desert
B. Completely wrapped with tin
C. Placed near seashore
D. Painted

□

##C Air near seashore is full of droplets of sea water. The water droplets contain salts which speed up rusting. A is wrong because iron will not rust in desert as there lacks water, which is an essential factor for rusting; B and D are wrong as tin and paint coating act as physical barriers to protect iron from water and oxygen.##

|!|EMB031313009O|!|
Which of the following statements CANNOT explain the rapid rusting of iron car exhaust pipes?

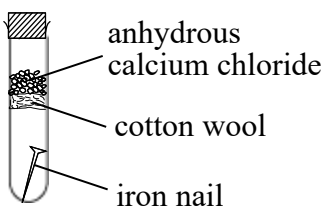
A. Exhaust gases contain water vapour.
B. Car exhaust pipes are under high temperature.
C. Exhaust gases contain much oxygen.
D. Exhaust gases usually contain acidic compounds.

□

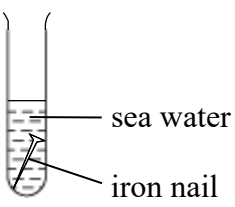
##C Water is an essential factor for rusting to occur. Higher temperature increases rate of all chemical reactions, so is the case of rusting. Exhaust gases should contain less oxygen, but may contain acidic gases like sulphur dioxide and nitrogen dioxide which will speed up rusting.##

|!|EMA031313010O|!|
Four set-ups are shown below. Arrange the rates of rusting of the four iron nails in ascending order.

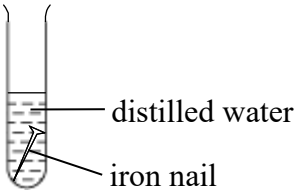
A.



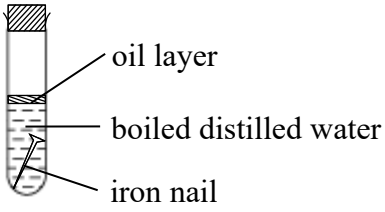
B.



C.



D.

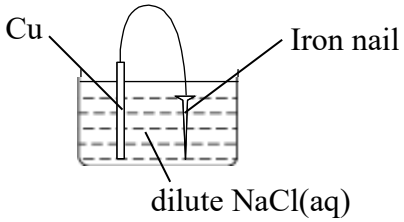


A. C, B, D, A
B. B, C, A, D
C. B, D, A, C
D. D, A, C, B

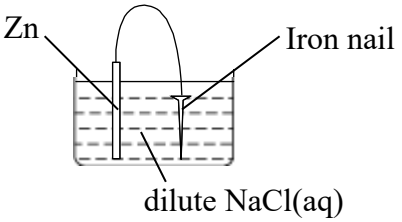
##D The iron nail in B rusts at the highest rate as sea water contains ions; the iron nail in D rusts at the lowest rate as the oil layer prevents oxygen from dissolving in water and boiled water has its oxygen removed already. These make the nail has very little contact with oxygen. The iron nail in C rusts faster than that in A because it can contact with water and dissolved oxygen; while A has anhydrous calcium chloride which absorbs the moisture in air.##

|!|EMB031313011O|!|
Consider the following diagrams. In which set-up would iron rust fastest?

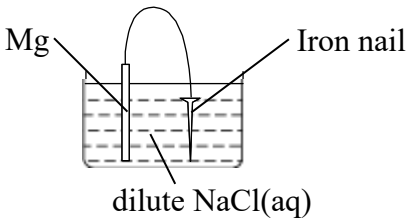
A.



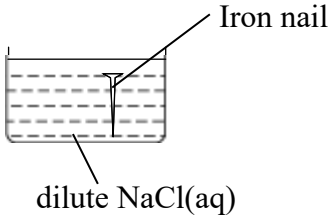
B.



C.



D.



##A As copper is less reactive than iron, this increases the speed of rusting.##

|!|EMA031313012O|!|
Iron will rust at the fastest rate when connected to

A. magnesium.
B. zinc.
C. lead.
D. copper.

##D As copper is the least reactive metal among the four so iron would lose electrons and form $Fe^{2+}(aq)$ ions most easily.##

|!|EMA031313013O|!|
Iron rusts faster at high temperatures because

A. high temperatures change the chemical properties of iron.
B. high temperatures speed up the rate of chemical reactions.
C. air contains a higher oxygen content at high temperatures.
D. iron gains electrons more readily at high temperatures.

##B##

|!|EMA031313014O|!|
Which of the following would speed up rusting of iron?

