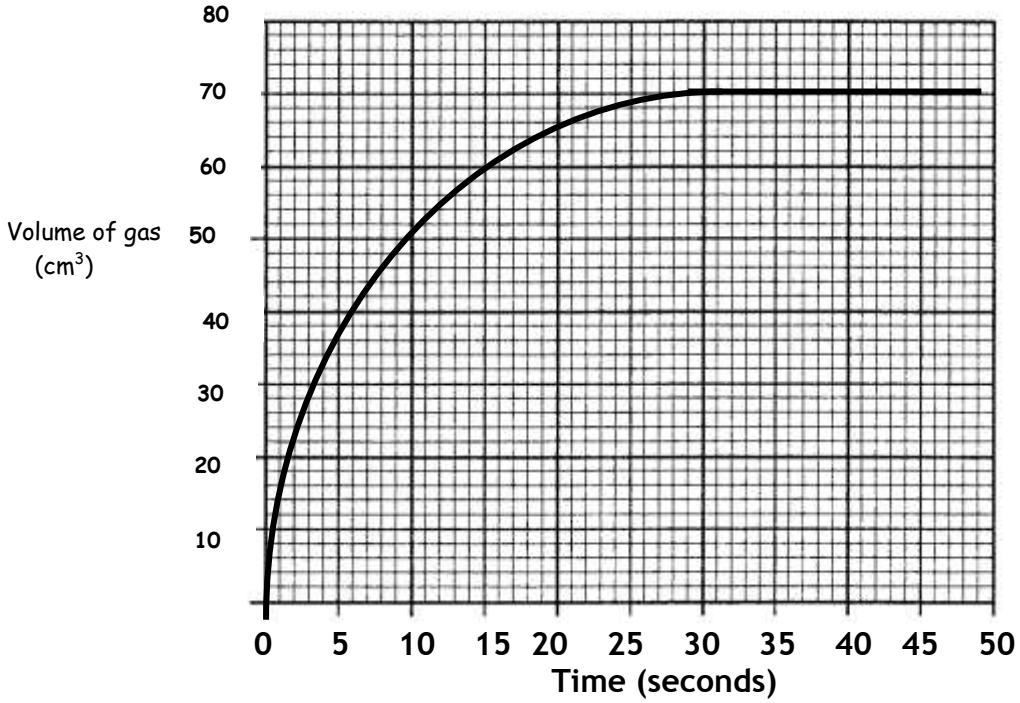
REACTION RATES HOMEWORK

1. The graph below shows the volume of hydrogen given off when a 2 cm long strip of magnesium ribbon (mass 0.1 g) was added to an excess of 1 mol l^{-1} hydrochloric acid solution.



a) Calculate the average rate of reaction (Show your working)
i) over the first 10 seconds. (1)
ii) between 10 seconds and 20 seconds. (1)

b) i) How does the rate change as the reaction proceeds. (1)
ii) Explain this change in rate. (1)

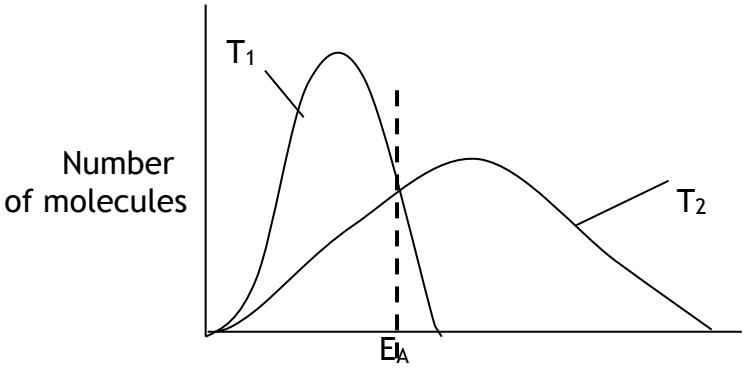
c) After what time does the reaction stop? (1)

d) Draw a labelled diagram of the apparatus that could be used in this experiment. (2)

e) Sketch the graph shown
i) add the curve you would expect to get when 0.1 g of magnesium powder had been used instead of 0.1 g of magnesium ribbon. (1)

ii) add the curve you would expect to get if 0.05 g of magnesium ribbon had been added to an excess of 2 mol l^{-1} hydrochloric acid solution. (1)

