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CfE Higher Chemistry
Unit One - Chemical Changes & Structure
Homework Booklet

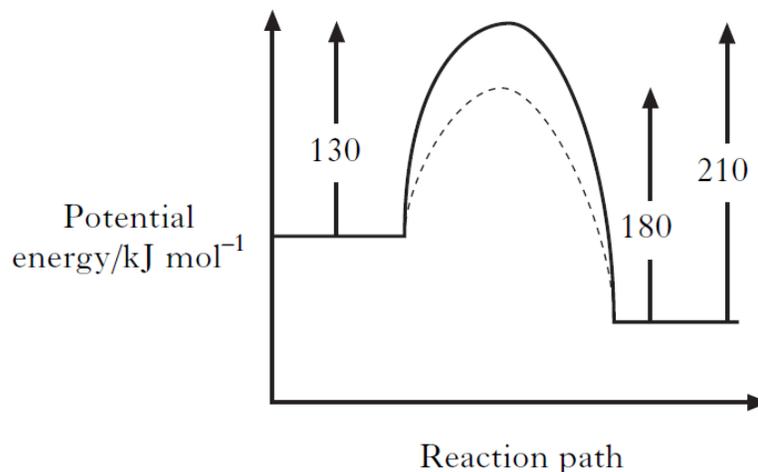
Topic	Mark	Page
1) Controlling The Rate Teacher Comments:	/19	2
2) Periodicity Teacher Comments:	/13	9
3) Structure & Bonding Teacher Comments:	/23	12

For multiple choice questions circle your answer.

Reference may be made to the Chemistry Higher and Advanced Higher Data Booklet.

1) Controlling the Rate

1. The following potential diagram is for a reaction carried out with and without a catalyst.

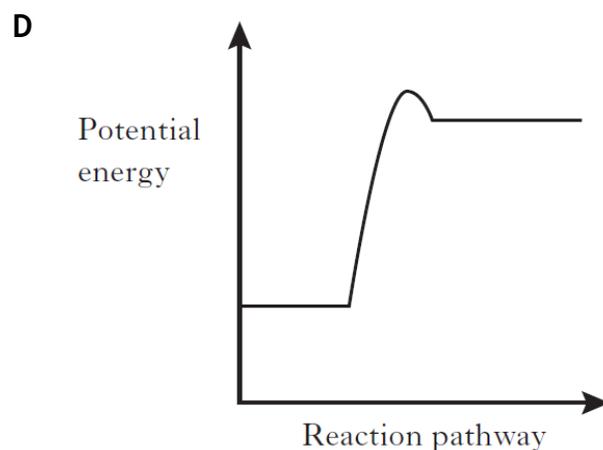
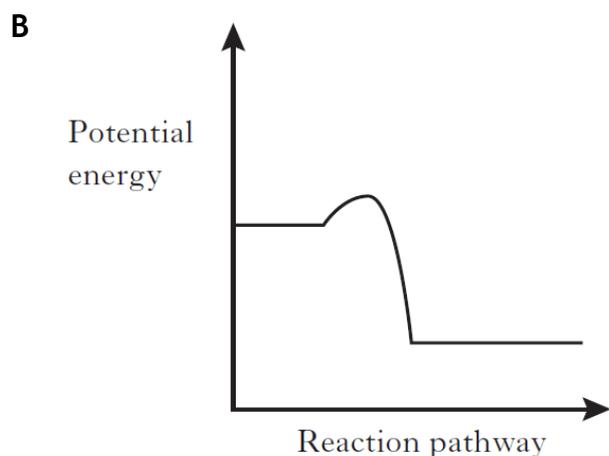
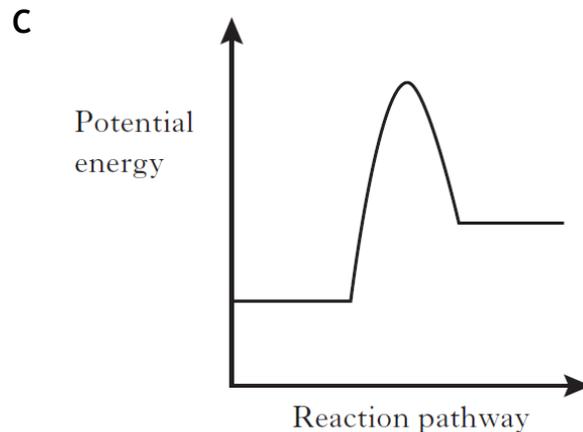
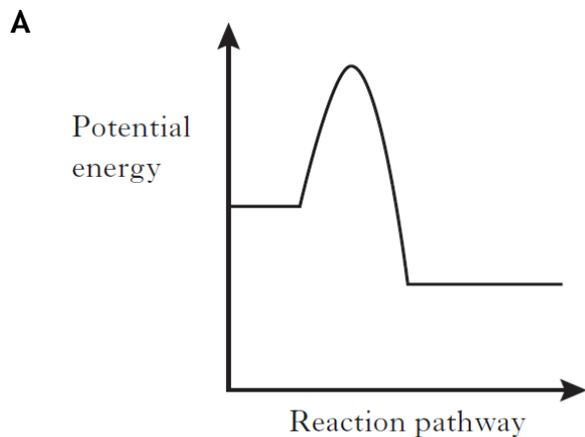


