

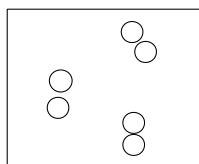
Year 11 half yearly answers 2009

Part A: Answer grid for multiple choice questions.

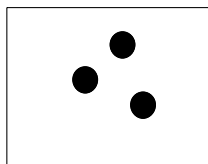
1.	A O	B O	C ✓	D O
2.	A O	B ✓	C O	D O
3.	A O	B O	C ✓	D O
4.	A O	B O	C ✓	D O
5.	A O	B O	C O	D ✓
6.	A ✓	B O	C O	D O
7.	A O	B ✓	C O	D O
8.	A O	B O	C O	D ✓
9.	A O	B ✓	C O	D O
10.	A O	B O	C O	D ✓
11.	A ✓	B O	C O	D O
12.	A O	B ✓	C O	D O
13.	A O	B O	C ✓	D O

Mark	
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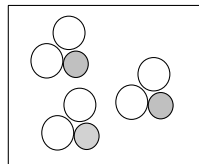
1. Which of the diagrams illustrates molecules of an element?



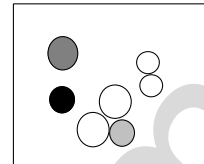
i



ii



iii



iv

- (A) i,ii,iii,iv
 (B) i,ii and iii only
 (C) **i, ii, only**
 (D) iii and iv only

Outcome(s): P13

2. If the formula of sodium pyrotantalate is $\text{Na}_4\text{Ta}_2\text{O}_7$, what is the formula of calcium pyrotantalate?

- (A) CaTa_2O_7
 (B) **$\text{Ca}_2\text{Ta}_2\text{O}_7$**
 (C) $\text{Ca}_4(\text{Ta}_2\text{O}_7)_2$
 (D) $\text{Ca}(\text{Ta}_2\text{O}_7)_2$

Outcome(s): P13

3. The spheres of the earth contain examples of mixtures of elements and compounds. Which choice places the mixtures in the correct sphere?

	<i>biosphere</i>	<i>lithosphere</i>	<i>hydrosphere</i>	<i>atmosphere</i>
(A)	saliva	oceans	underground water	air
(B)	blood	fecal matter	opal	soot
(C)	sap	limestone	ocean	car exhaust
(D)	coal	sweat	glacier	smoke

Outcome(s): P13

4. Which separation techniques are suitable for the given mixtures? Assume that both components of the mixture are to be recovered.

Mixture	<i>sand & gravel</i>	<i>dusty air</i>	<i>ethanol- water</i>	<i>salt solution</i>
(A)	sieving	filtration	distillation	evaporation
(B)	filtration	filtration	distillation	distillation
(C)	sieving	filtration	distillation	distillation
(D)	filtration	precipitation	distillation	evaporation

Outcome(s): P11

5. What is the subatomic particle composition of ${}^{204}_{81}\text{Th}^{4+}$?

	<i>proton</i>	<i>neutron</i>	<i>electrons</i>
(A)	81	204	81
(B)	81	204	77
(C)	123	81	119
(D)	81	123	77

Outcome(s): P13

6. Mendeleev's periodic table listed the elements in order of what increasing feature?

- (A) **Atomic mass**
(B) Atomic number
(C) Mass number
(D) Proton number

Outcomes : P1

7. The data book lists the properties of lithium metal as the following :

- (i) density (g/cm^3) = 0.53
(ii) melting point ($^{\circ}\text{C}$) = 180
(iii) boiling point ($^{\circ}\text{C}$) = 1336
(iv) reacts slowly with water and liquid bromine

Which of the above properties are physical properties?

- (A) (i),(ii),(iii),(iv)
(B) **(i),(ii),(iii) only**
(C) (i) and (iv) only
(D) (iv) only