(1) Connecting iron to copper
(2) Adding iron to hot water
(3) Adding iron to acidic solutions

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

##D When iron is connected to a less reactive metal (e.g. copper), it loses electrons and changes to $Fe^{2+}(aq)$ ions more easily.##

|!|EMB031313015O|!|
Car exhaust pipes made of iron rust rapidly. Which of the following are correct reasons?

(1) Car exhaust pipes are subject to high temperatures.
(2) Car exhausts contain water vapour.
(3) Car exhausts contain acidic gases.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

##D##

Section 13.4
|!|EMA031313016O|!|
At which positions of an iron nail would rusting go faster?

(1) Tip
(2) Shank
(3) Bending areas

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

##C##

Section 13.5

|!|EMB031313017O|!|

'Tin is used to coat with iron food cans'. Which of the following about this statement is correct?

A. Tin can do sacrificial protection.
B. Tin is poisonous.
C. Tin forms a protective oxide layer to keep water and oxygen away from iron.
D. Tin gives an attractive appearance to the food cans.

☐

##C Tin are resistant to corrosion because they form a protective oxide layer on the surface. A is wrong because tin is less reactive than iron, so it cannot do sacrificial protection; B is wrong as tin is non-poisonous to make food cans; D is wrong as tin doesn't have an attractive appearance.##

|!|EMA031313018O|!|

Which of the following metals can prevent iron from rusting by sacrificial protection?

A. Zinc
B. Lead
C. Copper
D. Silver

☐

##A Only zinc is more reactive than iron among the metals above.##

|!|EMA031313019O|!|

Which of the following is the best method to prevent a small iron moving part in a machine from rusting?

A. Paint its surface.
B. Place a piece of zinc close to it.
C. Add oil on its surface.
D. Coat it with plastic.

☐

##C Oil not only protect the part from contacting water and oxygen, but also acts as a lubricant.##

|!|EMA031313020O|!|

Which of the following is/are disadvantage(s) of coating tin on iron food cans?

(1) Tin is toxic.
(2) Iron will rust quickly if the tin layer is scratched.
(3) It is difficult to paint tin.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

##B As iron is more reactive than tin, iron rusts faster if the tin layer is scratched. Tin is non-toxic, so it can be used to coat iron food cans.##

|!|EMB031313021O|!|
Zinc, but not tin, is usually used to coat the surface of an iron tool because

A. zinc is poisonous while tin is non-poisonous.
B. the underlying iron does not rust easily even if the zinc surface is damaged.
C. galvanizing is cheaper than tin-plating.
D. the extraction cost of zinc is lower than that of tin.

##B Zinc is more reactive than iron, therefore, even if zinc surface is damaged, the underlying iron does not rust easily. Tin is less reactive than iron. If tin surface is damaged, the underlying iron will rust faster.##

|!|EMA031313022O|!|
Painting is not a good method for protecting a bicycle chain from rusting because

A. once the paint sticks to the bicycle chain, it is difficult to remove.
B. compounds in the painting layer react with iron.
C. the bicycle chain does not need attractive colour.
D. the paint would be scratched off easily.

##D##

|!|EMA031313023O|!|
Which of the following methods is/are suitable to protect iron ship body from rusting?

(1) Painting
(2) Tin-plating
(3) Galvanizing

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

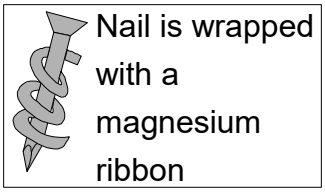
##C Tin-plating is not suitable. If the tin coating is scratched off, iron rusts faster, as iron is more reactive than tin.##

|!|EMB031313024O|!|
Which of the following statements about electroplating is INCORRECT?

A. The object to be electroplated makes the anode.
B. Electroplating can improve the object's appearance.
C. Metals low in the reactivity series are usually used as plating materials.
D. Chromium can be used to plate objects in electroplating.

##A The object to be plated makes the cathode.##

|!|EMA031313025O|!|
In which of the following situations will the iron nail rust most rapidly?

A.		B.	
C.		D.	

##B Magnesium can protect the iron from rusting by sacrificial protection. Copper is less reactive than iron, so the iron nail would rust more readily. Adding grease to the iron nail can prevent it from contacting oxygen in air. D is a control experiment.##

|!|EMA031313026O|!|
Pieces of metal are usually attached to the hull of a ship to protect it from rusting. The metal could be

A. silver.
B. potassium.
C. tin.
D. zinc.

##D Zinc will corrode instead of iron and the latter is protected from rusting by sacrificial protection.##

|!|EMA031313027O|!|
Which of the following methods can be used to prevent iron wheels in a machine from rusting?