The activation energy for the catalysed reaction is

- A 30 kJ mol^{-1}
B 80 kJ mol^{-1}
C 100 kJ mol^{-1}
D 130 kJ mol^{-1} .
- [Q9. 2011]
2. In a reaction involving gases, an increase in temperature results in
- A an increase in activation energy
B an increase in the enthalpy change
C a decrease in the activation energy
D more molecules per second forming an activated complex.
- [Q26. R2012]
3. In which of the following will both changes result in an increase in the rate of a chemical reaction?
- A A decrease in activation energy and an increase in the frequency of collisions.
B An increase in activation energy and a decrease in particle size.
C An increase in temperature and an increase in the particle size.
D An increase in concentration and a decrease in the surface area of the reactant particles.

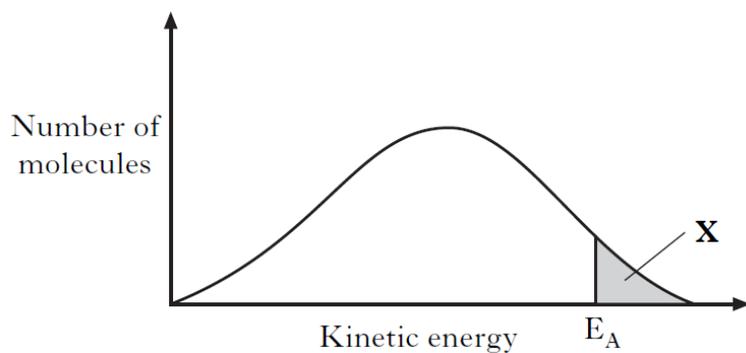
[Q25. R2013]

4. Which of the following diagrams represents an exothermic reaction which is most likely to take place at room temperature?



[Q26. R2013]

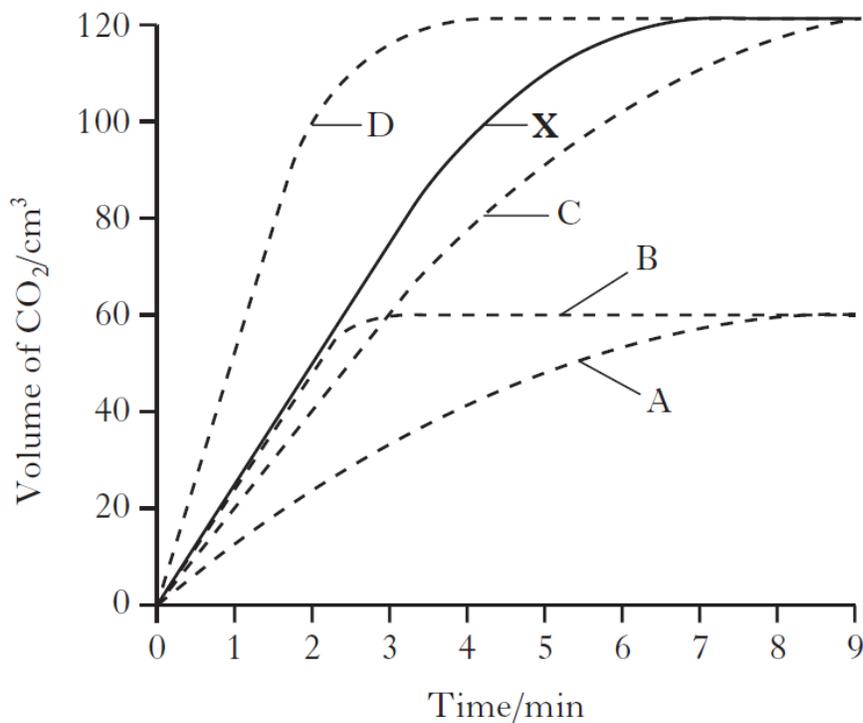
5.



