Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Metallic elements and alloys

Time allowed: 40 minutes

Subject code **0620**

Chemistry

Questions from Paper 1, Paper 2 and Paper 3

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 40

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 40 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 Which metal is used in aircraft manufacture because it has a low density?

A aluminium

B copper

C iron

D potassium

Properties and uses of metals Click for more variations

Answer A

2 Which statement describes the alloy brass?

A It is a mixture of iron and nickel.

B It is a mixture of iron compounds.

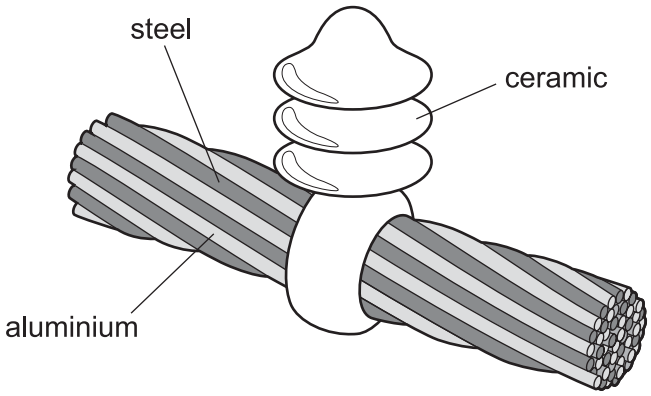
C It is a compound of copper, zinc and non-metals.

D It is a mixture of the metals copper and zinc.

Alloys Click for more variations

Answer D

3 The diagram shows a section of an overhead power cable.



Which statement explains why a particular substance is used?

A Aluminium has a low density and is a good conductor of electricity.

B Ceramic is a good conductor of electricity.

C Steel can rust in damp air.

D Steel is more dense than aluminium.

Properties and uses of metals Click for more variations

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Answer A

4 Solid X has a high boiling point.

Its structure has positive ions surrounded by a sea of electrons.

Which other properties does solid X have?

A brittle and an electrical conductor

B brittle and an insulator

C malleable and an electrical conductor

D malleable and an insulator

Properties and uses of metals Click for more variations

Answer C

5 Four substances, P, Q, R and S, are described.

- P is diatomic.
- Q is a good conductor of electricity when solid and when molten.
- R is a silver solid with a very high melting point.
- S reacts with oxygen to form a brown gas.

Which substances are metals?

A P and Q **B** P and S **C** Q and R **D** R and S

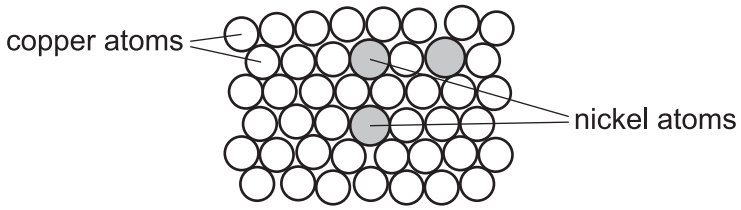
Properties and uses of metals Click for more variations

Answer C

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6 Cupronickel is used to make coins.

The arrangement of atoms in cupronickel is shown.



Which kind of substance is cupronickel?

A an alloy

B an isotope

C a compound

D a transition element

Alloys Click for more variations

Answer A

7 Which row compares the strength of alloys with pure metals and explains the difference in strength?

	strength of an alloy compared to a pure metal	explanation
A	weaker	larger atoms slide more easily over smaller atoms
B	weaker	larger atoms make it harder for layers to slide over one another
C	stronger	larger atoms slide more easily over smaller atoms
D	stronger	larger atoms make it harder for layers to slide over one another

Alloys Click for more variations

Answer D

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8 This question is about metals.

(a) State **three** general physical properties common to most metals.

1 .....

2 .....

3 .....

[3]

(b) Metals are often used in the form of alloys.

(i) State the meaning of the term *alloy*.

.....

..... [1]

(ii) Explain in terms of their properties why alloys are used instead of pure metals.

..... [1]

(iii) Stainless steel is an alloy.

Give **one** use of stainless steel.

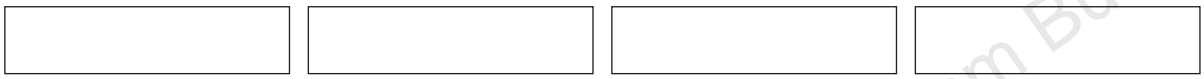
..... [1]

(c) Place these metals in order of their reactivity with oxygen.

copper
magnesium
potassium
zinc

Put the least reactive metal first.

least reactive ⟶ most reactive



[2]

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(d) When 4.8 g of magnesium reacts with excess oxygen, 8.0 g of magnesium oxide is formed.