Outcomes : P13

8. Which of the following compounds contains only covalent bonds?

- (A) NH_4NO_3
(B) CuO
(C) Ag_2SO_4
(D) **CO_2**

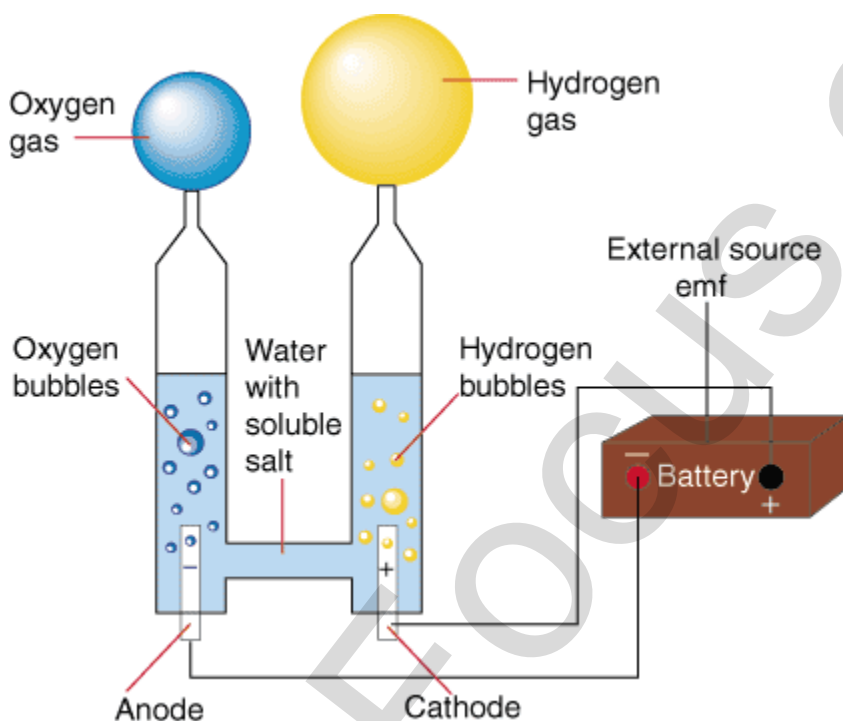
Outcomes : P6,P8

9. What is the name of the alloy made up of approximately 70%Pb and 30% Sn?

- (A) Bronze
- (B) Solder**
- (C) Steel
- (D) Brass

Outcomes : P4

10. The electrolysis of water may be represented by the following diagram.



Which of the statements about the electrolysis of water is true?

- (A) Electrolysis of water is a physical change that produces a soluble salt.
- (B) Electrolysis of water is a physical change that produces oxygen and hydrogen.
- (C) Electrolysis of water is a chemical change that produces a salt.
- (D) Electrolysis of water is a chemical change that produces oxygen and hydrogen.**

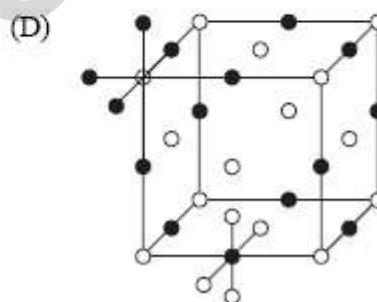
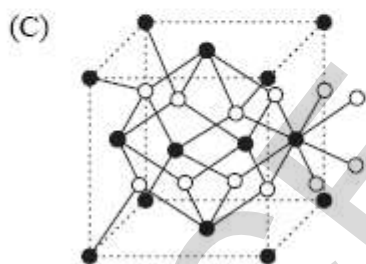
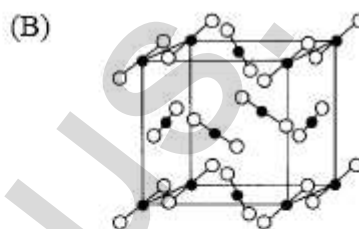
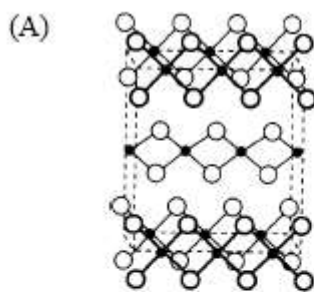
Outcomes : P7

11. Which half equations correctly describe the electron transfer reaction between magnesium and sulfuric acid ?

- | | | | | | |
|-----|-------------------------------|---------------|-------------------------|---|---------------|
| (A) | Mg | $\rightarrow$ | Mg^{2+} | + | 2e^- |
| | H^+ + e^- | $\rightarrow$ | $\frac{1}{2}\text{H}_2$ | | |
| (B) | Mg | $\rightarrow$ | Mg^{2+} | + | 2e^- |
| | SO_4^{2-} | $\rightarrow$ | SO_4^{2-} | + | 2e^- |
| (C) | Mg | $\rightarrow$ | Mg^+ | + | e^- |
| | 2H^+ + 2e^- | $\rightarrow$ | H_2 | | |
| (D) | Mg + 2e^- | $\rightarrow$ | Mg^{2+} | | |
| | 2H^+ + 2e^- | $\rightarrow$ | H_2 | | |

Outcomes : P8, P10

12. Which of the following diagrams of crystal forms represents the structure of solid carbon dioxide?



Outcomes : P6

13. Which of the following best explains the trend in atomic radius as you move from left to right across the periodic table?