In area X

- A molecules always form an activated complex
- B no molecules have the energy to form an activated complex
- C collisions between molecules are always successful in forming products
- D all molecules have the energy to form an activated complex. [Q7. 2008]

6. Graph X was obtained when 1 g of calcium carbonate powder reacted with excess dilute hydrochloric acid at 20 °C.



Which curve would best represent the reaction of 0.5 g lump calcium carbonate with excess of the same dilute hydrochloric acid?

[Q22.R2014]

7. Which of the following is **not** a correct statement about the effect of a catalyst?
The catalyst

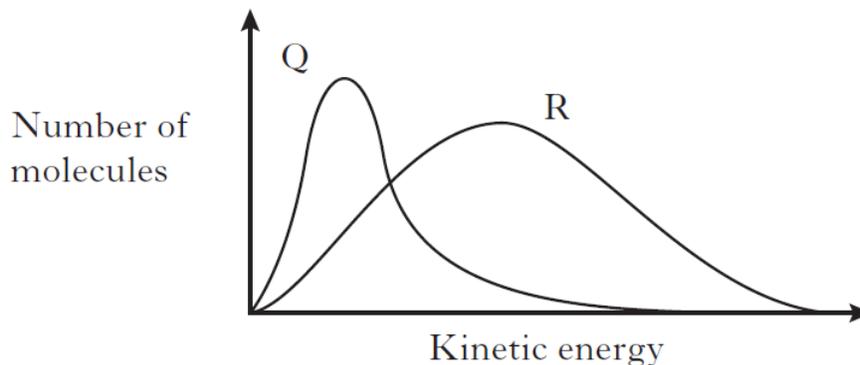
- A provides energy so that more molecules have successful collisions
- B lowers the energy which molecules need for successful collisions
- C provides an alternative route to the products
- D forms bonds with reacting molecules.

[Q26.RSQP]

8. For any chemical, its temperature is a measure of
- A the average kinetic energy of the particles that react
 - B the average kinetic energy of all the particles
 - C the activation energy
 - D the minimum kinetic energy required before reaction occurs.

[Q4.2010]

9.

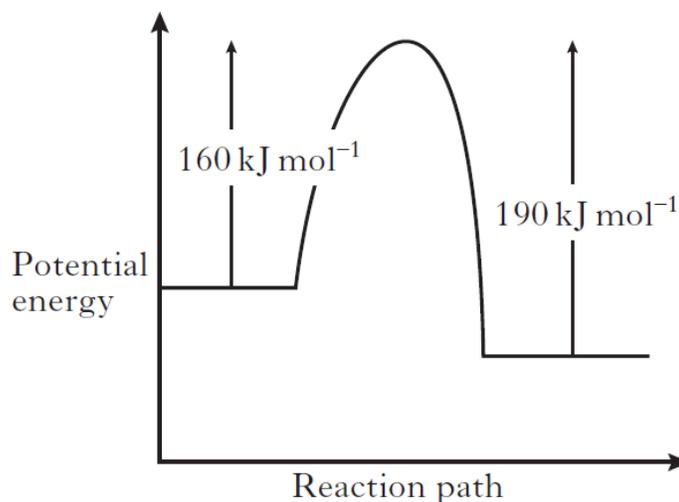


Which line in the table is correct for curves Q and R in the above graph?