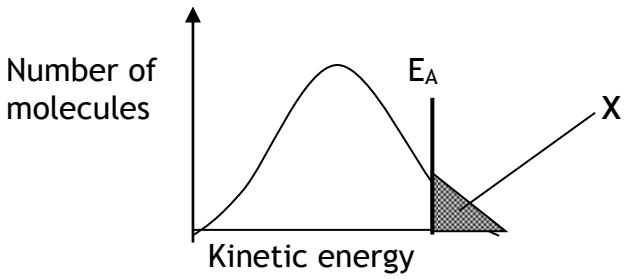
2.



Which of the following is the correct interpretation of the above energy distribution diagram for a reaction as the temperature <u>decreases</u> from T_2 to T_1? (1)

	Activation energy (E_A)	Number of successful collisions
A	**remains the same**	**increases**
B	**decreases**	**decreases**
C	**decreases**	**increases**
D	**remains the same**	**decreases**

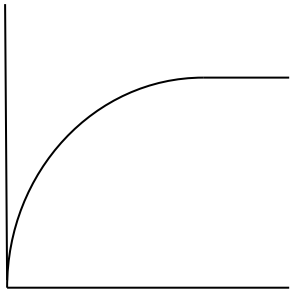
3.



In area **X** (1)

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

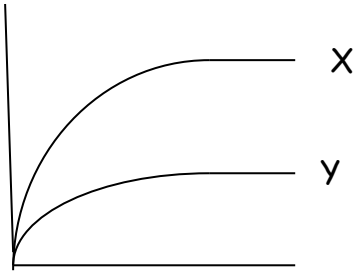
4. The following graph was obtained when 1g of calcium carbonate powder reacted with excess dilute hydrochloric acid at 20°C. Copy the graph:



a. Add a curve to represent the reaction of 0.5g of calcium carbonate with excess of the same dilute hydrochloric acid. (1)

b. Add a curve to represent the reaction of 1g of calcium carbonate powder with excess of the same dilute hydrochloric acid at 15°C. (1)

5. Consider the following graph:



The change from X to Y could be achieved by:

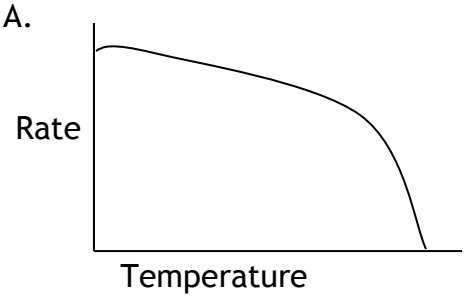
A increasing the concentration of the acid
B decreasing the mass of zinc
C decreasing the particle size of the zinc
D adding a catalyst (1)

6. Two identical samples of zinc were added to an excess of two solutions of sulphuric acid, concentrations 2mol l^{-1} and 1mol l^{-1} respectively. Which of the following would have been the same for the two samples?

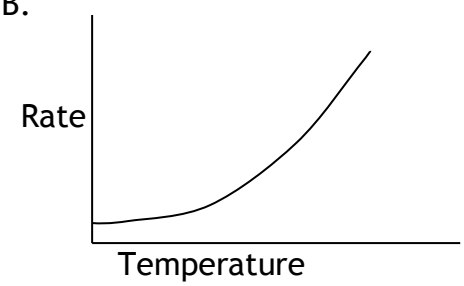
A the total mass lost
B the total time for the reaction
C the initial reaction rate
D the average rate of evolution of gas (1)

7. Which of the following graphs of rate of reaction against temperature would apply to the neutralisation of dilute hydrochloric acid with zinc? (1)

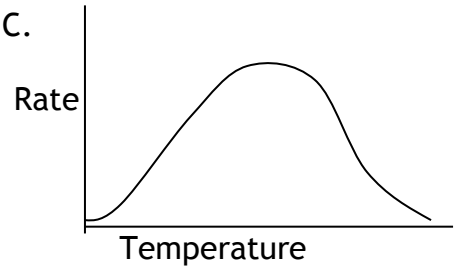
A.