A. Painting
B. Oiling
C. Chromium-plating
D. Coating with plastic

##B Painting is not used because the paint may flakes off easily when the wheels turn. Greasing can provide a surface coating to prevent the wheels from contacting with oxygen in air. Chromium-plating is too expensive. Plastic can fall apart easily especially in friction.##

|!|EMA031313028O|!|
Which of the following methods could NOT protect iron from rusting?

A. Iron is coated with an oxide layer.
B. Iron is alloyed with chromium.
C. Iron is connected to magnesium.

D. Iron is coated with plastic.

□

##A An oxide layer flakes off from iron easily.##

|!|EMA031313029O|!|
Stainless steel is not used to make large objects because
A. stainless steel is easier to corrode in large objects.
B. stainless steel is too expensive.
C. stainless steel is in low abundance in the Earth's crust.
D. stainless steel is too soft.

□

##B##

|!|EMA031313030O|!|
Which of the following are the advantages of plating iron with chromium?
(1) It gives a beautiful shiny appearance.
(2) It protects iron from rusting.
(3) It becomes more malleable and ductile.
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

□

##A##

|!|EMB031313031O|!|
Although iron corrodes more easily than a number of other metals, it is widely used in construction and transport. This is because
(1) iron is the cheapest metal.
(2) iron is strong.
(3) there are methods of preventing or slowing down rusting.
(4) iron is the most ductile and malleable.
Which of the following combinations is correct?
A. (1) and (2) only
B. (3) and (4) only
C. (1), (2) and (3) only
D. (1), (2), (3) and (4)

□

##C##

|!|EMA031313032O|!|
Which of the following are commonly used to coat iron to prevent rusting?
(1) Sodium
(2) Aluminium
(3) Zinc
(4) Tin
A. (1) and (2) only
B. (1) and (3) only

C. (2) and (4) only
D. (3) and (4) only

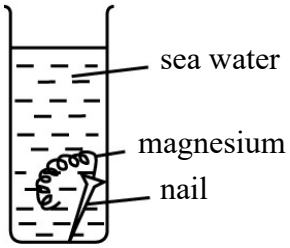
##D##

|!|EMA031313033O|!|
Which of the following methods CANNOT prevent iron from rusting?
A. Iron alloyed with chromium
B. Iron coated with paint
C. Iron coated with grease
D. Iron connected by a wire to a tin plate

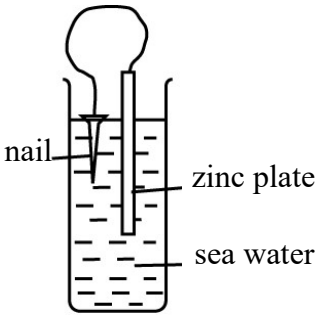
##D##

|!|EMB031313034O|!|
The following experiments were set up to investigate the corrosion of an iron nail (in the figure below). In which situation would the nail corrode most rapidly?

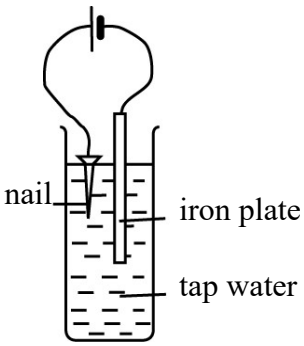
A.



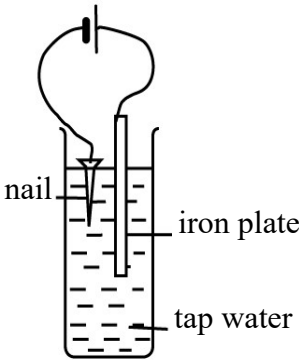
B.



C.



D.



##C##

Section 13.6
|!|EMA031313035O|!|
Which of the following statements about rusting is INCORRECT?
A. The chemical formula of rust is $Fe_2O_3 \cdot nH_2O$.
B. Rusting causes great economic losses.
C Corrosion of aluminium is also called rusting.
D Acid rain speeds up rusting.

##C Rusting refers to the corrosion of iron but not aluminium.##

Section 13.7

|!|EMA031313036O|!|
Aluminium is resistant to corrosion because

A. it is unreactive.
B. there is a protective hydroxide layer on its surface.
C. there is a protective oxide layer on its surface.
D. it corrodes so slowly that it cannot be noticed.

□

##C The thin layer of aluminium oxide is non-porous and adheres firmly on the aluminium surface to prevent the aluminium from contact with oxygen.##

|!|EMA031313037O|!|
Which of the following statements about galvanizing is correct?

A. Zinc is used as it is more reactive than iron.
B. Zinc is used as it is harder than iron.
C. Aluminium is used as it has a protective oxide layer.
D. Aluminium is used as it provides an attractive appearance.