	Curve Q	Curve R
A	1 mol of O ₂ at 50 °C	2 mol of O ₂ at 100 °C
B	1 mol of O ₂ at 100 °C	2 mol of O ₂ at 100 °C
C	2 mol of O ₂ at 50 °C	1 mol of O ₂ at 100 °C
D	2 mol of O ₂ at 100 °C	1 mol of O ₂ at 100 °C

[Q23.R2014]

10.

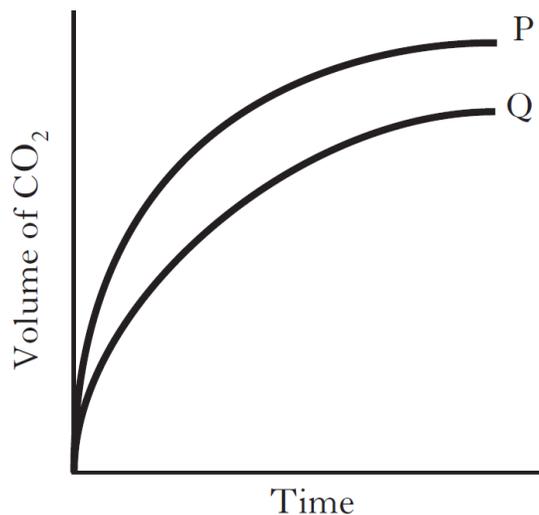


When a catalyst is used, the activation energy of the forward reaction is reduced to 35 kJ mol⁻¹. What is the activation energy of the catalysed reverse reaction?

- A 30 kJ mol⁻¹
- B 35 kJ mol⁻¹
- C 65 kJ mol⁻¹
- D 190 kJ mol⁻¹

[Q24.R2014]

11.



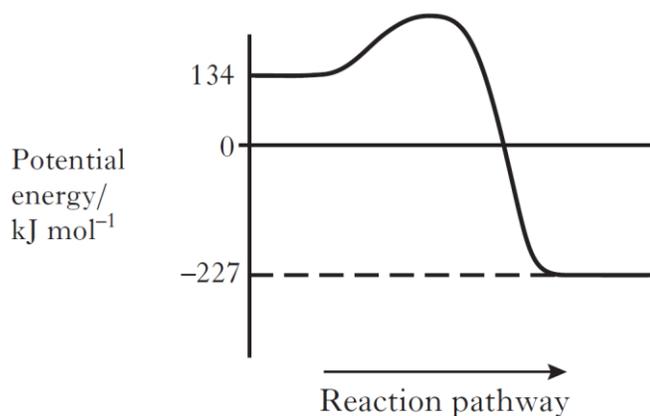
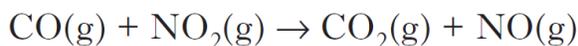
When copper carbonate is reacted with excess acid, carbon dioxide is produced. The curves shown above were obtained under different conditions.

The change from P to Q could be brought about by

- A increasing the concentration of the acid
- B decreasing the mass of copper carbonate
- C decreasing the particle size of the copper carbonate
- D adding a catalyst

[Q24.RSQP]