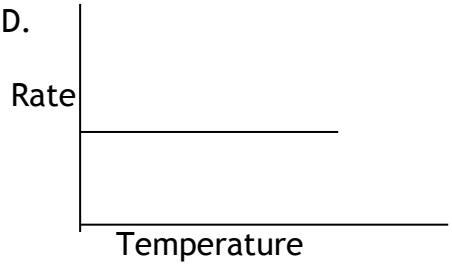
B.



C.



D.



8. A small increase in temperature results in a large increase in rate of reaction. The **main** reason for this is that (1)

A. more collisions are taking place
B. the enthalpy change is lowered
C. the activation energy is lowered
D. many more particles have energy greater than the activation energy

9. The following results were obtained in the reaction between marble chips and dilute hydrochloric acid.

time/minutes	0	2	4	6	8	10
Total volume of carbon dioxide production/cm^3	0	52	68	78	82	84

What is the average rate of production of carbon dioxide, in cm^3 min $^{-1}$, between 2 and 8 minutes?

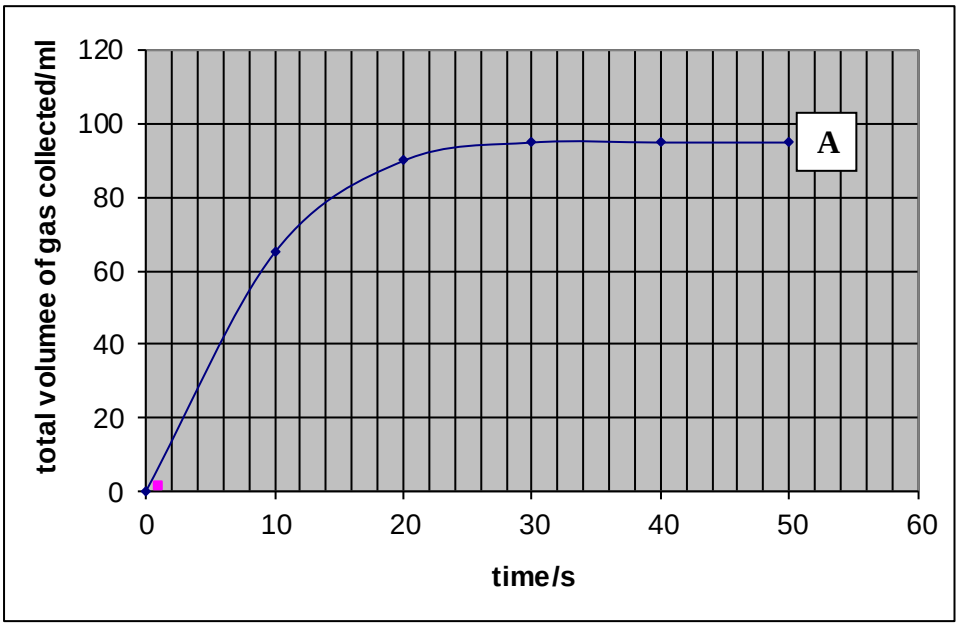
(1)

A. 5
B. 26
C. 30
D. 41

10. The rate of carbon dioxide production was measured in three laboratory experiments carried out at the same temperature and using excess calcium carbonate.

Experiment	*Acid*	*Calcium carbonate*
A	**40cm^3 of 0.10 mol l^{-1} sulphuric acid**	**1g lumps**
B	**40cm^3 of 0.10 mol l^{-1} sulphuric acid**	**1g powder**
C	**40cm^3 of 0.10 mol l^{-1} hydrochloric acid**	**1g lumps**

The curve obtained for Experiment **A** is shown.