Calculate the minimum mass of magnesium needed to produce 24.0 g of magnesium oxide.

minimum mass = ... g [1]

[Total: 9]

Properties and uses of metals Click for more variations

Reduced to 77% to fit the page (wider than A4).

8(a)	1 mark each for any three of: • conduct electricity / conduct heat • malleable • ductile • shiny / lustrous • sonorous / rings when hit	**3**
8(b)(i)	mixture of metal with another element	**1**
8(b)(ii)	(alloy is) hard(er) / (more) resistant to corrosion / strong(er)	**1**
8(b)(iii)	cutlery / chemical plant / surgical equipment	**1**
8(c)	copper , zinc , magnesium , potassium (2) if 2 marks not scored: 1 mark for one consecutive pair reversed	**2**
8(d)	14.4 (g)	**1**

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9 The table shows the properties of some steels.

steel	percentage of carbon in the steel	relative strength	melting point range / °C	ease of corrosion
A	1.0	8.0	1430–1460	corrodes easily
B	0.50	6.5	1430–1450	corrodes fairly easily
C	0.25	5.0	1410–1430	corrodes fairly easily
D	0.10	4.0	1440–1450	resistant to corrosion

(a) Use the information in the table to answer the following questions.

(i) What is the relationship between the percentage of carbon in the steel and its strength?

..... [1]

(ii) State whether there is a relationship between the percentage of carbon in the steel and its melting point range.
Explain your answer.

.....

..... [1]

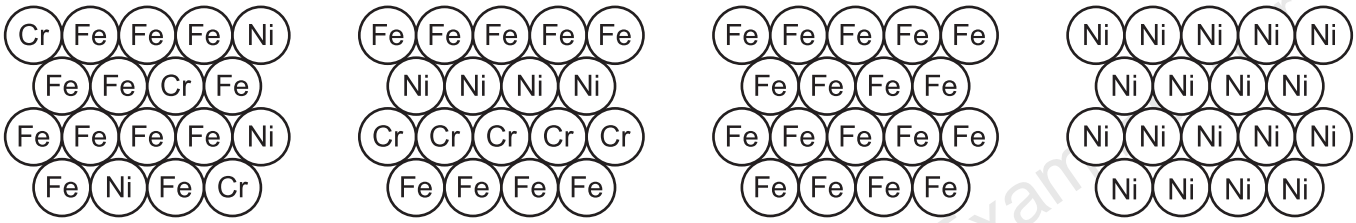
(iii) Which steel would be best to use for making a bicycle chain?
Explain your answer.

.....

..... [1]

(b) Steel is an alloy.

Which **one** of the diagrams best represents an alloy?
Draw a ring around the correct answer.



A **B** **C** **D**

[1]

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(c) High voltage electricity cables are made from aluminium with a steel core.

(i) Apart from conducting electricity, what is the purpose of the steel core?

..... [1]

(ii) Aluminium is a good electrical conductor.

Give **one** other use of aluminium and state a property of aluminium which makes it suitable for this use.

use .....

property .....

[2]

(d) Aluminium powder reacts with powdered iron(III) oxide. The equation for this reaction is shown.

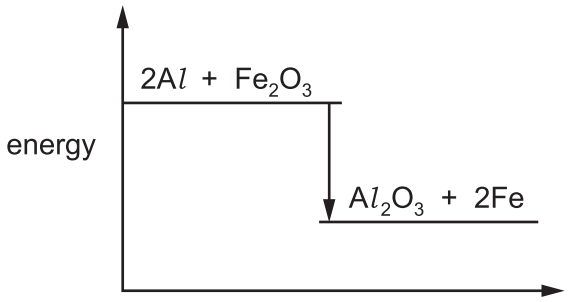
$$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$$

(i) Which substance is oxidised in this reaction?
Explain your answer.

.....

..... [2]

(ii) The energy level diagram for this reaction is shown.



Is this reaction exothermic or endothermic?
Explain your answer.

.....

..... [1]

[Total: 10]

Practical skills: planning, apparatus, measuring and results Click for more variations

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9(a)(i)	the more carbon, the higher the strength **ORA**	**1**
9(a)(ii)	(no) the melting point range does not increase regularly / the melting point range goes up and down / the melting point range remains fairly constant **OR** (yes) the more carbon, the greater the melting point range / the difference between the higher and lower number is greater with more carbon **OR** (yes) the average melting point range is higher the more carbon (except for **D**) / the general trend is for a higher melting point range with more carbon	**1**
9(a)(iii)	**D** because it is resistant to corrosion	**1**
9(b)	**A**	**1**
9(c)(i)	gives strength / so the wire does not break / so the wire does not sag / for support	**1**
9(c)(ii)	*use:* any suitable use, e.g. food container / saucepan / aircraft body / *property:* any suitable property related to the use, e.g.(food container) resistant to acidic foods / (saucepan) good conductor of heat / (aircraft body) low density /	**1** **1**
9(d)(i)	A*l* / aluminium it gains oxygen	**1** **1**
9(d)(ii)	exothermic because the reactants have more energy than the products / exothermic because the products have less energy than the reactants	**1**

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10 Aluminium and gallium are in Group III of the Periodic Table.