□

##A##

|!|EMA031313038O|!|
Which of the following statements is NOT correct?

A. Rusting goes faster in summer than in winter.
B. Rust indicator turns blue if it contacts with Fe^{2+}(aq) ions.
C. Rusting can be prevented by anodizing the iron objects.
D. An iron nail does not rust in vacuum.

□

##C Iron is not anodized because it cannot form a non−porous and tough oxide layer on the metal surface.##

|!|EMA031313039O|!|
Which of the following substances corrodes most easily?

A. Stainless steel
B. Aluminium
C. Iron
D. Tin

□

##C Stainless steel is an alloy which is resistant to corrosion; aluminium has a protective oxide layer on its surface; tin is less reactive than iron.##

|!|EMA031313040O|!|
Both iron and aluminium react with air to form oxides. Aluminium oxide can form a protective oxide layer, while iron(III) oxide cannot. It is because

A. aluminium is more reactive than iron.
B. iron(III) oxide is corrosive to iron.

C. iron(III) oxide layer flakes off easily.
D. aluminium has a smaller atomic number than iron does.

##C##

|!|EMB031313041O|!|
Which of the following substances are NOT made of anodized aluminium?
A. Window frames
B. Saucepans
C. Bottle caps
D. Electrical wires

##D Electrical wires are usually made of copper as it is an excellent conductor of electricity.##

|!|EMA031313042O|!|
After anodizing, aluminium metal
A. becomes stronger.
B. has a thinner aluminium hydroxide layer on its surface.
C. becomes more resistant to corrosion.
D. has a more attractive appearance.

##C After anodizing, aluminium metal has a thicker layer of aluminium oxide protecting the metal from further corrosion.##

|!|EMA031313043O|!|
Which of the following is/are the advantage(s) of anodizing aluminium?
(1) It makes aluminium stronger.
(2) It enables dyeing on the metal surface.
(3) It increases the percentage of oxygen in a piece of aluminium.
A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

##B Anodizing cannot make aluminium stronger, though it improves the metal's resistance to corrosion. Although (3) is a fact, it is not an advantage of anodizing.##

|!|EMA031313044O|!|
Which of the following statements about aluminium is INCORRECT?
A. Anodized aluminium can be dyed easily.
B. The oxide layer of aluminium can be thickened by further reaction with air.
C. Aluminium can be extracted by electrolysis of its molten ore.
D. Aluminium reacts with dilute sulphuric acid to give hydrogen.

##B The oxide layer of aluminium is non-porous, and so it prevents the metal from

further reaction with oxygen.##

|!|EMA031313045O|!|
Which of the following methods can be used to prevent iron from rusting?
(1) Anodizing
(2) Electroplating
(3) Galvanizing

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

☐

##C Anodizing is used to enhance the corrosion resistance of aluminium but not iron.##

|!|EMA031313046O|!|
Aluminium metal is protected by anodizing. This process adds

A. aluminium.
B. zinc.
C. oxygen.
D. grease.

☐

##C##

Each question below consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table:

A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
B. Both statements are true and the 2nd statement is NOT a correct explanation of the 1st statement.
C. The 1st statement is false but the 2nd statement is true.
D. Both statements are false.

Sections 13.1−13.2
|!|EMA031313047O|!|

An iron nail kept in the moon will not rust at all.	Rusting only occurs when both oxygen and water are present.

☐

##A##

Sections 13.3−13.5
|!|EMA031313048O|!|

Tin-plating can be used to prevent iron cans from rusting.

Tin corrodes less readily than iron.

☐

##B##

|!|EMA031313049O|!|

Tin blocks are often attached to the steel legs of offshore oil platforms.

Tin is more reactive than iron.

☐

##D Zinc blocks are often used instead of tin. Tin is less reactive than iron.##

|!|EMA031313050O|!|

Galvanized iron is not used for making food cans.

Zinc ions are poisonous.

☐

##A##

|!|EMA031313051O|!|

Iron does not rust when it is connected to silver.

Silver protects iron from rusting by sacrificial protection.

☐

##D Silver could not protect iron from rusting as it is less reactive than iron. When iron is connected to a less reactive metal (e.g. silver), it loses electrons and changes to $Fe^{2+}(aq)$ ions more easily.##

|!|EMA031313052O|!|

Tin protects iron from rusting by sacrificial protection.

Tin loses electrons more easily than iron and prevents iron from forming $Fe^{2+}(aq)$ ions.

☐

##D Iron is often coated with tin as tin is corrosion-resistant. However, as tin is less reactive than iron, rusting would occur even more quickly if the coating is damaged. ##