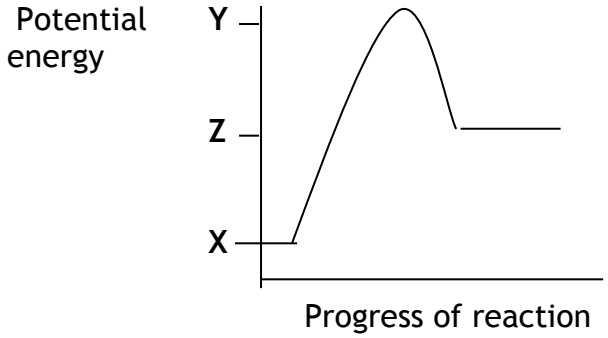


Make a rough copy of the graph
Draw curves on the graph to show the results that could be obtained for experiments **B** and **C**.
Label each curve clearly. (2)

TOTAL = 20

POTENTIAL ENERGY HOMEWORK

1. Refer to the energy diagram below.



What is the activation energy (E_A) for the forward reaction? (1)

A. Y
B. Z - X
C. Y - X
D. Y – Z

2. Which of the following describes the effect of a catalyst? (1)

	Activation energy	Enthalpy of reaction
A	decreased	decreased
B	decreased	no change
C	no change	decreased
D	decreased	increased

3.

Which set of data applies to the above reaction? (1)

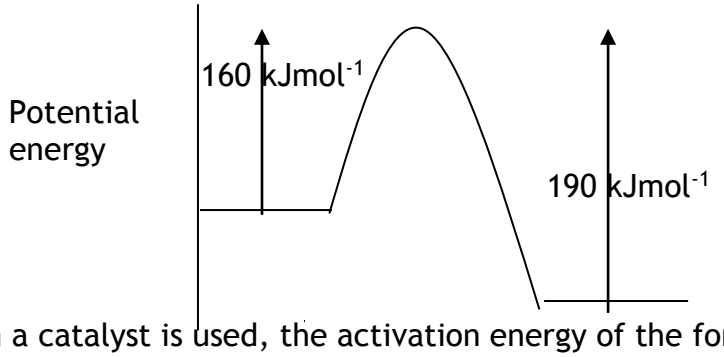
	Enthalpy change	Activation energy/ kJmol $^{-1}$
A	Exothermic	60
B	Exothermic	80
C	Endothermic	60
D	Endothermic	80

4. Which of the following is not a correct statement about the effect of a catalyst?

The catalyst

A. provides an alternative route to the products
B. lowers the energy which molecules need for successful collisions
C. provides energy so that more molecules have successful collisions
D. form bonds with reacting molecules (1)

5.



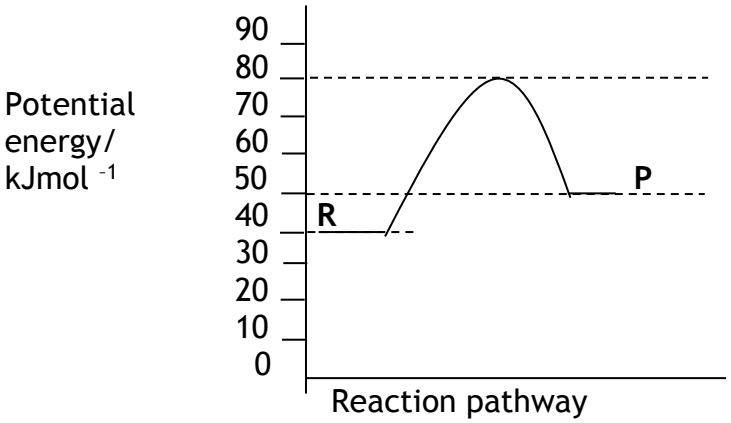
When a catalyst is used, the activation energy of the forward reaction is reduced to

35kJmol^{-1}.

