

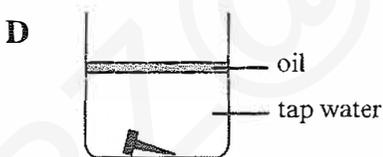
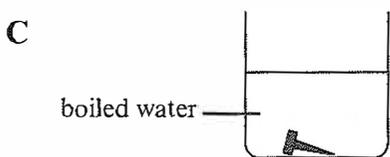
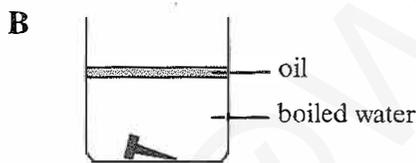
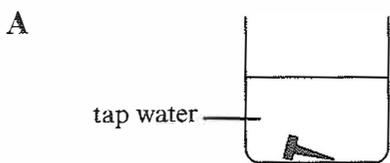
6. A metal is known to be between sodium and aluminium in the reactivity series. Which method is the most suitable to extract the metal from its ore?
- A Heat the metal ore in hydrogen gas.
 - B Heat the metal ore with carbon.
 - C Dissolve the metal ore in water and carry out electrolysis.
 - D Melt the metal ore and carry out electrolysis. ()
7. Iron is harder to recycle than aluminium because
- A it is more reactive than aluminium.
 - B it rusts so the rust needs to be removed before recycling.
 - C it has magnetic properties so it can be separated from other objects easily.
 - D it is cheaper to produce iron than to recycle it. ()
8. Carbon can reduce the oxides of X and Y but hydrogen can only reduce the oxide of X. Which of the following statements about X and Y is true?
- A Y will displace X from an aqueous solution of X chloride.
 - B X will displace Y from an aqueous solution of Y chloride.
 - C Y reacts explosively with dilute acids.
 - D X reacts vigorously with dilute acids. ()
9. Which of the following statements describes the extraction of iron in a blast furnace correctly?
- A Molten iron is less dense than slag so it floats on slag.
 - B Carbon monoxide is formed in the furnace to oxidise the iron ore.
 - C Limestone decomposes into calcium oxide which reacts with acidic impurities to form slag.
 - D Iron oxide reacts with carbon to form carbon monoxide. ()

10. Which of the following shows the waste gases produced in the extraction of iron?

- A carbon dioxide, carbon monoxide, sulfur dioxide and oxides of nitrogen
- B carbon dioxide and carbon monoxide
- C steam and carbon dioxide
- D sulfur dioxide and hydrogen

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11. In which experiment will the iron nail take the longest time to rust?



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12. Which metals will slow down the rusting of steel objects when attached to them?

- A copper and aluminium
- B magnesium and zinc
- C lead and silver
- D iron and sodium

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13. A factory manager wants to buy a material to make toy cars. He should buy

- A stainless steel because it does not rust.
- B mild steel because it is more malleable.
- C pure iron because it is cheap.
- D high carbon steel because it is strong.

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14. A student performs three tests to confirm the identity of X.
- 1 XCO_3 produces a gas and a yellow powder on heating. The powder remains yellow on cooling.
 - 2 XO produces a silver grey metal when heated with hydrogen.
 - 3 X does not react with cold water.

Which metal is X likely to be?

- | | |
|----------|--------------|
| A sodium | B magnesium |
| C lead | D silver () |

15. Adding carbon to iron makes it become

- A more malleable and ductile.
- B softer but more brittle.
- C more malleable and stronger.
- D harder but more brittle. ()

Use the following to answer Questions 16 and 17.

Pieces of zinc are added separately to test tubes containing salt solutions of X, Y and Z. The zinc pieces are weighed again after 30 minutes and the results are recorded in the table below.

	Mass of zinc piece (g)		Observation
	Before	After	
X	3.0	3.0	No changes are observed.
Y	3.2	2.4	Blue colour of the solution fades. Pink deposits observed.
Z	3.1	2.8	Silvery grey deposits are seen.

