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# CHEMISTRY

## PHYSICAL CHEMISTRY

Level & Board	CIE (A-LEVEL)
TOPIC:	STATE OF MATTER
PAPER TYPE:	QUESTION PAPER - 1
TOTAL QUESTIONS	6
TOTAL MARKS	51

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## States of Matter

1)

(a) State two assumptions of ideal gas behavior. Use of the *Data Booklet* is a relevant in (b) and (c).

(b) The ideal gas equation is  $pV = nRT$ . Explain as fully as you can the meaning Of the following terms, and give the units for each to correspond with the value of R given in the *Data Booklet*.

[6]

(c) (i) When an evacuated glass bulb of volume 63.8 cm<sup>3</sup> is filled with a gas at 24 °C and 99.5 kPa, the mass increases by 0.103g. Deduce whether the gas Ammonia, nitrogen or argon.

(ii) Explain why ammonia is the most likely of these three gases to deviate from ideal gas behavior.

[5]

2)

The table below gives data on some oxides of elements in period 3 of the periodic table.

oxide	Na <sub>2</sub> O	MgO	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	P <sub>4</sub> O <sub>10</sub>	SO <sub>3</sub>
melting point / K	1193	3125	2345	1883	853	290
boiling point / K	1548	3738	3253	2503	.	318

(a) Write equation for the reaction of aluminium with oxygen to form aluminium oxide.

[1]

(b) Drawing diagrams where appropriate, suggest in terms of structure and bonding explanation for the following.

- (i) the high melting point and boiling point of  $\text{Al}_2\text{O}_3$
- (ii) the low boiling point of  $\text{SO}_3$
- (iii) The melting point of  $\text{SiO}_2$  is much higher than that of  $\text{P}_4\text{O}_{10}$  [7]

(c) Water was added to each of the oxides in the table.

Choosing a suitable oxide in each case, write an equation for the formation of

- (i) an alkaline solution,
- (ii) an acidic solution. [2]

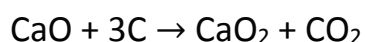
**3)**

The unsaturated hydrocarbon ethyne (acetylene), is widely used in 'oxy – acetylene acetylene forches' for cutting and welding metals. In the forch, ethyne is burned in oxygen to produce a flame with a temperature of 3400 K.

- (a) Ethyne is a linear molecule with a triple bond,  $\text{C} \equiv \text{C}$ , between the two carbon atoms.

Draw a 'dot – and – cross' diagram of an ethyne molecule. [1]

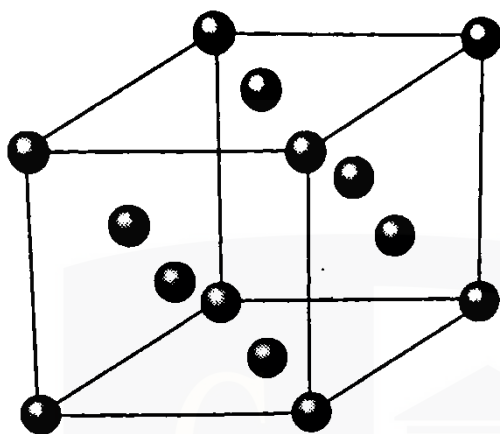
- (b) When used for cutting or welding, ethyne is transported in cylinders which contain the gas under pressure. A typical cylinder has a volume of  $76 \text{ dm}^3$  and contains ethyne gas at 1515 kPa pressure at a temperature of  $25^\circ\text{C}$ . Use the general gas equation,  $pV = nRT$ , to calculate the amount in moles, of ethyne in this cylinder. [2]
- (c) In some countries, ethyne is manufactured from calcium carbide,  $\text{CaC}_2$ , which is produced by heating quicklime and coke together at 23000 K.




When water is added to the  $\text{CaC}_2$ , calcium hydroxide,  $\text{Ca}(\text{OH})_2$ , and ethyne,  $\text{C}_2\text{H}_2$ , are produced.

4)

Copper and iodine are both solids which have different physical and chemical properties. Each element has the same face – centered crystal structure which is shown below.



The particles present in such a crystal may be atoms, molecules, anions or cations. In the diagram above, the particles present are represented by 

(a) Which type of particles are present in the iodine turns into a vapour. [2]

(i) Explain, in terms of the forces present in the solid structure, why copper remains a solid while the iodine turns into a vapour.

(ii) Explain, in terms of the forces present in the solid structure, why iodine turns into a vapour when heated to  $50^{\circ}\text{C}$ .

(c) (i) Although copper is a relatively unreactive metal, when it is heated to a high temperature in an excess of chlorine, copper (II) chloride is formed.

How does chlorine behave in this reaction?

(ii) When a mixture of copper and iodine is heated to a high temperature, no reaction occurs.

Suggest a reason for this difference.

[2]

5) The elements carbon and silicon are both in Group IV of the Periodic Table. Carbon is the second most abundant element by mass in the human body and silicon is the second most common element in Earth's crust.

Carbon and silicon each form an oxide of general formula  $XO_2$ .

At room temperature,  $CO_2$  is a gas while  $SiO_2$  is a solid with a high melting point.

(a) Briefly explain, in terms of the chemical bonds and intermolecular forces present in each compound, why  $CO_2$  is a gas and  $SiO_2$  is a solid at room temperature. [3]

(b) Draw a simple diagram to show the structure of  $SiO_2$ . Your diagram should contain at least two silicon atoms and show clearly how many bonds each atom forms. [2]

$CO_2$  does not behave as an ideal gas.