12. The potential energy diagram for the reaction below is shown.

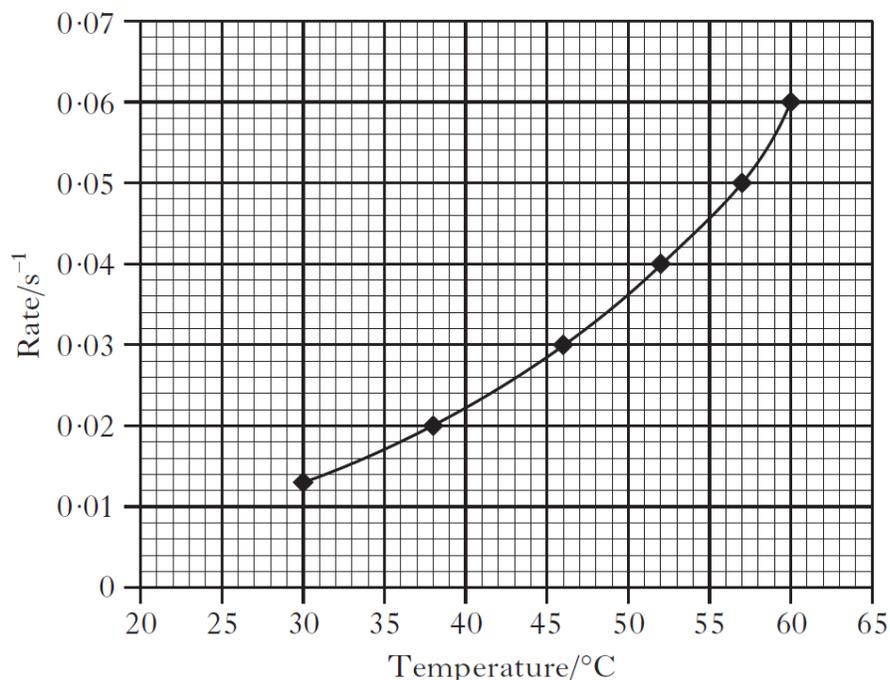


ΔH , in kJ mol^{-1} , for the forward reaction is

- A +361
- B -93
- C -227
- D -361.

[Q25.RSQP]

13. A student investigated the effect of changing temperature on the rate of chemical reaction. The results from the investigation are shown in the graph below.



- (a) (i) Use the graph to determine the temperature rise required to double the rate of reaction.

1

- (ii) The reaction time recorded in one experiment was 25 s. Use the graph to determine the temperature, in °C, of this reaction.

1

- (iii) The answer below was taken from a student's examination paper. The answer is incorrect. Give the correct explanation.

Question Why does a small increase in temperature produce a large increase in reaction rate?

Student Answer *Because rising temperature increases the activation energy which increases the number of collisions which speeds up the reaction greatly.*

Correct Explanation

1

(b) Collision theory can be used to explain reaction rates.

Collision theory states that for two molecules to react, they must first collide with one another.

State **two** conditions necessary for the collisions to result in the formation of products.

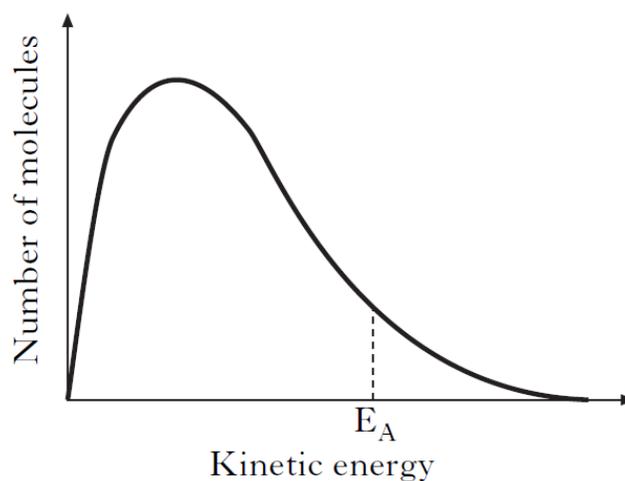
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(5)

[Q11a. 2009]

[Q9.R2014]

14. The graph shows the distribution of kinetic energy for molecules in a reaction mixture without a catalyst.



(a) On the diagram, label the activation energy (E_A) for the catalysed reaction.

1

(b) Explain why using a catalyst allows industrial processes to be carried out at lower temperatures.

1

[New]

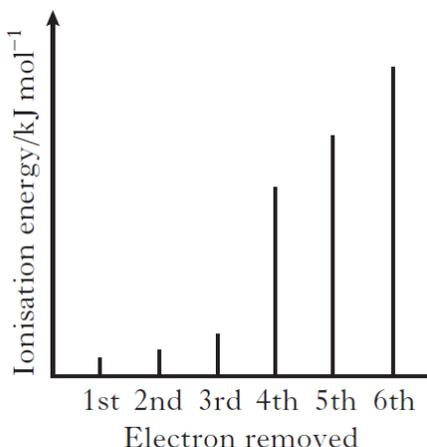
2) Periodicity

1. Which of the following elements has the greatest attraction for bonding electrons?

- A Lithium
- B Chlorine
- C Sodium
- D Bromine

[Q1. R2013]

2. The spike graph shows the variation in successive ionisation energies of an element, Z.



In which group of the Periodic Table is element Z?

