

**O-level**

**RUSTING OF IRON**

When iron is left in damp air for some time it become covered with a brown coat called rust. Chemically rust is hydrated iron III oxide  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ .

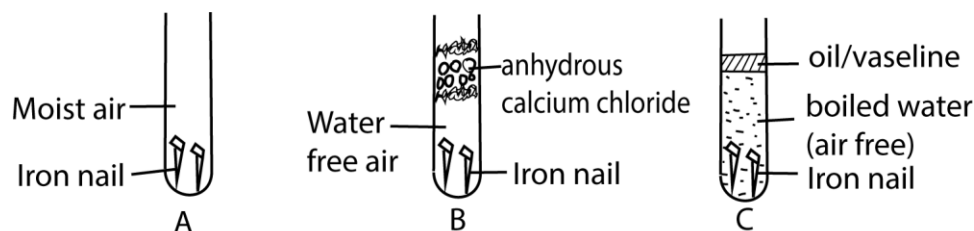
Disadvantage of rusting

1. Weaken objects made of iron
2. Makes objects made of iron look ugly

Conditions necessary for rusting

1. Oxygen not air
2. Water

Experiment to show that oxygen and water is necessary for rusting



The experiment is set up as shown above and left for several days

1. Test tube A contains nails and moist air
2. Test tube B contains nails and dry air because moisture is removed by anhydrous calcium chloride
3. Test tube C contains nail and air free water; boiling removes dissolved air from water while a layer of oil prevents entry of air into water

Observation after several days

1. In test tube a rusting took place because there is both oxygen and water necessary for rusting to take place.
2. In test tube B rusting did not take place because there was not water
3. In test tube C rusting did not take place due to absence of air

## Conclusion

Both oxygen and water are necessary for rusting to take place

## Method of preventing rusting

1. Keeping iron and steel equipment in air or water free environment, i.e., in the dry places (from water).
2. Oiling (protects equipment from water and oxygen).
3. Painting (protects from both air and water)
4. Tin plating protects iron from both air and water; however, tin-plate is only effective provided the layer of tin remains intact
5. Galvanizing: this is coating iron with zinc. Zinc protects iron because it is passive in air but also it can reduce iron III to ion.

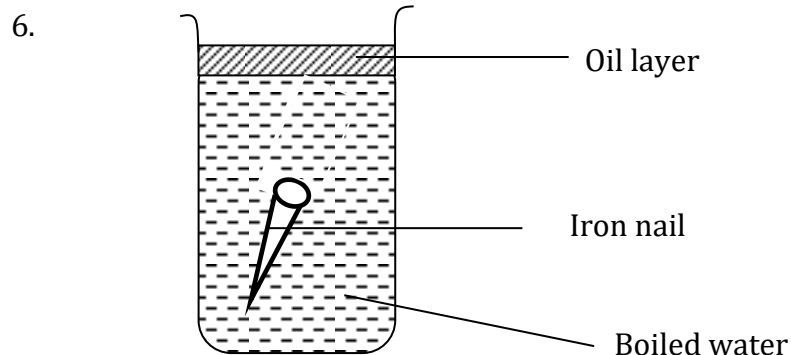
## Exercise

1. Which one of the following is the formula of the brown solid that is formed on iron when left exposed in damp air?
  - A.  $\text{Fe}_2\text{O}_3$
  - B.  $\text{Fe}_3\text{O}_4$
  - C.  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$
  - D.  $\text{Fe}_3\text{O}_2 \cdot x\text{H}_2\text{O}$
2. The hydroxide which turns brown when exposed to air from the list below
  - A. Copper II hydroxide
  - B. Iron II hydroxide
  - C. Lead II hydroxide
  - D. Iron III hydroxide
3. A steel tank is protected from rusting when it is connected to metal M as shown below



- Which one of the following metal is not likely to be M
- A. Aluminium
  - B. Zinc
  - C. Magnesium
  - D. copper
4. The formula of rust is
    - A.  $\text{Fe}(\text{OH})_2$
    - b.  $\text{FeO} \cdot n\text{H}_2\text{O}$
    - C.  $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$
    - D.  $\text{Fe}_2\text{O}_2(\text{OH})$