- (A) Atomic radius increases as electrons are added.
- (B) Atomic radius increases as electron number decreases.
- (C) **Atomic radius decreases as electrons are added.**
- (D) Atomic radius decreases as electron number decreases.

Outcomes : P6

Part B

Question 14 (7 marks)

The composition of a mixture consisting of salt, sand and water was quantitatively analysed.

- (i). The mixture consisting only of salt, sand and water weighed 65.8g. The dry, empty sample tube weighed 15.3 g.
- (ii). The mixture was filtered through a weighed filter paper (0.52 g) into an evaporating basin weighing 23.0g.
- (iii). The filtrate was evaporated and dried. The residue and the basin weighed 28.0g.
- (iv). The filter paper containing the sand was dried. The combined weight of the filter paper and sand was 26.1 g.
- (a) Construct a table of result for this determination. (2 marks)

<i>Item</i>	<i>mass (g)</i>
<i>mixture + sample tube</i>	65.8
<i>empty sample tube</i>	15.3
<i>mixture only</i>	50.5
<i>sand + filter paper</i>	26.1
<i>filter paper</i>	0.52
<i>sand only</i>	25.6
<i>residue + evaporating basin</i>	28.0 g
<i>evaporating basin only</i>	23.0
<i>residue only</i>	5.0
<i>water</i>	19.9

<i>Criterion</i>	<i>Mark</i>
<i>a table with columns and rows</i>	<i>1</i>
<i>correct entry and calculation of masses</i>	<i>1</i>

- (b) Calculate the percentage composition of the mixture: (3 marks)

ANS:

$$\% \text{ sand} = \frac{\text{mass of sand}}{\text{mass of sample}} \times 100 = \frac{25.6}{50.5} \times 100 = 50.7\%$$

$$\% \text{ salt} = \frac{\text{mass of salt}}{\text{mass of sample}} \times 100 = \frac{5.0}{50.5} \times 100 = 9.9\%$$

$$\% \text{ water} = 100\% - (\% \text{ salt} + \% \text{ sand}) = 39.4\%$$

<i>Criterion</i>	<i>Mark</i>
<i>each correct percentage or calculation of percentage</i>	<i>1</i>

- (c) On comparison with the *true* value it was found that the % salt was lower than the *true* value and the % sand were higher than the true value. Explain the possible sources of these errors. (1 mark)

The lower value for salt could be due to incomplete separation of the salt from the mixture due to incomplete rinsing of the sand with water to remove excess salt. This is confirmed by the higher than the true value result for sand. Some of the salt in solution was adsorbed on the surface of the sand.

- (d) How can the reliability of the results be increased? (1 mark)

The reliability of the result can be increased by repeating the experiment several times and reporting the average value rather than any of the individual results.

Outcome(s): P10, P11, P12, P13, P14

Question 15 (2 marks)

Write Lewis structures for the reactants and products of the reaction of solid sodium metal with chlorine gas

