Past-paper walk-through

Metallic bonding ▪ 2.7

eXercise

Questions in this set

- 0620/21 N25 Q7 ▪ 1 mark
- 0620/22 N25 Q9 ▪ 1 mark
- 0620/41 J25 Q3 ▪ 15 marks
- 0620/43 J25 Q3 ▪ 15 marks
- 0620/22 M25 Q8 ▪ 1 mark

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 7

0620/21 N25 ▪ Q7 ▪ 1 mark

7 Which statement explains why solid magnesium is a good conductor of electricity?

A Magnesium has delocalised electrons that can move through the lattice.

B Magnesium has strong attractions between ions.

C Magnesium consists of a giant lattice of anions in a ‘sea’ of delocalised electrons.

D Magnesium consists of metal ions that move through the lattice.

Solution 7

Answer: **A**

Why

- In a metal the outer electrons leave the atoms and become delocalised.
- Those electrons are free to move right through the lattice.
- Moving charge is an electric current, which is why magnesium conducts even as a solid.

Question 9

0620/22 N25 ▪ Q9 ▪ 1 mark

9 Which row describes the structure and bonding in cobalt?

	structure	bonding
A	giant	ionic
B	simple	ionic
C	giant	metallic
D	simple	metallic

Question 9

Solution 9

Answer: **C**

Why

- Cobalt is a metal, so it is built from positive ions with delocalised electrons.
- That bonding extends throughout the sample, so the structure is giant, not simple.
- Giant metallic – there are no ionic or molecular units.

Question 3

0620/41 J25 ▪ Q3 ▪ 15 marks

3 This question is about copper and compounds of copper.

(a) (i) Describe the bonding in a metallic element such as copper.

Question 3

(ii) Explain how solid copper conducts electricity.

Question 3

(b) Copper is in alloys such as brass.

(i) State **one** reason why alloys are more useful than pure metals.

Question 3

(ii) Name the substance that is present in brass, other than copper.

Question 3

(c) Copper(II) sulfate crystals are made by the reaction between copper(II) carbonate and dilute sulfuric acid, using the following steps.

The sulfuric acid has a concentration of 0.100 mol/dm^3.

step 1 Powdered copper(II) carbonate is added to dilute sulfuric acid. The mixture is stirred. A reaction occurs.

step 2 More copper(II) carbonate is added, with stirring, until the reaction stops.

step 3 Unreacted copper(II) carbonate is separated from aqueous copper(II) sulfate by filtration.

step 4 Aqueous copper(II) sulfate is heated until some of the water evaporates.

step 5 The remaining solution is allowed to cool and crystallise.

step 6 The crystals are removed and dried.

Question 3

Step [illegible] The crystals are removed and dried.

Question 3

(i) Give **two** observations in **step 1**.

Question 3

Question 3

[2]

(ii) State why the reaction stops in **step 2**.

Question 3

(iii) Name the residue in **step 3**.

Question 3

(iv) Name a substance, other than copper(II) carbonate, that can be added to dilute sulfuric acid to produce aqueous copper(II) sulfate.

Question 3

(v) The solution at the end of **step 4** contains the maximum amount of copper(II) sulfate that will dissolve at that temperature.

State the term used to describe this type of solution.

Question 3

(vi) **Step 1** is repeated using sulfuric acid of concentration $0.200\,mol/dm^3$ instead of $0.100\,mol/dm^3$.

All other conditions are the same.

The rate of reaction increases.

Explain why the rate of reaction increases. Give your answer in terms of particles.

Question 3

(vii) Copper(II) sulfate crystals have the formula $CuSO_4 \cdot 5H_2O$.

State the term used to describe a substance that is chemically combined with water.

Question 3

[Total: 15]

Solution 3

(a)(i)

Mark scheme

- M1 positive ions / cations(1) M2
- sea of electrons /
- mobile electrons /
- delocalised electrons(1) M3
- attraction between positive ions and electrons(1)
- 3

Solution 3

(a)(ii)

Mark scheme

- electrons move /
- electrons mobile /
- electrons flow
- 1

Solution 3

(b)(i)

Mark scheme

- harder or stronger
- 1

Solution 3

(b)(ii)

Mark scheme

- zinc
- 1
- 0620/41
- May/June 2025

Solution 3

(c)(i) Mark scheme

- Any two from:-
- ▪
- solid disappears / solid dissolves
- ▪
- fizzing / bubbling / effervescence
- ▪
- blue solution
- 2

Solution 3

(c)(ii)

Mark scheme

- all the sulfuric acid had reacted
- 1

(c)(iii)

Mark scheme

- copper(II) carbonate
- 1

Solution 3

(c)(iv)

Mark scheme

- copper(II) oxide / copper(II) hydroxide
- 1

(c)(v)

Mark scheme

- saturated (solution)
- 1

Solution 3

(c)(vi)

Mark scheme

- M1 more particles per unit volume M2
- more collisions per unit time / increased collision frequency
- 2

Solution 3

(c)(vii)

Mark scheme

- hydrated
- 1

Question 3

0620/43 J25 ▪ Q3 ▪ 15 marks

3 This question is about zinc and compounds of zinc.

(a) Zinc is held together by electrostatic forces of attraction between particles.