What is the activation energy of the catalysed reverse reaction? (1)

A. 30kJmol^{-1}
B. 35kJmol^{-1}
C. 65kJmol^{-1}
D. 190 kJmol^{-1}

6. The potential energy diagram below refers to the reversible reaction involving reactants **R** to **P**.



What is the enthalpy change, in $kJmol^{-1}$, for the reverse reaction **P** ⟶ **R**? (1)

A. +30
B. +10
C. –10
D. –40

7. Nitrogen dioxide gas can be prepared in different ways.
It is manufactured industrially as part of the Ostwald process. In the first stage of the process, nitrogen monoxide is produced by passing ammonia and oxygen over a platinum catalyst.

$$NH_3(g) + O_2(g) \longrightarrow NO(g) + H_2O(g)$$

a) Balance the above equation. (1)

b) Platinum metal is a heterogeneous catalyst for this reaction.
What is meant by a **heterogeneous** catalyst? (1)

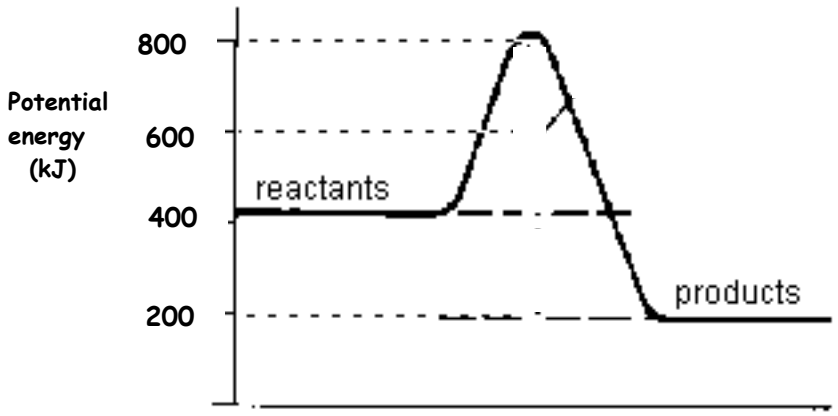
8. Catalytic converters in car exhaust systems convert poisonous gases into less harmful gases.

a) Two less harmful gases are formed when nitrogen monoxide reacts with carbon monoxide. Name the **two** gases produced. (1)

b) The catalyst is made up of the metals platinum, palladium and rhodium. Explain what happens to molecules in the exhaust gas during their conversion to less harmful gases.
You may wish to draw a labelled diagram. (2)

9. Sketch a potential energy diagram for a chemical reaction where the activation energy for the reaction is $60kJmol^{-1}$ and the enthalpy change is $+20kJmol^{-1}$. (2)

10.



a) What is the activation energy for
   i) the forward reaction
   ii) the back reaction? (2)

b) What is the enthalpy change for the formation of products? (1)

c) Is this reaction endothermic or exothermic? Explain your answer. (1)

d) On the diagram and add a dotted line to show the effect of using a catalyst. (1)

e) What is meant by the term "Activated Complex"? (1)

f) Mark with an **X** the position where the activated complex would be formed. (1)

TOTAL = 20

TRENDS IN THE PERIODIC TABLE HOMEWORK

1. A positively charged particle with electronic configuration 2,8 could be
   A. a fluoride ion (1)
   B. a sodium atom
   C. an aluminium ion
   D. a neon atom

2. A metal (melting point 328°C, density 11.3 gcm^{-3}) was obtained by electrolysis of itS molten chloride melting point melting point 501°C, density 5.84 gcm^{-3}).
   During the electrolysis, how would the metal occur? (1)
   A. as a solid on the surface of the electrolyte
   B. as a liquid on the surface of the electrolyte
   C. a solid at the bottom of the electrolyte
   D. a liquid at the bottom of the electrolyte