- A 1
- B 3
- C 4
- D 6

[Q1.R2014]

3. Atoms of nitrogen and element X form a bond in which the electrons are shared equally.

Element X could be

- A carbon
- B oxygen
- C chlorine
- D phosphorus.

[Q4. RSQP]

4. Which of the following elements would require the most energy to convert one mole of gaseous atoms into gaseous ions each carrying two positive charges?
(You may wish to use the data booklet.)

- A Scandium
- B Titanium
- C Vanadium
- D Chromium

[Q2.RSQP]

5. The Periodic Table allows chemists to make predictions about the properties of elements.

(a) The elements lithium to neon make up the second period of the Periodic Table.

Li	Be	B	C	N	O	F	Ne
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Explain why the atoms decrease in size from lithium to neon?

1

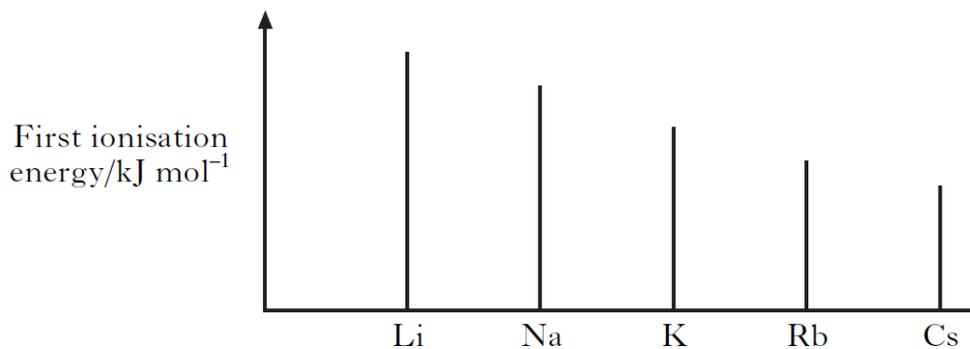
(b) On descending Group 1 from lithium to caesium, the electronegativity of the elements decreases.

Explain clearly why the electronegativity of elements decreases as you go down the group.

2

[Q1.R2012]

6. The first ionisation energy of an element is defined as the energy required to remove one mole of electrons from one mole of atoms in the gaseous state. The graph shows the first ionisation energies of the Group 1 elements.



Clearly explain why the first ionisation energy decreases down this group.

2

[Q11ai.2010]

7. The answer below was taken from a student's examination paper.

The answer is incorrect. Give the correct explanation.

Question Explain the difference in atomic size between potassium and chlorine atoms.

Student Answer *A potassium nucleus has 19 protons but a chlorine nucleus has only 17 protons. The greater pull on the outer electron in the potassium atom means the atomic size of potassium is less than that of chlorine.*

Correct Explanation

1

[Q11b. 2009]

8. The elements from sodium to argon make up the third period of the Periodic Table.

(a) On crossing the third period from left to right there is a general increase in the first ionisation energy of the elements.

(i) Why does the first ionisation energy increase across the period?

1

(ii) Write an equation corresponding to the first ionisation energy of chlorine.

1

(b) The electronegativities of elements in the third period are listed on page 10 of the data book.

Why is no value provided for the noble gas, argon?