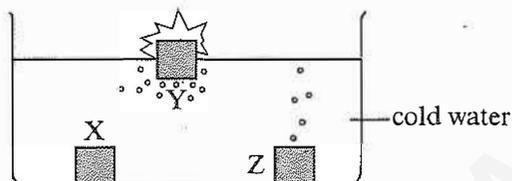
16. Which of the following statements must be true?
- A X is zinc because zinc cannot displace itself.
 - B Y is copper because copper solutions are blue.
 - C Z is lead as it is displaced by zinc.
 - D X, Y and Z are less reactive than zinc. ()

17. What is observed when metal X is added to a solution of Y?

- A No changes are observed.
- B Blue colour of the solution fades.
- C Silver deposits are observed.
- D Solution turns green.

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Use the following to answer Questions 18 and 19.



18. Metals X, Y and Z are likely to be

- A iron, sodium and zinc respectively.
- B potassium, magnesium and zinc respectively.
- C copper, calcium and iron respectively.
- D zinc, potassium and magnesium respectively.

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19. What is observed when metal Z is added to a solution of Y_2CO_3 ?

- A No changes are observed.
- B White precipitate forms.
- C Bubbling observed.
- D Silvery-grey deposits form.

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20. Some experiments are conducted on the compounds of potassium. What is a likely observation?

- A Potassium carbonate does not decompose on heating.
- B Potassium carbonate neutralises alkalis.
- C Potassium oxide dissolves in water to form an acidic solution.
- D Potassium oxide is reduced to potassium metal by heating it with carbon.

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Structured Questions

1. Galena is a lead mineral rich in lead(II) sulfide. It contains approximately 87% lead by weight. To recover metallic lead from galena, the ore is first crushed into small pieces and then it is roasted to form lead(II) oxide.

(a) Write an equation for the conversion of lead(II) sulfide into lead(II) oxide.

(b) Suggest why this process is considered non-environmental friendly.

(c) Lead(II) oxide is heated in a blast furnace to reduce it into metallic lead. Slag forms on top of the metallic lead layer in the blast furnace.

(i) Name one other raw material required to carry out the reduction.

(ii) Name one impurity present in slag.

(iii) Suggest a reagent that can be used to remove the impurity named.

2. Pieces of zinc and iron are added to nitrate solutions of metals P and Q separately. The results are tabulated below.

	Nitrate of P	Nitrate of Q
Zinc	Solution turns from emerald green to colourless. Silvery deposits are observed.	Solution turns from dark purple to colourless. Silvery deposits are observed.
Iron	Solution turns from emerald green to pale green. Silvery deposits are observed.	Solution remains dark purple.

- (a) Arrange zinc, iron, P and Q in order of increasing reactivity.

- (b) Predict what happens when

- (i) metal P is added to copper(II) nitrate.

- (ii) metal Q is added to the nitrate solution of P.

- (c) Suggest where P and Q are likely to be located in the Periodic Table.

- (d) Nick claims that metal Q can only be recovered from its ore by electrolysis. Is he correct? Why?

3. Objects made of iron or steel are known to rust if left unprotected. One way of protecting the objects is tin plating.

(a) State the conditions needed for rusting.

(b) Tin plating is commonly used to protect iron or steel food cans. Explain why the contents of a dented can should not be consumed.

(c) Another method used to protect iron is galvanising.

(i) Name the metal used to protect iron in galvanising.

(ii) Explain why the iron does not rust even when the protecting metal layer is damaged.

4. Four unknown metals from the reactivity series are tested with different metal nitrate solutions and the results are recorded below.

Metal Metal nitrate	P	Q	R	S
$Mg(NO_3)_2$	×	○	×	×
$Zn(NO_3)_2$	○	○	×	×
$Pb(NO_3)_2$	○	○	×	○
$AgNO_3$	○	○	○	○

Key: × no reaction ○ reaction observed

- (a) Arrange P, Q, R and S in order of their reactivities, starting with the least reactive metal.

- (b) Suggest the identities of P and Q.

- (c) Write an equation for the reaction between P and silver nitrate.