3. Which equation represents the first ionisation energy of a diatomic element, X_2?
   A. $\frac{1}{2}X_2(s) \longrightarrow X^+(g)$ (1)
   B. $\frac{1}{2}X_2(g) \longrightarrow X^-(g)$
   C. $X(g) \longrightarrow X^+(g)$
   D. $X(s) \longrightarrow X^-(g)$

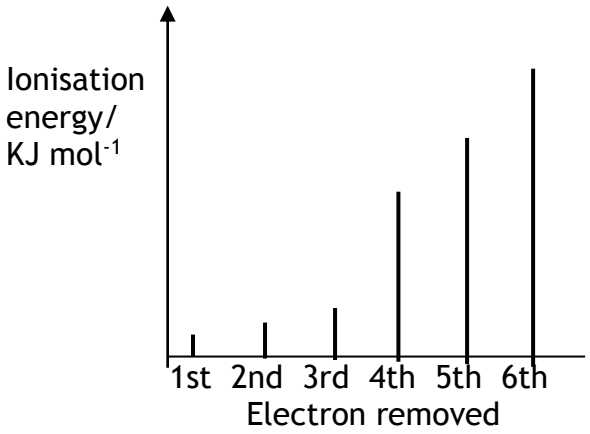
4. Which of the following chlorides is likely to have the **least** ionic character?
   A. $BeCl_2$ (1)
   B. $CaCl_2$
   C. LiCl
   D. CsCl

5. As the atomic number of the alkali metal increases (1)
   A. the first ionisation energy decreases
   B. the atomic size decreases
   C. the density decreases
   D. the melting point increases

6. Which chloride is most likely to be soluble in tetrachloromethane, CCl_4?
   A. barium chloride (1)
   B. caesium chloride
   C. calcium chloride
   D. phosphorus chloride

7. Which of the following has the least attraction for bonding electrons?
   A. Carbon (1)
   B. nitrogen
   C. phosphorus
   D. silicon

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



In which group of the Periodic Table is element **Z**? (1)
   A. 1
   B. 3
   C. 4
   D. 6

9. Explain the change in covalent radius of the elements:

a) across the Periodic table from lithium to fluorine. (1)

b) down group 1 from lithium to caesium. (1)

10. Explain why a Na^+ ion is larger than a Mg^{2+} ion. (1)

11. Explain a calcium, Ca^{2+} ion is larger than a Mg^{2+} ion. (1)

12. a) What is meant by the first ionisation energy of an element? (1)

b) Explain why the ionisation energy is an endothermic process. (1)

c) Write an equation corresponding to the first ionisation energy of Lithium. (1)

d) Explain why the first ionisation energy of fluorine is greater than the first ionisation energy of lithium. (1)

e) Explain why the first ionisation energy of sodium is less than the first ionisation energy of lithium. (1)

f) Explain why second ionisation energy of sodium is very much higher than the first ionisation energy of sodium. (1)

5. Using the ionisation energies in the data booklet calculate the energy required for

$Al(g) \longrightarrow Al^{3+}(g) + 3e^-$ (1)

6. Explain why a Si^{4+} ion is smaller than a P^{3-} ion. (1)

TOTAL = 20

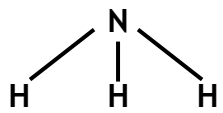
INTERMOLECULAR BONDING HOMEWORK

8. Which of the following occurs when crude oil is distilled? (1)
   A. covalent bonds break and form again
   B. London dispersion forces break and form again
   C. covalent bonds break and London dispersion forces form
   D. London dispersion forces break and covalent bonds form

2. In which of the substances, in the solid state, would London dispersion forces be a significant intermolecular force? (1)
   A. sodium chloride
   B. carbon dioxide
   C. magnesium
   D. ice

3. Hydrogen gas has a boiling point of –253°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)

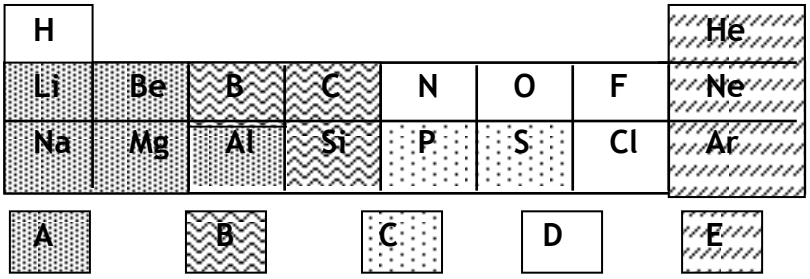
4. Compared to other gases made up of molecules of similar molecular masses,
   ammonia has a relatively high boiling point.