(i) Name the type of bonding in zinc [1]

(ii) Name the two types of particles held together by the bonding in (a)(i). 1 2 [2]

(iii) Name the type of particle whose movement allows zinc to conduct electricity [1]

(b) Zinc is present in alloys such as brass.

(i) State the meaning of the term alloy [1]

(ii) Name the substance that is present in brass, other than zinc [1]

(c) Zinc sulfate crystals are made by the reaction between zinc carbonate and dilute sulfuric acid, using the following steps.

step 1 An excess of powdered zinc carbonate is added to dilute sulfuric acid.

step 2 Excess zinc carbonate is separated from aqueous zinc sulfate by filtration.

Question 3

step 3 Aqueous zinc sulfate is heated until a saturated solution is formed.
step 4 The saturated solution is allowed to cool and crystallise.
step 5 The crystals are removed and dried.
(i) Give two observations which show that the zinc carbonate is in excess in step 1. 1 2 [2]
(ii) Name the filtrate in step 2 [1] , ,
(iii) Name a compound, other than zinc carbonate, that can be added to dilute sulfuric acid to produce aqueous zinc sulfate in step 1 [1]
(iv) State what is meant by the term saturated solution [2]
(v) Step 1 is repeated using large pieces of zinc carbonate instead of powdered zinc carbonate.
All other conditions are the same.
The rate of reaction decreases.

Question 3

Explain why the rate of reaction decreases. Give your answer in terms of particles [2]
(vi) Hydrated crystals form in step 4.
State what is meant by the term hydrated [1]

, ,
(a)(i) (a) Zinc is held together by
electrostatic forces of attraction between particles. (i) Name the type of bonding in zinc.

....

[1] **[1]**

(a)(ii) (ii) Name the two types of particles held together by the bonding in (a)(i). 1

....

2

....

[2] **[2]**

Question 3

(a)(iii) (iii) Name the type of particle whose movement allows zinc to conduct electricity.

....

[1] **[1]**

Question 3

0620/43 J25 ▪ Q3 ▪ 15 marks

3 This question is about zinc and compounds of zinc.
(a) Zinc is held together by electrostatic forces of attraction between particles.
(i) Name the type of bonding in zinc [1]
(ii) Name the two types of particles held together by the bonding in (a)(i). 1 2 [2]
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(b) Zinc is present in alloys such as brass.
(i) State the meaning of the term alloy [1]
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step 1 An excess of powdered zinc carbonate is added to dilute sulfuric acid.
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Question 3

step 4 The saturated solution is allowed to cool and crystallise.
step 5 The crystals are removed and dried.
(i) Give two observations which show that the zinc carbonate is in excess in step 1. 1 2 [2]
(ii) Name the filtrate in step 2 [1] , ,
(iii) Name a compound, other than zinc carbonate, that can be added to dilute sulfuric acid to produce aqueous zinc sulfate in step 1 [1]
(iv) State what is meant by the term saturated solution [2]
(v) Step 1 is repeated using large pieces of zinc carbonate instead of powdered zinc carbonate. All other conditions are the same.
The rate of reaction decreases.
Explain why the rate of reaction decreases. Give your answer in terms of particles [2]
(vi) Hydrated crystals form in step 4.
State what is meant by the term hydrated [1]

, ,

Question 3

(b)(i) (b) Zinc is present in alloys such as brass. (i) State the meaning of the term alloy.

....

[1] **[1]**

(b)(ii) (ii) Name the substance that is present in brass, other than zinc.

....