(a) The heat from your hand is sufficient to melt gallium.
Describe the change in state from solid to liquid in terms of the kinetic particle theory.
In your answer include

- the difference in arrangement and closeness of the particles in a solid and a liquid,
- the difference in the motion of the particles in a solid and a liquid.

.....

.....

.....

.....

..... [5]

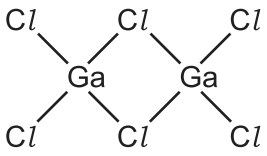
(b) Gallium is a metal. Describe **three** physical properties of gallium which are typical of most metals.

1. .....

2. .....

3. ..... [3]

(c) When it is a gas, gallium(III) chloride has the structure shown below.

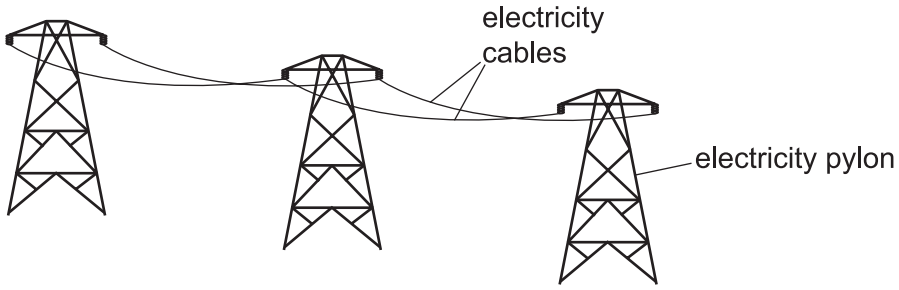


Write the molecular formula for gallium(III) chloride.

..... [1]

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(d) Aluminium is used to make high voltage electricity cables.



The table shows some properties of four metals which could be used for overhead power cables.

metal	relative strength	density in g / cm^3	relative electrical conductivity	price $ per tonne
aluminium	9	2.70	0.4	2120
copper	30	8.92	0.7	9600
tungsten	100	19.35	0.2	450
steel	50	7.86	0.1	700

(i) Suggest why aluminium, rather than tungsten, is used in overhead power cables?

..... [1]

(ii) Suggest why steel, rather than copper, is used as a core for overhead power cables.

..... [1]

(iii) Give **two** reasons why aluminium is used for overhead power cables rather than copper.

1. .....

2. ..... [2]

(e) State **one** use of aluminium other than as an electrical conductor.

..... [1]

[Total: 14]

Solids, liquids, gases and changes of state Click for more variations

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10 **(a)** Any four of: [4]

- in solid, particles are arranged regularly (or are ordered) / in a lattice
- in solid, particles are close together
- in solid, particles are not moving / only vibrate / are in fixed position
- in liquid, particles randomly arranged / disordered / have random motion
- in liquid, particles slide over each other / move slowly
- in liquid, particles are close together

IGNORE: particles are closer together

Any one of: [1]

- during melting, particles become less ordered
- during melting, particles start moving / move more / move faster

IGNORE: during melting, particles get further apart
NOTE: there must be a reference to particles to score marks

(b) Any three of: [3]

- lustrous or shiny **ALLOW**: silvery
- conduct heat / conduct electricity / conduct
- malleable or can be shaped: **ALLOW**: can be bent
- ductile / can be drawn into wires
- **ALLOW**: solid at room temperature / solid below 37 °C

IGNORE: high boiling point / comments about density / sonorous / comments about hardness

(c) Ga_2Cl_6 [1]

(d) **(i)** lower density / better electrical conductor [1]
IGNORE: low density / lighter / lightweight / good electrical conductor
NOTE: comparative needed

(ii) stronger / cheaper [1]
NOTE: comparative needed

(iii) lower density; cheaper (1 mark each) [2]
NOTE: comparative needed

(e) food containers / cooking utensils / aircraft or cars (bodywork) / rail truck (or rail car) (bodywork) / bicycles / (drink) cans / foil / windows / doors / roofing / walking poles / alloy magnets / (some types of) CD's / transistors / (high brightness) LEDs / paints / (solid) rocket fuels / coins / guitar plates (or necks) / mirrors / any other suitable use [1]

[Total: 14]

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