- (d) State and explain whether a reaction would occur between

- (i) metal P and the nitrate of R

- (ii) metal S and the nitrate of Q

5. Pieces of metals were added to beakers of cold water and removed after 2 minutes. Each piece was dried and weighed again. The table below records the results of the experiment.

Metal	Mass of metal (g)	
	Before	After
A	3.3	2.6
B	2.7	2.4
C	3.0	3.0
D	3.1	2.7

- (a) Use the table to arrange the metals in order of their reactivities, starting from the most reactive metal.

- (b) Given that C reacts with dilute acid and is extracted from its ore using electrolysis while A does not react explosively with water, suggest the identities of the four metals.

- (c) Write the equation for the reaction between A and cold water. Describe what you would observe.

6. Use the list of metals to answer the questions below.

Sodium	Aluminium	Magnesium	Zinc
Copper	Lead	Tin	

Name a metal

- (a) that floats on water _____
- (b) that does not react with dilute hydrochloric acid _____
- (c) whose oxide can be reduced by carbon but not hydrogen _____
- (d) that is used in the making of food cans _____
- (e) that displaces iron from iron(II) nitrate _____

7. Waste cupric chloride from copper etching can be treated with electrolysis to recover the copper. A cheaper alternative would be to use another scrap metal to displace copper from cupric chloride.

(a) Write an equation for the reaction between iron and cupric chloride (CuCl_2).

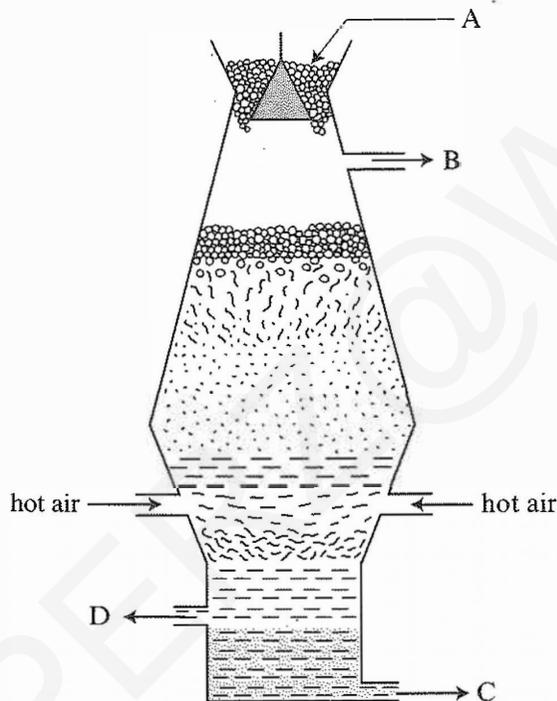
(b) How does the ferromagnetic property of iron make it ideal for this reaction?

(c) Suggest another reason why iron is an ideal metal for this reaction.

- (d) The recycled copper can be purified to make wires and water pipes. What properties of copper make it ideal for such applications?
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Free Response Questions

1. Iron is produced by smelting haematite in a blast furnace as shown below.



- (a) Write down the names of
- the raw materials added in at A
 - three waste gases given off at B
 - products C and D
- (b) Use equations to explain how
- iron is extracted from its ore
 - the impurities are removed
- (c) Iron rusts easily when in contact with air and water. Suggest how the following objects can be protected and why.
- bicycle handles
 - ship hulls
 - motor cars

2. Duralumin is an alloy used to make aircraft bodies. It consists of 4.5% copper, 1.5% magnesium, 0.5% manganese and the remaining 93.5% aluminium.
- (a) Suggest why pure aluminium is not used to make aircraft bodies.
 - (b) Give another use of duralumin.
 - (c) With the aid of diagrams, explain how alloying changes the structure and properties of aluminium.
 - (d) Duralumin is made mainly from recycled aluminium. Recycled aluminium objects are melted down at high temperatures and additives are added to make duralumin.
 - (i) What are the advantages and disadvantages of using recycled aluminium to make duralumin?
 - (ii) Why is it important to recycle metals?