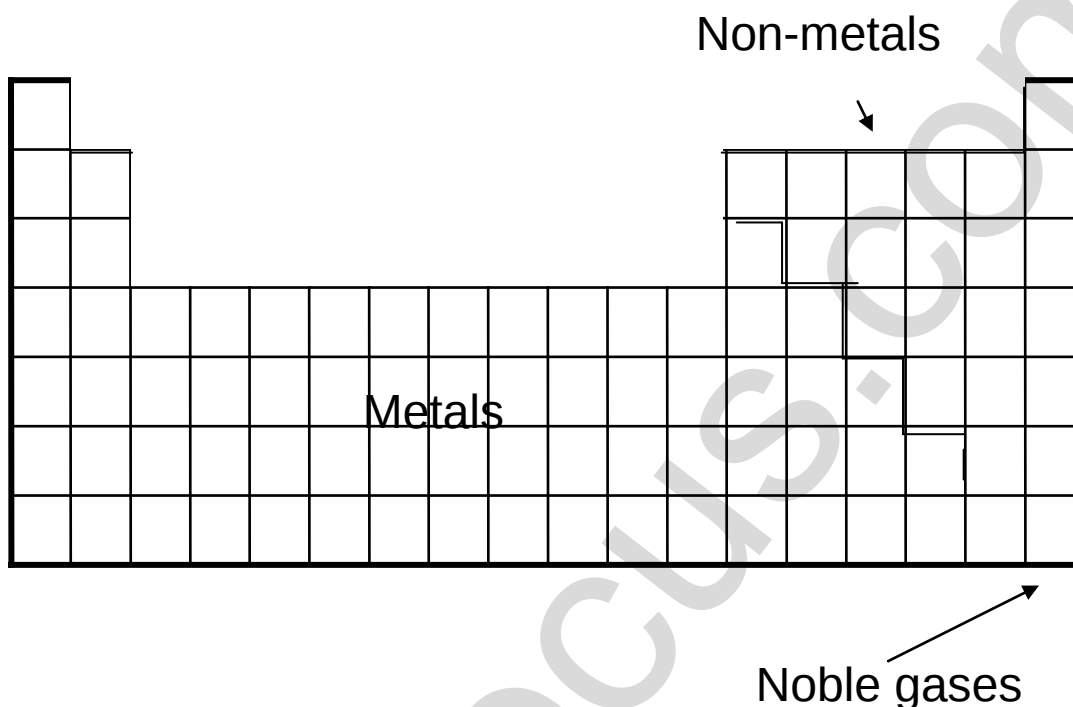


Outcome(s): P13, P6

Criteria	Marks
correct Lewis structure for the reactants (1) and products(1)	2
correct Lewis structure for the reactants (1) and products(1)	2

**Question 16** (5 marks)

Given the following outline of a periodic table, label the areas in the table where metals, non-metals and noble gases can be found. Justify one physical property of a named metal and one named non-metal based on their structure(s) and the chemical property of one named metal and one named non-metal based on their electronic configuration.

**ANS**

Helium has a lower boiling point compared with magnesium because of the very weak intermolecular forces between molecules of helium compared with the stronger metallic bonds between magnesium atoms. It requires very much less energy to overcome the forces of attraction between helium molecules than it is to overcome the metallic bond in the magnesium lattice.

The difference in reactivity of chlorine and magnesium can be attributed to the difference in their electronic configuration. Magnesium has 2 electrons in its outermost shell. These electrons are easily lost as magnesium reacts to form magnesium ions and hence assume a configuration similar to the noble gas, argon. Chlorine has 7 electrons in its outermost shell so its tendency is to gain an electron to have an electronic configuration similar to argon.

Criteria	Marks
<i>Difference in structure used to explain difference in a particular physical property</i>	2
<i>Difference in electronic configuration used to explain difference in a particular chemical property</i>	2

Outcomes:P6, P7

Question 17 (2 marks)

Lattice energy is the energy released when gaseous ions bind together into a solid ionic compound. The value of the lattice energy is therefore, equal to the energy required to break the bonds between ions in a crystal.

The table shows the lattice energy and the melting point of several Group I chlorides:

<i>Ionic Substance</i>	<i>Lattice Energy (kJ/mol)</i>	<i>Melting point (°C)</i>
NaCl	780	801
KCl	710	770
RbCl	686	715
CsCl	651	645

Between which elements is the ionic bond the strongest? Justify the values of the melting point on the basis of the lattice energy.

Outcome(s):P6, P7

ANS

The strongest ionic bond is between sodium ion and chloride ion in sodium chloride.

Sodium chloride has the highest lattice energy and the highest melting point.

This relationship is shown by the parallel trend between lattice energy and melting point by the other metal chlorides. The lattice energy is directly related to the energy required to break the ionic bonds. As the energy required to break the bond increases, the melting point, the energy required to separate the ions from each other to melt the crystal also increases.

<i>Criteria</i>	<i>Marks</i>
<i>Correct interpretation of the data in the table that show the direct relationship between lattice energy and melting point</i>	2

Question 18 (4 marks)

During your practical work you performed a first-hand investigation to determine the relative activity of a number of metals.

Outline the procedure you used and describe the results obtained.

Sample Answer

Three different metals, Mg, Fe and Cu were tested for their reactions with hot water (in test tubes), burning in oxygen (in the Bunsen flame) and hydrochloric acid (in test tubes). From the observed results an activity series was determined.

	<i>Hot water</i>	<i>Oxygen</i>	<i>Acid</i>
<i>Mg</i>	<i>Bubbles formed</i>	<i>Bright white light and white powder formed</i>	<i>Bubbles formed</i>
<i>Fe</i>	<i>NR</i>	<i>Glowed red,</i>	<i>Bubbles formed</i>
<i>Cu</i>	<i>NR</i>	<i>NR</i>	<i>NR</i>

NR = no reaction

Mg is more reactive than Fe, which is more reactive than Cu.