[1] **[1]**

Question 3

0620/43 J25 ▪ Q3 ▪ 15 marks

3 This question is about zinc and compounds of zinc.
(a) Zinc is held together by electrostatic forces of attraction between particles.
(i) Name the type of bonding in zinc [1]
(ii) Name the two types of particles held together by the bonding in (a)(i). 1 2 [2]
(iii) Name the type of particle whose movement allows zinc to conduct electricity [1]
(b) Zinc is present in alloys such as brass.
(i) State the meaning of the term alloy [1]
(ii) Name the substance that is present in brass, other than zinc [1]
(c) Zinc sulfate crystals are made by the reaction between zinc carbonate and dilute sulfuric acid, using the following steps.
step 1 An excess of powdered zinc carbonate is added to dilute sulfuric acid.
step 2 Excess zinc carbonate is separated from aqueous zinc sulfate by filtration.
step 3 Aqueous zinc sulfate is heated until a saturated solution is formed.

Question 3

step 4 The saturated solution is allowed to cool and crystallise.
step 5 The crystals are removed and dried.
(i) Give two observations which show that the zinc carbonate is in excess in step 1. 1 2 [2]
(ii) Name the filtrate in step 2 [1] , ,
(iii) Name a compound, other than zinc carbonate, that can be added to dilute sulfuric acid to produce aqueous zinc sulfate in step 1 [1]
(iv) State what is meant by the term saturated solution [2]
(v) Step 1 is repeated using large pieces of zinc carbonate instead of powdered zinc carbonate. All other conditions are the same.
The rate of reaction decreases.
Explain why the rate of reaction decreases. Give your answer in terms of particles [2]
(vi) Hydrated crystals form in step 4.
State what is meant by the term hydrated [1]

, ,

Question 3

(c)(i) (c) Zinc sulfate crystals are made by the reaction between zinc carbonate and dilute sulfuric acid, using the following steps. An excess of powdered zinc carbonate is added to dilute sulfuric acid. step 1 Excess zinc carbonate is separated from aqueous zinc sulfate by filtration. step 2 Aqueous zinc sulfate is heated until a saturated solution is formed. step 3 The saturated solution is allowed to cool and crystallise. step 4 The crystals are removed and dried. step 5 (i) Give two observations which show that the zinc carbonate is in excess in step 1. 1

....

2

....

[2] **[2]**

Question 3

(c)(ii) (ii) Name the filtrate in step 2.

....

[1] , , **[1]**

(c)(iii) (iii) Name a compound, other than zinc carbonate, that can be added to dilute sulfuric acid to produce aqueous zinc sulfate in step 1.

....

[1] **[1]**

(c)(iv) (iv) State what is meant by the term saturated solution.

....

....

[2] **[2]**

(c)(v) (v) Step 1 is repeated using large pieces of zinc carbonate instead of powdered zinc carbonate. All other conditions are the same. The rate of reaction decreases.

Question 3

Explain why the rate of reaction decreases. Give your answer in terms of particles.

....

....

....

[2] **[2]**

(c)(vi) (vi) Hydrated crystals form in step 4. State what is meant by the term hydrated.

....

[1] **[1]**

Solution 3

(a)(i)

Mark scheme

- metallic (bonding)
- 1

Solution 3

(a)(ii)

Mark scheme

- M1 positive ions M2
- electrons
- 2

Solution 3

(a)(iii)

Mark scheme

- electrons
- 1

Solution 3

(b)(i)

Mark scheme

- a mixture of a metal with other elements
- 1

(b)(ii)

Mark scheme

- copper
- 1

Solution 3

(c)(i)

Mark scheme

- M1 solid stops dissolving / disappearing M2
- no more bubbles / fizzing / effervescence on addition of solid
- 2

Solution 3

(c)(ii)

Mark scheme

- aqueous zinc sulfate
- 1
- 0620/43
- May/June 2025

Solution 3

(c)(iii)

Mark scheme

- zinc oxide
- OR
- zinc hydroxide
- 1

Solution 3

(c)(iv)

Mark scheme

- M1 (a solution containing the) maximum concentration of a solute dissolved in the solvent M2
- at a specified temperature
- 2

Solution 3

(c)(v)

Mark scheme

- M1 (large pieces have) smaller surface area M2
- frequency of collisions between (zinc carbonate and acid) particles decreases
- 2

Solution 3

(c)(vi)

Mark scheme

- (crystals that are) chemically combined with water
- 1

Question 8

0620/22 M25 ▪ Q8 ▪ 1 mark

8 Which row identifies the positive and the negative particles present in a giant metallic lattice?

	positive particles	negative particles
A	anions	cations
B	anions	delocalised electrons
C	cations	anions
D	cations	delocalised electrons

Solution 8

Answer: **D**

Why

- A metal atom loses its outer electrons, leaving positive ions – cations.
- Those electrons are free to move through the whole lattice, so they are delocalised.
- There are no anions anywhere in a metal.