5. Which of the following hydroxides when exposed to air turns brown?
- A.  $\text{Pb}(\text{OH})_2$
  - B.  $\text{Fe}(\text{OH})_2$
  - C.  $\text{Zn}(\text{OH})_2$
  - D.  $\text{Mg}(\text{OH})_2$

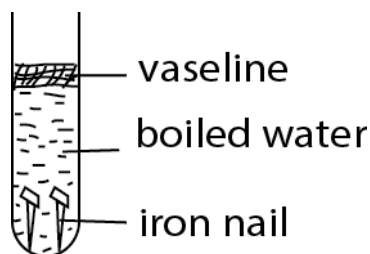


- From the experiment above, the purpose of the oil layer is
- A. to prevent presence of water vapour
  - B. to prevent entry of air
  - C. to absorb carbon dioxide from air
  - D. to restrict presence of dust into water

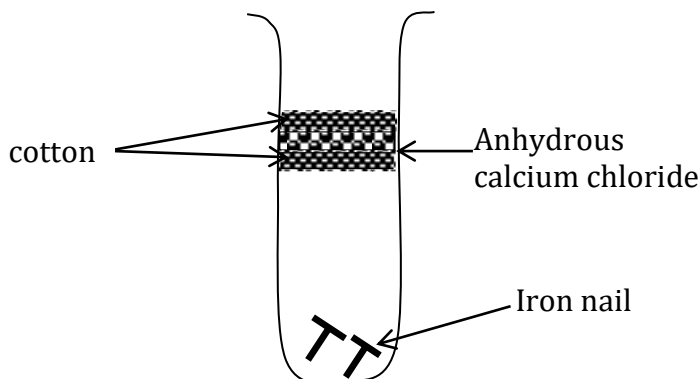
For question 7 one or more of the answers given may be correct. Read each questions carefully and then indicate the correct answer according to the following

- A. If 1, 2, 3, only are correct
  - B. If 1 and 3 only are correct
  - C. If 2 and 4 only are correct
  - D. If 4 only is correct
7. Iron is prevented from rusting by
- 1. greasing
  - 2. electroplating
  - 3. galvanizing
  - 4. neutralizing

8. (a) State the conditions necessary for rusting to take place.
- (b) During an investigation to show the conditions under which an iron nail may rust. An experiment was set up as shown in figure below



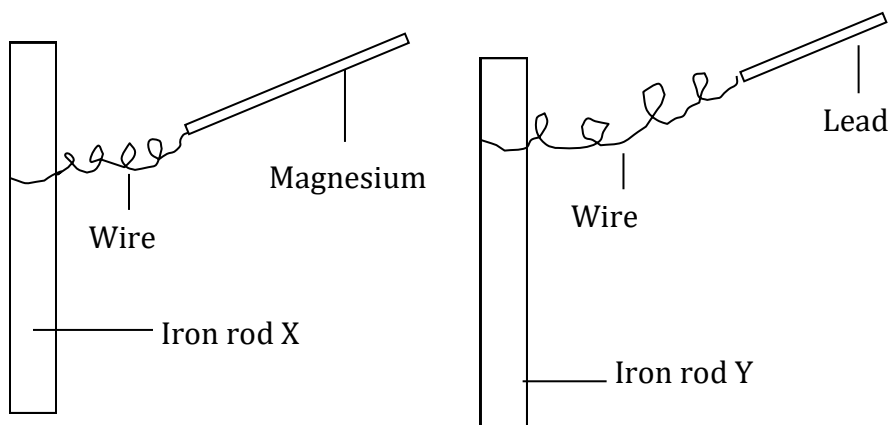
- State the condition which was being investigated.
- (c) State one disadvantage of rusting
- (d) (i) What is galvanized iron?
- (ii) State one use of galvanized iron
9. Rusting a process that occurs when an iron object is exposed to damp air.
- (a) Give the name of rust
- (b) State two disadvantages of rusting
- (c) State three methods that can effectively prevent rusting of objects
- 10 (a) State the conditions necessary for rusting to occur
- (b) During an investigation to show the conditions under which an iron nail can rust, an experiment was set up as shown below