Marking Criteria	Marks
• Outlines a valid procedure and describes results obtained	3/4
• Outlines a valid procedure or • Describes results obtained	2
• Identifies a procedure or • Lists an activity series of at least 3 metals or • Describes the results of one procedure	1

Outcomes : P11, P12, P13

Question 19 (3 marks)

Complete the table by giving the names or formulae of the following substances.

<i>Name</i>	<i>Formula</i>
Sulfur hexafluoride	SF_6
Copper(II) sulfate	$CuSO_4$
Barium hydroxide	$Ba(OH)_2$
Ammonium carbonate	$(NH_4)_2CO_3$
Sodium sulfide	Na_2S
Dinitrogen tetroxide	N_2O_4

Outcomes : P6,P8

Question 20(3 marks)

Consider the modified periodic table below.

I	II		III	IV	V	VI	VII	Noble Gases
				P		W	U	
	Q		R	Z	S	T		
							V	
								X
Y								

Use the symbols on the table to write the formulae of the following: *Sample answers*

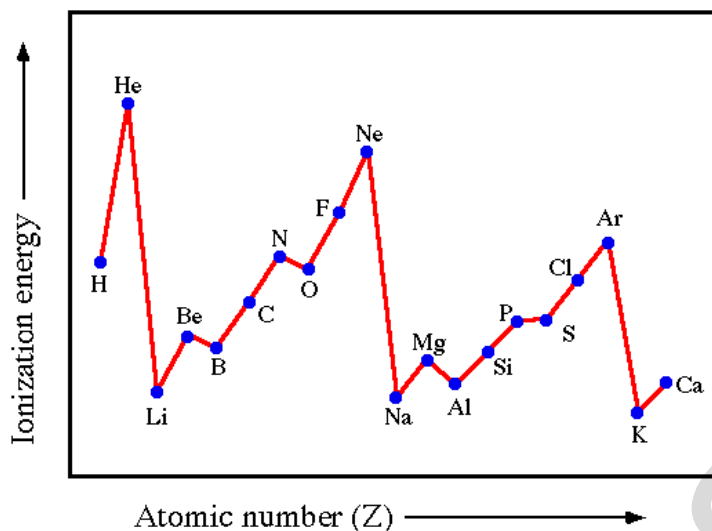
- (a) An ionic compound QW
 (b) A diatomic gas U_2
 (c) A liquid non-metal V
 (d) A molecular covalent compound TU_2
 (e) The metal with the lowest ionization energy Y
 (f) A covalent network compound ZW

Outcomes : P6

<i>Marking Criteria</i>	<i>Marks</i>
• 6 correct answers	3
• 4 or 5 correct answers or • 6 correct answers using periodic table symbols eg Br	2
• 2 or 3 correct answers	1

Question 20 (5 marks)

Consider the graph of first ionization energies for the first 20 elements.



- (a) Write an equation for the first ionization energy of an atom of lithium.



- (b) Explain the relationship between the position of elements on the periodic table and the trends in first ionization energy.

Sample Answer

There is a general increase in ionization energy from left to right across the periodic table within a period. This occurs because as electrons are added to the same outer shell the added protons in the nucleus exert a greater attractive force on the valence electrons and more energy is required to remove one from the atom.

With each new period, (Li, Na, K) the outer electron is in a new shell of its own, a long way from the nucleus. Therefore it doesn't require much energy to remove it so the ionization energy is lowest for that period.

<i>Marking Criteria</i>	<i>Marks</i>
• Identifies and explains two trends	4
• Explains one trend and identifies another	3
• Explains one trend or • Identifies two trends	2
• Identifies one trend	1

Outcomes : P6, P14

Question 21 (4 marks)

Sand and salt are two substances common in the lithosphere and hydrosphere. The main chemical substance present in each of these is given below.

Salt - sodium chloride (NaCl)

Sand - silicon dioxide (SiO₂)

Explain, in terms of the structure of these substances, why

- (a) a solution of salt water will conduct electricity (2 marks)

Sample answer

When dissolved, the sodium and chloride ions are released from the rigid crystal lattice and are mobile and therefore able to transfer charge.

Marking Criteria	Marks
Explains conductivity in terms of structure	2
- Explains conductivity or - Explains conductivity in terms of structure but mentions electrons or - Identifies ions in solution	1

- (b) sand is hard (2 mark)

Sample answer

Silicon dioxide is a network covalent substance. The bonding electrons are locked into directional covalent bonds that occur throughout the crystal lattice

Marking Criteria	Marks
Explains hardness in terms of structure	2
- Explains hardness or - Identifies covalent network structure	1

End of Test