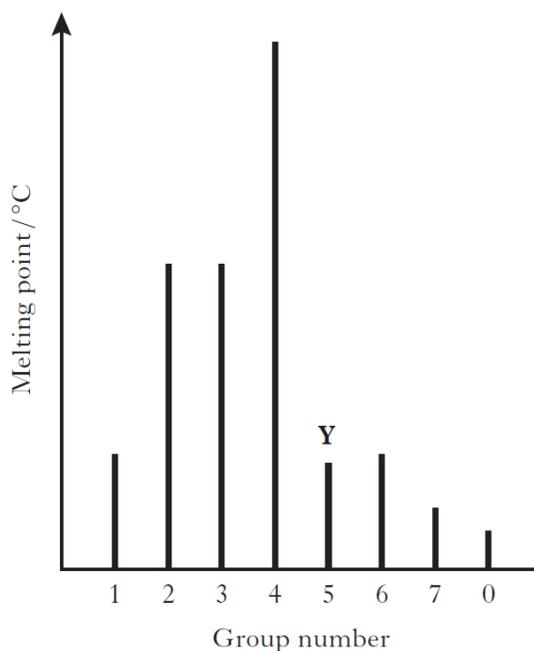
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(3)

[Q2.2011]

3) Structure & Bonding

1. The diagram shows the melting points of successive elements across a period in the Periodic Table.



Which of the following is a correct reason for the low melting point of element Y?

- A It has weak ionic bonds.
- B It has weak covalent bonds.
- C It has weakly-held outer electrons.
- D It has weak forces between molecules.

[Q5. R2013]

2. Which of the following does not contain covalent bonds?

- A Hydrogen gas
- B Helium gas
- C Nitrogen gas
- D Solid sulphur

[Q2. R2012]

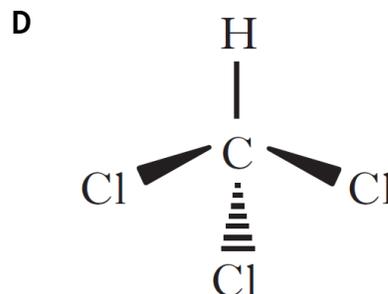
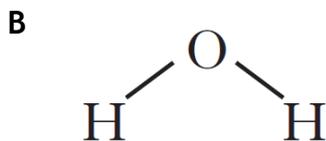
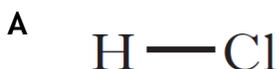
3. Diamond has

- A an ionic lattice structure
- B a covalent network structure
- C covalent molecules linked by London dispersion forces
- D covalent sheets with only London dispersion forces acting between sheets.

[Q1. RSQP]

8. The shapes of some common molecules are shown below and each contains at least one polar bond.

Which molecule is non-polar?



[Q5. R2014]

9. Which of the following chlorides is likely to have the most ionic character?

- A LiCl
- B CsCl
- C BeCl_2
- D CaCl_2

[Q4. RSQP]

10. Which line in the table represents the solid in which only London dispersion forces are overcome when the substance melts?

	Melting point/ $^{\circ}\text{C}$	Electrical conduction of solid
A	714	non-conductor
B	98	conductor
C	660	conductor
D	44	non-conductor

[Q6. R2012]

11. Which of the following chlorides is likely to have the most ionic character?

- A LiCl
- B CsCl
- C BeCl_2
- D CaCl_2

[Q4. RSQP]

12. Information about four elements from the third period of the Periodic Table is shown in the table.

Element	aluminium	silicon	phosphorus	sulfur
Bonding		covalent		covalent
Structure	lattice		molecular	

- (a) Complete the table to show the bonding and structure for each element.

2

- (b) Why is there a decrease in the size of atoms across the period from aluminium to sulfur?

1

[Q1a,b.R2014]

13. Hydrogen gas has a boiling point of $-253\text{ }^{\circ}\text{C}$.

Explain clearly why hydrogen is a gas at room temperature.