(c) (i) State the basic assumptions of the kinetic theory as applied to an ideal gas.

(ii) Suggest one reason why  $CO_2$  does not behave as an ideal gas [5]

Carbon exists in a number of forms, one of which is a conductor of electricity and one of which is a non-conductor of electricity. Silicon is the main component of most semi-conductors.

(d) Graphite is the form of carbon that is a conductor of electricity. Give a simple explanation for this property. [1]

When carbon and silicon (IV) oxide are heated together at about 2000 °C, silicon carbide,  $SiC$ , is formed. Silicon carbide is a hard material which is widely used as an abrasive and in ceramics.

(e) (i) Construct an equation for the reaction of carbon and silicon (IV) oxide.

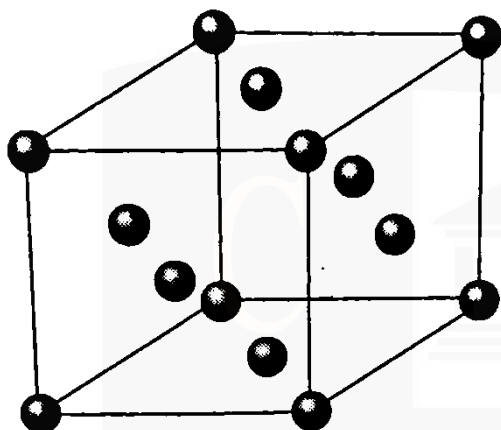
(ii)  $SiC$  has a similar structure to one of the common forms of carbon,


Which form is this? Give a reason for your answer. [2]

6)

Copper, proton number 29, and argon, proton number 18, are elements which have different physical and chemical properties.

In the solid state, each element has the same face – centred cubic crystal structure which is shown below.



The particles present in such a crystal may be atoms, molecules, anions or cations. In the diagram above, the particles present are represented by 

(a) Which types of particle are present in the copper and argon crystals?

In each case, give their formula.

element	particle	Formula
Copper		
argon		

[2]

At room temperature, copper is a solid while argon is a gas.

(b) Explain these observations in terms of the forces present in each solid structure. [4]

Although copper is a relatively unreactive element, when it is heated to a high temperature in an excess of chlorine, copper (II) chloride is formed.

When a mixture of argon and chlorine is heated to a high temperature, no reaction occurs.

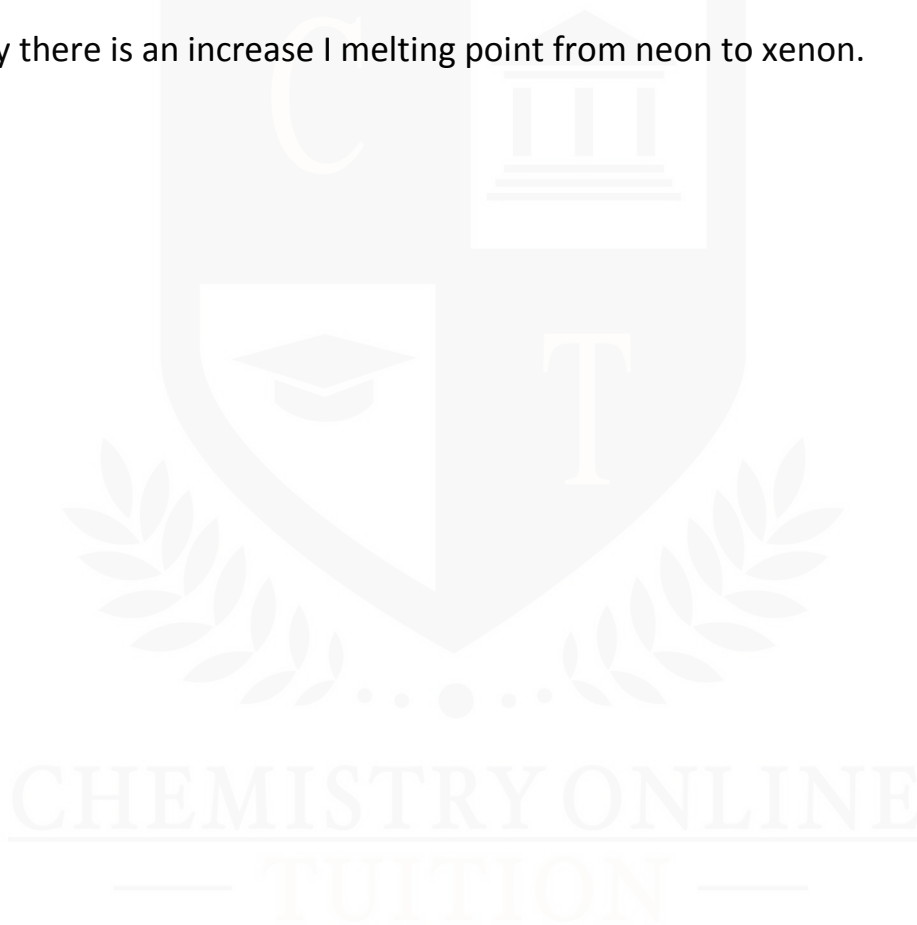
(c) (i) How does chlorine behave in its reaction with copper?

(ii) Suggest a reason for the lack of a reaction between argon and chlorine. [2]

The melting points of the noble gases neon to xenon are given below.

	Ne	Ar	Kr	Xe
melting point /K	25	84	116	161

(c) Explain why there is an increase in melting point from neon to xenon. [2]



I am Sorry !!!!!





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- Founder & CEO of Chemistry Online Tuition Ltd.
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