   In terms of the intermolecular bonding present, **explain clearly** why ammonia has a relatively high boiling point. 2)

5. Explain why the melting point increases from top to bottom when down group 7 of the Periodic Table. (1)

6. The table below shows the elements in the first three periods of the Periodic Table in four classes (A) to (D).



b) In which of the groups (A, B, C, D or E) are the following correct?

i) Mobile electrons allow the element to conduct when solid. (1)

ii) Both covalent bonds and London dispersion forces are present? (1)

iii) Only covalent bonds are present. (1)

iv) Only London dispersion forces are present. (1)

7.

A covalent bonding	**B** polar covalent bonding	**C** metallic bonding
D London Dispersion forces	**E** hydrogen bonding	**F** ionic bonding

Which box, or boxes, shows a type of bonding or force of attraction that:

a) Is responsible for the low melting point of noble gases? (1)

b) Exists between molecules? (1)

c) Could be considered an intermediate between ionic and covalent bonding? (1)

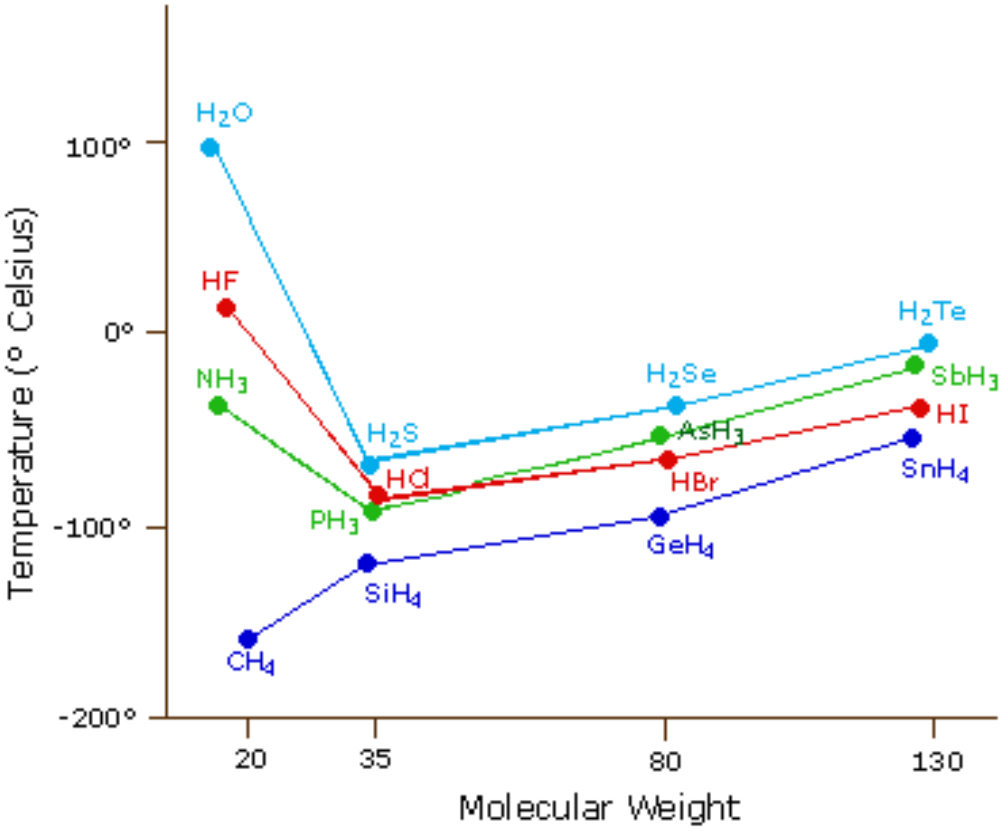
d) Allows electrons a lot of movement? (1)

e) Is important when none of the others are present? (1)