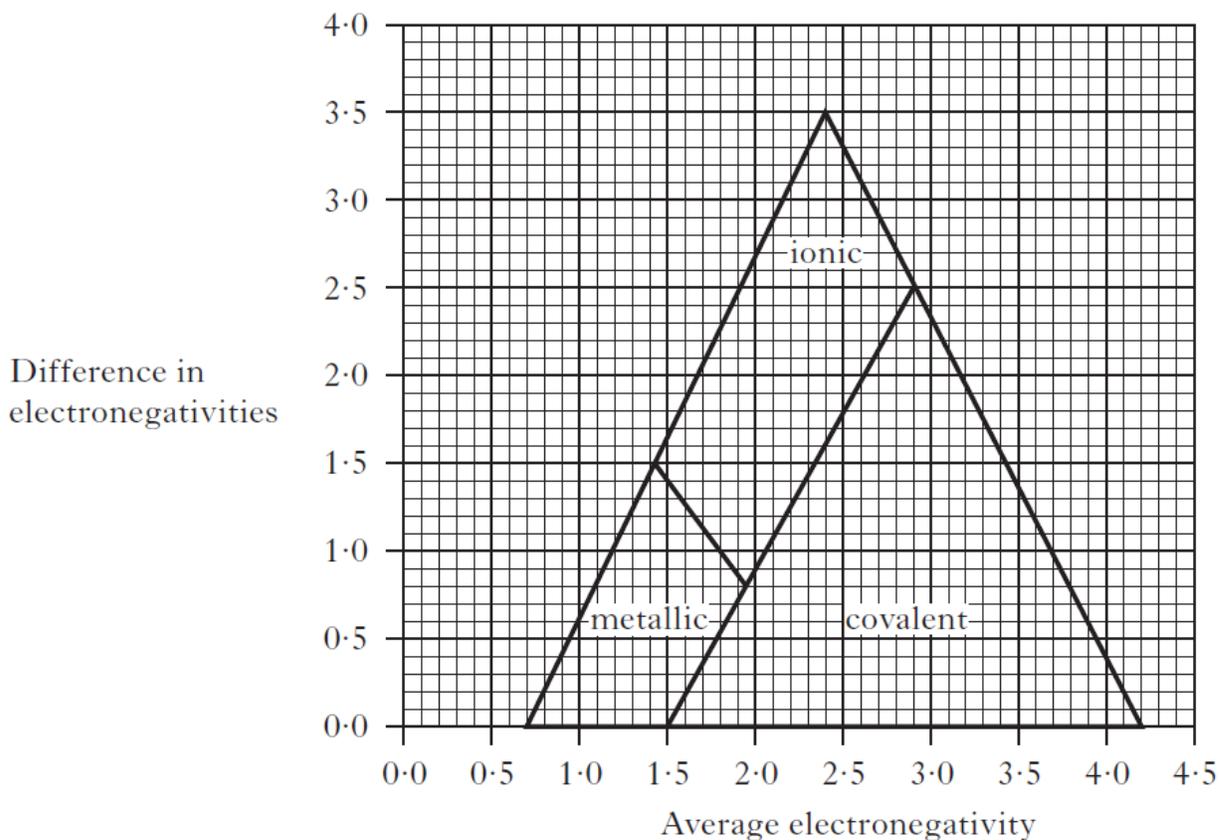
In your answer you should name the intermolecular forces involved and indicate how they arise.

2

[9a.2008]

14. Electronegativity values can be used to predict the type of bonding present in substances.

The type of bonding between two elements can be predicted using the diagram below.



- (a) Using the information in the diagram, state the highest average electronegativity found in ionic compounds.

1

- (b) The diagram can be used to predict the bonding in tin iodide.

Electronegativity of tin = 1.8

Electronegativity of iodine = 2.6

Average electronegativity = 2.2

Difference in electronegativity = 0.8

Predict the type of bonding in tin iodide.

1

(c) The electronegativities of arsenic and chlorine are shown below.

Electronegativity of arsenic = 2.2

Electronegativity of chlorine = 3.0

Place a small cross on the diagram to show the position of arsenic chloride.

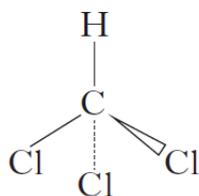
Show calculations clearly.

2

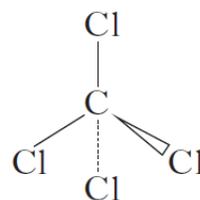
(4)

[Q7,R2012]

15. The structures below show molecules that contain chlorine atoms.



trichloromethane



tetrachloromethane

The compounds shown above are not very soluble in water.

Trichloromethane is around ten times more soluble in water than tetrachloromethane.

Explain clearly why trichloromethane is more soluble in water than tetrachloromethane.

Your answer should include the names of the intermolecular forces involved.

3

[Q3a,R2013]