Year 12 Chemistry **Topic Test # 2 (Bonding) - 2012**

Name: **ANSWERS**

Part 1: Multiple Choice Section **10 marks**

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1. **D** 2. **C** 3. **A** 4. **B** 5. **C** 6. **B** 7. **A** 8. **C** 9. **B** 10. **B** ✓ **each**

Part 2: Short Answer Section **34 marks**

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1. Nitrogen (N_2) exists is a gas at room temperature. Nitrogen trichloride ($NC\ell_3$) exists as a liquid at room temperature.

   (a) Name the bonding that would exist in a container of each substance giving reasons for your answer.

   N_2 **N-N bonds are covalent** ✓

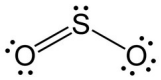
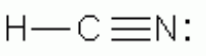
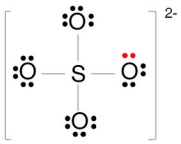
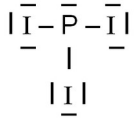
   Intermolecular bonding is dispersion forces only as N_2 molecules are non-polar ✓

   $NC\ell_3$ **N-Cℓ bonds are covalent** ✓

   Intermolecular bonding is dipole-dipole and dispersion forces
   – dipole-dipole because molecule is polar ✓
   − dispersion forces because they occur between all particles ✓

   (5 marks)

2. Complete the following table:

Species	*Electron dot diagram*	*Name of shape*	*Polarity (polar or non-polar)*
SO_2		**bent**	**polar**
HCN		**linear**	**polar**
SO_4^{2-}		**tetrahedral**	N/A
PI_3		**pyramidal**	**polar**

(11 marks)

3. The following table gives some information about three elements in the fourth row of the Periodic Table.

Element	*Electrical conductivity (MS m^{-1})*	*First ionisation energy (kJ mol^{-1})*	*Melting point (°C)*
Potassium	14	425	63
Calcium	29	596	650
Germanium	1×10^{-4}	762	938

(a) What type of bonding would you expect to occur in germanium?

covalent network ✓

(1 mark)

(b) Justify your answer.

Poor electrical conductor, so can't be metallic ✓

High melting point, so can't be molecular ✓

Obviously not ionic, so ∴ covalent network ✓

(3 marks)

(c) Explain the trend in ionisation energies of the elements above.

Increasing nuclear charge (from K to Ca to Ge), with a similar degree of shielding

∴ more energy required to remove e^- from Ge than Ca than K.✓

(1 mark)

(d) Would the value of potassium's second ionisation energy be larger or smaller than that for calcium? Explain why.

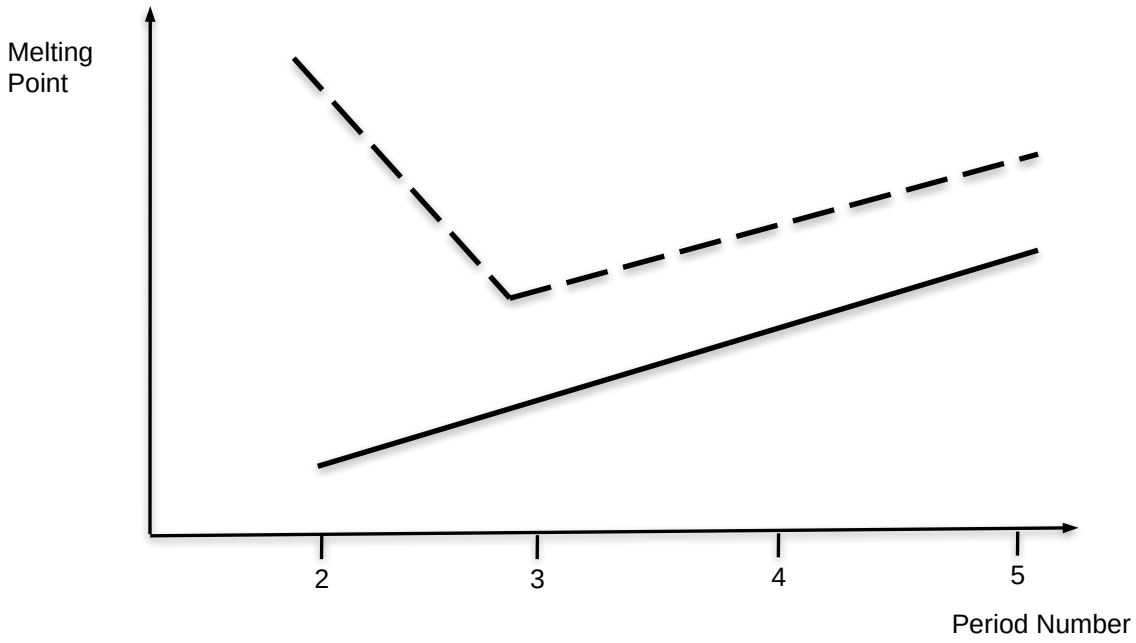
Larger ✓

The removal of 2nd e^- from Ca is from the same (fourth) shell, whereas K is from the third shell – less shielding, ∴ more strongly attracted and more energy required ✓

(2 marks)

4. Use your understanding of atomic structure and bonding to:

(a) Complete a sketch showing the boiling points of the hydrides of group 14 (———) and group 17 (- - - - -) on the following graph.



✓ **mp of group 14 hydrides increasing**
✓ **mp of group 17 hydrides higher than group 14**
✓ **mp of group 17 hydrides increasing from period 3 to period 5**
✓ **mp of group 17 hydride in period 2 (HF) higher than period 3**

(4 marks)

(b) Explain the overall trend shown on the graph:

Increasing mp with increasing size of molecules ✓

This is due to increasing strength of dispersion forces with increasing size of molecule, as temporary dipoles become larger ✓

(2 marks)

(c) Give reasons for any exceptions to this trend.

HF has a particularly strong form of dipole-dipole attraction, called hydrogen bonding.

This arises due to the great difference in electronegativity between H and F and the small size of F. ✓

(1 mark)

5. Using your knowledge of atomic structure and bonding explain the following physical data:

Substance	*Solubility in water at 25°C (g L^{-1})*
1-pentanol ($CH_3CH_2CH_2CH_2CH_2OH$)	22.0
1-hexanol ($CH_3CH_2CH_2CH_2CH_2CH_2OH$)	5.9

Water is polar molecule and contains with dispersion forces and hydrogen bonding between molecules. ✓

Hydrogen bonding also exists between molecules of each alcohol, but dispersion forces become more significant as the molecule becomes larger (as the carbon chain increases in length). ✓

Only dispersion forces form between the carbon chain and water, which are much weaker than hydrogen bonds between water and dispersion forces between alcohols. ✓

As the alcohol size increases, solubility in water decreases. ✓

(4 marks)

End of Test