8. Carbon dioxide is a gas at room temperature while silicon dioxide is a solid because:
(1)

A. London dispersion forces are much weaker than covalent bonds
B. Carbon dioxide contains double covalent bonds while silicon Dioxide contains single covalent bonds
C. Carbon-oxygen bonds are less polar then silicon-oxygen bonds
D. The relative formula mass of carbon dioxide is less than that of Silicon dioxide.

9. The graph shows the boiling points of Group 4, 5, 6 and 7 hydrides:



a) Explain why the boiling points increase from H_2S to H_2Te. (1)

b) Why does H_2O have an unusually high boiling point compared to the other Group 6 hydrides? (2)

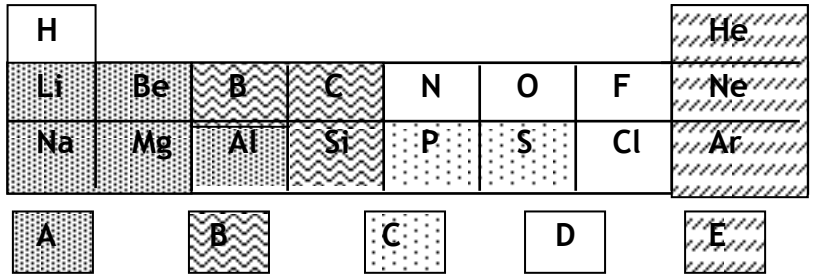
TOTAL = 20

STRUCTURE AND BONDING HOMEWORK

1. Which type of structure would you expect each of the substances A to D to have?
   A. A grey solid which conducts electricity and melts at 850°C. (1)
   B. A white solid which melts at 770°C and conducts electricity when molten but not in the solid state. (1)
   C. A grey solid which melts at 1410°C and which does not conduct electricity in either solid or molten state. (1)
   D. A white solid which melts at -190°C. (1)

2. Explain the following in terms of particles, structure and bonding.
   A. Ionic substances do not conduct electricity when they are solid but metallic structures do. (1)
   B. Substances with covalent network structures generally do not conduct electricity, except for graphite which is a good conductor. (1)

3. The table below shows the elements in the first three periods of the Periodic
   Table in four classes (A) to (D).



Use the key shown above to identify the groups of elements (A,B,C,D or E) which show the following bond types.

a) Monatomic gases. (2)

b) Covalent network solids

c) Covalent molecular gases.

d) Metallic lattice.

e) Covalent molecular solids.

4. Two types of carbon are diamond and fullerene.
How does the structure of fullerene differ from that of diamond? (1)

5. The formulae for three oxides of sodium, carbon and silicon are Na_2O, CO_2 and SiO_2.Copy and complete the table to show both the bonding and structure of the three oxides at room temperature.
(3)

Oxide	***Bonding and structure***
Na_2O	
CO_2	
SiO_2	

6. Calculate the differences in electronegativity for the elements in the following compounds and indicate which compound will be the most ionic and which will be the most covalent.
a. KBr b. NaI c. CsCl (3)

7. The American scientist Linus Pauling devised a scale to compare the attraction of atoms for bonding electrons. This scale is called the electronegativity scale. Some electronegativity values are shown in the Data Book.
a. Use the electronegativity values to explain why carbon disulphide contains pure covalent bonds. (1)
b. Explain **clearly** why trichloromethane ($CHCl_3$)is a polar molecule but tetrachloromethane (CCl_4) is non polar. (2)
c. Draw a labelled diagram of the assembled apparatus you would use test which of these liquids is which. (2)

TOTAL = 20