State the condition which was being eliminated

- (c) State two disadvantages of rusting
- (d) (i) What is galvanized iron?
- (ii) State two uses of galvanized iron
- 11 (a) State two conditions necessary for rusting to occur.
- (b) Draw a diagram of the setup of the apparatus that can be used to show that iron does not rust in absence of oxygen.
- (c) Explain why iron coated with zinc does not rust even if the zinc layer is cracked.
- 12 (a) Define the term rusting
- (b) Draw a well labeled diagram t show that rusting cannot take place in the absence of oxygen (1 mark)

- (c) Two Iron rods X and Y were connected with a wire to magnesium and lead metal respectively as shown in figure below



The Iron were left in the open for several months  
State what would be observed on

- |    |       |  |
|----|-------|--|
|    | (i)   | Iron rod X   |
|    | (ii)  | Explain your answer in (c)(i)  |
|    | (iii) | Iron rod Y   |
|    | (iv)  | Explain your answer in (c)(iii)  |
| 13 | (a)   | With aid of a diagram describe an experiment you would use to show that rusting requires oxygen and water. |
|    | (b)   | (a) Describe three ways of preventing rusting  |

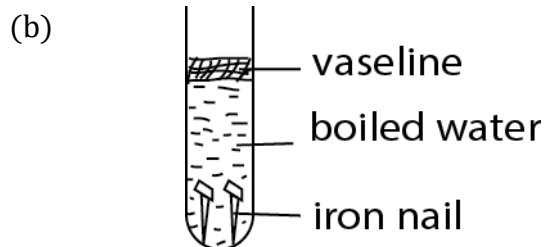
## Answers

1. D 2. B 3. D 4. C 5. B 6. D 7. A

8. (a) Water and oxygen  
 (b) Oxygen  
 (c) Weaken iron objects  
 Make iron objects look ugly  
 (d) (i) Iron coated with zinc  
 (ii) Making water tanks  
 Roofing iron sheet
9. (a) Hydrated iron III oxide,  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$   
 (b) Weaken iron objects  
 Make iron objects look ugly  
 (c) - Oiling  
 - Painting  
 - galvanization

10. (a) Oxygen and water  
 (b) Water  
 (c) Weaken iron objects  
 Make iron objects look ugly  
 (d) (i) Iron coated with zinc  
 (ii) Making water tanks  
 Roofing iron sheet

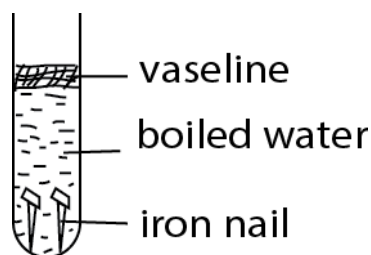
11. (a) Water and oxygen



- (c) Zinc is higher in electrochemical series therefore reduces oxidised iron oxide to iron

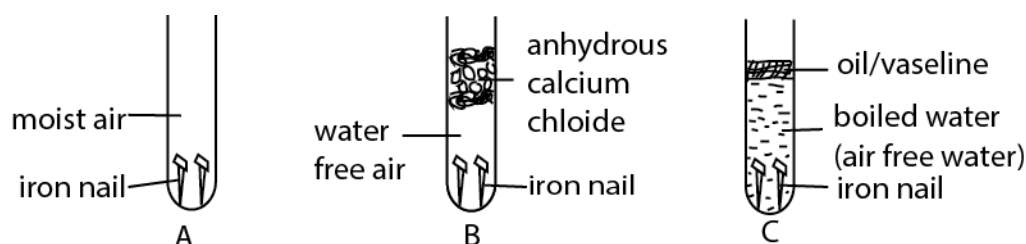
12 (a) Oxidation of iron in presence of oxygen and water to form brown coat

(b)



- (c) (i) Rusting did not take place  
(ii) Magnesium reduces rust to iron  
(iii) Brown coat formed  
(iv) Lead is below iron in the reactivity series thus cannot reduce rust

Experiment to show that oxygen and water is necessary for rusting



The experiment  Fig. 1 ..... above and left for several days

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Observation after several days

1. In test tube A rusting took place because there is both oxygen and water necessary for rusting to take place.
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Conclusion

Both oxygen and water are necessary for rusting to take place

(b) – galvanizing, oiling and painting